# ENVIRONMENTAL DESIGN

**4th International Conference on Environmental Design**

9-11 May 2024

MDA
MEDITERRANEAN DESIGN ASSOCIATION

# ENVIRONMENTAL DESIGN

Conference proceedings of the
4th International Conference on Environmental Design

Environmental Design: IVth International Conference on Environmental Design
Edited by Mario Bisson, Associate Professor at Politecnico di Milano, Department of DESIGN

Proceedings (reviewed papers) of the IVth International Conference on Environmental Design,
Mediterranean Design Association | www.mda.center | info@mda.center
9-11 May 2024, Ginosa, Italy

Graphic design and layout: Federico De Luca and Giulia Alvarez
Cover image: Federico De Luca
ISBN 978-88-5509-634-8

Palermo University Press | Printed in the month of June 2024

## President

Federico Picone

## Scientific Director

Prof. Mario Bisson

## Industry Relations Manager

Dr. Giorgio De Ponti

## Organization

Giulia Alvarez
Andrea Cavaliere
Federico De Luca
Alessandro Ianniello
Benedetta Meretti
Stefania Palmieri
Dario Russo

## Scientific Committee

Prof. Lina Ahmad - College of Arts and Creative enterprises Zayed University, Abu Dhabi - UAE
Prof. Tiziano Aglieri Rinella - IUAV Venezia, Italy
Prof. Giuseppe Amoruso - Politecnico di Milano,Italy
Prof. Venanzio Arquilla - Politecnico di Milano, Italy
Prof. Antonino Benincasa - Libera Università di Bolzano, Italy
Prof. Alessandro Biamonti - Politecnico di Milano, Italy
Prof. Mario Bisson - Politecnico di Milano, Italy
Prof.sa Cristina Boeri - Politecnico di Mlano, Italy
Prof.sa Monica Bordegoni - Politecico di Milano,Italy
Prof.sa Daniela Calabi - Politecnico di Milano, Italy
Prof.sa Rossana Carullo - Politecnico di Bari, Italy
Prof. Mauro Ceconello - Politecnico di Milano, Italy
Prof. Giovanni Maria Conti - Politecnico di Milano, Italy
Arch. Riccardo Culotta, Italy
Prof. Clice De Toledo Sanjar Mazzilli - Faculdade de Arquitetura e Urbanismo da USP, Brasil
Ing. Giorgio De Ponti - Politecnico di Milano, Italy
Prof. Barbara Del Curto - Politecnico di Milano, Italy
Prof. Dincyrek Ozgur - Eastern Mediterranean University , Cyprus
Prof. Elisabetta Distefano - Università degli Studi di Palermo, Italy
Prof. Luca Donner - American University in the Emirates, United Arab Emirates
Prof. Michele Fiorentino - Politecnico di Bari, Italy
Dr. Luca Fois - Politecnico di Milano, Italy
Prof. Claudio Gambardella - Università della Campania Luigi Vanvitelli, Italy
Prof. Franca Garzotto - Politecnico di Milano, Italy
Prof. Luca Guerrini - Politecnico di Milano, Italy
Prof. Sandra Hipatia Nuñez Torres - Universidad Técnica de Ambato, Ecuador
Dr. Lisa Hockemeyer - Politecnico di Milano, Italy
Prof. Alessandro Ianniello - Delft University, Netherlands
Prof. Lorenzo Imbesi - Università la Sapienza - Roma, Italy
Prof. Matteo Ingaramo - Politecnico di Milano, Italy
Prof. Tomasz Jelenski - Cracow University of Technology Poland
Prof. Andres López Vaca - Universidad Internacional SEK, Ecuador
Prof. Giuseppe Lotti - Università degli Studi di Firenze, Italy
Prof. Carlo Martino - Università la Sapienza Roma, Italy
Prof. Diana Navas - PUC - San Paulo, Brasil
Prof. Valentina Nisi - University of Madeira, Portugal
Prof. Nuno Jardim Nunes - University of Lisbon, Portugal
Prof. Stefania Palmieri - Politecnico di Milano, Italy
Prof. Frida Pashako - Epoka University - Tirana, Albania
Prof. Pier Paolo Peruccio - Politecnico di Torino, Italy
Prof. Silvia Piardi - Politecnico di Milano, Italy
Prof. Savita Raje - Maulana Azad National Institute of technology Bopal, India
Prof. Pinto Reaes - Università LUSIADA lisbona portogallo, Pourtugal
Prof. Francesca Rizzo - Politecnico di Milano, Italy
Prof. Garcia Rubio Ruben - Tulane university- New Orleans, USA
Prof. Dario Russo - Università degli Studi di Palermo, Italy
Prof. Francesca Scalisi - Università degli Studi di Palermo, Italy
Prof. Antonio Scontrino - Bowling Green State University, USA
Prof. Marco Sosa - Zayed University, United Arab Emirates
Prof. Cesare Sposito - Università degli Studi di Palermo, Italy
Prof. Paolo Tamborrini - Università di Parma, Italy
Prof. Toufic Haidamous - American University in the Emirates, United Arab Emirates
Dr. Diego Vainesman - New York, Usa
Prof. Sonsoles Velais - Tulane University- New Orleans, USA
Prof. Min Wang - China Central Academy of Fine Arts, China
Prof. Cui Wei - Beijing Institute of Fashion Technology, China
Prof. Francesco Zurlo - Politecnico di Milano, Italy

*Special Thanks to*


*With the patronage of:*

POLITECNICO MILANO 1863

Politecnico di Bari

ArCoD dipartimento Architettura Costruzione Design

FAUUSP Faculdade de Arquitetura e Urbanismo Universidade de São Paulo

Universidad Indoamérica

Università degli Studi di Palermo

ADI ADI ASSOCIAZIONE PER IL DISEGNO INDUSTRIALE DELEGAZIONE PUGLIA E BASILICATA

## INTRODUCTION



## SUSTAINABLE DEVELOPMENT

## SOCIAL INNOVATION

## TECHNOLOGY APPLICATIONS



## HEALTHCARE AND WELLNESS

## POLICY AND GOVERNANCE



## ALTERNATIVE FUTURES

## MADE IN...

# Introduction

*by Mario Bisson*

> *"Everyone engaged in devising courses of action aimed at transforming current situations into more desirable ones is essentially involved in design. Whether in fields such as engineering, medicine, business, architecture, or painting, the focus is not merely on what is necessary but on what is possible. These disciplines concern themselves with envisioning alternative futures, exploring potentialities rather than accepting things as they are. In essence, they are concerned with design."*
>
> - Herdbert Alexander Simon

Progress necessitates a proactive approach, one that involves researching and understanding our environment with a view toward shaping future outcomes. We often find ourselves immersed in discussions about environmental issues such as pollution, traffic, and consumption, yet active participation is not always as prevalent.

The Environmental Design Conference serves as a platform for shedding light on the outcomes of research efforts across various fronts. It fosters scientific discourse among researchers, making visible both theoretical frameworks and empirical evidence. Moreover, it aims to raise awareness among public institutions and businesses about the necessary steps for a sustainable future, ultimately enhancing personal well-being and community welfare.

Engaging in discussion, analysis, and proposal is imperative in navigating the challenges that lie ahead. By inviting scientific luminaries from diverse backgrounds and distinguished research institutions, the conference facilitates the exchange of ideas, fostering innovation and driving progress. It provides an invaluable opportunity for emerging scholars to showcase their research on an international stage, fostering collaboration and enriching the collective vision of the MDA community, dedicated to enhancing the quality of life.

MDA periodically hosts conferences open to researchers worldwide who share an interest in contributing to the ongoing dialogue on improving quality of life. The 2024 Conference held in Ginosa saw participation from researchers from different disciplines. The outcomes of this event have been documented in a volume accessible on the association's website (mda.center), serving as a testament to the collective efforts toward a better future.

# SUSTAINABLE DEVELOPMENT

# RAISE ecosystem: urban design for accessible and inclusive Smart Cities

*Francesco Burlando[1], Federica Maria Lorusso[2], Claudia Porfirione[1]*
*francesco.burlando@unige.it, federicamaria.lorusso@unicampania.it, claudia.porfirione@unige.it*

*[1]Department of Architecture and Design, University of Genoa, Italy*
*[2]Department of Architecture and Industrial Design, University of Campania Luigi Vanvitelli, Italy*

***Keywords:***
*Urban Design*
*Public Spaces*
*Smart City*
*Evaluation criteria*

## Abstract

The article investigates the correlation between urban design and technological and digital innovation in the empowerment of Smart Cities through the analysis of the case study RAISE, an innovation ecosystem in the region of Liguria focused on artificial intelligence and robotics. The design research team of the University of Genoa operates within the project with the aim of identifying technological design solutions aimed at the regeneration of urban public spaces through the active involvement of citizens and a fruitful interaction with public administrations. In the first year, the team conducted an analysis of 60 international case studies on smart and responsive street furniture, products, services and installations designed to improve and make urban public spaces more inclusive. In this context, the contribution examines the research methods applied for the preliminary analysis.

## Introduction

The article outlines the potential of technological and digital innovation in the enhancement and improvement of Smart Cities, through the analysis of the RAISE case study, acronym for 'Robotics and AI for socio-economic empowerment'. RAISE represents an innovation ecosystem in the Liguria region, focused on Artificial Intelligence and robotics, whose objective is to establish a dialogue between research entities and the production system, aiming at improving the quality of Liguria's urban spaces and generating new innovation opportunities that exploit the territory's strengths by actively involving the local community.

The RAISE project, financed by the MUR for the three-year period 2023-2025 with Investment 1.5 (M4C2) of the PNRR of 109 million euro, was designed by the National Research Council, the Italian Institute of Technology and the University of Genoa, under the coordination of the Liguria Region, which hosts the main robotics and AI research laboratories in Italy.

The increasing use of robotic technologies and artificial intelligence is crucial for the development of inclusive and technologically performant Smart Cities. These technologies, now widespread in daily life, can contribute to improving the quality of urban life by supporting various citizen tasks. Among their many applications, they play a significant role in traffic management, urban safety, energy efficiency optimisation, waste collection and recycling, and serve to offer more efficient public services, thereby in

creasing more sustainable urban mobility. Hence, it is fundamental to generate new processes of territorial enhancement, exploiting local resources, new robotic technologies and artificial intelligence for the design of smart cities with accessible and inclusive urban public spaces.

In particular, the University of Genoa's Design research team is involved in the activities of Spoke 1 entitled 'Accessible and inclusive urban environments and services', which aims to design and implement technologies, devices and services to improve the enjoyability of urban services. UNIGE-DAD team is involved in Work Package 5 'From inclusive technologies to inclusive smart cities', in the framework of tasks 5.3 'PA-citizens interaction and citizens' engagement' and 5.4 'Identification of design-driven solutions for urban regeneration strategies'. The latter focuses on the active engagement of citizens, fruitful interaction with public administrations and the individuation of design-driven solutions aimed at urban regeneration.

In this context, the paper examines in detail the research methodologies implemented for the first phase of the project. It consisted of the collection, critical analysis and cataloguing of 60 case studies worldwide, temporary or permanent, that at different scales have addressed the issue of urban regeneration supported by technology.

## Desk analysis

During the first year of the RAISE project (from 2023 to 2024), the UNIGE-DAD research team conducted a preliminary desk analysis of the state of the art aimed at the initiation of tasks 5.3 and 5.4. This phase focused on a critical-analytical study of technological, interactive and responsive urban furniture, products, installations and services that improve the quality, usability, attractiveness, user experience and social inclusion of a specific urban space, whilst enhancing citizens' perceived sense of well-being.

From a wide range of international technological projects, the interdisciplinary team - composed of designers, architects, sociologists and urban planners - has identified 60 relevant case studies, selecting only those that require a simple installation in the space, avoiding radical architectural interventions or significant alterations to the morphology of the existing public space.

Firstly, the research team selected the most appropriate characteristics to study and classify the different projects in a coherent and standardised manner. Secondly, it collected and catalogued in a template the various information regarding the projects examined, including descriptions, images, technical and technology drawings, as well as synoptic charts highlighting the strengths and weaknesses of each case study graphically.

## Evaluation Criteria

Therefore, besides a textual description, each project was represented in a synoptic table that analysed it according to four specific categories, making use of icons and Kiviat diagrams, allowing us to obtain a summarised and complete graphical sheet for each case study.

The four categories analysed are as follows:

- Space: it is highlighted in which type of space and environment, among public parks, public streets or pavements, squares, green areas and public urban buildings, the project was located.

- Development level: the stage of development of the project is noted, among concept, experimental prototype, temporary project or permanent project.

- Purpose: one or more purposes of the project are identified from the following eight parameters: data collection and provision of real-time feedback to users, usability, accessibility, inclusiveness, sustainability and promotion of environmentally sustainable behaviour, wayfinding, security and urban identity marker.
- Technology and interaction mode: this highlights what type of technology is used and what mode of interaction with the user there is among the following eight parameters: movement sensors, lighting, sound elements, tactile interactions, walkable surface, message output/feedback, physical/virtual installation and gamification.

For the final two categories, it was essential to make use of Kiviat diagrams to quantify within a range from 1 to 5 how much each parameter is present in the examined project.

## Glossary

During the process of smart urban project analysis, in order to facilitate communication and understanding of the different parameters analysed by the interdisciplinary team, it was necessary to structure a detailed glossary to ensure a clear and common language. Within it, unambiguous definitions were provided for the more complex parameters, such as those in the "purpose" and "technology" categories.

## Purpose

**Data collection and provision of real-time feedback to users**

Technology applied to the urban environment and the furniture in it is an important tool for achieving sustainable development and making cities more efficient (Qin, 2022).

It enables obtaining detailed data in real time, which are useful for tackling urban challenges more effectively (Keçecio lu Da lı et al., 2022), allows monitoring and recording various significant city-related data, such as air quality, noise pollution, waste management, lighting, weather data, public transport data or sensitive information about individual citizens. In particular, data collection is relevant for mapping urban conditions that are not visible to everyone, making citizens aware of specific issues. Indeed, through the collection of data and its instantaneous sharing, it is possible to reveal emerging dynamics and observe the city from a new perspective (Ratti, 2016). Some urban projects can be useful to communicate these data in aggregate form, informing citizens about the current situation and thus suggesting, more or less explicitly, certain behaviours.

**Accessibility**

Urban spaces and the technological devices therein should be accessible, welcoming and usable by anyone, at any time of day, without external restrictions. They should be designed according to the Design for All approach, thus paying special attention to the needs of the widest number of users (Burton, 2006). Just think of children, the elderly or people with permanent disabilities, such as physical, cognitive, hearing or visual ones; or temporary needs, such as pushing a pram in the city or getting around by bike or skateboard. Therefore, the pedestrian space should be provided with continuous surfaces, urban furniture and devices should be arranged in such a way as to offer the opportunity to walk and move along obstacle-free paths, stand leaning on some support or sit on benches grouped in a "talkscape" for socialising (Gehl, 2010).

**Inclusion**

Products and services placed in an urban space should facilitate interaction and socialisation between groups of people with different backgrounds, interests, ethnicities and ages. Responsive devices have the potential to contribute to interaction between people and the creation of multicultural and intergenerational groups. The design of the urban environment and its furnishings have a significant impact on the possibility of establishing social relationships (Deasy, 1985). For example, semi-circular, spiral or facing benches create a more convivial atmosphere than benches arranged in rows (Allahdadi, 2017), while playful devices and installations that can be used by several users at the same time act as facilitators for active participation in community life, inviting people of different ages and abilities to engage in the same action. Such installations promote social inclusion and contribute to the strengthening of a sense of community.

**Usability**

In urban spaces, smart urban furniture, devices, services and their interfaces must be intuitive and easy to use, to ensure their acceptance by the community and the perception of their usefulness in everyday life. For example, totems and devices for public transport, parking, waste collection or payment systems, if designed in an intuitive and usable way even for those unfamiliar with technology, can greatly enhance and simplify the user experience in the city. The usability of such devices makes it possible to fully exploit the potential of technology and, in particular, to overcome the rejection of technological devices by reticent users. In this context, the concept of feedback becomes significant, as an immediate response from the device allows users to understand whether they have acted correctly, thereby increasing user confidence in the system and improving the overall user experience.

**Sustainability and promoting environmentally sustainable behaviour**

Increasing urbanisation and growing environmental awareness have placed the focus on designing sustainable urban solutions for environmental regeneration. It is increasingly important to prefer urban furniture, installations and devices that have a positive impact on the environment and multiple species and ecosystems, including, but not limited to, humans (Maller, 2021). Among the various eco-sustainable alternatives, projects with integrated nature-based solutions predominate, i.e. solutions inspired and supported by nature, which are advantageous both economically and environmentally, as they use eco-friendly materials (Wild et al., 2020). Many projects incorporate the use of biotechnological plants or biofilters, solar panels and renewable energy sources, or the use of recycled materials, thus mitigating urban pollution in traffic-intensive areas, improving biodiversity in the city, combating heat islands and reducing emissions. Furthermore, certain furniture or initiatives can act as a nudge (Radchenko, 2023) for the adoption of sustainable practices, promoting more ecological lifestyles. For instance, the integration of bicycle routes from recycled plastics encourages both the reduction of polluting vehicles and greenhouse gas emissions; or furnishings such as interactive and playful smart bins can simplify proper waste collection and make a positive action for the planet enjoyable.

**Wayfinding**

Urban furniture, responsive devices and temporary installations, when strategically designed, can be used as wayfinding elements, in other words, directional signs that suggest the way to a destination that is not directly visible. People are constantly looking for hints and cues on the best way to navigate the environment (Deasy,1985), and classical wayfinding meth-

odologies are also making way for technological and interconnected urban furniture systems that are no longer just designed to identify the way to go, but to support the greatest number of users, including the elderly, tourists, and people with visual, hearing or cognitive disabilities. Consequently, due to current wayfinding systems, the endless list of information for reaching places is transformed into an innovative and interactive communication system that makes use of different languages, including, for example, communicative synthesis, braille language, conceptual symbolism, in order to meet the specific needs of each user.

By strategically integrating wayfinding principles into street furniture, cities can improve the overall navigation experience for residents and visitors, making public spaces more accessible and user-friendly.

**Safety**

A walking space is mainly frequented when it is perceived as a safe, lively and pleasant place. Adequate lighting, orderly and welcoming spaces, proper wayfinding and shops in the city contribute to people's safety. Concerns in the city can be many, including insecurity due to fear of crime in isolated places, vehicular traffic, or the danger of physical harm (Gehl, 2011). With the installation of interactive and attractive devices, the crime of street life can be prevented in those places targeted by vandals and therefore perceived as unsafe. These places can become stimulating meeting spaces in which residents and workers in the immediate surroundings unknowingly take on the role of "street watchers" (Jacobs, 1961), that is, people who both day and night, attracted by the urban bustle, have their sights set on the street, conferring greater security in the city and considerable mutual protection between passers-by.

**Urban identity markers**

Places of interest such as historic squares, monuments, statues and panoramic views not only give the city a distinctive appearance, but also provide meeting spaces and landmarks for citizens and tourists alike (Lynch, 1960). Urban furniture becomes a real design theme for city municipalities, which goes beyond mere functionality, becoming a key element in the visual communication of urban identity. Urban elements should be compatible with the meaning of the urban space and reflect the character of the environment in which they are located. Characteristics such as shape, material, colour or processing method can reflect the identity and culture of the city (Uslu et al., 2019). In contemporary projects, it is sometimes complex to determine whether the furniture respects urban identity canons; however, it is clear that when furniture and urban devices are well inserted in a public space, they succeed in conveying and emphasising a cohesive and enduring urban identity, and in peripheral locations that do not have a strong identity they are particularly effective because they help to strengthen local identity by giving value and character to the surroundings.

## Technology and interaction modes

**Motion sensors**

The use of motion sensors in urban planning projects and public place installations represents an important innovation for improving user interaction and the collection of useful data for the design of smarter, more interactive cities. Motion sensors make it possible to create immersive and interactive experiences that engage users in new and exciting ways (Riether, 2011).

They can be used to trigger numerous feedbacks - which are discussed more specifically below - based on people's actions, creating a dynamic and responsive environment. Motion sensors can collect real-time data on user behaviour, which can be used to monitor people's actions and analyse their preferences (Heravi et al., 2018). This data can be used to optimise users' enjoyment of a place by adapting context features based on specific needs (Dong et al., 2019).

**Illumination**

Urban lighting is a key element in the safety, livability and usability of public spaces. The use of innovative technologies, such as the Internet of Things (IoT) and artificial intelligence (AI), allows the creation of intelligent and interactive urban lighting systems that can improve interaction with users and the collection of useful data for urban design (Sikder et al., 2018). Smart lighting can increase safety in public areas, can reduce energy consumption (Bachanek et al., 2021), and can also be used to create immersive and interactive experiences that engage users in new and exciting ways (Foth & Caldwell, 2018). This last point was the main focus of the selection of case studies reviewed. Getting more specific on how this technology can be harnessed, lighting can adapt to user behaviour, creating a safer and more comfortable environment (Ye et al., 2019). For example, lighting can increase in intensity when a person approaches an intersection or crosswalk. It can provide feedback to external events or cues, such as direct interaction with users who can control its color and intensity through a given physical or digital interface. In addition, urban lighting can be used by designers to project images or videos onto urban surfaces, creating an immersive visual experience. For example, projecting artwork onto historic buildings or creating interactive light effects on the floor. More broadly, then, leveraging IoT and AI to create lighting designs can improve the enjoyment of public environments by generating greater engagement, and improving comfort and safety.

**Sound elements**

The urban soundscape is an often overlooked element in urban design. However, sound can have a significant impact on the perception of public spaces and the well-being of inhabitants. The use of innovative technologies, such as AI and IoT, makes it possible to create intelligent and interactive sound environments that can improve the user experience and the collection of useful data for urban design. Sound design proves to be very important in urban design as sound can help create identity, influence the psychological and physical well-being of inhabitants, and be used to create multisensory interactive experiences (Anderson, 2019). Indeed, sounds can be triggered by motion or proximity sensors and be generated in real-time based on the user's behaviour, creating a unique and personalized experience. Users can then also be actively involved in the creation of sounds and music through co-design tools (Steele et al., 2019). Sound design can thus foster engagement and participation, as well as encourage creativity in users (Lundmark et al., 2023).

**Tactile interaction**

The sense of touch is also often underestimated in urban design. However, touch can play an important role in creating more approachable, inclusive, and sensorially engaging public spaces (Baldioli et al., 2022). The use of different materials and surfaces can create unique and stimulating tactile experiences that can enrich the experience of public spaces. In fact, tactile elements can help people with visual or cognitive disabilities orient and enjoy public spaces and provide an alternative sensory experience that can

be enjoyed by all. For example, sensory areas with different tactile surfaces and sounds can be used by people with cognitive disabilities to explore and experience the world around them (Murthy, 2019). More generally, tactile street furniture, such as benches or seating with different textures, can provide a richer and more enjoyable sensory experience for all users.

**Walkable surface**

Walkable surface is certainly a primary element in urban design, yet its characteristics are often taken for granted, while proper design choices could positively or negatively influence people's experience (Rasoulpour & Mamandi, 2021). In fact, it influences not only the aesthetics of public spaces, but also the usability, safety, and inclusiveness of cities. The choice of different materials, colors, and textures can create unique and stimulating sensory experiences for users. Natural stone, wood, porcelain stoneware, colored asphalt, and tactile paving are just a few examples of materials that can be used to create sensory pathways, play areas, or relaxation zones. In addition, it is now possible to sensorialize the pavement, allowing useful data to be collected on elements such as pedestrian flow and environmental conditions (Contigiani et al., 2018). But the walking surface can also be used to communicate data and information to users, for example through LEDs integrated into the pavement that can indicate the direction of a path.

**Message output / Feedback**

Urban installations can be used to provide users with feedback and real-time information about the city, creating an immersive experience. This can be done through different technologies, such as interactive screens that can be installed to provide real-time information on events, services, news and environmental data, or through physical actuators that can be activated by sensors and structurally modify the physical space according to specific situations. On a digital level, instead, data can be communicated through mobile applications. By providing feedback to users, urban installations can make them more aware of their environment and choices, encouraging virtuous behaviour. Indeed, people are encouraged to interact with the city more actively and responsibly and make more informed decisions about their daily lives, with the ultimate goal of improving the overall quality of life in cities.

**Real / Virtual**

Urban installation projects can be enriched by a level of virtual interaction that broadens the user experience. Indeed, combining the real and virtual worlds creates a hybrid dimension that makes projects more engaging and immersive for people (Senese et al., 2019). This fusion can be achieved through the use of augmented, virtual or mixed reality, but also through dedicated apps that can offer interactive content or insights related to the installation, which can be activated via QR code or NFC. Projects of this type allow users a more involving and personalised level of interaction and offer the opportunity to learn more about a topic or place through interactive multimedia content that can also provide real-time data on the surroundings, as mentioned above (Song, 2021).

**Gamification**

Gamification, namely the use of game dynamics in non-game contexts, represents an innovative approach to improve user interaction and the collection of useful data for urban design. It involves applying game design principles and mechanisms to non-game activities to increase motivation, engagement and participation (Alsawaier, 2018). Gamification techniques have been very successful in recent years and have been used in a variety

of contexts including training and learning, marketing and communication, work and productivity (Hamari et al., 2014). Interestingly, based on the basic theoretical literature, these techniques should be functional, particularly with the new post-millennial generations who seem to be highly engaged by stimulating and challenging contexts (Diz, 2021). However, gamification has also been shown to produce benefits when used in activities with adults and older people (Burlando, 2023).

In the urban context, gamification can increase users' motivation to participate in co-designed space activities, making them more fun and engaging (Redondo et al., 2020), but it can also facilitate interaction between users and the urban environment, creating a sense of community and belonging (Thibault, 2019). By encouraging interaction between people and spaces, gamification can be used to collect data on user behaviour, which can improve urban design and the enjoyment of public spaces (Mohammed & Hirai, 2021).

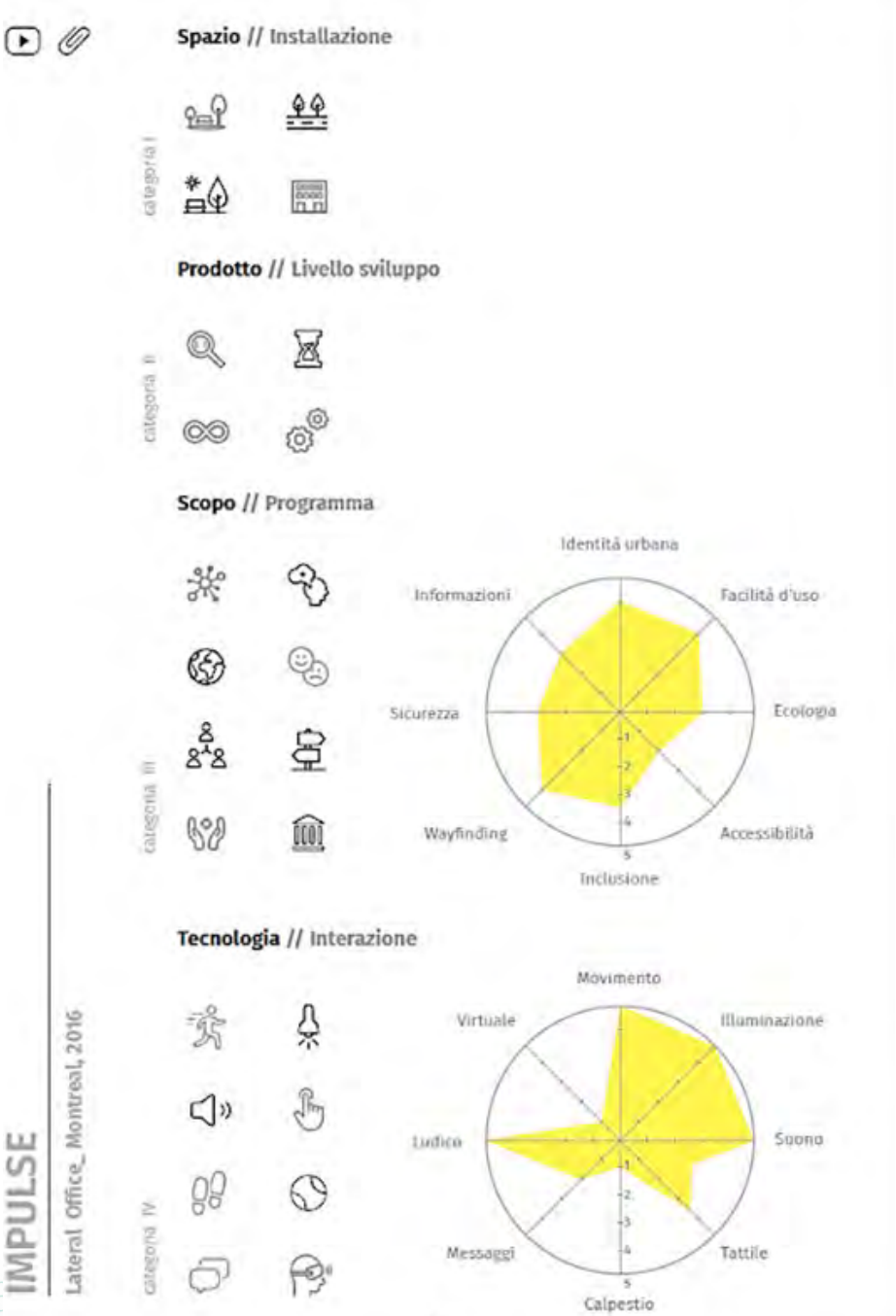


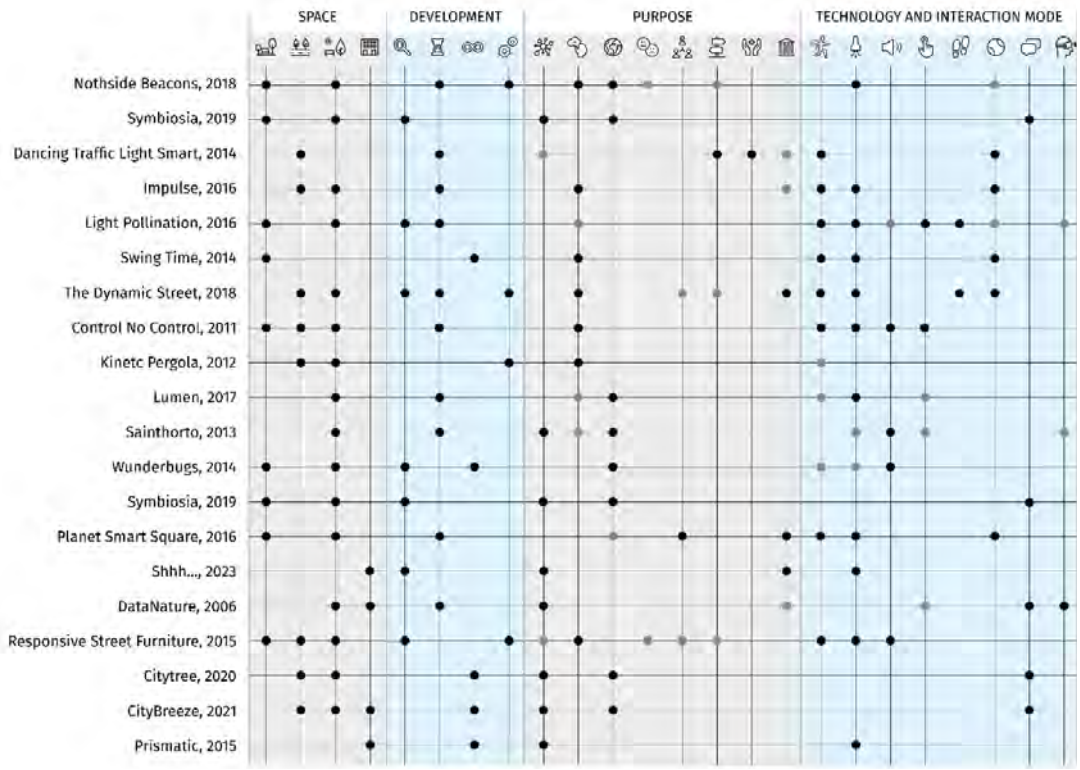

*Fig.1 Example of a summary table of the evaluation parameters of a project, UniGe-DAD, 2023, RAISE project*

## Final considerations

The analysis of the case studies based on the categories set forth above has been translated into a synoptic table that highlights how each project interfaces with respect to the categories of space, development, purpose and technology-interaction mode. In Figure 2 showing an excerpt from the synoptic table, it is possible to observe the projects that have a high level of relevance to each category (highlighted with a black dot) and those that have a good level of relevance (gray dot). In total, compared to the 60 case studies analyzed, it was inferred that only 20 percent are related to an indoor context while 80 percent are implemented in an outdoor context. Of these, almost 50 percent are embedded in an urban park, while 35 percent are along a road. Regarding the type of development, only about 35 percent of projects can be found related to the research setting and even fewer (15 percent) at the prototype level. Finally, more than 50% of the case studies are related to permanent installations. Regarding the purpose for which such urban installations are designed, the most responsive categories are certainly data collection and provision of real-time feedback (>50%) and usability improvement (>50%) while accessibility, inclusion and security are found in less than 10 projects. Wayfinding is also a category that finds little response, with just 18 percent of cases. Finally, on the types of technology used and modes of interaction, it was possible to observe that motion and lighting sensors are the most common ones (70% and 75%, respectively), while few projects use sensors placed on the walking surface (<15%) as well as the implementation of augmented and/or virtual reality (<20%).

These data highlight how some categories that are very important for urban life, such as accessibility, inclusion and safety, and technologies that are now widely available and widely used, such as augmented and virtual reality, are still lacking in the urban installations analyzed. It therefore becomes important for the next phases of the work pertaining to the RAISE ecosystem to identify how these technologies and categories can be implemented to foster improvements in urban public life in many respects.

*Fig.2 Figure 2. Extract from the synoptic table created following the analysis of the case studies, Federica Maria Lorusso, 2024, RAISE project.*



## Conclusion

The proper design of urban furniture, products, services and devices contributes to maximising participation in public life. Spaces characterised by the presence of interactive and responsive devices for public use can enliven urban space, encourage active participation and intensify social relations, improving the quality of life of the community. On the contrary, the neglect of collective spaces creates threats, both for the place itself and for the community that frequents it, as it could be converted into abandoned territory, lacking vitality and target for vandalism (Allahdadi, 2017).

The preliminary analysis of the case studies for the RAISE project provided a detailed overview of the applications of Artificial Intelligence and robotics in the design and implementation of Smart Cities. The research focused on the analysis of projects that improve the quality of urban life through innovative technological solutions. Overall, this desk analysis phase laid the foundation for the subsequent phases of the RAISE project, highlighting how technologies can contribute to the creation of smart cities that are inclusive, sustainable and at the forefront of technology. The methodology adopted in the collection and analysis of the case studies provided an operative framework to further explore the possibilities of innovation in the urban context, suggesting that in the next phase of designing a new urban device, it will be essential to take into account the importance of the characteristics listed and explored, so that the latter can effectively improve the quality of the urban environment, as well as the well-being and safety of the citizens and users who frequent it daily.

## Acknowledgments

Although the work should be considered as the result of the joint effort of all authors, the following paragraphs are to be attributed to F. Burlando: Glossary-technology and interaction modes, Final considerations, Conclusions, while the following paragraphs are to be attributed to F.M. Lorusso: Introduction, Desk Analysis, Glossary-Purpose. The work was carried out under the supervision of C. Porfirione.

The contribution presents work carried out within tasks 5.3 and 5.4 of WP5-From Inclusive Technologies to Inclusive Smart Cities of the RAISE Robotics and AI for socio-economic empowerment project funded by PN-RR-M4C2-I1.5 funds. The team of researchers from the Department of Architecture and Design of the University of Genoa who worked on the project consists, in addition to the authors of the contribution, of Niccolò Casiddu, Manuel Gausa, Silvia Pericu, Stefano Poli, Emanuele Sommariva, Nicola Valentino Canessa, Chiara Centanaro.

# References


1. Allahdadi, M. (2017). Effectiveness of Urban Furniture Designing to Enhance Social Interactions. In International Conference on Contemporary Iran an Civil Engineering Architecture and Urban Development.
2. Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. The International Journal of Information and Learning Technology, 35(1), 56–79. https://doi.org/10.1108/IJILT-02-2017-0009
3. Anderson, S. (2019). Discursive strategies for urban sound design and acoustic planning. In INTER-NOISE and NOISE-CON Congress and Conference Proceedings (Vol. 259, No. 3, pp. 6900-6911). Institute of Noise Control Engineering.
4. Bachanek, K. H., Tundys, B., Wi niewski, T., Puzio, E., & Marouškovᡠ, A. (2021). Intelligent street lighting in a smart city concepts—A direction to energy saving in cities: An overview and case study. Energies, 14(11), 3018.
5. Baldioli, S., Edson, S., Grady, A., & Matos, N. (2022). Touch Points: Co-Designing Tactile Exhibition Elements with User/Experts. Journal of Museum Education, 47(2), 166-178.
6. Burlando, G. (2023). Duolingo in university settings: Fostering English language acquisition among adult and senior learners. ELT Research Journal, 12(2), 159-173.
7. Burton, E., Mitchell, L., (2006). Inclusive Urban Design: Streets For Life.
8. Contigiani, M., Frontoni, E., Mancini, A., Zingaretti, P., Gatto, A., & Groppo, R. (2018). Use of an energy harvesting smart floor for indoor localization of people. INTERNATIONAL JOURNAL OF MECHANICAL ENGINEERING AND TECHNOLOGY, 9(8), 404-411.
9. Deasy C. M., (1985). Designing places for people, New York. Whitney Library of Design
10. Diz, M. (2021). Gen Z and Millennials in the Workplace: How are Leaders Adapting to their Short Attention Span and How Will they Keep them from Leaving a Qualitative Study. FIU Electronic Theses and Dissertations. https://doi.org/10.25148/etd.FIDC010295
11. Dong, B., Prakash, V., Feng, F., & O'Neill, Z. (2019). A review of smart building sensing system for better indoor environment control. Energy and Buildings, 199, 29-46.
12. Foth, M., & Caldwell, G. A. (2018). More-than-human media architecture. In Proceedings of the 4th media architecture biennale conference (pp. 66-75).
13. Gehl, J. (2010). Cities for People. Island Press.
14. Gehl, J. (2011). Life between buildings: using public space. Island Press.
15. Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification Work? – A Literature Review of Empirical Studies on Gamification. 2014 47th Hawaii International Conference on System Sciences, 3025–3034. https://doi.org/10.1109/HICSS.2014.377
16. Heravi, B. M., Gibson, J. L., Hailes, S., & Skuse, D. (2018). Playground social interaction analysis using bespoke wearable sensors for tracking and motion capture. In Proceedings of the 5th International Conference on Movement and Computing (pp. 1-8).
17. Jacobs, J., (1961). The Death and Life of Great American Cities. New York. Random House.
18. Keçecio lu Da lı, P., Özdemir Durak, M., (2022). Smart urban furniture as innovative landscape design elements in public spaces. Conference: III. International Urban Research Congress 2022.
19. Lundmark, S., Jonsson, M., Myhre, M., Hjuberger, A., & Rodela, R. (2023). Listening to the Future: Using Participatory Sound Fiction to Engage Young People in Urban Design. In Proceedings of the 26th International Academic Mindtrek Conference (pp. 223-232).
20. Lynch, K., (1960). L'immagine della città. MIT Press. Cambridge
21. Maller, C., (2021). Re-Orienting Nature-Based Solutions with More-than-Human

Thinking. Cities 113, https://doi.org/10.1016/j.cities.2021.103155.
22. Mohammed, A. M., & Hirai, Y. (2021). Utilising urban gamification for sustainable crime prevention in public spaces: A citizen participation model for designing against vandalism. International Journal of Sustainable Development and Planning, 16(1), 25-38.
23. Murthy, C. (2019). tac.tic: Tactile design language for indoor-outdoor pedestrian navigation. Carnegie Mellon University. Thesis. https://doi.org/10.1184/R1/7765469.v1
24. Qin, K. (2022). Reflections on the Future of Smart City Planning: Urban Furniture Design Based on Sustainable Development Goals. Proceedings of the 2022 International Conference on Social Sciences and Humanities and Arts (SSHA 2022), Advances in SocialScience, Education and Humanities Research, 653, 889-893.
25. Radchenko, K., (2023). Applying Nudge Theory to Foster the SDGs in Smart Cities. In Proceedings of the Central and Eastern European eDem and eGov Days 2023 (CEEeGov '23). Association for Computing Machinery, New York, NY, USA, 1–7. https://doi.org/10.1145/3603304.3603355
26. Rasoulpour, H., & Mamandi, M. (2021). Investigating the Effect of Sidewalk Flooring on the Behavioral Pattern (Walking) of Citizens in Urban Spaces (Case Study: Vali asr St., Tehran). Journal of Construction Research, 1(2).
27. Ratti, C., Claudel, M. (2017). La città di domani. Come le reti stanno cambiando il futuro urbano. Einaudi.
28. Redondo, E., Giménez, L., Navarro, I., & Fonseca, D. (2020). "Gamification" for teaching collaborative urban design and citizen participation. In Graphical Heritage: Volume 3-Mapping, Cartography and Innovation in Education (pp. 431-441). Springer International Publishing.
29. Riether, G. (2011). Towards digitally integrated urban places. In Kybernetes, Vol. 40 No. 7/8, pp. 1129-1136. https://doi.org/10.1108/03684921111160359
30. Senese, V. P., Pascale, A., Maffei, L., Cioffi, F., Sergi, I., Gnisci, A., & Masullo, M. (2020). The influence of personality traits on the measure of restorativeness in an urban park: a multisensory immersive virtual reality study. Neural approaches to dynamics of signal exchanges, 347-357.
31. Sikder, A. K., Acar, A., Aksu, H., Uluagac, A. S., Akkaya, K., & Conti, M. (2018). IoT-enabled smart lighting systems for smart cities. In 2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC) (pp. 639-645). IEEE.
32. Song, S. (2021). Research on Public Art Parameterization of Interactive Installation Based on Sensor and Virtual Reality. Mobile Information Systems, 2021, 1-11.
33. Steele, D., Legast, É., Trudeau, C., Fraisse, V., & Guastavino, C. (2019). Sounds in the city: Improving the soundscape of a public square through sound art. In Proceedings of the ISCV (Vol. 26, No. 8).
34. Thibault, M. (2019). Re-interpreting cities with play Urban semiotics and gamification. In Interactivity, Game Creation, Design, Learning, and Innovation: 7th EAI International Conference, ArtsIT 2018, and 3rd EAI International Conference, DLI 2018, ICTCC 2018, Braga, Portugal, October 24–26, 2018, Proceedings 7 (pp. 276-285). Springer International Publishing.
35. Uslu, E,. Ertürk, B., Esra A., (2019). A design approach of urban furniture in a historical place: Safranbolu. Turkish Studies. Turkish Studies, Social Sciences, Volume 14 Issue 4, 2019, p. 1841-1866 https://doi.org/10.29228/TurkishStudies.23499
36. Wild, T., Freitas, T., Vandewoestijne S. (2020) Nature-based solutions: State of the Art in EU-funded Projects, Publications Office of the European Union.
37. Ye, J., Cheng, J., An, D., Yang, C., Shen, S., & Lu, J. (2019). Research on innovative design of urban smart lighting equipment based on user experience. In Human-Computer Interaction. Design Practice in Contemporary Societies: Thematic Area, HCI 2019, Held as Part of the 21st HCI International Conference, HCII 2019, Orlando, FL, USA, July 26–31, 2019, Proceedings, Part III 21 (pp. 374-386). Springer International Publishing.

# Culture, meaning, value and sustainability: A terminological analysis

*Piera Losciale*
*p.losciale1@phd.poliba.it*

*Department of Architecture, Construction and Design, Politecnico di Bari, Italy*

***Keywords:***
*Sustainable Made in Italy*
*Culture*
*Sense*
*Value*

## Abstract

The paper reports part of my doctoral research, included in "Circular and Sustainable Made in Italy" project funded by PNRR, on circular and resilient innovation in the Made in Italy upholstered furniture supply chains. In particular, the contribution relates to the first phase of the research, which aimed to create the sense behind it, useful both to broaden the knowledge horizon and to focus on the future application.

Through a review of the literature, value references are constructed from fields seemingly distant from design to address the complex dimension of value chain management, which requires a transdisciplinary approach. A theoretical-critical reflection of the context of the investigation and the approach used is reported through the study of keywords at the cognitive basis of the research. This terminological examination supports the research's desire to hold together the traditional field of product design, with a strategic approach, to others, in particular to management.

## Introduction

The paper concerns the first extensive exploratory phase of my doctoral research, which is part of the PNRR-funded 'Circular and Sustainable Made in Italy' project, which intervenes to support the innovation of Made in Italy production chains, with specific reference to the upholstered furniture sector. The aim of the macro-research is to support the competitiveness of local production systems by enhancing the identity of culture-based products and services. The research addresses the broad topic of sustainability in order to identify a design-driven strategic approach that enables and implements the contemporary sense of sustainability, be it environmental, economic, social or cultural (Amari, 2016). The proposed model will be applied to the specific case study of the upholstery sector, however it can also be abstracted to other similar industrial sectors.

The proposed contribution relates to the first phase of the research that creates the sense behind it, useful not only to broaden the cognitive horizon but also to focus on the future application dimension. Methodologically, the research operated through an initial broad traditional literature review which made it possible to identify the key words and subsequently delve into them by drawing on newspaper articles, books and conference contributions.

Through the extensive literature review, value references from fields seemingly distant from design are constructed to address the complex dimension of corporate value chain management (Berger, 2013; Porter, 1998; Di Roma et al., 2024). In this perspective, today's design research requires a transdisciplinary and project-based approach, which clearly identifies the role of the actors in the supply chain and defines the context of product and service innovation, based on the valorisation of knowledge (also defined on a cultural basis) and practices related to the use and consumption of goods, as well as production processes.

A theoretical-critical reflection of the context of investigation and the transdisciplinary approach is reported through key words identified as the cognitive basis of the research. In fact, the theoretical approach requires a useful and preferable integration of different tools, methods, resources available in the epistemic field, rather than choosing some for the benefit of others (Corvi, 2023): an integrated epistemology. From this perspective, the construction of a participatory lexicon is necessary for an effective dialogue between actors from different fields, such as design, management, economics, social sciences and anthropology. This terminological examination supports and demonstrates the research's desire to hold together the more traditional field of product design, with a strategic approach aimed at sustainable innovation, with others and in particular that of management.

## Complexity and transdisciplinarity: the context

The complexity of the world around us manifests itself on different scales, resisting being reduced to a single dimension. Reality can be explored through physical, biological, economic, social perspectives, to name a few fields of investigation, as well as macro or microcosm. The coexistence of the natural landscape and man-made reality, with their interactions, presents articulated challenges due to the complexity and diversity of the environment. This awareness suggests a critical appraisal of hyper-specialisation that, without denying its importance, emphasises the need to coordinate the notions of heterogeneous fields and recognises reality as an open entity (Corvi, 2023) in which it is difficult to establish definite connections: a vision of knowledge that goes beyond the sum of disciplines. An epistemology that interacts with different objects, involves the content of several subjects, demands different methods and approaches, generates and requires distinct but complementary competences, with the aim of enriching the image of the world. Knowledge is best described by a set of communicating vessels, instead of a set of watertight compartments (Gattei, 2023): an integrated epistemology. This, with a view to building bridges between the various disciplines and between the ways in which human beings relate, requires a systemic approach: whereas the reductionist approach risks losing complexity by decomposing complex phenomena into simple elements, the systemic approach addresses complexity by identifying different elements and studying the conditions emerging from the interactions between them (von Bertalanffy, 2004).

This perspective adopts a transdisciplinary approach, considering knowledge as an intricate system that draws on the dynamics of different domains. (Corvi, 2023). Transdisciplinarity extends "to what is simultaneously within individual disciplines, across disciplines and beyond all disciplines" (Nicolescu, 2002) with the aim of understanding the world today. In the transdisciplinary perspective, the boundaries of disciplines do not necessarily dissolve, but are considered critically, challenging the universalism of knowledge and aspiring to overcome the boundaries that separate paradigms and disciplinary categories, emphasising multidimensionality,

inclusiveness and creativity (Failla, 2021). The sharing of conceptual and methodological references concretises transdisciplinarity, promoting its mutual overcoming.

The exchange and contamination between the economic and social systems of different countries, the globalisation, in recent years has outlined a landscape in which local and global dimensions are intertwined in continuous interactions. Acting on a global scale, it involves production, consumption and lifestyles, redefining boundaries and generating new economic, social and cultural zones (Giddens, 2000), towards a global identity. Products, cultural expressions, knowledge and technologies permeate everyday life without their territorial and cultural identity, they are daughters of a single world in which production activities, customs and lifestyles tend to become common. The development of the digital world has contributed in increasing the possibility of connecting, interacting and disseminating content (Tapscott & Williams, 2006) and by accessing a wide space of relationships, vast communities of producers and consumers easily interact, opening up modern possibilities for disseminating knowledge and cultural content as well. The global network of relationships, including countries with low-cost labour, has caused considerable competitive pressure and the consequent fragmentation of value production chains, leading to a constant international reconfiguration of production activities, oriented towards the search for economic advantages and market differentiation (Berger, 2006).

The widening of geographical boundaries, driven by economic advantages and technological support, has loosened the links of territorial proximity that characterised and strengthened the Italian entrepreneurial context since the 1970s with the affirmation of Made in Italy (Beccatini, 1998; Rullani, 2000). Although our industrial system still possesses those distinctive characteristics, such as excellence, quality, creativity, tradition and craftsmanship, compared to most countries, and thus a considerable competitive advantage, today, faced with the evolution of markets, contemporary organisational models, the inclination towards digital and the growing difficulties of competition, it is beginning to manifest its limits and to need original drivers of innovation (Belfanti, 2019). New knowledge values are emerging, bringing together the creative, cultural and production dimensions in a coherent and convergent manner (Sbordone, 2020).

Innovation, occurring in the product, in communication, in services, is generated at the level of the product-system and of strategies regarding the management, coordination and proposal of the media plurality of the company. This becomes the field of action of (strategic) design, a synergetic activity of interdisciplinary skills (Zurlo, 2014), today transdisciplinary, which interfaces with management. It manages and coordinates the enterprise with different competences, interfacing with local actors, and generating innovative logics in the creation of value, through peculiar ideas and ways of perceiving reality: an agent of change that modifies pre-existing rules, delineates new boundaries, introduces unexpected elements and alters the way something is understood, generating novel value for the enterprise and the user.

The trans-disciplinary approach is necessary to cope with this complexity and requires, for an effective dialogue between actors in different fields, a participatory vocabulary. What follows is an examination of terminology based on a few key words at the heart of the research: culture, sense and value.

## Culture_materal culture_cultural product

'Culture', lacking an unambiguous definition, is commonly linked to positive values, such as intellectual culture, but in reality culture can also be referred to with negative meanings (e.g. rape culture). Being a behavioural dynamic and a human phenomenon, it is elusive and neither defined nor definable. In the humanistic field, culture designates both a set of activities almost exclusively the preserve of intellectuals and, in a broader sense in use in anthropology, a group of activities characteristic and qualifying of a society, from material production systems to conventions in dress to religious rituals to the way of spending free time (Cultural Studies Dictionary, 2023).

Refining and circumscribing the concept of culture, whose boundaries are too blurred, the research moves on to 'material culture'. The concept of material culture is recent and the humanistic disciplines (e.g. anthropology, sociology) have begun to converge on it, emphasising how the interpretation of human artefacts should be traced back to the cultural context (Fabietti, 1982). While in the past, material culture was considered a historical artefact, thus testifying to a past life, the novelty of the concept can be found in anthropology (Ciabarri, 2018), extending its domain of application and associated meanings. Material culture is defined by anthropologists, distancing themselves from the idea of a set of concrete artefacts and their meanings, as an incoming and outgoing process: when designing and producing an object, this is a synonym for culture, understood as specific theoretical and practical skills, as the designer's subjective worldview and perception. When the object is placed in society it acts as a lever, in turn creating culture (Munn, 1986; Ciabarri, 2018). It is a continuous process of dribble between man and the environment: man modifies the environment, and this modifies man, consistent with Marx's idea that men are shaped by their products. Thus, in philosophical terms, the product is no longer something in its own right, outside the subject: there is no longer an ontological difference between subject and object, but there is a strongly cultural dynamic of compromise between subject and object. The generative role of objects in today's systemic view of the world can be found in analyses of production systems and the production relations that objects define, as well as in the ways in which objects are related to value systems and social identities. Material components and actors in the supply chain create material culture, where is meant a reciprocal relationship between objects and subjects (both producers and users) in a continuous process. This reciprocal exchange underlies Latour's (2008) term 'thing', where artefacts are complex assemblages of contradictory issues, linked to a 'mattern of concern', which only make sense in relation to the specific context, consistent with the etymology of the term, and Ehn's (2008) Design Things, which identify dynamic socio-material environments that enable interaction with an object of shared interest.

Also in the concept of 'cultural product' the research finds, despite more varied interpretations (Rudolph, 2013; Clarke, 2016), the common idea that it is, once again, man's dynamic activity on the object that makes it become from a cultural artefact, which exists autonomously, to a cultural product, through the awareness of its existence and interest in its dissemination (Udovic & Sorgo, 2023); joining then with other cultural products, it takes a prominent place in society.

## Sense_sensemaking

Material culture thus intersects with the dimension of meanings that the product takes on in relation to the user's world, his values, and the reality he experiences. By 'meanings' we allude to the sense that the product takes

on for the user, the identity of the product, its symbolic and cognitive aspect, the values that want to be communicated and subsequently learnt and made one's own. There is no such thing as an object without an attribution of sense that is expressed in the reason for use, affective, symbolic, functional. The attribution of sense is never absolutely defined and definable, but is renegotiated according to the cultural contexts in which one finds oneself. In the past we spoke of 'sign' where an object therefore had a signifier, its 'external' part, and a signified, its concept and value. Today sign is replaced in sociology by text (Pozzato, 2020), where the concept of interweaving threads is inherent in the very etymology of the word: every object is a text with a signifier, it has a producer of the text and a reader who, on the basis of his or her own cultural encyclopaedias of reference, attributes a meaning to what he or she reads (Eco, 1979).

The dimension of 'sense', a key aspect of design-driven innovation (Verganti, 2009), shifts its focus from technologies, functions and performance, to languages, codes and meanings: the product is a medium capable of transferring messages, values, emotions that can be interpreted by people. Therefore, "Design is making sense of things" (Krippendorff, 2005), can be considered the paradigm behind the theories of innovations characterised by design (Verganti, 2017). Stories, status symbols, community and a sense of belonging are built around the product-system through emotional and symbolic aspects (Cautela & Rampino, 2019): sense-making is a powerful lever of innovation that creates competitive advantage. For some, meaning lies in the product's purchase motivation, which directly impacts an industry's competitive logics and cultural registers (Rindova et al., 2011), for others in the essence of the user experience (Verganti, 2009), concerning the dynamics of meaning formation.

The process of sense-making takes place at the user's end and is not directly generated by the company, in fact it is rarely the result of a single organisation, but rather takes the form of a collective process, and often involves voices from outside the industries involved in the change (Cautela & Rampino, 2019). The designer becomes the interpreter of strategic directions into aesthetic and functional elements that convey the desired meaning (Verganti, 2017), becoming responsible for the transformation of a strategic vision into a material artefact and, in this process, acts as an intermediary of languages and cultural registers between different industries. It performs the function of 'broker' in the negotiation and integration of perspectives from heterogeneous contexts, facilitating the convergence of desired meanings into concrete and 'material' solutions (Ravasi et al., 2012).

In the context of management practices, sense becomes sensemaking, focusing on the collective construction of meaning within organisational structures; in general, it is a set of processes implemented with the intention of attributing meaning to experience by adapting data within an organisational conceptual framework and simultaneously shaping this framework according to the information acquired, similarly to what happens in the construction of meaning of objects (Bolognini, 2018). Weick's definition of sensemaking is revisited, focusing on the collective construction of meaning within organisational structures, which are dynamic and continually evolving, creating a common self-awareness: not merely a mental phenomenon based on the interpretation of experiences, it involves a constant comparison with action and its associated effects. Thus, organisational culture is not limited to individual thought, but manifests itself through people's actions (Bolognini, 2018). By emphasising the intrinsic link between thought and action (Weick, 1997), sensemaking provides to managers a conceptual framework for understanding and influencing organisational dynamics, facilitating the building of solid foundations for strategic change.

## Value_value chain

The acquisition through experience of new meanings and senses, to the creation of which contribute the social and cultural contexts within which the experience is lived, represents an added value vector (Addis, 2007) of products. Within the globalised economy, competitive advantage is realised in the processes of value creation, which in recent years have rediscovered the 'immaterial elements', linked to symbolic, aesthetic, and emotional contents, as important as the economic ones.

The concept of 'value' has its roots in various fields, including philosophy, psychology, sociology, economics and management (Sidor huk, 2015). It presents different facets already in its Latin origin, it shows its multidimensionality in its application in various disciplines (Franklin et al., 2019), each of which has collaborated in defining an unshared meaning. Value, originally introduced by neoclassical economics, describes the relative value, usefulness or importance of something (Lindsey & Sirianno, 2016), is determined by the consumer, does not always represent a single reflection of costs (Myszewski & Sinha, 2020), and is derived from an overall assessment of the usefulness of a good, based on the perceived quality of the product-service, the most significant benefit to customers (Pevec & Pisnik, 2018). In the social and anthropological fields, value indicates aspirations and desires shared by a collectivity, manifesting itself explicitly or not in one or more individuals or groups, of which it influences the pursuit of modes, means and ends of action (Kluckhohn, 1951), providing general references for social action.

In order to promote the creation of value, as a producer of competitive advantage, Porter (1985) identifies the 'value chain' as a set of activities that contribute to its creation: a process involving all stages of production, from the acquisition of raw materials to the final use of the good (Simatupang et al., 2017). For Porter, value is the amount that buyers are disposed to pay for what a company provides. However, this research finds that economic value is not the only one that can promote competitive advantage.

As a result of the terminological analysis carried out, the conceptual framework constructed provided an understanding that the contemporary sense of sustainability within the MII sectors can be understood in cultural terms. Contextually to the creation of value in Porter's terms, research coined the concept of 'cultural value chian' (Di Roma et al., 2024) as responsible for creating value for the customer through products that offer differentiated propositions in terms of meaning, experience, aesthetics, access mode, participation. They are enriched products that incorporate and express specific cultures, knowledge, traditions of the territory of origin, and are affirmed through an 'identity'. They are vehicles, also in a competitive sense, of the characteristics and assets of cultural, productive, social resources peculiar to a territorial system towards wider contexts.

By accumulating value along all stages, the cultural value chain is read from a supply chain perspective rather than a product perspective, shifting the focus from this to the know-how that characterises all material production and processing stages associated with the product-system (Martinuz & Soldini, 2021). It is these value chains that play a key role for MII sectors, whose products are traditionally associated with the concepts of quality, authenticity, excellent craftsmanship, high production skills (Temperini et al., 2016), especially in the furniture and fashion industries (Micelli, 2016; Rullani, 2019; Bettiol et al., 2022).

The competitive advantage of MII sectors has been recognised in the literature in production traditions, local know-how, social proximity, tacit knowledge, small business size, radical and incremental innovation and

flexibility of the production process (Becattini, 1998; Fortis, 1998; Quadrio Curzio & Fortis, 2000; Rullani, 2000; Carbonara, 2002).

The cultural value, inherent in objects, enhances, if recognised, the customer's culture and contributes to preserving the cultural capital of each territory by generating a variety of cultural experiences. Intangible culture 'lives', in the sense that it is created, sediments, regenerates, in people, relationships, artefacts, institutions, production organisations and products that, together, constitute communities and their territories.

## Conclusions and research perspectives

Considering that this research is about circular and resilient innovation in MII supply chains, the terrain on which it moves is that of environmental, economic and social, but also cultural 'sustainability'. The affirmation of sustainable development and its integration in policies, in public and private sector strategies, in the priorities and behaviour of civil society, of citizens, necessarily passes also through a cultural change. Design, however, can contribute to the construction of this new social culture, producing visions (Hoger, 2006), helping to initiate a transition towards sustainability understood as a metadiscourse in which we should all stand (Manzini & Vezzoli, 1998) to contribute to the construction of a new and different common sense.

The maro-research supports that the strategy of valorising the cultural value chain is a path that can be followed by SMEs in the Made in Italy sectors to enable a sustainable transition in accordance with their peculiarities. That strategies of the cultural value chain focus on implementing aspects of social and cultural sustainability aimed at preserving, maximizing, and highlighting the cultural value of a product or service across all phases of the primary production chain.

Therefore, the research is working on the design of design strategies which, starting from the knowledge of local know-how and production characteristics, develop innovative product models based on them, enhancing the capital of experience and knowledge.

In particular, the doctoral research will focus on investigating methods for sustainable product design, based on a conceptual paradigm that introduces the value of the good into the design process. To do this, the research has shifted the investigation towards an area of attention that links the meaning of artefacts to the value and meaning they take on in social life.

## Acknowledgments

Project financed by the European Union - NextGenerationEU – Piano Nazionale di Ripresa e Resilienza (PNRR) - Mission 4 Component 2 Investment 1.3 - Notice No. 341 of 03/15/2022 from the Ministry of University and Research. Protocol of the application PE00000004, decree granting the loan no. 1551 of 11/10/2022, CUP D93C22000920001, Made in Italy Circular and Sustainable MICS. SPOKE 7 "New and consumer-driven business models for resilient and circular SCs" P.3 Research project "Cultural value chains: From local traditional production districts to a new country of origin effect" (coordinator Prof. Annalisa Di Roma) Wp1_ Sofa supply chain. Sustainable innovation (research group: Annalisa Di Roma, Piera Losciale, Anna Christiana Maiorano, Alessandra Scarcelli).

# References


1. Addis, M. (2007). Ad uso e consume. Il marketing esperenziale per il manager. Pearson-Prentice Hall.
2. Amari, M. (2016). La sostenibilità culturale: un nuovo paradigma. In P. Bilancia (Ed.), Diritti culturali e nuovi modelli di sviluppo. Edizioni Scientifiche Italiane.
3. Beccatini, G. (1998). Il distretto industriale. Un nuovo modo di interpretare il cambiamento economico. Rosemberg & Sellier.
4. Belfanti, C. M. (2019). Storia culturale del Made in Italy. Il Mulino.
5. Berger, S. (2006). Mondializzazione: come fanno a competere? Garzanti.
6. Berger, S. (2013). Making in America: From Innovation to Market. MIT Press.
7. Bettiol, M., Chiarvesio, M., Di Maria, E., & Micelli, S. (2022). La trasformazione dei distretti industriali tra catene globali del valore e digitalizzazione. Economia e Società Regionale.
8. Bolognini, B. (2018). Il sensemaking organizzativo e il comportamento delle persone. Una chiave di lettura Impresa Progetto. Electronic Journal of Management, 2.
9. Carbonara, N. (2002). New models of inter-firm networks within industrial districts. Entrepreneurship & Regional Development, 14(3), 229–246.
10. Cautela, C., & Rampino, L. (2019). Le tipologie d'innovazione nel design. Analisi critica di una relazione complessa. AGATHÓN – International Journal of Architecture, Art and Design, 05, 127–136.
11. Ciabarri, L. (2018). Cultura materiale. Oggetti, immaginari, desideri in viaggio tra mondi. Raffaello Cortina Editore.
12. Clarke, D. (2016). Theorising the Role of Cultural Products in Cultural Diplomacy from a Cultural Studies Perspective. International Journal of Cultural Policy, 22(2), 147–163.
13. Corvi, R. (2023). Frontiere aperte. Verso un'epistemologia transdisciplinare. Morcelliana Scholè.
14. Di Roma, A., Losciale, P., Scarcelli, A. (in press). Cultural value chain. An explorative literature review from a design driven perspective.
15. Dizionario studi culturali, (2023).
16. Eco, U. (1979). Lector in fabula. Bompiani.
17. Ehn, P. (2008). Participation in design things. 10th Conference on Participatory Design, 92–101.
18. Fabietti, U. (1982). Selvaggi e vittoriani: sulla nascita dell'antropologia sociale Edizioni di Storia e Letteratura. In B. Gentili (Ed.), L'età vittoriana: l'immagine dell'uomo tra letteratura e scienza. Edizioni di Storia e Letteratura.
19. Failla, A. (2021). Transdisciplinarietà: Un'analisi critica. Rivista Di Studi Interdisciplinari, 15(3), 123–145.
20. Fortis, M. (1998). Il "made in Italy" - Quando stile e creativite non sono solo moda. Il Mulino.
21. Franklin, E. F., Nichols, H. M., Charap, E., Buzaglo, J. S., Zaleta, A. K., & House, L. (2019). Perspectives of Patients With Cancer on the Quality-Adjusted Life Year as a Measure of Value in Healthcare. VALUE IN HEALTH, 22, 474–481.
22. Gattei, S. (2023, December 1). La complessità della conoscenza: percorsi per un'epistemologia integrata. Convegno Nazionale CUID 2023.
23. Giddens, A. (2000). Il mondo che cambia. Come la globalizzazione ridisegna la nostra vita. Il Mulino.
24. Hoger, H. (2006). Design Education. Abitare Segesta.
25. Kluckhohn, C. (1956). Toward a comparison of value-emphases in different cultures. In L. D. White (Ed.), The state of the social sciences (pp. 116–132).
26. Krippendorff, K. (2005). The semantic turn: A new foundation for design. CRC Press.
27. Latour, B. (2008, September 3). A cautious prometheus? A few steps toward a philosophy of design. Networks of Design meeting of the Design History Society.

28. Lindsey, E., & Sirianno, M. P. C. (2016). Three keys to value from patient's perspective: time, communication, education. Practice Management.
29. Manzini, E., & Vezzoli, C. (1998). Lo sviluppo di prodotti sostenibili. I requisiti ambientali dei prodotti industriali. Maggiori editore.
30. Martinuz, M., & Soldini, E. (2021). 100 anni di design italiano: contesto economico e cultura del progetto. LetteraVentidue.
31. Micelli, S. (2016). Fare è innovare. Il Mulino.
32. Munn, N. D. (1986). The Fame of Gawa: A Symbolic Study of Value Transformation in a Massim (Papua New Guinea) Society. Cambridge University Press.
33. Myszewski, J. M., & Sinha, M. (2020). A model for determining the value of patient satisfaction in healthcare. Business Process Management Journal, 26(3), 798–815.
34. Nicolescu, B. (2002). Manifesto of Transdisciplinarity. State Univ of New York Press.
35. Pevec, T., & Pisnik, A. (2018). Empirical Evaluation of a Conceptual Model for the Perceived Value of Health Services. Slovenian Journal of Public Health. 57(4), 175–182.
36. Porter, M. (1985). The Competitive Advantage: Creating and Sustaining Superior Performance. Free Press.
37. Porter, M. (1998). Clusters and the New Economics of Competition. Harward Business Review, 76(6), 77–90.
38. Pozzato, M. P. (2020). Semiotica del testo. Metodi, autori, esempi. Carocci Editore.
39. Quadrio Curzio, A., & Fortis, M. (2000). Il made in Italy oltre il 2000. Innovazione e comunità locali. Il Mulino.
40. Ravasi, D., Rindova, V., & Dalpiaz, E. (2012). The cultural side of value creation. Strategic Organization, 10, 231–239.
41. Rindova, V., Dalpiaz, E., & Ravasi, D. (2011). A cultural quest: A study of organizational use of new cultural resources in strategy formation. Organization Science, 22, 413–431.
42. Rudolph, H. (2013). The Material Culture of Diplomacy. The Impact of Objects on the Dynamic of Habsburg-Ottoman Negotiations at the Sublime Porte (1530–1650). In G. Barth-Scalmani, H. Rudolph, & C. Steppan (Eds.), Politische Kommunikation zwischen Imperien. Der diplomatische Aktionsraum Südost- und Osteuropa (pp. 211–237). StudienVerla.
43. Rullani, E. (2000). Crescita e innovazione nel Made in Italy. In A. Quadrio Curzio & M. Fortis (Eds.), Il made in Italy oltre il 2000. Innovazione e comunità locali. Il Mulino.
44. Sbordone, M. A. (2020). Discronie. La moda oltre i fenomeni del contemporaneo. LIStLab.
45. Sidor huk, R. (2015). The Concept of "Value" in the Theory of Marketing. Asian Social Science, 11(9), 320–325.
46. Tapscott, D., & Williams, A. D. (2006). Wikinomics: How Mass Collaboration Changes Everything. Portfolio.
47. Temperini, V., Gregori, G. L., & Palanga, P. (2016). The brand made in Italy: A critical analysis. Management Studies, 4(3), 93–103.
48. Udovic, B., & Sorgo, L. (2023). Giuseppe Tarantini: soltanto un'attrazione culturale locale o un ponte diplomatico verso gli altri paesi? ACTA HISTRIAE, 31(2), 183–210.
49. Verganti, R. (2009). Design driven innovation: changing the rules of competition by radically innovating what things mean. Harvard Business Press.
50. Verganti, R. (2017). Overcrowded: designing meaningful products in a world awash with ideas. MIT Press.
51. von Bertalanffy, L. (2004). Teoria generale dei sistemi. Fondamenti, sviluppo, applicazioni. Mondadori.
52. Weick, K. (1997). Sensemaking in organizations. Raffaello Cortina Editore.
53. Zurlo, F. (2014). Le strategie del design. Disegnare il valore oltre il prodotto. Libraccio Editore.

# Bio-inspired design: A systemic and interdisciplinary design approach to increase the sustainability of processes and products

*Lucia Pietroni[1], Mariangela Francesca Balsamo[1], Giuliana Flavia Cangelosi[2]*
*lucia.pietroni@unicam.it, mariangela.balsamo@unicam.it, giulianaflavia.cangelosi@unicampania.it*

*[1]University of Camerino, Italy*
*[2]Università degli Studi della Campania "Luigi Vanvitelli", Italy*

***Keywords:***
*Bio-inspired Design*
*Interdisciplinary Approach*
*Environmental Sustainability*

## Abstract

Bio-inspired design is based on the imitation of natural processes to create innovative and sustainable design solutions. Bio-inspired design represents a powerful engine of innovation for design, using new knowledge produced by nanoscience to understand and replicate natural phenomena observed at the nanoscale. At this scale, complex and layered structures and unprecedented performances of nature can be observed that are fundamental for the development of bio-inspired and sustainable designs and products. The emulation of natural principles and strategies requires an interdisciplinary and systemic approach to design in order to optimise the technical, functional and environmental performance of products. Bio-inspired design requires a multiplicity of skills and knowledge of advanced computational design tools. Biomimicry represents a crucial interdisciplinary research field for the future of sustainable design and for meeting the challenges of the UN Sustainable Development Goals (SDGs).

## Introduction

**Bio-inspired design: an interdisciplinary approach to innovation**

Effective interdisciplinary collaboration that crosses the boundaries of established disciplines is crucial for innovation today. Interdisciplinarity is considered a key characteristic for addressing complex research and design problems in our society (Wissa et al., 2022), and is necessary to address contemporary environmental and social issues with innovation-driven design approaches, such as the integration of the bio-inspired approach in the design process of sustainable and circular products and systems.

In the scientific literature, there are numerous terms used to define the design approach that is inspired by nature and that aims to transfer natural solutions to solve the technological problems of man and society. These include Biomimicry, Biomimetics, Bionics, and many others (Fayemi et al., 2017). Common to most definitions of these terms is the abstraction of natural principles and the emulation of biological processes and structures in the development of engineering solutions (Speck et al., 2017). Bio-inspiration is the process of transferring biological knowledge into design through a direct or mediated relationship between scientists from natural disciplines and designers, with the aim of not being limited to a formal or biomorphic emulative process (Pietroni, Mascitti, 2013 and 2019).

Man has always been inspired by nature for the design of his habitat and artefacts, imitating the constructive and functional patterns and models of natural organisms, which can be replicated both geometrically and structurally. Nowadays, thanks to the development of nanoscience, supported by nanotechnology (Garg et al, 2017), we have the possibility of knowing and interpreting, in a new way compared to the past, the functions, principles and process patterns adopted by nature in order to survive, and we have the ability to replicate them to develop innovative products.

Nanoscience is concerned with understanding the properties of natural phenomena occurring at the nanoscale, the characteristics or properties of which turn out to be profoundly different from those observable at the macro-micro scale: biological systems, in order to perpetuate species, adopt resilient and sustainable strategies that can inspire design, such as strategies of redundancy, autopoiesis, hierarchisation, adaptation, building complex structures from the bottom up, and distribution of functions instead of concentration of functions. These strategies generate innovative performances, such as super-adhesion capacity, hydrophobicity, structural colour (Pietroni, Mascitti, 2016). Nanotechnologies allow the knowledge gained to be replicated and applied in different fields to create new materials, devices and systems with unique and improved characteristics, especially in terms of sustainability.

The emergence of nanoscience and nanotechnological development represent a scientific paradigm shift in the understanding of natural phenomena. This has sparked a renewed interest in the scientific design community in observing and analysing the natural world, forming new bases for bio-inspired design and the foundations for the development of Biomimicry, now considered a driver of innovation in the design of high-performance and more sustainable products.

The term Biomimicry was coined by Janine M. Benyus to define an interdisciplinary area of research in which the design approach is aimed at consciously emulating nature's efficient strategies to find innovative design solutions (Benyus, 2002). Biomimicry proposes learning from nature rather than exploiting it as a resource, consciously studying and emulating the principles of adaptation and survival, understanding not only forms, functions and structures, but also processes and contexts on a systemic level. Today, Biomimicry has defined bio-inspired methodologies for design centred on the observation of biology as a source of knowledge. Despite considerable theoretical developments (Gleich, 2019; Bar-Cohen, 2011; Lepora et al., 2016; Dicks, 2023), examples of bio-inspired products, and the definition of methodologies and tools (Salvia et al., 2009; Fayemi, 2017), Biomimicry is still not considered an established discipline (Fiorentino, Hunt, 2021).

Therefore, bio-inspired design, in order to increase the sustainability of products and processes, needs to understand the functioning of the biological ecosystem to replicate its resilient strategies and enable a greater balance between the natural cycle and the technological cycle (Malshe et al., 2023). Biomimicry is deeply interconnected with environmental sustainability and the Circular Economy, as all three are based on the principles of ecosystem interconnection and collaboration (Mejía-Villa et al., 2023). The Circular Economy is a production and consumption model that is directly inspired by natural ecosystems (Ellen MacArthur Foundation, 2013), and involves sharing, reusing, repairing, reconditioning and recycling existing materials and products for as long as possible. The goal of the Circular Economy is to realise a production model that contrasts with the traditional model of the Linear Economy, one that is capable of self-generation and has flows of biological materials, capable of being reintegrated into the biosphere, and flows of technical materials, destined to be revalorised without impacting the biosphere.

In this scenario, Biomimicry can contribute to the socio-cultural and technical-productive change necessary for the transition towards a Circular Economy. Indeed, by imitating nature's strategies, bio-inspired design can contribute to increasing the sustainability and circularity of processes and products in line with the principles of the Circular Economy.

This article intends to analyse some of the principles, strategies and natural processes replicated in bio-inspired designs and products, in order to explicate the innovation potential of bio-inspired design for the development of new sustainable products, highlighting their environmental benefits. Subsequently, the bio-inspired design process is described, with a focus on the main approaches used in product design, with the "Top-Down Approach" being the most common approach for designers. For each phase, some of the methods and tools used in bio-inspired design are defined in order to provide an overview. Furthermore, the paper emphasises the importance of adopting computational design tools and approaches, which support a radical change in the traditional way of designing and manufacturing products, highlighting the considerable potential of these technologies in replicating and realising sustainable solutions, observed in nature at the nano, micro and macro scale, that would not be possible with other traditional manufacturing processes.

**Biomimicry as a driver for increasing the environmental sustainability of processes and products**

Biomimicry starts from the "assumption that if one imitates nature, one automatically falls into an inherently eco-sustainable state, since nature by definition operates in a sustainable manner" (Salvia et al., 2009). These qualities should manifest themselves in the project in three aspects: low degree of risk, increased possibility of ecological appropriateness, and ingenuity (Gleich, 2009). It is assumed that solutions that have proven successful in the competitive process of biological evolution are virtuous, efficient, resilient and low risk in solving human technical problems.

Observation of nature at the nanoscale has strongly driven the development of, for example, new materials capable of replicating certain natural phenomena, offering designers the possibility of applying new, high performance properties to products that were previously unavailable with traditional technologies. These new performances include, for example, self-cleaning, antibacterial, self-repairing, super-hydrophobic and structural colour. Thanks to these new performances of nanostructured materials, designers have the opportunity to greatly expand the functionality of products while drastically decreasing their environmental impact. For example, structural colour allows products to be coloured without the use of pigments; self-repairing materials facilitate the extension of product life; and self-cleaning allows for less maintenance. So, in addition to the extended functions, the new performances generate economic and environmental benefits.

Structural colour emulation is the focus of Lilian van Daal's "Microscopic Imitations" research, developed in collaboration with the microbiology company Hoekmine. This research offers an exciting and promising perspective on the future of colour production and pigmentation. Bacteria have been used to generate structural colours, representing an innovative and sustainable alternative to traditional chemical pigments. This approach not only reduces the use of non-renewable resources, but also limits the environmental impact associated with the production and disposal of chemical pigments (Fig.01).

And again, the self-regulating capacity present in living organisms has aroused much interest in the scientific design community for the experimentation and design of, for example, responsive and adaptive products.

Mention should be made of Nike's Micro React cone-effect technical sports fabric design, containing hydrophobic polyester fibres and hydrophilic yarns based on polyamide fibres. The thermally adaptive fabric is capable of responding to body moisture by opening or closing U-shaped slits. Another declination of the self-regulating principle found in nature is the passive cooling of structures created by termites. In fact, "Biomimicry" by Simon Pavy (2023) is inspired by termite mounds to create a terracotta cooling system. Thanks to its honeycomb structure, it promotes optimal air flow while maintaining a cool internal temperature. Using a computational approach with tools such as Grasshopper and 3D printing, it was successfully developed by an interdisciplinary team consisting of designers, mechanical engineers and Additive Manufacturing experts. The system adopts environmentally friendly materials and 3D printing technology to create an efficient and sustainable device, reducing energy consumption and environmental impact in cooling buildings (Fig.02).

Furthermore, the study at the micro and nano scale of biological structures plays an important role in the development of new products with high environmental performance. In fact, nanostructures built on precise rules of modularity are found in nature. For example, the spongy structures of human bone trabeculae have inspired the design of lighter and stronger building systems, following the natural principle of orienting materials along stress trajectories. Cellular structures, such as the hexagonal honeycombs of bees, have inspired techniques to lighten and increase strength and surface area in the design of new products and constructions. And again, scallop shells have inspired corrugated sheets, lightweight and highly resistant structures currently used in numerous buildings (Fig. 03). These examples demonstrate how the observation of nature at different scales can inspire engineering and architectural innovations that improve the sustainability and performance of many man-made artefacts, making efficient use of raw materials and significantly reducing waste production.

Examples of experimental projects using the bio-inspired approach to find solutions to increase or optimise structural strength include the work of researchers Marco Pelanconi and Alberto Ortona of the Swiss Mechanical Engineering and Materials Technology Institute. They have developed a new ultralight bio-inspired structure, based on the scales of butterfly wings, called a "gyroid". This structure, reinforced with external ribs, was optimised for bending using the finite element method. The topological approach adopted allows for the design of tailor-made structures by positioning the reinforcements along tension lines, similar to what occurs in natural structures (Pelanconi et al., 2019), using much less material and implementing structural strength (Fig. 04). Another example with this approach can be found in a publication in Nature Communications Materials describing the structure of the sponge exoskeleton studied by the Purdue University research team (Mistry et al., 2023). The exoskeleton features a selective articulation that allows compression and even force distribution, giving the structure a remarkable suppleness and softness. To examine the structure of the exoskeleton in detail, the research team took X-ray tomographic scans of the "Venus basket of flowers". Subsequently, the team reproduced the structures using 3D-printed models (Fig. 05). This experimental contribution also generates lightweight yet strong structures through the reduced use of material. In this context, geometry plays a fundamental role, allowing the creation of repeated modules with a unique continuity, in order to minimise material consumption, simplify the production process and increase the durability of the structure.

Bio-inspiration allows for sustainable design innovation. An example of a radical performance innovation inspired by natural structures is the Airless tyre, which emulates the cellular structure by eliminating the need for

compressed air for impact absorption (Fig.06). The tyre consists of a solid inner hub mounted on the vehicle's axle, from which a series of shock-absorbing spokes enclosed in a tensioned band form the outer edge of the tyre. The tension given by the band combined with the configuration of the spokes allows the new component to perform the same performance as compressed air in conventional tyres, achieving both safety and environmental benefits. Integrating airless tyres into a vehicle means significantly reducing the likelihood of a puncture and/or tyre blowout, which translates into a significant reduction in road accidents. The bio-inspired structure is based on the principle of structural redundancy, which ensures the integrity of the structure even if one of its components breaks. This is achieved through hierarchical and spatial duplication of shapes, allowing the structure to maintain its primary functionality despite damage. This allows the selective repair of the damaged part, prolonging the useful life of the product and reducing the production of waste and the volume of waste destined for landfill at the end of its life cycle. Because of its advantageous aspects, research on the airless tyre has been constant in recent years, from the prototypes of the companies Michelin and Bridgestone, to the latest model presented by Hankook at CES 2022.

Bio-inspired design allows design to learn how to use material efficiently, to produce no waste, to organise structures according to a hierarchical order or relationship, and to adapt form to function according to material- and energy-saving morphologies. This approach, combined with digitisation in the design process, made possible by advanced software and rapid production techniques, opens up new perspectives for the design of innovative and sustainable products.

**The process of developing bio-inspired and sustainable products: methodological approaches, phases and tools**

The bio-inspired design process is based on interdisciplinary collaboration between designers and biologists, and this synergy makes it inherently complex. It is a process that is rarely linear: it is characterised by a continuous intertwining of interactions and collaborations involving a vast number of stakeholders (Malshe et al., 2023). This fluidity requires considerable flexibility and adaptability from the experts involved, as choices made at one stage can influence and be influenced by subsequent stages of the process. In using Biomimicry, designers can adopt two main design methodologies: Bottom-Up and TopDown.

## Methodological Approaches

The first approach starts with basic biological research to make insights available in technological fields for further investigation and development. This approach may be called in different ways (e.g. Biology Influencing Design or Biology to Design) and refers to the realisation of a potential invention application to create or improve a product or process based on the observation of a characteristic of an organism or ecosystem. An example of a Bottom Up product concerns the discovery of the attachment properties of the flowers of the Burdock plant by George de Mestral. The numerous small hooks on the flower were imitated to make Velcro, today one of the most widely used durable materials for adhering two surfaces in a reversible manner. The above examples are just some of the technologies we rely on today that have been influenced by solutions observed in nature.

The opposite approach, termed Top-Down, searches for suitable biological models to solve specific, predefined problems. This process may also be referred to by different names (e.g. Design looking to biology or Problem-Driven Biologically Inspired Design) and indicates the way in which

designers look to nature and organisms to find solutions, recognising exact design problems and associating them with organisms that have solved such problems in a similar way. Among the best known bio-inspired products is Japan's Shinkansen Bullet Train whose aerodynamics were inspired by the shape of the beak of a Kingfisher bird. Starting with the goal of solving the roar generated by the air pressure as the train exited the tunnel, the chief engineer of the West Japan Railway Company and his team created a shape similar to a kingfisher's beak to be mounted on the front of the train, so that as it passes, it separates the air rather than compressing it, thus solving the roar problem and achieving further benefits: 15% less electricity consumption and 10% more speed than before (Wolpert, 2013).

**Phases of the design process**

Although there have been attempts to articulate and sub-articulate the Top-Down process (Fayemi, 2017), in this paper, the main stages that characterise biomimetic design have been described: starting with the identification of a problem to be solved, the process continues with (i) the solution-finding phase through analogies with the natural world and the identification of relevant principles, (ii) the abstraction of the biological model and (iii) the application to the design.

The first step (i) concerns the translation of the design problem into an analogous biological problem. It is then necessary to formulate the design problem by breaking it down into sub-problems in order to identify the biological counterpart. To support designers in this research phase, databases have been created that allow them to explore the solutions adopted by nature by analogy. Among these, the best known and most accessible is the AskNature.org database proposed by the Biomimicry Institute, where it is possible to search through keywords or more articulate phrases for solutions adopted by nature.

For the identifying's phase the correct biological function, there is a growing awareness of the importance of biodiversity (Lepora et al. 2013). The term biodiversity refers to the wide variety of life on Earth, and includes plants, bacteria, animals and humans. Biodiversity is not only an important aspect of the well-being of natural ecosystems (Duffy, 2009), but also a promising source for the production of new products and ideas (Broeckhoven and du Plessis 2022). Pennik et al. (2022), building on the use of comparative methods in biology - which are based on phylogenetic analysis to understand the evolution of traits in species - propose a comparative approach that is based on biodiversity from a wide range of species. In bio-inspired design, the comparative methods of structure and function adopted by biologists can be used to identify morphological-behavioural aspects that can be abstracted into biological design principles. After identifying the group of organisms, it is customary to adopt methods of mapping biological connections and elements.

Abstraction (ii) is useful for distilling the most relevant biological details into a useful neutral principle to be transferred and implemented in the design, and is the most critical step in the creation of analogies between biology and design, requiring multiple interactions and an evaluation of the abstract principle's accuracy and relevance. Indeed, Biomimicry involves interaction between the two domains at different levels of abstraction and through iterative cycles of study, design and continuous improvement (Yeter et al, 2023). The level of abstraction indicates the point in the hierarchical scale at which a design is manipulated to create a biomimetic solution. This concept has been categorised in various ways, for example by distinguishing between substance, structure, space, time, energy and information. Furthermore, biological phenomena can be classified into three categories: form, behaviour and principles, with forms including materials, structures,

mechanisms and processes (Bhasin et al, 2018). The method of design by analogy plays a central role within this process, as it defines the translation of the essential elements, features or functions of the identified biological model to apply them to the technological domain. Abstraction and translation into design strategies turns out to be one of the most difficult steps in the biomimetic process. In fact, the continuous interaction with biology experts makes it possible to understand the biological model in order to summarise and faithfully illustrate it in the design strategy. Once the biological strategies have been identified and translated into design strategies, it is possible to use techniques such as brainstorming to stimulate new ideas, so as to organise the biologically inspired design strategies into a visual or graphic format, and to identify the components of greatest interest in initiating biomimetic design development.

Finally, the phase of transferring and applying the bio-inspired solution to design development (iii), i.e. the process of transposing the outlined biological criteria and principles to the technical functionalities, thus initiating the design development of the bio-inspired design, considering multidisciplinarity as a key feature of the biomimetic process. For this phase, there are supporting methods for designers, such as the Functional Behaviour Structure (FBS) adapted to the BID (Liu et al., 2019).

**Computational tools for bio-inspired design**

In support of designers in the bio-inspired product development phase, there are now tools and approaches that enable the analysis, modelling, replication and processing of complex shapes and structures typical of living beings (du Plessis et al., 2019). The application of algorithmic thinking and systemic vision in design processes allows us to interpret and create models that facilitate the design of resilient, high-performance, sustainable and circular structures.

Through computational approaches, designers must master the collection and analysis of data collected from scientific studies, which are indispensable for their designs. Data represents the main innovation in the digital age, guiding the creative process with mathematical rigour and defining the logical path of design algorithms (Tedeschi, Lombardi, 2018). These data feed the development of computational models, which simulate the behaviour of bio-inspired structures and materials. These models optimise the design process, predict performance and identify relevant design challenges (Estévez, 2017). These include the scalability factor, i.e. the relationship between the dimensional scale of the biological model and that of the product. Features observed in nature cannot always be directly transferred and scaled to the design, thus risking the application of ineffective solutions (Langella, 2019).

The introduction of parametric modelling has revolutionised the design flow because it allows designers to control complex variables, parameters and functions throughout the process (Paciotti et al, 2021). This gives more possibilities to evaluate and improve the digital model of the product in its technical and functional aspects: models can be created based on associative parameters and geometries, allowing modifications, adaptations and regenerations according to predefined conditions, thanks to the interconnection of elements (Yalinay et al, 2008). The term "generative design" is often associated with parametric design because it implies the automatic generation of design solutions based on a set of parameters and constraints defined by the designer (Ozkan et al, 2022).

The complex structures found in models of nature are often beyond the capabilities of conventional production methods. In response to this challenge, 3D printing technology has been implemented to reproduce bio-inspired structures, ranging from plant to animal and insect imitations. This

has opened up new perspectives for the practical application of bio-inspiration in various scientific and industrial fields (Yan et al, 2021). Additive Manufacturing (AM) is a set of advanced technologies that uses layer-on-layer deposition of materials to create complex geometries. This method offers new opportunities to create a wide range of customised structures from models generated by computer-aided design systems (Buccino et al, 2021). AM is crucial for the production of complex modular structures, often inspired by biological configurations. This technology not only replicates naturally occurring modules, but also allows us to explore the creation of complex products that combine different properties and functionalities.

*Fig.1 "Microscopic Imitations" (2021) by Lilian van Daal. Research project investigating structural colour. (From the designer's website: www.lilianvandaal.com).*

## Reflections and conclusions

Bio-inspired design is crucial to obtain a radical innovation in the development process of sustainable products, because it is an interdisciplinary and systemic design approach that allows the highly efficient and resilient principles and strategies of nature to be understood and replicated in man-made artefacts. In fact, there is the possibility of transferring high-performance solutions to the design of products and increasing their sustainability. The application of natural strategies such as, for example, redundancy, hierarchisation, construction of complex structures, self-adjustment, or self-repair, offers new perspectives to product design.

*Fig.2 "Biomimicry" (2023). Cooling system inspired by termite nests. Designer: Simon Pavy. (image taken from the article An Old Idea Made New: Biomimcry 3D-Printed Terracotta Cooler, design-milk.com https://design-milk.com/biomimcry-3d-printed-terracotta-cooler/)*

The process of bio-inspired design requires interdisciplinarity, a fundamental characteristic for the development of innovative and sustainable projects. Interdisciplinarity fosters the sharing of knowledge and experience, enabling the complex challenges that characterise nature-inspired design to be tackled more effectively.

In addition, the computational approach allows us to accelerate the product design and optimisation process, enabling us to find solutions quickly and cost-effectively. This approach not only improves efficiency and precision in the design phase, but can also facilitate the scalability and reliability of the results obtained. Bio-inspired design, in combination with technological innovations, makes it possible to generate products that are more durable, less polluting, less energy-consuming, with new and high functional performance.

Bio-inspired design, in combination with technological innovations (digital tools and computational softwares, 3D printing, etc.) makes it possible to generate products that are more durable, less polluting, less energy-consuming, with new and high functional performances.

Bio-inspiration does not only concern the product conception phase, but the entire new product development process, thus also including design and production.

In conclusion, Bio-inspired design could effectively support and accelerate effectively the radical change towards a Circular Economic model.

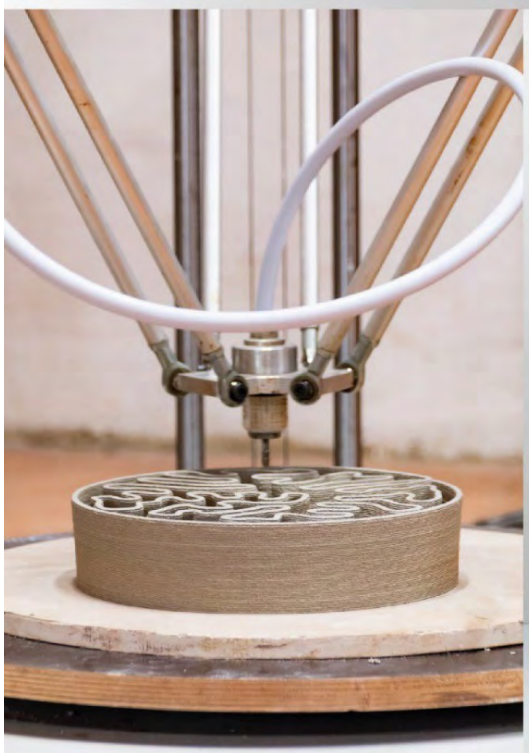


*Fig.3 . A-The trabeculae of bones led to lighter constructions and strengths; B-Cellular structures inspired the design of new products and constructions; C-Shells of Scallops inspired corrugated sheets. (Image produced by the authors).*

*Fig.4 Optimized structure inspired by butterfly wing scales to maximize stiffness and density (Pelanconi et al., 2019).*

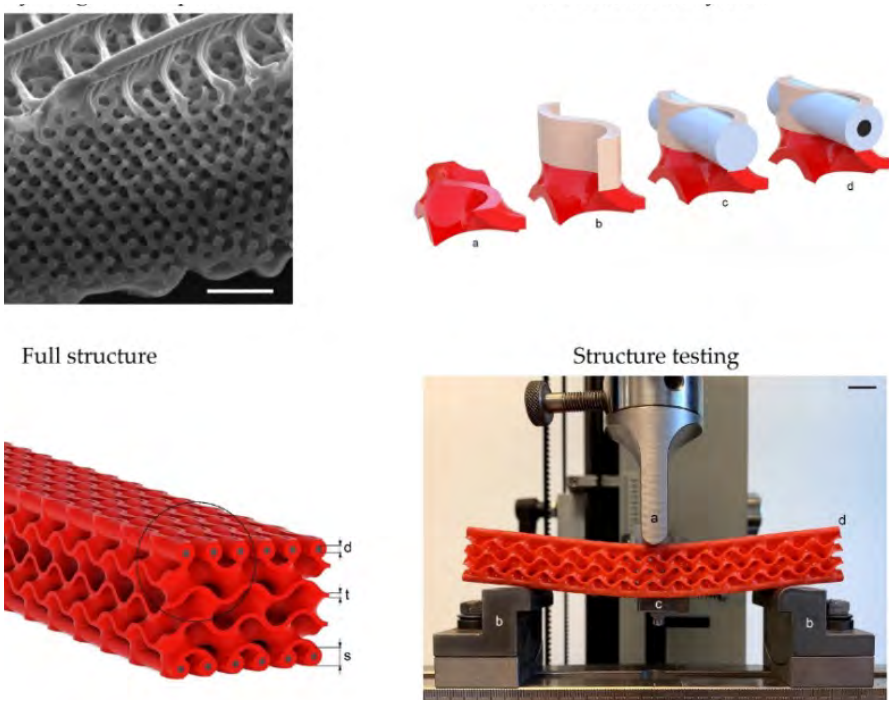



*Fig.5 Study of the flexible exoskeleton of the marine sponge analyzed and replicated with 3D models. (Mistry et al, 2023).*


*Fig.6 Hankook airless i-Flex. Latest model unveiled at CES 2022. (www.hankooktire.com).*

# References


1. Bar-Cohen, Y. (2011). Biomimetics: Nature-Based Innovation; Taylor & Francis: New York, NY, USA.
2. Benyus, J.M. (1997), Biomimicry: innovation inspired by nature, Perennial, New York.
3. Bhasin, D., & McAdams, D.A. (2018). The Characterization of Biological Organization, Abstraction, and Novelty in Biomimetic Design. Designs, 2(4):54.
4. Broeckhoven, C., & du Plessis, A. (2022). Escaping the labyrinth of bioinspiration: biodiversity as key to successful product innovation. Adv Funct Mater. 32:2110235.
5. Buccino, F., Aiazzi, I., Casto, A., Liu, B., Sbarra, M.C., Ziarelli, G., Vergani, L.M., & Bagherifard, S. (2021). Down to the Bone: A Novel Bio-Inspired Design Concept. Materials, 14(15):4226.
6. Dicks, H. (2023). The Biomimicry Revolution: Learning from Nature How to Inhabit the Earth, Columbia University Press
7. Duffy, J.E. (2009). Why biodiversity is important to the functioning of real-world ecosystems. Front Ecol Environ. 7:437–44.
8. du Plessis, A., Broeckhoven, C., Yadroitsava, I., Yadroitsev, I., Hands, C. H., Kunju, R. & Bhate, D. (2019). Beautiful and functional: A review of biomimetic design in additive manufacturing. Additive Manufacturing, 27, 408–427.
9. Ellen MacArthur Foundation. (2013). Towards the circular economy. Retrieved from www.ellenmacarthurfoundation.org
10. Estévez, A.T. (2017). Biodigital, Architecture & Genetics. ESARQ (UIC Barcelona)
11. Fayemi, P.E., Wanieck, K., Zollfrank, C., Maranzana, N., & Aoussat, A. (2017). Biomimetics: process, tools and practice. Bioinspir Biomim. 12:011002.
12. Fiorentino, C., & Hunt, K. (2021), Biomimicry: una epistemología en construcción. Cuadernos del Centro de Estudios de Diseño y Comunicación, 133, 117-129.
13. Garg, P., Ghatmale, P., Tarwadi, K. V., & Chavan, S. (2017). Influence of Nanotechnology and the Role of Nanostructures, in Biomimetic Studies and Their Potential Applications. Biomimetics, 2(4), 7.
14. Gleich, A., Pade, C., Petschow, U., & Pissarskoi, E. (2009). Potentials and Trends in Biomimetics. Springer.
15. Langella, C. (2019). Design e Scienza. Collana scientifica Design Experience. Trento/Balrcellona: ListLab.
16. Lepora, N..F, Verschure, P., & Prescott, T.J. (2013). The state of the art in biomimetics. Bioinspir Biomim. 8:013001
17. Malshe, A.P., Bapat, S., Rajurkar, K.P., Liu, A., Linares, J. (2023). Exploring the intersection of biology and design for product innovations. CIRP Annals, 72(2), 569-592.
18. Mistry, Y., Weeger, O., Morankar, S., Shinde, M., Liu, S., Chawla, N., Chen, X., Penick, C.A., & Bhate, D. (2023). Bio-inspired selective nodal decoupling for ultra-compliant interwoven lattices. Commun Mater, 4 , 35.
19. Ozkan, D., Morrow, R., Zhang, M., & Dade-Robertson, M. (2022). Are Mushrooms Parametric? Biomimetics. 7(2):60.
20. Paciotti, D., & Di Stefano, A. (2021). Design generativo e prodotto industriale. Connettere la dimensione fisica/digitale del progetto. AGATHÓN, 10, 158-167.
21. Pennick, C.A., Cope, G., Morankar, S., Mistry, Y., Grishin, A., Chawla. N., & Bhate. D. (2022). The comparative approach to bio-inspired design: integrating biodiversity and biologists into the design process. Integr Comp Biol. icac097.
22. Pelanconi, M., & Ortona,A. (2019). Nature-Inspired, Ultra-Lightweight Structures with Gyroid Cores Produced by Additive Manufacturing and Reinforced by Unidirectional Carbon Fiber Ribs. Materials, 12(24), 4134.
23. L. Pietroni, & J. Mascitti. (2013). Biomimetic Materials for Design, in H. Bartolo et al., Green Design, Materials and Manufacturing Processes, Proceedings of the 2nd International Conference on Sustainable Intelligent Manufacturing, Lisbon, June 26-29, pp. 579-582 CRC Press, Taylor & Francis Group, London UK.

24. Pietroni,L., Mascitti, J. (2016). Superfici biomimetiche. I materiali bioispirati per un design sostenibile e rigenerativo. MD JOURNAL, 3, 66-77.
25. Pietroni,L., Mascitti, J. (2019). Oltre il biomorfismo: l'approccio bioispirato, in Op. cit., 165, 51-65.
26. Salvia, G., Rognoli, V., & Levi, M. (2009). Il Progetto della Natura. Gli strumenti della biomimicry per il design. Ed.FrancoAngeli , Milano.
27. Speck, O., Speck, D., Horn, R., Gantner, J., & Sedlbauer, K.P. (2017). Biomimetic bio-inspired biomorph sustainable? An attempt to classify and clarify biology-derived technical developments. Bioinspir. Biomim. 12 011004
28. Spiegel, C., Hippler, M., Münchinger, A., Bastmeyer, M., Barner-Kowollik, C., Wegener, M., & Blasco, E. (2019). 4D Printing at the Microscale. Advanced Functional Materials, 30(26), 1907615.
29. Tedeschi, A., & Lombardi, D. (2018). The Algorithms-Aided Design (AAD). In: Hemmerling, M., Cocchiarella, L. (eds) Informed Architecture. Springer, Cham
30. Yeter, I.H., Tan, V.S.Q., & Le Ferrand, H. (2023). Conceptualization of Biomimicry in Engineering Context among Undergraduate and High School Students: An International Interdisciplinary Exploration. Biomimetics. 8(1):125.
31. Yan, X., Bethers, B., Chen, H., Xiao, S., Lin, S., Tran, B., Jiang, L., & Yang, Y. (2021). Recent Advancements in Biomimetic 3D Printing Materials With Enhanced Mechanical Properties. Frontiers in Materials. 8:518886.
32. Yalinay Cinici, S., Ozsel Akipek, F., & Yazar, T. (2008). Computational Design, Parametric Modeling and Architectural Education. 16-23.
33. Wissa A., Alleyne M., Barley W. C., & Suarez A.V. (2022). Best Practices of Bioinspired Design: Key Themes and Challenges, Integrative and Comparative Biology, 62(5), 1147–1152.
34. Wolpert, H. (2013). Engineered biomimicry: the world's top Olympians. Engineered biomimicry (eds A Lakhtakia, RJ Martı´n-Palma), pp. xix – xxiv. Waltham, MA: Elsevier

# Eco-sea design.
# Transdisciplinary products and services for sustainability in seaside contexts

*Ivo Caruso*[1], *Vincenzo Cristallo*[2]
*ivo.caruso@unina.it, vincenzo.cristallo@poliba.it*

[1]*University of Naples "Federico II", Italy*
[2]*Politecnico di Bari, Italy*

***Keywords:***
*Beach design*
*Seaside environments*
*Sustainable tourism*

## Abstract

The contribution analyzes the operational framework of eco-sustainable projects tested in coastal and seaside contexts. Specifically, the research we conducted in the last five years focuses on methods and practices capable of integrating the protection of the beaches with the typical touristic functions and their relations with the urbanized environments. The set of examples, collected on an international scale, represents a testimony of the possible coexistence between anthropic activities and ecological emergencies and traces a path of good practices exemplifying a progressive culture of regeneration of the maritime environments. The research shows how the sea-space has a status of fragile "inhabited and habitable nature" in which man over time has regularly brought together needs and interests. On the beach, therefore, the complexity of contemporary living is fully reflected: from the evolution of customs to technological innovation; from economic to social changes; from ideological to cultural transitions. This context is notoriously characterized by the combination of natural elements, artefacts and rituals, acting in relation to the advantages of local communities, the beneficiaries of the sea coasts and the different economic chains. In this framework new "devices" can be designed with principles of coexistence and collaboration between territories, nature and communities, so in an attempt to balance the degree of anthropization of nature with innovations able to include new priorities and sensitivities. The contribution conducts a phenomenological mapping that outlines an operational reference framework that declines the different sustainabilities for solutions that represent new possible models of "shared innovation".

## Introduction

The paper summarizes the products and the results of two complementary researches that address the issues of usability and enhancement of the beaches, namely: "Medonia. Design for the protection of Posidonia Oceanica" (field research - 2015/2017) and "Spiaggiaverde. Projects, products, actions and services for the sustainability of the seaside environment" (desk research 2018/2020). The study places the beach in the so-called "culture of regeneration" which can be included in the broad disciplinary perimeter of "design for the territory" and recognises, in it, the existence of peculiar models of action and innovation (Cristallo, 2017). The critical treatment of

the two research projects - which over time continued with "Com.Beach. Development of communication models on an infographic basis for the seaside environment (2020), and "Beach practices. Analysis of design-led seaside regeneration models" (2021) - already had the opportunity to be developed in other scientific dissemination activities reported in the bibliography.

As one of the most widespread topics in the revitalization processes of territories, of the urban contexts, down to individual artefacts, regeneration represents an unavoidable objective, in any project scale, for the projects that are expected to be sustainable. Regeneration, rather than a specific tool, can be considered as a set of activities regulated in a practice. These activities take place, also in reference to the "extensions" with which they manifest themselves (urban planning, housing, socio-economic, environmental, cultural), through public or private entities, and are supported by local communities. What emerges is therefore the inclusive, "multi-sense" and "pluridisciplinary" meaning which has taken on the expression "urban regeneration" in design practices (Bellicini, 2015). An extension that overcomes the apparent determinism of words such as recovery and reuse to promote a greatness (especially on the basis of the European experiences of urban regeneration and urban renewal) that fully supports the correlated growth of economic, cultural and social assets of an available urban or territorial context (Mantini, 2013). It is no coincidence that

> Graeme Evans and Phyllida Shaw, in the essay "The contribution of culture to regeneration in the UK: a review of evidence" (2004) - which contributed to a further evolution of the definition of urban regeneration in the English context - even placed their attention on the link between building regeneration and cultural regeneration, and on how the latter can be the real catalyst for urban redevelopment policies (Bellicini, 2015).

Policies that must necessarily make use of the discernment that persists in the relationship between quantity and quality when linked to local goods and how these are used. These topics are directly linked to the concepts of "limit" and "common goods"; two issues that directly impact the project statute in the case of regenerative variables and abilities.

We have to consider that, in addition to material and spatial ones, we can define as "common goods" all the social practices and phenomena such as "collaborative skills", "widespread skills" and "solutions to collective problems" which encourage the formation of "project coalitions" (Manzini, 2018). In addition to an intelligent and parsimonious use of resources in the framework of the circular economy (Levi, 2016), it is therefore necessary to induce changes that support a process of cultural reform which naturally increases in the correction of consumption combined in an innovative model of well-being (Bassi, 2017). That means to look at the social role of design also in political-strategic variables (Mortati et al, 2016). It appears a new projectual function that declares sustainability in the concreteness that the project itself inspires and encourages environmentally virtuous conducts. (1)

The beach space, in relation to these themes, represents a particular "territorial capital" (Thackara, 2008) which over the years has made it possible to delimit a specific "seaside culture" (La Pietra, 2015). Consequently, the design for the seaside context involves a varied patrimonial ensemble composed of natural characteristics, economic interests, cultural qualities, local characteristics and social activities. Furthermore, this transition band symbolically represents an «ambiguous and fluid limit: it is an apparently defined but perpetually changing line in the design of a dynamic balance» (Forte, 2014, p. 74), which stands out for being an urban or suburban void, seasonally overpopulated or almost uninhabited. So we can consider the

beach as a unique condition in which to make peculiar regeneration initiatives possible for these "voids" and, on a par with other urban contexts, to imagine for it to apply "design practices which, avoiding pauperistic solutions or practices that deny development, but rather choices that represent opportunities for rereading spaces, actions and artefacts [...] and more generally of the functions they host" (Caruso, 2018, p.37) in order to produce cultural as well as social and economic changes (Olmo, 2004). It is therefore recognized that the beach represents a "sensitive territory" in which to experiment with specific regenerative practices that propose sustainable actions and uses in consideration of the needs of local communities and occasional users.

From the applied experiments we conducted and from the critical analysis of best practices of international importance, the research delimits three specific models of regenerative actions which involve seaside environments and which, through them, outline some "processes of rediscovery of the intrinsic potential and opportunities in the mix of naturalness and anthropic nature" (Nan, 2013, p. 142). They are ecological and "significant" regenerations that graft the materials of the sea to new value production processes and that experiment with collaborative eco-services designed as models of interaction and "eco-social pact" between nature, elements, contexts, living species, territories, communities, economies.

## Material deposits

The first group of good practices brings together projects that consider the sea and the beach as places of arrival and accumulation of materials deriving from natural phenomena or anthropic activities. These materials can be the subject of new actions for their collection, reprocessing and "change of domain" or context, becoming, in fact, inputs for new systemic productions (Bistagnino, 2009). In the last 60 years, for example, the global production of plastic has increased exponentially and, in reference to the environmental problems that have arisen from it, the culture of design can be an effective tool for "re-organization" and narration about the complexity and gravity of the events at stake and critical guidance to create responsible change solutions entrusted to individuals and active social groups. Doing "things" according to these principles generally means to denote the public and social value of the project which manifests itself starting from "local", "participatory" and, at times, "minimal" objectives, nevertheless capable of generating impacts and spreading value of an eco-oriented sensitivity (Manzini, 2015). Sometimes real business opportunities arise, often strengthened by collaboration between companies, institutions, environmental associations and active communities.

A good example is the "Upcycling the Oceans" experience. A project developed by the Ecoalf company. A collective action that intends to contrast the presence of marine waste with the help of the fishing industry. An international initiative that was born in Spain in 2015 and, during the years, it also been implemented in Thailand, Greece, Italy and France. The "men of the sea", involved in the role of actors in the field, were asked to remove residues of fishing nets, plastics and other abandoned materials from the sea waters to produce, with recycling processes, yarns for footwear and clothing. After approximately eight years of activity, the project now sees the involvement, on a voluntary basis, of more than 4200 fishermen active on more than 1000 fishing vessels authorized to deliver various types of waste recovered at sea in 71 ports.

The "Sea Chair" research project by Studio Swine and Kieren Jonesla, from 2012, belongs to the same challenge, but it is supported by the ideolog-

ical dimension of critical and social design. This initiative too places the crucial role of fishermen who are asked to work symmetrically as "ecological lookouts" and makers for the creation of small artifacts made of reprocessed plastic. The stools that take shape by hand represent an explicit reflection on the problematic current situation of the fishing industry in the United Kingdom and, more generally, on the destiny of the sea and the beach so that they are no more places of "plunder" but habitats to be safeguarded.

The idea of a collective and "parceled" recovery is then developed in 2020 by the experimental project "Cloud of Sea" by Matteo Brasili. It is a special boat fender capable of retaining even very small plastic particles. This recreational filter suggests creating a community of navigator-gatherers, even occasional, who together contribute to the health of the sea.

Another eco-social cooperation project is the one tested, starting from 2021, by the Vestre brand with the "Coast" project. The street furniture manufacturing company, within the Ogoori environmental initiative (promoted in partnership with the companies Vestre, Ivar and Ope), has given shape to what it defines as "the first bench in the world made with ownerless marine plastic", obtained, therefore, by reprocessing the waste collected from the beaches and waterways of Norway.

Another particular case of regeneration of a specific "sea waste" to be used in new contexts is the recent Shellmet project. Sarufutsu village in Hokkaido (Japan) is a major scallop farming center. The food industry connected to this product generates waste of around 40,000 tonnes of shells every year. The local community has collaborated with product design startup Quantum and plastics manufacturer Koushi to find a solution to reuse these enormous quantities of special waste, now uncontainable in local landfills. The main chemical component of seashells is calcium carbonate, a compound also found in hard materials such as eggshells, pearls, and in some rocks and minerals. Combined with a specific polymer blend, the substance produces a material resistant enough to make possible the production of protective helmets. Inspired by the idea of biomimicry, Shellmet incorporates a special ribbed structure into its design that simulates the structure of the scallops themselves. These ribs and the properties of this new material have made it

*Fig.1 Accumulation of wasted scallops shells in Sarufutsu - Japan. Photo courtesy TBWA/Hakuhodo.*

possible to have a mechanical resistance that is approximately 33% higher than common helmets on the market. The project therefore recreates, on a new product, the original function of the material: protection. Initially intended for local operators in the fishing sector, the product can also be used in other work, sporting or urban contexts. Furthermore, to maximize the diffusion of the product, the desired ecological impact and also its symbolic value, a particular historical moment was chosen. In fact, starting from April 2023, the obligation for all cyclists to use helmets came into force in Japan.

*Fig.2 Shellmet, multipurpose protective helmet, design TBWA\Hakuhodo's creative team, Quantum, Hiroshi Uyama, manufactured by Koshi Chemical, 2023. Photo courtesy TBWA/Hakuhodo.*

## Spatial resemantizations

The second group of case studies collects initiatives capable of acting on the scale of the beach space with temporary actions capable of imagining times, themes and uses different from those typical of bathing for the context. These practices therefore operate in low season periods in which the beach is normally abandoned to the severe natural elements and in which, in fact, it is unable to reconfigure itself to provide users, whether occasional or resident, with new functions or interests. The collected practices, instead, give new meanings to the context by imagining new languages, new audiences and new cultural contents for it. The beach thus becomes an "open square", almost metaphysical, capable of stimulating creative interventions that transform its identity, perceived value and its relationships with the city and local economies. A very famous example is the "Sculpture by the Sea" initiative. This is a contemporary art exhibition founded in 1997 by David Handley with the idea of creating an opportunity for free and public art enjoyment, and therefore intended for a wide range of users. The first edition, thanks to its democratic spirit, managed to involve many voluntary collaborators, and received more than one hundred proposals from Australian artists, the interest of the media, the approval of the Council and a sponsor from the water supply company Sydney Water which puts $5,000 available to establish the first Sydney Water Sculpture Prize. Produced on a shoestring budget, the first exhibition was organized in just ten weeks and lasted just one day. However, it managed to attract around 25,000 visitors and the quality of the exhibition and the interest of the media gave the necessary impetus for the development of the initiative. Thanks to this, Waverley Council

authorized the staging of a multi-day exhibition the following year. In 1998 the Organizing Committee of the Sydney Olympic Games (SOCOG) commissioned five exhibitions of Sculpture by the Sea in as many Australian locations. Over 260 sculptures are created and installed in a year. This event quickly creates a national network joined by private citizens, financiers and public and private stakeholders. In 2002, an educational program was launched for primary and secondary schools carried out during the exhibitions which every year involves around 2,500 students in art workshops and guided tours. Since 2005, the popularity of the Bondi Beach exhibition has led to the creation of a second annual event in Perth. In 2011 the New South Wales State Government recognized the importance of the exhibition in the cultural and tourism calendar and granted the organization multi-year funding to cover the 2011-2014 exhibitions of $300,000 per year which is renewed annually and increased to $400,000 as of 2020. Since 1997, the Bondi exhibition has displayed over 2,400 sculptures, while around 600 different artists have exhibited in Cottesloe. The initiative has been instrumental in launching the careers of many emerging sculptors, supported the careers of senior sculptors, brought the general public closer to contemporary sculpture, and generated many millions of dollars in revenue for what was previously one of the most of art with fewer resources in Australia. Every year, it is estimated that between two and three million dollars are earned by the artists from the sales of their works. The initiative then enhances tourist attractiveness even in typically less profitable periods of the year, consequently fueling all the related economies.

Similarly to the Australian example, the triennial Beaufort exhibition has been held in Belgium since 2003. The initiative intends to create an open collection of monumental art installations distributed along tens of kilometres, between small and medium-sized towns and the North Sea. In 2009, Phillip Van den Bossche succeeds Willy Van den Bussche as director of Mu.ZEE (a museum that merges the former Museum of Fine Arts and PMMK) and as curator of the festival. With his selection, the new curator focused on works that dialogue with the sea, the heritage, the inhabitants and the history of the coast.

In Italy, since 2011, the Demanio Marittimo Km-278 initiative has been organized as a moment of cultural debate, analysis, and also fascination to-

*Fig.3 Demanio Marittimo.km-278, curators: Pippo Ciorra, Cristiana Colli, Senigallia, Italy, 2016. Photo courtesy Demanio Marittimo.km-278.*

wards the coastal territory of the Marche and Adriatic Sea. Every year, on the beach of Marzocca-Senigallia, on a July night, a pop-up event dedicated to art, architecture, design, performance, installation and cinema comes to life. The festival was born within the Mappelab magazine and, since its debut, has been conceived and managed as a strategic choral project, supported by a complex network of public/private, local, national and international relations. This "seaside suburb", from dusk to dawn, thus becomes the ideal context for stimulating multidisciplinary debates, for thinking and implementing conscious, calm, surprising ways of enjoying it. Over the years, this cultural marathon has brought young people, associations, administrators, academics, designers and artists from all over the world to "land" on this Adriatic beach and has stimulated and welcomed reflections, installations, workshops, competitions and productions.

Another peculiar initiative is the international Winter Stations design competition which has been held annually since 2015 in Toronto, Ontario, Canada. Participants are tasked with designing temporary winter installations that incorporate existing lifeguard towers between Kew and Woodbine city beaches. These towers, disused during the cold period, are considered anchoring and distribution points for the installations. Every year, four to six proposals are created and they remain freely accessible for a period of six weeks. These projects aim to encourage mainly local users to use the beach even in cold periods and to let them experiment with new models of interaction with the otherwise unwelcoming context.

Since 1969, in France, the Société des Réalisateurs de Films has organized La Quinzaine des Réalisateurs, a film festival parallel to the Cannes Film Festival which includes an international program of short films, movies and documentaries. Since 2004, in order to strengthen the communication of the event and the link with the place that hosts it, the Smarin studio has designed temporary interventions on a stretch of the rocky coast between Cannes and Nice. In 2016, for example, with the Les Marches project, eighty-five blocks of waterproofed foam were created and distributed along the coast, cut so as to have sharp edges that visually suggest an idea of hardness, as if they were made of raw concrete. The modules are actually soft to the touch and they adapt to the context. The installation, created in collaboration with the artist Céleste Boursier-Mougenot, beyond the mere function of mediation with an inhospitable place, represents a conceptual act for how it inserts a "second nature" into a harsh context, a sort of flexible interface between bather and soil, yet landscape-integrated.

First there is a Mountain is, then, a traveling artistic project by Katie Paterson which, in 2019, involved the communities of various British seaside towns. The artist invited the participants to meet on the beach to create many small mountain chains of sand and, thus, form imaginary micro-geologies. To enable these collective performances, the author provided the participants with a series of thermoformed buckets made as small-scale versions of mountains considered representative of the five continents: Mount Kilimanjaro (Africa), Mount Shasta (North America), Mount Fuji (Asia), Stromboli (Europe) and Uluru (Oceania). By random aggregation of hundreds of these small promontories, the participants, from time to time, created symbolic topographic maps which were an opportunity for storytelling and reflection on the time that connects the oldest rocks on Earth with the coastal geological landscape, celebrating, thus, the local, the national and the international dimension. After each event, the mountain ranges naturally disappeared due to the effect of the tides, staging in an accelerated manner the transformative effects of the millennial erosive processes. This inevitable ephemeral character of the work of art invites the user to manipulate the context, to experiment with the natural materiality of the beach context, to take an active role in the generation of the work itself and to delve into concepts of

a philosophical, astrophysics and geological nature. The result is an invitation for the audience to slow down, pause and put reality aside to create an experience that is engaging and meditative at the same time. An experience that pushed participants to reflect on the space we occupy as a human race and to reconsider the interconnections between millennial events and daily actions. The collective performance touched twenty-five different beaches in the United Kingdom. Furthermore, for each "stage", an unpublished textual contribution was commissioned that linked the initiative to the specific place. The twenty-five writings have been collected in an open access digital anthology in which essayists, poets, geologists, earth scientists, ecologists, technologists and art critics collaborated. Each text, recited aloud at the beginning of each performance, creatively implemented and diversified the art event providing interpretation keys and multidisciplinary perspectives. The different writings connect, with different expressive languages, to each location, relating the work of art to the place, its people, history and the broader global geological context.

*Fig.4 First there is a mountain, art performances in 25 different beaches in UK, artist: Katie Paterson, 2019. Photo courtesy Katie Paterson.*

## Eco-systemic cooperations

The third group of design experiences collects practices that interpret and regenerate the place and materials (anthropic or natural) of the beach to define, on the beach itself, new products, services, immediate solutions in favor of the context itself. The beach is, once again, understood as a deposit of various types of common goods, but the regenerative practices here stand out for "remaining on the territory" in a sustainable way and therefore for solving specific contextual problems. Here we therefore can find proposals that test new possible collaborations between nature and anthropic activities, new possible balances, new "pacts" of coexistence between communities, spaces, environmental conditions, plant and animal species.

An emblematic case study of this approach to design for (and with) the beach is the Weltevree Strandtuin by Floris Schoonderbeek (2015). This is a pop-up seaside facility that explores new ways of recreational use that are not limited to the passive supply of goods and services, but which, in a general perspective of eco-social awareness, encourage holidaymakers to have

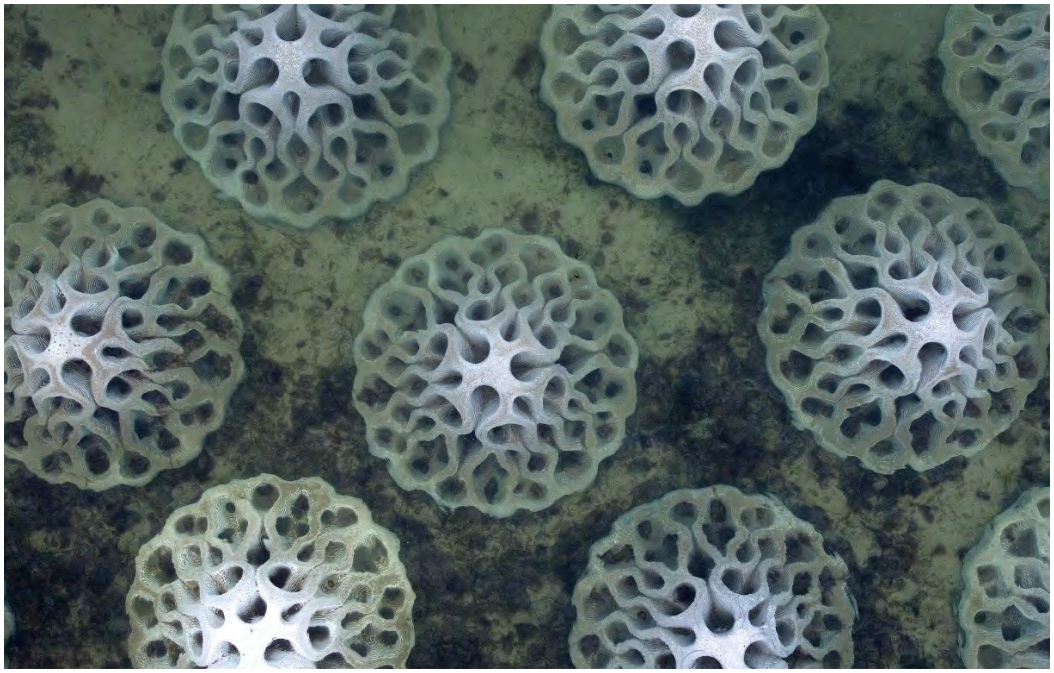
an active role in the functioning of the space. The temporary installation is designed to be energetically self-sufficient and to use, in a self-sustainable way, everything that the beach has to offer: the wind barriers are made of sand dunes, the dry wood collected nearby by the users themselves fuels small ovens for the food and stoves to heat water for the two relaxation pools, solar and wind energy provide the electricity needed for lighting and cooling systems, and a local well provides fresh water. Food and drinks are kept cold in the Groundfridge cell which uses the insulating effect of the sand. The Strandtuin, in the designer's intentions, therefore does not put the visitor in "a cottage with a view of the sea", but requires a collaborative effort, thus making him feel part of and creator of the place. It brings him into direct contact with the elements of the context, making him a proactive subject in commensurate with them with a non-predatory attitude, but in search of a possible balance between nature and the pleasantness of using the seaside elements. The holidaymaker thus becomes a bit of a bricoleur, a bit of a maker, a bit of a romantic castaway and enjoys, together with his peers, creating sufficient conditions of comfort and anthropization. The Weltevree Strandtuin was set up for the Into the Great Wide Open event, a music festival that takes place annually in Vlieland, a North Sea island in the Netherlands. The project was implemented in collaboration with Lab Vlieland, the Forestry Commission and the local Stortemelk campsite.

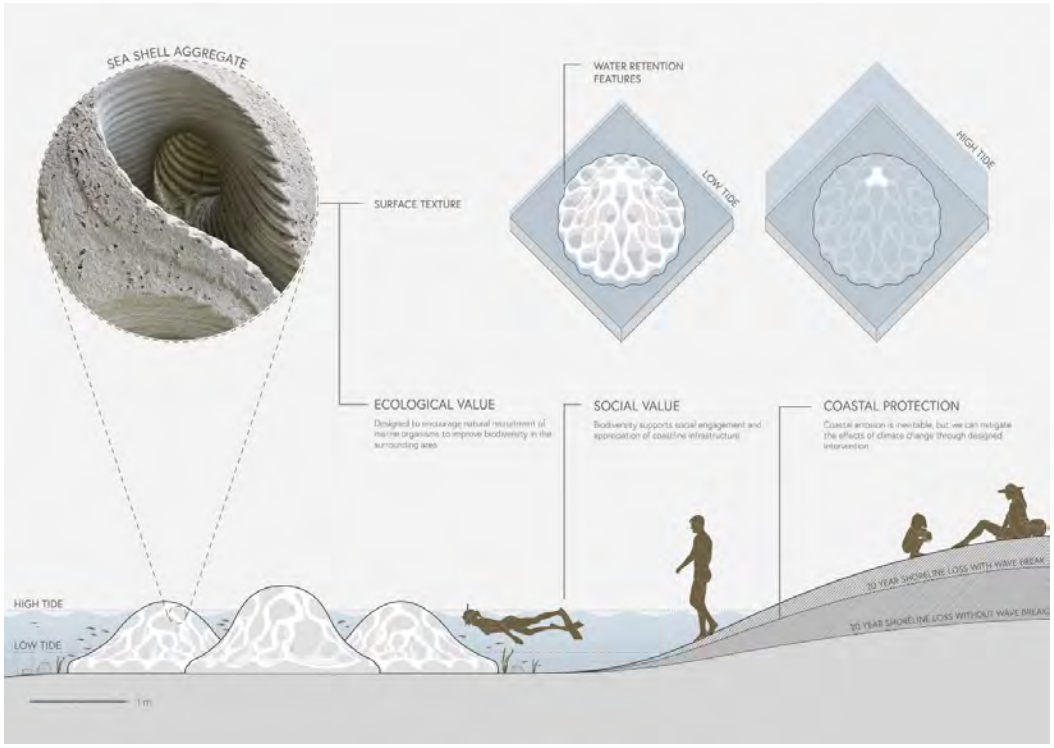
*Fig.5 Strandtuin, temporary passive beach facility, designer: Floris Schoonderbee, in partnership with Into the Great Wide Open, Lab Vlieland, Weltevree, Staatsbosbeheer, Hoogvuur, 2015. Photo courtesy Floris Schoonderbee, Photography: Tatjana Quax & Ben Lamers.*

Also worth mentioning is 'Underwater sculpture', the artistic research conducted since 2006 by Jason deCaires Taylor. In collaboration with marine biologists, the sculptor, using a neutral pH cement, has moulded groups of human figures to create underwater installations that function as passive dwellings for the proliferation of marine species. On this occasion, art in the service of the sea has created a mise-en-scene that serves as a warning about the ecological duties from which man cannot escape as the guardian of a unique and fragile heritage.

With similar criteria, but exploring other paradigms, Sheng-Hung Lee and Wan Kee Lee designed "TetraPOT" in 2016, concrete breakwater modules, hollow on the inside, which, once distributed along the coastlines most

exposed to erosion phenomena, act as coastal defence agents and containers for mangroves. It is precisely the mangroves, in addition to solidifying the blocks with their roots, that provide a home for other plant and animal life.



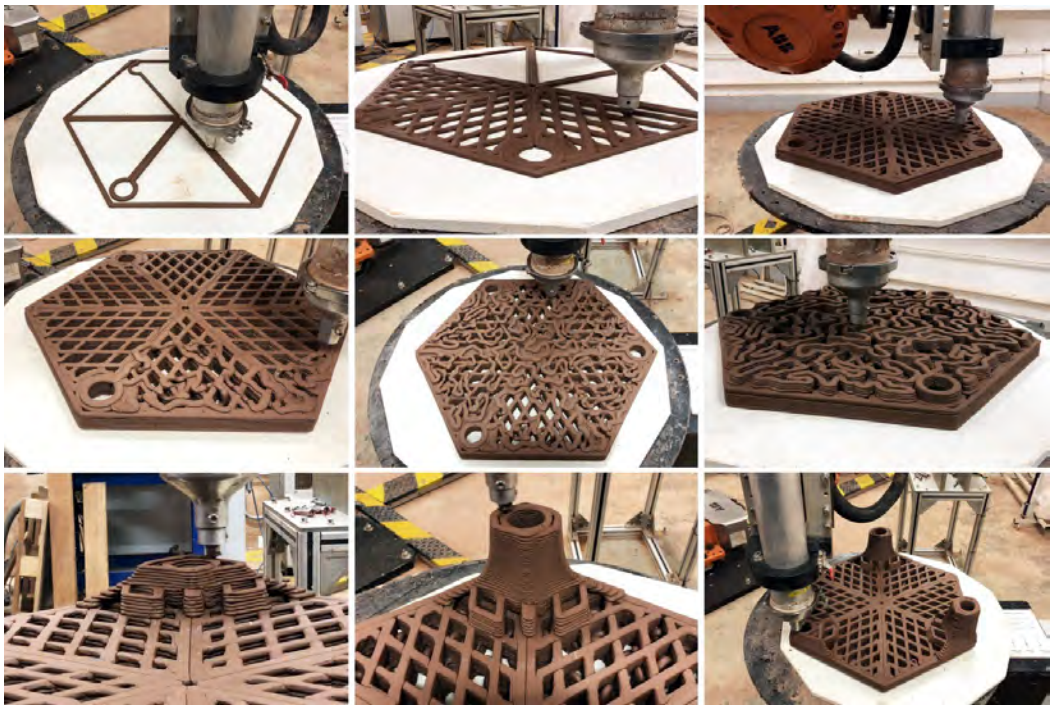



Similarly, in different parts of the world, various systems for the repopulation of different marine species have been under experimentation for several years now, involving a useful balance between animal and plant species, the involvement of local communities and tourism activities. Among the most relevant experiences are the Reef Cells developed by Christopher Xavier O'hare in the USA since 2005, the Econcrete project launched in 2012 by the Israelis Ido Sella and Shimrit Perkol-Finkel, the Living seawalls,

*Fig.6 Fig.7 EMU - Erosion Mitigation Units, designer: Reef Design Lab, Dell Eco Reef in Clifton Springs Victoria, Australia, 2023. Photo courtesy Reef Design Lab.*

*Fig.8 Fig.9 3D printed tiles, designer: Archireef, University of Hong Kong (Christian J. Lange, Lidia Ratoi, Dominic Co Lim, Jason Hu from Robotic Fabrication Lab, Vriko Yu, David Baker, Phil Thompson from Swire Institute of Marine Science - SWIMS), in partnership with Chinese Agriculture, Fisheries and Conservation Department (AFCD), San Kung Peninsula, Hong Kong, 2020. Photo courtesy Archireef and Hong Kong University.*

MARS, mangrove planters, Reef habitat project by Reef Design Lab (Sydney Institute of Marine Science with designer Alex Goad), the French X-Reef project active since 2017, the modular 3D printed tiles system born in 2020 in Hong Kong from the collaboration between Archireef, University of Hong Kong (Christian J. Lange, Lidia Ratoi, Dominic Co Lim, Jason Hu from Robotic Fabrication Lab, Vriko Yu, David Baker, Phil Thompson from Swire Institute of Marine Science - SWIMS) and the Chinese Agriculture, Fisheries and Conservation Department (AFCD).



## Conclusions

All the projects we have presented show how the themes of environmental sustainability - complementary to those of urban regeneration - are fully present in the beach context. More in general, this observation shows how the complex contemporary transformations dictated by changed social and economic conditions, as well as suggested by the role of technologies and climate change, is fully manifested in this specific context. In other ways it can be said that, by crossing different experiences, objectives and geographies, the examples illustrated highlight the strong complex relationship that exists between "territorial capital", "beach environment" and "design culture". Moreover, the products, services and concepts we selected give evidence of the polyvalence of seaside spaces in exploring the very concreteness and the metaphor of the "green project". That is to say, that whatever design action is carried out in the beach-sea context, it is exercised in the field of a "natural heritage" that demands regenerative practices resulting not from opportunistic compromises but from intelligent practices in the mediation between nature and artifice. The territory-beach thus represents a privileged position from which to examine the responsibility of the project in proceeding according to different and possible models of development. This is a particular point of observation that the essay intends to focus on according to three keys of interpretation (Material deposits, Spatial resemantizations, Eco-systemic collaborations) that circumscribe some of the most experimental design scenarios concentrated in seaside areas. The set of examples described does not therefore proceed in the search for recurring methodologies from which to derive operational invariants which in turn can be traced back to theoretical questions, but rather in indicating operational plans from which to observe the possible coexistence between anthropic realism and ecological urgencies, in the perspective of a regenerative culture appropriate to the seaside environment (2).

## Acknowledgements

Project funded by the European Union - NextGenerationEU - National Recovery and Resilience Plan (PNRR) - Mission 4 Component 2 Investment 1.3 - Notice No. 341 of 15/03/2022 of the Ministry of University and Research (MUR). Application protocol PE000004, grant decree no. 1551 of 11/10/2022, CUP D93C22000920001, Made in Italy Circular and Sustainable MICS. SPOKE 7 "New and consumer-driven business models for resilient and circular SCs" P. 5 Research project "Cultural value chains: From local traditional production districts to a new country of origin effect" (coordinator Prof. Annalisa Di Roma).

## Footnotes

1) Cfr.: Cristallo, V., Caruso, I. (2021), "Beach Practices. Modelli per la rigenerazione balneare guidata dal design", in "La seconda vita dell'ambiente costruito, The second life of the built environment", AGATHÓN | International Journal of Architecture, Art and Design, n. 9., p. 216.

2) Cfr.: Cristallo, V., Caruso, I. (2022), "Modelli e pratiche per la rigenerazione balneare e la salvaguardia degli arenili", in Dal Buono, V., Morozzo della Rocca, M. C., Pericu, S., (a cura di), "BLUEDESIGN. Acqua e design nell'equilibrio tra uomo e ambiente", MD JOURNALL n. 13, edizioni Media MD, Ferrara, pp. 54-55.

# References


1. Bassi, A. (2017), Design contemporaneo. Istruzioni per l'uso, Il Mulino, Bologna.
2. Bellicini, R. (2015), Rigenerazione urbana sostenibile, in Enciclopedia Italiana - IX Appendice, Istituto della Enciclopedia Italiana fondata da Giovanni Treccani, Roma.
3. Bistagnino, L. (2009), Design sistemico. Progettare la sostenibilità produttiva e ambientale, Slow Food Editore, Bra.
4. Caruso, I. (2018), Design, energie e territori, Edizioni Nuova Cultura, Roma.
5. Cristallo, V. (a cura di), (2018), Medonia. Il design per la salvaguardia della Posidonia Oceanica, Edizioni Nuova Cultura, Roma.
6. Cristallo, V., Caruso, I. (2022), "Modelli e pratiche per la rigenerazione balneare e la salvaguardia degli arenili", in Dal Buono, V., Morozzo della Rocca, M. C., Pericu, S., (a cura di), "BLUEDESIGN. Acqua e design nell'equilibrio tra uomo e ambiente", MD JOURNALL n. 13, edizioni Media MD, Ferrara
7. Cristallo, V., Caruso, I. (2021), "Beach Practices. Modelli per la rigenerazione balneare guidata dal design", in "La seconda vita dell'ambiente costruito, The second life of the built environment", AGATHÓN | International Journal of Architecture, Art and Design, n. 9.
8. Forte, L., (2014), "Ispirazioni dal rapporto terra-mare. Visioni di paesaggio, indirizzi al progetto", in TRIA – Territorio della Ricerca su Insediamenti e Ambiente, vol. 7, issue 13, pp. 67-82.
9. La Pietra, U. (2015), "Introduzione" in Fassi, D., Sulla spiaggia. Progettare gli spazi della balneazione, Maggioli Editore, Santarcangelo di Romagna 2015, pp. 11-13.
10. Levi, M. (2016), "L'economia circolare del pensiero green", in Domus, issue 1005, allegato Green.
11. Mantini, P. (2013), Rigenerazione urbana, resilienza, re/evolution. Profili giuridici, in Sbetti F., Rossi F., Talia M., Trillo C., Città come motore di sviluppo del Paese – Proceedings of the XXVIII Congresso Istituto Nazionale di Urbanistica, Salerno, June 28-29, 2013, INU Edizioni, Roma, pp. 1-26.
12. Manzini, E. (2015), Design, When Everybody, Designs. An Introduction to Design as Social Innovation, Mitt Press, Cambridge, MA.
13. Manzini, E. (2018), Politiche del quotidiano, Edizioni di comunità, Roma.
14. Mortati, M., Villari, B., Maffei, S., Arquilla, V. (2016), Le politiche per il design e il design per le politiche. Dal focus sulla soluzione alla centralità della valutazione, Maggioli editore, Santarcangelo di Romagna.
15. Nan, E. (2013), "Rinaturactivazione urbana nel Mediterraneo: nuove strategie da antichi genomi", in TRIA – Territorio della Ricerca su Insediamenti e Ambiente, vol. 6, issue 11, pp. 131-144.
16. Olmo, C. (2004), "I dilemmi della rigenerazione", in Alcozer, F., Gabrielli, S., Gastaldi, F., Urban ReGENeration. +Città, Alinea, Firenze, pp. 73-75.
17. Tamburrini, P., Stabellini, B. (2018), "Metodologie e strumenti per l'innovazione sostenibile", in Design e territori, MD Journal, vol. 5, issue 1, pp. 50-57.
18. Thackara, J. (2008), In the bubble. Design per un futuro sostenibile, Umberto Allemandi & C, Torino.

# Fashioning a Sustainable Future: Navigating Zero-Waste Practices in Textile Chain

*Maria Antonia Salomè*
*mariaantonia.salome@unifi.it*

*Università degli Studi di Firenze, Italy*

***Keywords:***
*Zero-Waste Design*
*Pre-Consumer Textile Waste*
*Fashion Industry*
*Literature Review*

## Abstract

This research highlights the significant issue of textile waste generation in Europe, with over 15 kilograms per person annually, making the clothing and textile industry highly resource-intensive and waste-generating. In Italy alone, 480,000 tons of textile waste were produced in 2019, originating mainly from the textile industry and urban waste sorting. While some efforts were made to recover materials from this waste, a considerable portion still ended up in disposal or intermediate activities. The research, part of a national project funded by the NextGeneration EU program, aims to analyse the textile sector's strategic importance and advocate for more sustainable and circular approaches. It explores the implementation of zero-waste design principles in fashion through a literature review, emphasising the role of design decisions in the entire garment lifecycle and the potential for textile scrap to drive innovation and socio-economic benefits in the industry.

## Introduction

Today, more than 15 kilograms of textile waste is generated per person every year in Europe (McKinsey, 2022) and the clothing and textile industry is considered a highly resource-intensive and waste generating industry (Bonifazi et al., 2022). According to the report "Italy of recycling" (2022), the Foundation sustainable development and Unicircular, in 2019 Italy produced 480,000 tons of textile waste. 50% of these come from the textile industry, 30% from urban waste sorting, and the remaining 20% from other types of activity. As stated in the report, in 2019 46% of the waste in the textile sector was started to recover material, while 11% was destined for disposal. A very large share of waste, about 43%, was allocated to intermediate activities, such as pretreatment and storage.

This research is part of the national research project "Re-Waste. Circular Ecosystems in Textile Chain", ongoing at University of Florence, founded by NextGeneration EU programme whose aim to analyse the strategic sector of made in Italy, as the textile sector, in which it could find remarkable critical points that underline the negative aspects of linear model and its unsustainable nature (Di Giacomo, 2013). At the same time, this model shows the urgent need to change practices towards more sustainable and circular approaches and methodologies. The contribution wants to explore the implementation of zero-waste design principles in the fashion field (ElShish-

tawy et al., 2022; McQuillan, 2011; Rissanen & McQuillan, 2016; Rissanen, 2014, 2013) through an in-depth literature review, with a specific focus on the pre-consumer stages of the textile supply chain e their poetics (Binotto & Payne, 2017).

The review synthesises a comprehensive analysis of the various approaches and tools used in the fashion field and how they are employed by various stakeholders to address and manage textile waste having to do with the reduction, the recycle and the reuse of this materials, and also the use of processes that can be able to extend the life of the products e ameliorate the end-of-life process (Bonifazi et al., 2022; Di Giacomo, 2013). Highlighting the attention on the importance of adopt circular economic model, the opportunity that this model offers to the companies (Bastos et al., 2021; Gazzola et al., 2020), and the social role of designers, it underlines how design decisions impact the entire life cycle of garments. Moreover, the collection of textile scrap represents a great resource (deadstock and leftovers) that could support innovation in the textile field with a virtuous action able to elicit an enhancement in the economics and social area (Vaccari & Cerulli, 2014).

## Methodology

The text aims to present the results of an initial literary analysis conducted between January and December 2023. Throughout the investigative phase of academic literature, the research expanded to encompass themes related to the social role of the fashion designer and the tools and approaches that can be employed in the prevention and management of textile waste, as well as in the production of new value from recovered materials. The research commenced by employing selected keywords pertinent to the theme of circularity and textile waste. The analysed texts were identified based on a series of keywords considered relevant to the ongoing research. Furthermore, the keywords were selected because they were deemed effective in obtaining a comprehensive overview within the context of sustainability and circularity regarding pre-consumer waste in the textile and fashion sector, with a focus on the potential to generate added value through the reintroduction of these products into the supply chain. Among the criteria for selecting the examined contributions is also the publication date: the selected texts span a period from 2014 to 2023, with a few exceptions that were included in the research due to their relevance to the topic or because more recent texts on the subject could not be identified.

The research was conducted through desk analysis of useful databases (e.g., the university's library catalogue and Google Scholar) to search for books, journals and articles. This process was undertaken subsequent to the creation of a list of keywords related to the research question, including all newly discovered keywords during the literature search. The identified keywords include: supply chain, textile supply chain, zero-waste, circular economy, textile and garment end-of-life, Prato textile district, zero-waste textile, sustainability in fashion, the poetics of waste in fashion, repurposing in fashion design practice, zero waste supply chain in Italy, recycling, textile mapping in Italy, regenerative fashion, digital transformation, fashion transition, community, and environmental sustainability. The employed keywords in the research underscore the intention to investigate the Italian situation regarding the pre-consumer supply chain and the desire to identify a new cultural and economic framework for textile by-products that are still considered unrecoverable—and devoid of value—by a significant portion of Italian production entities [1].

## The production of waste materials and the end-of-life issue

In the academic realm, research highlights the interest of numerous authors in analysing the primary factors influencing the production of waste materials. As emphasised by Rissanen & McQuillan (2016), there are two broad categories of textile waste: waste generated by industry (pre-consumer textile waste) and waste generated by consumers (post-consumer textile waste).

The life cycle of textile products (i.e., fabrics and clothing) generates numerous environmental impacts so much that textiles were identified as a "priority product category for the circular economy" by the European Commission in 2019 [2], encourage technologies for textile waste recovery and recycling—the most effective methods for textile waste disposal due to their lower environmental impact even currently less than 1% of textiles are recycled globally, with rates around 25% in Europe and 16.2% in the US (Bonifazi et al., 2022), and obliging member states to separate these materials as of January 1, 2025 [3].

Textile waste as unused and/or unsold fabrics could represent a significant resource for fashion students as "put back on the market goods destined for disposal and thus create a virtuous action capable of generating improvement both from an economic and social point of view" (Vaccari & Cerulli, 2014). Authors highlight a significant issue within unused fabrics redirected to stockist market loss origin traces, disrupting "textile biography" data and lifecycle tracking and, in the case of branded fabrics or products produced under exclusive agreements these products face destruction due to copyright. Moreover, the European Commission's call to reduce the use of natural resources to improve energy efficiency, Di Giacomo (2013) points out that the EU hosts approximately 50% of the industries worldwide that work starting from waste. The fashion production system [4], precarious and unsustainable in its linear model, is opening up to new opportunities that can arise from the view of waste as a solution to develop new economic activities.

## Circular Economy and the Benefits for Businesses

Circular Economy (EC) is an economic model aimed at minimising waste and making the most of resources by reusing, recycling, and regenerating products and materials. Some authors report upon existing frameworks and methodologies for assessing circular economy initiatives providing a basis for policy-making of Italian regional levels (Bastos et al., 2021). Others analyse new trends in the fashion industry, focusing on the importance of the circular economy (Gazzola et al., 2020) underlines the need for companies within this sector to understand the opportunities offered by the circular economy. Italian Circular Economy Atlas is a web-based platform that documents the experiences of economic and associative entities applying circular economy principles in Italy since 2017. Pezzoli and Vaghi (2019) describe the criteria for evaluating circularity and environmental and social sustainability of circular initiatives, insights into the development and implementation of the Italian Circular Economy Atlas to confirm the importance of integrating sustainability principles into circular initiatives.

To understand cross-country differences in the sustainability performances of the manufacturing and service sectors, Mazzanti and Nicolli (2012) investigate the relationship between sustainability and innovative dynamics,

focusing on the role of firms, particularly public utilities, in environmental innovation. Combining quantitative and qualitative methods, it shows how environmental regulations can drive innovation for both economic and environmental gains, emphasising firms, including public utilities, as producers of mixed public goods.

According to Salvi et al. (2021), circular cities as case study of Prato, characterised by inclusive governance and innovative policies, can serve as models for sustainable urban development as represent a new approach to public life that emphasises the environment as a central actor, highlights the importance of collective action and addressing environmental and social challenges through collaborative approaches.

Providing a comprehensive analysis of Circular Economy (CE) adoption challenges and responses in the textile and fashion industries, Saccani et al. (2023) addresses the challenges hindering the transition towards a CE in industries with significant environmental impacts. Authors proposing a circular supply chain framework to address challenges within a case study conducted in the Prato regenerated wool district to emphasise the importance of adopting a systemic approach to overcome barriers effectively.

## Fashion Industry 4.0

Investigating the themes of pre- and post-consumer waste in the Italian textile fashion sector also entails analysing the primary factors influencing the production of waste materials through a comprehensive understanding of production processes and supply chain mechanisms. In their study, Pratt et al. (2012) address the need to understand the fashion industry not only as a form of personal and cultural expression but also as a complex economic sector where to explore the parameters of the fashion industry and its implications for urban and regional economies, particularly in Europe. Federico Visconti, in the introduction to the book "Innovation and Sustainability in the Textile Industry" (2017, p. 9), draws attention to the industrial and economic dimension of the textile-fashion sector in Italy, emphasising the importance of manufacturing as the "beating heart of the Italian economy." The textile-clothing supply chain is a foundational sector of Italian manufacturing (p.9) with several industrial districts and their ancient history characterised by productive excellences, technological innovations, and a culture of craftsmanship that has developed strong innovative capacity that could experience a revitalization through sustainability initiatives, including the production of recycled and bio-based materials and fostering the whole supply chain. The sustainable fashion movement aimed to promote change in this industry, often with the risk of being simple greenwashing and social-washing, have raised an increasingly responsible attitude that is spreading on the part of the companies themselves and consumers who influence the market with their purchasing choices (Giorgianni, 2022).

## The environmental impacts of products

When discussing sustainability, it is imperative to focus on those processes of Life Cycle Assessment (LCA), a methodology used to assess the environmental impacts of products, services, and systems throughout their entire life cycle (Scalbi, 2012), and material recovery for the production of secondary raw materials obtained from recycling materials external to the textile supply chain. These types of processes, as highlighted by Magni and Noè (2017), should be considered as a solution to achieve a reduction in energy consumption in the production of new materials, as well as the down-

sizing of unsustainable volumes of plastic waste (as in the case of PET).

Academic literature addresses the need for suitable assessment tools to improve the sustainability performance of products, services, and processes for assessing the environmental impacts of products, encompassing all stages from raw material extraction to end-of-life disposal, and on evaluating the social impacts of products throughout their life cycle in evaluating the environmental and social impacts of textile products. According to this theory, Lenzo et al. (2018), suggest to combine the approaches of Life Cycle Assessment (LCA) and Social Life Cycle Assessment (S-LCA), focus on conducting the first LCA and S-LCA on an Italian-made wool/cashmere garment to assess the social and environmental impacts associated with the garment's production [7].

The challenge faced by textile and clothing companies in translating sustainability commitments into action due to various factors such as a lack of information, difficulty in defining the business case, and flawed execution highlighting the improvement of including the social dimension into the decision making process (Resta et al., 2016). To examine the spread of LCA methodology across various sectors and its scientific development, Scalbi (2012) worked on mapping groups involved in product life cycle evaluation to address the dissemination and application of the LCA methodology and to identify groups engaged in LCA activities. The study reveals that a growing number of groups involved in LCA activities utilise this methodology for environmental certification purposes as a comprehensive approach to studying the environmental impacts of products and systems, may limit its relevance to more recent developments in the field.

## The management and collection of textile waste

The European strategy to increase levels of separate collection of textile waste [8], anticipated by Italian regulations [9], according to Chezzi (2022), includes the introduction of an "Extended Producer Responsibility" (EPR) regime in relation to textile products. In line with these objectives, the National Recovery and Resilience Plan (PNRR) has allocated significant resources to so-called "Textile Hubs" for the establishment of new textile recycling plants from a systemic perspective. In this context, the author introduces RETEX.GREEN [10], to represent a proactive response to upcoming regulatory changes and confirms the growing recognition of Extended Producer Responsibility (EPR) as a viable strategy for addressing sustainability in the textile industry.

Discussing the challenges and strategies associated with treating textile waste, another issue essential due for the industries is the wastewater from textile supply chain. The concept of zero liquid discharge (ZLD) was introduced by Jahan et al. (2022) as a promising approach for sustainable water management for understanding different wastewater treatment techniques to achieve ZLD. Only a small portion of textile waste is collected and recycled because several waste is made of blended textile (Navone et al., 2020). The authors propose a sustainable solution for the recycling of wool fabric blends by enzymatically digesting wool fibres from wool-polyester blends, to separate the wool and recover the polyester fibres, which, retaining their properties, can be reused in new garments or other products and offers.

The importance of implementing a circular economy through proper management of resources that have become waste is at the core of Manco et al.'s research (2016) and the discussion of ecological footprint as a method of evaluating anthropogenic activities. In line with the European Union's recommendations for sustainable development, the scholars highlight the importance of separate collection of urban waste to reduce the extraction

of raw materials and limit the reintroduction of waste products into the environment (Manco et al., 2016). Pay particular attention to the concept of waste (p.238) and its origin (from the verb "to refuse"), they emphasise the shift that has led to considering waste as a resource to be valued thanks to the involvement and awareness-raising of the community (p.272). The social and moral value of waste is a central topic in the theory of waste poetics put forward by Binotto and Payne (2017). In particular, Binotto and Payne focus on the mechanism employed by the fashion industry to prioritise novelty and the first cycle of consumption, while emphasising the tendency to alter the perception of waste through the adoption of zero-waste approaches that reshape, repackage, transform, and "hide" waste under a new guise and attribute a new positive value to these products that led waste to be "accepted" and reintroduced into the value chain.

## Sustainable fashion and zero-waste approaches

The ongoing discussions in the field of sustainable fashion and textiles waste combines established frameworks such as systems thinking and design thinking with innovative approaches to address sustainability challenges in this sector (Matthes et al., 2021; Mellick et al., 2021; Solino et al., 2020; Brooks et al., 2017; Gardetti & Torres, 2017). Fletcher in the book "Sustainable fashion and textiles: Design journeys" (2013) states that sustainability, once marginalised, has gained traction among large corporations and is increasingly integrated into various aspects of the industry, including fashion weeks and government initiatives. New methods, materials, and approaches to sustainability were introduced as fostering ecological integrity, choosing materials to minimise environmental impact and optimising supply chain processes to reduce waste and resource consumption. While existing sustainability frameworks focus on metrics or economic value, Mellick et al. (2021) propose to combine the Sustainable Value Chain Analysis (SVCA) approach with the Cambridge Value Mapping Tool (CVMT) to identify sustainable value and opportunities for future value creation.

Sustainability issues in the global textile and fashion value chain are questions linked to various drivers and indicators (Matthes et al., 2021). The environmental threats posed by unbridled clothing consumption demand the adoption of new materials and economic models to mitigate the impacts of clothing production and use, particularly in relation to laundry practices in Britain (Brooks et al., 2017). Water usage and waste generation, moreover to job insecurity and child labour, are a significant environment and social impacts of the textile industry that fashion industry needs to pose as sustainability challenges (Gardetti & Torres, 2017). In response to the negative impacts of fast fashion, the rise of the slow fashion movement has been discussed in academic research, providing insights into its emergence, development and dissemination with the fashion industry with exponential growth particularly in countries like Brazil and the United States (Solino et at., 2020).

In these considerations, take sides the Zero Waste philosophy that focuses itself on "designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them" (Pasricha & Greeninger, 2018) [11]. Also, is a creative and participatory approach to engaging citizens in envisioning desirable "zero" waste futures, aiming to counterbalance predominant technology-centred visions of waste management (van den Eijnden, 2022) and policies (Altamura & Baiani, 2019). Zero waste (ZW) manufacturing put together various techniques for achieving zero waste by means of resource recycling (Awogbemi et al., 2022). Many

scholars investigate the zero-waste approaches as an opportunity to explore innovative aspects of waste management from various perspectives and disciplines. Such as reframing waste to grow recognition of the potential value in waste materials, or the concept of Zero Waste as an effective approach to addressing solid waste issues reshaping the resource supply chain to prioritise reuse and recycling, aiming to minimise waste generation (Awasthi et al., 2021).

In fashion and textile, scholars investigate the zero-waste approach to integrate sustainability practice into fashion design curriculum exploring the effectiveness of teaching zero-waste design within fashion design courses to increase students' awareness of fabric waste generation during the design process (Gam & Banning, 2020), effort reshaping the pattern-making process. According to Rissanen (2014), 'zero-waste fashion design' (ZWFD) has received considerable attention and interest from fashion media, industry and education since 2008 for providing a useful lens through which we can examine the fashion system and the relationships between and within the fashion industry and fashion users, but also for its focus on designing out pre-consumer fabric waste: zero waste fashion design (Rissanen & McQuillan, 2015). As an apparel production approach, zero-waste implies challenges because it tends to create one-size-fits-most option limiting mass-market applicability (Carrico et al., 2022), needs to be implemented using digital pattern cutting and marker making techniques (Ramkalaon & Sayem, 2020), and, moreover, for the feasibility and desirability of zero-waste fashion design within contemporary fashion (Rissanen, 2013). Some scholars worked on different methods to develop zero-waste patterns. C&P (Cutting and packing (C&P) focuses on mathematical and computational techniques for minimising fabric waste in marker planning, while ZWFD (Zero-Waste Fashion Design) provides creative pattern-making solutions to achieve zero fabric waste (ElShishtawy et al., 2022). Transformational Reconstruction (TR), is an innovative pattern-making technique in which the pattern cutting process was integrated into the design progression toward zero-waste resulting in more fitted garments (Saeidi & Wimberley, 2018).

To try to respond to the combination of cheap production of textiles and apparel (McQuillan, 2011), the challenge of waste could be addressed by proposing a User Modifiable Zero Waste Fashion (UMZWF) to democratise fashion production, empower users to engage with garment making and modification, and reduce waste in both production and use (McQuillan et al., 2018) or addressing the potential of three-dimensional (3D) software in zero-waste fashion design. 3D software could transform design practices in industry, education, and research, particularly focusing on its application in reducing fabric wastage during garment production (McQuillan, 2020). Carrico & Kim (2013, 2014) developed a method of resizing garments without making changes to the original pattern shape through carefully planned seam placements with varying widths.

Zero-waste fashion design offers new opportunities for engaging with fashion manufacture, particularly in addressing issues such as fabric utilisation and garment pattern grading (Rissanen, 2013). It can also be a creative pattern making challenge by uniting the roles of designer and patternmaker in a holistic approach to creating garments, considering aesthetics and function simultaneously, states Carrico & Kim (2014) that worked on of McQuillan "design practices" for zero-waste apparel design Shaping Sustainable Fashion (2011), proposing a fifth "design practice" draping the whole cloth with minimal cutting, called "minimal cut". In the context of a sustainable fashion system, other approaches define circular design to understand and recognise the potential for design in creating a circular fashion future as well (Goldsworthy, 2018).

The transition to a circular economy in the textile industry involves re-

thinking traditional linear production models and adopting waste valorization practices (Stanescu, 2021). Various solutions for valorizing textile waste are discussed in literature including recycling into second-hand clothes or new products, upcycling into fibres or composites, using textile waste as energy sources, and utilising it for soil improvement. A growing emphasis on upcycling textile waste to recover materials and energy viewing it as a potential source of carbon and energy within the context of the circular economy (Stanescu, 2021). Advanced upcycling methods in fashion practice, with the specificity of design methods, are centred on revaluation and resignification of waste materials (Bigolin et al., 2022). To address the feasibility of implementing upcycling design and production methods to mitigate this waste, some authors analysed the amount and types of textile waste and fabric leftovers generated in garment production, identified suitable methods for industrial upcycling, and developed innovative design approaches to utilise this waste effectively (Aus et al., 2021). A significant amount of this waste comes from post-consumer textile waste (PCTW) generated from used or second-hand clothing (SHC), waste that is not repurposed or recycled, but rather discarded. This clothing waste, very often fast fashion that helps sate deeply held desires mimic luxury fashion trends among young consumer (Joy et al., 2015), could be repurposed as new clothing developing a closed-loop supply chain that can support new product manufacture, divert textile waste, and enable an additional stream of revenue from reclaimed apparel (Lewis et al., 2016).

## Conclusions

The academic discourse on textile waste and sustainability in the fashion industry underscores the urgent need for comprehensive strategies to address textile waste and promote circular economy principles. Life cycle assessment methodologies play a crucial role in evaluating the environmental and social impacts of textile products, while waste management strategies such as extended producer responsibility and zero liquid discharge systems offer practical solutions for reducing waste in the supply chain. Additionally, the adoption of zero-waste approaches in fashion design and production, along with the promotion of circular design principles and upcycling techniques, presents promising avenues for achieving a more sustainable and environmentally conscious fashion system. However, further research and collaboration are needed to effectively implement these strategies and drive meaningful change across the industry.

## Acknowledgments

Project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 - Call for tender No. 341 of 15/03/2022 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU. Award Number: PE00000004, Concession Decree No. 1551 of 11/10/2022 adopted by the Italian Ministry of University and Research, CUP B83C22004890007. MICS (Made in Italy - Circular and Sustainable).

Spoke 2 Eco-Design strategies: from materials to Product Service Systems – PSS

## Footnotes

[1] To verify the truthfulness of this statement, the author is conducting a mapping operation of Italian entities that, at various stages of the supply chain (weaving, manufacturing, design, recycling, etc.), are required to deal with the production and/or management of textile waste and scraps. The mapping aims to identify the moments when this production/management occurs in order to pinpoint best practices.

[2] The European Commission has identified textiles (i.e., apparel and fabrics) as a "priority product category for the circular economy", encouraging the development of technological applications for textile waste reuse and recycling. Moreover, the European Directive EU 2018/851 obliges Member States to start the separate collection of textile waste by 1 January 2025

[3] Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste https://eur-lex.europa.eu/legal-content/IT/TXT/?uri=CELEX%3A32018L0851

[4] "The fashion system produces tons of waste every year that end up in landfills, which could be reintegrated into the production cycle. This happens despite the numerous studies that seek to develop optimization systems for reuse possibilities." (Di Giacomo, 2013, p.3).

[5] The ISPRA report on special waste in 2012 estimated that 37.4% of non-hazardous waste from manufacturing came from the textile, clothing, and tanning industries. ISPRA, Urban Waste Report 2012. https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/rapporto-rifiuti-urbani-2012

[6] The authors specifically cite the production reality of Prato as an example of a district long oriented towards the recycling of woollen products and the recovery of textile materials, such as clothing items, by companies or associations that allow for the extension of the product life cycle. Alternatively, small brands and cooperatives employ fabric recovered from warehouse stocks for social sustainability projects. (p.48)

[7] The authors focus their study on the environmental and social life cycle assessment of a knitted garment produced in a textile factory (San Lorenzo Group), located in San Marco d'Alunzio, Messina (Italy), a village situated in the Nebrodi (Sicilian mountains), as an agricultural reality characterised by farmhouses, to identify positive and negative impacts of the product in this specific context and to use the results as an input for the decision-making process in the company. (Lenzo et al., 2018).

[8] Starting from 2025 (Dir. 2018/851/EU).

[9] Italian legislation has moved up the deadline to January 1, 2022 (Legislative Decree No. 116/2020).

[10] https://retex.green/

[11] An updated definition of Zero Waste, adopted by the ZWIA board on December 2018, aligning the definition to the guiding principles of the Zero Waste Hierarchy, states: "Zero Waste: The conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health." Last updated December 20th, 2018. https://zwia.org/zero-waste-definition/

# References


1. Altamura, P., & Baiani, S. (2019). Superuse and upcycling through design: approaches and tools. IOP Conference Series: Earth and Environmental Science, 225, 012014. https://doi.org/10.1088/1755-1315/225/1/012014
2. Aus, R., Moora, H., Vihma, M. et al. Designing for circular fashion: integrating upcycling into conventional garment manufacturing processes. Fash Text 8, 34 (2021). https://doi.org/10.1186/s40691-021-00262-9
3. Awasthi, A., Cheela, V. R. S., D'Adamo, I., Iacovidou, E., Islam, M., Johnson, M., Miller, T. R., Parajuly, K., Parchomenko, A., Radhakrishan, L., Min, Z., Zhang, C., & Li, J. (2021). Zero waste approach towards a sustainable waste management. Resources, Environment and Sustainability, 3, 100014. https://doi.org/10.1016/j.resenv.2021.100014
4. Awogbemi, O., Von Kallon, D. V., & Bello, K. A. (2022). Resource Recycling with the Aim of Achieving Zero-Waste Manufacturing. Sustainability, 14(8), 4503. https://doi.org/10.3390/su14084503
5. Bastos, J., Rizzari, M., Agosti, E., D'Alonzo, V., Hoffmann, C., & Vettorato, D. (2021). Analisi dello stato dell'arte: Report sui settori e attività produttive per promuovere l'Economia Circolare.
6. Bigolin, R., Blomgren, E., Lidström, A., De Oliveira, S. M., & Thornquist, C. (2022). Material Inventories and Garment Ontologies: Advancing upcycling Methods in fashion practice. Sustainability, 14(5), 2906. https://doi.org/10.3390/su14052906
7. Binotto, C., & Payne, A. (2017). The poetics of waste: Contemporary fashion practice in the context of wastefulness. Fashion Practice, 9(1), 5–29. https://doi.org/10.1080/17569370.2016.1226604
8. Bonifazi, G., Gasbarrone, R., Palmieri, R., & Serranti, S. (2022). End-of-Life Textile Recognition in a Circular Economy Perspective: A Methodological Approach Based on Near Infrared Spectroscopy. Sustainability, 14(16), 10249. https://www.mdpi.com/2071-1050/14/16/10249
9. Brooks, A., Fletcher, K., Francis, R. A., Rigby, E., & Roberts, T. G. (2017). Fashion, sustainability, and the Anthropocene. Utopian Studies, 28(3), 482–504. https://doi.org/10.5325/utopianstudies.28.3.0482
10. Carrico, M., Dragoo, S. L., McKinney, E., Stannard, C., Moretz, C., & Rougeaux-Burnes, A. (2022). An inquiry into gradable zero-waste apparel design. Sustainability, 14(1), 452. https://doi.org/10.3390/su14010452
11. Carrico, M. and Kim, V. (2014) Expanding zero-waste design practices: a discussion paper, International Journal of Fashion Design, Technology and Education, 7(2), 58-64.
12. Carrico, M., & Kim, V. (2013). Expanding zero-waste design practices: a discussion paper. International Journal of Fashion Design, Technology and Education, 7(1), 58–64. https://doi.org/10.1080/17543266.2013.837967
13. Chezzi, M. (2022). Il riciclo dei rifiuti tessili e la responsabilità del produttore: La funzione di general contractor per il waste management. GeoTrade : Rivista Di Geopolitica e Commercio Estero : 3, 2022, 88–91. https://doi.org/10.1400/288848
14. Di Giacomo, M. (2013). IL "FINE VITA" DEI PRODOTTI NEL SISTEMA MODA. ARES, 2. https://informatex.it/wp-content/uploads/2017/06/Il-fine-vita-dei-prodotti-nel-sistema-moda.pdf
15. ElShishtawy, N., Sinha, P., & Bennell, J. A. (2022). A comparative review of zero-waste fashion design thinking and operational research on cutting and packing optimization. International Journal of Fashion Design, Technology and Education, 15(2), 187–199. https://doi.org/10.1080/17543266.2021.1990416
16. Fiasco, Federico (A.A. 2017/2018) Impresa 4.0: esame della situazione attuale e prospettive evolutive nel manifatturiero italiano: il caso Beste S.p.a. Tesi di Laurea in Economia e gestione delle imprese, LUISS Guido Carli, relatore Maria Isabella Leone, pp. 65. [Tesi di Laurea triennale]
17. Fletcher, K. (2014). Sustainable Fashion and Textiles: Design Journeys (2nd ed.). Rout-

ledge. https://doi.org/10.4324/9781315857930
18. Fondazione per lo sviluppo sostenibile & FISE UNICIRCULAR (Unione Imprese Economia Circolare). (2022). L'Italia del riciclo 2021. Parte 1. Approfondimento sul settore tessile. Fondazione per lo sviluppo sostenibile e FISE UNICIRCULAR. https://www.ecocerved.it/media/l-italia-del-riciclo-2021-estratto-
19. Gam, H. J., & Banning, J. (2020). Teaching Sustainability in Fashion Design Courses Through a Zero-Waste Design Project. Clothing and Textiles Research Journal, 38(3), 151-165. https://doi.org/10.1177/0887302X20906470
20. Gardetti, M. A., & Torres, A. L. (Eds.). (2013). Sustainability in fashion and textiles: values, design, production and consumption. Routledge & CRC Press. Retrieved February 25, 2024, from https://www.routledge.com/Sustainability-in-Fashion-and-Textiles-Values-Design-Production-and-Consumption/Gardetti-Torres/p/book/9781906093785
21. Gazzola, P., Pavione, E., Grechi, D., & Raimondi, V. (2020). L'economia circolare nella fashion industry, ridurre, riciclare e riutilizzare: alcuni esempi di successo. Economia Aziendale Online, 11(2), 165-174. http://riviste.paviauniversitypress.it/index.php/ea/article/view/2036/2177
22. Giorgianni, M. (2022). POSTFASHION E «RIVOLUZIONE DELLA SOSTENIBILITÀ» NELL'ECONOMIA GLOBALIZZATA. COMPARATIVE LAW REVIEW, 12(1). http://www.comparativelawreview.unipg.it/index.php/comparative/article/view/224
23. Goldsworthy, K., Earley, R., & Politowicz, K. (2018). Circular Speeds: A Review of Fast & Slow Sustainable Design Approaches for Fashion & Textile Applications. Journal of Textile Design, Research and Practice, 6(1), 42–65. https://doi.org/10.1080/20511787.2018.1467197
24. Jahan N, Tahmid M, Shoronika AZ, Fariha A, Roy H, Pervez MN, Cai Y, Naddeo V, Islam MS. A Comprehensive Review on the Sustainable Treatment of Textile Wastewater: Zero Liquid Discharge and Resource Recovery Perspectives. Sustainability. 2022; 14(22):15398. https://doi.org/10.3390/su142215398
25. Joy, A., Sherry, J. F., Venkatesh, A., Wang, J. J., & Chan, R. Y. K. (2012). Fast fashion, sustainability, and the ethical appeal of luxury brands. Fashion Theory, 16(3), 273–295. https://doi.org/10.2752/175174112x13340749707123
26. Lacy, P., Long, J., Orneli, S., Spindler, W. (2021). Il manuale della circular economy: Realizzare il vantaggio circolare. Italia: Egea.
27. Lenzo P, Traverso M, Mondello G, Salomone R, Ioppolo G. Sustainability Performance of an Italian Textile Product. Economies. 2018; 6(1):17. https://doi.org/10.3390/economies6010017
28. Lewis, T., Park, H., Netravali, A. N., & Trejo, H. (2016). Closing the loop: a scalable zero-waste model for apparel reuse and recycling. International Journal of Fashion Design, Technology and Education, 10(3), 353–362. https://doi.org/10.1080/17543266.2016.1263364
29. Manco, I., & Cordoni, C., Vaccari, V., (2017). Il Ciclo del Rifiuto. Economia Aziendale Online, 7(4), 237–275. https://doi.org/10.13132/2038-5498/7.4.237-275
30. Matthes, A., Beyer, K., Cebulla, H., Arnold, M. G., & Schumann, A. (Eds.). (2021). Sustainable textile and fashion value chains: Drivers, concepts, theories and solutions. Springer International Publishing. https://doi.org/10.1007/978-3-030-22018-1
31. Mazzanti, M., & Nicolli, F. (2012). Firm's social and economic role within Local-Global sustainability strategies: EU frameworks, environmental innovations, public goods. Economia Dei Servizi, 2, 249–272. https://doi.org/10.2382/38876
32. McKinsey & Company. (2022). Scaling textile recycling in Europe—turning waste into value. McKinsey & Co. https://www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/scaling%20textile%20recycling%20in%20europe%20turning%20waste%20into%20value/scaling%20textile%20recycling%20in%20europe%20turning%20waste%20into%20value.pdf?shouldIndex=false
33. McQuillan, H. (2020). Digital 3D design as a tool for augmenting zero-waste fashion design practice. International Journal of Fashion Design, Technology and Education, 13(1), 89–100. https://doi.org/10.1080/17543266.2020.1737248
34. McQuillan, H., Archer-Martin, J., Menzies, G., Bailey, J., Kane, K., & Fox Derwin, E. (2018). Make/use: A system for open source, user-modifiable, zero waste fashion practice. Fashion Practice, 10(1), 7–33. https://doi.org/10.1080/17569370.2017.1400320
35. McQuillan, H. (2011). Zero-waste design practice: Strategies and risk taking for garment design. In Shaping Sustainable Fashion. Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203126172-12/2-4-zero-waste-design-practice-holly-mcquillan
36. Mellick, Z., Payne, A., & Buys, L. (2021). From fibre to fashion: Understanding the value of sustainability in global cotton textile and apparel value chains. Sustainability, 13(22), 12681. https://doi.org/10.3390/su132212681
37. Navone, L., Moffitt, K., Hansen, K. A., Blinco, J. P., Payne, A., & Speight, R. (2020). Closing the textile loop: Enzymatic fibre separation and recycling of wool/polyester fabric blends. Waste Management, 102, 149–160. https://doi.org/10.1016/j.wasman.2019.10.026
38. Noè, C., & Magni, A., (2017). Innovazione e sostenibilità nell'industria tessile. 1–137.

https://www.torrossa.com/it/resources/an/5085233
39. Pasricha, A., & Greeninger, R. (2018). Exploration of 3D printing to create zero-waste sustainable fashion notions and jewelry. Fashion and Textiles, 5(1), 30. https://doi.org/10.1186/s40691-018-0152-2
40. Pezzoli, S., & Vaghi, S. (2019). VALUTARE L'ECONOMIA CIRCOLARE SECONDO UN APPROCCIO DI LIFE CYCLE THINKING: L'ATLANTE ITALIANO DELL'ECONOMIA CIRCOLARE. Ingegneria Dell'Ambiente, 6(2). https://doi.org/10.32024/ida.v6i2.211
41. Pratt, A., Borrione, P., Lavanga, M., & D' Ovidio, M. (2012). International change and technological evolution in the fashion industry. In Mauro Agnoletti, Andrea Carandini, Walter Santagata (eds), Essays and Researches. International Biennial of Cultural and Environmental Heritage / Studi e ricerche. Biennale internazionale dei beni culturali ed ambientali. Florence/Firenze 2012 (pp. 359–394). Retrieved from http://hdl.handle.net/1765/51737
42. Ramkalaon, S., & Sayem, A. S. M. (2020). Zero-Waste Pattern Cutting (ZWPC) to tackle over sixty billion square metres of fabric wastage during mass production of apparel. Journal of the Textile Institute, 112(5), 809–819. https://doi.org/10.1080/00405000.2020.1779636
43. Rana, S., Karunamoorthy, S., Parveen, S., & Fangueiro, R. (2015). Life cycle assessment of cotton textiles and clothing. In Handbook of Life Cycle Assessment (LCA) of Textiles and Clothing (pp. 195–216). Elsevier. https://doi.org/10.1016/B978-0-08-100169-1.00009-5
44. Resta, B., Gaiardelli, P., Pinto, R., & Dotti, S. (2016). Enhancing environmental management in the textile sector: An Organisational-Life Cycle Assessment approach. Journal of Cleaner Production, 135, 620–632. https://doi.org/10.1016/j.jclepro.2016.06.135
45. Rissanen, T., & McQuillan, H. (2015). Zero waste fashion design. Bloomsbury Publishing.
46. Rissanen, T. (2014). The fashion system through a lens of zero-waste fashion design. In Routledge Handbook of Sustainability and Fashion. Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203519943-24/fashion-system-lens-zero-waste-fashion-design-timo-rissanen
47. Rissanen, T. I. (2013). Zero-waste fashion design: A study at the intersection of cloth, fashion design and pattern cutting [Thesis]. https://opus.lib.uts.edu.au/handle/10453/23384
48. Saccani, N., Bressanelli, G., & Visintin, F. (2023). Circular supply chain orchestration to overcome Circular Economy challenges: An empirical investigation in the textile and fashion industries. Sustainable Production and Consumption, 35, 469–482. https://doi.org/10.1016/j.spc.2022.11.020
49. Saeidi, E., & Wimberley, V. (2017). Precious cut: exploring creative pattern cutting and draping for zero-waste design. International Journal of Fashion Design, Technology and Education, 11(2), 243–253. https://doi.org/10.1080/17543266.2017.1389997
50. Salvi, T., Borsacchi, L., & Barberis, V. (2021). Modelli integrati di governance di economia circolare a livello urbano Il caso di Prato. CONTESTI, 97.
51. Scalbi, S. (2012). MAPPATURA NAZIONALE DEI GRUPPI E DELLE ATTIVITÀ NEL CAMPO DELL'ANALISI DEL CICLO DI VITA (LCA). https://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/V2013MappaturaLCA2012.pdf
52. Solino, L. J. S., Teixeira, B. M. de L. ., & Dantas, Ítalo J. de M. (2020). The sustainability in fashion: a systematic literature review on slow fashion. International Journal for Innovation Education and Research, 8(10), 164-202. https://doi.org/10.31686/ijier.vol8.iss10.2670
53. Stanescu, M. D. (2021). State of the art of post-consumer textile waste upcycling to reach the zero waste milestone. Environmental Science and Pollution Research, 28(12), 14253–14270. https://doi.org/10.1007/s11356-021-12416-9
54. Vaccari, A., & Cerulli, M. C. (2014). Textile and Fashion Hub: come estendere il ciclo di vita di tessuti e altri materiali della moda. https://air.iuav.it/handle/11578/273422
55. Van Den Eijnden, T., Baibarac-Duignan, C., De Lange, M., & De Goede, M. (2022). Materials and modes of translation: Re-imagining inclusive "zero"-waste futures. Frontiers in Sustainable Cities, 4. https://doi.org/10.3389/frsc.2022.958423

# The black hole of the fashion system: The contribution of design to the sustainable transition of the fashion system

*Elena Pucci*
*elena.pucci@unicampania.it*

*Università degli Studi di Firenze, Italy*

***Keywords:***
*Textile Regulation*
*Fashion Value Chain*
*Sustainable Strategies*

## Abstract

The urgency to transition to circular models of production, distribution, and consumption, promoting transparent and sustainable practices of regeneration, seems to have involved all sectors of the fashion system. This contribution represents the preliminary results of an ongoing doctoral research aiming to compare the fragmented regulatory system in Italian and European ecosystems to assess product sustainability, analyzing the natural, social, political, and economic context. The new regulations will impact all companies in the sector, including those most prepared to embrace this transition. Therefore, it is crucial to intervene with an interdisciplinary approach in a landscape characterized by an uncontrollable fashion regime, exploring where design can contribute to the development of new systemic approaches to designing products intended to be easily repairable and reusable, made as much as possible with recycled fibers, free of hazardous substances, easily disposable, and produced in accordance with social and environmental rights.

## Introduction

This contribution represents the preliminary results of an ongoing doctoral research. The systematic and critical exploration of the existing literature has allowed for a comprehensive understanding of the context, challenges, and emerging trends, thereby identifying potential gaps and issues where research can make a significant contribution. This preliminary phase is crucial for establishing a solid theoretical foundation that will shed light on the encountered issues.

The progressive change our planet is undergoing, exacerbating the depletion of global resources, poses a growing threat and demands an immediate response to ensure a sustainable future (Rockström et al., 2009).

Extensively discussed is the pollution generated by the fashion industry, second only to the petroleum industry (Ash, 2019), where lengthy supply chains, largely unregulated, produce high-volume chemical discharges and enormous carbon emissions (Friedman, 2018).

The fashion industry consumes vast amounts of natural resources, including water, energy, and materials such as cotton and polyester. Cotton plantations alone consume over 10% of the world's pesticides and 2 billion synthetic fertilizers annually (Blanco, 2018). The intensive consumption of

materials like cotton can also lead to deforestation and the destruction of natural habitats, endangering biodiversity and contributing to climate change.

Fabric production often involves highly energy-intensive chemical processes, which can lead to increased air and water pollution (Cho & Jin, 2019).

The fashion sector also contributes to pollution through the disposal of chemicals from pesticides, fertilizers, and dyes (Blanco, 2018). The emission of such chemicals poses a threat not only to the environment but also to the water security of producing nations (Matthews, 2015). Textile dyeing and finishing processes often involve the use of harmful chemicals that are discharged into surrounding water bodies, causing pollution of surface and groundwater. The chemical compounds used for fabric dyeing, often untreated, account for approximately 17-20% of global industrial water pollution (Chavan & Mahadik, 2021).

Nearly 35% of chemicals used for dyeing and treating fabrics are released into the environment, and synthetic fabrics release nearly half a million tons of microfibers into the oceans each year due to simple consumer clothing washing (European Environment Agency, 2022).

The textile sector was the third-largest source of water degradation and land use in 2020. In that year, an average of 9 cubic meters of water, 400 square meters of land, and 391 kilograms (kg) of raw materials were needed to provide clothing and shoes to each EU citizen (European Environment Agency, 2022). Every year, about half a million tons of microfibers, 60% of which are plastic derived from polyester, are discharged into the oceans due to consumer clothing washing (McFall-Johnsen, 2019). In 2017, the International Union for Conservation of Nature highlighted that about 35% of all microplastics in the oceans result from washing clothing made of polyester and other synthetic fabrics (McFall-Johnsen, 2019). It is noteworthy that these tiny plastic particles never undergo a biodegradation process, thus contributing to the growing contamination of the marine ecosystem. The enormous quantity of plastic microfibers released into the marine environment represents a significant threat to oceanic ecosystems, as they can be ingested by fish, mollusks, and other marine organisms, leading to severe consequences for the food chain (Wright & Kelly, 2017).

Global textile production nearly doubled between 2000 and 2005, and clothing and footwear consumption is expected to increase by 63% by 2030, from the current 62 million tons to 102 million tons in 2030 (EEA 2019). "The EU must legally compel manufacturers and major fashion companies to operate more sustainably. People and the planet are more important than textile industry profits" (Burkhardt, 2023).

The fashion industry is characterized by rapid cycles of production and consumption, with a strong emphasis on new trends and the rapid replacement of clothing items. This model promotes excessive waste and contributes to the problem of environmental pollution (Fletcher & Tham, 2019). Waste thus transforms into refuse, becoming the final link in a process that immediately demonstrates its unsustainability.

The waste issue symbolizes the fashion system's gaping void: pre and post-consumer waste, unsold items, and the countless quantities of clothing discarded daily by consumers all contribute to open-air landfills, contributing to atmospheric pollution (Fletcher, 2008). Synthetic materials also degrade very slowly, sometimes never, and organic materials emit methane during the decomposition process, which is one of the most potent and harmful greenhouse gases (Arnett, 2019).

The fashion system represents a layered problem (Fletcher, 2010) that requires an integrated approach aimed at promoting collaboration among various actors such as companies themselves, governments, non-governmental organizations, and consumers. European Union regulations are seeking to address this complexity through the introduction of recommendations

that are evolving into targeted regulations. The European Union should impose legally binding standards to compel manufacturers and major fashion companies to adopt more sustainable practices. However, the path to implementing these regulations is long and complex, considering the multifaceted nature of the fashion industry and the various stakeholders involved.

This contribution thus intends to address this complexity by analyzing the economic, environmental, and social context; recognizing design as playing a central role in promoting solutions to accompany fashion industry companies toward a sustainable transition.

## Utopia of a Sustainable Fashion System

The Fashion System reveals itself as an intricate web of dynamics ranging from creation to destruction, in a perpetual cycle of renewal. As emphasized by Fry (2011), every creative act within this system inevitably leads to a sort of parallel destruction. This deep connection between creation and destruction is a distinctive characteristic that permeates the entire fabric of the fashion world.

In the context of fashion, creation is expressed through the design and production of new styles, trends, and innovative clothing items. However, this incessant creativity cannot exist without its opposite side: destruction. Destruction in fashion can manifest in multiple ways, such as the rapid obsolescence of certain styles, the abandonment of old trends, or even the demolition of unsold stock (Yoo & Kim, 2016).

This dynamic relationship between creation and destruction within the Fashion System is essential for its very existence. Fashion, in fact, derives its vitality from the continuous reinvention of itself. Every new collection, every stylistic innovation, contributes not only to defining new aesthetics but also to breaking down the boundaries of what has been surpassed. In this incessant cycle, the oblivion of old creations becomes the necessary premise for the emergence of new ideas and approaches (Simmel, 1971). This constant process of creation and destruction not only characterizes the world of fashion but also drives it forward. Through this dynamic, the Fashion System embraces change as a constant, challenging pre-existing ideas and allowing the emergence of new perspectives. In this marriage of birth and decline, the Fashion System finds its strength and resilience, always remaining in tune with the ever-changing spirit of the times (Rocamora, 2009).

In today's landscape, where fashion represents a sector in which styles and trends constantly change, often in rapid and unpredictable ways, the "Dialogue of Fashion and Death" from Giacomo Leopardi's Operette Morali of 1987 offers a current and contemporary point of reflection.

"Fashion: I am Fashion, your sister.

Death: My sister?

Fashion: Yes, don't you remember that we both were born from Transience?

Death: What should I remember, I am the arch-enemy of memory.

Fashion: But I remember it well; and I know that both of us, equally, continuously undo and change things down here, even though you go about it one way and I another."

Leopardi's critique describes a culture that today we would define as "consumerist," destined to have a short life, as ephemeral as every aspect of modernity. To the point that death, in the times of the empire of fashion, leaves absolutely nothing behind, and "whoever dies [...] leaves behind not a trace that is not also dead" (Leopardi, 1827).

The dialogue on the transience of death highlights a series of aspects related to sustainability, where fast fashion obtains a significant impact on the environment due to excessive production and disposal of garments, and

where the need to implement more sustainable production and consumption models represents the very transience itself, seen as the destruction of a linear ecosystem, destined for circularity.

The need to radically transform the fashion system to make it more sustainable both environmentally and socially emerges, with the adoption of design and production practices that reduce environmental impact, promote social justice, and encourage a more conscious and responsible approach to fashion (Fry, 2011).

The inherent transience and unsustainability of the contemporary fashion system represent a central issue in the current socio-economic debate. This paradigm has been masterfully illustrated by Ricchetti through the paradox of sustainable fashion (Ricchetti, 2009), an enigmatic contradiction that highlights the fundamental challenges in attempting to make fashion a more eco-friendly sector.

Awareness of the system's criticalities is becoming increasingly widespread, fueled by reports from NGOs and private agencies. Greenpeace's famous report, "the king is naked," has uncovered the less flattering realities behind the glamorous veil of the fashion industry, shedding light on the unsustainable practices that often characterize it (Tufarelli, 2021). At the same time, we are witnessing a growing sensitivity among consumers to these issues. However, it is important to note that this awareness does not always translate into more responsible purchasing behaviors. Multiple factors influence consumer decisions, and often economic convenience and the desire to conform to social standards prevail over ethical and environmental considerations.

In this context, supranational governmental guidelines play a prominent role. The recommendations of the European Union, for example, outline a roadmap for a more circular and sustainable economy, with the aim of reducing the environmental impact of the fashion sector and promoting more responsible production practices. The redesign of a new textile system where circular principles occupy a central position is indispensable, with the ultimate goal of fostering growth that brings benefits to both citizens and businesses. This new approach aims to eliminate negative impacts, such as waste production and pollution, through recycling and reuse practices of materials (MacCarthy, 2017).

As Armiero (p.19, 2022) argues, the era of humans is characterized by a "techno-stratigraphy of waste materials accumulating on the earth's surface," in which waste in recent decades has transformed the environment into a gigantic landfill where "discard means deciding what has value and what does not" (Armiero, p.20, 2022). The Wasteocene described by Armiero (2022) represents the era of waste relationships, processes that systematically discard even living beings, human and non-human, knowledge, places, and memories. This highlights not only an environmental crisis but also a social and cultural one, which requires a holistic approach and a radical change in our relationships with the world around us. Armiero emphasizes how the weight of plastic and waste materials represents twice that of all animals combined and how we have become the planet of things, destined to become garbage. It is a sign of humanity's domination over nature, but also of its failures in sustainably managing the resources and waste it produces. The need for a profound transformation that includes new ways of thinking and acting, embracing a broader and interconnected vision of our relationship with the planet and other living beings, represents an indispensable challenge that requires a cultural, social, and economic change towards sustainability, respect for life, and conservation of resources for future generations.

It is legitimate to wonder if and when this change will be possible and through what means. As advocated by Fletcher (2010, p.263), "'prevailing

ways of thinking lock us into particular ideas about the shape and practices of the fashion sector'", stating that current modes of thought in the fashion industry keep us "imprisoned" in specific concepts and practices that have become predominant. This means that we often find ourselves adhering to established patterns without considering alternatives, thus limiting our ability to innovate and change. The capitalism described by Fisher (2009) has created economic structures focused on unlimited growth that can be harmful to the environment and natural resources and that have limited our ability to imagine and implement alternative economic systems that could be more sustainable in the long term. This lack of imagination may be one of the main obstacles to change, as we cannot act on what we cannot imagine (Leerberg, et al., 2010).

Dominant practices in the fashion sector, as well as in the globalized economic system in general, limit the possibility of systematic and sustainable change in the future. Addressing global challenges and promoting a shift towards greater sustainability represents the only possible solution in light of these issues.

The responsible designer challenges the paradigm of the current consumerist society, examining the impacts of design and the product lifecycle and does so by testing ideas, exploring alternative scenarios, through the evaluation of materials, production processes, form, and functionality, also considering the emotional involvement of the consumer (Leerberg, et al., 2010). Moreover, the aim is to educate on the concept of design responsibility, seeking to instill an awareness of how designers can contribute to creating value and meaning in people's lives through the products and services they create (Margolin, 2002; Riisberg, 2006).

## Will regulations succeed in making the fashion system sustainable?

In 1974, under the auspices of the General Agreement on Tariffs and Trade (GATT), the predecessor organization of the current World Trade Organization (WTO), the Multifiber Arrangement (MFA) was established, an international agreement regulating the trade of textile and clothing products among member countries (Alam et al., 2019). The primary objective of the MFA was to limit imports of textile and clothing products from developing countries into industrialized countries, in order to protect national textile industries from excessive competition. The MFA set import quotas for each exporting country and determined the types of products subject to these quotas (Kenton, 2023). The MFA was gradually reformed over the years and eventually phased out in 2005 in accordance with WTO agreements. Its elimination led to increased liberalization of textile and clothing trade, allowing for greater flexibility and competitiveness in the sector (WTO). It is legitimate to question why this regulation was eliminated, providing fast fashion companies with a pass to the market of overproduction and excessive consumption. These companies continue to thrive due to this lack of additional regulation (Hausmann & Hilty, 2017).

The urgency to transition to circular models of production, distribution, and consumption, promoting transparent and sustainable regeneration practices, seems to have involved all sectors of the fashion system. Supporting this transition are initiatives promoted by the European Commission, such as the Green Deal, which aims to make the European continent climate-neutral by 2050 (EU Digital Agenda, 2022).

In the European landscape, the "Sustainable Textile Strategy for 2030" is asserted, aiming to improve product circularity, as well as to hold brands accountable for textiles sent to landfills. It also focuses on resource energy

efficiency, regeneration and recycling, and educational requirements, including digital product passports (EU Digital Agenda, 2022). Particularly in the Italian context, the enforcement of regulations that extend Producer Extended Responsibility (EPR) to the textile and fashion sector represents a turning point at the community level, as it encourages companies to design more sustainable and recyclable products and production processes, based on waste management and environmental pollution concepts.

The lack of traceability and clarity in supply chains within the fashion industry means that consumers have little knowledge about their garments beyond the indication of the country of origin (Stauffer, 2017). The widespread outsourcing of production abroad in the fashion industry makes the supply chain more challenging to track and ultimately more harmful to the environment when crossing different nations with various environmental regulations (Perry & Wood, 2019). Furthermore, it is common for different companies to simultaneously produce in the same facility, making it even more difficult to trace a particular product (Clifford & Greenhouse, 2013).

In conclusion, it is evident that fashion companies should be encouraged to gradually eliminate unsustainable materials from production, implement supply chain and lifecycle responsibility, thereby developing innovative and ecological materials, low-emission production techniques, and sustainable best practices. It is estimated that most of the environmental burden can be alleviated through design decisions, which determine up to 80% of the life cycle impacts of a product, making the integration of environmental issues into the design process crucial (Schwarz et al., 2017). Therefore, the responsibility of the designer in the design phases and in the creation of fashion products becomes crucial, influencing not only the aesthetics and functionality of garments but also production practices and materials used. Thus, understanding the role of design in the context of EU regulations is fundamental to addressing the challenges of the fashion industry effectively and sustainably.

## Design “through” the context

Addressing the complex issue described requires a holistic methodological approach that involves different levels, from product design to industrial practices, regulation, and education (Kimbell, 2011).

Concrete actions and a global approach are needed to tackle the challenges of sustainability and move towards a fairer, responsible, and environmentally respectful system. A systemic redesign is indispensable where design must be educated and, at the same time, educate about sustainability. However, addressing the complexity of the fashion industry through design requires an integrated approach that involves not only designers themselves but the entire fashion system. Furthermore, it is essential to promote training and education for designers on sustainable and ethical practices, as well as encourage collaboration and knowledge exchange among industry professionals. In conclusion, design plays a fundamental role in addressing the complexity of the fashion industry and implementing EU regulations. Fully understanding the role of design and promoting sustainable and ethical design practices are crucial steps towards creating a more responsible and sustainable fashion sector.

*Table 1. Reflect on the crucial role of design and its contribution towards sustainable design.*

| | The Contribution of Design | Tools by which Design can make an impact |
|---|---|---|
| **Conscious Products, Services, and Systems"** | Conscious design can enhance user experience and reduce environmental impact by designing products, services, and systems for disassembly and repairability, while considering social implications | • Life Cycle Analysis (LCA)<br>• Circular Economy<br>• Sustainable Materials<br>• Technological Innovation - Collaborations |
| **Education** | Educational design can promote awareness and understanding of environmental and social issues, transforming learning into an engaging and meaningful experience | Training Programs<br>Interactive Workshops<br>Visual Communication Tools<br>Simulations and Educational Games<br>Participatory Design |
| **Transparency and Accountability** | Design can promote transparency and accountability by openly communicating information about production processes, material choices, and the environmental impact of products and services | • Visual Communication<br>• Digital Product Passport<br>• Sustainability Reports<br>• Stakeholder Engagement |

## Conclusion

Regulating practices within the fashion industry can contribute to mitigating its environmental impact. Stricter regulations may require greater responsibility in waste management, reducing greenhouse gas emissions, and using more sustainable materials (Fletcher, 2010). Imposing standards on the fashion industry could also help raise consumer awareness about the sustainability and ethics of the products they purchase, encouraging them to make more conscious and responsible choices. Although adapting to stricter regulations may pose a challenge for companies, in the long run, it could lead to economic and reputational benefits (Kim & Damhorst, 2019).

Sustainable fashion extends beyond the production process of a garment but encompasses the entire product lifecycle, from inception to disposal. This approach demands ongoing commitment from companies to adopt sustainable practices in all phases, including design, production, and clothing

| The Contribution of Design | Tools by which Design can make an impact |
|---|---|
| **Designing Conscious Products, Systems, and Services**<br>Disassemble, repairable, recyclable | **Life Cycle Assessment (LCA)**<br>Environmental impact of textile products throughout their entire life cycle. Identifying critical points and phases of the process that contribute most to pollution and resource exploitation |
| **Educating for Sustainability**<br>Educating oneself and others. Implementing educational programs aimed at creating awareness that guides purchasing choices towards sustainable products | **Circular Economy**<br>Promoting circular production and consumptio models, encouraging repairability, reuse, and recycling of textile products. Implementing collection and recycling programs at an industrial level |
| **Transparency and Responsibility**<br>Taking ownership of one's responsibility with more transparent supply chains and promoting informed choices for consumers | **Research and Development of Sustainable Materials**<br>Investing in research and development to identify and utilize sustainable and recyclable materials, thereby reducing dependency on non renewable resources. Exploring alternatives to synthetic fibers and promoting the use of biodegradable materials |
| | **Technological Innovations**<br>Investing in innovative technologies that can improve the efficiency of production practices, reduce environmental impacts, and facilitate material recycling |
| | **Collaborations and Intersectoral Initiatives**<br>Encouraging collaboration among companies, designers, institutions, and non-governmental organizations to address the challenge of sustainability in fashion. Creating joint initiatives to share resources, research, and best practices |

*Table 2. Analyzing potential tools through which design can intervene to contribute to the creation of a new textile system.*

disposal. However, while companies must take responsibility for improving their sustainability, consumers play a crucial role in driving positive change. As emphasized by Cotler (2019), consumers have the power to influence the market through their purchasing choices. Opting for products from brands that embrace sustainable practices can further incentivize the industry to enhance its environmental and social performance. It's important for consumers to be aware of the implications of their choices and to consider not only aesthetics and price but also the environmental and social impact of the products they purchase.

Lifecycle responsibility is essential for addressing the issue of climate change because it would reduce waste and landfill emissions, and combined with supply chain responsibility, would hold a company accountable for

every stage of its product's existence. A reduction in the vast amount of fast fashion garments produced would automatically reduce emission levels, further contributing to a climate change solution (Braungart & McDonough, 2002).

The new regulations will impact all companies in the sector, even those most prepared to embrace this transition, ultimately having a significant impact on all textile industry companies, as they will require compliance with more stringent standards in terms of environmental and social sustainability. It will be interesting in the coming months to analyze the landscape of the Italian textile and fashion sector to understand how companies may embrace these new regulations and whether they will have the necessary tools to respond to market demands.

A redesign of the fabric will be necessary, different from what was produced in the past, where the use of fiber blends may no longer be allowed, also considering the possibility that some regulations might prohibit the use of certain materials or require the adoption of more sustainable practices in textile production. It is legitimate to wonder whether Europe will understand the impact difference between natural and synthetic fibers because each has different origins, pathways, end-of-life scenarios, and durability.

In conclusion, the role of the Designer becomes fundamental for the design of new products conceived from a more rational perspective of resources (Thorpe, 2007; Fletcher & Grose, 2012; Fletcher, 2014), which are easy to repair and reuse, mostly made from recycled fibers in turn, free from hazardous substances, easily disposable, and produced respecting social rights and the environment.

Sustainability in the textile industry requires a holistic approach that involves not only companies and producers but also designers, consumers, and regulatory authorities. Only through common collaboration and commitment can a significant transformation towards a more sustainable and responsible fashion industry be achieved.

# References

1. Agenda Digitale Eu. (2021) Piano nazionale di Ripresa e Resilienza: cos'è e novità 2021https://www.agendadigitale.eu/infrastrutture/piano-nazionale-di-ripresa-e-resilienza-la-grande-scommessa-per-dare-un-futuro-allitalia
2. Alam, M.S. et al. (2009). The Apparel Industry in the Post-Multifiber Arrangement Environment: A Review, 23 REV. DEV. ECO. 454, 455
3. Armiero, M. (2021). L'era degli scarti. Cronache dal wasteocene, la discarica globale. Ed Passaggi Einaudi
4. Ash, L. (2019). Why Regulations Aren't Solving the Fashion Industry's Environmental Problem. https://perma.cc/4L2L-6JMS.
5. Blanco, F. J. (2018). Clothing and fashion: american fashion from head to toe – volume four: the postwar period into the 21st century.
6. Braungart, M., & McDonough, W. (2002). Cradle to Cradle: Remaking the Way We Make Things. North Point Press.
7. 
8. Burkhardt, D. (2023).
9. https://it.euronews.com/cultura/2023/08/07/la-battaglia-dellunione-europea-contro-il-fast-fashion
10. 
11. Chavan, R. B., & Mahadik, S. V. (2021). Textile Wastewater Treatment: Review of Dye Removal Methods. In Advances in Sustainable Textile Engineering (pp. 177-201). Springer, Singapore.
12. Cho, S., & Jin, B. S. (2019). Green technology innovation and sustainable development in the textile industry: A review. Sustainability, 11(12), 3362.
13. Clifford, S. & Greenhouse S. (2013). Fast and Flawed Inspections of Factories Abroad, N.Y. TIMES https://perma.cc/F8CW-4EAN.
14. Cotler, A. (2019). Why Sustainable Fashion Matters, FORBES https://perma.cc/L7F6-PMN8
15. European Environmental Agency (2022) Textiles and the environment: the role of design in Europe's circular economy. https://www.eea.europa.eu/publications/textiles-and-the-environment-the
16. European Environmental Agency (2022). Textiles and the environment: the role of design in Europe's circular economy. https://www.eea.europa.eu/publications/textiles-and-the-environment-the
17. Fletcher, K. (2008). Sustainable Fashion and Textiles: Design Journeys. Routledge.
18. Fletcher, K. (2010). "Slow Fashion: An Invitation for Systems Change." Fashion Practice: The Journal of Design & Creative Process 2 (2): 259-266.
19. Fletcher, Kate. (2014). "Design for Sustainability in Fashion and Textiles." In Handbook of Fashion Studies, edited by Sandy Black, Amy de la Haye, Regina Root, Agnès Rocamora and Helen Thomas, 562-579: Bloomsbury.
20. Fisher, M. (2009). Capitalist Realism: Is there no alternative? (Zero Books), Paperback.
21. Fletcher, K., & Grose, L. (2012). Fashion & sustainability: Design for change. Laurence King Publishing.
22. Fletcher, K., & Tham, M. (2019). The Slow Fashion Movement. London: Bloomsbury Publishing.
23. Friedman, V. (2018). The Biggest Fake News in Fashion, N.Y. TIMES https://perma.cc/XCL4-R42C
24. Fry, T. (2011). Design as politics. English ed. New York: Berg. Gordon, Jennifer Farley and Colleen Hill. 2015. Sustainable Fashion: Past, Present and Future. London: Bloomsbury.
25. Kenton, W. (2023). Multifiber Arrangement (MFA), INVESTOPEDIA https://perma.cc/V5F3-BTS5
26. Kimbell, L. (2011) "Rethinking design thinking: Part I." Design and Culture 3.3: 285-

306.
27. Kim, H., & Damhorst, M. L. (2019). Consumer Perceptions of Corporate Social Responsibility in the Fashion Industry: A Cross-Cultural Study. Clothing and Textiles Research Journal, 37(2), 108-122.
28. Leerberg, M., Riisberg V. and Boutrup, J. (2010). Design Responsibility and Sustainable Design as Reflective Practice: An Educational Challenge. Sustainable Development 306–317. Wiley Online Library
29.
30. Leopardi, G. (1827). Operette morali, Napoli.
31. MacCarthy, L. (2017). "Ellen MacArthur, H&M, Nike Challenges Take-Make-Dispose Model with New Circular Fibres Initiative," Next Economy, May 11. http://www.sustainablebrands.com/news_and_views/next_economy/libby_maccarthy/ellen_macarthur_hm_nike_challenge_take-make-dispose_mode
32. Margolin, V. (2002). The Experience of Products. In: Margolin V. (ed.). The Politics of The Artificial – Essays on Design and Design Studies. The University of Chicago Press: Chicago, pp. 38–59
33. Matthews, A. (2015). The Environmental Crisis in Your Closet, NEWSWEEK https://perma.cc/84AX-BGU5.
34. McFall-Johnsen, M. (2019). The Fashion Industry Emits More Carbon than International Flights and Maritime Shipping Combined. Here Are the Biggest Ways It Impacts the Planet., BUS. INSIDER https://perma.cc/E4VJ-PSHF.
35. Perry, P. & Wood, S. (2019). Exploring the international fashion supply chain and corporate social responsibility: cost, responsiveness and ethical implications, https://perma.cc/w928-k4uy.
36. Rocamora, A. (2009). Fashioning the City: Exploring Fashion Cultures, Structures, and Systems. Routledge
37. Rockstrom, J., et al. (2009) Planetary Boundaries: Exploring the Safe Operating Space for Humanity, Ecology and Society, vol 14, No 2, December.
38. Ricchetti, M. (2009). L'etica, la sostenibilità e i paradossi della moda. Naturalmente tessile, 2, 12-19.
39. Riisberg, V. (2006). Design og produktion af trykte textiler – fra analoge til digitale processer [Design and Production of Printed Textiles – from Analogue to Digital Processes] (unpublished PhD dissertation, English summary). Aarhus School of Architecture: Aarhus/Kolding School of Design: Kolding
40. Schwarz, T. E., Schopf, K., & Arnberger, A. (2017). Reducing conflicts of interest in Ecodesign: The relation of innovation management and Ecodesign in the automotive sector. In M. Matsumoto, K. Masui, S. Fukushige, & S. Kondoh (Eds.), Sustainability through innovation in product life cycle design. EcoProduction (environmen- tal issues in logistics and manufacturing) (pp. 33–45). Springer ISBN: 978-981-10-0471-1.
41. Simmel, G. (1971). Fashion. The American Journal of Sociology, 62(6), 541-558.
42. Stauffer, B. (2017) Follow the Thread: The Need for Supply Chain Transparency in the Garment and Footwear Industry, HUM. RTS. WATCH https://perma.cc/224W-LG5U.
43. Tufarelli, M & Stasi, R. (2021). Can Sustainability Be Unsustainable? Paradoxes and Contradictions of a Necessary Evolution. FASHION AND TEXTILE DESIGN RECONSTRUCTION – VOL 14 PAD 20
44. Thorpe, A. (2007). The Designer's Atlas of Sustainability. Island Press.
45. Wright, S.L., & Kelly, F.J. (2017). Plastic and Human Health: A Micro Issue? Environmental Science & Technology, 51(12), 6634–66
46. World Trade Organization (WTO). (s.d.). The Agreement on Textiles and Clothing (ATC). https://www.wto.org/english/docs_e/legal_e/16-tex_e.htm
47. Yoo, J., & Kim, M. (2016). The Influence of Fast Fashion and Disposability on Millennial Consumers' Commitment to Fashion. Journal of Fashion Marketing and Management, 20(4), 400-417.

# Digital art direction and sustainable communication for fashion in Italy: A literature review

*Filippo Maria Disperati*[1], *Elisabetta Cianfanelli*[2]
*filippomaria.disperati@unicampania.it, elisabetta.cianfanelli@unifi.it*

[1]*Università degli Studi della Campania "Luigi Vanvitelli", Italy*
[2]*Università degli Studi di Firenze, Italy*

***Keywords:***
*Art Direction*
*Digital Fashion*
*Made in Italy*
*Artificial Intelligence*

## Abstract

The contribution explores the digital dimension of art direction for fashion in Italy, with the aim of understanding how the identity concepts of Made in Italy intertwine and reconfigure with the double transition. Thanks to an in-depth literature review, it will be investigated which technologies can concretely operate in the fashion context in favour of digital sustainability. The aim of this analysis is to take an initial stock of the state of the art through the analysis and review of publications and paper positions. It will review the most recent scientific analyses conducted about art direction, digital, VR, AR and A.I. with a focus on fashion. This contribution represents an important starting point for the development of new research in this field.

## Introduction

In order to define the mechanisms that link art direction practices in the digital and sustainable spheres, in fashion communication in Italy, we can start from the concept of the mediatisation of fashion, which, as Agnès Rocamora writes:

> Mediatisation means examining the ways in which fashion practices have adapted to and been transformed by the media. It does not mean focusing on the media themselves, but on the ways in which people and institutions in fashion have changed their practices for and with the media. (Rocamora, 2016, p. 509)

More than anything else, the digital is a new environment capable of encompassing all previous media and reconfiguring social and economic relations in both quantitative and, above all, qualitative terms. The digital completely and profoundly pervades every sphere of contemporary culture, economy and creativity (Barile, 2022, p.143). In recent years, the interest of fashion brands and online sales platforms in virtuality, gaming, NFT and the Metaverse has grown exponentially. However, the current debate on the Metaverse is suspended between the risk of a new bubble that could implode within a few years, or the emergence of a new 'metamedium' (Manovitch, 2013). In a 2019 report by the WGSN international trend analysis platform, it is predicted that the significance of a product will surpass purely physical criteria, indicating that the physicality of products is gradually

losing importance (Mjasnikova, 2021). Another crucial aspect to be considered is the great debate on artificial intelligence, which not only concerns the idea that much of today's work will disappear in the next decade due to the Fourth Industrial Revolution, but also, and above all, the way in which our daily lives will be totally transformed by automation not only in physical activities, but also in cognitive ones. Communication plays, also in fashion, a key role in this balancing act between the value of the product and its digital and physical representation. The customer experience is optimised through the synergic management of channels and technologies, fostering design processes capable of organising, narrating and objectifying the offer system (Iannilli & Spagnoli, 2021). Brands engage in direct partnerships with technology or social media companies, (notably Facebook, Instagram and Snapchat) in luxury hubs strategically based in Paris to advise on ways to translate their visual environment online, to extend their digital visibility by scouting new models and internet celebrities, and to develop the statistical tools needed to measure their media effectiveness (Cappelli, 2018). This arrangement is illustrative of how technology companies and digital technologies are now underpinning the more traditional brand/media/fashion retailer business structure (Rees-Roberts, 2020). However, it would seem to emerge that the figure of the art director and his or her relationship with the digital aspect of fashion communication have not yet been addressed in detail and in depth. This study intends to understand, through a critical and synthetic analysis of existing studies, the current state of research related to digital art direction for sustainable communication in Italian fashion.

## Digital art direction and sustainable fashion communication

Art direction is the process of providing creative and visual guidance, encompassing digital communication projects that may involve photography, video, graphics, and other elements. In the realm of fashion, digital art direction focuses on crafting and conveying a brand's image through digital platforms such as websites, social media, and online advertising. Academic literature identifies several emerging trends in digital art direction for fashion. One of these is the increasing use of augmented reality (AR) and virtual reality (VR) to deliver immersive experiences to users. Other trends include the adoption of digital influencers and the integration of interactive storytelling into websites and advertising campaigns. The task of the art director is to define the visual essence of the brand as the set of aspects and sensations that characterise it, through consistency between the brand itself, its strategy and all the visual elements that compose it, kept constant over time. Furthermore, a good art director takes into account distinctive and original visual elements that can differentiate the brand within the competitive landscape. To initiate the creative process, art directors make use of advertising examples of previous brands and visual briefs, both to fuel their own creativity and to understand the visual preferences of the client. Finally, they rely on their aesthetic preferences and the emotions aroused to assess whether the meanings of each possible visual element match the brand identity; thus, the selection of visual elements does not follow predefined rules and is not a purely promotional action (Phillips, et al., 2014). The rise and experimentation of digital art direction practices certainly exploded during the initial spread of the Covid-19 pandemic, when companies in the fashion industry found themselves having to introduce new business and communication strategies towards digital in order to increase interest and satisfy the needs of their customers, so as to stimulate and increase sales both online, via eCommerce platforms, and in physical shops (Noris

& Cantoni, 2021). The entire fashion scene, including companies, brands, designers, magazines and photographers, has started to consider the possibilities offered by digital technologies to discover new ways of relating, both personally and professionally. The lockdown period has clearly highlighted how the intimate and private domestic space has been transported to the screen, taking on a new public dimension, as well as making the opposite seem true (Vaccari & Franzo, 2020). A relevant example of digital art direction for fashion, born in Italy during the Covid -19 period, was the Sunnei Canvas project, launched in July 2020 by the brand Sunnei, founded in Milan in 2014 by Loris Messina and Simone Rizzo. This project offered a platform where digital avatars wore and presented some of the brand's most iconic unisex garments, including accessories, footwear and bags. This example supports the idea of expanded design, where the retailer becomes a co-designer of the collection, influencing creative choices that move from the digital to the physical. It is assumed that in the future it will be possible to buy and try on digital clothing, with reduced costs due to the lack of materials and logistical expenses, and convert them into physical products if satisfied. Another element influencing art direction practices is the advent of artificial intelligence, which is already today, and will increasingly become, a very powerful medium at the disposal of fashion companies for the analysis of images and the development of communication campaigns as well; at present, many e-commerce brands in the fashion industry process images that are collected via user account panels. Thanks to the categorisation of the images, trend products with key trend components are subsequently identified. In order to be sure that a product is truly trending, the volume of images found with the product itself is then analysed to ensure the reliability of the data (Silvestri, 2020), the same strategy can apply to art direction.

## Systematic literature review: research question and methodology

In order to try to delimit a perimeter and a state of the art of digital art direction and sustainable communication practices for fashion in Italy, in this analysis we have chosen to select research articles published in the last 15 years, related to research carried out in Italy or abroad, linked to the topic of fashion communication in Italy. Through the academic databases of Google scholar and Scopus, a series of interconnected articles and scientific contributions were selected. [Figure 1].

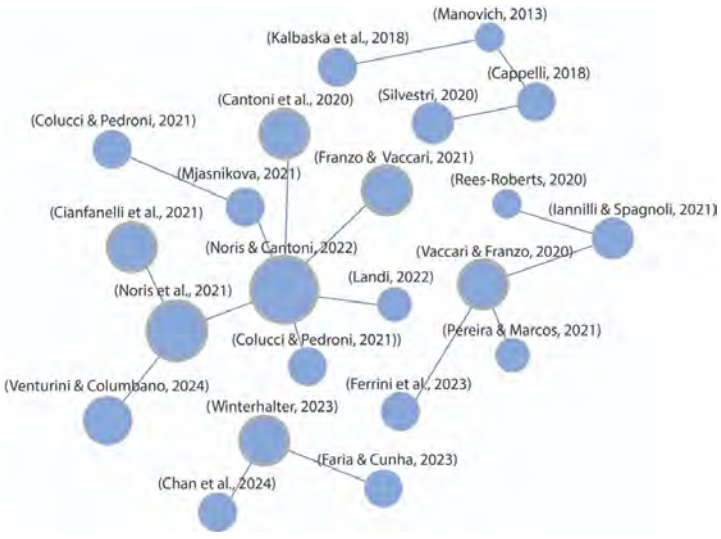



*Fig.1 Visual map of the contributions analysed for the literature review*

An attempt was made to answer the following research question: what are the methods and tools to build, through the digital dimension of art direction, the communication of the future related to sustainable fashion products?

In the contribution Fashion communication: Between tradition and digital transformation, an editorial in the academic journal Studies in Communication Sciences (Kalbaska et al., 2018), dedicated to Fashion Communication, the authors offer us a heterogeneous view of the topic, exploring fashion from the perspective of communication. They highlight how communication and its media have become intertwined with fashion and its related industries and practices, and how the recent digital transformation has impacted fashion, making way for new communication possibilities and business models. For the authors, new business models in the fashion industry, supported by technology and immediate user demand, have revolutionised the timing and pace of communication, even altering the dynamics of fashion shows. Moreover, the Internet has promoted hybridisations between communication and commerce, giving rise to powerful new players in the fashion market (Kalbaska et al.,2018). Among the relevant technological trends in the field of fashion communication, the text mentions data analysis (big data) and artificial intelligence, which are widely used to deepen the understanding of users' purchasing behaviour, profiles and habits, but also the development of the creative process. For Kalbaska, Sádaba and Cantoni, we could consider three different levels at which fashion interacts with information and communication technologies (ICTs) - which can be referred to, in one word, as e-Fashion or 'digital fashion': ICTs used to design, produce and distribute fashion products; ICTs, which have an impact on marketing and sales; and ICTs used in communication activities with all stakeholders and which contribute to co-creation in the fashion world. An interesting contribution to understanding technologies for fashion communication activities is that of An Exploration of Digital Fashion in Pandemic Italy: Districts, Designers, and Displays (Franzo & Vaccari, 2021), which, through the analysis of a series of experiences, seeks to verify whether fashion has played a role as a tool of resistance and redemption from the health emergency, also thanks to digital technologies, supporting desirable - rather than unsustainable - futures. Within the contribution, the authors also question how fashion can be shown and sold outside the physical reality. In Metamorphic Fashion Design. Nature Inspires New Paths for Fashion (Cianfanelli et al., 2021) an attempt is made to analyse how the digital proper can increasingly consolidate itself as a tool for new innovative trajectories within the fashion system. This research project intends to propose a new form of communication for fashion excellence with the possibility of extending this experimentation to the Made in Italy system. The paper uses the experience of the Metamorphic Fashion Design project born during the pandemic period within the Master's degree courses in Fashion at the University of Florence and is inspired by the very concept of natural metamorphosis, to reflect the dynamics and mechanisms in garment design. Another interesting article to understand the transformations in fashion communication towards a digital horizon following the pandemic is Mediatized Fashion: State of the art and beyond ( Colucci & Pedroni, 2021). Fashion for Colucci and Pedroni is profoundly influenced by mediatisation and digitisation, which transform the way brands interact with their audience. Both mass-market brands and renowned fashion houses are increasingly relying on digital to advertise, reach their targets, sell and retain customers. Consumers are immersed in a digital environment, navigating e-commerce and social media on their path to purchase. Retail has been redefined by the digital presence, creating an omni-channel experience and concepts such as 'phygital', combining the

physical and digital experience. For Colucci and Pedroni, fashion today has been moved from its traditional spaces, the shops and printed magazines, to the digital environment, where it is present in fashion blogs and Instagram profiles. The boundaries between the editorial and commercial spheres have now blurred and new media have reshaped the spaces of fashion. Online media and blogs have helped to change magazines, making them more visual and interactive than ever before; computer and tablet screens become tools for fashion information and for the creation of fashion content, right up to the development of shops with digital mirrors and their integration with websites and apps. To better understand the variety of disciplines involved in the study of digital fashion communication, the contribution Digital fashion: A systematic literature review. A perspective on marketing and communication (Noris et al., 2021), aims to develop a comprehensive picture of the field of digital fashion in order to describe and classify it. The purpose of this classification is to provide an overview of the current state of digital fashion and to assist academics and practitioners in exploring such a diverse and rapidly evolving field. The research was conducted on the databases Eric (Education Resources Information Centre), Springer Link and Scopus. These databases were selected for their focus on technology and digital, Eric for its importance in the field of education for the fashion industry, Springer Link for its social aspect and Scopus for identifying the maximum number of articles and validating the presence of research articles in multiple databases. The keywords used were 'fashion' and 'digital'. Three categories were identified from the analysis: C&M - Communication and Marketing; D&P - Design and Production; C&S - Culture and Society. The Communication and Marketing category encompasses processes that relate to the execution of marketing and communication activities and their impact on consumers; The Design and Production category, understood in its broadest sense, refers to the creation and implementation of elements/processes, tangible and intangible, devised by humans or machines and that contribute to the advancement of the fashion industry. Finally, the category of Culture and Society encompasses the areas in which digital fashion interacts with and contributes to culture, education and societal development. The study shows that digital fashion is increasingly attracting the interest of academics and practitioners, particularly in the Communication and Marketing category, in which the largest number of publications were identified. However, the research has some limitations, starting with the fact that the categorisation was carried out considering each identified main topic as mutually exclusive. Therefore, according to the authors, future studies could consider this aspect to further develop the categorisation, also examining the implications and relationships between the different levels. In Digital Fashion Communication: An (Inter) cultural Perspective (Noris & Cantoni, 2022), the authors argue that the digital transformation has reduced the distances between nations, enabling global communication in fashion. However, they noted that cultural misunderstandings have been amplified, generating crises in the industry. They pointed out that what is culturally acceptable to one audience may not be to another, highlighting the need for cultural localisation or translation. Examining these crises and reflecting on their causes indicated that the new digital media ecosystem requires considerable effort to manage different cultures and approaches. Furthermore, the authors observed how fashion, an integral part of popular culture, is becoming a place where culture is discussed, defended and re-evaluated between different parties. In Extended reality (XR) in the digital fashion landscape (Faria & Cunha, 2023), the two authors point out that augmented reality is opening new doors for companies in the fashion industry, offering them an unprecedented opportunity to engage their customers. This has prompted brands to invest more and more in the technology, with revenue forecasts promising exciting re-

sults. According to Faria & Cunh, the use of AR/VR technologies allows brands to enrich customer experiences and explore new ways to tell their stories, thereby increasing their brand value. The use of XR environments allows for a high level of measurability, offering marketers crucial data to tailor customer buying experiences. However, the adoption of XR entails high costs and technical implications that could affect consumer perception. Furthermore, designing for XR is more intricate than for web and mobile devices, requiring more in-depth knowledge in several areas. The text advises those wishing to become interested in immersive technologies to focus not only on the technology, but also to conduct in-depth research and constantly consider consumer needs when designing experiences. In order to achieve digital excellence in XR, it is crucial, according to the authors, to add value and place quality as a long-term priority. The aim of this article is to deepen the understanding of XR in the context of fashion, identifying themes that could guide future work. The authors hope that this research will stimulate and encourage practitioners and researchers to fully explore the potential of XR in fashion and its communication. Another element that emerges in the study of digital fashion communication are NFTs (non-fungible tokens), in the contribution How Do Luxury Brands Utilise NFTs to Enhance Their Brand Image? (Ferrini et al., 2023), the structure of the proposed research idea aims to discover how NFTs are used to enhance the image factors of luxury brands and what additional opportunities managers working within these brands associate them with. Here we observe a deliberate choice towards qualitative research, a method that shows a commitment to deeper analysis. We opt for the reactive qualitative interview method, which encourages active participation on the part of interviewees, prompting them to provide detailed and in-depth answers. This approach encourages an open dialogue, allowing participants to offer vivid examples and detailed explanations that enrich the discussion. In essence, it is a choice that promises to bring to light a deeper understanding of the topic at hand. The study, however, has some potential limitations according to the authors. One obstacle lies in the still limited exploration of the research topic, highlighting a significant lack of academic studies on NFT with regard to luxury brands. Furthermore, the recruitment of interview participants follows very specific criteria, making the extension of the study sample difficult. Paolo Landi in his contribution How Digital Technology Influences Information about Fashion (Landi, 2022) points out that the transformation of materialism in consumer society is evident. For Landi, although the new social networks always offer additional shopping opportunities, the focus is no longer just on the possession of goods, but on the pursuit of a satisfying life. At present, it seems to be relegated to a secondary role, as clothes and accessories are considered mere objects derived from a disorganised flow of information that is difficult to control. Landi argues that the economy is undergoing a rapid transformation towards digitalisation, and major companies in the fashion industry are undergoing a complete branding process that leads them to focus increasingly on financial aspects. In this context, interest in dematerialisation through the adoption of blockchain technologies is emerging. Through the use of NFTs (non-fungible tokens), it is possible to register artefacts as 'unique and authentic', creating a parallel market within the still developing world of cryptocurrencies. This parallel market will potentially play a significant role in the future, especially with the advancement of the metaverse, which represents the next level of social networks. In the metaverse, virtual reality will allow users to interact via avatars, create objects or properties, participate in remote events and actions, and even experience teleportation simultaneously. In this context, another interesting contribution is Metaverse and Its Communication. The Future is Here (Winterhalter, 2023); the author examines the definitions and concepts of the

metaverse and analyses their meaning and impact, studying digital art and fashion and identifying their criticalities. Her study shows how fashion companies have invested enormous capital in a metaverse in order to generate profit, increase consumption and collect user data for profiling purposes. In the study 'Fashioning'the metaverse: A qualitative study on consumers' value and perceptions of digital fashion in virtual worlds' (Venturini & Columbano, 2024), the factors that drive fashion consumers' use of the metaverse, both for commercial and leisure purposes, are examined. A qualitative method was adopted in the research to identify five context-specific consumer values, namely 'utilitarianism', 'social identity', 'personhood', 'hedonism' and 'personal values'. The results of this study contribute to extending the application of TCV (theory of consumption values) in the context of digital technologies in the fashion industry. The analysis indicates that the top five values in the metaverse emerge for both work and leisure purposes, with social and epistemic values predominating. Among the participants, 11 mention social values (7 for leisure, 4 for work) and 9 mention epistemic values (5 for leisure, 4 for work). No significant differences were found between the age, gender or nationality of the participants, but the limited sample size reduces generalisability. In summary, the metaverse appeals for transversal values, although its adoption is influenced by context of use and individual motivation. In the recent article The adoption of digital fashion as an end product: A systematic literature review of research foci and future research agenda (Chan et al, 2024), an attempt is made to summarise the current state of digital fashion by analysing academic literature, industry publications and relevant sources. The result of the research reveals that the current literature is not up to date with the latest developments in digital fashion and lacks manuscripts related to its adoption, although the authors clarify that only articles with management/marketing perspectives were included (excluding design and technical articles). In addition, this text offers a useful methodological orientation for the analysis of digital fashion as an end product, assisting scholars in the formulation of their study project and pointing directions for further investigation. The authors highlight how, with the growth of the virtual economy and 3D technologies, digital fashion is evolving from a mere tool to an autonomous end product. This evolution is influencing the focus of fashion research, focusing on 3D virtual technologies and emphasising the importance of digital fashion as an end result. Finally, in Post-digital fashion: the evolution and creation cycle (Pereira & Marcos, 2021), an analysis of the creation cycle of post-digital art highlights the importance of fashion artefacts as artistic and not just commercial expressions. These artefacts, both tangible and intangible, often simulate textiles or wearable clothing, although they do not necessarily represent the human body. The creative process starts from the artist's vision and involves multidisciplinary teams. The post-digital artefact merges art with utility. Similar to digital media art, post-digital fashion artefacts offer enriching sensory, emotional and intellectual experiences, exploiting technological innovations to create new aesthetics. Not limited to digital materials, these hybrid artefacts manifest themselves in tangible and virtual forms, adapting to both physical spaces and online exhibitions. This new wave of creativity challenges traditional boundaries, pushing towards a new era of artistic expression that evolves between the digital and the material. This approach, as illustrated in the post-digital art creation cycle, emphasises the crucial role of artistic intentions in contemporary fashion, promoting the fusion of art and design in the digital age. The latter aspect is crucial in art direction practices for the fashion industry.

## Discussion, limits and further research

The study of the scholarly literature selected here, through a qualitative analysis, highlights a significant gap regarding the topic of digital art direction for fashion and the practices that art directors adopt to promote sustainability through digital. This lack of explicit contributions on this topic suggests the emergence of a new and interesting field of investigation. In the contemporary fashion landscape, digital art direction is becoming increasingly relevant as digital technologies play a key role in the creation, promotion and distribution of fashion products. However, despite the growing importance of digital art direction, there is a dearth of studies specifically exploring its link to sustainability. Sustainability has become a central theme in the fashion industry, with growing awareness of the environmental and social impact of traditional industrial practices. Art directors, as key figures in shaping the image and narrative of fashion brands, play a crucial role in promoting more sustainable practices within the industry. However, this review of selected scientific literature reveals how specific contributions exploring how digital art direction can be employed to promote sustainability in the fashion industry are lacking, if not non-existent. This represents a significant opportunity for future research. Exploring the role of digital art direction in promoting sustainability could open up new perspectives and innovative approaches to address the environmental and social challenges of the fashion industry. One possible area of study could be the examination of visual communication strategies used by art directors to convey sustainability-related values and messages through digital channels. This could include the analysis of advertising campaigns, social media content, websites and other forms of visual communication used in digital fashion. Furthermore, it could be interesting to explore how digital technologies can be used to improve the traceability and transparency of the fashion supply chain, enabling consumers to make more informed decisions about their purchasing choices. In the near future, art directors could play a key role in developing innovative digital tools that facilitate this transparency and encourage more sustainable practices by fashion brands. Another area of interest could be the development of digital business models that foster sustainability. In addition, it could be useful to explore how digital art direction can help educate consumers on the sustainability of fashion and the actions to be taken to reduce environmental impact. This could include the development of educational and informative content on topics such as ethical production and conscious consumption. Finally, the analysis of the scientific literature of the last ten years highlights the importance of interdisciplinary approaches to address the challenges of sustainable fashion. Art directors, together with sustainability experts, digital technologists, designers and other industry professionals, could work together to develop innovative solutions that integrate creativity, technology and social and environmental responsibility. In conclusion, the absence of explicit contributions on digital art direction for fashion and sustainability in the scientific literature represents a significant research opportunity. Exploring this field could lead to new knowledge and practices that contribute to a more sustainable and responsible fashion industry.

## Acknowledgments

Project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 - Call for tender No. 341 of 15/03/2022 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU. Award Number: PE00000004, Con-

cession Decree No. 1551 of 11/10/2022 adopted by the Italian Ministry of University and Research, CUP B83C22004890007. MICS (Made in Italy - Circular and Sustainable).

# References


1. Barile, N. (2022). Dress Coding: Moda e stili dalla strada al Metaverso [Dress Coding: Fashion and Styles from the Street to the Metaverse]. Meltemi.
2. Cappelli, P. (2018). Les médias sociaux se payent le luxe. CB News, 72, 106-114.
3. Cianfanelli, E., Giorgi, D., Tufarelli, M., Giliberti, L., Pupparo, P., & Pucci, E. (2021). Metamorphic Fashion Design. Nature Inspires New Paths for Fashion Communication. PAD, 61-85.
4. Chan, H. H. Y., Henninger, C., Boardman, R., & Blazquez Cano, M. (2024). The adoption of digital fashion as an end product: A systematic literature review of research foci and future research agenda. Journal of Global Fashion Marketing, 15(1), 155-180.
5. Colucci, M., & Pedroni, M. (2021). Mediatized Fashion: State of the art and beyond. ZoneModa Journal, 11(1), III-XIV.
6. Faria, A. P., & Cunha, J. (2023, July). Extended reality (XR) in the digital fashion landscape. In International Conference on Fashion communication: between tradition and future digital developments (pp. 49-56). Cham: Springer Nature Switzerland.
7. Ferrini, G., Huber, S., & Batt, V. (2023, July). How Do Luxury Brands Utilize NFTs to Enhance Their Brand Image?. In International Conference on Fashion communication: between tradition and future digital developments (pp. 80-87). Cham: Springer Nature Switzerland.
8. Franzo, P., & Vaccari, A. (2021). An Exploration of Digital Fashion in Pandemic Italy: Districts, Designers, and Displays. DIID. DISEGNO INDUSTRIALE INDUSTRIAL DESIGN, 73, 126-135.
9. Iannilli, V. M., & Spagnoli, A. (2021). Phygital retailing in fashion. Experiences, opportunities and innovation trajectories. ZoneModa Journal, 11(1), 43-69.
10. Kalbaska, N., Sádaba, T., & Cantoni, L. (2018). Fashion communication: Between tradition and digital transformation. Studies in Communication Sciences, 18(2), 269-285.
11. Landi, P. (2022). How Digital Technology Influences Information about Fashion. ZoneModa Journal, 12(1), 29-34
12. Manovich, L. (2013). Software takes command (p. 376). Bloomsbury Academic.
13. Mjasnikova, K. (2021). Transcending the Physical Body: The Influence of E-Sports on Digital Fashion. LAP LAMBERT Academic Publishing.
14. Noris, A., & Cantoni, L. (2022). Digital Fashion Communication: An (Inter) cultural Perspective. In Digital Fashion Communication (pp. 1-147). Brill
15. Noris, A., Nobile, T. H., Kalbaska, N., & Cantoni, L. (2021). Digital fashion: A systematic literature review. A perspective on marketing and communication. Journal of Global Fashion Marketing, 12(1), 32-46
16. Pereira, S., & Marcos, A. (2021). Post-digital fashion: the evolution and creation cycle. ZoneModa Journal, 71-89.
17. Phillips, B. J., McQuarrie, E. F., & Griffin, W. G. (2014). The face of the brand: How art directors understand visual brand identity. Journal of advertising, 43(4), 318-332.
18. Rees-Roberts, N. (2020). After fashion film: social video and brand content in the influencer economy. Journal of Visual Culture, 19(3), 405-421.
19. Rocamora, A. (2017). Mediatization and digital media in the field of fashion. Fashion Theory, 21(5), 505-522.
20. Silvestri, B. (2020). The future of fashion: How the quest for digitization and the use of artificial intelligence and extended reality will reshape the fashion industry after COVID-19. ZoneModa Journal, 10(2), 61-73.
21. Vaccari, A.., & Franzo, P. (2020). Mise en abyme. L'esperienza espansa della moda nell'età della mixed reality [Mise en abyme. The expanded experience of fashion in the age of mixed reality]. ZoneModa Journal, 10, 75-89.
22. Venturini, A., & Columbano, M. (2024). Fashioning the metaverse: A qualitative study on consumers value and perceptions of digital fashion in virtual worlds. Journal of Global Fashion Marketing, 15(1), 6-22.
23. Winterhalter, C. (2023, July). Metaverse and Its Communication. The Future is Here. True or False?. In International Conference on Fashion communication: between tradition and future digital developments (pp. 37-48). Cham: Springer Nature Switzerland.

# Fast Fashion. Sustainability and the negative psychological and social impacts for consumers

*Giovanni Maria Conti*
*giovanni.conti@polimi.it*

*Politecnico di Milano, Italy*

***Keywords:***
*Sustainable Fashion*
*Fast Fashion*
*Business model*
*Consuming*

## Abstract

Fashion's purpose in society is intertwined with its meaning in people's lives. People who have different realities and different relationships with their clothes. It is risky to determine a new set of rules for all stockholders without this being taken into consideration. It's a move like this that seems to be happening in the fashion industry. All in the name of sustainability. Sustainability is not a new term in the fashion industry, however it was previously seen as just an option and often linked to a rustic, handmade aesthetic. Everything changed when news of hidden horrors throughout the supply chain started reaching the end consumer and industries across different segments started evaluating their environmental impact. Considering the pace at which fashion has followed in recent decades, it is not surprising that its industry is unsustainable. However, the rush to fix all the industry's flaws may have overlooked an important aspect to consider. Fast Fashion has reached a part of society that could never fully experience fashion as more privileged people could. However, this business model has created some horrible disasters in the industry. But sometimes his condemnation and the alternatives presented as solutions could represent an even bigger problem. In the following paper, the set of solutions presented in the name of sustainability will be analyzed and above all we will try to answer the following questions: what would it mean for those who depend on fast fashion to be involved in a new way of consuming? What would the impacts be on their lives? And finally, are sustainable practices appropriate for all consumers?

## Introduction

The purpose of fashion in society is entangled with its meaning in people's lives. People that have different realities and different relationships with its clothes. With that in mind, it is risky to determine a new set of rules for all players without that being taken into consideration. It is a move like this one that seems to be undergoing in the fashion industry. All in the name of sustainability.

Sustainability it is not a new term in the fashion industry, however, it was earlier view just as an option and often linked with a rustic and hand-made aesthetic. It all changed when the news about the horrors hidden throughout the supply chain started reaching the final consumer, as well as industries

from different segments started assessing their environmental impact. Considering the pace fashion has been working for the last decades, it came as no surprise that its industry unsustainable. Nonetheless, the hurry to right all the wrong in the industry might have neglected an important aspect to be taken into consideration.

In the last decades the world experienced fashion in a way that had never before, all that due to a business model called Fast Fashion. Fast Fashion reached a part of the society that could never fully experience fashion like more privileged people could. However, as everything in life, the system took on an extreme turn and was stage to horrible disasters in the industry. The problems with the business model are unquestionable. Nevertheless, its condemnation and the alternatives presented as solutions might present an even bigger problem.

It is the vilification and the set of solutions presented in the name of sustainability that will be analyzed throughout this thesis. What would they mean for individuals that depend on the business model to be involved in fashion? What would be the impacts in their lives? And at last, are the sustainable practices adequate for all consumers?

## Fashion? A possible background

Fashion evolves not only in clothing but also in related elements like materials and behaviors. Fashion is not superficial; it involves creating identities through product design. Designers must understand societal changes and interpret them by delivering coherent products or services. Global trends are acknowledged, but the emphasis is on global issues impacting social contexts, with sustainability being a significant concern. The paper highlights that fashion choices are political statements that define individuals' preferences based on factors like manufacturing, materials, price, and quality. Again, fashion and its dynamics can have negative repercussions and negative psychological and social impacts for consumers. Sustainability in fashion reflects awareness of choices impacting the environment and human existence. The complexity of sustainability was first defined in 1987 during the World Commission on Environment and Development's inaugural international conference. It emphasizes balancing present needs without compromising future generations' requirements. Environmental sustainability involves caring for the environment and reducing human impact on Earth. Economic sustainability aims for lasting economic growth, wealth, employment, and community support. Social aspects of sustainability are crucial, especially after events like the Rana Plaza collapse in Bangladesh, which led to the global Fashion Revolution movement founded by Orsola De Castro. This shift focuses not only on resources and products but also on those involved in making clothes to ensure optimal welfare conditions for workers in the industry.

## So, what's Fashion?

With the development of fashion studies over the years, theorist came up with different meanings for the phenomenon. Those differences range, mostly, accordingly to the area of study. Nonetheless, it is unanimous that fashion goes way beyond garments and their production. For this study, it will be adopted the anthropological definition, highlighting the impact new sustainable practices have in low-income individuals' life.

Alison Bancroft (2012, p. 2) starts her introduction in "Fashion and Psychoanalysis: Styling the Self" saying that "Fashion is, perhaps, primarily

concerned with innovation in the surface decoration of the body, and the wider social and cultural responses of this innovation." Highlighting two important aspects of fashion for its anthropological definition: first, it is made on the surface of the body, and the object alone means nothing; second, there is a response to the act of wearing it. Those two aspects show the importance of focusing on the wearer, and that the social and cultural responses that will be instigated are directly linked with the reality of this individual, for it is the center of fashion.

Seeing as the social responses instigated by the act of wearing are part of the definition of fashion by anthropologists, it is also important to understand which are these social movements and how they are important for an individuals' life.

The first social movement explored in this paper is the theory of imitation by Gabriel de Tarde explained by Gilles Lipovetsky (2002); for Tarde, fashion is essentially a form of human relationship, as social relationship characterized by the imitation of one's contemporaries and the love of foreign novelties. […] The resemblance among human beings is what institutes the social bond, to such an extent that Tarde can assert that "society is imitation".

Looking through the lens of anthropology imitation could be interpretated as the individuals' effort of socially belonging. As well as an important movement that promoted the diffusion of fashion.

Nonetheless, the sense of belonging does not exclude the self-expression purpose of dressing. Highlighted as the second social movement important for the development of this dissertation. As pointed out by political scientist Joshua Miller (2005), self-expression can also result in political exchanges. It is the act of presenting yourself: what you are, or what you want to be, or even what you would like others to think of you. The interaction among individuals often starts with the way they are dressed, that interaction being the third and last social aspect.

As such, one would be hardly in the wrong to assume the industry would try to be rid of a business model that democratize and expand individuals' access to fashion. But as we stand today, once again society has remembered the dire consequences of taking an endeavour to the furthest extreme, as noble as the initial goal might be.

## Fast Fashion: Villain of Sustainability

Numerous scandals surrounding the Fashion Industry marked the last decades. From the reappearance of sweatshops linked with famous USA brands in the 90's, to being one of the most polluting for its water usage, chemical abuse, and the amount of greenhouse gas emission during the entire supply chain (Sadowski, M., Perkins L., McGarvey E., 2021). However, the number of garments purchased per capita between 2000 and 2014 still increased by 60 percent (McKinsey 2016).

A way to explain the on-growing demand even with all the news mentioned above is the success of one of the most complex business models of the industry: the Fast-Fashion. This business model entails: a rapid change of collections, not adhering to the once traditional seasonal calendar of 4 collections per year but reaching a neck-breaking pace of delivering mini-collections every week. All while offering cheap purchasing prices, attained via low-quality raw-material, cheap labour, and mass production. "Sacrifices" made in the name of the democratization of fashion. However, Fast Fashion did not merely stay confined in the business model category, it went beyond and ingrained itself as a consumer behaviour, characterized by overconsumption. Therefore, it did not come as a surprise that, with an

ever-growing pressure for more and more sustainable industry, companies following the fast fashion tenets found themselves in the center of heavy scrutiny. Even though famous ready-to-wear brands also incentivized this new consumer behaviour and, often, shared the same warehouses as the Fast Fashion Brands, they bore less of the brunt. In this villainization campaign, the target was clear – and easy to pin the blame.

With organizations such as Fashion Revolution, Global Fashion Agenda, The Fashion Pact, UN Alliance for Sustainable Fashion, and so many other important players, the arduous work of identifying and righting all the wrongs within the Fashion Industry started. At the same time, consumers with not as much knowledge of the supply chain and less-that-trustworthy sources also started sharing their news, findings, as well as their own opinions. The legitimacy of such news channels is not being questioned in this essay; it is, however, an undoubtable force that amplified the cacophony surrounding the unique business model in question: a system that's is as faulty as it is brilliant; as lucrative as it is damaging; and as dangerous as it is inclusive.

Albeit undoubtedly unsustainable and in desperate need of reform, Fast Fashion serve as a bridge for those who have no other way of experiencing fashion. It was the first to extend their hand towards a significant portion of the population, which lacked the resources and access to alternatives. It brought up the question if the fashion industry is indeed considering these people when developing the sustainable practices being implemented.

## Sustainability in the Fashion Industry

But what sustainability looks like in the Fashion Industry? For the last decade the term sustainability has been a constant in the fashion industry. The need for a change became undeniable with the deadliest garment-factory accident in history in April 2013 at the Rana Plaza in Dhaka, Bangladesh (Hobson J., 2013). Since then, there was an increase in scandals as consumers started to learn how the industry works to make their incredible product. They started to demand a change from the companies and part of them went beyond by changing their own consuming behaviour.

To keep the focus of this study in the psychological and social impact fashion has over an individual's life, this section will not delve into industrial practices being implemented. Instead, it will consider the new consumer behaviour advised. Again, the need of those changes will not be questioned in this dissertation, only if their application could also have a negative impact in consumers' life.

The set of new practices are, in fact, a response to the overconsumption lead by the extreme adherence of Fast Fashion. These practices are buying second-hand, prolonging the lifespan of clothes, and buying basic garments.

Resale as a business model has increased in the last few years, being expected to double its size from 2021 by 2027 according to ThreadUp (Resale Report, 2023). It is one way of leading the industry to a more circular model. It was once viewed just as channel to acquire vintage pieces or for those who had no means to buy new clothes, now it is known as a sustainable consumer behaviour.

As an additional step towards a circular industry, there is a strong incentive on prolonging the lifespan of clothes. Strategies go from raising awareness regarding the proper ways to care for garments up to offering maintenance and repair programs. The practice became even more famous after co-founder of Fashion Revolution, Orsola de Castro (2022), said "The most sustainable garment is the one already in your wardrobe".

Finally, there's also incentives for adopting seasonless clothes in order to

make one's wardrobe more versatile, longstanding. A non-rare critique for this sustainability trend is that some brands went as far as being becoming "boring" due to the basic aesthetic. Considering fashion's primary purpose as we've stated, there is a balance to be found here.

Taking only the practices above into account with the characteristics listed on the last section, it wouldn't be wrong to affirm that Fast Fashion veers in the opposite direction of what Sustainable Fashion poises to be. But, alas, it is this very same affirmation that is questioned in this essay. The reason is that this same Fast Fashion remains as the only option of a part of the population to experience fashion. So how does vilifying it and crusading against it impact the lives of lower income consumers? Surely, it must not be dismissed the environmental and waste burden brought upon by their activities, but equally important is that it shouldn't be neglected the social and psychological role their products play.

## Are the Sustainable Practices for the Fashion Industry Adequate for All Consumers?

As discussed, fashion relies primarily on the wearer and then on social and cultural responses instigated. Bearing this affirmation in mind, it's not unexpected to find the myriad of different business models we have in the fashion industry – as its product, fashion industry hardly finds a one-size-fits-all. It is then more than reasonable to expect that the reality of the wearer, their cultural scenario, social context, a broader set of circumstances should be considered when structuring any radical change in the industry.

Nevertheless, it has come to light that most strategies and practices developed to turn the fashion industry into a more sustainable one might have disregarded the efforts necessary in this exercise.

The emphasis on industrial solutions and ethical awareness effectively bypasses fashion's entanglement in more complex and contested issues, such as globalization, social conflict, the politics of identity and community, labour organization, precarious work, and the imperative to achieve, and not least public and mental health. The hope (von Busch, O., 2022) appears to be of "fixing" sustainability without questioning the systemic impact of fashion in current societies. The quote above was taken from an article by the PhD Professor from Parsons University together with a more public discussion that happen on Twitter, recounted at Business of Fashion (Deeley, R. 2023), as well as the vilification of Fast Fashion. All three different type of sources reinforce the possibility of inadequacy on the sustainable strategies for the fashion industry.

To test out this statement the next step is to analyse what would mean for the consumers that depend on Fast Fashion the implementation of the sustainable practices listed on the last section. Keeping in mind that it will all be view through a psychological and sociological lens, one of the key points highlighted by Otto von Busch: politics of identity and community and, public and mental health.

## Analysis

This analysis will be carried out by listing the sustainable practices stablished as relevant for this dissertation then, using a curated set of refences to understand their psychological and social impact in the individual's life. The reality set for this individual is of a consumer that do not have the resources to buy outside the Fast Fashion business model.

The first practice to be analysed is the second-hand market. The resale

business model it is not new for the reality traced above, it is whoever, linked to a necessity of getting dressed. Salvations' Army, church sales and other institutions that resell clothes affordable to this public are far from offering the same trendy or vintage pieces found in the new sustainable resale shops nor at the affordable Fast Fashion hacks. To populations emerging from poverty (von Busch, O.,2022), fashion can be a tool to transgress being downtrodden and move toward new possibilities emotionally. After that we get to the second practice, expanding the lifespan of garments. Besides strategies on how to take better care of your clothes, promoting repairs, and offering a better-quality product, all three would require a financial investment above what the population in question could offer. There is a fourth strategy used to promote expanding the lifespan of clothes that is creating an emotional connection to them. However, an emotion connection first requires good memories tied to those clothes, that it is rarely the case in this reality.

The last sustainable practice it is opting for seasonless clothes. For that aspect the journalist Michelle Lee in her book Fashion Victim, pointed out two important social movement seen in the first section on this dissertation: the act of presenting oneself and self-expression. She says (Lee, M., 2003), clothing is one of the few things we can readily change about ourselves. Our clothes are visible symbols of who we are and who we want to be.

For individuals that have no other means to change their precarious situation in life, fashion could be their only outlet of self-expression, and their only sense of control. And finally, the vilification of Fast Fashion. The business model pointed out throughout this dissertation, as the only way a part of the population can experience fashion from an anthropological and social aspect. It is through Fast Fashion that a big part of the population on developing countries can enter in the "imitation schema" and get the sense of belonging to a community. It is also through the faulty business model that people can engage in social and political movements explained by the political scientist Joshua Miller. In conclusion, experience fashion in all its anthropological depth.

## From Fashion-good to Fashion-abilities.

This transition signifies a shift from focusing solely on the aesthetic or superficial aspects of fashion to emphasizing the capabilities and potential impact of fashion in promoting sustainability and responsible practices within the fashion industry. Vanessa Friedman, in a 2018 New York Times article, explains well that we shouldn't believe the lies that can be told about fashion. It underlines the importance of storytelling and educating oneself about sustainability within the fashion system, highlighting a deeper understanding of how fashion can evolve beyond just being visually appealing to actively contributing to positive environmental and social change. An industrial system characterized by the variability of its products should be acknowledged as significantly impactful on resources. However, it is essential to recognize that certain industrial sectors, albeit less publicized due to their divergence from topics directly related to individuals, exert far greater environmental impacts that often escape public awareness. For instance, sectors like cement and steel (Friedman, 2018) production stand out for their substantial industrial carbon emissions, despite the fact that these materials are not directly purchased by most consumers.

When considering brands committed to eco-conscious practices, as highlighted in an article by Eliza Huber (2021) in the New York Times, it is more transparent and honest to acknowledge that they may be deemed "unsustainable." This perspective emphasizes the importance of continuous improvement and the necessity for brands to address their environmental im-

pact truthfully. Rather than portraying constant progress with each season, acknowledging areas of unsustainability allows for a more genuine evaluation of efforts towards sustainability within the fashion industry.

In the realm of sustainable fashion, it is crucial to avoid distorting the reality that sustainable products, typically priced higher than others, may be accessible to affluent segments of the population, while fast fashion predominantly caters to less affluent groups. To foster a more sustainable fashion industry, designers (Karaosman, 2021) must scrutinize any inconsistencies, evaluate the values they promote, and ensure that their designs cater to those in society who are most in need of clothing.

Finally, "If we are serious about the ideals, we strive for making fashion more sustainable, the question must become how we can offer fashion users a wider interface towards the ideal practices we say we promote? If we are earnest about the virtues of sustainability, the honesty, integrity, authenticity and commodity support, how can we think of fashion as a tool for cultivating these ideals in the living practices of our users for these values?" (Karaosman, 2021).

To embrace the notion that design can encapsulate values like authenticity, honesty, or integrity, a shift in focus from fashion products to fashion practices is imperative. This transition emphasizes the importance of cultivating what can be termed as "fashion skills", highlighting the significance of how individuals engage with and care for their clothing as a means of respecting both the craftsmanship behind the garments and the natural resources that enable their creation.

## Conclusion

The social and psychological gains that Fast Fashion brings to individual that has no other access to fashion are irrefutable after the analysis. The comparison between the delimitated set of sustainable practices, the curated list of references and the discussion about what is the meaning of fashion through the anthropological and social studies made that affirmation possible.

Not only that, but also that most sustainable practices need to be revised before being established as a one-fit-all solution. The need for a sustainable industry it is not the question, nor is the big part that Fast Fashion plays in the urgent matter. However, it cannot be forgotten the psychological and social purpose that this business model has in a big part of their consumers life.

The fashion industry still has a long way to become a more sustainable industry. The strategies and innovations would help lead this change, nevertheless, the impact and purpose of fashion in all individuals' lives cannot be forgotten and must be taken into consideration.

As Orsola De Castro asserts, we must learn to maintain our clothes because, by taking care of them, we respect the people who made them. But above all, we respect the nature that has provided us with the resources for that type of garment to be created and for me to have been able to choose it.

## Acknowledgments

The author thanks Débora Homem Pessanha de Mello whose research for her Master's thesis in Product Sustainability Management was used in the writing of the following article.

# References


1. AA.VV., (2023). ThreadUp Resale Report 2023, https://www.thredup.com/resale/
2. Anguelov, N. (2016). The Dirty Side of the Garment Industry: Fast Fashion and Its Negative Impact on the Environment and Society. CRC Press Taylor & Francis Group
3. Bancroft, A. (2012). Fashion and Psychoanalysis: Styling the Self. Bloomsbury Publishing
4. Brooks, A. (2015). Fast Fashion: A Cut from Clothing Poverty with Exclusive New Content, United Kingdom: Zed Books.
5. de Castro, O., (2022), Fashion Revolution Post August 2022, Instagram. https://www.instagram.com/p/ChpKcRQsnvN/
6. Deeley, R. (2023). Is Sustainable Fashion Elitist? The Business of Fashion. https://www.businessoffashion.com/articles/sustainability/sustainable-ethical-fast-fashion-shein-elitist-classist-waste-overconsumption-regulation-debate/
7. Friedman, V. (2018). The Biggest Fake News in Fashion, Dec. 18, 2018, The New York Times, https://www.nytimes.com/2018/12/18/fashion/fashion-second-biggest-polluter-fake-news.html
8. Hobson, J. (2013). To die for? The health and safety of fast fashion. Occupational medicine (Oxford, England), 63(5), 317–319. https://doi.org/10.1093/occmed/kqt079
9. Huber, E. (2021). Brands Are Claiming That They Are Not Sustainable. Here's Why That's A Good Thing, April 23, 2021. https://www.refinery29.com/en-us/2021/04/10433427/fashion-brands-claim-not-sustainable-transparency-ganni-noah
10. Karaosman, H. (2021). Responsible supply chain (two) curatorial editing, Lampoon Magazine, April 2021
11. Khurana, K., Muthu, S.S., (2022). Are low- and middle-income countries profiting from fast fashion?, Journal of Fashion Marketing and Management, Vol. 26 No. 2, pp. 289-306. https://doi.org/10.1108/JFMM-12-2020-0260
12. Lee, M. (2003). Fashion Victim: our love-hate relationship with dressing, shopping, and the cost of style, New York: Broadway Books.
13. Lipovetsky, G. (2002). The Empire of Fashion: Dressing Modern Democracy. United Kingdom: Princeton University Press.
14. Miller, J. I. (2005). Fashion and democratic relationships. Polity 37 (1): 3-23.
15. Minozzo, A. C. (2022). Entangled Fashion: A Psychosocial Contribution to Fashion Ethics in Times of Crises, Fashion Studies, Vol. 3, No. 2, pp. 1-20.
16. Pucker, K. P. (2022). The Myth of Sustainable Fashion, Harvard Business Review: Business and Society. https://hbr.org/2022/01/the-myth-of-sustainable-fashion
17. Otto von Busch (2022). What is to be sustained?: Perpetuating systemic injustices through sustainable fashion, Sustainability: Science, Practice and Policy, 18:1, 400-409, DOI: 10.1080/15487733.2022.2069996
18. Remy, N. and Speelman, E. and Swartz, S. (2016). Style that's sustainable: A new fast-fashion formula, McKinsey
19. Sadowski, M., Perkins, L., McGarvey, E. (2021). Roadmap to Net-Zero: Delivering Science-Based Targets in the Apparel Sector. Working Paper. Washington, DC: World Resources Institute. Available online at https://doi.org/10.46830/wriwp.20.00004King, M. (2000). Wrestling with the angel: A life of Janet Frame. Auckland, New Zealand: Viking.

# Mixed reality for addressing boredom at work: grounds and perspectives for PhD

*Francesco Musolino, Dario Gentile, Michele Fiorentino*
*f.musolino@phd.poliba.it , d.gentile7@phd.poliba.it, michele.fiorentino@poliba.it*

*Politecnico di Bari, Italy*

***Keywords:***
*Mixed Reality*
*Job boredom*
*Gamification*
*Cognitive Load*
*Psychology*

## Abstract

Due to automation, optimization and digitalization of work processes and everyday life, job boredom is an increasing problem of modern society that affects wide range of industries like storage, logistics, transportation, and manufacturing. The proven negative effects are reduced productivity and lower outcome for companies, job dissatisfaction and premature retirement. A curious aspect is that boredom is more severe on young workforce. This PhD research program aims to explore the potential of Mixed Reality technology to address work boredom. The methodology involves a multidisciplinary approach integrating industrial design, psychology and information technology. The first part will study the state of the art in literature of job boredom and its causes, followed by the research of any existing MR approaches in literature. Subsequently the focus will be on the design of new concepts, like explorative auditory and visual feedbacks, gamification and avatars. Best concepts will be implemented using Unity Engine and experimented with case studies, in laboratory first then with partner companies. The validation will involve quantitative metrics for cognitive psychological parameters and UI functionality and likeability. The expected outcomes are to discover new methods and improving worker productivity and well-being.

## Introduction

In designing Mixed Reality (MR) applications, it is important to first understand problem, target industry and involved users. Literature demonstrated that people experience workplace boredom when an activity is either simple, challenging, or meaningless (Westgate and Steidle 2020; Loukidou et al. 2009; Harju et al. 2014). In particular, are evidenced storage, transportation, and manufacturing sectors as the most critical for this problem (Loukidou et al. 2009; Harju et al. 2014). Additionally, a relevant study with 87 Finnish organizations revealed that most of the employees are males and under the age of 36 and that the educational level is not a predictor (Harju et al. 2014).

Boredom impacts Industrial/organizational workplaces with reduced productivity and lower outcome for companies, counterproductive job dissatisfaction and premature retirement (Westgate and Steidle 2020; Loukidou et al. 2009; Harju et al. 2014).

Nowadays Industry 5.0 in which the presence of MR tools is increasingly strong, designing considering this problem is in the end applying a proper human centered approach by placing the user at the center of the creative process and involving needs, emotions and behaviors for addressing tangible issues (Formati et al., 2021; Sanders, 2008).

## Boredom and attention

The definition of boredom is debated in the literature and as the researcher Vogel-Walcutt reports, mostly because of inconsistencies in the assessment methodologies, research findings, lack of generalizability and elusive strategies for mitigation (Vogel-Walcutt et al., 2011). Proposed definition is «State boredom occurs when an individual experiences both the (objective) neurological state of low arousal and the (subjective) psychological state of dissatisfaction, frustration, or disinterest in response to the low arousal» (Vogel-Walcutt et al., 2011). Thus, boredom can be understood as an emotion conveying insights about external environments and internal psychological states, while fit serves as a gauge indicating successful and meaningful engagement of attention.

*Figure 1. Sketches of gamificated tasks made (the author Francesco Musolino,2024)*

Boredom in psychology studies is related to attention, especially "Sustained" and "Divided" types are useful for outline how and how much MR applications can affect workers performing their job (Chung-Fat-Yim et al., 2022; Krauzlis et al. 2021). The impact on attention, will be assessed using the NASA task load index to gauge mental, physical, temporal demands, performance, effort, and frustration. This analysis not only evaluates specific case studies but also quantifies the complexity and attention requirements of MR applications to achieve their goals (Hart & Staveland, 1988). Our research has identified four factors that cause boredom in workplaces:

*Figure 2. Sketches of tasks with more feedback (the author Francesco Musolino,2024)*

1. Monotony," namely the repetitiveness of the tasks to be performed and the oppressive routine;
2. "Loneliness," both in environments where there is little communication among workers and especially in solitary occupations such as those of drivers or astronauts;
3. "Lack of meaning," due to the perceived distance from one's work and the inability to see the results of what one is doing;
4. "Idle times," usually long periods of time during which no activity is scheduled and during which it is difficult to find stimuli to stay active and engaged.

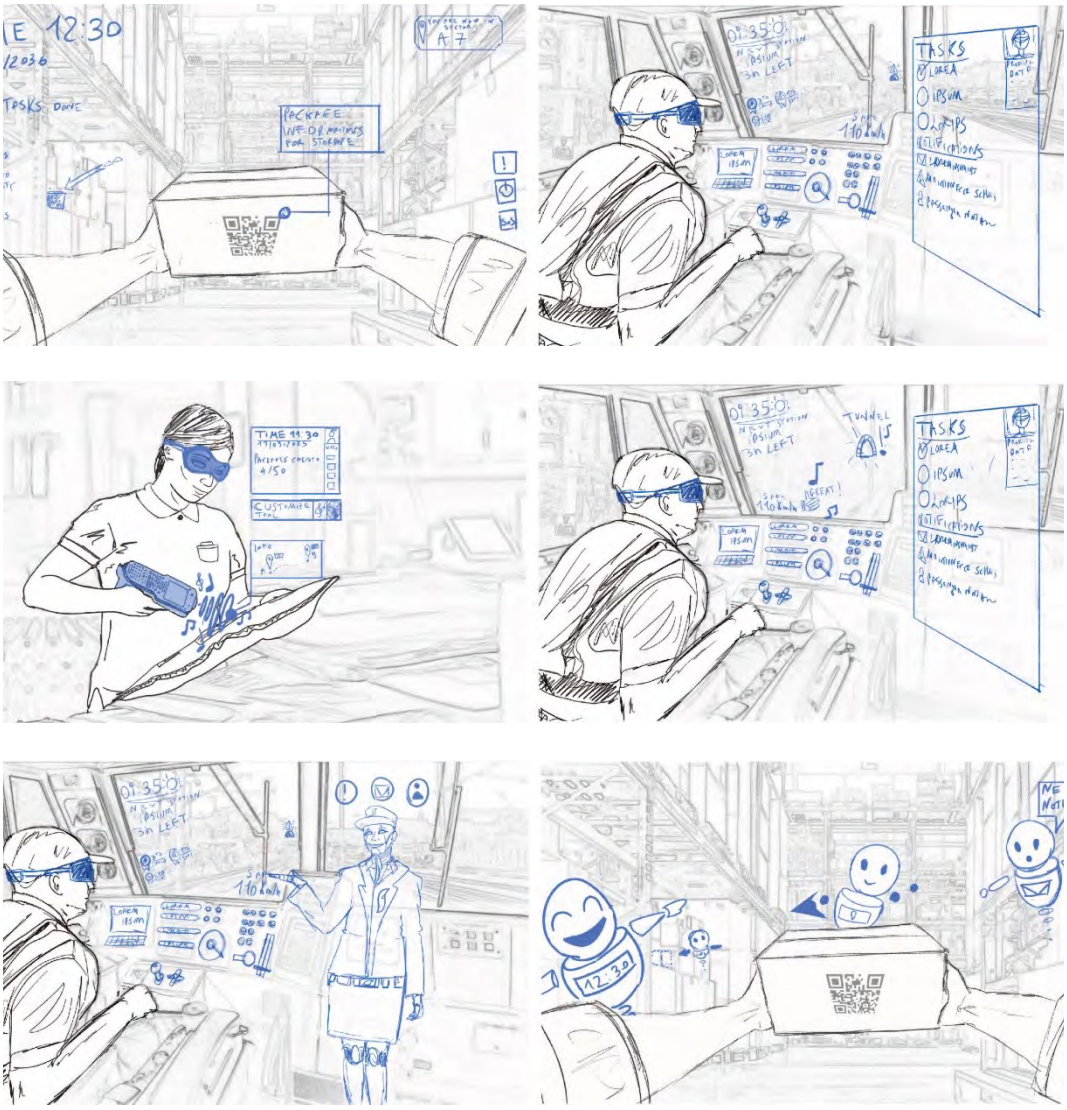
*Figure 3. Sketches of tasks with virtual assistants (the author Francesco Musolino,2024)*

## Mixed Reality as tool to reduce boredom

From literature three main solutions drivers for MR tools have been found:

1. Gamification, in terms of coherent gamificated tasks for the worker such keeping constant the idle speed for a driver (Bier et al., 2019) or a system of points, badges, leaderboards, performance graphs, avatars, and profile development to increase motivation and performance with a virtuous competition (Ponis et al. 2020). This solution points to "monotony", "lack of meaning" and "idle times";
2. Feedback into two forms, namely video and audio interfaces, offer enhanced engagement, aiding decision-making, reducing cognitive burden, and enhancing accessibility (Robb et al. 2017). Additionally, the use of work-related data visualization, such as tracking travel distances, package origins and destinations, or assembly rates over time (Deci and Ryan, 2000). Feedback solution is aimed against "monotony" and "lack of meaning";

3. Assistants: Virtual characters with a wide range of embodiment from humanoids to pets. All of them will be interact with the user and providing feedback, assist training and activities, schedule and manage tasks, giving cheers and suggestions, entertaining in idle times or just talk. AI chat functionalities can be used, also customized with the specific personality of worker (Lehmann et al., 2023). They can provide a visible improvement in doing specific tasks and reducing the feelings of loneliness and monotony (Habler et al., 2019) (Pesty & Duhaut, 2011) (Rickel & Johnson, 1999). They are meant to face all the four causes of job boredom, loneliness in particular.



## Methodology

The methodology will combine literature review, case studies and on-field analysis to define personas and scenarios. The application's visual elements will be informed by storyboards, moodboards, sketching, and iterative design revisions with FOR.REAL Lab of the University of Bari composed of PhDs and researchers in psychology fields. Prototyping using Unity Engine will precede experimentation with workers, employing both quantitative and qualitative metrics rooted in psychology and user interface research. For certain variations, both between-subjects and within-subjects comparisons will be employed to evaluate the potential of the application to improve the worker experience. The research will conclude with data analysis, visualization, and preparation for publication.

## Validation

The planned research and development phases will utilize metrics found in the existing literature. The selection of metrics is based on their academic importance, especially how often and in what areas they have been used.

1. Dutch boredom scale (DUBS) for checking the work boredom perceived by the workers of the case study (Reijseger et al., 2013). Given its being a much-cited psychometric scale applied to a very large number of people up to the point of having its own validated version specifically for the Japanese (Kawada et al., 2022), the quantitative data that can be collected and analyzed by this scale are crucial for conducting experiments within subjects;

*Table 1. Dutch boredom scale statements for the scale from 0 "Never" to 6 "Always" (Wilmar Schaufeli 2009)*

| **Dutch boredom scale statements for the scale from 0 "Never" to 6 "Always"** | |
|---|---|
| 1. At work, time goes by very slowly | 2. I feel bored at my job. |
| 3. At work, I spend my time aimlessly | 4. At my job, I feel restless |
| 5. During work time I daydream | 6. It seems as if my working day never ends |
| 7. I tend to do other things during my work | 8. At my work, there is not so much to do |

2. System usability scale (SUS) for having feedback on the ease of use of the developed tool (Brooke, 1996);

*Table 2. System usability scales statements, five response options from Strongly agree to Strongly disagree (John Brooke, 1986)*

| **System usability scales statements, five response options from Strongly agree to Strongly disagree (John Brooke, 1986)** | |
|---|---|
| 1. I think that I would like to use this system frequently. | 2. I found the system unnecessarily complex |
| 3. I thought the system was easy to use | 4. I think that I would need the support of a technical person to be able to use this system |

| | |
|---|---|
| 5. I found the various functions in this system were well integrated | 6. I thought there was too much inconsistency in this system |
| 7. I would imagine that most people would learn to use this system very quickly | 8. I found the system very cumbersome to use |
| 9. I felt very confident using the system | 10. I needed to learn a lot of things before I could get going with this system |

3. User Experience Questionnaire (UEQ) for measuring perceived attractiveness, perspicuity, efficiency, dependability, stimulation and novelty (Schrepp et al., 2017);

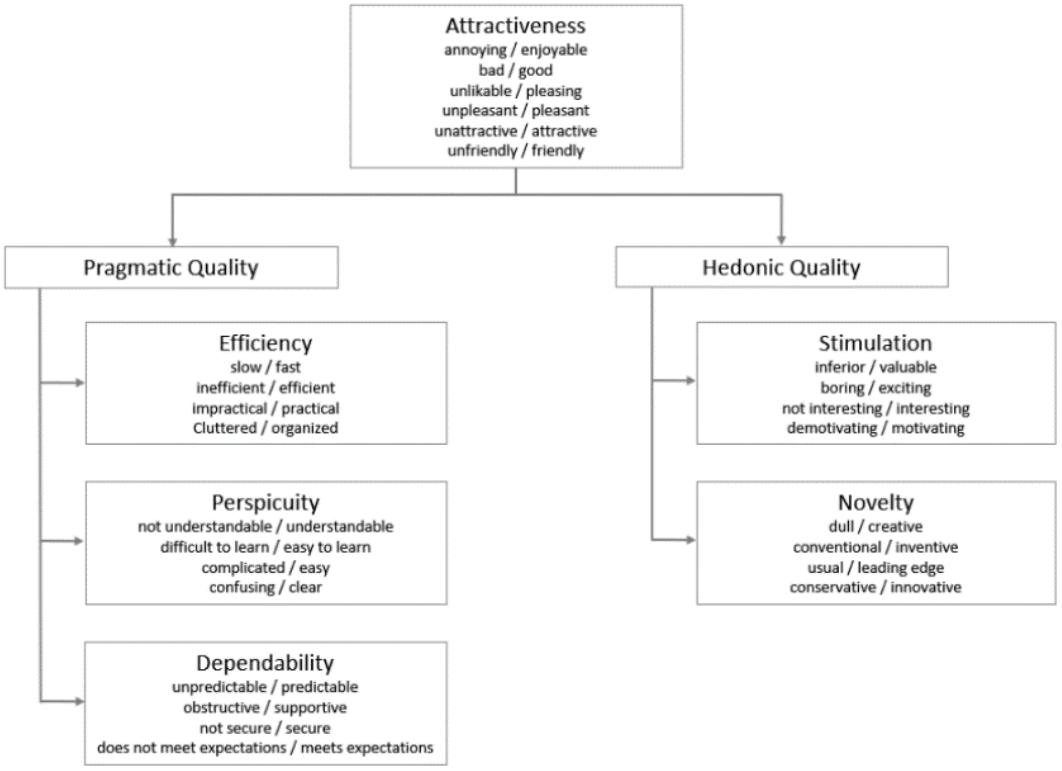



*Figure 4. Assumed scale structure of the UEQ (Dr. Martin Schrepp, 2023)*

4. Nasa Task Load Index (TLX) for understanding the perception of users on the intrusiveness of another attention stimulus in a principal task (Hart & Staveland, 1988);

*Table 3. NASA Task Load Index (TLX) method assesses workload for five 7-point scales (Hart & Staveland, 1988)*

**NASA Task Load Index (TLX) method assesses workload for five 7-point scales (Hart & Staveland, 1988)**

| | |
|---|---|
| 1. How mentally demanding was the task? | 2. How physically demanding was the task? |
| 3. How hurried or rushed was the pace of the task? | 4. How successful were you in accomplishing what you were asked to do? |

| | |
|---|---|
| 5. How hard did you have to work to accomplish your level of performance? | 6. How insecure, discouraged, irritated, stressed, and annoyed were you? |
| 7. How mentally demanding was the task? | 8. How physically demanding was the task? |

5. User engagement scale (UES) for checking the enthusiasm of the users with a tool for improving his approach to the work (O'Brien & Cairns, 2015)

Factors of Engagement and their Definitions

| Factor | Definition |
|---|---|
| Aesthetic Appeal (AE) | The users' perception of the visual appearance of a computer application interface. |
| Endurability (EN) | Users' overall evaluation of the experience, its perceived success and whether users would recommend the e-shopping site to others. This factor combines concepts related to users' likelihood to return (Webster & Ahuja, 2006) and evaluation of system success (DeLone & McLean, 2003). |
| Felt Involvement (FI) | Users' feelings of being drawn in, interested, and having fun during the interaction. |
| Focused Attention (FA) | The concentration of mental activity (Matlin, 1994); contained some elements of Flow, specifically focused concentration, absorption, and temporal dissociation (Csikszentmihalyi, 1990). |
| Novelty (NO) | Users' level of interest in the task and curiosity evoked by the system and its contents. |
| Perceived Usability (PUs) | Users' affective (e.g., frustration) and cognitive (e.g., effort) responses to the system. |

*Figure 5. Factors of Engagement and their Definitions of UES (O'Brien & Toms, 2013)*

## Expected results

This research aims to develop MR applications with varying degrees of functionality and innovation. The purpose is to improve enjoyment and engagement in modern Industry work by addressing issues such as repetitiveness, long idle times, poor stimulation, and lack of meaning. The anticipated results include improved worker morale, increased productivity, and enhanced engagement at both individual and industry levels. Additionally, the research aims to expand beyond industrial interfaces by introducing more dynamic and interactive elements.

## Acknowledgements

Project funded under the National Recovery and Resilience Plan (NRRP), Mission 4 Component 2 Investment 1.3 - Call for tender No. 341 of 15/03/2022 of Italian Ministry of University and Research funded by the European Union – NextGenerationEU. Award Number: PE00000004, Concession Decree No. 1551 of 11/10/2022 adopted by the Italian Ministry of University and Research, CUP D93C22000920001, MICS (Made in Italy – Circular and Sustainable).

We thank Genesys Software Srl for providing feedback, contacts and support for research.

# References


1. Bier, L., Emele, M., Gut, K., Kulenovic, J., Rzany, D., Peter, M., & Abendroth, B. (2019, October 29). Preventing the risks of monotony related fatigue while driving through gamification. European Transport Research Review, 11(1). https://doi.org/10.1186/s12544-019-0382-4 [Accessed 27 February 2024]
2. Brooke, J.B. (1996). SUS: A 'Quick and Dirty' Usability Scale. [Accessed 27 February 2024]
3. Chung-Fat-Yim, A., Calvo, N., & Grundy, J. G. (2022, June 3). The Multifaceted Nature of Bilingualism and Attention. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.910382 [Accessed 27 February 2024]
4. Deci, E. L., & Ryan, R. M. (2000, October). The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. Psychological Inquiry, 11(4), 227–268. https://doi.org/10.1207/s15327965pli1104_01 [Accessed 27 February 2024]
5. Filtness, A., & Naweed, A. (2017, April). Causes, consequences and countermeasures to driver fatigue in the rail industry: The train driver perspective. Applied Ergonomics, 60, 12–21. https://doi.org/10.1016/j.apergo.2016.10.009 [Accessed 27 February 2024]
6. Formati, F., Laudante, E., & Buono, M. (2021). Human-Centered-Design for Definition of New Collaborative Scenarios. Advances in Human Dynamics for the Development of Contemporary Societies, 78–85. https://doi.org/10.1007/978-3-030-80415-2_10 [Accessed 27 February 2024]
7. Habler, F., Schwind, V., & Henze, N. (2019, September 8). Effects of Smart Virtual Assistants' Gender and Language. Proceedings of Mensch Und Computer 2019. https://doi.org/10.1145/3340764.3344441 [Accessed 27 February 2024]
8. Harju, L., Hakanen, J. J., & Schaufeli, W. B. (2014). Job Boredom and Its Correlates in 87 Finnish Organizations. Journal of Occupational and Environmental Medicine, 56(9), 911–918. https://www.jstor.org/stable/48500475 [Accessed 27 February 2024]
9. Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research. Advances in Psychology, 139–183. https://doi.org/10.1016/s0166-4115(08)62386-9 [Accessed 27 February 2024]
10. Kawada, M., Shimazu, A., Tokita, M., Miyanaka, D., & Schaufeli, W. B. (2022, January). Validation of the Japanese version of the Dutch Boredom Scale. Journal of Occupational Health, 64(1). https://doi.org/10.1002/1348-9585.12354 [Accessed 27 February 2024]
11. Krauzlis, R. J., Wang, L., Yu, G., & Katz, L. N. (2021, June 24). What is attention? WIREs Cognitive Science, 14(1). https://doi.org/10.1002/wcs.1570 [Accessed 27 February 2024]
12. Loukidou, L., Loan Clarke, J., & Daniels, K. (2009, October 26). Boredom in the workplace: More than monotonous tasks. International Journal of Management Reviews, 11(4), 381–405. https://doi.org/10.1111/j.1468-2370.2009.00267.x [Accessed 27 February 2024]
13. O'Brien, H., & Cairns, P. (2015, July). An empirical evaluation of the User Engagement Scale (UES) in online news environments. Information Processing & Management, 51(4), 413–427. https://doi.org/10.1016/j.ipm.2015.03.003 [Accessed 27 February 2024]
14. O'Brien, H. L., & Toms, E. G. (2013, September). Examining the generalizability of the User Engagement Scale (UES) in exploratory search. Information Processing & Management, 49(5), 1092–1107. https://doi.org/10.1016/j.ipm.2012.08.005 [Accessed 27 February 2024]
15. Pesty, S., & Duhaut, D. (2011, December). Artificial companion: Building a impacting relation. 2011 IEEE International Conference on Robotics and Biomimetics. https://doi.org/10.1109/robio.2011.6181746 [Accessed 27 February 2024]
16. Ponis, S., Plakas, G., Agalianos, K., Aretoulaki, E., Gayialis, S., & Andrianopoulos, A.

(2020). Augmented Reality and Gamification to Increase Productivity and Job Satisfaction in the Warehouse of the Future. Procedia Manufacturing, 51, 1621–1628. https://doi.org/10.1016/j.promfg.2020.10.226 [Accessed 27 February 2024]
17. Reijseger, G., Schaufeli, W. B., Peeters, M. C. W., Taris, T. W., van Beek, I., & Ouweneel, E. (2013). Dutch Boredom Scale. PsycTESTS Dataset. https://doi.org/10.1037/t62656-000 [Accessed 27 February 2024]
18. Rickel, J., & Johnson, W. L. (1999, May). Animated agents for procedural training in virtual reality: Perception, cognition, and motor control. Applied Artificial Intelligence, 13(4–5), 343–382. https://doi.org/10.1080/088395199117315 [Accessed 27 February 2024]
19. Robb, J., Garner, T., Collins, K., & Nacke, L. E. (2017, February 1). The Impact of Health-Related User Interface Sounds on Player Experience. Simulation & Gaming, 48(3), 402–427. https://doi.org/10.1177/1046878116688236 [Accessed 27 February 2024]
20. Sanders, L. (2008, November). ON MODELINGAn evolving map of design practice and design research. Interactions, 15(6), 13–17. https://doi.org/10.1145/1409040.1409043 [Accessed 27 February 2024]
21. Schrepp, M., Hinderks, A., & Thomaschewski, J. (2017). Design and Evaluation of a Short Version of the User Experience Questionnaire (UEQ-S). International Journal of Interactive Multimedia and Artificial Intelligence, 4(6), 103. https://doi.org/10.9781/ijimai.2017.09.001 [Accessed 27 February 2024]
22. Vogel-Walcutt, J. J., Fiorella, L., Carper, T., & Schatz, S. (2011, October 13). The Definition, Assessment, and Mitigation of State Boredom Within Educational Settings: A Comprehensive Review. Educational Psychology Review, 24(1), 89–111. https://doi.org/10.1007/s10648-011-9182-7 [Accessed 27 February 2024]
23. Westgate, E. C., & Steidle, B. (2020, October 24). Lost by definition: Why boredom matters for psychology and society. Social and Personality Psychology Compass, 14(11). https://doi.org/10.1111/spc3.12562 [Accessed 27 February 2024]

# Design as a catalyst for sustainability – bridging disciplines in the anthropocene

*Dario Russo*
*dario.russo18@unipa.it*

*Università degli Studi di Palermo, Italy*

***Keywords:***
*Transdisciplinary design*
*Circular economy*
*Systemic innovation*
*Humanity-Centric design*

## Abstract

In the Anthropocene era, design emerges as a pivotal discipline with the power to bridge diverse fields and tackle pressing environmental challenges, heralding a shift from traditional practices towards a holistic, transformative approach. This paper explores design's evolution from a functional role to a broader societal and human experience, highlighting its potential to foster a circular economy and systemic innovation. By examining the contributions of key figures like Adriano Olivetti and Ezio Manzini, and through the lens of emerging paradigms such as service and systemic design, the study reveals design's capacity to integrate values, sustainability, and innovation, thereby reorienting focus towards comprehensive experiences over individual products. The discussion extends to the importance of a transdisciplinary approach, underscoring design's role in orchestrating synergies across technology, culture, and environmental sustainability. This approach not only addresses complex global challenges but also emphasizes human experience, aiming to create meaningful, enriching interactions that drive social, economic, and environmental innovations. Ultimately, the paper advocates for a reconceptualization of design as a crucial agent in humanizing technology and fostering a sustainable, harmonious future, thereby establishing a new paradigm where design, technology, and sustainability are inseparably intertwined.

## Introduction

In the Anthropocene era, design takes on a pivotal role, acting as an interdisciplinary bridge among various fields and responding to the growing environmental challenges. This paper aims to investigate how design, as a hinge discipline, can influence and coordinate other disciplines to address complexity and promote a circular economy. Through examining seminal figures such as Adriano Olivetti and Ezio Manzini and referencing holistic visions of culture, we trace the evolution of design from a mere practical function to a broader human and social experience. The emerging paradigms of service design and systemic design will also be explored, revealing how the integration of these practices can strengthen our response to the ecological crisis and reorient the focus from individual products to an overall experience that encapsulates values, sustainability, and innovation. In this context, the article aims to outline a new vision for design, not merely

as a sectoral activity but as a holistic and transformative approach that can significantly contribute to the shaping of a more sustainable and humanly enriching future. From overcoming the dichotomy between humanistic and scientific culture to adopting a transdisciplinary approach, the paper seeks to rediscover design as a tool for systemic innovation, capable of humanizing technology and contributing to the establishment of a new planetary humanism.

## Design: a pivotal discipline

The modern world is marked by increasing complexity, where the challenges we face do not fit within the traditional boundaries of individual disciplines. Design emerges as a pivotal discipline, capable of uniting and interpreting different languages and methodologies to create integrated solutions and respond to complex needs. In its mediating role, design is not limited to purely aesthetic or functional areas but becomes a key player in orchestrating synergies across sectors such as technology, architecture, psychology, and the behavioral sciences. It is a discipline of coordination, capable of integrating and enhancing diverse contributions, converging aesthetics with functionality, technological innovation with cultural tradition, and economic efficiency with environmental sustainability. It is no longer sufficient for design to meet the requirements of form and function; it must also lead towards a more sustainable and equitable future that considers the biogeochemical cycles of our planet and the social systems that inhabit it.

Ezio Manzini, a leading figure in international design, redefines the role of the designer as a «facilitator» who harmonizes multidisciplinary skills, which is essential in an era where design is increasingly participatory: Design. When Everybody Designs (2015). Naturally, emphasizing the importance of a collaborative approach, Manzini encourages designers to transcend the role of mere mediators of processes and to take a proactive stance in defining and solving problems. While facilitating dialogue and cooperation, designers must bring their technical skills and aesthetic sensitivity, as well as a deep understanding of social contexts to transform needs and aspirations into concrete solutions (Manzini, 2015, p. 49). In doing so, the designer asserts themselves as an innovator who integrates individual and collective knowledge, steering complex projects toward innovative, inclusive, and transformative outcomes, generating a tangible social impact.

Adriano Olivetti provides another historical example of how design can function as a pivotal discipline. His vision of industry was not confined to the production of quality objects but included a broader concept of quality of life, integrating work ethics, social responsibility, and community well-being. This holistic approach allowed Olivetti not only to create innovative products but also to foster a corporate culture that valued beauty, art, and humanism. In Olivetti's work, we see "il tentativo di connettere I progressi della tecnologia di allora con la storia della cultura e la scrittura (l'epigrafia, la Stele di Rosetta, i geroglifici...) [...] Il tentativo di fornire un'interpretazione estetica della tecnologia" (Vinti, 2021, p. 71). An emblematic example of how Olivetti applied these principles to the design of technological products is the ELEA 9003, the first commercial transistor computer (ELaboratore Elettronico Aritmetico), developed between 1957 and 1959. It not only represents a formidable technological innovation but also evokes the Eleatic School, founded by Parmenides in the 5th century BC, emphasizing a deep bond between technical progress and philosophical heritage. The design

of ELEA 9003, therefore, can be understood as a physical expression of the integration between technology and cultural legacy.

In this regard, design emerges as a "sovereign technique (basiliké téchne)" in service of humanity, a Platonic expression that describes wise governance as the art of coordinating different functions within the polis (Plato, 304 e). As Umberto Galimberti suggests, for Plato, politics is not merely the exercise of power but the ability to weave together various skills and knowledge for the collective well-being (see Galimberti, 2020, p. 217). Sovereign technique is directing technique. Similarly, modern design transcends the creation of objects, spaces, or interactions, taking on the responsibility to integrate these endeavors within a larger and interconnected system. Following Plato's model of "sovereign technique", modern design becomes a form of "practical politics", where the designer acts as a conductor harmonizing a wide variety of elements and skills towards a unifying and coherent goal. The designer's task, then, is to mediate between technological innovation and human values, between economic efficiency and environmental sustainability, to create a symphony of elements that together promote a sustainable future in harmony with the needs of society. With this perspective, the designer reaffirms themselves as the keeper of balance and promoter of a holistic vision, considering each project not as an end in itself but as an integral part of a complex ecosystem. This is the challenge and opportunity of contemporary design: to be simultaneously technique and art, science and vision, guiding humanity towards a shared and responsible future.

In this context, Manzini's reflections, which in one of his latest works outline design as:

> *una sequenza di azioni che influenzano i sistemi sociotecnici (e quindi anche economici, politici e culturali) in cui si opera e con cui si entra in relazione: delle azioni sul mondo, attinenti alla vita di tutti i giorni, fatte operando dove si è. (Manzini, 2018, p. 114)*

Regarding policies for design, *Le politiche per il design* e il design per le politiche by Marzia Mortati, Beatrice Villari, Stefano Maffei and Venanzio Arquilla delves into the role of design as a strategic lever for innovation in Europe, highlighting the importance of evaluating design policies to support economic growth and programming efficiency (Mortati, Villari, Maffei and Arquilla, 2016). These works are part of the broader context of design as an institutional political practice, where the focus is on integrating design into existing political structures to promote innovation. Design for Policy by Christian Bason (2014) represents a fundamental contribution in this direction, exploring how design can innovate public policies through collaborative approaches, emphasizing the importance of design thinking in the policy-making process. Bason positions design as a strategic tool for policy improvement and innovation, highlighting how design can significantly contribute to the formulation and implementation of more effective and citizen-oriented policies. On the other hand, Design as Politics by Tony Fry (2010) and The Politics of Design by Ruben Pater (2016) present different angles – the first with a theoretical-academic approach, and the second with a practical-project-oriented approach – focusing on how design can serve as a form of activism and social critique. These authors explore the collaboration between design and innovation in public policies from a perspective that emphasizes the potential of design to contribute to socio-economic progress through collaborative approaches, but with a critical emphasis on the political and social implications of design, thus moving away from the more institutionalized approach1.

## From product design to product-service-system design

In the era of sustainability, design takes a new direction, moving from the tangible boundaries of the product to the experiential realms of service. This shift, triggered by the need to respond to urgent environmental challenges, is rooted in an understanding of the complexity and biogeochemical cycles that govern life on Earth (Butera, 2021). The approach of service design, evolved from the pioneering works of the late last century that already envisioned low material density product-services with high social participation (Manzini, 1997), assumes a human-centric dimension as theorized by Donald Norman, aiming to create an experience that goes beyond mere practical function and thus the technical efficiency of the product (user-centered design) to touch the emotional dimension and personal values (human-centered design) (Norman, 2013). Service design goes beyond the traditional conception of product design to focus on the configuration of experiences, as well pointed out by Stigliani and Fayard (2010). A significant example is IO, a free public services app that aims to revolutionize the relationship between citizens and Italian institutions by adopting an approach centered on people's needs. IO, awarded in 2022 with the prestigious Compasso d'Oro, historically associated with the design of physical products, offers everyone a single platform to access public administration services (https://www.adi-design.org/un-app-per-cittadini-e-istituzioni.html).

Indeed, service design is not limited to the digital realm but remains connected to the tangible world insofar as it implements a precise organization of interaction phases, with both physical and digital artefacts, defined as "touchpoints". The aim is to create a flow of engaging and memorable experiences for people. This approach ensures that the service design encompasses all aspects of the user's interaction with the service, from the physical environment and objects they encounter to the digital interfaces they use. The focus is on crafting a holistic experience that resonates on multiple levels, including the emotional and the practical, ensuring a seamless integration of the physical and digital aspects of the service.

In this context, product and service are not antithetical terms but components of a holistic strategy that also includes the communicative event, as indicated in the Prosev Strategy by Carlo Vannicola: the synthesis of product (Pro-), service (-se-), and event (-ev) into a cohesive and meaningful narrative (2017). An immediately clarifying example, suggested by Vannicola himself, is the activity of a small winery that combines the wine product with a range of services, from offering home cooking to managing sommelier courses, and organizes events, such as cyclical tastings of local products or opening its cellar to the public, becoming "il terminale di un sistema territoriale che diffonde la propria cultura in un mercato 'conosciuto' de-globalizzato" (Vannicola, 2017, p. 22). In short, design is no longer just a matter of form and function but a complex and reflective practice that intersects different disciplines, from psychology to environmental sciences, to design solutions that are engaging, ethical, and sustainable.

But there is more. Today, discussing design inevitably entails addressing its systemic dimension and its integration with the circular economy. Systemic design forms a set of optimal connections for sustainable and regenerative functioning, much like in nature, where every output becomes a new input. System, service, circular economy, as emphasized by the authors of the Torino Innovation Lab, are fundamental prerequisites

for sustainability (environmental, social, and economic) and essential ingredients of innovation: "Il design è innovazione sistemica" (Design is Systemic Innovation) (2022). Therefore, design today is increasingly a system-product-service design, a holistic dimension that tends to spread both in design practice and in university education, as demonstrated by the presence of a Master's Degree Course in Product Service System Design – Design for the System Product Service (PSS) at Politecnico di Milano. As clarified by Carlo Vezzoli, an eco-efficient PSS resolves into

*an integrated mix of products and services that are together able to fulfill a particular customer demand (to deliver a 'unit of satisfaction') based on innovative interactions between the stakeholders of the value production system (satisfaction system), where the economic and competitive interest of the providers continuously seeks environmentally beneficial new solutions. (Vezzoli, 2024, p. 50)*

This shift in design to embrace the entire ecosystem, including living beings and the entire environment, characterizes the latest work by Donald Norman on Design for a Better World (2023). This means transitioning from human-oriented design, as we have mentioned earlier, to humanity-oriented design, giving the term "Humanity" the widest possible semantic extension. More precisely: "Designers must still follow the design principles of human-centered design, but now within the broader scope of the entire globe: all living things; the quality of the land, water, and air; the loss of species; the changes in climate" (Norman, 2023, p. 188). But we will return to this topic at the end of the paper.

## Transdisciplinary approach

But at this point, let's ask ourselves: is design multidisciplinary, interdisciplinary, or transdisciplinary? In fact, these three terms, although often used interchangeably, are far from coincident. The prefixes that distinguish them leave no doubt: multi- indicates coexistence; inter- implies placement (between); and trans- indicates passage, crossing, something more dynamic, oriented toward synthetic transformation. As Bernard C. K. Choi and Anita W. P. Pak emphasize:

*Multidisciplinarity draws on knowledge from different disciplines but stays within their boundaries. Interdisciplinarity analyzes, synthesizes, and harmonizes links between disciplines into a coordinated and coherent whole. Transdisciplinarity integrates the natural, social and health sciences in a humanities context, and transcends their traditional boundaries. (Choi, Pak, 2003)*

That's why, as the design process becomes more complex, it leads to more significant results by ascending to the transdisciplinary dimension. Let's be clear, delving into a subject by tempering different perspectives, embracing ever-wider horizons, incorporating methods, techniques, and tools from other disciplines into one's knowledge base, in short, hybridizing the established knowledge of one discipline by contaminating it with others, is inherently fruitful, if only to expand human knowledge. But there's more to it. It's also a matter of flavor. When a talent from one discipline interacts with a talent from another discipline, unpredictable and inevitably fruitful synapses are created. When talents multiply, characterizing a particular place at a specific time, individual talent is destined to expand significantly, increasing the overall creative potential. This gives rise to a kind of creative resonance that leaves a mark in history, as it happened in Athens in the 5th century BC, the era of Pericles2, or in Florence during the Renaissance3, or

even in Vienna during the Belle Époque4.

Let's return to design: multidisciplinary, interdisciplinary, or transdisciplinary? It is multidisciplinary when it draws on knowledge and approaches from various disciplines to solve specific design problems. Similarly, design can be interdisciplinary when there is very close integration of the involved disciplines. In an interdisciplinary context, different disciplines work together more synergistically, aiming for common understanding with a unified approach to solving design problems. Nonetheless, design can aspire to become transdisciplinary when it goes beyond the mere integration of existing disciplines by developing new ways of thinking and addressing problems. Transdisciplinarity involves crossing approaches from very different disciplines to address complex and global challenges. The system-service-product design, as mentioned earlier, emerges as a key approach in this perspective. It involves the integration of specific skills into the design, going beyond product design and considering the entire system of services and products. The system-service- product designer, unlike a narrow specialization, must extend their field of intervention to other skills and disciplinary areas, creating synergies among them. This holistic, interdisciplinary, and transdisciplinary approach is essential for addressing complex and global challenges. Similarly, design moves away from linear solutions and embraces a holistic and interconnected perspective. Its ability to collaborate with other disciplines is one of its main strengths in solving complex and global problems.

In the world of design, the transdisciplinary approach can be described using the metaphor of letters to depict it. The "T" represents this concept, where the vertical segment symbolizes the specific expertise of a designer, such as font design or user experience (UX) / user interface (UI) design. The horizontal segment represents the designer's ability to extend their scope to other skills and disciplines. A designer with a broader horizontal segment is capable of effectively collaborating with diverse professionals, facilitating dialogue and fruitful exchange. "Da osservare – as Francesco Zurlo points – che in qualche modo è proprio quest'ultima dimensione orizzontale che ha consentito al design di assumere un ruolo di rilievo nel dibattito sulla strategia" (Zurlo, 2012, p. 110). This multidisciplinary approach evolves towards transdisciplinarity when the designer integrates various skills and transcends the boundaries of established disciplines. On the contrary, the "I" represents the monodisciplinary designer, solely focused on one expertise, without significant expansion into other areas. However specialized, he is destined to be a "lone star" (Collins and Hansen, 2021, p. 32), resistant to interdisciplinary connections. The "X" indicates the designer with interconnected skills in various disciplines, represented by the intersection of lines. Therefore, they can converge the design team towards a common goal, working holistically and interdisciplinarily. Lastly, the "Pi Greco" represents the designer with two specific skills, clearly correlated, integrated into a new transdisciplinary approach. This hybridization process leads to the creation of new design methods and represents an evolution of the "T", adding a second vertical stroke symbolizing the new transdisciplinary expertise. Thus, design evolves, configuring new letters with multiple vertical segments that implement horizontal aggregations, developing innovative approaches to projects and communication methods (Chung, 2022).

Continuing to segment design into specializations (product, interior, communication, fashion, etc.) is limiting considering its transdisciplinary nature. Because, as you have seen, design is a holistic process that extends

far beyond the materiality of the product, becoming an experience and a strategy. Vignelli's philosophy reminds us that "Design is One" (2012, p. 22), a single field that expresses itself through a thousand forms (Ars una species mille, as the Latins used to say), where the culture of design is not divided into humanistic and scientific, but unifies in the method (Munari, 1981). Munari and Moholy-Nagy have taught us that design does not reside in a specific sector but in the systemic approach and the design attitude that addresses the complexity of the world (Moholy-Nagy, 1947, p. 42), aiming for sustainable and inclusive innovation.

## Experience and transdisciplinarity – from Gastrophysics to Geopolitics

In today's design landscape, experience asserts itself as a fundamental principle. Understood as the designed and perceived life experience of an individual, it becomes a crucial criterion for evaluating design. Indeed, the validity of a project is measured not only through its tangible results but also, and most importantly, in the impact it has on the lives of its intended users. Therefore, design, aiming to improve the quality of everyday life, resolves into the project of experiences that are not only functional but also enriching, meaningful, and capable of conveying values and stimulating social, economic, and environmental innovations. By focusing more on the experience (person) than the product, the potential of design to evolve into an essential tool for addressing and solving complex problems is revealed. This process requires a synergistic orchestration of diverse disciplines, working together to pose relevant questions and develop effective solutions. In this perspective, the reflections of John Dewey, the famous American philosopher, assume particular significance. With his essay Democracy and Education (1916) and the subsequent work Art as Experience (1934), he placed experience at the heart of aesthetic and educational discourse. His philosophy permeated the Bauhaus of Weimar, inspiring what would become the leitmotif of the most influential design school of the first half of the 20th century: "Learning by Doing". This approach places direct experience at the center of learning and designing, emphasizing that knowledge deepens and enriches more through continuous practice and experimentation. His words remain an inexhaustible source for us: "The work takes place when a human being cooperates with the product so that the outcome is an experience that is enjoyed because of its liberating and ordered properties" (Dewey, 1934/1980, p. 214).

In reference to the concept of experience, it is interesting to explore the emerging field of gastrophysics, as outlined by Charles Spence in his brilliant essay *Gastrophysics: The New Science of Eating* (2017). This is a terrain where gastronomy and psychophysics converge. According to Spence, the taste of a dish is not simply the result of its physical components but rather the outcome of a complex series of influences operating at sensory and conceptual levels. In this context, food transcends its nourishing function to become a medium through which a meaningful experience can be designed, enriched by stimuli that involve sight, smell, hearing, touch, and taste, as well as numerous other psychological aspects. Similarly, service design relates to product design as gastrophysics does to food: it's not so much about satisfying a nutritional need as it is about making the gastronomic experience memorable. Success is achieved through a systemic approach, aiming for innovation5.

The parallelism between design and gastrophysics proves particularly fruitful when considering their transdisciplinary nature: gastrophysics exemplifies how the fusion of different disciplines

– in this case, gastronomy, psychology, and physics – can create new modes of understanding and appreciating food. Furthermore, as Spence highlights, gastrophysics reaches its full potential when it collaborates with design, technology, and behavioral sciences, thus offering a model of how transdisciplinary collaboration can amplify innovation and human experience.

The adoption of a transdisciplinary approach, which skillfully intertwines multiple disciplines to explore new ways of working and interpreting the world, is at the heart of the renewed interest in geopolitics. Publications like Limes, led by Lucio Caracciolo, and Domino, under the direction of Dario Fabbri, exemplify this success. Fabbri introduced the concept of Geopolitica umana (2023), an expression that highlights the importance of the "Il fattore umano" and revitalizes traditional geopolitics, often criticized for its determinism, by intertwining geography, history, politics, economics, psychology, philosophy, and literature (Limes, 2019). This renewal demonstrates that, although geopolitics may be more ideology than an actual science, its transformation into an increasingly intricate and nuanced field of study allows for deep and complex analyses. The integration of both scientific and humanistic disciplines reveals that, despite the individual elements being familiar, it is in their transdisciplinary combination that the true added value lies. For, as we well know, the whole is greater than the sum of its parts.

## Humaizing technique

Reflecting upon the substance of design, one ponders: What is the essence of a designer's activity? Stripping the concept of complex definitions, a simple truth emerges – design is the humanization of technique. Born with the Industrial Revolution, its aim was to shape new industrial products, not only functionally but also meaningfully. There was a need to give a soul to the industry, infusing art into mechanical products (Art Industries). In the 19th century, the concept of "applied art" defined what we today recognize as design: art applied to industry, to the practical function of a product. This tension between function and form persists to our present day, as evident in the title of the catalog for the 4th edition of the Triennale Design Museum in Milan: *Le fabbriche dei sogni* – Dream Factories (Alessi, 2011).

Let's quickly examine some historical examples, tracing key milestones. In the early 20th century, Hermann Muthesius, founder of the Werkbund, spoke of the "stile tedesco" (Vitta, 2001, p. 146). Later, Walter Gropius revitalized the Bauhaus by declaring: "Arte e tecnica – una nuova unità!" (Gropius, 1923, p. 137). In the early 1960s, Gillo Dorfles identified the "esteticità" as a fundamental condition of design (Dorfles, 1972, p. 10). This concept was reiterated by the philosopher Fulvio Carmagnola, who discussed on "'impura', ovvero capace di scendere dalle regioni alte della bellezza fino al contatto con le merci e le manifestazioni mediali del nostro mondo" (Carmagnola, 2001, p. 8). Designed goods, thus, develop an imaginary or symbolic component insofar as this "è diventata una parte strutturale del loro valore economico" (Carmagnola, 2006, p. 6). A process of "ipersignificazione che le merci hanno conquistato grazie all'inserimento al loro interno di una nuova qualità energetica, che ha saputo trasformarle in entità dotate di forte attrattività", according to Ernesto Francalanci (2006, p. 34). The history of design is Il progetto della bellezza, as Maurizio Vitta states: "La bellezza è tornata ad essere l'orizzonte delle cose" (Vitta, 2001, p. 320). A beauty that is not an end in itself but is equivalent to making products and services expressions of culture, or in other words, to humanizing technique.

In this regard, the words of Ettore Sottsass are iconic:

*Per me fare design non significa dare una forma a un prodotto più o meno stupido per un'industria più o meno sofisticata. Per me il design è un modo di discutere la vita, la socialità, la politica, il cibo e perfino il design. (quoted in Radice, 1984, p. 187)*

Morover: design has always existed, since the time when «significava incidere sulle frecce segni magici o simboli e così via; o anche dare una forma speciale alle frecce» (Sottsass, 2019, p. 69).

In response to the challenges of our times – which encompass both environmental issues, particularly the reduction of CO2 emissions and the preservation of biodiversity, and the need to humanize the ecological transition or "forking" (Butera, 2023, pp. 113-114) – design emerges as a crucial discipline. Humanizing the ecological transition means, once again, infusing humanity into technique, designing configurations, devices, interfaces, systems, strategies, services... that incorporate shared values, embraced not as obscure impositions but as individual aspirations within the framework of collective cultural advancement. In this context, design, with its procedural nature and transdisciplinary approach, considering hard sciences and humanities as inseparable parts of the same culture (Bucciantini, 2023), fully responds to the call of Mauro Ceruti and Francesco Bellusci in Umanizzare la modernità: un modo nuovo di pensare il futuro (2023). This means recovering humanism in a planetary dimension, rekindling anticipatory imagination and long-term visions, and redefining the ideas of progress and future "per proporre vie di uscita dalla crisi della modernità che la crisi di quelle idee ha generato" (Ceruti and Bellusci, 2023, p. 16). It also means, as Stephen Toulmin suggests, "recuperare la saggezza a misura d'uomo del Rinascimento, senza perdere di conseguenza i vantaggi guadagnati durante trecento anni in cui la vita intellettuale è stata dominata dalla filosofia cartesiana e dalle scienze esatte" (Toulmin, 2022, p. 228). It means embracing an «ecologia integrale», as enunciated by Pope Francesco (quoted in Oreskes, 2024, p. IX), recognizing that "la relazione precede l'esistenza" (Ceruti and Bellusci, 2023, p. 86), insofar as every entity (physical, chemical, biological, human, social, ecological...) coexists before it exists. And in the design of the relationship – or interaction – design is called upon to make a significant contribution.

## Conclusions

At the conclusion of our discussion, it becomes evident that design, in its role as a pivotal discipline, represents a valuable resource in addressing the environmental and social challenges of our time. This consideration leads us to view design not merely as the creation of objects with aesthetic functions, but as a transformative and integrated field of action, where technique, humanism, and sustainability converge. Thus, design today tends to transcend its original function, assuming a key role in orchestrating synergies between technology, culture, and the environment. The figures of Ezio Manzini and Adriano Olivetti remind us of the importance of converging ethics, aesthetics, and functionality, shifting the focus from the individual product to interaction with the entire ecosystem. This systemic approach, evident in the evolution towards system-product-service design, reflects a fundamental change in the way we conceive of and interact with our environment.

The adoption of a transdisciplinary approach is at the heart of the change in the world of design. Integrating knowledge and skills from diverse disciplinary fields has become essential to navigate the complexity of our current context. This transdisciplinary methodology allows for crossing the traditional boundaries of design, paving the way for solutions that are as innovative as they are sustainable. In this way, the interconnection of social, environmental, and economic systems is valued, giving life to a rich and dynamic design result, ready to respond agilely to the pressing needs of the present.

The emphasis on human experience further underscores this evolution. We are no longer limited to meeting functional needs but aim to shape meaningful experiences capable of stimulating social, economic, and environmental innovations. This shift in focus from the object to the experience allows us to explore new ways of interacting with the world, integrating concepts from fields such as gastrophysics and geopolitics.

The humanization of technology through design proves to be an indispensable piece, serving as a bridge between innovation and fundamental human values. This process not only makes technology more usable and ethical but also aligns it with our values, emphasizing a commitment to environmental respect and sustainability. Consequently, design transforms into a catalyst for a future where technology, humanity, and nature do not merely overlap as distinct entities, but intertwine harmoniously, together composing an integrated and coherent result.

In conclusion, we underscore the invitation to rethink the role of design in our world – a fundamental discipline that contributes to improving daily life towards a sustainable and harmonious future, integrating knowledge and skills from a wide variety of fields. This transformative approach not only responds to the immediate challenges of our time but also lays the foundation for a future in which design, technology, and sustainability merge into a holistic and innovative paradigm.

## Notes

**1** Carl DiSalvo, in his work Design, Democracy, and Agonistic Pluralism, presented at the DRS International Conference 2010, offers a fundamental distinction between "political design", which deals with individual approaches and activism and "design for politics", which focuses on how design can be integrated into institutional political practices. This distinction allows us to appreciate the diversity of approaches in the field of political design and policy design, highlighting how design can variously influence and contribute to the political and social context. In line with Fry's critical observations, it is crucial to recognize that his view challenges widely accepted concepts such as "sustainability" and "progress", reflecting an anti-progressivist stance that he shares with thinkers like Cameron Tonkinwise. Therefore, in discussing their work, it is essential to avoid attributing to them a vision not consistent with their critical thinking, especially in relation to innovation and progress in design.

**2** Anaxagoras, Gorgias, Protagoras, Parmenides, Zeno, Melissus, Democritus, Archelaus, Socrates, Plato, Hippias, Prodicus, Isocrates, and Antiphon, among the philosophers; Aeschylus, Sophocles, and Euripides, among the tragedians; Aristophanes, among the playwrights; Hippocrates, among the physicians; Myron, Phidias, Praxiteles, Zeuxis, Ictinus, Hippodamus, Callicrates, Mnesicles, Alcamenes, Ctesilaus, and Polyclitus, among the artists; Herodotus, Thucydides, and Xenophon, among the historians; Hyperides, Thrasymachus, and Lysias, among the orators.

**3** Brunelleschi, Leon Battista Alberti, Masaccio, Fra Angelico, Paolo Uccello, Piero della Francesca, Filippo Lippi, Andrea del Castagno, Domenico Veneziano, Francesco Squarcione, Andrea Mantegna, Michelangelo, Raphael, Botticelli, Perugino, Domenico Ghirlandaio, Donatello, Luca della Robbia, and, of course, the immense Leonardo da Vinci (the quintessential genius).

**4** Gustav Mahler, Arnold Schoenberg, Alban Berg, and Anton von Webern (music); Alfred Roller, Gustav Klimt, Carl Moll, Egon Schiele, and Oskar Kokoschka (painting); Sigmund Freud, Carl Gustav Jung, and Alfred Adler (psychoanalysis); Karl Kraus, Arthur Schnitzler, Robert Musil, and Joseph Roth (literature); Otto Wagner, Joseph Maria Olbrich, Josef Hoffmann, Koloman Moser, and Adolf Loos (architecture).

# References


1. Germann, F., Ebbes, P., & Grewal, R. (2015). The chief marketing officer matters! Journal of Marketing, 79(3), 1-22.
2. Alessi, A. (2011), Le fabbriche dei sogni. Uomini, idee, imprese e paradossi delle fabbriche del design italiano = Dream Factories. People, Ideas and Paradoxes of Italian Design, Milano: Electa – La Triennale di Milano Design Museum.
3. Bason, C. (2014), Design for Policy, London: Gower Ashgate.
4. Bucciantini, M. (2023), Siamo tutti galileiani, Torino: Einaudi.
5. Butera, F. (2023), Sole Vento Acqua. Italia a emissioni zero nel 2050, Roma: Manifestolibri.
6. Butera, F. (2021), Affrontare la complessità. Per governare la transizione ecologica, Milano: Edizioni Ambiente.
7. Carmagnola, F. (2006), Il consumo delle immagini. Estetica e beni simbolici nella fiction economy, Milano: Mondadori.
8. Carmagnola, F. (2001), Vezzi insulsi e frammenti di storia universale. Tendenze estetiche nell'economia del simbolico, Roma: Sossella.
9. Ceruti, M. and Bellusci (2023), Umanizzare la modernità. Un modo nuovo di pensare il futuro, Milano: Cortina.
10. Choi, B. C. K. and Pak, A. W. P. (2006), Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness [Online] Available at: https://pubmed.ncbi.nlm.nih.gov/17330451/#affiliation-1 [Accessed 7 February 2024].
11. Collins, J. and Hansen, Morten T. (2021), Great by Choice. Uncertainty, Chaos and Luck – Despite Them All, New York: HarperCollins.
12. Chung, K. (2022), I, X, and T-Shaped Designers: What's the Difference? [Online] Available at: https://www.uxbeginner.com/i-x-and-t-shaped-designers/ [Accessed 7 February 2024].
13. Dewey, J. (1934/1980), Art as Experience, New York: Perige Books.
14. Dewey, J. (1916/2015), Democracy and Education. An Introduction to the Philosophy of Education, Edinburgh: Bibliotech Press.
15. DiSalvo, C. (2010), Design, Democracy, and Agonistic Pluralism, Available at: www.mckinsey.com/industries/capital-projects-and- infrastructure/our-insights/imagining-constructions-digital-future [Accessed 7 February 2024].
16. Dorfles, G. (1972), Introduzione al disegno industriale, Torino: Einaudi.
17. Gropius, W. (1924), "Breviario per i membri del Bauhaus (abbozzo)", in Wingler, H. M. (trad. 1972) (ed.), Il Bauhaus. Weimar Dessau Berlino 1919-1933, Milano: Feltrinelli, p. 137.
18. Francalanci, E. (2006), Estetica degli oggetti, Bologna: il Mulino.
19. Fry, T. (2010), Design as Politics, Oxford: Berg.
20. Gaiardo, A., Remondino, C., Stabellini, B., Tamborrini, P., (2022), Il design è innovazione. Metodi e strumenti per gestire in modo sostenibile la complessità contemporanea: il caso Torino, Siracusa: LetteraVentidue.
21. Galimberti, U. (2020), I miti del nostro tempo, Milano: Feltrinelli.
22. Fabbri, D. (2023), Geopolitica umana. Capire il mondo dalle civiltà antiche alle potenze odierne, Milano: Gribaudo.
23. Limes – Rivista italiana di geopolitica, 9, 2019 ("Il fattore umano").
24. Manzini E. (2018), Politiche del quotidiano, Roma: Edizioni di Comunità.
25. Manzini E. (2015), Design. When everybody designs. An Introduction to Design for Social Innovation, Cambridge (MA) – London: The MIT Press.

26. Moholy-Nagy, L. (1947), Vision in Motion, Chicago: Theobald.
27. Mortati, M., Villari, B., Maffei, S. and Arquilla, V. (2016), Le politiche per il design e il design per le politiche, Rimini: Maggioli.
28. Munari, B. (1981/2010), Da cosa nasce cosa. Appunti per una metodologia progettuale, Roma-Bari: Laterza.
29. Norman, D. (2023), Design for a Better World. Meaningful, Sustainable, Humanity Centered, Cambridge (MA) – London: The MIT Press.
30. Norman, D. (2013), The Design of Everyday Things. Revised and Expanded Edition, New York – London: The MIT Press – Basic Books.
31. Oreskes, N. (2024), "L'ecologia integrale di cui abbiamo bisogno", in Il Sole 24 Ore – Domenica, newspaper, 21 January, p. IX.
32. Pater, R. (2016), The Politics of Design. A (Not So) Global Design Manual for Visual Communication, London: Laurence King.
33. Plato (1991), Tutti gli scritti, Milano: Rusconi.
34. Radice, B. (1984), Memphis. Ricerche, esperienze, risultati, fallimenti e successi del nuovo design, Milano: Electa.
35. Stigliani, I. and Fayard, A. (2010), Designing New Customer Experiences. A Study of Socio-material Practices in Services Design, London: Imperial College Business School.
36. Simon, H. A. (1969/1996), The Sciences of the Artificial, Cambridge (MA): The MIT Press.
37. Spence, C. (2017), Gastrophysics. The New Science of Eating, London: Penguin.
38. Sottsass, E. (2019), Molto difficile da dire, Milano: Adelphi.
39. Toulmin, S. (trad. 2022), Cosmopolis. La nascita, la crisi e il futuro della modernità, Milano: Mimesis.
40. Vannicola C. (2017), La Prosev Strategy. Il servizio del prodotto servizio evento, Firenze: Forma.
41. Vezzoli, C., Kohtala, C., and Srinivasan, A. (2017), Product-Service System Design for Sustainability, New York: Routledge.
42. Vignelli, M. (2010), The Vignelli Canon, London: Prestel Publishers.
43. Vinti, C. (2021), "Lo stile Olivetti", in Di Tondo and G., Peruccio P. P. (eds), Caleidoscopio Olivetti, Torino: Allemandi, pp. 67-71.
44. Vitta, M. (2001), Il progetto della bellezza. Il design fra arte e tecnica, 1851-2001, Torino: Einaudi.
45. Zurlo, F. (2012), Le strategie del design. Disegnare il valore oltre il prodotto, Milano:

# The environmental labels for sustainable communication design

*Francesca Scalisi, Dario Russo*
*francesca.scalisi@unipa.it, dario.russo18@unipa.it*

*Università degli Studi di Palermo, Italy*

***Keywords:***
*Communication design*
*Eco-labels*
*Greenwashing*
*Consumers*
*Sustainability*

## Abstract

Sustainability in communication design is a rapidly and continuously evolving field, with growing attention to eco-compatibility, the use of sustainable materials, and effective communication strategies to promote environmental awareness among users. To improve the commercialization of products-services and demonstrate a tangible commitment towards the now essential requirement of environmental sustainability, companies are adopting more ecological production processes and paying greater attention to the durability, repairability, and recyclability of products. The paper examines environmental labels as a tool for environmental communication, characterized by specific and transparent languages, as opposed to generalities and greenwashing. Such a strategy should characterize companies that clearly communicate their position on sustainability, distinguishing themselves in the market and reaching their users effectively.

## Introduction

According to the Brundtland Commission's definition, sustainable development is about ensuring "that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 15). Initially used to define more equitable dynamics of economic development, the term 'sustainability' has quickly become commonplace and has been progressively used to characterize not only the development model but also individual actions or situations where this model is applied and materializes (from sustainable production to sustainable market), including the use of recyclable and biodegradable materials, with the aim of limiting the use of fossil fuels, the consumption of non-renewable resources, and the production of waste. This definition has been repeatedly cited and expanded upon with new and specific nuances by numerous institutional documents of strategic guidance that have followed one another to the present day at an ever-increasing pace, starting with Agenda 21 (UN, 1992), the Climate-Energy Package 20-20-20 (European Commission, 2009), and the Sustainable Development Goals of the 2030 Agenda (UN – General Assembly, 2015), through the Action Plan entitled Closing the Loop (European Commission, 2015), the European Green Deal (European Commission, 2019), the Renovation Wave (European Commission, 2020a), the Circular Economy Action Plan (European Commission, 2020b),

and the Next Generation EU (European Commission, 2020c), reaching the New European Bauhaus (European Commission, 2021).

The current geological era has been termed the 'Anthropocene', a term with which Paul Crutzen and Eugene Stoermer (2000) emphasize the central role of human activity on the 'grave condition' of the Earth's ecosystem and the fact that such impacts will continue for long periods. Although the authors themselves consider it somewhat arbitrary to assign a date to the beginning of the Anthropocene, they place it in the second half of the 18th century, because it is during the last two centuries that "the global effects of human activities have become clearly noticeable, [and this date] coincides with James Watt's invention of the steam engine in 1784" (Crutzen & Stoermer, 2000, pp. 17-18). The authors argue:

> *"Without major catastrophes like an enormous volcanic eruption, an unexpected epidemic, a large-scale nuclear war, an asteroid impact, a new ice age, or continued plundering of Earth's resources by partially still primitive technology […] mankind will remain a major geological force for many millennia, maybe millions of years, to come, [so it is necessary] to develop a world-wide accepted strategy leading to sustainability of ecosystems against human induced stresses will be one of the great future tasks of mankind, requiring intensive research efforts and wise application of the knowledge thus acquired" (Crutzen & Stoermer, 2000, p. 18).*

However, despite the environmental impact of the entirety of human productive activities (the anthropic footprint on the ecosystem) being recognized long enough to characterize the geological era we are going through – the Anthropocene, indeed – it seems that designers have not really taken responsibility for the increasingly evident problem. Already in 1972 Papanek stated: "There are professions more harmful than industrial design, but only a very few of them" (Papanek, 1972, p. 18). From this point, the international debate on design has developed an increasingly marked sensitivity about the environmental issue until reasserting the ecological centrality of the project in the concept of ecodesign (Borthwick et al., 2022). However, it is appropriate to note that this term is tautological or at least hyperbolic because, as Paolo Tamborrini (2009, p. 7) insists, all design is, in a strict sense, ecological: there is no such thing as non-ecological design just as there cannot be non-ethical or non-functional design. An emblematic example of the maturity of this debate is the 'Broken Nature' exhibition, curated by Paola Antonelli at the XXII Triennale di Milano: Design has been a powerful tool of the Anthropocene, however it should be centred not only on humans, but on the future of the biosphere (Antonelli, 2019, pp. 19, 38). Thus, there is a progressive shift towards methodological approaches where the absolute centrality of man wanes (Badalucco, 2022), moving from Human-centred Design to Life-centred Design (Borthwick et al., 2022). In this perspective, the latest indication by Donald Norman towards a Humanity-cantered Design is to be understood, one that embraces "the entire globe: all living things; the quality of the land, water, and air; the loss of species; the changes in climate" (Norman, 2023, p. 188).

For this purpose, industrial and scientific research over the last two decades has begun to focus its attention on 'low-energy' products, their production method, and recycling possibilities: beyond technical and aesthetic characteristics, environmental aspects based on Life Cycle Assessment (LCA) are starting to gain importance already in the initial phase

of the decision-making process, thus optimizing the production processes of materials, the consumption of non-renewable resources, and the related impacts on the ecosystem and on humans (Campioli et al., 2018). From a business perspective, the next step is to identify communication tools to guide consumers towards products that pay special attention to environmental sustainability. Among the various tools available, environmental labels stand out for their potential to facilitate producer-consumer communication (Bengtsson, 2018), in providing accurate information about a product's impact on the environment throughout its entire life cycle (Fan et al., 2019), and in guiding consumer behavior towards more informed and environmentally respectful purchasing decisions (Marrucci et al., 2019).

In light of the mentioned cultural context, this article aims to contribute to the understanding of the state of the art in environmental communication and, in particular, regarding environmental labels, highlighting the risks of greenwashing and the need for accurate and verifiable environmental information, especially from the consumer's perspective, who represents the main driver for the green transition.

## 'Environmental communication' and greenwashing

The ISO 14063:2020 directive (p. V) defines environmental communication as "the process of sharing information to build trust, credibility and partnerships, to raise awareness, and to use in decision-making. The processes used and the content of environmental communication will vary with the objectives and circumstances of the organization and can be built on substantive information" (Figure 1). The relevance of a product's environmental communication is evidenced by a recent survey conducted by Rathee & Milfeld (2023), which reports that one in five goods produced is currently marketed as sustainable, and the growth of these products is about seven times greater than that of 'traditional' products (Crawford, 2020). Other research (Kong et al., 2021; Simpson & Radford, 2012; Xu et al., 2021) suggests that sustainability has become prevalent in product branding and advertising, taking on the role of strategic resource for a competitive advantage for companies that adopt it, given that over 85% of users worldwide indicate they are oriented towards purchasing more sustainable products. Therefore, it becomes strategic for companies to be able to effectively communicate the sustainability of their products or services to consumers (Yang et al., 2015).

As early as the 1990s, Carlson et al. (1993) systematically tackled the subject of environmental communication, until then on the side-lines of scientific debate, fostered by the growing environmental awareness and the desire of consumers to find sustainability information directly on products and their labels (Mayer et al., 1992). The response from companies was quick to follow: the use of terms like 'degradable', 'recycled', 'recyclable', 'eco', and 'sustainable' became a constant in product advertisements, sometimes accurately reflecting their real characteristics, other times exaggerating or even falsely claiming them, leading to the phenomenon of greenwashing. This occurs, precisely, when consumers are misled about the environmental practices of companies or the environmental benefits of a product or service.

Indeed, Carlson et al. (1993) identify four types of greenwashing: 1) overly vague or ambiguous communication; 2) communication that omits important information necessary to assess its truthfulness or reasonableness; 3) inaccurate or false, misleading or deceptive communication; 4) environmental communication that combines two or more of the points

listed above. To overcome these issues, the Federal Trade Commission (FTC) intervened in 1992, enacting guidelines and general criteria for environmental sustainability communications. These guidelines require that such communications clearly report any environmental sustainability of the product, packaging, or both, avoid being generic, and specify parameters useful for comparing their characteristics with those of similar products. Although they do not have the force of regulatory obligations, according to the FTC, these 'guidelines' should have been sufficient to encourage

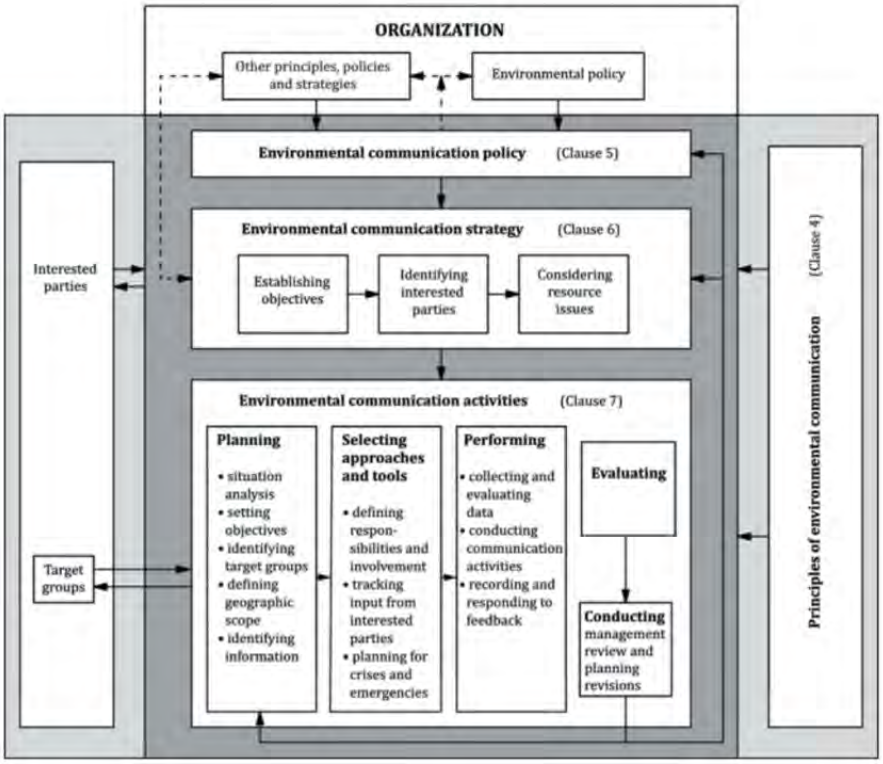



*Figure 1. The interrelationships and flow of environmental communication (ISO 14063:2020).*

marketing operators to voluntarily conform to greater transparency.

In the following decades, the growing demand from consumers for green products led industry operators to allocate increasingly larger budgets for environmental communication (Sheehan & Atkinson, 2012), which in fact increased the spread of greenwashing, also in the form of what Parguel et al. (2015) have called 'executional greenwashing'. This involves the use of images that evoke nature or renewable energy sources, which can trigger 'ecological interference' that may mislead consumers regarding the actual sustainability characteristics of the product. A recent study by the European Commission on Environmental Claims in the EU – Inventory and Reliability Assessment (Mcguinn et al., 2020) found that in 2020, out of 150 products on the market, 53.3% of the environmental sustainability claims made in advertising or on the product itself were vague, misleading, or unfounded, while 40% were completely unfounded.

These findings were also confirmed by the outcome of a recent 'sweep' (a set of checks carried out simultaneously by national enforcement authorities to identify breaches of EU consumer law in a particular sector or area) carried out by the Consumer Protection Cooperation Authorities (2020 – Sweep on misleading sustainability claims[1]): of the 344 sustainability claims evaluated

in 2020, the authorities had at least reasonable doubt that they might be false or misleading in 42% of cases and thus could potentially constitute an unfair trade practice under the Unfair Commercial Practices Directive 2005/29/EC (UCPD) and the Unfair Consumer Rights Directive 2011/83/EU (CRD); in addition, in 57.5% of cases, companies did not provide sufficient evidence to clarify and validate the claims; in many cases, authorities had difficulty identifying whether the claim covered the entire product or only one of its components (50%), whether it referred to the company or only to certain products (36%), and which stage of the product life cycle it covered (75%); 37% of claims contained vague statements (such as 'green', 'nature friendly') that could easily mislead consumers (Figure 2). Most stakeholders consulted for the survey impact assessment agreed that greenwashing was a problem, with the notable exception of industry representatives (European Commission, 2022).

The absence of common standards for companies making voluntary environmental self-declarations thus paves the way for greenwashing and creates conditions of disparity in the market of the old continent, to the detriment of genuinely sustainable businesses. In light of this, in January 2024, the European Parliament overwhelmingly approved a directive that prohibits the use of generic terms like 'green' or 'biodegradable' without supporting evidence[2].

## Environmental labels: classification and characteristics

Among the various tools available that can curb the phenomenon of greenwashing, environmental labels stand out. Their goal is to promote the demand and supply of products or services that have a lesser impact on the environment, by communicating accurate and verifiable information. Environmental certification meets the growing requirements for information transparency resulting from increasingly restrictive legislation on how information must be communicated to consumers (Bovea et al., 2014).

The ISO 14020:2000 standard, recently replaced by the ISO 14020:2022 standard, classifies environmental labels into three types: Type I label, which describes the environmental impact of a product or services, is based on voluntary action and is regulated by ISO 14024:1999, replaced by ISO 14024:2018, which is currently undergoing the revision process; Type II label,

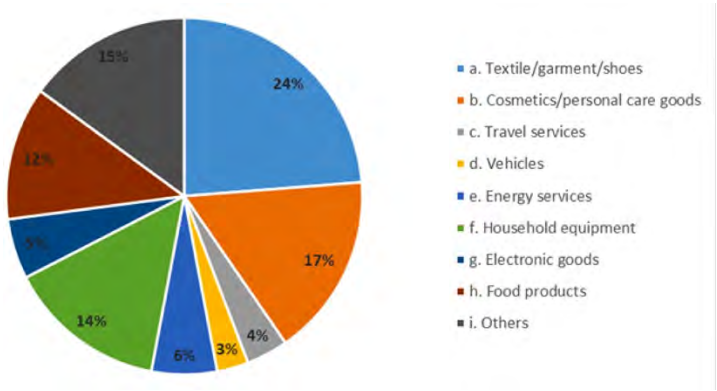



*Figure 2. 2020: sweep on misleading sustainability claims (ec.europa.eu/info/live-work-travel-eu/consumer-rights-and-complaints/enforcement-consumer-protection/sweeps_en).*

consisting of self-declared environmental statements by companies and organizations, unverified by third parties, is regulated by ISO 14021:1999, replaced by ISO 14021:2016; Type III label or Environmental Product Declaration (EPD), regulated by ISO 14025:2010, provides information, verified by an independent third party, based on compliance with a set of predefined Product Category Rules (PCR) for each product category. This allows for the comparison of relevant environmental characteristics of products within the same category and communicates quantitative information both for producers and distributors (business-to-business) and for the end consumer (business-to-consumer).

Environmental labels provide information based on Life Cycle Assessment (LCA) in accordance with the ISO 14040:2006 series of standards and are independently verified to estimate the environmental impacts of goods and services from the extraction of raw materials to end-of-life. However, while theoretically, the analysis should be conducted on all life cycle phases, it is possible, where data for one or more life cycle phases are not available, to opt for a partial analysis provided that this choice (the system boundary) is explicitly stated in a transparent manner and is declared among the study's limitations.

The first sustainable label in the world was the Blue Angel, established in Germany in 1978 (Torma & Thøgersen, 2021); in the following years, numerous other labels emerged, including the Nordic Swan Ecolabel in Norway, Sweden, Finland, Iceland, and Denmark, the Eco Mark in Japan in 1989, the Green Seal in the USA in 1990, and the EU Ecolabel in 1992. As of today, there are 456 environmental labels present in 199 countries and involving 25 industrial sectors, as reported by the Ecolabel Index[3], and its diffusion is reflected in the presence of over 37,000 products marketed on the European market that bear the EU Ecolabel on their packaging[4]. The more recent labels focus more specifically on the requirements of the circular economy, as well as on the durability and reparability of products.

Environmental labeling has two main objectives: the first is to make consumers aware of the effects of their consumption on the environment and to encourage them to change habits by adopting sustainable consumption patterns; the second goal is to motivate policy makers, producers, and suppliers to produce goods and provide services that comply with national and international environmental standards. In this perspective, the use of environmental labeling can generate demand for goods that are increasingly desirable in environmental terms and, consequently, induce producers to supply goods and services that meet such expectations (Wojnarowska et al., 2021; Prieto-Sandoval et al., 2016). In summary, environmental labeling systems on one hand can serve as an incentive to improve the environmental performance of products-services, and on the other, provide the opportunity to differentiate a company's products from other competitors that are not 'green' (Yokessa & Marette, 2019). The three factors that determine the eco-innovation of a product or service are supply, demand, and national and international policies (Horbach et al., 2013).

Achieving positive results and gaining consumer acceptance through the implementation of an eco-label, incentivises companies to design and improve products with higher environmental performance and cleaner production methods. Eco-innovation is defined as the production, application, or exploitation of a good, service, production process, organizational structure, management method, or business method that is

new to the company or the user and that involves, throughout its life cycle, a reduction of environmental risk, pollution, and negative impacts of resource use (including energy) compared to relevant alternatives (Kemp & Pearson, 2007). In this sense, eco-labelling can be seen as a process of eco-innovation (Dangelico & Pujari, 2010) and thus defined as «a visible manifestation of an eco-innovation process» (Prieto-Sandoval et al., 2020, p. 857).

Environmental labels and consumers

The ongoing scientific debate and recent research cited in the essay highlight how and to what extent communication regarding the environmental sustainability of products and services remains an open issue. Its relevance lies in the fact that, on one hand, it offers formidable potential to achieve various United Nations Sustainable Development Goals (SDGs) (Figures 3, 4) – directly affecting Responsible Consumption and Production (SDG 12) but also indirectly impacting Quality Education (SDG 4), Clean Water and Sanitation (SDG 6), Affordable and Clean Energy (SDG 7), Industry, Innovation and Infrastructure (SDG 9), Sustainable Cities and Communities (SDG 11), Climate Action (SDG 13), Life on Land (SDG 15), and Partnership for the Goals (SDG 17). On the other hand, if not adequately regulated, it can lead to greenwashing phenomena that deceive consumers and betray their expectations.

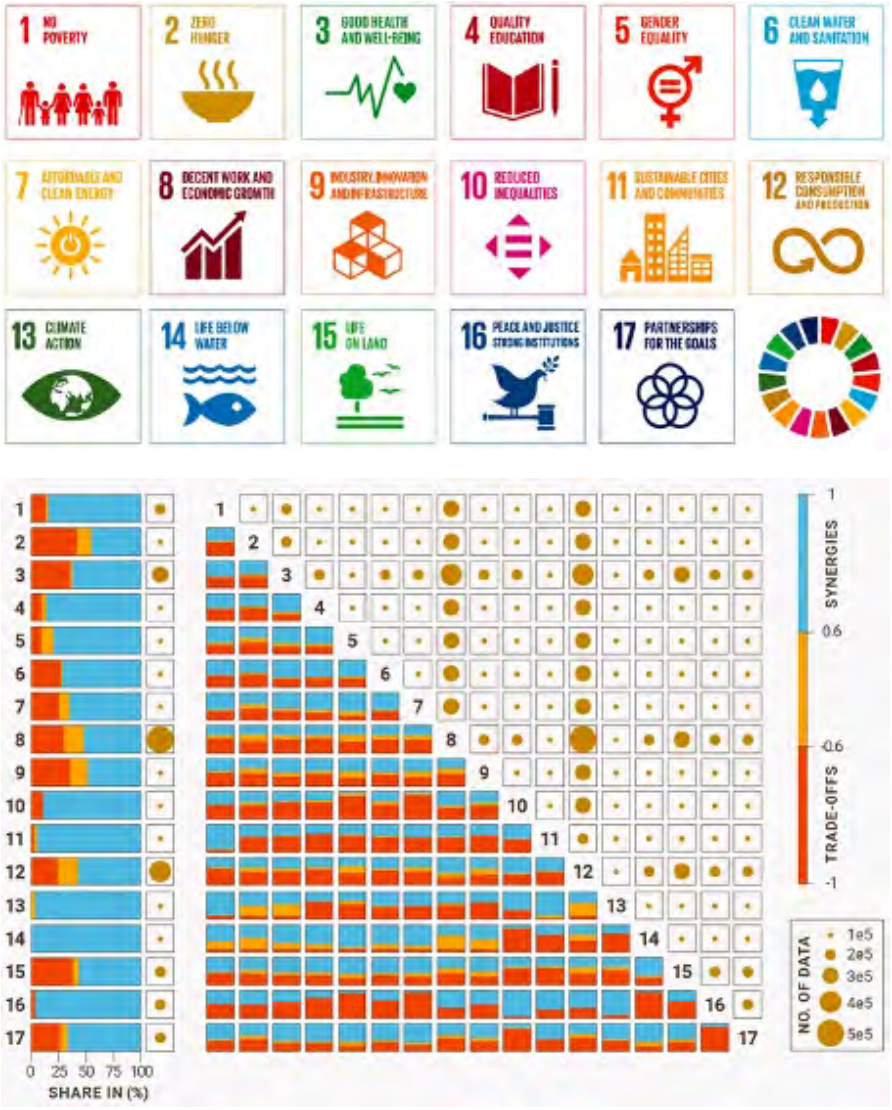



*Figure 3. Interlinkages between the Sustainable Development Goals create synergies and trade-offs. Results from an illustrative study of interlinkages between the Sustainable Development Goals. Note: Interactions within the 17 Goals (left) and among 136 pairs of Goals (right) based on data from 2018 (Department of Economic and Social Affairs, Statistics Division 2019). The shares of synergies (light blue), non-classifieds (yellow), and trade-offs (orange) are represented by the colour bars. The number of data pairs of Sustainable Development Goal indicators is depicted by the areas of the circle in the boxes. Here, 1e5, 2e5, 3e5, 4e5, and 5e5 are 100, 1,000, 10,000, 100,000, and 500,000, respectively (Anderson et alii, 2022; IGS, 2023).*

*Figure 4. Projected global achievements to 2030 (left) and 2050 (right) for select sustainable development goals indicators. A value of zero represents the baseline value of the indicator in 2015, while 100% means the target is fully met; negative values represent a worsening of the situation. The main scenarios, middle-of-the-road (SSP2-NDC) and ambitious (SDP-1.5C), are shown as bars (Soergel et alii, 2021; IGS, 2023).*


To achieve the sustainability of a product, various actions can be taken today, ranging from the use of biobased materials or renewable energy resources to a circular approach according to a new model that aims for economic development while limiting or eliminating the consumption of finite non-renewable resources (Ellen MacArthur Foundation, 2015), surpassing the traditional 'linear approach', which translates to 'take', 'use', 'consume', and 'dispose' (Campbell-Johnston et al., 2019). Although recycling is a lower-order goal of the circular economy, eco-labels can be enhanced by including information on durability, repairability, recycled content, or regenerated properties (Gossen et al., 2019; Wastling et al., 2018), for example, in the form of care instructions for the product or for recycling.

However, the most powerful driver is the consumer, for whom an eco-quality label proves effective based on the awareness of it and the trust in the claims associated with a label, closely tied to the credibility of the source, which must demonstrate three fundamental requirements: competence,

reliability, and attractiveness. Therefore, environmental claims coming from third parties are perceived as more transparent and accurate – Type I and Type III labels (Yokessa & Marette, 2019). Thus, the success of labelling, from the consumer's perspective, could mainly depend on the following requirements (Meis-Harris et al., 2021):

– Labeling systems should be reliable and transparent, with accurate product evaluations based on agreed criteria and methods;
– Information on labeling systems should be clear and visible to consumers; this means for eco-quality label designers that written instructions should be clear, easy to read, and understandable, and that recommended behaviours (e.g., reuse, recycling, repair) should be simple to execute (Kools, 2011), given that interpreting the environmental information offered by some products often turns out to be quite confusing;
– Product labeling criteria should be associated with tangible environmental credentials that distinguish them from other products; if consumers could experience the tangible environmental credentials of eco-quality labelled products as soon as possible, support for labeling systems would likely increase.

## Conclusions

In an era where the human footprint on the ecosystem is reshaping the future of our planet, the urgency to transform production and consumption patterns forcefully asserts itself. This paper has explored the dynamics and potential of environmental communication in the field of communication design, highlighting how environmental labels not only serve as a bridge between producers and consumers but also as a powerful tool to convey values of sustainability, transparency, and responsibility. It has been observed how, in the Anthropocene, the role of design and communication becomes crucial in guiding choices towards more sustainable models, but also how it is necessary to overcome superficial and misleading approaches, such as greenwashing, in favour of strategies that aim for transparency and communicative effectiveness, capable of positively influencing consumer behaviour and directing companies towards genuine eco-innovation.

The approval of new directives at the European level against the misuse of generically positive environmental terminology marks a paradigm shift in the regulation of environmental communication, signalling the transition from an era of ambiguity to one of greater clarity and reliability. In this context, environmental labels emerge as a benchmark for a new model of transparency, taking on the role of privileged tools for the promotion of deeper awareness and more informed choices. The future of sustainability in communication design requires a collective and multidisciplinary commitment, where designers, businesses, institutions, and consumers collaborate to build an ecosystem of genuinely sustainable products and services. It is essential that environmental labels continue to evolve, incorporating increasingly stringent and comprehensive criteria that reflect the entire life cycle of products and services, from production to post-consumption.

In conclusion, this contribution not only confirms the critical importance of effective and transparent environmental communication but also lays the groundwork for ongoing and constructive dialogue among all stakeholders involved: only through shared commitment and the valorization of authentic and reliable communicative tools, such as environmental labels, can we aspire to achieve sustainable development goals, while ensuring that future generations inherit a world in which it is still possible to thrive. Show the

full name before you use acronyms the first time.

## Acknowledgments

The contribution, resulting from a common reflection, is to be assigned in equal parts to both Authors.

## Notes

1) For more information, see the webpage: ec.europa.eu/info/live-work-travel-eu/consumer-rights-and-complaints/enforcement-consumer-protection/sweeps_en - 2020-sweep-on-misleading-sustainability-claims [Accessed 06 February 2024].

2) For more information, see the webpage: europarl.europa.eu/news/it/press-room/20240112IPR16772/il-pe-adotta-una-nuova-legge-contro-greenwashing-e-informazioni-ingannevoli [Accessed 06 February 2024].

3) For more information, see the webpage: ecolabelindex.com [Accessed 06 February 2024].

4) For more information, see the webpage: europa.eu/youreurope/business/product-requirements/labels-markings/ecolabel/index_it.htm [Accessed 06 February 2024].

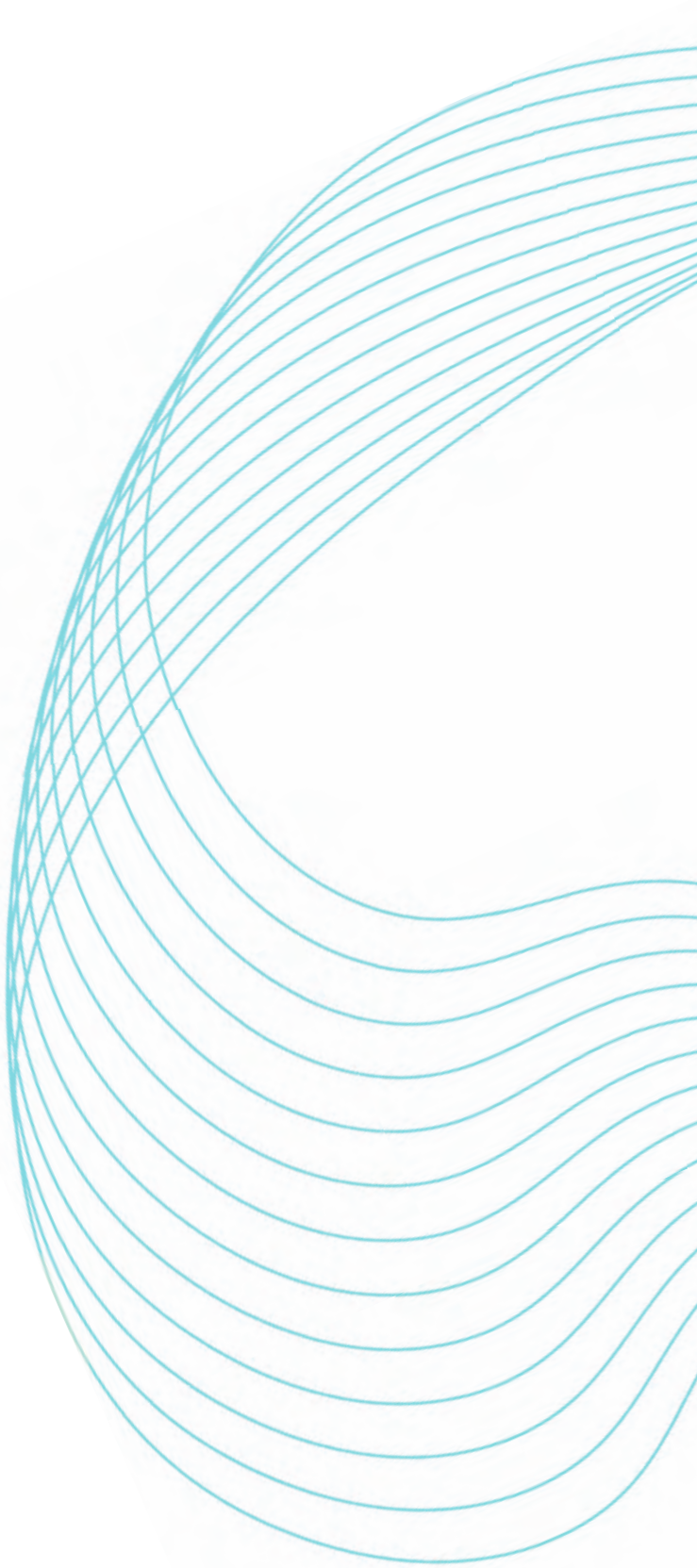
# References

1. Anderson, C. C., Denich, M., Warchold, A., Kropp, J. P., & Pradhan, P. (2022). A systems model of SDG target influence of the Goals on the 2030 Agenda for Sustainable Development. Sustainability Sciences, 17, 1459-1472. https://doi.org/10.1007/s11625-021-01040-8
2. Antonelli, P. (2019), Broken nature. In Antonelli, P., & Tannir A. (eds), Broken nature – XXII Triennale di Milano (pp. 16-42). Milano: Electa.
3. Badalucco, L. (2022). Design, formazione e ricerca per l'economia circolare. In Badalucco, L. (ed.), Futuro continuo – Esperienze di design per la transizione ecologica e digitale (pp. 10-25). Treviso: Anteferma.
4. Bengtsson, M. (2018). Transforming systems of consumption and production for achieving the sustainable development goals – Moving beyond efficiency. Sustainability Science, 13(6), 1533-1547. https://doi.org/10.1007/s11625-018-0582-1
5. Borthwick M., Tomitsch M., & Gaughwin M. (2022). From human-centred to life-centred design – Considering environmental and ethical concerns in the design of interactive products. Journal of Responsible Technology, 10, 100032. https://doi.org/10.1016/j.jrt.2022.100032
6. Bovea, M. D., Ibáñez-Forés, V., & Agustí-Juan, I. (2014). Environmental Product Declaration (EPD) labelling of construction and building materials. In Pacheco-Torgal, F., Cabeza, L. F., Labrincha, J., & de Magalhães A. (eds), Eco-efficient Construction and Building Materials – Life Cycle Assessment (LCA), Eco-Labelling and Case Studies (pp. 125-150). Cambridge: Woodhead Publishing Limited.
7. Campbell-Johnston, K., ten Cate, J., Elfering-Petrovic, M., & Gupta, J. (2019). City level circular transitions – Barriers and limits in Amsterdam, Utrecht and The Hague. Journal of Cleaner Production, 235, 1232-1239. https://doi.org/10.1016/j.jclepro.2019.06.106
8. Campioli, A., Della Valle, A., Ganassali, S., & Giorgi, S. (2018). Designing the life cycle of materials – New trends in environmental perspective. Techne | Journal of Technology for Architecture and Environment, 16, 86-95. https://doi.org/10.13128/Techne-23016
9. Carlson, L., Grove, S. J., & Kangun, N. (1993). A Content Analysis of Environmental Advertising Claims – A Matrix Method Approach. Journal of Advertising, 22 (3), 27-39. https://doi.org/10.1080/00913367.1993.10673409
10. Crawford, E. (2020, 7 March). Sustainably-marketed products drove more than half of all growth across CPGs in past five years. Food Navigator USA. https://foodnavigator-usa.com/Article/2020/07/23/Sustainably-marketed-products-drove-more-than-

half-of-all-growth-across-CPGs-in-past-five-years#
11. Crutzen, P. J., & Stoermer, E. F. (2000). The 'Anthropocene. IGBP News Letter, 41, 17-18. igbp.net/download/18.316f18321323470177580001401/1376383088452/NL41.pdf
12. Dangelico, R. M., & Pujari, D. (2010). Mainstreaming green product innovation – Why and how companies integrate environmental sustainability. Journal of Business Ethics, 95, 471-486. https://doi.org/10.1007/s10551-010-0434-0
13. Ellen MacArthur Foundation (2015). Growth Within – A Circular Economy Vision for a Competitive Europe. Retrieved from: https://mckinsey.com/capabilities/sustainability/our-insights/growth-within-a-circular-economy-vision-for-a-competitive-europe [Accessed 16 February 2024].
14. European Commission (2022). Commission staff working document – Impact Assessment Report –Accompanying the document – Proposal for a Directive of the European Parliament and of the Council amending Directives 2005/29/EC and 2011/83/EU as regards empowering consumers for the green transition through better protection against unfair practices and better information, document 52022SC0085, 85 final. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022SC0085 [Accessed 16 October 2023].
15. European Commission (2021). New European Bauhaus – Shaping more beautiful, sustainable and inclusive forms of living together. Retrieved from: https://europa.eu/new-european-bauhaus/index_en [Accessed 16 October 2023].
16. European Commission (2020a). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A Renovation Wave for Europe – Greening our buildings, creating jobs, improving lives, document 52020DC0662, 662 final. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=160 3122220757&uri=CELEX:52020DC0662 [Accessed 16 October 2023].
17. European Commission (2020b). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A new EU Circular Economy Action Plan for a cleaner and more competitive Europe, document 52020DC0098, 98 final. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=15839 33814386&uri=COM:2020:98:FIN [Accessed 16 October 2023].
18. European Commission (2020c). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Europe's moment – Repair and Prepare for the Nex Generation, document 52020DC0456, 456 final. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0456&qid=1700296616928 [Accessed 16 October 2023].
19. European Commission (2019). Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – The European Green Deal, document 52019DC0640, 640 final. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN [Accessed 16 October 2023].
20. European Commission (2015). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Closing the Loop – An EU action plan for the Circular Economy, document 52015DC0614, 614 final. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614 [Ac cessed 16 October 2023].
21. European Commission (2009). Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community, document 32009L0029, L 140/63. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT /?uri=CELEX:32009L0029 [Accessed 16 October 2023].
22. Fan, T., Song, Y., Cao, H., & Xia, H. (2019). Optimal eco-labeling strategy with imperfectly informed consumers. In Industrial Management & Data Systems, 119(6), 1166-1188. https://doi.org/10.1108/IMDS-06-2018-0256
23. FTC – Federal Trade Commission (1992). Guides for the Use of Environmental Marketing Claims. Washington, D.C.
24. Gossen, M., Ziesemer, F., & Schrader, U. (2019). Why and how commercial marketing should promote sufficient consumption – A systematic literature review. Journal of Macromarketing, 39(3), 252-269. https://doi.org/10.1177/0276146719866238
25. Horbach, J., Oltra, V., & Belin, J. (2013). Determinants and specificities of ecoinnovations compared to other innovations – An econometric analysis for the French and German industry based on the community innovation survey. Industry and Innovation, 20(6), 523-543. https://doi.org/10.1080/13662716.2013.833375
26. IGS – Independent Group of Scientists appointed by the Secretary-General (2023). Global Sustainable Development Report 2023 – Times of crisis, times of change – Science for accelerating transformations to sustainable development. New York. Retrieved from: https://sdgs.un.org/sites/default/files/2023-09/FINAL%20GSDR%2020 23-Digital%20-110923_1.pdf [Accessed 16 December 2023].

27. ISO/WD 14024. Environmental labels and declarations – Type I environmental labelling Principles and procedures Status – Under development.
28. ISO 14020:2022. Environmental statements and programmes for products – Principles and general requirements.
29. ISO 14063:2020. Environmental management – Environmental communication – Guidelines and examples.
30. ISO 14024:2018. Environmental labels and declarations – Type I environmental labelling Principles and procedures.
31. ISO 14021:2016. Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling).
32. ISO 14025:2006. Environmental labels and declarations – Type III environmental declarations – Principles and procedures.
33. ISO 14040:2006. Environmental management – Life cycle assessment – Principles and Framework.
34. ISO 14020:2000. Environmental labels and declarations - General principles.
35. ISO 14024:1999, Environmental labels and declarations – Type I environmental labelling – Principles and procedures.
36. ISO 14021:1999. Environmental labels and declarations – Self-declared environ-mental claims (Type II environmental labelling).
37. Kemp, R., & Pearson, P. (2007). Final Report MEI Project About Measuring Eco-innovation. Maastricht: UM Merit.
38. Kong, H. M., Witmaier, A., & Ko, E. (2021). Sustainability and social media communication – How consumers respond to marketing efforts of luxury and non-luxury fashion brands. Journal of Business Research, 131, 640-651. https://doi.org/10.1016/j.jbusres.2020.08.021
39. Kools, M. (2011). Making written materials easy to understand. In Abraham, C., & Kools, M. (eds), Writing Health Communication – An Evidence-Based Guide (pp. 23-42). London: Sage Publications.
40. Marrucci, L., Daddi, T., & Iraldo, F. (2019). The integration of circular economy with sustainable consumption and production tools – Systematic review and future research agenda. Journal of Cleaner Production, 240, 118268. https://doi.org/10.1016/j.jclepro.2019.118268
41. Mayer, R. N., Scammon, D. L., & Zick, C. D. (1992). Turning the Competition Green – The Regulation of Environmental Claims. In Bloom, P. N., & Starr, R. G. Jr. (eds), Proceedings of the 1992 Marketing and Public Policy Conference (pp. 152-165). Chicago: American Marketing Association.
42. Meis-Harris, J., Klemm, C., Kaufman, S., Curtis J., Borg, K., & Bragge, P. (2021). What is the role of eco-labels for a circular economy? A rapid review of the literature. Journal of Cleaner Production, 306, 127134. https://doi.org/10.1016/j.jclepro.2021.127134
43. Mcguinn et al. (2020). Environmental claims in the EU Inventory and reliability assessment – Draft final report. Luxembourg: Publications Office of the European Union. Retrieved from: qualenergia.it/wp-content/uploads/2023/01/Envclaims_inventory_2020_final_publi.pdf [Accessed 16 October 2023].
44. Norman, D. (2023). Design for a Better World – Meaningful, Sustainable, Humanity Centered. Cambridge (MA): The MIT Press.
45. Papanek, V. (1972). Design for the real world. Pantheon.
46. Parguel, B., Benoit-Moreaua, F., & Russell, C. A. (2015). Can evoking nature in advertising mislead consumers? The power of executional greenwashing. International Journal of Advertising, 34(1), 107-134. https://dx.doi.org/10.1080/02650487.2014.996116
47. Prieto-Sandoval, V., Mejía-Villa, A., Ormazabal, M., & Jaca, C. (2020). Challenges for ecolabeling growth – Lessons from the EU ecolabel in Spain. The International Journal of Life Cycle Assessment, 25(5), 856-867. https://doi.org/10.1007/s11367-019-01611-z
48. Prieto-Sandoval, V., Alfaro, J. A., Mejía-Villa, A., & Ormazabal, M. (2016). ECO-labels as a multidimensional research topic – Trends and opportunities. Journal of Cleaner Production, 135, 806-818. https://doi.org/10.1016/j.jclepro.2016.06.167
49. Rathee, S., & Milfeld, T. (2024). Sustainability advertising – Literature review and framework for future research. International Journal of Advertising, 43(1), 7-35. https://doi.org/10.1080/02650487.2023.2175300
50. Sheehan, K., & Atkinson, L. (2012). Special issue on green advertising – Revisiting green advertising and the reluctant consumer. Journal of Advertising, 41(4), 5-7. https://doi.org/10.1080/00913367.2012.10672453
51. Simpson, B. J., & Radford, S. K. (2012). Consumer perceptions of sustainability – A free elicitation study. Journal of Nonprofit & Public Sector Marketing, 24(4), 272-291. https://doi.org/10.1080/10495142.2012.733654
52. Soergel, B., Kriegler, E., Weindl, I., Rauner, S., Dirnaichner, A., Ruhe, C., Hofmann, M., Bauer, N., Bertram, C., Bodirsky, B. L., Leimbach, M., Leininger, J., Levesque, A., Luderer, G., Pehl, M., Wingens, C., Baumstark, L., Beier, F., Dietrich, J. P., Humpenöder, F., von Jeetze, P., Klein, D., Koch, J., Pietzcker, R., Strefler, J., Lotze-Campen H., & Popp, A. (2021). A sustainable development pathway for climate action within the UN 2030 Agenda. Nature Climate Change, 11(8), 656-664. https://doi.org/10.1038/

s41558-021-01098-3
53. Tamborrini, P. (2009). Design sostenibile – Oggetti, sistemi e comportamenti. Milano: Electa.
54. Torma, G., & Thogersen, J. (2021). A systematic literature review on meta sustainability labeling – What do we (not) know? Journal of Cleaner Production, 293, 126194. https://doi.org/10.1016/j.jclepro.2021.126194 [Accessed 16 October 2023].
55. UN – United Nations (1992). Agenda 21 – United Nations Conference on Environment and Development – Rio de Janeiro, Brazil, 3 to 14 June 1992. Retrieved from: sdgs.un.org/sites/default/files/publications/Agenda21.pdf [Accessed 16 October 2023].
56. UN – General Assembly (2015). Transforming our World – The 2030 Agenda for Sustainable Development, document A/RES/70/1.Retrieved from: sdgs.un.org/2030agenda [Accessed 16 October 2023].
57. Wastling, T., Charnley, F., & Moreno, M. (2018). Design for circular behaviour – Considering users in a circular economy. Sustainability, 10(6), 1743. https://doi.org/10.3390/su10061743
58. Wojnarowska, M., Sołtysik M., & Prusak, A. (2021). Impact of eco-labelling on the implementation of sustainable production and consumption. Environmental Impact Assessment Review, 86, 106505. https://doi.org/10.1016/j.eiar.2020.106505 [Accessed 06 February 2024].
59. WCED – World Commission on Environment and Development (1987). Our Common Future. Retrieved from: www.are.admin.ch/are/it/home/media-e-pubblicazioni/pubblicazioni/sviluppo-sostenibile/brundtlandreport.html [Accessed 06 February 2024].
60. Xu, W., Jin, X., & Fu, R. (2021). The influence of scarcity and popularity appeals on sustainable products. Sustainable Production and Consumption, 27, 1340-13488. https://doi.org/10.1016/j.spc.2021.03.014
61. Yang, D., Lu, Y., Zhu, W., & Su, C. (2015). Going green – How different advertising appeals impact green consumption behavior. Journal of Business Research, 68(12), 2663-2675.https://doi.org/10.1016/j.jbusres.2015.04.004
62. Yokessa, M., & Marette, S. (2019). A review of eco-labels and their economic impact. International Review of Environmental and Resource Economics, 13(1-2), 119-163. https://doi.org/10.1561/101.00000107



# SOCIAL INNOVATION

# Urban lifestyle in twenty years. Forecasts from a Young Generation of Interior Designers

*Luca Guerrini*
*luca.guerrini@polimi.it*

*Department of Design, Politecnico di Milano, Italy*

***Keywords:***
*Future*
*Research Through Design*
*Design Teaching*
*Interior Design*
*Gen Z*

## Abstract

How young generations envision their future is the aim of a six-year research/teaching project at the School of Design of Politecnico di Milano. The project was carried out in a first-year interior design studio. Students were invited to design exemplary environments suitable for urban life on a 20-year time horizon. Burning issues such as climate change, new technologies, and social behaviours were investigated using disciplinary and extra-disciplinary methodologies – especially the speculative approach of Italian design. In six years, the design studio collected more than one hundred proposals produced by over three hundred students. They undoubtedly show naïvety and approximation of young in-training designers. Some are profession-like proposals, others visionary, paradoxical or ironic. Nevertheless, this vast effort delineates the contours of a generation deeply involved in sustainability, fascinated by nature, and focused on concrete issues – all promising traits for our future.

## Introduction

This essay reports the outcomes of a six-year research/teaching project in a first-year design studio at the School of Design of Politecnico di Milano between 2017 and 2022. Each year, 60 students, guided by five instructors[1], tackled the multiple challenges of anticipation: « the process of using the future in the present, which includes a forward-looking stance and the use of that forward-looking stance to effect a change in the present » (Poli, 2019, p. V). Indeed, it was a steep path for the students and the teachers, made step by step (Fig. 1). Previous essays outlined some stages of this itinerary (Guerrini, 2018; 2019). The task now remains a comprehensive evaluation of the training goals, the methods adopted, and the results achieved.

The idea of the future crosses Western culture historically (Cantarella et al., 2021). However, anticipating our living conditions in the years to come has become crucial in a rapidly changing world. Science and technology proceed incredibly fast, increasing concern and anxiety for the coming decades. The pandemic even exacerbated these trends.

It is no coincidence that science fiction has accustomed our imagination to the gloomiest atmospheres for the future, from "Blade Runner" (1982) and "Brazil" (1985) to "Matrix" (1999), "Minority Report" (2002) and "Her" (2013).

Whatever their topic, from genetics to bio-engineering, big-data processing or artificial intelligence, these mainstream products show a world population overwhelmed by technology and social control. Even "Ready Player One" (2018), a happy ending movie, depicts an unequal society, giving the poorest no chance for redemption but in a virtual reality.

«Designers, more than classically trained researchers, aim to find or create possible (desirable) futures, rather than precisely understand past or present for its own sake» (Stappers and Sleeswijk Visser, 2014). Regarding long-term perspectives, they usually rely on rational thinking and concreteness rather than appeal to emotions like fear and anxiety, as writers and filmmakers often do.

The future dimension is deep-rooted in the design discipline. The word 'project' itself derives from the Latin *pro-jàcere*, launch oneself forward, with both a spatial and temporal meaning. The same Latin verb, however, originates the word 'projectile'. Therefore, designing may be a risky endeavour requiring heavy responsibility. In the words of Victor Papanek (1985), « Design is the most powerful tool yet given man with which to shape his products, his environments, and, by extension, himself; with it, he must analyse the past as well as the foreseeable future consequences of his acts » (p. 102).

In recent years, many design scholars have entitled their studies to the future. Their forecasts are challenging and contradictory. Artificial Intelligence and big-data processing are substantially changing our behaviour at home (Norman, 2007) and in the city (Ratti and Claudel, 2016). We can address these challenges individually and collectively by summoning resilience, that is, considering these innovations as unavoidable opportunities, as these authors suggest. Or we can scrutinise the aims and consequences of these technologies to make a responsible choice. In this respect, design responsibility becomes crucial: as a practice focused on innovation and newness, it can really shape our future (Yelavich and Adams, 2014), but innovation and newness must also be capable of dissipating ethical, social and environmental concerns (Fry, 2008). Moreover, the search for design operational responses has increased under the pressure of the pandemic. Rawsthorn and Antonelli (2022) collect several experiences addressing the most pressing global issues in four areas: technology, society, communication, and ecology, showing how all creative professions can contribute to facing the challenges of a time of crisis, which is definitively our own.

Whether strengthening the dominant economic paradigm (Ito and Howe, 2016) or searching for more socially sustainable and publicly shared alternatives (Ehn, Nilsson, and Topgaard, 2014), all these scholars delineate a design practice increasingly becoming social, ethical, and political.

Similarly, art and design exhibitions in the last decade have introduced a larger audience to the urgency of anticipating our future. "The future is not what it used to be" (Istanbul Design Biennial, 2014) focuses on the concept of 'manifesto' questioning how designers and artists can reshape this cultural provocation of the early 20th century to respond to the challenges of a contemporary multi-layered world. "The future starts here" (V&A, London, 2018) brings together more than one hundred technologies and products to make sense of the nascent digital revolution. Most of them are functioning prototypes, showing undeniable physical objectivity. Still, their multi-faceted complexity pushes the future in several directions, and which one to choose becomes a collective deliberation. "Future and the Arts" (Mori Art Museum, Tokyo 2019) showcases examples of art, design, and architecture influenced by cutting-edge developments in science and technology, including artificial intelligence, biotechnology, robotics, and augmented reality. They call into question the anthropocentric interpretation of the world and bring us to reconsider the value of humankind and the notion of 'the living' between natural and artificial. Finally, "Designs for Different Futures" (Phil-

adelphia Museum of Art, 2020)[2] adopts a more critical/speculative approach to how design might shape our future, addressing intractable problems such as income inequality, global warming, environmental degradation and the scarcity of essential resources from fresh air to clean water.

## Goals

In 2017, although debated by experts for decades, environmental and climate change issues were still neglected by the media[3]. The discussion on new technology focused on fake news spread by social networks. The so-called «elephant chart»[4] about the social inequality of globalisation was unknown to most. Therefore, younger generations addressing design discipline for the first time may be unaware of these crucial issues. We, as teachers, felt our responsibility. We could not go on helping the students shape beautiful pieces of furniture and pleasurable interiors for a wealthy social minority, nor let them tackle such overwhelming issues without an appropriate pedagogical approach.

Our task was twofold: on the one hand, first-year design studios should provide the students with the disciplinary foundation of interior design; on the other, social, cultural and environmental issues had to emerge. Delving into the future became our strategy to integrate them into a coherent whole.

A consolidated design pedagogy focuses on the history (of design, art, and technology) and, therefore, on the past as the foundation of design knowledge and practice. In our age, the past does not seem to contain the answers to the questions of the future. The transformations triggered by technology, globalisation, and climate change require the construction of entirely new scenarios. Therefore, the pedagogy is somehow reversed from the past to the future. The search for materials, the acquisition of interpretative tools, the elaboration of hypotheses and the development of design proposals mark the stages of a joint work of students and teachers – an actual political confrontation aimed at building consensus about the most credible future scenarios and their solutions.

From a broader pedagogical perspective, the relevance of the future in education has been underlined by authors such as David Hicks (2002) and Keri Facer (2011). «The crucial role of education – states Hicks (2002) – is helping young people understand the nature of local and global change and the social and environmental impacts such change will have on their future». It is a collective endeavour involving «both students and teachers think more critically and creatively». Moreover, it is an undeniable institutional task. According to Facer (2011, p. IX) «schools have to act as democratic resources for building secure and desirable futures for all of their students» and the only way to reach this goal is «by rewriting the stories we tell ourselves about the relationship between education, technology and social change» (Facer, 2011, p. X).

Design, in general, and interior design, in particular, have disciplinary tools to deal with such stories. Italian designers have extensively made use of models or mock-ups of interiors to envision contemporary or future lifestyles. From the 'rooms' at the Milan Triennale in 1936 up to the present-day installations during the Milan Design Week, «mock-up spaces are message-objects, which first and foremost "show off" themselves » (Scodeller, 2014, pp. 12-13)[5], and, at the same time, «while lacking any reference to what is real or realisable» they have their own significant function, «the function of providing informational facts about the nature and future of architecture» (Celant, 1972, p. 383).

Our design studio is deeply rooted in this trajectory: translating ideas into real-scale installations makes the process more effective as a tool to test the message embedded in the project and as a learning methodology.

Therefore, the overall purpose of our teaching/research activity became the design of exemplary models of single-environmental spaces as part of an exhibition on future urban lifestyles in Milan in the next twenty years (Fig. 2).

## Structure, approaches and methods

The design studio teaching approach follows its dual feature. On the one hand, students were encouraged to expand their knowledge of interiors by investigating topics such as perception (Arnheim, 1974; 1977), psychology (Hall, 1966), poetics (Bachelard, 1964), fiction (Perec 1998) and cultural issues (Lees-Maffei and Fallan, 2014; Dellapiana, 2022). On the other hand, substantial work was done to familiarise the students with disciplinary methods aimed at future forecasting, such as Design Fiction (Bleecker, 2009; Hales, 2013) and Speculative design (Dunne and Raby, 2013). The extensive literature on Future Studies was also explored and tested (Slaughter, 1999; Voros, 2001; Poli, 2019).

We wanted the interior design complex and interweaving references to emerge from a direct experience. Therefore, we set up a learning path in three steps: a) experimenting with the space by building a real-scale mock-up of a 20 $m^2$ room shaped and coloured in different ways, b) understanding the space by making a 1:20 scale model of the same room and verifying its features and potentials as an installation, and finally c) testing the space, by re-designing the model as part of the hypothetical exhibition about living in Milan on a 20-year time horizon. Reports, sketches, drawings and videos complemented each learning process step. They were collectively discussed and evaluated to reach a consensus on the aims, tools and outcomes of the research/teaching work (Guerrini, 2018). In this respect, we confirmed a teaching approach to interiors previously tested in other design studios (Guerrini, 2006), which relies on the material construction of spaces thanks to the facilities available at the Exhibit Lab. of the School.

*Figure 1. The design studio in action: thinking, making, designing*

*Figure 2. Collage of proposals: an exhibition on future urban life*

Finding appropriate tools to translate data about future trends into an effective design brief was far more complex. The research integrated traditional methods (desk, case studies) with tools from Future Studies, such as STEPE[6] analysis, cluster maps and trend analysis. These tools, especially the first, were gradually introduced and eventually became a consolidated procedure until 2020. As we know, STEPE methods «provide knowledge of probable futures. Leaping into possible/preferable futures is a matter of creativity. It implies divergent thinking, and therefore, it is a matter of design» (Corazza, 2019, p. 768). For this reason, managing these methods proved to be problematic for first-year students. They found it especially hard to translate general future trends into effective design briefs. Therefore, we fundamentally revised our approach in 2021 by collaborating with a design PhD candidate in our Department. Her research (Stepanović, 2022) focuses on enhancing critical thinking in design processes, relying on disciplinary future forecasting approaches – especially Design Fiction and Speculative design – and tools such as anticipatory scenarios and diegetic prototypes (Kirby, 2010). One of the outcomes of her work is a protocol based on an extensive repository of science-fiction movies. Adopting the new procedure proved engaging and successful in stimulating critical debate among the students. Since the protocol is primarily focused on design practice, it made it much easier for the students to turn their ideas into spaces.

The design studio scheduling also benefited from the methodological shift. STEPE analysis required more than one month of data collection, interpretation, and discussion before student teams and the teachers could envision a clear design direction. Analytical work proceeded parallel to real-scale space experience, making it hard to find an appropriate match between the two learning processes. With the new protocol, on the contrary, one week of preparatory work and a full-day workshop reached the same result and could be tested immediately after on the mock-ups and models.

The new approach also clarified and made the dual feature of the design studio more coherent from a disciplinary perspective. Speculative design, on which much of Stepanović's research is based, focuses on the material construction of prototypes «to open up all sorts of possibilities that can be discussed, debated, and used to collectively define a preferable future for a given group of people» (Dunne and Raby, 2013, p. 6). Not surprisingly, this attention to the matter by Anthony Dunne and Fiona Raby derives from Italian design culture (Dunne, 2005).

## Outcomes

In six years, the design studio collected more than one hundred proposals produced by over three hundred students. They undoubtedly show naïvity and approximation of young in-training designers. Some are profession-like proposals, others visionary, paradoxical or ironic. Nevertheless, this vast effort delineates the contours of a generation deeply involved in sustainability, fascinated by nature, and focused on concrete issues – all promising traits for our future.

At the end of the research/teaching work, a database was set up to collect the proposals by year and classify them by categories that may be useful for further analysis. These categories come from the design studio approach and goals and consist of the main activity involved, the kind of activity (temporary or permanent), the main design issue addressed, and the type of users involved. We can extract useful information by elaborating on these data to assess the outcomes of our experience.

Apart from the first two years and the last one, in which we suggested the students focus on specific activities , they were free to choose what field to explore. Therefore, the distribution of their choices may be relevant to understanding what they think interior design is about, what they are interested in as designers, and what they envision as a potential/preferable professional field for their future. If we sharply cut the proposals into three large categories of service, home, and work (Fig. 3), we find that almost half of the students focus on the first (47%), 37% of them delve into the issues of domestic spaces, and only a few (16%) deal with work.

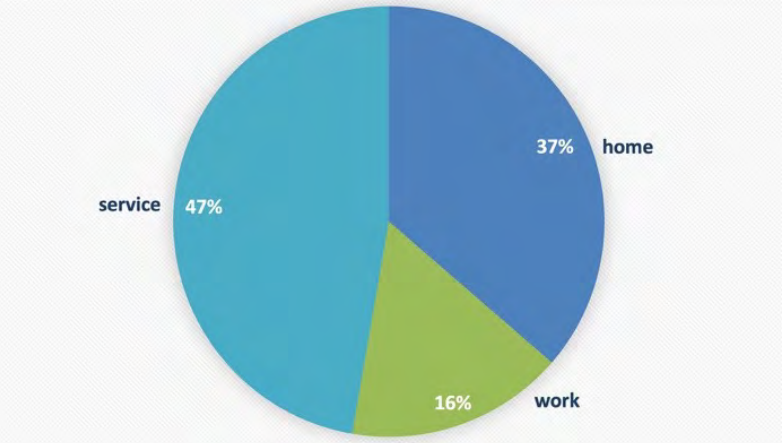



*Figure 3. Data analysis: Main activity in the project*

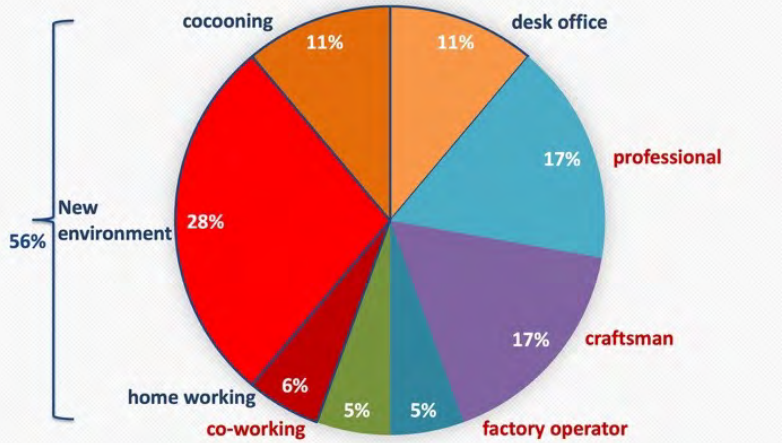



*Figure 4. Data analysis: Type of work*

From what we see (Fig. 4), students primarily identify working with office work in large enterprises (56%). Words like 'stress', 'fatigue', and 'pressure' are common in their design briefs. Therefore, their approach is most frequently to redesign the whole working environment. They reshape furniture to stimulate new postures and interactions; experiment with light, colour, and sound to increase well-being; use rock, tree bark, and plants, instinctively identifying natural materials as antidotes against tension and anxiety. Especially they reject the typical desk-and-chair layout in favour of more freely shaped and distributed work 'spots'. Students who explore other working spaces focus on their future professional life (17%) or – surprisingly – on the world of craftmanship (17%). In both cases, however, they envision a substantial contribution of new technology – especially artificial intelligence and mixed/augmented/virtual reality – in facilitating the day-by-day working process; even the tailor combines body scanning with sewing to produce the best hand-made garment.

A consistent 37% of the students preferred working on home spaces (Fig. 3). The domestic environment is at hand, and first-year students may think it is easier to envision the future of homes rather than investigating unknown design topics. As we will see further, this also happens when they choose services they experience directly. Moreover, as soon as they enter the School of Design, students meet in history courses the numberless interpretations of domestic issues produced by Italian designers, pushing them to choose the topic. Analysing their performance, however, is a challenging task. A significant 40% of the proposals (fig. 5) suggest temporary solutions tailored to individuals (32%), young couples (27%), or co-housing communities (23%). In this respect, they are aware that the future urban population will consist more and more of nomadic workers and temporary lovers. The solid traditional family of the grandparents settled to raise children is substantially out of their sight.

*Figure 5. Data analysis: Type of home users*

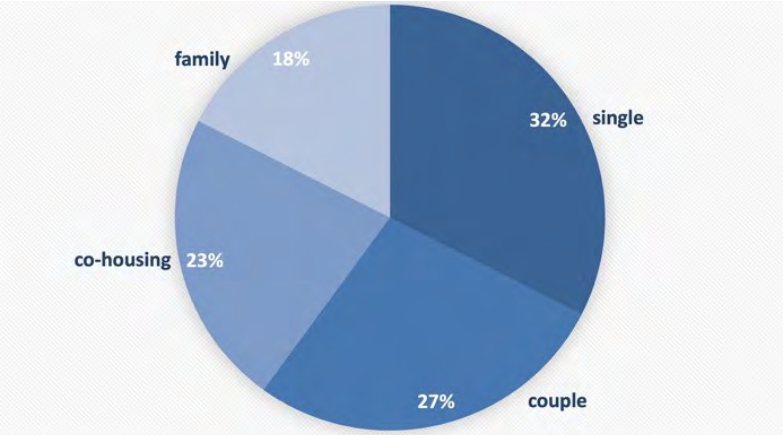
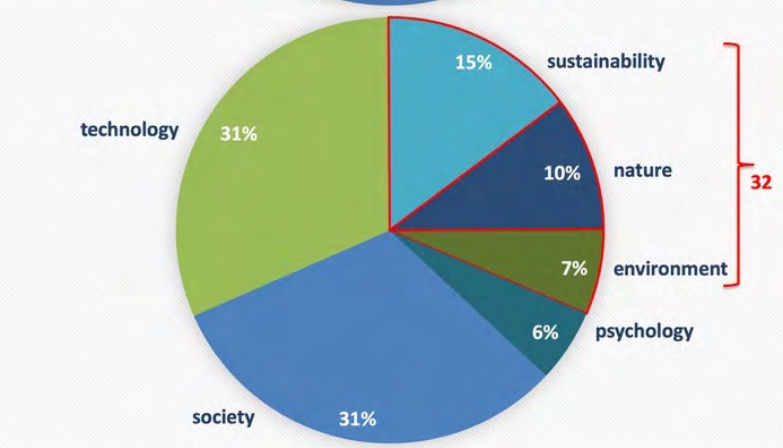



*Figure 6. Data analysis: Main issues tackled by the proposals*



The design of homes, however, does not evolve accordingly. The modernist functional layout persists in many students' proposals due to their own experience of home. On the contrary, furniture design shapes the new geometry of behaviours, habits, and interactions (Fig. 12). There are pieces of furniture you pack up like luggage and bring from one house to another; large multi-purpose tables suitable for cooking, socialising, home-working, and mixed reality social events; huge polyurethane shapes you pick up from a rack on the wall to adjust your home according to necessities. The avant-garde design of the 1960s and 1970s revives in new forms to interpret the rules of ever-evolving domestic rituals.

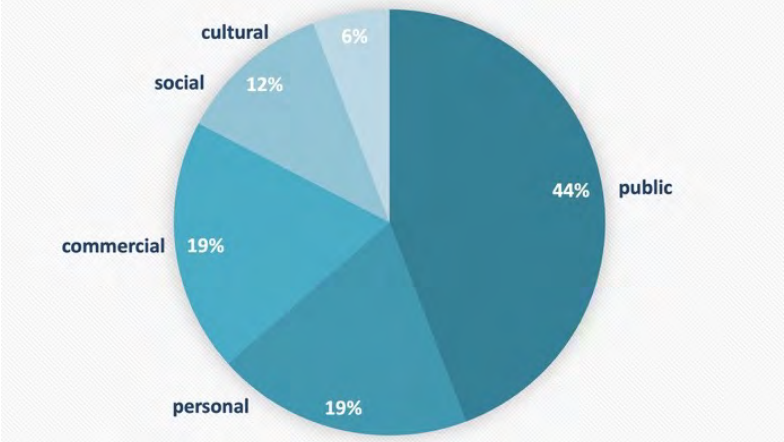



*Figure 7. Data analysis: Type of service*

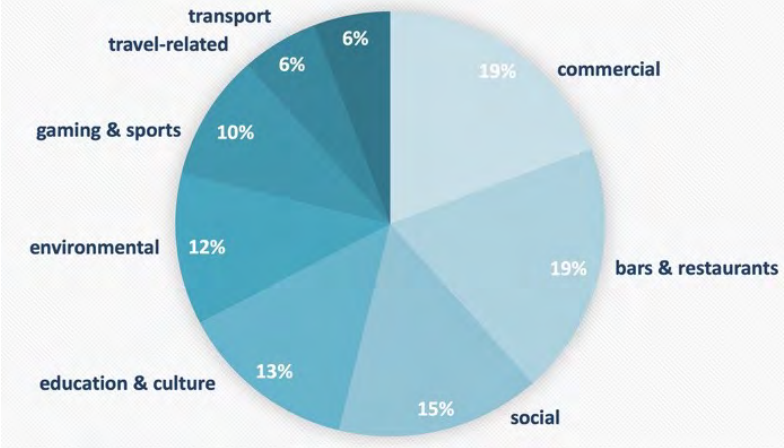



*Figure 8. Data analysis: Type of public services*

Services, as we have seen, involve almost half of the proposals. Whether tangible or intangible actions are concerned, all the design proposals fall under the category of «service to the people» (Lovelock, 1983). Students choose these services – as they do with domestic spaces – for they experience them directly in everyday life. Therefore, in their view, the design process rests on a solid basis.

The service types involved are (Fig. 7, 8) commerce (19%), bars and restaurants (19%), social services (15%), education and culture (13%), environment (12%), gaming and sports (10%), travel-related (6%) and transport services (6%). This list clearly shows the students' perception of the service sector nowadays rather than a forecast for the future. However, we discover an exciting landscape if we delve into the design proposals. Models walk down the catwalk in the lingerie shop; a redesigned tram on the tramway network brings farm-to-market vegetables to your doorstep; a robot waiter instantly serves you toast sandwiches. Students not only naïvely echo the principles of the experience economy (Pine and Gilmore, 1999) but also genuinely test new design opportunities by mixing desires, behaviours, and

events, always accurately, sometimes paradoxically, or ironically. Therefore, it is hard to fit many projects into a unique type of service. A coffee shop becomes a social experiment on food sustainability, from vegetable growing to waste disposal (Fig. 9). Shopping online turns into an opportunity to understand the process of customer retargeting (Fig. 11). Designing a social service always involves inter-generational, multi-user, and multi-cultural issues. Delving into the topic of education may produce an appropriate classroom layout to stimulate active learning or an exhibition about plastic pollution in the oceans.

*Figure 9. Design studio project. The Jungle Bar: farm-to-market no-waste food for students (Alessia Gianoli, Chiara Socin, Francesca Sutz)*

*Figure 10. Design studio project. Pocket Nature: pop-up oasis of green in the urban heat (Frédéric Lemoine, Simone Palai, Giulia Senni)*

Especially the students who addressed environmental and climate change issues came up with insightful design proposals. In most cases, they designed small protected environments spread in the urban space – which we named 'the pavilions' – and each proposal aimed to respond to an environmental issue and offer citizens a chance to participate in social gatherings. A barge, set up with plants, trees, and seats, slowly flows along the Navigli of Milan while a filtering system in the hull cleans up their water. A hypogean hall takes advantage of the lower subsoil temperature to host the citizens in the torrid summer, and so does a micro-lake enclosed with a thick palm tree curtain (Fig. 10). From a pedagogical perspective, it does not matter whether these proposals technically work or not. What counts is the knowledge the students can get about the issues involved. At this first stage, design education should teach students how to pose the appropriate question rather than insist on the necessity of finding the correct answer.

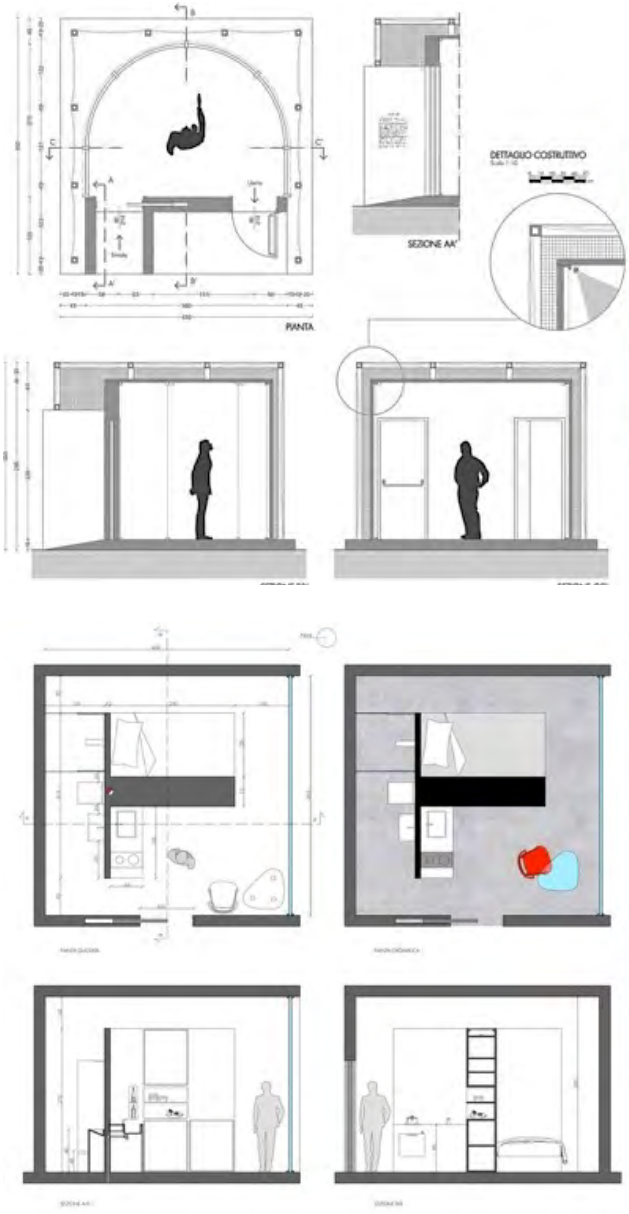



*Figure 11. Design studio project. Login: re-targeting or the hidden power of persuasion of the internet (Elisa Gazzola, Francesca Maggioni, Sonia Morosato)*

*Figure 12. Design studio project. Essenza: micro-living for nomadic workers (Alessia Orizio, Alessandro Meraviglia, Simone Savio)*

From a broader perspective, we may check what topics the students address as the main focus of their proposals. The analysis may be helpful from a sociological point of view in understanding the issues of future society which attract this young generation the most. As we have seen in previous analyses, each proposal addresses various design questions. The overlapping of several topics is typical of these students' design approach. It seems as if one single issue was insufficient to stimulate their creativity. Connections are far more galvanising. Therefore, the challenging design brief usually lies at the intersection of several research lines, no matter whether it makes the developing process much more demanding.

There is, however, a fundamental issue around which all the others revolve in any design proposal. Isolating this core issue, we see (Fig. 6) that the projects are equally distributed into three areas: technology (31%), society (31%), and the environment (32%).

A generation of digital natives (Prensky, 2001), the students are fascinated by technology in general and digital in particular. It is part of their life, and it is there when needed. Therefore, every space becomes a smart one. At home, at work, or in any shop, digital technology suggests new proposals that some students can even test and prototype. Environmental control applications are pervasive. 3D printers, body scanners, and domestic robots populate any place. Piezoelectric tiles spread on the floor of gyms and discos to produce energy through the movement of people. Mixed reality is a standard tool for discussing working topics. Wearing VR glasses is a habitual gesture to surf the metaverse for gaming, chatting, or travelling.

Envisioning such a joyful invasion of technology in the future, students confirm Ian Bogost's statement: «The services people seek out are the ones that allow them to use computers to do things […]. People choose computers as intermediaries for the sensual delight of using computers, not just as practical, efficient means for solving problems» (Bogost, 2017). Students quickly identify the potential behavioural change technology induces but rarely reflect on the consequences. The impact of technological change seems unavoidable. Only three proposals over more than a hundred delve into the hidden side of this new world: the exhibition mentioned above on customer retargeting, the psychiatric-clinic-like home of a metaverse addicted, and the surveillance-proof working space of a hacker.

Societal issues increased year by year progressively after we adopted STEPE analysis to produce an adequate background for the design brief and boomed with the pandemic. Also, the small number of projects dealing with psychology may fall into this category as individual issues caused by more extensive social conditions. Students seem aware that society is going through a substantial transformation – and the more it will in the future – but, unlike with technology, they are committed to understanding the issues at stake and, as designers, suggesting valuable solutions. None of the problems seems as big as to push them to renounce – ageing, health, education, and shrinking job opportunities equally fit into their agenda. The future society they depict crumbles in numberless individual behaviours moulded by culture, gender, age, politics, and census differences. To reshape such a pulverised social matter, the strategy they adopt is, in most cases, sharing and dialogue. Collaborative practices only can address the complexity of such problems. Therefore, they shape public and private places capable of stimulating such practices. Spaces themselves are adaptable, flexible and changing, similar to the processes they would like to promote and encourage.

Environmental issues have been addressed since the beginning. Students were eager to cope with such topics, although, in many cases, they naïvely perceived nature – in any of its manifestations – as sustainable per se. Besides wood and stone, natural fibres and natural dye, with which to cover the surfaces and make the furniture, the space was invaded by greenery, grass, rocks, tree trunks and bamboo cane. To cope with climate change, most proposals focused on mitigating temperature by using greenhouses or green walls; sometimes, the whole space sinks underground, producing spectacular 'wells' or 'caverns'. Not only were natural materials preferable to artificial ones, but nature had to be exhibited, even if it was not always understood how much technology was required for its maintenance and at what costs.

There were, however, proposals focusing on environmental issues such as waste recycling, water storage and cleaning, and sewage treatment with an appropriate, sustainable approach. Students addressed these topics as an opportunity to reshape public spaces in innovative and captivating ways rather than technically, underlining the value of future city living. Food production and consumption were also the core issues of many projects:

*Figure 13. Design studio project. Plastiki Taka: floating cocktail bar on the Pacific Trash Islands (Federica Conetta, Gaia Drago Cordaro, Anna Macchietto Pinotto)*

*Figure 14. Design studio project. The Judge's House: up in the sky looking from a distance the city life (Margherita Mansone, Vittoria Pezza, Elisa Zorzi)*

healthy eating behaviours, farm-to-table delivery, and home vegetable gardening have definitively entered our students' lifestyles.

Finally, a few proposals delve into the topic more critically, relying primarily on the design of paradoxical settings. Among them is an orbital hotel where luxury clients spend their time collecting space garbage to bring home as souvenirs or an urban shop only selling clean, fresh air to intoxicated citizens. One of the most provocative proposals we have seen in these years was "Plas Tiki Taka", a floating bar in the middle of the Pacific Trash Vortex where tourists arrive by ship to spend their time swimming and enjoying special drinks like Plasticolada, Treshquila and Rabbish on the beach (Fig. 13).

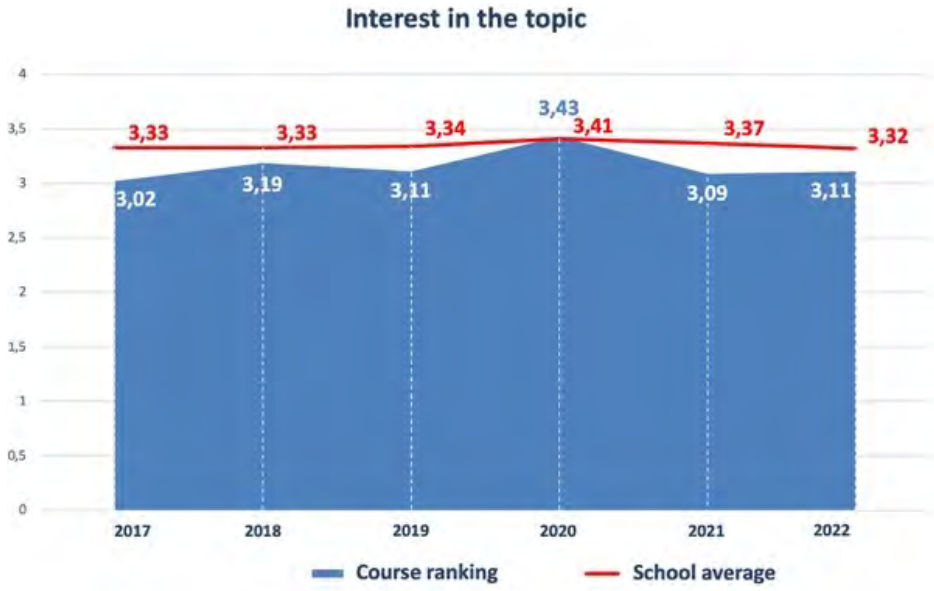
We may wonder whether there was a change in the students' proposals before and after the pandemic. If we check our database from this perspective, the shift may not appear, apart from the proliferation of hyper-sanitised entrances, wardrobes and bathrooms. Some new home dwellers, however, appear on the scene, like the metaverse-addicted and the judge in their house (Fig. 14). Why is the first living locked at home and the second rising in the cityscape if not because the metaverse-addicted foresees a real-world deprived of appeal and the judge embodies a claim for justice? Indeed, our students' perspectives subtly shifted. In 2021, one group – the only one out of over a hundred – suggested the design of a secular cemetery chapel where people can pause to meditate and recall their passed-away relatives.

## Conclusion

We can eventually flip our perspective from the students to the teachers. The Politecnico provides us with detailed feedback about our students' satisfaction . Quantitative data on several topics are carefully collected and compared to the School average. Only a few questions, however, are meaningful to test the effectiveness of this particular work. For instance, we know the students were interested in the subject of our course, which was constantly ranked slightly below the School average (Fig. 15), but they were unsatisfied with the outcomes (Fig. 16). From their perspective, our ability to motivate their learning progressively decreased from the initial years to the last (Fig. 17), which may be interpreted as fatigue of 'repetition'. However, they always appreciated us – some years even above average – as communicators and discussants (Fig.18). Students can also leave written comments. Only 165 out of 330 students did it (50%), 13% made proposals about improving the quality of our course, 14% appreciated and thanked ourselves for our work, and 23% criticised – sometimes harshly – the teachers and the course management.

The social dynamic of a design studio varies greatly yearly, as we all know, and managing this pedagogical tool is always challenging (Boling et al., 2016). Moreover, students' expectations of teaching in our School are very high. Nevertheless, it is hard to merge such contradictory evaluations. Undoubtedly, we took our students on a bumpy road. Behavioural psychologists tell us it is hard «to connect to our future self». Many people cannot even recognise their ageing faces and, therefore, make long-term plans for their lives (Hershfield, 2011). Whatever our students' personal future will be, the aim of the design studio was to let them understand that the social future is definitively a matter of design.


Satisfaction with the course
4
3,5
3
2,5
2
1,5
1
0,5
0
2,97
2,97
3
3,14
3,16
3,08
2,47
2,7
2,54
2,89
2,68
2,61
2017
2018
2019
2020
2021
2022
Course ranking
School average


Interest in the topic
4
3,5
3
2,5
2
1,5
1
0,5
0
3,33
3,33
3,34
3,43
3,41
3,37
3,32
3,02
3,19
3,11
3,09
3,11
2017
2018
2019
2020
2021
2022
Course ranking
School average


Teachers' ability to motivate
4
3
2
1
0
3,07
3,25
3,07
3,09
3,21
3,23
3,12
2,84
2,86
2,99
2,72
2,7
2017
2018
2019
2020
2021
2022
Course ranking
School average

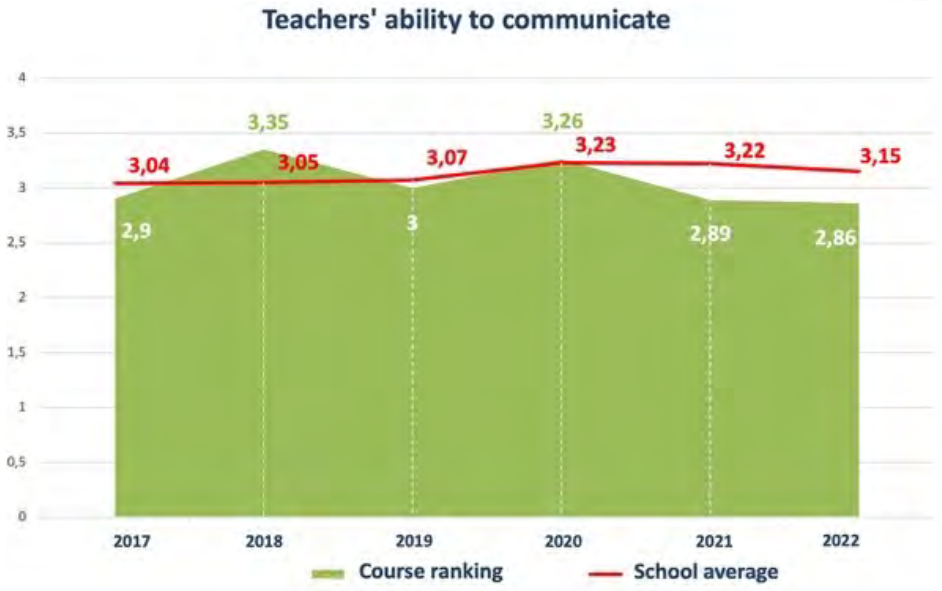



*Figure 15. Students' evaluation: Interest in the topic of the course*

*Figure 16. Students' evaluation: Satisfaction with the course*

*Figure 17. Students' evaluation: Teachers' ability to motivate*

*Figure 18. Students' evaluation: Teachers' ability to communicate*

Five years after we started this teaching/research project, a student I met the first year came back asking me to supervise his thesis. While discussing his work, I asked him what he recalled about his first-year design studio experience. He answered: «It is not an easy design studio for first-year students, but I do not see this as a negative aspect. On the contrary, it was one of the most valuable courses in my education. It is hard for anyone to imagine what the world will be like in 20 years, but it certainly helps to think outside the box. […] Thinking about the ethical and not only the aesthetic aspects of design is super important nowadays. We have always been taught to think about function and quality but never about our power to shape the world».

## Footnotes

1. The Design studio was directed by the author, with the help of colleagues who turned over the years: Rodolfo Maffeis and Paola Cordera (art historians), Daniela Maurer (product designer), Alessandra Di Virgilio (interior designer). They were assisted by Valentina Bisi (architect), Ludovica Squillacioti (interior designer), and Milo Mussini (interior designer).
2. A collaboration between the Philadelphia Museum of Art, the Walker Art Center of Minneapolis and the Art Institute of Chicago, the exhibition took place in the three institutions in October 2019-March 2020, September 2020-January 2021 and February-May 2021, respectively.
3. Fridays for Future was established in 2018. Milan's first Fridays for Future event occurred on March 15, 2019. For the first time, thousands of high school students gathered in the city centre and marched through the streets, protesting against the adults' apathy and inaction about climate change.
4. The « elephant chart » about global income inequality was firstly published by Branko Milanovic in a World Bank working paper in 2012. Krugmann, P. (January 2, 2015), "Twin Peaks Planet", Section A, p. 21 of the New York edition, The New York Times.
5. Translated from the Italian by the author.
6. Acronym of Social, Technological, Economic, Political, and Ecological. Richardson, J. (2017), A Brief Intellectual History of the STEPE Model or Framework. [Online] Available at: https://pages.gseis.

# References


1. Arnheim, R. (1974), *Art and visual perception*, University of California Press, Berkley, CA. [Online] Available at: https://monoskop.org/images/e/e7/Arnheim_Rudolf_Art_and_Visual_Perception_1974.pdf [Accessed 25 February 2024].
2. Arnheim, R. (1977), *The dynamics of architectural form*, University of California Press, Berkley, CA.
3. Bachelard, G. (1964), *The Poetics of Space*, translated by Maria Jolas, Orion Press, New York.
4. Bleecker, J. (2009), *Design Fiction: A Short Essay on Design, Science, Fact and Fiction, Near Future Laboratory*. [Online] Available at: https://blog.nearfuturelaboratory.com/2009/03/17/design-fiction-a-short-essay-on-design-science-fact-and-fiction/ [Accessed 19 February 2024].
5. Bogost, I. (2017), "You are already living inside a computer", *The Atlantic*, September 14, 2017. [Online] Available at: https://www.theatlantic.com/technology/archive/2017/09/you-are-already-living-inside-a-computer/539193/ [Accessed 25 February 2024].
6. Boling, E., Schwier, R.A., Gray, C.M., Smith, K.M. and Campbell, K. (eds.) (2016), *Studio Teaching in Higher Education*, Routledge, New York.
7. Carruthers, M. and Ryan, Z. *(eds.) (2014), The Future Is Not What It Used to Be: The 2nd Istanbul Design Biennial*, IKSV/Hatje Canz Verlag, Istanbul/Stuttgart.
8. Cantarella et al. (2021), *Il Futuro: Storia di un'idea*. Laterza, Roma-Bari.
9. Celant, G. (1972), "Radical Architecture", in Ambasz, E. (ed.), *Italy: The New Domestic Landscape*, The Museum of Modern Art, New York, pp. 380-387.
10. Corazza, G.E. (2019), "Creativity and Anticipation", in Poli, R. (ed.), *Handbook of Anticipation*, Springer, Cham, CH, pp. 761-772.
11. Dellapiana, E. (2022), *Il design e l'invenzione del Made in Italy*, Einaudi, Torino.
12. Dunne, A. and Raby, F. (2013), *Speculative Everything: Design, Fiction and Social Dreaming*, The MIT Press, Cambridge, MA.
13. Dunne, A. (2005), *Hertzian Tales. Electronic Products, Aesthetic Experience and Critical Design*, MIT Press, Cambridge, MA.
14. Ehn, P., Nilsson, E. and Topgaard, R. (2014), *Making Futures: Marginal Notes on Innovation, Design, and Democracy*, MIT Press, Cambridge, MA.
15. Facer, K. (2011), *Learning Futures: Education, technology and social change*, Routledge, London-New York.
16. Fry, T. (2008), *Design Futuring: Sustainability, Ethics and New Practice*, Berg, Oxford.
17. Guerrini, L. (2019), "Towards the future. Insights on research and training", in Bisson, M. (ed.), *Proceedings of the 3rd International Conference on Environmental Design*, Marsala, IT, October 03-04, 2019, University of Palermo Press, Palermo, pp. 211-218.
18. Guerrini, L. (2018), "Envisioning the future: report on a first-year design-studio project", in Collina, L., Abraham, A., Sagar, P. and Thapa, T. (eds.), *Letters to the Future, Cumulus Conference Proceedings Bengaluru 2017*, Srishti Institute of Art, Design and Technology, Bengaluru, pp. 223-237.
19. Guerrini L. (2006), "Seasons 'x1'. Abitare il cambiamento" [Seasons for 1: living the change], in Ciccone, F. and Büssgen C. (eds.), *Seasons in Design, Proceedings of the International Conference*, Università delle Calabrie, Cosenza, IT, April 26-29, 2006, Unical, Cosenza, pp. 84-95.
20. Hales, D. (2013), "Design fictions an introduction and provisional taxonomy", in *Digital Creativity*, vol. 24, issue 1, pp. 1-10.
21. Hall, E.T. (1966), *The Hidden Dimension*, Doubleday, New York.
22. Hershfield, H. E. (2011), "Future self-continuity: How conceptions of the future self transform intertemporal choice", *Annals of the New York Academy of Sciences*, vol. 1235, issue 1, pp. 30-43. [Online] Available at: https://doi.org/10.1111/j.1749-6632.2011.06201.x [Accessed 26 February 2024].

23. Hicks, D. (2002), *Lessons for the Future: The Missing Dimension in Education*, Routledge Falmer, London-New York.
24. Hiesinger, K.B., Millar Fisher, M., Byrne, E., Borjabad López-Pastor, M. and Ryan, Z. (eds.) (2019), *Designs for Different Futures*, Yale University Press, New Haven.
25. Hyde, R. and Pestana, M. (eds.) (2018), *The future starts here*, Victoria and Albert Publishing, London.
26. Ito, J. and Howe, J. (2016), *Whiplash: How to Survive Our Faster Future*, Grand Central Publishing, New York.
27. Kirby, D. (2010), "The future is now: Diegetic prototypes and the role of popular films in generating real-world technological development", in *Social Studies of Science*, vol. 40, issue 1, pp. 41-70. [Online] Available at: https://doi.org/10.1177/0306312709338325 [Accessed 25 February 2024].
28. Lovelock, C.H. (1983), "Classifying Services to Gain Strategic Marketing Insights", in *Journal of Marketing*, vol. 47, issue 3, pp. 9-20.
29. Lees-Maffei, G. and Fallan, K. (eds.) (2014), *Made in Italy: Rethinking a Century of Italian Design*, Bloomsbury, London.
30. Nanjo, F., Kondo, K., Tokuyama, H. and Harger, H. (eds.) (2019), *Future and the Arts: AI, Robotics, Cities, Life - How Humanity Will Live Tomorrow*, Mori Art Museum/Bijutsu Shuppan-Sha Co. Ltd., Tokyo.
31. Norman, D. (2007), *The Design of Future Things*, Basic Books, New York.
32. Papanek, V. (1985), *Design for the Real World* (2nd Ed.), Thames and Hudson, London.
33. Perec, G. (1998), *Species of Spaces and Other Pieces*, translated by John Sturrock, Penguin Classics, London.
34. Pine, B.J. and Gilmore, J.H. (1999), *The Experience Economy: Work is Theatre & Every Business a Stage*, Harvard Business School Press, Boston, MA.
35. Poli, R. (ed.) (2019), *Handbook of Anticipation*, Springer, Cham, CH.
36. Prensky, M. (2001), "Digital Natives, Digital Immigrants", in *On the Horizon*, vol. 9, issue 5, pp. 1-6. [Online] Available at: http://www.marcprensky.com/writing/Prensky%20%20Digital%20Natives,%20Digital%20 Immigrants%20-%20Part1.pdf [Accessed 10 February 2024].
37. Scodeller, D. (2014), "Exhibition, anti-exhibition: su alcune questioni espositive del pop e radical design italiano, 1966–1981", in *AIS/Design*, vol. 2, issue 3, pp. 10-28. [Online] Available at: https://www.aisdesign.org/ser/index.php/SeR/article/view/52/47 [Accessed 10 February 2024].
38. Slaughter, R. (1999), *Futures for the Third Millennium: Enabling the Forward View*, Prospect Media, Sydney.
39. Stappers, P.J. and Sleeswijk Visser, F. (2014), "The role of prototypes and frameworks for structuring explorations by research through design", in Rodgers, P. and Yee, J. (eds.), *The Routledge Companion to Design Research* (1st ed.), Routledge, Abingdon, UK, p. 164 (caption of figure 13.1).
40. Stepanović, M. (2022), *Design fiction for critical thinking: designing consciously technological artefacts to tackle aware behaviours*, Doctoral thesis, PhD programme in Design, Politecnico di Milano, Supervisor Prof. V. Ferraro. Discussed March 24, 2022.
41. Voros, J. (2001), "A Primer on Futures Studies, Foresight and the Use of Scenarios", in *Prospect, the Foresight Bulletin*, vol. 6, issue 1. [Online] Available at: https://www.downloadmaghaleh.com/wp-content/uploads/edd/maghaleh/1398/13260.pdf [Accessed 10 February 2024].
42. Yelavich, S. and Adams, B. (eds.) (2014), *Design as Future-Making*, Bloomsbury, London.

# Design as a catalyst for rural regeneration: Insights from a Research through Design study

*Alessandro Ianniello[1], Riccardo Palomba[2]*
*a.ianniello@tudelft.nl*

*[1]TU Delft, The Netherlands*
*[2]IUAV, Italy*

***Keywords:***
*Territorial Regeneration*
*Common Good*
*Design Futures*
*Co-Design*

## Abstract

Design, as both an image and a tool for envisioning contemporaneity (Maze, 2019), plays a crucial role in challenging established paradigms to promote the Common Good amidst escalating global complexity and unsustainable dominant models (Dorst et al., 2016). Focusing on regenerative practices, this contribution originates from a critique of urban models (Ahvenniemi et al., 2017), specifically tackling the desertification of rural areas, that creates greater uncertainty into the social fabric, but also brings a dynamism due to their openness to change. (Maak, 2020).

Given these premises, the paper discusses a series of design tools, developed to facilitate bottom-up actions and to support practices of regeneration, involving local communities.

Developed through a synthesis of typical Design methodologies, the tools underwent testing in an iterative Research through Design process (Stappers & Giaccardi, 2017). This approach facilitated the creation of effective tools utilized in a collaborative workshop involving academic and associational entities. The paper concludes by discussing the results achieved.

## Introduction

Contemporary society is characterized by an extreme complexity (Raymond et al., 2020) that manifests in many of its aspects, from the political sphere to the environmental one, passing through the economy and the technological development (Benbya et al., 2020).

This increasing complexity is the cause and, at the same time, the consequence of a series of wicked issues and problems (Lönngren & van Poeck, 2021), which require new approaches and methodologies capable of recognising them (Grewatsch et al., 2023) and thus making sense of them (Earle & Leyva-de la Hiz, 2021), as a necessary condition for systemic transformations in the current paradigms, capable of defining solutions (Miikka et al, 2022): one of these, central to the development of the research reported here, is identifiable in the growing global urbanization that, among the various consequences it generates, strongly impacts on the state and quality of life in non-urban territories, bearers of a series of values that are more contemporary and necessary than ever, but at high risk of abandonment.

Starting from these considerations, while recognizing the responsibilities of design in perpetuating and being instrumental in maintaining a system of

values and apparatuses (Maze, 2008) that are the cause of the various crises we are experiencing (Santangeli et al., 2022), it is also true that, due to its dual nature as a constructor of meanings and as a problem-solver (Manzini, 2014a), this discipline, in some of its declinations, can become a transformative vehicle and a catalyst for forms of social and environmental regeneration (Manzini, 2014b).

Since the 2000s, building on a pre-existing drive (Raby, 2008), design has increasingly critically questioned its own role, generating, as a response, a series of disciplines, methodologies, approaches and design practices that aim to stimulate abstract and concrete, sense-making and problem-solving, transformative and regenerative processes, devoted to a collective and pluriversal definition (Demaria et al., 2023) of more responsible, equitable and just future visions (Malpass, 2017).

In this heterogeneous ecosystem, three particular areas of design have been highlighted that, when blended into a holistic methodology and practice (Kaitouni et al., 2023), can foster and stimulate the aforementioned processes, becoming a means of researching, devising and applying regenerative practices for the territory and the communities that inhabit it (Manzini, 2014b).

The practices identifiable under the umbrella of design futures (Galloway & Caudwell, 2018; Candy & Kornet, 2019; Baumer et al., 2020) are tools capable of catalyzing imaginative processes and the construction of visions, scenarios, narratives and future artifacts, capable of stimulating critical thinking and meaning-making around complex issues.

Transition design (Irwin, 2015) is a design discipline that systemically and strategically defines a series of alternative pathways capable of leading towards imagined desirable futures, applying tools and methods derived from design for social innovation and sustainability.

Finally, through the application of co-design principles (Sanders & Stappers, 2008), the methodology identified allows for the activation of mediation processes, also enabling the territorial communities of reference to participate in design practices that place them and the territory at the center of their activities.

The aim of the paper is therefore to present the methodology and the tools devised, useful to facilitate project processes that aim to co-regenerate territories at risk of abandonment together with their communities of place. In this contribution, a first phase of a more articulated process involving several steps to achieve the aforementioned objective is presented. The focus is therefore oriented on the design and the first meta-design experimentation of the tools created, useful to understand their complexity of use.

The first section of the paper introduces the background and context of the research, while in the second the discourse focuses on the role of design in regeneration processes. The third part is devoted to the introduction of the tool developed, the testing phase in a workshop and the results obtained.

The contribution concludes with a discussion part that makes the highlighted limitations explicit and then defines potential guidelines for overcoming them, as well as outlining possible future developments.

## Background

The contribution is positioned within a specific reference context, which has its origins in a critique of more recent models of cities, such as smart cities, and urbanization (Han & Kim, 2021).

This type of city is not proving capable of supporting and encouraging the changes demanded by different social groups, who seek a slower and more local dimension of life, which favors the construction of intimate and

meaningful relationships. In fact, urban space is presented as too defined, incapable of imagining new spaces for new demands, which is why Maak (2020) defines the smart city as a simply efficient 'eco' version of existing urban models. Changes in work, demographics, technology and social rituals call for new strategies, systems, structures and spaces that encourage different ways of living in community, but in this context of technological revolution, the focus is still strongly on urban models.

Due to increasing urbanization, many rural regions are often perceived as backward when thinking about them, especially in terms of services, when compared to cities (Š astná and Vaishar, 2017). There is no doubt that rural areas have some critical issues, in addition to the one just described: they are further subject to desertification and abandonment processes that are causing an aging population (Kroll and Haase, 2010) and an abandonment of activities (Yang et al., 2018), as younger segments migrate to the city, in search of new opportunities (Crow, 2010).

While representing pressing threats, these phenomena and this instability characterize the rural environment with a certain mutability and flexibility, making it less static and defined than the urban environment, more permeable, inclusive and open. These factors are decisive in characterizing these places as spaces for experimenting with models that pursue values of environmental, social and economic sustainability (AMO et al., 2020) and new ways of living rooted in the context, integrating care of the land as a prerogative for these models. In this sense, rural environments can become spaces of freedom, experimentation and self-responsibility, and local initiatives can be an appropriate response to the global challenges we collectively face (Maak, 2020).

In conclusion, the rural territory, in this vision, becomes the center of processes of reconnection between different living systems - and of humans with places and nature - in search of a reconstruction of the metabolic divide that exists between us and the latter (Thackara, 2019). It is the cause of the crisis of values, which in turn generates an environmental and social crisis. The land thus becomes a common good (Dorst et al., 2016), the care of which can regenerate the communities that inhabit it towards more sustainable futures.

## Design as facilitator for territorial regenerative processes

The aforementioned issues challenge many aspects characterizing current models and paradigms, and as stated earlier, design can be a tool for maintaining the status quo or transforming it.

In the relevant context, taking an internally critical perspective of the discipline, design means seeking and applying a holistic approach that considers the interests of local communities, land, and biodiversity as equals and parts of a system made of interconnections and complex interdependencies (Thackara, 2019).

Consequently, community involvement is one of the key aspects to be sought, leveraging co-design practices that systematize different knowledge and expertise. In this regard, Manzini (2015) suggests that everyone possesses the ability to design, even if not everyone is a competent designer and even less a professional designer, who should focus energies in allowing multiple social actors to take part in co-creation processes (Calvo & De Rosa, 2017).

The designer thus assumes a facilitator role, as he or she enables the con-

struction of co-designed visions with non-experts, translating and making understandable needs, wants, and desires that emerge during the co-creation of futuristic strategies.

For this reason, the research carried out by the authors investigates-as another key element-that thematic area defined as design futures, which is generally concerned with imagining and hypothesizing alternative futures to the most likely ones. Within these practices, very often storytelling (Ciancia, 2016) and world-building (von Stackelberg & McDowell, 2015) are used as tools for constructing narratives that define and make experiential the imagined future scenarios. Indeed, design possesses a profound ability to construct meaning through the creation of tangible outputs that thus foster processes of empathizing with the scenarios and narratives envisioned (Coulton et al., 2017).

In addition, design is capable of constructing meaning by reframing complex issues in the present and thus enabling stakeholders to arrive at a shared understanding and vision, which is essential for coordinating short- and long-term actions.

Instead, building a future that seeks to overcome the complex issues of the present allows actors involved in design processes to co-create desirable visions and develop "transitional pathways" to achieve them (Irwin, 2019).

This process ensures that long-term thinking becomes a shared process and that future visions maintain a high degree of dynamism, in a continuous process of evolution and transformation, based on feedback and results from present and short-term projects.

The research therefore aims, following the theories of transition design (Irwin, 2015), to address complex issues in a systemic and multilevel manner, considering different perspectives and investigating the relationships between global, regional and local impacts.

In order for these processes to be effectively activated, it is crucial to stimulate social transitions, which, in the context of reference, means supporting bottom-up forms of innovation through the creation of conscious dynamics of change (Tonkinwise, 2014).

## A Research through Design approach: The creation of the toolkit

Research through Design is a research methodology that is based on the correlation between reflection and action, where the latter is not a solution-oriented means, but a meaning-making tool, emphasizing, therefore, a continuity between experience, experimentation, processes, and research (Rylander, 2012). Therefore, experience, as the result of interactions, becomes the space for inquiry and construction of meaning (Feilzer, 2009): creative action is a tool for nurturing a constant and continuous process of transformation and change (Creswell & Plano Clark, 2011).

In the design discipline, theory and practice, and reflection and action are strongly interrelated with each other, making this field highly experimental, interventionist, and transformative (Dalsgaard, 2014).

Design research is, therefore, based on active and reflective practices as a means to building new knowledge situated in the real world (Reich, 2017): hence, the tangible outputs of these practices foster both processes of knowledge creation and of critical reflections, adopting particular issues as a starting point for RtD processes, also becoming a tool to connect theories with practices (Goldkuhl & Sjöström, 2018).

Therefore, RtD can be defined as a scientific inquiry that exploits design practices and actions to gather data and to provide a better understanding of complex and future-oriented issues (Godin & Zahedi, 2014).

In the context of the research reported here, the design of the method and the enabling toolkit represented the design output that was tested in a workshop, to understand its validity and limitations within a more structured process. And consequently, to understand the validity and limitations of the interpretation of the research carried out by the authors.

## Method and tools development

After identifying the theoretical foundations of the research, we moved on to a more operational phase in which the selected methodologies could find integration and application through the creation of tools capable of proactively involving other actors in the design processes of futuristic scenarios.

The method developed involves six steps, facilitated by canvas and decks of cards developed specifically for this type of activity, echoing tools typical of the integrated design areas.

In the reference context, the first activity required to design a scenario is an in-depth analysis of the places, taking into consideration several factors of relevance, in some cases latent, to the communities who inhabit these territories. At this stage, it is essential to have a well-delineated general picture of the historical and geographical characteristics of the territory, the lifestyle of the people, and the dynamics that occur in this society.

To facilitate this step, the first canvas was developed, which introduces an ice-breaking activity in which the focus is on the human and non-human actors who will populate the scenario and the actual place where it will be contextualized. Further focus is made on the trends of relevance to be considered in constructing the scenario. To facilitate these choices, a deck of cards has been developed in which some possibilities are shown, specifying, however, that the choice should not be constrained to the suggested options, which serve as examples and inspiration.

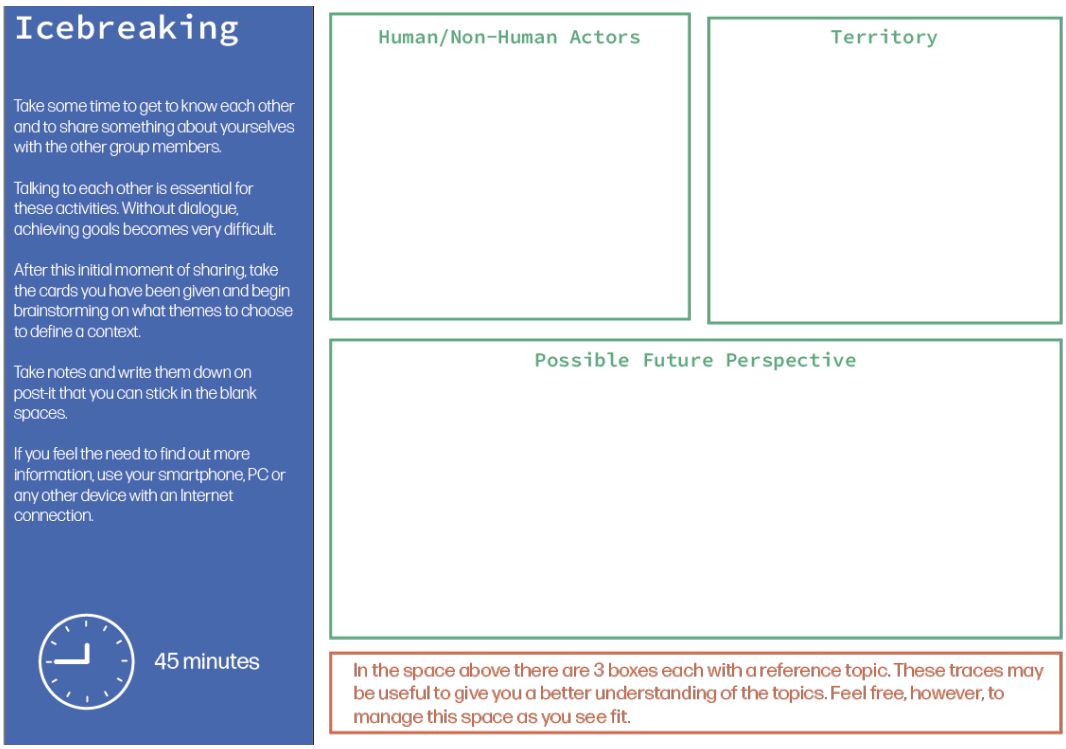



*Figure 1. Deck of the first phase of the workshop with attached cards: Icebreaking.*


*Figure 2. Deck of the first phase of the workshop with attached cards: Icebreaking.*

The second phase involves an immersion in the place of reference, whose choice is guided by the tools developed to facilitate this phase: based on the selection made during the previous activity, one among four "Place" cards is handed out, which report an introductory description of a real existing place, considered to be in the process of being abandoned.

STEEP (an acronym for Social, Technological, Environmental, Economical, Political) analysis is then conducted concerning this place. It is a tool developed in the field of future studies and spatial analysis, which establishes a framework for analyzing the current situation and potential future trends of a context. To better understand what the potential changes triggered by these trends might be, it is effective to categorize them, mapping the complexity of a spatial system at different levels to hypothesize future directions (Akinyeke et al., 2018). Taking advantage of the designed canvas, participants conduct independent research focusing on one or more of the STEEP domains, thus directing the focus of the scenario.

In this way, it is possible to obtain a systemic picture of the context in which they intend to work, obtaining knowledge that is fundamental to laying the groundwork for the development of possible paths toward the creation of future scenarios.

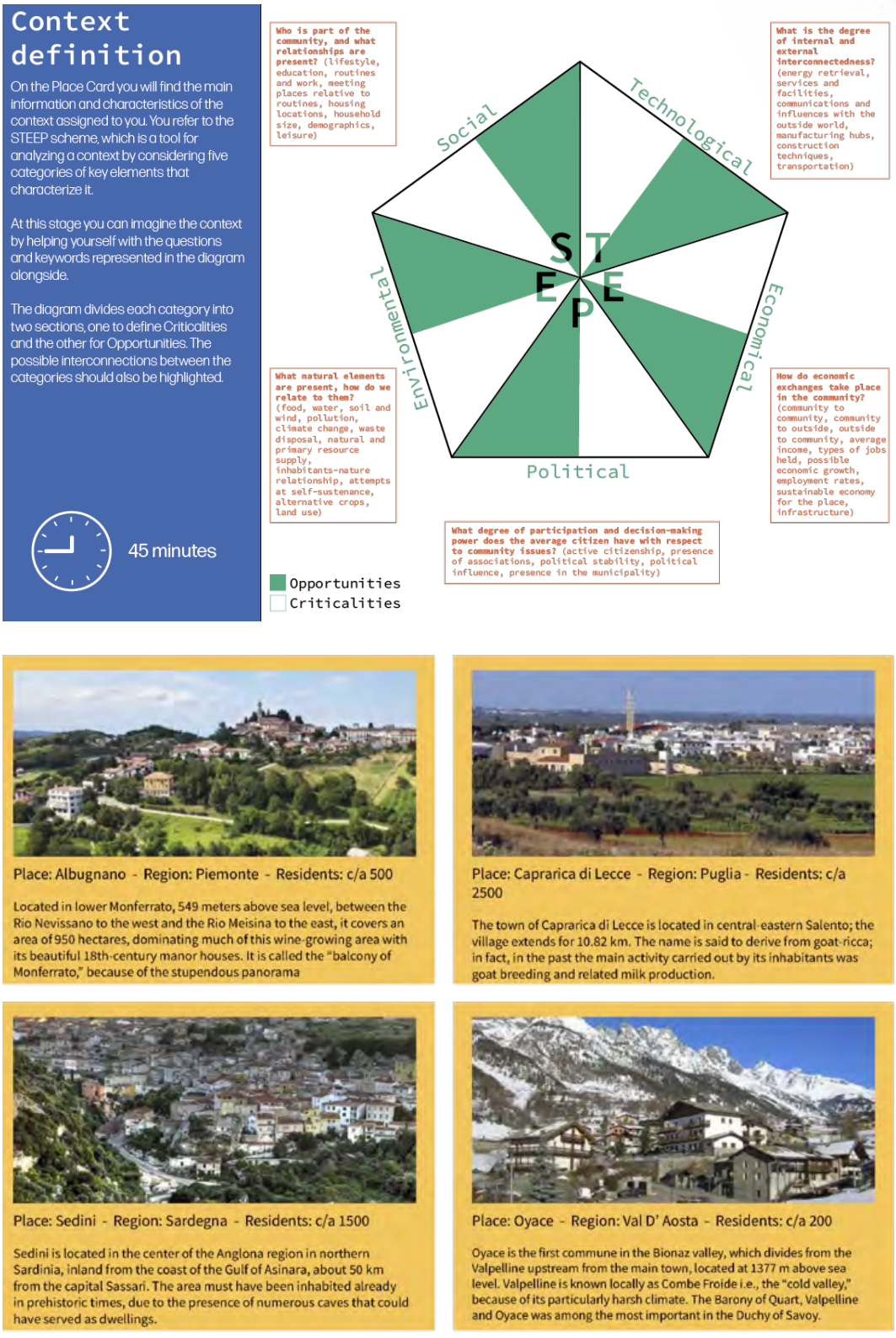


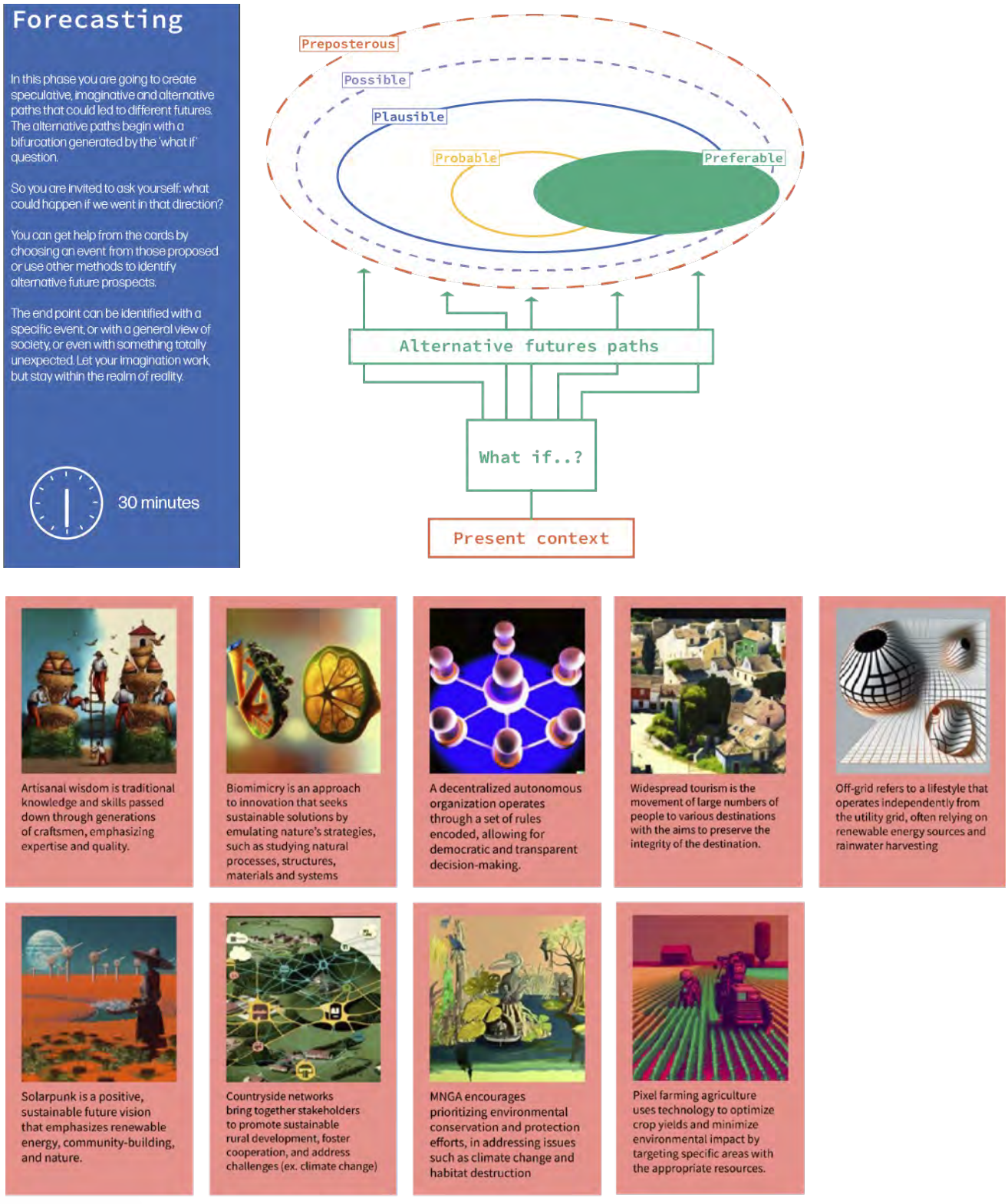

*Figure 3. Figure 4. STEEP analysis phase table with attached maps: Context definition.*

Once the contextual analysis has been constructed, possible directions for territorial regeneration can be identified by supporting speculative and imaginative reasoning that enables the creation of pathways to alternative futures.

This forecasting phase is based on counterfactual and hypothesis-building processes (Abrahams, 2020) activated through "what if" questions. In this way it is possible to reconstruct transition paths by visualizing a goal

and trying to anticipate actions to achieve it. Further help was provided through the deck of "Alternative Perspectives" cards depicting previously studied future trends. These are to be considered as suggestions to reinforce the construction of a future vision and answer the "what if" question in more detail.

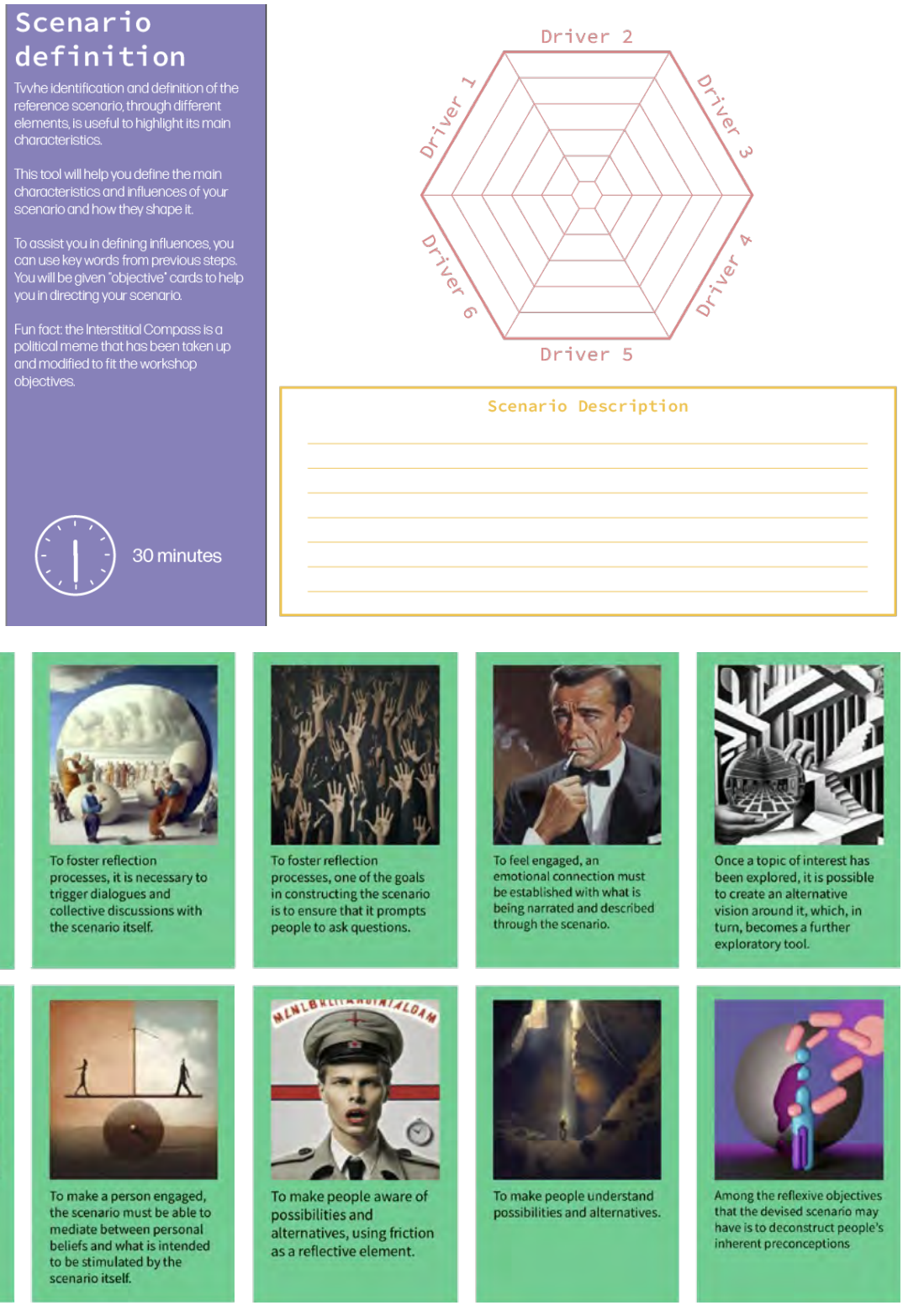
*Figure 5. Figure 6. Table of the futuristic projection stage with attached cards: Forecasting.*



Once the alternative path has been established, we enter the future scenario construction phase, which is done by compiling a radar diagram. From the territory analyses and identified trends, participants extrapolate a maximum number of six drivers through which to define the scenario, its characteristics, and the relationships it establishes with the territory.

To support this activity, the deck of "Objective" cards is designed to provide potential inspirations on the motivations for building a scenario that tends toward some features more than others.

*Figure 7. Figure 8. Scenario creation phase deck with attached cards: Scenario definition.*



The next phase involves imagining a situation that could plausibly take place in the constructed scenario, in the form of a narrative. It is then required to specify the actors involved, their goals and values, contextualising the spatial and temporal dimensions and highlighting the relationship system between the actors and the territory. In this way, different aspects of the scenario and possible ways to achieve it can be further detailed.

*Figure 9. Table of the storytelling phase: Narrative world.*

*Figure 10. Table from the last phase of concept generation: Wheel of things.*

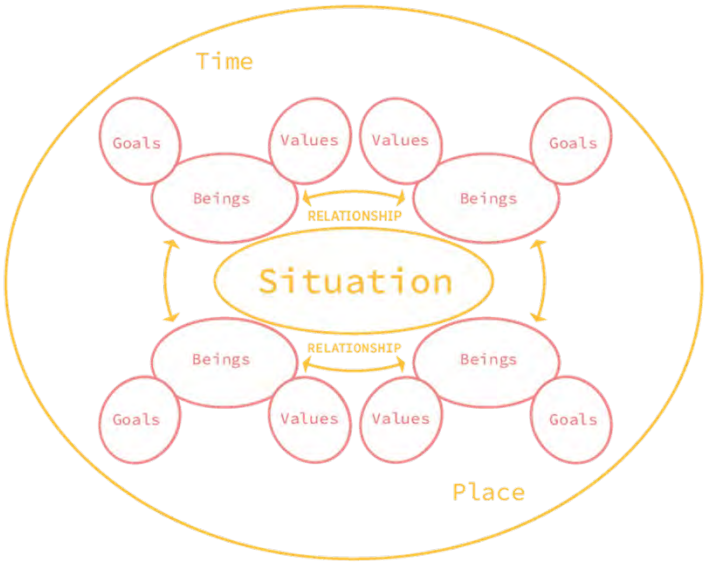
## Narrative world

Think on the definition of a precise draft narrative, referring to the conceived scenario, to serve as a characterising and communicative element for the scenario itself.

The tool you are going to use in this phase will help you in the creation of a draft narrative world, which can be placed within the reference scenario.

You will be asked to imagine a particular situation and place it in space and time; to indicate some of the beings that inhabit your narrative, what relationships they establish, their values and goals.

45 minutes




## Wheel of things

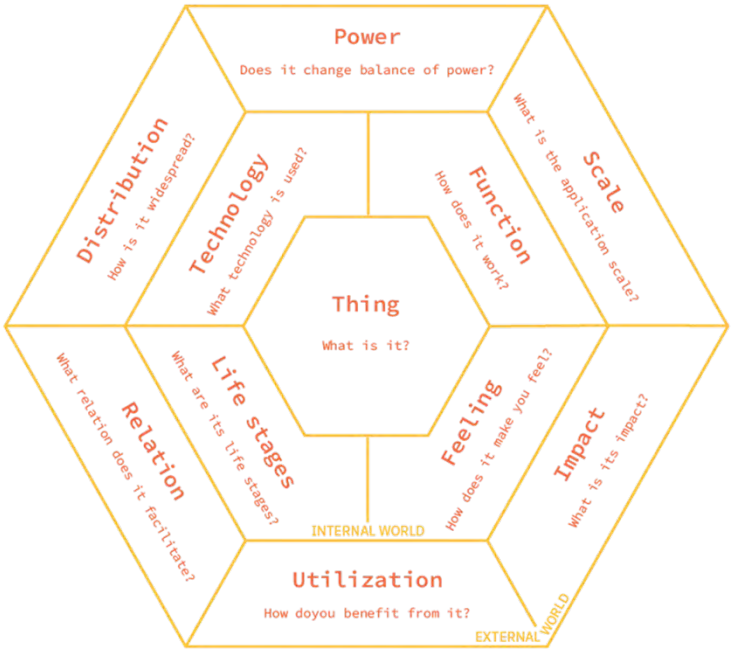
Try to project something situated within the narrative world outlined in the previous activity. Through this design activity, an alternative scenario can be made tangible and experienceable.

You will use this tool to define a thing (object, setup, dataviz, performance and many more) belonging to the narrative world you have created.

By highlighting the descriptive aspects of the tool, you will be able to delve into the main elements characterising your object and begin to give it a shape.

Fun fact: this tool was born from the hacking of one developed by Imagis Lab, a research laboratory of the Politecnico di Milano.

45 minutes



The last phase involves the creation of a concept that can be situated in the previously identified narrative, be it a product, a space or a service. There are two canvases developed to facilitate this final activity: a white board in which one can represent a concept exploiting free techniques and tools; and a second board that instead helps to focus attention on certain features of the concept, such as, for example, appearance, function, technology, use, scale, impact, and so on.

This is useful for further grounding the scenario, detailing and deepening it by devising a situated concept that highlights additional features.

## Testing the method and the toolkit

To test the method and the designed tools, a workshop was organized, in which 12 young designers participated. The decision to involve such a specific target audience was motivated by the need to understand the degree of complexity of the tools, first by gathering the impressions of a group of people trained in design and, therefore, with greater sensitivity and experience in determining potential weaknesses when the tools should be proposed to non-experts.

After the introduction of the activities and tools, the participants were divided into three groups and went through the different stages in about 5 hours. Each group was able to develop their own scenario, reference narrative, to the point of defining and creating a situated concept within the proposed narrative. After the last phase ended, each group quickly presented their scenario, recounting the process they followed and how they used the tools presented. The following is a brief summary of the outputs achieved by the three groups:

- The first group focused on devising a digital platform capable of connecting different activities in the area, managing to produce a circular system whereby the waste from an activity can be material for experimentation for other actors and realities. Specifically, from the study of a hilly territory with strong ties to viticulture, a proposal emerged to use waste to innovate the fashion industry, hybridizing modern technologies with traditional crafting techniques. This platform is useful for strengthening the collaborative dynamics of local networks.
- From a study of a seascape-related territory, the second group focused instead on designing a structure for tourism services that enhances the natural assets offered by the target area. Using niches and caves, naturally carved out, it is possible to house people for short periods, offering services related to the traditions and practices that characterize the area.
- The third group focused on identifying a series of technological implementations that bring innovation to the agricultural system from the knowledge of tradition. Working on the small and medium scale, a system was created in which to engage local communities with land tenant practices, fostering local self-sustenance and consolidating agricultural production.

Following this telling phase, we carried out a last dialogue in which participants expressed their views on how the workshop was organized, the tools and activities designed, making explicit strengths and weaknesses. This conversation was useful for rethinking some of the dynamics activated, which, as will be read later, were questioned in order to overcome their highlighted limitations.

## Results

The processes activated by the designed method and facilitated by the created tools, allowed all groups to begin a systemic design process that considered aspects of transitional development that can proactively involve different local and non-urban territory actors. In this regard, the project objective was successfully achieved, namely, the construction of a future and plausible scenario through which to activate a paradigm shift that fosters forms of territorial regeneration by combining local traditions with contemporary social practices and technologies.

In addition, the projects, although at the conceptual stage, show originality and are characterized by a notable applicative component. Despite the short time given to them, the results achieved by the different groups brought forth disruptive ideas that can stimulate the construction of alternative, meaningful and applicable regenerative practices.

One element that was considered particularly supportive were the different decks of cards provided to the participants as further guidance in carrying out the activities. During the concluding discussion, it was suggested that their number and relevance to the different processes should be increased.

Additional indications of interest emerged from the participants, such as the need to provide moments of interaction between the different groups involved, in order to share potentially useful intragroup information, which, if working on different contexts and themes, would result in mutual inspiration, without the risk of conceptual contamination.

A further aspect of relevance highlighted is the need to have more support in the production of the different outputs during the process, in terms of the expressive form of the content produced.

The STEEP analysis activity and its graphical translation in the canvas were found to be difficult to understand and use for all groups, therefore denoting the need to simplify them or to introduce practical examples to support the requests, capable of guiding the process. This observation can be generally extended to all the realized canvases which were considered excessively abstract by the participants.

Finally, a last observation focused on the importance of emphasizing the ambiguity and uncertainty of the different processes activated and, consequently, the free interpretation of the tools by the participants, who should not feel constrained by them, nor under pressure and cognitive load in carrying out a project with a precise and well-defined expected outcome.

## Discussion

The research presented here represents the first in a series of steps, some of which had already been developed at the time of writing this paper. From the experience gained in this step and the suggestions gathered from the workshop participants, it was possible to understand the need to rethink the structure of the method and activities, in order to shift the focus from constructing narratives to building strategies for achieving the desired alternative scenario.

Version 2.0 of the toolkit, which will not be discussed in depth here, incorporates methods that hybridize more speculative approaches to the discipline of transition design, which can facilitate those more pragmatic steps needed to translate visions into future strategies.

Despite the awareness developed in this first phase, some critical reflections around limitations highlighted by participants remained valid in the

development of later versions of the toolkit.

The complexity of processes and tools becomes more evident and problematic by remembering the real target audience for the developed activities, namely communities of place who are unfamiliar with design processes, although they are repositories of highly situated and contextualized knowledge.

In this sense, it is therefore crucial to develop understandable tools that can dialogue with people who are not used to dealing with the complexity of a design process. To achieve a good result and establish a direct relationship aimed at the pro-active participation of these people, it is useful to refer to some typical methods of Sociable Design (Tjahja and Yee, 2022). A sociable designer is guided by three core characteristics that are based on essential values and actions when operating in the social innovation space: building trust and healthy social relationships with the community of place; active engagement and clear communication of one's intentions to community members; and an equal approach to the community (Hancock 2019), clearly recognizing one's own role and that of others with a view to achieving a shared goal.

With this in mind, we are aware that the tools proposed for the workshop cannot be presented to a target audience of non-designers. Therefore, it is necessary to use the structure and tools tested as an outline to simplify the language, creating a smoother process that can be understood by all the stakeholders involved. A socially integrated practice requires that designers simultaneously create and become part of the social fabric surrounding the initiative before attempting to co-design any kind of solution, product or service.

The above reflections are mainly concerned with methodological aspects and issues around the structure, objectives, language and complexity of the toolkit and the different design phases enabled by it. A further reflection must be reported, which instead concerns a more content-related aspect that cannot be overlooked: all the groups that participated in the workshop failed to imagine a non-human component involved in the scenario and narrative, interpreting Nature as merely a context of reference, to be preserved but not actively included in the design process.

This lack can be caused by numerous reasons: first and at a higher level, especially for Western individuals, it turns out to be more complicated to interpret Nature as an active subject with its own agency and intelligence (Epstein, 2020), while the main role given to it is that of an object, at best, to be preserved. This is a symptom of what Thackara (2019) calls a metabolic fracture between humans and the natural world, which needs to be overcome in order to activate real regenerative processes at the inter-relational and inter-species level, thus with the local territory and its community of humans and non-humans. Starting from this rationale and applying it to the research at hand, it is evident that the tools developed have not been effective enough in facilitating this complex process of perspective change. Their revision must also and necessarily therefore come through increased attention and guidance towards this specific aspect.

## Conclusion

The contribution is contextualized in a critical discussion towards contemporary urbanization processes and the main city models promoted and researched. It identifies rural spaces as a potential alternative that is flexible, dynamic and open to the experimentation of more sustainable, inclusive, innovative, and regenerative practices from a social and environmental standpoint.

It also identifies design, and especially the integration of some of its approaches, as a possible catalyst for the construction of alternative visions that can stimulate these regenerative processes from the bottom, including communities and inter-species assemblages of place in them.

From these considerations, the paper proposes a method and tools that hybridize approaches of design futures to processes of transition design and co-design, with the aim of co-designing scenarios, narratives and concepts belonging to desirable and regenerative futures.

The toolkit was tested in a workshop involving several designers, in order to understand its strengths and weaknesses, especially in function of the fact that the reference co-designer to be involved will be the communities of place, who have no experience in design practice, although they are repositories of high situated knowledge. The paper then proposes and analyzes the results obtained from this activity and concludes with a discussion in which some critical reflections are reported, regarding methodological and content aspects.

# References


1. Abraham, A. (Ed.). (2020). The Cambridge handbook of the imagination. Cambridge University Press.
2. Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities? Cities, 60, 234–245.
3. Akinyele, D., Belikov, J., & Levron, Y. (2018). Challenges of Microgrids in Remote Communities: A STEEP Model Application. Energies, 11(2), 432.
4. AMO, Koolhaas, R., Design, H. G. S. of, Arts, T. B. C. A. of F., University, W., Netherlands, the, Nairobi, T. U. of, & Boom, I. (2020). Koolhaas, Countryside, A Report. TASCHEN.
5. Baumer, E. P. S., Blythe, M., & Tanenbaum, T. J. (2020). Evaluating Design Fiction: The Right Tool for the Job. Proceedings of the 2020 ACM Designing Interactive Systems Conference, 1901–1913.
6. Benbya, H., Nan, N., Tanriverdi, H., Tanriverdi, H., & Yoo, Y. (n.d.). Complexity and Information Systems Research in the Emerging Digital World.
7. Calvo, M., & De Rosa, A. (2017). Design for social sustainability. A reflection on the role of the physical realm in facilitating community co-design. The Design Journal, 20(sup1), S1705–S1724.
8. Ciancia, M. (2016). Storytelling & Worldmaking: The world-building activity as a Design Practice. In The Pearl Diver. The Designer as Storyteller. DESIS Philosophy Talks: Storytelling & Design for Social Innovation. (pp. 72-76). DESIS Network Association-Dipartimento di Design, Politecnico di Milano.
9. Coulton, P., Lindley, J., Sturdee, M., & Stead, M. (n.d.). Design Fiction as World Building.
10. Creswell, J. W., & Clark, V. L. P. (2017). Designing and conducting mixed methods research. Sage publications.
11. Crow, H. (2010). Factors influencing rural migration decisions in Scotland: an analysis of the evidence (pp. 1-69). Edinburgh, UK: Scottish Government.
12. Dalsgaard, P. (2014). Pragmatism and Design Thinking. 8(1).
13. Demaria, F., Kothari, A., Salleh, A., Escobar, A., & Acosta, A. (2023). Post-development: From the Critique of Development to a Pluriverse of Alternatives. In S. Villamayor-Tomas & R. Muradian (Eds.), The Barcelona School of Ecological Economics and Political Ecology (Vol. 8, pp. 59–69). Springer International Publishing.
14. Dorst, C. H., Kaldor, L., Klippan, L., & Watson, R. (2016). Designing for the common good: A handbook for innovators, designers, and other people (K. Dorst, Ed.). BIS publishers.
15. Earle, A. G., & Leyva-de La Hiz, D. I. (2021). The wicked problem of teaching about wicked problems: Design thinking and emerging technologies in sustainability education. Management Learning, 52(5), 581–603.
16. Epstein, S. (2023). Rights of nature, human species identity, and political thought in the anthropocene. The Anthropocene Review, 10(2), 415–433.
17. Galloway, A., & Caudwell, C. (2018). Speculative design as research method. In G. Coombs, A. McNamara, & G. Sade (Eds.), Undesign (1st ed., pp. 85–96). Routledge.
18. Godin, D., & Zahedi, M. (2014). Aspects of Research through Design: A Literature Review.
19. Goldkuhl, G., & Sjöström, J. (2018). Design Science in the Field: Practice Design Rese-

arch. In S. Chatterjee, K. Dutta, & R. P. Sundarraj (Eds.), Designing for a Digital and Globalized World (Vol. 10844, pp. 67–81). Springer International Publishing.
20. Grewatsch, S., Kennedy, S., & (Tima) Bansal, P. (2023). Tackling wicked problems in strategic management with systems thinking. Strategic Organization, 21(3), 721–732.
21. Hancock, F. (2019). A relational approach to community and social innovation: Practices that make a difference. Auckland, New Zealand: Auckland Council.
22. Idrissi Kaitouni, S., Pfafferott, J., Jamil, A., Ahachad, M., & Brigui, J. (2023). A holistic digital workflow methodology to shifting towards net zero energy urban residential buildings in a semi-arid climate. Solar Energy, 263, 111959.
23. Irwin, T. (2015). Transition Design: A Proposal for a New Area of Design Practice, Study, and Research. Design and Culture, 7(2), 229–246.
24. Irwin, T. (2019). The Emerging Transition Design Approach. Cuadernos Del Centro de Estudios de Diseño y Comunicación, 73.
25. Kroll, F., & Haase, D. (2010). Does demographic change affect land use patterns? Land Use Policy, 27(3), 726–737.
26. Lehtonen, M. J., Yeow, P., & Chew, J. (2022). Empowering change for future-making: Developing agency by framing wicked problems through design. Futures, 139, 102952.
27. Lönngren, J., & Van Poeck, K. (2021). Wicked problems: A mapping review of the literature. International Journal of Sustainable Development & World Ecology, 28(6), 481–502.
28. Maak, N. (2020). Eurodrive: Repopulation Utopia. In AMO, Koolhaas, R., Design, H. G. S. of, Arts, T. B. C. A. of F., University, W., Netherlands, the, Nairobi, T. U. of, & Boom, I. (Eds). Koolhaas, Countryside, A Report. (pp. 20-61). Köln: TASCHEN.
29. Malpass, M. (2019). Critical design in context: History, theory, and practice. Bloomsbury Publishing.
30. Manzini, E. (2014a). Design em um mundo conectado e em transformação. Strategic Design Research Journal, 7(2), 95–99.
31. Manzini, E. (2014b). Making Things Happen: Social Innovation and Design. Design Issues, 30(1), 57–66.
32. Manzini, E. (2015). Design, when everybody designs: An introduction to design for social innovation (R. Coad, Trans.). The MIT Press.
33. Mazé, R. (2008). Criticality Meets sustainability: Constructing critical practices in design research for sustainability. In Changing the Change: Design, Visions, Proposals and Tools: Proceedings (Vol. 1). Allemandi Conference Press.
34. Mazé, R. (2019). Politics of Designing Visions of the Future. Journal of Futures Studies, 23(3).
35. Nikki Han, M. J., & Kim, M. J. (2021). A critical review of the smart city in relation to citizen adoption towards sustainable smart living. Habitat International, 108, 102312.
36. Raby, F. (2008). Critical Design. In M. Erlhoff & T. Marshall (Eds.), Wörterbuch Design (pp. 80–82). Birkhäuser Basel.
37. Raymond, C., Horton, R. M., Zscheischler, J., Martius, O., AghaKouchak, A., Balch, J., Bowen, S. G., Camargo, S. J., Hess, J., Kornhuber, K., Oppenheimer, M., Ruane, A. C., Wahl, T., & White, K. (2020). Understanding and managing connected extreme events. Nature Climate Change, 10(7), 611–621.
38. Reich, Y. (2017). The principle of reflexive practice. Design Science, 3, e4.
39. Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. CoDesign, 4(1), 5–18.
40. Santangeli, A., Buechley, E. R., Mammola, S., & Lambertucci, S. A. (2022). Priorities for research and action to prevent a New World vulture crisis. Biological Conservation, 270, 109563.
41. Stappers, P. J., & Giaccardi, E. (2017). Research through design. In The encyclopedia of human-computer interaction (pp. 1-94). The Interaction Design Foundation.
42. Š astná, M., & Vaishar, A. (2017). The relationship between public transport and the progressive development of rural areas. Land Use Policy, 67, 107–114.
43. Stuart Candy & Kelly Kornet. (2019). Turning Foresight Inside Out: An Introduction to Ethnographic Experiential Futures. Journal of Futures Studies, 23(3).
44. Thackara, J. (2019). Bioregioning: Pathways to Urban-Rural Reconnection. She Ji: The Journal of Design, Economics, and Innovation, 5(1), 15–28.
45. Tjahja, C., & Yee, J. (2022). Being a sociable designer: Reimagining the role of designers in social innovation. CoDesign, 18(1), 135–150.
46. Tonkinwise, C. (2014). How We Intend to Future: Review of Anthony Dunne and Fiona Raby, Speculative Everything: Design, Fiction, and Social Dreaming. Design Philosophy Papers, 12(2), 169–187.
47. Von Stackelberg, P. & McDowell, A. (2015). What in the World? Storyworlds, Science Fiction, and Futures Studies. Journal of Futures Studies, 20(2).
48. Yang, Y., Liu, Y., Li, Y., & Li, J. (2018). Measure of urban-rural transformation in Beijing-Tianjin-Hebei region in the new millennium: Population-land-industry perspective. Land Use Policy, 79, 595–608.
49. Yvonne Feilzer, M. (2010). Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm. Journal of Mixed Methods Research, 4(1), 6–16.

# The role of the communication design for the Mediterranean enhancement and development. The representative case studies map

*Chiara Tuttolani*
*chiara.tuttolani@gmail.com*

*Politecnico di Bari, Italy*

***Keywords:***
*Communication Design*
*Territory*
*Community*
*Local Development*

## Abstract

The context of the research is about the territory not only by looking at its spatial and topological aspect, but above all by considering its anthropological character. In fact, the word territory is also correlated with the word community, which is capable of continuously defining the material and immaterial heritage of which the territory is composed. The aim of the research is to investigate the role that communication design plays in the processes of enhancing these cultural assets in order to promote 'local development' connected to the valorizations of territorial 'historical-cultural deposits'. It is a study on trends, methodologies, and contemporary practices of communication design for cultural heritage. At the end of the first step of research, the main trajectories come to light thanks to and the mapping of a critical-methodological analysis of a system of case studies on the specific Mediterranean scene.

## Introduction

The cultural stratification of territories, like the Mediterranean area, is considered as the outcome of centuries-old processes of socio-historical sedimentation that have shaped an exclusive identity (Colin, Troiano, 2014). As a result of this process, the territory has been constituted as an immense collective, intergenerational, cultural heritage, rich in knowledge, arts, and sciences, endowed with an identity recognizable through its landscapes. (Magnaghi, 2020). For centuries, the Mediterranean has been shaped by contacts between the peoples living on its coasts, making trade between Europe, Asia and Africa possible. Hence, two fundamental issues for Mediterranean territories emerge: community and identity. (Abulafia D., 2023). Both have never been fully constituted and it would seem more appropriate to speak of a system of territorial identity and a community in continuous definition. This research aims to define how communication design can dialogue with the tangible and intangible identities of a place, contributing to its development.

## The communication design as a tool for the territorial enhancement and development

Looking at the design methodologies for the valorization of territories, more conservative actions have gradually been replaced by new 'models of use' that have promoted new meanings to the definition of 'cultural heritage' of territories. These are models of "culture-oriented development, which aim to generate, activate and increase the value of cultural heritage in its patrimonial, historical, civic and developmental function. They are aimed at the growth of platforms and systems capable of connecting territories and communities through culture and knowledge; and, moreover, to update the correlations between local-global, tradition-innovation, public-private" (Lupo, 2013).

From the first definition of the scientific disciplinary framework, the research proceeds to analyze and understand the role of communication design for local development. From this study, the main current trajectories of communication design in the valorization and enhancement of the tangible and intangible cultural assets of territories are defined.

Furthermore, the definition of the main current trends in communication design as a tool for local development are described in cultural-oriented models that are defined as: diffuse musealisation; festivals and big cultural events; cultural centres; maps; place branding and soft mobility projects.

This definition is supported by a mapping exercise that analyses emblematic case studies in the Mediterranean landscape in a critical key.

## The representative case studies map

This first data collection coincides with the first part of the desk research. It is the definition of a theoretical-critical scientific framework within which the research of communication design for the cultural heritage of the territories is placed. The methodology used to define this framework is articulated through two parallel approaches: the analysis of bibliographic sources and the analysis of case studies. The first one is developed through the study of paper and digital sources, databases, archives, and platforms. This first process allows for the definition of the six categories within which communication design works to enhance the heritage of territories: diffuse musealisation; festivals and big cultural events; cultural centres; maps; place branding and soft mobility projects. On the other hand, the analysis of case studies is developed through the realization of specific mapping. Thus, the methodology used for data collection and context definition is a parallel practice in which the two analyses proceed distinctly but complement each other. This text, in fact, is the result of that integration that defines the context of communication design for territories. An important tool that made it possible to consolidate the methodology adopted was the *Stretch the Edge platform*[1] . This platform was created following the conference held in June 2023 in San Marino. It is a database of examples in which the design process enhances the assets of a territory.

The entire method described is visualized below by means of an infographic map summarizing the guidelines extracted from the study of the bibliographic sources and applied to the analysis of the case studies.

Infographics are used for the representation of data because of their intrinsic character as collector, organizer, and interpreter of information. Information design is therefore able to unveil and connect 'data' of which it designs relationships of meaning. Relations reproduced in the form of a visual language capable of fixing the authenticity of already known information but above all generating further traces of knowledge (Cairo, 2013). This

[1] *https://stretchtheedge.unirsm.sm/explorer/?s=m:{}*

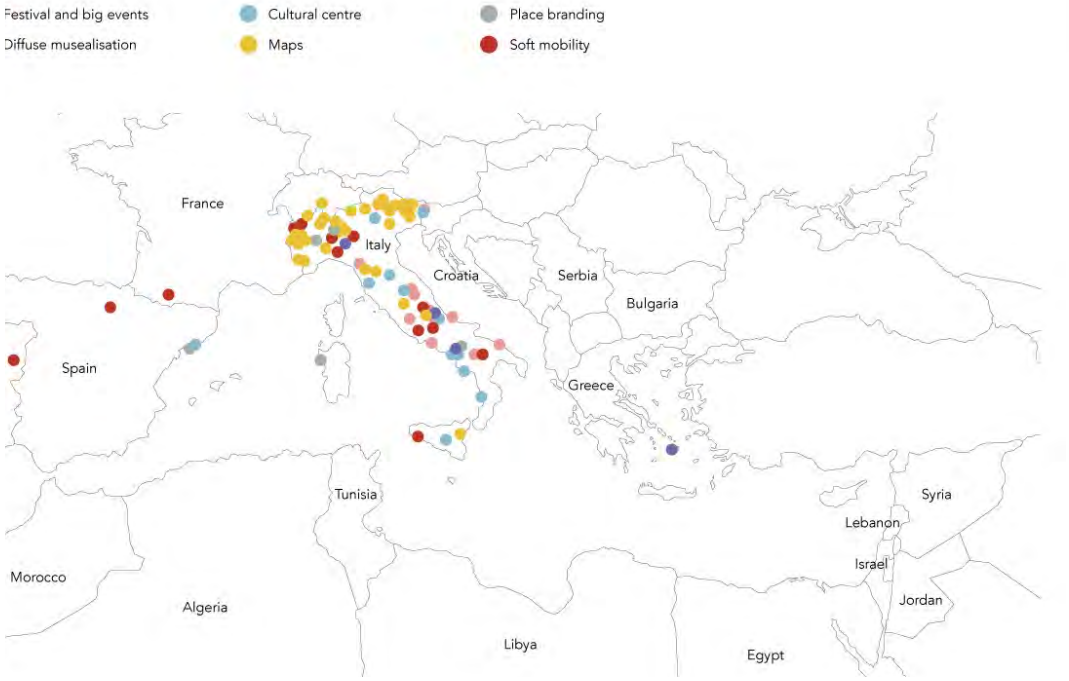



*Figure 1. The graph shows the main communication design case studies related to the six proposed models.*

mapping, in fact, has the purpose of outlining a critical-current framework to support the definition of the role of communication design for the valorization of the tangible and intangible heritage of the territory, but also that of opening a debate and new opportunities and possibilities for research.

The disciplinary framework is investigated on the Italian territory as shown in the graph. Communication design in Italy is nowadays articulated more through the map, especially in inland areas in northern Italy. The map is used as a tool for the active participation of the community that defines its own territorial space. This trend could be useful to explore in order to define its own methodological features for the valorization of the material and immaterial heritage of territories by the communities that inhabit them. Moreover, the analysis conducted so far on the Italian territory could be considered a case study and could be applied to the analysis of other Mediterranean countries.

# References


1. Cairo A. (2016). L'arte del vero. Dati, grafici e mappe per la comunicazione. Italy: Pearson.
2. Colin G., Troiano A. (2014). Le mappe del sapere. Italy: Rizzoli.
3. Irace F., Ciagà G.L, Lupo E., Trocchianesi R. (2013). Design & cultural heritage. Italy: Electa.
4. Lotti, G. (2020). Design per città intelligenti del mediterraneo Narrare i gruppi: Etnografia dell'interazione quotidiana, prospettive cliniche e sociali, design - vol. 15, n 1, luglio 2020, 14-28.
5. Lupo E. (2009). Il design per i beni culturali. Pratiche e processi innovativi di valorizzazione. Milan, Italy: Franco Angeli.
6. Magnaghi A. (2020). Il principio territoriale. Turin, Italy: Bollati Boringhieri.
7. Matvejevi P. (2006). Breviario Mediterraneo. Milan, Italy: Garzanti.
8. Meroni A. (2007). Creative communities People inventing sustainable ways of living. Milan, Italy: Edizioni POLI.design.
9. PAD 15 (2018). Research Alert on Mediterranean Urban Spaces and Cultural Heritage. Milan, Italy: Aiap.
10. PAD 21 (2021). Design values in the Mediterranean. Milan, Italy: Aiap.
11. The Passenger (2023). Mediterraneo. Milan, Italy: Iperborea.
12. Volpe G. (2015). Patrimonio al futuro. Un manifesto per i beni culturali e il paesaggio. Italy: Electa.

# From concepts to open products: The experience of a design hackathon for inclusive open-source products

*Federica Caruso[1], Venanzio Arquilla[1]*
*federica.caruso@polimi.it, venanzio.arquilla@polimi.it*

*[1]Design Department Politecnico di Milano*

***Keywords:***
*Open-source*
*Hackathon*
*Inclusive Design*
*Design & Autism*

## Abstract

This paper explores the role of a Hackathon within the Open Cometa project, an initiative stemming from the rich experience of Cometa Lab. Originally conceived within educational settings, Open Cometa has evolved into a digital platform promoting open-source collaboration within the autism community. Through strategic partnerships with local FabLabs and other autism associations, the platform facilitates the exchange of resources and fosters information sharing. It enables the development of accessible solutions for autistic individuals. The transition towards an open-source approach addresses the increasing demand for customised products, addressing a significant market gap. The hackathon engaged 30 students from diverse backgrounds and played a role in refining and aligning projects with platform requirements. The event aimed to bridge the gap between education and professional practice through multidisciplinary collaboration, enhancing participants' soft skills and technical competencies. The hackathon fosters innovation and inclusivity within the autism community by transforming student projects from concept to tangible, open products with real-world impact.

## Introduction

Hackathons are short events where participants work together in small groups to generate ideas, develop solutions, and present them (Flus & Hurst, 2021). According to Flores et al. (2018), they have been used in various settings and for multiple purposes, such as networking, education, and accelerating creativity. Organisations can manage them internally or as public open events (Briscoe & Mulligan, 2014).

Hackathons also differ widely in length; they can last as short as weeks or as long as months or even years, although they usually last 24 to 36 hours without interruption. The term "hackathon" combines the words "hack" and "marathon" (Briscoe & Mulligan, 2014), where "marathon" implies a race-like event. In contrast, the term "hack" relates to the term used in cybercrime; in this context, it refers to exploratory programming, as these events are typically associated with digital innovation and software development.

The hackathon was first conceptualised as an "event where developers, programmers, designers, and computer amateurs meet and work intensively to create software projects" (Flus & Hurst, 2021). From 1999 onwards,

since the name "hackathon" was coined to describe this kind of event, hackathons have gained global recognition and traction (Briscoe & Mulligan 2014; Richterich 2019), making this kind of work popular outside the software industries. To that end, hackathons have become platforms to facilitate rapid innovation. They are also known in other areas by other names, such as game jams, design jams, hacking festivals, hack days, sprints of designs, and code fests. The most crucial factor in encouraging individuals with similar interests to participate is the hackathon's aim and the challenge of achieving it, even if many also offer a prize or a work placement. The opportunity to collaborate, co-create with others, and try out new designs are additional motivators for participation.

To help characterise the Hackathon's goal, Briscoe et al. (2014) have helpfully offered a classification system that ranges from a tech-centric to a focus-centric approach (Page et al., 2016). While focus-centric hackathons mainly address social or business concerns or positively impact a societal issue, tech-centric hackathons typically focus on developing a particular technology or application (Page et al., 2016). What is clear from the definition of the hackathon is that this type of event can foster collaboration and drive participants to achieve complex problems by working together.

The hackathon discussed in this paper falls under the category of focus-centric hackathons, as it was organised primarily to address innovation in a social context rather than solely focusing on technical issues, despite participants being tasked with utilising specific technological tools and scenarios. Due to its hybrid nature, this event could enhance technical and soft skills among participants.

The emergence of hackathons in the 1990s and their subsequent rise in popularity in the 2000s (Briscoe & Mulligan, 2014; Richterich, 2019) coincides with the development of change design. This evolution has seen several "waves", including a period of formalising the link between design and innovation, known as the third wave, and a subsequent era, the fourth wave, characterised by the acceptance of design beyond its traditional disciplinary boundaries (Flus & Hurst, 2020). The event described in this paper aligns with these overarching trends in change design by aiming to establish new boundaries and foster collaboration across fields. The event's organisation is covered in depth in the following paragraphs.

## Context and Problem Statement

The hackathon discussed in this paper is an integral component of the Open Cometa project, which originated from the decade-long experience of Cometa Lab, a bachelor's degree program in Product Design. Initially conceived within the classroom setting, Open Cometa has since evolved into a digital platform that is currently being launched. Open Cometa (to see the work-in-progress website, visit https://www.designhub.it/opencometa/) is an open-source platform hosting autism-related projects, thereby expanding the realm of Design-Autism.

The platform's primary objectives encompass sharing resources within the autism community, facilitating information exchange, employing rapid prototyping techniques, providing essential materials, and extending support through a network of FabLabs and partners. This framework simplifies the implementation of accessible and reproducible solutions for interested users. Leveraging the extensive expertise of COmeta Lab, over ten concepts emerge annually, offering diverse perspectives on autism, proposing solutions, and engaging in meaningful discourse on the subject. Traditionally, these projects have been archived on a blog for educational purposes, garnering interest from parents and caregivers seeking to procure the highlighted solutions.

This growing interest underscored both a project opportunity and a noticeable gap in the market for products addressing the needs of the autism community, prompting the involvement of the COmeta team in the platform's design and development.

Responding to the rising user demand, a strategic shift was initiated towards an alternative approach to supply and demand. This transition aimed to foster collaborations with partners while providing the autism community with a more accessible means to access products. As a result, the focus shifted towards an open-source dimension, emphasising inclusion and accessibility.

The concept of "open design" emerged in the late 1990s, denoting the unrestricted sharing, modification, and evolution of designs (Van Abel et al., 2012). This collaborative approach is particularly relevant in autism, where individualised requirements present challenges for mass production. Open design allows for broad participation in the design process, which is crucial when addressing the nuances of autism. Moreover, it streamlines the design and manufacturing phases, traditionally separate and outsourced, by leveraging local production facilities like Fab Labs and maker spaces (Boisseau et al., 2018). These facilities enable the production of individual prototypes or limited series of artefacts, reducing cost barriers and skill requirements.

The hackathon activity was organised to facilitate data entry into the platform. This extracurricular initiative engaged 30 design, engineering and architecture students in enhancing the quality of selected projects and ensuring their alignment with platform requirements. Hackathons are renowned for fostering collaboration among diverse experts, enabling teams to leverage varied subject matter expertise (Frey & Luks, 2016). In this context, the multidisciplinary nature of the hackathon experience enabled young designers to assume the role of facilitators, guiding diverse stakeholders toward shared ideas and solutions. The Open Cometa project has provided a fertile ground for experimentation, bridging education and professional practice. By exposing students to different contexts, such as digital fabrication and web design skills, the Open Cometa experience aimed to reinforce both soft skills and technical competencies. In an increasingly hybridised landscape, where product designers require skills beyond their core expertise, the emphasis on cross-disciplinary collaboration and teamwork instilled valuable lessons essential for future professional success (Dorst, 2018). The overarching goal of the Hackathon is to facilitate the implementation and adaptation of projects from the COmeta Lab to fit within an open-design framework, thereby contributing to the expansion and enrichment of the Open Cometa platform. This event followed the methodology proposed by Kollwitz and Dinter (2019).

## Methodology

Kollwitz and Dinter (2019) formulated a taxonomy of hackathons to elucidate their nature, underlying characteristics, and understanding within organisational innovation processes. This taxonomy delineates two key aspects: operational design decisions, which mainly direct the workflow and procedures during a hackathon, and strategic design decisions, which are more abstract and stem from overarching aims. The event discussed in this paper follows this framework, specifically focusing on strategic design decisions such as defining the context and problem statement, identifying the solution space, and articulating the value proposition. Regarding operational design decisions, factors considered include the duration, venue, incentives, target audience, and level of elaboration.

## Hackathon structure

This paragraph outlines the structure of the hackathon, delineating its phases and identifying the stakeholders engaged in the event. Subsequent paragraphs will delve into strategic decision-making and operational design aspects.

The Open Cometa hackathon comprises three phases: pre-event, event, and post-event, corresponding to input, setting, and output components (see Figure 1).

During the pre-event phase, participants engage in both a preparatory stage and a kick-off event, where they receive fundamental information about the activity, available resources, and the hackathon's format. Moreover, the involvement of hackathon partners during the kick-off event helps participants become acquainted with the COmeta team and other relevant stakeholders.

During the hackathon phase, participants are immersed in the primary activities and setting where they actively pursue the set goals, guided by the partners and the Cometa team. Participants engage in hackathon activities in teams to achieve the defined objectives.


*Figure 1. Summary of Hackathon Path is divided into Pre, during and post and with the involvement of the human resources, you had different roles based on the hackathon phase*

In the post-event phase, emphasis is placed on reviewing outputs and disseminating results. This includes a closing event where participants present their work to partners and receive final feedback. Subsequently, participants collaborate with the COmeta team to upload their projects onto the Open Cometa platform, aligning with testing and refining the platform under development.

The hackathon fosters collaboration between autism association partners of the COmeta Lab, leveraging their expertise to assist participants in redesigning projects focusing on the end user's needs. Additionally, two Fab Labs in the Lombardia region actively support participants throughout the event. They provide access to cutting-edge technologies to experiment with digital fabrication and offer a wealth of professional experience to draw on.

Participants benefit from regular interactions with teaching staff and tutors, who provide guidance and mentorship throughout the event. These moments of discussion serve as opportunities for participants to seek advice, share insights, and refine their project ideas. The COmeta team's involvement was constant, but participants also received support from other partners.

Intensive Hacking is a moment organised after the third week of the

hackathon in which all the students are asked to complete their prototype directly in a Fab Lab with the help of an expert.

Additionally, the hackathon incorporates mid-week revisions, strategically scheduled during extracurricular hours, allowing participants to receive timely feedback and iterate on their designs in real-time.

Before the kick-off event, the COmeta team undertook thorough preparation and planning activities. This encompassed delineating the objectives and scope of the hackathon, along with selecting concepts from the pool of student projects available on the former COmeta blog. Selection criteria included: 1) projects generating significant interest from associations, partners, and potential users; 2) feasibility and adaptability of projects for available digital fabrication resources; and 3) innovation within project proposals.

Fifteen projects were chosen and categorised into two main groups (Figure 2):

- *"Born to be Open Concepts"* encompasses concepts in various stages of readiness for digital fabrication.
- *"Products to be Rethought in Open Logic"* focusing on technological and analogue products requiring substantial rethinking to align with digital fabrication. This differentiation aimed to highlight varying skill requirements, aiding participants in selecting projects based on their expertise or desired challenge, particularly for technological products, which demand specialised knowledge for development.

This selection was presented during the kick-off event, with all partners invited to participate. Hackathon participants could then choose a project to work on from the selection, forming teams led by the COmeta team.

*Figure 2. Selection of the COmeta project proposed to the hackathon participants*

## The strategic design decisions

**Challenge Design**

A fundamental aspect common to all hackathons is their association with addressing a specific task or resolving a problem (Briscoe & Mulligan, 2014 ). This dimension encapsulates the central focus of the hackathon's objective or challenge (Vanauer et al., 2015). Open Cometa's challenge aligns seamlessly with the platform's overarching mission, presenting a distinctive project opportunity. Participants were thus tasked with re-designing select concepts from the COmeta Lab to align them with open-source principles. This involved revisiting the project's concept and fundamental value based on the user research carried out earlier. Teams were tasked with restructuring elements, specifying materials, and determining the digital fabrication technologies essential for realising the product. Operating within a realistic context, teams navigated material sourcing and technology experimentation to craft viable solutions that meet user needs. The ultimate goal was to produce functional prototypes rooted in the original design concepts.

Therefore, the hackathon aimed to translate students' design concepts into tangible, shareable products in line with open-source principles. To this end, participants were required to develop instructional materials, including video tutorials, assembly guides, material lists, and practical tips, to empower users to create the product independently.

**Solution Space**

This aspect pertains to the parameters set for the execution of the hackathon. Kollwitz and Dinter (2019) categorise solution spaces into open, semi-structured, and structured. Open spaces feature broad challenges, allowing diverse interpretations and individual ideas and minimising requirements and restrictions that could block creativity. Conversely, structured spaces impose strict guidelines on both the process and outcomes, significantly constraining the solution space.

In Open Cometa, the solution space is typically semi-structured. While certain specifications, like digital fabrication constraints, provide boundaries, there is also room for individual creativity. Participants were encouraged to collaborate and devise innovative solutions to their chosen challenges. They were free to adapt the initial products to suit user needs better.

**Value Proposition**

This dimension recognises that hackathons are organised with clear objectives rather than isolated events (Nickerson et al., 2013). In the case of the Open Cometa hackathon, the primary goal is to generate data entry for the platform. Furthermore, the aim is to refine students' concepts and preliminary ideas based on well-structured user research but still need to be market-ready, into products ready to be shared and fabricated using open-source methods. Additionally, participants benefit from the opportunity to share their projects on the Open Cometa platform and contribute to the autism community.

## The operational design decisions

The operational design decisions inherent in the Open Comet Hackathon, outlined in Figure 3, are categorised into six dimensions, as described below.


*Figure 3. Hackathon organisation in terms of Target audience, communication means, material resources and Human resources.*

**Duration**

The Open Cometa Hackathon spans four weeks, incorporating various events such as a kick-off and closing ceremony. Unlike continuous hackathons, this setup incorporates breaks, enabling intermittent development periods (Rosell et al., 2014). Teams operate autonomously during the weeks but also convene for scheduled feedback sessions. Moreover, intensive work sessions are scheduled after the third week to refine prototypes before the closing event. The engagement of autism associations, alongside the COmeta team, is crucial, boosted by the active involvement of local FabLab experts. Leveraging their expertise in autism and digital fabrication, these experts offer valuable on-demand feedback and guidance to the projects.

**Venue**

The kick-off and closing events occurred at the university's FabLab, providing a collaborative space for participants to begin and conclude the hackathon. Weekly reviews occurred in university lecture halls, offering structured feedback sessions. Additionally, on-demand online meetings were arranged with the COmeta team to provide support beyond the scheduled reviews. A Telegram group chat was also established to facilitate asynchronous communication between participants and the COmeta team. During the intensive hackathon session, teams were hosted at another partner, FabLab, facilitating hands-on prototyping and refinement of solutions developed in the preceding weeks.

**Target Audience**

The hackathon is part of a program called "Passion in Action", a catalogue of open-participation teaching activities that the university offers to students to support the development of transversal, soft and social skills and to encourage/facilitate students in enriching their personal, cultural and professional experience. Students may choose from various subjects depending on their interests and aptitudes. For this reason, the Open Cometa Hackathon welcomed participation from designers, engineers, and architects interested in contributing to projects that promote inclusivity. Ideal candidates were those passionate about inclusive design and proficiency in rapid prototyping systems. Experience in 3D modelling was preferred, and familiarity with FabLab and maker environments, including rapid prototyping tools like 3D printing, laser cutting, and CNC, was beneficial. While the call was open to all university students, there was a focus on attracting individuals from various faculties, predominantly engineering, architecture, and design. Participation in the hackathon was considered an extracurricular activity alongside regular university commitments.

**Recruitment Process**

Out of more than 80 applicants, 30 participants were selected to form 6 groups of 5 members each. Prospective participants were required to submit a brief 280-character description outlining their motivation and the skills they could contribute. This initial step evaluated personal and professional motivations for joining the hackathon. The recruitment process aimed for diversity in skills, although most applicants were from design backgrounds, given the nature of the event. Consideration was given to participants' academic backgrounds, ensuring representation from disciplines such as product design and interaction design. Experience levels were also considered, with priority given to students beyond their first year of undergraduate studies to ensure a certain level of skill readiness. As a result, the participant composition reflected a diverse mix of academic backgrounds and years of study (Table 1).

*Table 1. The list of the participants composition with a diverse mix of academic backgrounds and years of study*

| Degree | Participant Number | Course of study | Year of Study |
|---|---|---|---|
| **Engineering** | **1** | Biomedical Engineering | 2° Bachelor's Degree |
| **Engineering** | **3** | Biomedical Engineering | 2° Master's Degree |
| **Engineering** | **1** | Materials Engineering and Nanotechnology | 1° Master's Degree |
| **Design** | **7** | Product Design | 2° Bachelor's Degree |
| **Design** | **6** | Product Design | 3° Bachelor's Degree |
| **Design** | **2** | Digital and Interaction Design | 1° Master's Degree |
| **Design** | **5** | Integrated Product Design | 1° Master's Degree |
| **Architecture** | **2** | Space & Interior | 1° Master's Degree |
| **Design** | **3** | Design & Engineering | 2° Master's Degree |

**Incentives**

Typically, hackathons are team-oriented events where the composition and size of teams may vary, whether formed beforehand or during the event (Brenner et al., 2014, Rosell et al., 2014). While collaboration is often encouraged, some hackathons adopt a competitive format with prizes at stake. However, the Open COmeta Hackathon takes a different approach, prioritising cooperation over competition.

Unlike many hackathons, the Open COmeta event did not incorporate a competitive aspect, nor were cash prizes offered, aligning with its educational purpose. Instead, participants received a participation badge and

earned five extra-curricular training credits, which benefited their academic evaluation. The primary motivation lies in fostering collaboration with diverse entities and the opportunity to explore skills beyond one's academic discipline.

**Resources**

The resources provided can range from hardware, software, or datasets to existing ideas, concepts, or prototypes that require further development. Additionally, human resources in the form of mentors or industry experts can offer valuable guidance to participants.

Students in the Open Cometa hackathon were provided with comprehensive research and materials gathered during the COmeta Lab phase to aid in developing their products. This included user research data, 3D model technical drawings, concept specifications, and detailed information.

Furthermore, students were allocated a monetary fund to buy materials essential for prototyping. Collaboration with FabLabs allowed participants access to state-of-the-art machinery for material processing, including 3D printers and laser cutters. Mentorship was provided by autism associations, offering project evaluations, and by FabLab experts, who conducted personalised reviews. Additionally, when faced with specific challenges, support was enlisted from the university's network of professors and professionals to address issues, for instance, those related to Arduino programming or technological aspects of software and hardware.

Participants were given a Google form at the kick-off event to vote for project concepts based on their interests and skills. Each participant could express three preferences, ranking them from 1 to 3. Using these preferences, the COmeta team organised the groups. If specific projects received fewer or more votes, redistribution occurred to ensure that each concept had at least four students working on it.

## Results and Discussion

Six projects were transformed from conceptual ideas into fully redesigned products ready to be shared on the open-source platform. The realised projects are (Figure 4):

**Go tag**

The kitchen organisation kit is designed to rationalise and differentiate kitchen utensils effectively. It includes holders for pots and pans and labels for ladles and knives. Each label indicates the food or the name of the utensil, facilitating recognition and use.

The open-source version offers the flexibility to create silicone components that can be applied to existing kitchen utensils. In addition to complete instructions, users receive 3D mould models for making the components and an instruction booklet complete with integrated cooking recipes.

**StarDreams**

A star-shaped puppet with a pass-through hole allows children to insert their hands inside and hug the puppet. Positioned within the opening are two buttons that activate the StarDreams inflation system, creating a calming sensation reminiscent of breathing to aid relaxation. The open-source iteration of this puppet entails modifying it by partially removing its stuffing and inserting a bag containing an Arduino connected to a small lever inside. This lever moves rhythmically and cyclically, simulating a breathing effect that induces relaxation when hugged. Accompanying the instructions are details for the Arduino code and electrical circuit.

*Figure 4. Products exhibited during the final events*

**Mowhee**

The project initially arose as a tool to assist Andrea, an 18-year-old passionate about cinema but facing challenges in communication and sharing emotions with those around him. The game consists of a cover containing three different discs, whose random rotation allows for the creation of various combinations that stimulate the user's behaviour. The manual interaction with Mowhee creates an anti-stress system, as its dimensions are ergonomically designed to fit comfortably in the palm. This toy can engage individuals through individual training and facilitate group activities, enhancing communication and sharing. The open-source version is 3D printed, and the content of the internal discs is customisable using a provided mock-up of the discs.

**Rabble**

It is a daily bag conceived for those who need to travel without fear of stress; it aims to assist users through sensory and insulating features, minimising stress from external stimuli. The bag boasts dual compartments capable of accommodating an 11" MacBook, a sensory lower pocket for tactile relaxation, and a shoulder strap equipped with a hood to reduce external noise. Its waterproof and sturdy material ensures reliable transport of personal items such as computers, books, and wallets. Additionally, the secure closures provide theft-proof functionality.

The open-source version adopts a design rooted in a modular fashion. This technique eliminates the need for stitching as the fabric takes shape through strategically positioned interlocks and cuts. This approach facilitates the bag's creation without requiring sewing skills or a sewing machine, which would have imparted a more artisanal feel to the product. Instead, with this method, one can laser-cut a 3mm felt sheet and then attach other components using glue. Furthermore, incorporating sound-absorbing fabric reduces noise during use in public transportation.

**Rulant**

Rulant is a game designed to enhance fine motor skills and coordina-

tion. The objective is to guide a ball out of a box by moving the sticks upwards. Rulant engages users by emphasising auditory and tactile sensory experiences. Crafted from wood and laser-cut materials, it offers options for personalised graphics. Additionally, the team designed a cardboard version that provides a more accessible alternative, allowing for quick and easy assembly with minimal resources at home, using printed cutting templates. The instructional materials include detailed guides and explanatory videos to introduce users to the gameplay and various challenge levels Rulant offers. This enables users to understand the game's difficulty levels and select the mode that best fits their needs.

**Snake fun**

A flexible and sensory anti-stress tool designed for those who require constant tactile input to calm down or tend to move their hands frenetically in uncomfortable situations. Its flexibility provides mental entertainment, encouraging users to experiment with and memorise new shapes. The open-source version is made of silicone, with the team focusing on designing the flexible joints that connect the anti-stress pieces and 3D-printed moulds used for casting the silicone. The silicone material was chosen to be food-grade compliant, ensuring safety if the user puts it in their mouth, thus avoiding toxicity issues.

Overall, the hackathon fostered innovation and creativity and highlighted the potential of open-source collaboration in addressing diverse needs and promoting inclusive design solutions. Each project showcases the power of collaboration and open-source principles in creating impactful solutions for various user groups.

## Conclusion

The strength of the outcomes lies in the inherent potential for continual refinement and testing through an open-source framework. While the products are not finalised, they embody solutions open to improvement and iteration. The OpenCometa Hackathon underscores the significance of experiential learning fostered through active engagement within social and cultural environments. Encouraging students to participate directly in FabLabs serves to extend learning beyond the confines of conventional university classrooms. This hands-on involvement empowers students to apply their skills in real-world settings, enriching their educational experience (Herrington et al. 2014). Student satisfaction was evident, with post-activity feedback highlighting three key outcomes:

**Technical Skill Enhancement**

Students gained valuable insights into digital fabrication, honing their prototyping and product creation abilities. Collaborative coding exercises broadened perspectives on teamwork and technical proficiency.

**Collaboration Development**

Exploring diverse perspectives and collaborating with peers from various backgrounds fostered an inclusive and dynamic learning environment. Skills and knowledge exchanges across groups enhanced the overall experience.

**Empowerment and Perspective**

Engaging with open-source concepts empowered students to prioritise simplicity in design, ensuring accessibility and user-centricity. Realising the feasibility of delivering user-ready products instilled a sense of empowerment.

In conclusion, the OpenCometa Hackathon demonstrates the potential of collaborative, experiential learning initiatives to empower students, foster interdisciplinary collaboration, and drive social impact. Through hands-on engagement and partnerships, students acquired technical skills, developed collaboration abilities, and gained insights into design and social change. This holistic approach prepares students to tackle real-world challenges creatively and empathetically.

# References


1. Boisseau, É., Omhover, J. F., & Bouchard, C. (2018). Open-design: A state of the art review. Design Science, 4, e3. https://doi.org/10.1017/DSJ.2017.25
2. Bada, D., & Olusegun, S. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning.
3. Brenner, W., Karagiannis, D., Kolbe, L., Krueger, J., Leifer, L., Lamberti, H.-J., Leimeister, J. M., Oesterle, H., Petrie, C., Plattner, H., Schwabe, G., Uebernickel, F., Winter, R., & Zarnekow, R. (2014). User, Use & Utility Research. Business & Information Systems Engineering, 6, 55–61. https://doi.org/10.1007/s12599-013-0302-4
4. Briscoe, G. & Mulligan, C. 2014 Digital Innovation: The Hackathon Phenomenon. Creativeworks London.
5. Dorst, K. (2018). Mixing Practices to Create Transdisciplinary Innovation: A Design-Based Approach. Technology Innovation Management Review, 8(8), 60–65. https://doi.org/10.22215/timreview/1179
6. Flus, M., & Hurst, A. (2021). Design at hackathons: New opportunities for design research. Design Science, 7, e4. https://doi.org/10.1017/dsj.2021.1
7. Flus, M., Rennick, C. & Hurst, A. (2020) Work in progress: improving engineering students' need finding abilities. In 2020 ASEE Virtual Annual Conference Content Access. doi: 10.18260/1-2--35649.
8. Flores, M., Golob, M., Maklin, D., Herrera, M., Tucci, C., Al-Ashaab, A., Williams, L., Encinas, A., Martinez, V., Zaki, M., Sosa, L. & Pineda, K. F. 2018 How can hackathons accelerate corporate innovation? In Advances in Production Management Systems (Vol. 535) (ed. I. Moon, G. Lee, J. Park, D. Kiritsis & G. von Cieminski), pp. 167–175. Springer. doi:10.1007/978-3-319-99704-9_21.
9. Frey, F. J. & Luks, M. 2016 The innovation-driven hackathon – one means for accelerating innovation. In ACM International Conference Proceeding Series. doi: 10.1145/3011784.3011794.
10. Herrington, J., Parker, J., & Boase-Jelinek, D. (2014). Connected authentic learning: Reflection and intentional learning. Australian Journal of Education, 58, 23–35. https://doi.org/10.1177/0004944113517830
11. Kollwitz, C., & Dinter, B. (2019). What the Hack? – Towards a Taxonomy of Hackathons. In T. Hildebrandt, B. F. van Dongen, M. Röglinger, & J. Mendling (Eds.), Business Process Management (pp. 354–369). Springer International Publishing. https://doi.org/10.1007/978-3-030-26619-6_23
12. Nickerson, R.C., Varshney, U., Muntermann, J., (2013) A method for taxonomy development and its application in information systems. Eur. J. Inf. Syst. 22, 336–359
13. Page, F., Sweeney, S., Bruce, F., & Baxter, S. (2016). THE USE OF THE "HACKATHON" IN DESIGN EDUCATION: AN OPPORTUNISTIC EXPLORATION. DS 83: Proceedings of the 18th International Conference on Engineering and Product Design Education (E&PDE16), Design Education: Collaboration and Cross-Disciplinarity, Aalborg, Denmark, 8th-9th September 2016, 246–251.
14. Richterich, A. 2019 Hacking events: project development practices and technology use at hackathons. Convergence: The International Journal of Research into New Media Technologies 25 (5–6), 1000–1026. doi:10.1177/1354856517709405.
15. Rosell, B., Kumar, S., & Shepherd, J. (2014). Unleashing innovation through internal hackathons (p. 8). https://doi.org/10.1109/InnoTek.2014.6877369
16. Vanauer, M., Bohle, C., Hellingrath, B. (2015) Guiding the introduction of big data in organizations: a methodology with business- and data-driven ideation and enterprise architecture management-based implementation. In: Proceedings of the Annual Hawaii International Conference on System Sciences (HICSS), Kauai, pp. 908–917
17. Van Abel, B., Evers, L., Klaassen, R., Troxler, P., & Micklethwaite, P. (2012). Open Design Now: Why Design Cannot Remain Exclusive by Bas van Abel, Lucas Evers, Roel Klaassen and Peter Troxler. The Design Journal, 15(4), 493–496. https://doi.org/10.2752/175630612X13437472804411

# ReMade Community Lab, Design explorations in a Proximity System

*Susanna Parlato*
*Susanna.parlato@unina.it*

*Università degli Studi di Napoli Federico II, DiARC, Dipartimento di Architettura*

***Keywords:***
*Community Design*
*Proximity*
*Co-design*

## Abstract

This paper is framed within the disciplinary field of social design intended as a design practice whose primary motivation is to generate positive social change. In the debate on design for social innovation, the strong relevance of the relational component and the concept of community has emerged as essential elements for actions aimed at generating positive social transformation. This contribution explores the concept of community by relating it to a case study, in the context of the Rione Sanità, a neighbourhood in the historic center of Naples characterized by a marginality condition, where a grassroots activation process of change has been underway since 2001. The article discusses how this process can be read as an example of diffuse design and this community as an enabling factor for the development of design-led experimentation and activism experiences that tackles environmental issues on a local scale.

## Introduction

Contemporary society appears to be characterized by an accentuation of social and economic inequalities (Piketti, 2020), produced by the models, ideas and practices of policies that see unlimited technical progress and globalization as their foundation. The reduction of every aspect of life to the category of competition and economic efficiency has led to the rarefaction of relational values (marginalization, connected solitudes), the consumption of what is public, and the commodification of the commons (Manzini, 2018). This model of development has shown its limits in the unlimited growth idea also from the environmental point of view, producing nefarious effects on the environment (climate change, widespread pollution, desertification and the loss of biodiversity, the accumulation of plastics, the extinction of numerous animal species) considered a direct cause of human action on the planet, which appears central in the scientific debate and also discussed with the proposition of defining a new geological era, the Anthropocene (Ellis, 2018). Awareness of unresolved problems and the loss of confidence in a progressive and unstoppable growth that would bring prosperity for all have brought out critical points of view. This critical viewpoint has led to the search for new solutions that aim to overturn the economic paradigm according to only from growth comes inclusion. The approach behind these new solutions revives the concept that "there is no economy without socie-

ty," expressed, in Italy as early as the 1950s, in Giorgio Ceriani Sebregondi's idea of "Development as integration" (Farnese, 2017) and recently revived by sociologists such as De Rita (2020) and Bonomi (2018). A concept that is reflected in the theories underlying social innovation (Murray, Culier Grice, Mulgan, 2010). Cities with their concentration of people, infrastructure and activities appear today as places of great vulnerability in continuous and accelerated metamorphosis in which critical social conditions and environmental issues find intensified problematic. Today we are witnessing a proliferation of practices, which starting from the social concept of inclusion, and applying the sociological theory of gift, through volunteering, mutualism, and social cooperation, generate a new economy of proximity (Manzini, 2021). Attention is growing for bottom-up processes or grass-roots, spontaneous initiatives that have succeeded in gaining the participation of communities and have been effective in the territories' transformative action, being able to grasp their potential and criticalities with more immediacy. When these experiences triggered processes of innovation and transformation of tangible and intangible resources into common goods, they did so starting from the implementation of a collective capacity, generating positive and more sustainable changes, and from the activities of taking care of places and people. These experiments challenge rigid, over-determined forms, and seek alternatives to centralized, vertical organizational models and rigid environments, which appear inadequate to respond to the uncertainty, variability and disorder of the complexity of contemporary phenomena (Sendra, Sennett, 2021). The case study described below can be framed within the framework of these approaches and has similarities with this pattern of experimentation.

## Territorial context description

Rione Sanità is a neighborhood in the city of Naples. Geographically it is located in the center of the city but is highly isolated. It has developed on the edge of the ancient city walls and is bordered by the surrounding hills, so it is a closed area with few points of permeability to the neighborhoods around it. This area has been considered for a long time and for various reasons, one of the most problematic neighborhoods in the city, characterized by a negative reputation due mainly to the presence of organized crime and micro-criminality, by reports of incidents of violence and oppression, and for alle these reasons described as a periphery in the center of the city. This condition has led to the development of a strong sense of place but also to a condition of exclusion and isolation. The social composition of the neighborhood, which today has about 30,000 inhabitants, has shared with the other neighborhoods of the historic center of Naples the same phenomenon of gradual estrangement of the population. Consequently, there has been a mutation of social stratification, which was originally characterized by greater mixite both economically and culturally. Therefore, in terms of social profile, the strong presence of unemployed and underemployed population, with low levels of knowledge and skills, the lack of prospects of its younger inhabitants, the high rates of school dropout continue to be critical factors.

## Social changing process

In response to the lack of institutional and welfare interventions, and the deficiency of a strong entrepreneurial ferment, a part of the local community started a bottom-up developing process activating self-organized entities (associations, social cooperatives, social promotion associations, voluntary associations, social enterprises) that by networking organize activities that

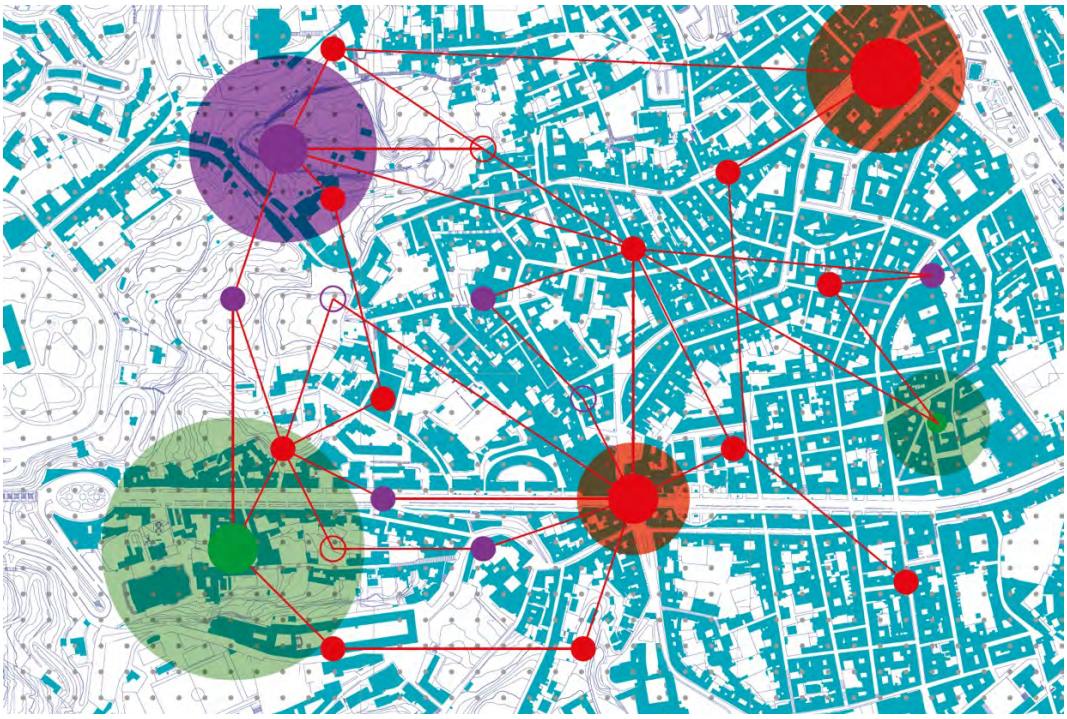


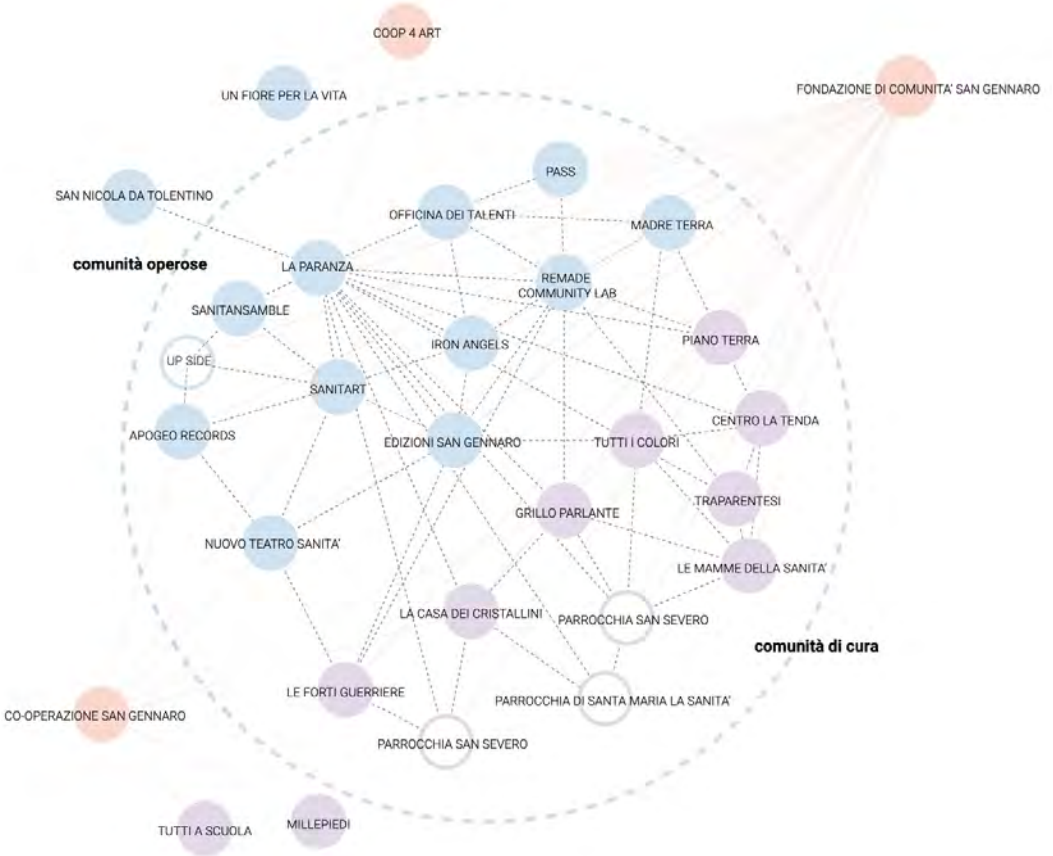
*Figure 1. The image shows the progressive diffusion and impact of the actions that changes the territory marginality conditions.*

address the problems and also seize the opportunities emerging from the communities and the territory.

The community involved in initiating the process of change was able to read their context by looking beyond the limits set by stereotypes, and to recognize the historical and artistic values of the area as elements from which to build their own development model. The first action of the change process was the renovation, valorization, reopening and management of the Catacombs of San Gennaro. The case of Rione Sanità has been analyzed through studies from the perspectives of economic and social disciplines (Consiglio & Riitano, 2015; Consiglio, Flora, Izzo, 2021; Corbisiero, 2020) and has been considered a best practice case in the field of design for territorial valorization. This is considered a best practice not only because, as pointed out by M. Parente (2010), it is a bottom up process, driven by the firm will of a group of young inhabitants of the neighborhood, guided by the charismatic figure of the Parish Priest of the Basilica of Santa Maria della Sanità, to work in the direction of the neighborhood's social change, but also because it shows the combined action of elements of "expert design" and "diffuse design" (Manzini, 2015), connects the different levels of territory, cultural, social and productive elements and sets a challenge for design that address the territory as a whole. There have been several initiatives with artists and designers who have joined the interventions of redevelopment of the historical architectural heritage of great value, misrecognized and abandoned, all these practices have contributed to convey a horizon of meaning to the operation. Around the neighborhood's renewed identity there has been a growing consensus both from the local community and from important supporters outside as well. Similar processes are common in different areas of Naples, actions, projects, communities that deal with the community and people caring in innovative and participatory ways activated directly by citizens. What appears peculiar in this specific case is that in addition to the proliferation of no profit's organizations and projects, there is an infrastructure that allows the connection and coordination of the different initiatives and so reinforces their efficacy, ensures their continuity, and facilitates the construction of new relationships, new projects, new communities. This infrastructure has been formalized through the establish-

ment of the San Gennaro Community Foundation, which acts as a binder and attracts funds for the realization of projects that are implemented through the connection of the organizations in the network. The network can be defined as a community of practice (Wenger, 1998) or more specifically a community of place (Manzini, 2021) that acts through separate and/or coordinated actions sharing a vision of change. It is an infrastructure which tends to maintain a high degree of openness, enabling the recreation of the conditions for its existence. The Sanità district can be considered similar to a social laboratory that activates processes of social change starting from the actions carried out by, what Aldo Bonomi defines as, communities of care and industrious communities: industrious communities, that is, entities capable of expressing renewal through innovative forms of producing and doing business; communities of care, that is, entities that place the relationship with people with fragile or vulnerable characterizations at the center of their activities, whether they are entrepreneurial, professional or voluntary. These bottom-up development processes express the aspiration to design an economic model which embodies the concept of environmental, social and organizational limits (Bonomi, 2018). Here, in fact, a connective tissue of initiatives and activities was created, which made it possible to overcome the atavistic cultural and educational deficiencies of this neighborhood, and then acted as a catalyst for the development of innovative ideas fostering new forms of entrepreneurship that although initially focused on the care of people and the care of places have then aggregated initiatives that integrate the social dimension with the ecological one.

*Figure 2. The diagram shows a representation of the network of cooperatives, associations and foundations that are operating in the Rione Sanità area. Chromatically distinguishing those that deal specifically with caring for people: the "caring communities", and those that carry out productive activities "industrious communities".*



## Local and global challenges and trends

The community network described can be identified as an enabling factor for the development of project practices that aim to generate positive change in society by fostering ecological conversion through more sustainable action. Among the many projects supported and developed in the Sanità neighborhood network, the ReMade Community Lab project will be presented here because it is strongly related to the field of design. The embryonic idea for this project originated from one of the residents of the Sanità neighborhood who had lost his job, supported by an environmental engineer presented his idea to the San Gennaro Foundation, which helped support the project by finding the initial funds required for the start-up. Subsequently, designers, engineers and other experts joined the group and fueled the project with their ideas. ReMade is funded thanks to participation in competitive calls and through successful fund-raising activities, resulting in the project receiving donations for its development. This project is critical of waste management models based on large-scale plants into which waste from vast territorial areas flows. This model has revealed obvious limitations both from the perspective of resource recovery and environmental protection. ReMade is a neighborhood production workshop that experiments with alternative interactions in the chain of ideation - production and consumption. The objective of the experimentation is to investigate alternative models that can reduce the environmental impact of consumption, production, and waste management. The laboratory concentrates the collection recycling and production phases in a single organizational unit, and the ideation phase of products and services is also managed internally by the heterogeneous group of designers. Low-complexity recycling technologies and digital fabrication are employed, allowing for flexible processing of different polymers and maintaining a continuous variety in the production of artifacts. The workshop activities address issues such as plastic pollution that have global dimensions, however the approach behind these activities embraces the concept of cosmopolitan localism. This term, coined by the German activist, author and educator Wolf- gang Sachs, describes a place-based way of life in which solutions to global problems can be addressed by lowering them into local circumstances and adapted to specific social and ecological contexts while being globally connected/linked in the exchange of information, technologies and resources (Sachs 1999; Manzini 2009, 2012, 2013). In the Neapolitan context, the issues related to waste management, acquire a specificity related to the succession of states of emergency, which have occurred since the 1990s and are still not completely solved. Those crises were caused by inefficiencies and delays in the governance and management of waste disposal aggravated by the inference of criminal organizations, and led to a very serious state of pollution of vast areas of the territory with repercussions on the health of the inhabitants verifiable by the increase in the incidence of cancerous diseases (Armiero, 2021; Iengo, Armiero 2017). This contextual element determines a sense of urgency because of the relevance of the problem at the local level, which has led to the emergence of several protest movements (Armiero, D'Alisa, 2012), committees and associations that have critically protested and initiated projects that aim to spread knowledge about environmental issues, global and local, and promote solutions through dialogue with institutions. The ReMade activities are closely related to and are fueled by the reflections that have been brought forward by these movements. The concept of an alternative proximity waste treatment model involving virtuous small-scale facilities that process waste in the same place where it is produced could generate a closed loop that can contrast external interference, reducing potential risks of criminal infiltration, and at the same time can increase people's aware-

ness of waste reduction and recycling issues to improve outcomes in terms of quantity and quality of waste collection.

In pre-industrial society, the design and production of artifacts took place within a specific and small local community, based on its resources and knowledge. In modernity, the last 150 years of industrial evolution have been dominated by a linear model of production and consumption, in which goods are manufactured from raw materials, sold, used, and then discarded as waste.

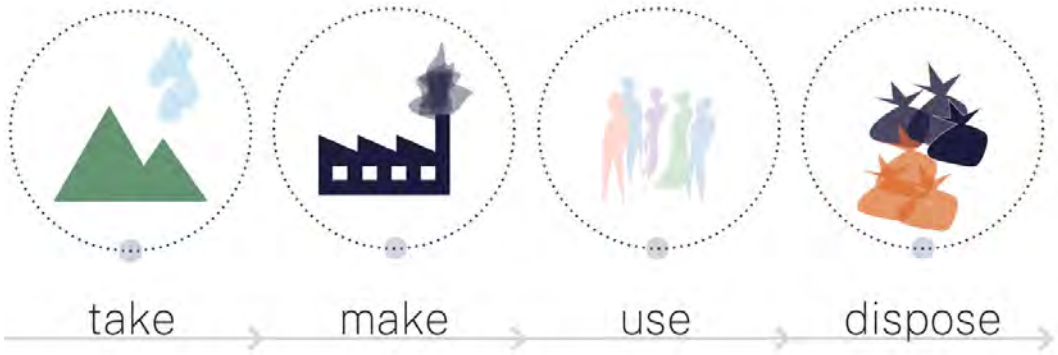



*Figure 3. The infographic shows a representation of the linear model.*

This model has enabled the supply of affordable products to consumers and material prosperity to billions of people. In developed economies it has largely supplanted a traditional economy that maintained high levels of reuse and remanufacturing but required more labor and produced lower returns on investment (Maffei, Bianchini, 2014). Our economy currently seems locked into a system in which everything from the economics of production to contracts, from regulation to the way people behave, favors the linear model of production and consumption. However, this constraint is weakening under the impetus of several trends. First, resource scarcity and tightening environmental standards are likely to remain. This creates an incentive effect that rewards enterprises that employ circular models. The circular economy has therefore become a new frontier within the political economic discourse of industrial production, energy efficiency, and sustainable development (Moreno, De los Rios, Rowe, & Charnley, 2016). It emerges as a new paradigm capable of pushing the frontiers of environmental sustainability by transforming the relationship between ecological systems and economic activities.

With the goal of reduced environmental and social impacts of human activities, the project focuses on transforming management from centralized to distributed. The predominant model of waste management is based on economy of scale and therefore on functional specialization. The different phases of the process collection, separation and treatment of waste are managed in large plants, which, to have large returns on investment, are equipped with machinery constrained to repetitive limits and thus to the treatment of large quantities of a single type of waste. These centers are delocalized, meaning they are placed far from the major centers of urban waste production: the cities. Delocalization results in increased logistical complexity in the management of the system and long-distance transport of waste with the consequent increase in environmental and economic impacts. The ReMade Community Lab project starts from the idea that the distributed systems model can be transferred to waste management. Therefore, the lab is ideally configured as a system node in which experimentation is carried out to understand what techniques and tools of recycling and production can be used to deal with the plastic portion of waste, and in parallel what products and services it can develop from the relationships and connections that can

potentially originate from the context. The identification of tools and technologies was done considering the need to develop recycling processes that would allow the treatment of a wide range of polymers present in urban waste, thus flexible and low-complexity processes; and production processes that would allow the activation of a direct relationship with the people and communities present at the proximate local level, thus flexible processes for varied production with a high degree of customization (digital fabrication). The collection of plastic material, which is the first step in the waste management process, take place through the involvement of the local community. Organizations of the local network along with also individuals and neighborhood educators collect the material and donate it to the laboratory, often the material is also separated by polymer type, and sometimes also by color, thus reducing pre-treatment work. At present, the lab is experimenting with three different recycling and production processes. In all processes, the first processing step is granulation, which transforms plastic waste into small flakes using small mechanical shredder. After granulation, the first process tested involves the use of a small extruder to produce a filament that is then used in FDM 3D printers. Initially this process was tried for recycling caps made of HDPE material, early trials failed due to problems with crystallization of the material in the production phase, so the process is now only used to recycle PLA waste produced by other fablabs in the city. For the recycling of two other very frequent materials in the plastic fraction of urban waste HDPE and PP, other two processes were implemented. One process involves making molds using high-temperature resistant resin through SLA 3D printers. The mold for the production of small objects is used for plastic (HDPE - PP) injection, which is done with a low-complexity machine. This machine allows easy setting of different temperatures and applies pressure through a hand lever. The use of 3D SLA printers for mold production allows to keep low costs and continuously vary production for small product series. The latest process was introduced to manufacture larger products and thus recycle larger quantities of materials. This involves the use of a thermos-press to produce sheets that are then cut through CNC cutting machines and assembled to form furniture elements. The low-complexity tools used in the three processes (the mechanical shredder, the manual injection machine, and the thermo-press) were selected from Precious Plastic an open source digital commons, a platform that connects people, machines, and knowledge to create an alternative recycling system for plastic waste. The elements introduced so far concern the technical choices made in setting up the laboratory. Although circular economy is presented as an interdisciplinary field of inquiry in the theoretical reflection technical aspects dominate, while circularity should be considered a social issue with technical component and not vice versa (Thorpe, 2010). It may be interesting to point out how even in the area of technical choices and advancements, relationships can increase the level of knowledge. In this context we talk about communities of interest, that aggregates around issues related to technology for digital fabrication, and experimentation with simplified recycling processes. The community of interest related to the topic of digital fabrication technology in the ReMade project is configured as a hybrid community consisting of the territorial network (with coalitions formed at the scale of the city and region) and the global network of makers and FabLabs to which the ReMade team refers to share knowledge about the technology, processes, and products. The community of interest related to recycling issues is also configured as a hybrid community. It includes on the one hand the community of Precious Plastic, and on the other hand some associations that work in the city area to raise awareness of waste pollution issues. From the observation of the practices activated by the ReMade Community Lab it is possible to develop a reflection on the social objectives of the circular economy, investigating how

the social relations that are activated in the processes of ideation production and consumption can influence the practice of design and on the other hand how design can affect the development of processes of circularity not only of materials but also of relations. On the economic perspective, the visions that underlie the design-led approaches of design for social innovation and transition design, which inspire this project, are based, on the possibility of generating new types of fair and integrated economic systems in which most needs can be supplied locally, exploring alternative modes of exchange (outside the dominant economic paradigm) whose goal is the satisfaction of the needs of all (as opposed to the generation of profit for the few) (Korten 1999, 2010; Douthwaite 1996; Mander 2012, in Irwin, T. , 2015).

## Design practices of the ReMade Community lab

The observation of the relationships that enabled the progress of the activities of the ReMade Community Lab allows us to highlight the types of communities that were formed during the project practices. We will refer to the definitions of Communities described by Manzini in his texts (2018, 2020, 2021) which are open, light and intentional communities that aggregate people around a theme, "matter of concern" (Latour, 1995). A distinction can be made between communities of purpose and communities of concern using practice as a differentiating factor, communities of purpose or project are those formed for the implementation of a project action, while communities of concern are identified by a theme around which knowledge exchanges are created without necessarily leading to the realization of a strategy for the implementation of specific practices or an artifact. From the analysis of the relationships and connections formed over the course of the project's development, it is possible to detect different levels of commitment and time-sharing of the people who aggregate around the issue, levels that also change according to the distance of proximit  to which the project refers. Sharing a purpose for the resolution of a complex issue at a global scale can generate a global community working at a distance to build a vision for radical system change. This type of community of interest can use digital tools of sharing (online platforms) to exchange ideas and projects, an example of this kind of community is the one created through the precious plastic platform mentioned above, but the contribution for the transition to that vision is through practice that takes place in the nodes, in the space of proximity, responding to the specificities of the contexts of action in a differentiated way and generating connections and community for problem solving at a local scale.

The following paragraphs will describe some practices that have been developed, by bringing out the relationships and communities formed for their implementation. The practices implemented by the Remade Community Lab project can be related to two different lines of development connected to each other:

- Dissemination - which concerns the activities developed to raise awareness and engage the local community by spreading ecological thinking and digital culture. These activities consist of developing educational processes that make use of the pedagogical vocation of design, which have been effectively tested as pathways in the form of workshops aimed at children and young people attending the network of proximity education center. This line of development has also been enriched through workshops, university theses, and internships that have provided training for university students on the issues addressed by the project but also involved new energy and new ideas for the other lines of development.

- Productive interactions - concerns experimentation related to material culture and strategies for connecting and networking the laboratory with other realities of handicrafts, micro-production and proximity trades, in order to stimulate even in these realities processes of innovation and reduction of the environmental impact of their activities. These practices are driven by principles of collaboration, cooperation, and mutualism, and use co-design methods for the democratization of design and production processes.

The building process of purpose/project communities appears to be dynamic and open-ended. This is composed of the experts who actively contributed to carrying out the project actions and forming an interdisciplinary group, composed of designers, engineers, technicians and administrators. This team of ReMade is joined by volunteers who depending on specific interests get involved in different activities, or students who contribute to bring new life to the project and set new possible strategies with alternative visions. In some cases, the people encountered in carrying out an action were then integrated into the internal community of purpose.

**Diffusion**

In the context of the Rione Sanità associations and social cooperatives has developed as a network of proximity educators center. This organization cooperate to generate social change in children and young people who express childhood distress caused by a multi problematic context (trauma-grief-emergencies of the socioeconomic condition of precariousness and deprivation caused by living in contact with adults who are themselves in a state of distress). ReMade started to co-operate with this network developing educational path for the children of the neiborhood. The coalition with proximity educational centers for the realization of creative workshops determined a new form of the community of purpose formed by the internal community of purpose (Team ReMade) with educators. In the ReMade Community Lab project, the relationship with the child is motivated through two intersecting purposes. On the one hand, the idea that positive change can be generated in the condition of children in the local community using the design process as a tool to acquire skills that can led children to become actors, active subjects of change. On the other is the idea of incremental outreach to the local community, starting with the children becoming ambassadors of ecological thinking in other social contexts (the family, the classroom, the neighborhood). ReMade educational pathways have two successive phases. In the first phase, adopting a playful approach to transmit notions (Nand, Baghaei, Casey, Barmada, Mehdipour, Liang, 2019), environmental issues are addressed to stimulate children to freely reflect on interactions in the chain of ideation - production and consumption. Activities introduce groups to waste reduction issues through their direct involvement in practices to design strategies to improve waste management and production in the educational and household context. In the second phase, co-design processes are activated as a design practice with the aim of conveying to children the importance of cooperating, sharing ideas and acting together to achieve a common goal. The project leads to the creation of an artifact into which collective thinking flows. The process of conception of these artifacts starts with the observation of heritage places in the territory. In these moments of exploration, participants are led by expert designers to extrapolate signs and shapes that will inspire the product design. Often the places chosen for exploration are in a degraded condition, and focused observation provides a different view. The educational pathways aim to generate in the child an awareness that he or she can take an active role in producing positive social change, and to achieve this a playful and activist approach is used. In this way, the transmission of design skills becomes a tool for empowerment.

*Figure 4. Photographs of different moments and activities carried out during the educational paths of ReMade Community Lab.*

**Productive interactions**

The productive interactions of the remade community lab connect to emerging demands from the local community. In this way, production practices can become an opportunity to develop and regenerate a "community of place". Community of place refers to the set of communities of purpose that share practices aimed at the care, enhancement, and development of the territory in which they operate. The community that allows Remade's project team to develop actions that can generate social change at the local level corresponds primarily to the network of third sector entities active in the neighborhood space of the Sanità district. Insightful knowledge of this network opens up the possibility of the development of social conversations and project related to the different spheres of action, which can be promoted by ReMade, and vice versa, the dissemination of ReMade and its knowledge by the community has also stimulate direct demand from the different entities that constitute its network. Exemplifications of these dynamics are the coalition with the co-operatives involved in the actions of care and enhancement of places with historical-artistic or architectural values in the territory. Seizing the opportunity to raise the cultural level of the souvenir object through a formal research that start from the signs of the territory by elaborating them into objects that express greater conceptual complexity the team of designers developed some product for the traveler. The specific function of the product in these processes is secondary to the emerging role of amplifier and witness of traditions and values, which goes far beyond figurative and formal contents, but is charged with intentions and instances for which the technological process reinforces and enhances the symbolic content. They themselves become traces that act on the behavior of visitors by triggering a process of response to the stimulus they induce, capable of evoking, in those who perceive it, feelings, emotions and memories, opportunities to know and to make known the places that inspires them (Fagnoni,

2018). In addition to incorporating the materialization of the visiting experience, these objects are charged with the instances of ecological thinking, because they are made through recycling and production processes with low environmental impact, thus working simultaneously on different goals of change. Here, too, the pedagogical vocation of design is invoked: "Designing a new object also means trying to bring to the surface in humans a cognitive capacity buried by the complexity of languages and information; like a child learning a new alphabet" (Branzi, 2008, p.195). Other productive interactions allowed to experiment with the relationship between digital fabrication design and restoration, thanks to some practices activated with a cooperative that deals with the restoration of cultural heritage and operates in a network with the realities of the Rione Sanità.

## Conclusion

ReMade refers to global communities in the sharing of an interest (contributing to the resolution of environmental issues, decreasing the environmental impact of municipal waste management) and a vision (stimulating a transformation in waste management from centralized management to a distributed system model), and to community in the space of proximity for the implementation of practices that can contribute to the transition to that vision (experimentation- production-diffusion-innovation) while helping to address specific problems arising from critical issues in the area (countering educational poverty, countering school dropout).

This discussion about the different communities, that correspond to different actors and consequently to different discipline, was made to point out the variety of relation and connection that a design practice need to build to approaches wicked problems.

We can state that in research that starts from practice, in the discipline of design, we recognize the goal of finding socially grounded knowledge instead of reliable knowledge. This goal finds a sociological motivation and interpretation in the idea of the "second modernity" in which autonomous and weakly contextualized science is replaced (or joined) by highly contextualized research that participates in society (Nowotny, H., Scott, P., Gibbons, M, 2010 in Herriott, 2019). "In this field, there is a need for long-term infrastructuring where relationships continue… that is, that a social design project instiga tes a conversation and relationships that can be on-going beyond the 'life' of the project itself. But that also makes the impact of social design very difcult to evaluate." – Pelle Ehn Professor of Interaction Design, Medea, Malmö University Interview, 22 November 2013. The quotation from Pelle Ehn cited here well specifies the aspiration of these research experiments that return a process of direct immersion and involvement of the researcher in an ongoing phenomenon with the aim of deep and participatory understanding.

## Acknowledgements

The reflections produced in this article are the result of research that began as part of the author's doctoral work in the PDTA department of Sapienza University of Rome and continues through active participation in the practices and coordination of the project that is developed through collaboration with the remade team (Andrea De Falco, Guilherme Nicolau Adad, Raniero Madonna, Massimo Punzo, Iole Sarno), with the network of organization of the Sanità district, and with students and recent graduates of the DiARC Dipartimento di Architettura of the University of Naples.

# References


1. Appiah K. A., (2019) La Menzogna dell'Identità, Milano, Feltrinelli
2. Armiero, M., (2021). L'era degli scarti. Giulio Einaudi Editore.
3. Armiero, M., & D'Alisa, G. (2012). Rights of resistance: the garbage struggles for environmental justice in Campa nia, Italy. Capitalism Nature Socialism, 23(4), 52-68.
4. Bonomi, A., & Pugliese, F. (2018). Tessiture sociali: la comunità, l'impresa, il mutualismo, la solidarietà. EGEA spa.
5. Branzi, A., (2009). Narrate o uomini la vostra storia. In M. Biraghi, G. Lo Ricco, S. Micheli, M. Viganò (a cura di), Italia 60/70, una stagione dell'architettura (pp. 153-167). Padova: Il Poligrafo.
6. Consiglio, S., & Riitano, A. (Eds.). (2015). Sud innovation. Patrimonio culturale, innovazione sociale e nuova cittadinanza. FrancoAngeli.
7. Corbisiero, F., (2020). Il turismo fa bene alle comunità? : il caso del Rione Sanità a Napoli in "Curacittà Napoli : salubrità e natura nella città collinare. - (La città come cura e la cura della città) - Macerata : Quodlibet, P. 169-176.
8. De Rita, G., (2020) Il lungo Mezzogiorno, Laterza
9. Ellis, E.G., (2020). Antropocene. Esiste un futuro per la terra dell'uomo. Giunti, Firenze.
10. Fagnoni, R. (2018). Da ex a next. Design e territorio: una relazione circolare basata sulle tracce. MD J, (5).
11. Herriott, R. (2019, September). What kind of research is research through design. In IASDR 2019.
12. Iengo, I., & Armiero, M., (2017). The politicization of ill bodies in Campania, Italy. Journal of Politi-cal Ecology, 24(1), 44-58.
13. Manzini, E. (2015). Design, when everybody designs: An introduction to design for social innovation. MIT press.
14. Manzini, E. (2020). Politiche del quotidiano, progetti di vita che cambiano il mondo. Edizioni di Comu nità
15. Manzini, E. (2021). Abitare la prossimità: Idee per la città dei 15 minuti. EGEA spa.
16. Manzini, E., Jegou F., (2008) Collaborative Services: Social Innovation and Design for Sustainability. POLI.design, Milano
17. Manzini, E., Vezzoli C., (2007) Design per la sostenibilità ambientale, Zanichelli.
18. Moreno, M., De los Rios, C., Rowe, Z., & Charnley, F. (2016). A conceptual framework for circular design. Sustai nability, 8(9), 937.
19. Parente, M. (2010), Il design per la valorizzazione territoriale. Il caso del Rione Sanità a Napoli. In Tafter Journal, aprile.
20. Piketti, T. (2020). Capitale ed ideologia. Milano, La nave di Teseo editore.
21. Sendra P., Sennett R., (2022), Progettare Il Disordine, Idee per la città del XXI secolo. Treccani
22. Thorpe, A., (2010). Design's Role in Sustainable Consumption. Design Issues, 26(2), 3–16. http://www.jstor.org/ stable/20749938
23. Wenger, E. (1998). Communities of practice: Learning as a social system. Systems thinker, 9(5), 2-3.

# Utensilia© to design.
# On the "process by which people go about producing things"

*Rossana Carullo*
*rossana.carullo@poliba.it*

*Politecnico di Bari, Italy*

***Keywords:***
*Richard Sennet*
*Utensilia© to Design*
*Design and Process*
*Design and Mezzogiorno*
*Contextual Design*

## Abstract

*Utensilia*© reinterprets Sennet's *The Craftsman*, to define a methodology of territorial mapping " better undertending of the process by which people go about producing things" (2008, p.16) in order to develop the potential existing in the manufacturing contexts of southern Italy.[1]

Sennet uses a title apparently allusive to pre-industrial conditions of production, turns it into a critique of the unlimited productivity of a technique and technology that have exchanged aims for means, generating a "culture founded on man-made things risks continual self-harm" on human artifacts that continually risks self-destruction" (p.12)

On the background of the meaninglessness of the tragedy of the Second World War, he re-discusses the distinction posed by Hannah Arendt, in *Vita Activa* (1958, transl. it. 2003) between *Homo faber*, judge of labor and material practices, and *Animal laborans*, for whom it matters only that a thing works in itself. Questioning that distinction offers us unprecedented keys to interpreting the relationship between thought and production.

## Utensilia© and context: design in the South

In February 2014 during an interview with Enzo Mari entitled Sono comunista (I am a communist), journalist Francesca Esposito asked, "What is the real secret you keep that no one has yet understood?" Mari's answer was as follows: "That Italian design was not invented by designers in Milan, but by southern artisans who later lost their jobs due to urbanization and the diffusion of technology. The artisans produced the essential objects for the farmers. For example, from a flat slab they would make a bucket. The problem is that that bucket was not called design, but it was the result of craftsmanship." (2014)

With these words Mari helps us to introduce *Utensilia*© research with great effectiveness. The Mezzogiorno has tended to apply foreign and inappropriate models of development and innovation with respect to its historically determined cultural background and skills. This has brought, in many cases, the beginning of processes of decontextualization of its territories, making unusable the attempt to combine scientific and technological progress with the preservation of knowledge and heritages linked to the contexts and communities that inhabited them (Carullo & Labalestra, 2020, pp.180-190; Carullo, 2019; Carullo, 2023; Carullo, 2024).

These are knowledges that arise from the connections present in a specific territory, unique knowledges that "leverage the relationship between tangible and intangible assets and the context that historically determined them" (Cristallo, 2018, p. 35).

The search for a different roots of production processes in the *Mezzogiorno*, the construction of a view from the South, on the issues of technological development and innovation, own of its apparent inadequacy and/or inactuality, appears strategic in the face of

> an economic globalization sustained by a technological macrosystem, understood as a unique and universal tool and language, which - among other things - determines decontextualized and deterritorialized aesthetic spaces and the crisis of the idea of shared culture within a given context and territory. (Bassi, 2017, pp. 76-77)

Doing and thinking design in the South, in an imperfect modernity, pushes to develop design dynamics in which socio-technical values and knowledge converge with historical-cultural ones.

This aspect in the present scenario of unlimited *Techne*[2] development, puts the South in a critical position of advantage. Values and knowledge require to be detected, to be interpreted in order to get out of a condition of fragmented and disconnected knowledge, they wait to be recognized in a new system of relations inscribed in the reference contexts. Attention to context design can only come through a mapping of this knowledge and the tangible and intangible heritages associated with it.

What does the process of making in the South to involve for design? Historically it has played an entirely different role from that assumed in the industrialized North. For a better understanding of these reflections, we refer to the author's studies (Carullo, 2020) regarding the planning of design training courses in Apulia since the late 1970s (Carullo & Pagliarulo, 2013). From those early studies it became increasingly clear that the Mezzogiorno would challenge the training models developed in Northern Italy, which were connected, although indirectly, to the international models they were inspired by: Bauhaus, HfG in Ulm and Institute of design in Chicago (Bulegato & Pastore, 2017).

The need to think of training models capable of joining the cultural and geographical diversities of the country, could have constituted itself as a valid tool for the development of that socio-technical potential that remained unexpressed although present in the Mezzogiorno and founded in the thickness:

> of the subaltern culture, of the material culture that in every region of Italy had and has, still for a short time in the Mezzogiorno, expressed rituals, festivals, popular traditions, objects and languages that were nevertheless and necessarily to become systems of reference for the analysis of new behaviors and new cultural and productive methodologies for all Italian culture. (Cresci, 1977, no page)

The terms used by Mario Cresci are unequivocal, and from that moment on they will give rise to a thought on design in the South with a strong critical importance, particularly on the role of technique, which is difficult to place in unambiguous alignments. The young Mario Cresci, who graduated from the *Corso Superiore di Disegno Industriale* in Venice (Bulegato & Pastore, 2017, Carullo & Pagliarulo, 2013) soon moved to Matera, in a cultural, social and economic context, completely different from that of his education, and

built his work in the specificity of the new context. A context that amplified what was being debated in those years on the so-called *Questione meridionale* between *Cassa del Mezzogiorno and Formez*[3] - the Formez was the body that supported the Cassa del Mezzogiorno for aspects of sustaining the social and educational development of the South (Carullo & Labalestra, 2020). The symbolic value of the city of Matera constrained Cresci at that time to come to terms with an idea of design linked to an economic-industrial development that challenged what was being pursued in the industrialized North, where his education came from. More than forty years ago, therefore, the need emerged to define a model of education that adhered to the complexity of the social and industrial reality of the places in which designers, once educated, were to act. This is an ante-litteram view of the need to read design in the geographies of its process of makings geographies that still await a scientifically shared methodology of critical mapping.

More recently, the literature concerning the relationship between design and territories (Parente & Sedini, 2018) insists on the role of the connections between socio-technical and historical-cultural values, referring to the importance that local communities have in this dynamic, compared to what is debated today about the heritages of material and immaterial culture that are determined in territories (Villari, 2018). The mapping model of the processes of *making of* Apulian artisans, offered by Utensilia©, intends to capture this aspect as well, in order to bring out the material and immaterial potential present in the production processes of the territories and understand how and whether it can be reactivated (Lupo, 2013).

If we take Cresci's thinking, mapping will also deliver us those knowledges for their patrimonialisation, according to the meaning introduced by the 2003 *Convention for the Safeguarding of the Intangible Cultural Heritage* (https://unesco.cultura.gov.it/convenzione-2003/)[4]. This was added to in 2005 by the Convention on the Value of Cultural Heritage for Society or the Faro Convention, https://www.coe.int/it/web/venice/faro-convention)[5] which was only recently transposed by Italy in 2021. The scope of these conventions only sanctions at the European level the importance of the relationships between material culture and communities inscribed in specific territories. Communities are recognized as having a specific creativity and interpretative capacity of their contexts, read also through historically stratified production processes. Both conventions configure a "prodigious extension of field toward those anthropological landscapes that, although at the origin of the three-dimensional world, remain on the margins of it due to the impossibility of being properly known, presented with traditional tools" (Irace, 2013, p. 8).

The Utensilia© methodology aims to get to know and understand these socio-technical landscapes, with an anthropological view, and on this basis to open up to a design planning focused on processes of making before products, on work before things. The aim is to produce operational maps, in which the will to practice such goods as the result of technical and social relations that

> "increase their value the more they are recognized and incorporated into the collective consciousness of a community [...]. In the cultural heritage valorisation chain, processes such as 'preserving and conserving' can thus be flanked by actions such as 'activating and practicing". (Lupo 2013, p. 80)

This point of view opens up to production strategies that Utensilia© reads and maps in its ability to generate not only productive value, as those knowledge still active, but also patrimonial value. The research collects five years of experimentation aimed at determining a methodology capable of

mapping Apulian craft micro-enterprises, with the aim of re-activating the production processes of this form of heritage related to material culture still existing in the contexts of the South to transform it into an open system of knowledge and project (fig. 1).

*Figure 1. Mapping the process making: author.*

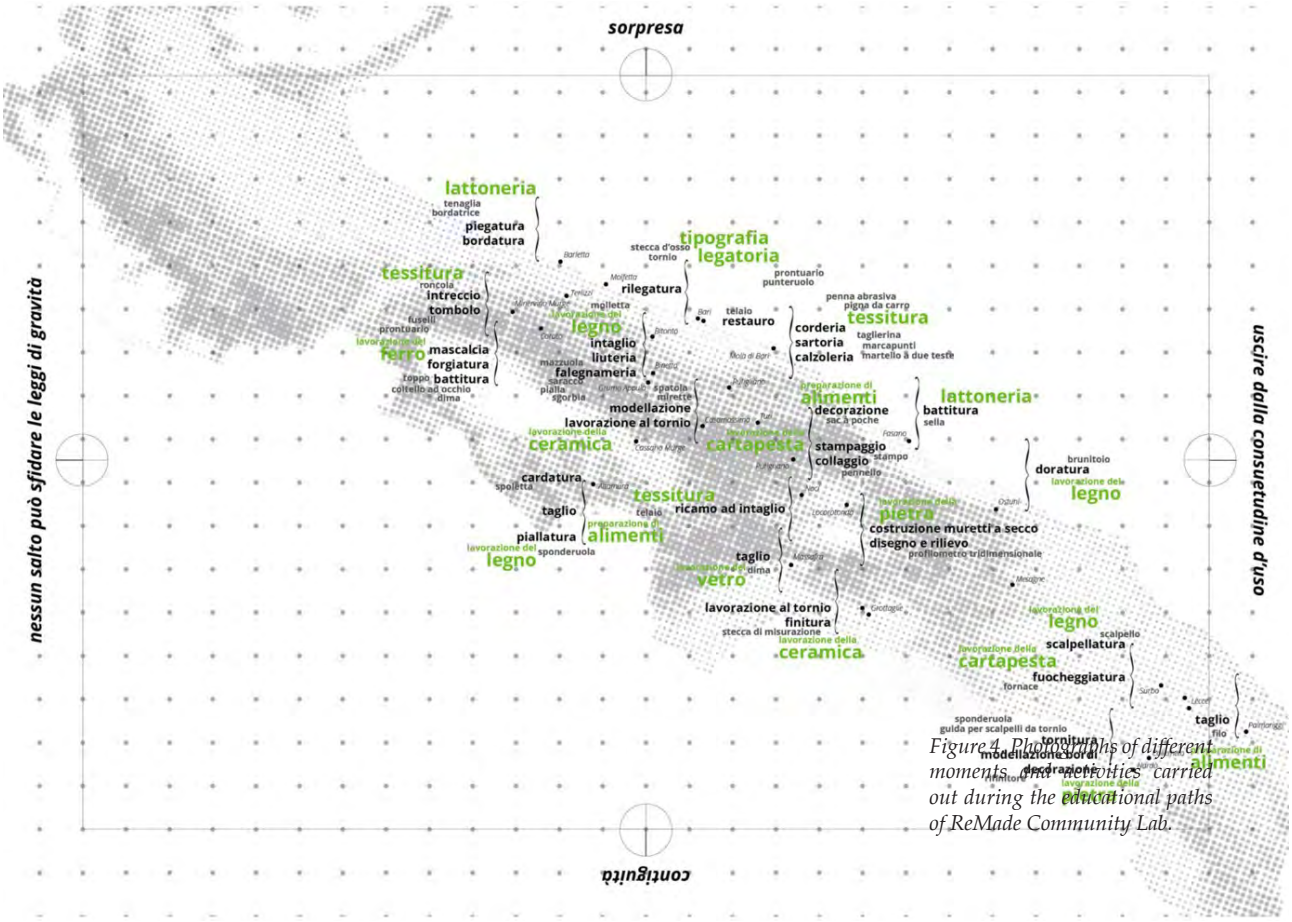



*Figure 4. Photographs of different moments and activities carried out during the educational paths of ReMade Community Lab.*

## Utensilia© and labor: The political space of processes of making

Utensilia© also answers other questions: is it possible to build a dialogue in the South between production processes and their contexts? Is it possible for them to engage with contemporary technological development without losing their specificity? That is, is it possible to imagine that this knowledge can dialogue on par with the technocratic development processes of the contemporary capitalist system? Does this dialogue, which is an indirect reflection on the relationship between technique and culture, succeed in bypassing the ideological dualism between romanticists and rationalists that runs through any debate on craft issues from Morris onward? Because finally we must have the awareness that:

> due to the fact that we inhabit a world in every part of it technically organized, technique is no longer an object of our choice, but is our environment where ends and means, purposes and ideations, conducts, actions and passions, even dreams or desires are technically articulated and need technique to express themselves (Galimberti, 1999, p. 34).

Utensilia©, is also intended to be a reflection on the role of technique in contemporary times. The craftsman then appears there as a figure of man at labor, as a reflection on the 'human condition' of the relationship with technique. This is the sense of The Craftsman, by Sennet, the craftsman is a metaphor for a reflection on the theme of "technique considered as a cultural issue rather than as a mindless procedure" (p. 18). To do this, the author is not concerned with artifacts, but with processes, indeed better still with the "process by which people go about producing things" (p. 16); he is concerned with understanding the connections that such processes imply in the relationship of self to the world; he is concerned with reflecting on the 'human condition' in the face of the constant pandoric danger of unlimited productivity leading toward self-destruction.

As Riccini recalls in Culture della tecnica e storia del design/Storia della tecnica e teoria del design (2013):

> "the study of artifacts must be conducted with processuality in mind. [...] focus of history's attention is not only the final artifact, but the process that leads to that artifact - or those artifacts -" (pp. 69-70).

What better expedient to account for processuality than to deal with that apparently service-oriented world of the Utensilia© of laboratories, machines, and instruments of labor, which technical historians first elected as protagonists of their object of study. In doing so, they brought into that history the material objects that accompanied its course:

> [e]ven more surprising are the interest and openings towards artifacts such as laboratory instruments, experimental prototypes, machines, by the historians of science who finally deal not only with the history of scientific ideas, but also and increasingly with the material objects that accompanied their adventure. (Riccini, 2013, p. 64)

If the attention to instruments becomes foundational for a design history in which technique is "not opposed to but intrinsic to the process of design's historical development" (p. 63), what is the significance of dealing with it from the point of view of the design and material culture of the territorial contexts of the South? Utensilia© here take on a double value, as objects and subjects of mapping, as instruments in themselves, expressions of a given socio-technical development, but also as protagonists of that technical process and its possible modifications, protagonists of labor. Taking care of Utensilia© means taking care of the processes of making, through the material objects that determine them; it means taking care of material culture starting from its lowest step, but perhaps for this reason from its most archetypal trait. For this reason Utensilia© is the interpretive device that can most verify Sennet's thought in its desire to rediscuss the premise that he himself poses to his text: the distinction posed by Hannah Harendt, his teacher, between the different figures of man at work treated in Vita Activa (1958, it. trans. 2003). Sennet particularly re-discusses the distinction between Homo faber and Animal laborans, which together with acting, constitute in Vita Activa the three conditions of man outside the contemplative life. The Animal laborans, a figure of man at labor, who produces in a repetitive and self-referential way, in order to make a thing work in itself (Sennet, p.16), as opposed to the homo faber, a figure of the operating who produces the things that are used:

> "as we use them, we become used and accostumed. As such, they give rise to the familiarity of the woorld, its custums and habits of intercourse between men and things as well as between men and men" (1958, it. trans. 2003, p. 67), a relationship that takes place in the sphere of discourse and memory, that struggles in political confrontation, in that gap between man and the world that artifacts are. (Dal Lago, 2003, p. XXVI)

The Homo faber, answering the 'why' of making, is thus a political figure superior to the Animal laborans, who is only concerned with the 'how'. According to this point of view for Sennet, the homo faber described by Arendt "is the judge of material labor and practice, not animal laborans's colleague but his superior" (p. 16). The Homo faber is one who in judging takes on the ethical-political task of the impact of man's making in the world and its implications in relations with other men, ultimately the fates contained in Pandora's Box.

Into this segment of the discourse comes the Utensilia© methodology, to verify, in the change of disciplinary domain from sociology to design, what Sennet in his text seeks to demonstrate: namely, that 'hinking is doing'. Once again it is a matter for Sennet to circumvent the dualism posed by Harendt:

> [t]his division seems to me false because it slights the pratical man or woman at work. The human animal who is Animal laborans is capable of thinking; the discussions the producer holds may be mentally wich materials rather than other people; people working together certainly talk to one another about what they are doing. For Arendt, the mind engages once labor is done. Another, more balanced view is that thinking and feeling are contained within the process of making (p.16),

the possibility of judgment about one's doing is already contained, a doing that is neither of industry nor craft, neither rationalist nor romanticist, a doing of the 'human condition'. In this trait there remains a strong reference to Vita Activa, and with it to the system of contextual and human-to-human relations that flow from it.

## Representation and project of the "Process by which people go about producing things": Methodology

Subtended by the concept of the utensil as a instruments of laboratory and production, below also opens up the dualism between in-strùere - the discours on how to build, on the code of constructive procedures, in a broader sense on instructing - and *in-signàre* - the discourse on the transmission of knowledge understood as the ability to imprint a sign, and therefore a meaning, to arrive at the 'why' of the processes of making and their representation. It can only pass from the discourse between men, a discourse on the processes of making accomplished from the university classrooms to the territorial context of reference and back. Utensilia© is this discourse, a discourse between teachers and students and between them and the 'process of making' of their places of origin. A discourse not about artworks and forms, but about the labor that makes them, where the *in-strùere* and the in-signàre coexist. Referring again to Mari's words, it could be said that "form is what it is, not what it seems for this it is necessary to talk about the work that realizes it" (Mari, 1999, no page).

The discourse is Sennet's own starting point when, having to discuss the ways of thinking about making, he opens an examination of the expressive instructions that articulate it (Sennet, 2008, it trans. 2010, pp. 174-186). An examination of the possible forms not of the artwork, but precisely of the thought about the labor that produces it. This is the first of the three moments in which the mapping of Utensilia© is structured. The research on the expressive instructions took place in the hundreds of local realities of the still lively handicraft fabric of the territory, in the meeting with the artisans in their laboratories, in the dialogue, for the determination of a language that from oral could land to writing. On the one side the in-strùere guides into the world of constructive procedures, into the slow identification of the fractions of labor that define the process. Here the discourse reviews, provides the informational elements that record the horizontal sequence of actions. On the other side the *in-signàre*, is, if anything, concerned with representing - in the sense of presenting a second time - those sequences, transfiguring them, recording the processes of imagination subtended in them, con-dividing the universal value of that doing and experience. Expressive instructions thus open up imagination, making and thinking, articulate their relationship by opening up the "large, difficult subject of the role of imagination in craftmanship" (Sennet, p. 176). No wonder that everything contained in the world of expressive instructions is also one of the main interests of the processes of heritagization of the intangible - oral traditions rather than behaviors - as advanced by the Unesco and Faro conventions.

The interweaving becomes more complicated; Utensilia© while reviewing, at the same time represents, and in these two actions patrimonialises, not things, but the processes and symbolic values subtended therein. There are now hundreds of books collecting the expressive instructions of local knowledge, after five years of research. They have mapped the histories of making with interviews and photographic campaigns, in which anthropological values seem to converge with social ones and these with technical ones. The latter are made precise by connecting each step of the process with the Utensilia© that identify it: the word approximates, the instrument specifies, the second moment of mapping opens. Sennet speaks explicitly of arousing tools (pp. 187-204), of their non-unique use, of their ability to make intuitive jumps, once again activating the imagination of its possible ways of use: the more polyvalent the instruments are presented as the more they expand their interpretive possibilities.

Mapping proceeds with the millimeter relief of the instrument to which the system of historical sequences that determined it is assigned. With the technical data emerge the mutant process fractions that involved it. From the Encyclopédie to industrial production and back, the mapping of instruments read in the now vertical sequence of its permanences, impermanences and innovations, (Kubler, 1972, p. 43-49), represents the precise place where the domain of design opens up. In this second moment of mapping, Utensilia© unfolds its design energy. One final step is addressed: the relationship between mind and hand that the instrument necessarily incorporates and the craftsman still can witness (Sennet, pp. 147-173). Paraphrasing Kant, Sennet sees in the hand "the window of the mind" (p. 147), in touch the activation of perceptual synaesthesia that turns into a real cognitive act (p. 152), as the anthropologists of the MàP group, Matière a penser, say: "this process of interaction between man and technical means produces a form of incorporation of material culture, with the subject that makes body with the object [...]" (Dei and Meloni, 2015, p. 87). But this is not enough because even in the total materiality and physicality of the body-artefact relationship, anthropologists recognize that in this very physical mediation "people can constitute themselves as individual, social and cultural subjects" (p. 85).

The books map hundreds of hand movements in the latter stage, in their

different modes of gripping, pliers simple, palmar pliers, cup pliers; they map the areas of contact between hand and tool, segment the process of embedding between human and tool. Finally, this complex system of technical thinking, brings about the design of new Utensilia©, artifacts and at the same time vehicles for the development of the 'making of things', without betraying the history, the person and the community to which they belong. The digital and the computational, can enter at any point of the mapped process fractions, not least that proper to sensoriality, reformatting craft instruments, attributing to them properties of technical reproducibility that the incorporation of movements had rendered tacit. The new Utensilia©, through design and comparison with the most advanced technologies, become technological hybrids. Processes scientifically fractionated through mapping, are thus available to be recomposed into new production processes and consequently enter into new contextual relations, including those of patrimonialisation and transmission of processes of making.

An exemplary case concerns the mapping of the weaving laboratory of "Le Costantine" Foundation craft realities among the most recognized in the weaving sector in Apulia (Laurenzi, 2018). The mapping follows the order of reference above. It starts from the expressive instructions that identify process fractions (fig. 2) from warping to reweaving, to binding the pedals with healds. The processes are then specified through the instruments involved, the arousing tools. From the Encyclopèdie to the present their typological permanence appears as an unalterable given for the project, the craft and mechanical dimensions appearing worlds irreconcilable (fig. 3). Finally, the hand: the incorporation of the weavers' gestures (fig. 4) leaves no openings for the transmissibility of processes. The determination of the right tension of the warp threads, the consistency between warping and reweaving, the ligatures with the pedals for moving the healds themselves, all appear to be the result of a mastery that cannot be reproduced. Here opens the project challenge, the possibility of translating those process steps into the possible universes of contemporary technological development, technically reproducible, so that from those gestures reverberate fragments of technical-creative innovation, an integral part of that original micro-social context. The tools that have come down to us from the Encyclopèdies under go a haking action, sensors and Arduino boards encapsulated in transparent silicone blocks, (fig. 5) bind themselves to the historical tools, recording their movements, from warping to rehousing, in a workflow that a specially designed app brings back into a system of new connections between computation and manual dexterity, a 4.0 workspace that becomes the intangible site of the transmission and emancipation of a knowledge embedded in the histories and techniques of the mapped processes of making (fig. 6).


*Figure 2. The expressive instruction that identity process fraction; autor with the students: Lazzari l. Macchia M., Miggiano A., Pezzarossa L., Sicuro A., Phd student leone T., 2023*

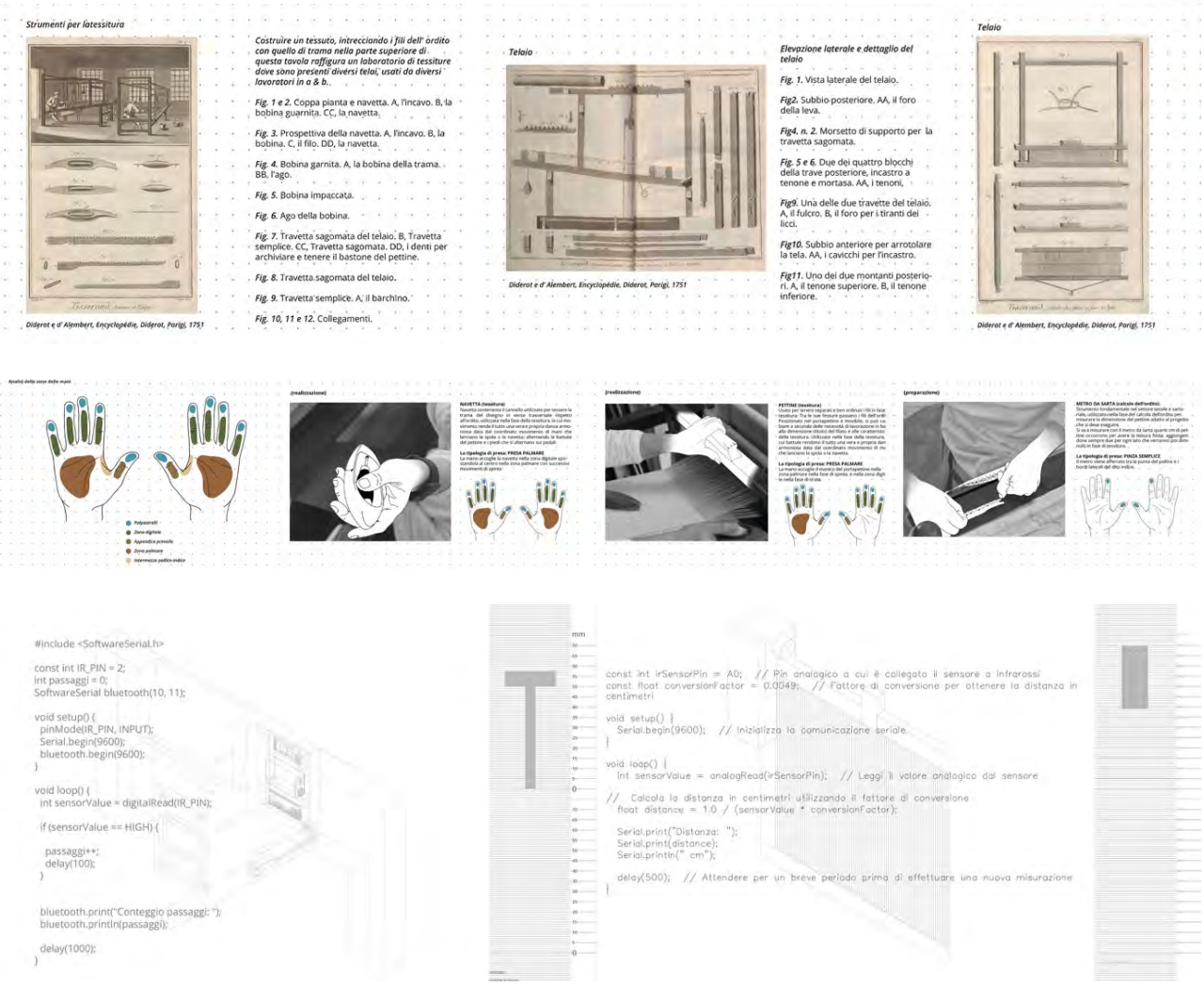








*Figure 3. The arousing tools. From the Encyclopèdie to the present; author with the students: : Lazzari l. Macchia M., Miggiano A., Pezzarossa L., Sicuro A., Phd student Leone T., 2023.*

*Figure 4. The hand: the incorporation of the weavers' gestures; author with the students: Lazzari l. Macchia M., Miggiano A., Pezzarossa L., Sicuro A., Phd student Leone T., 2023.*

*Figure 5. Sensors and Arduino boards encapsulated in transparent silicone blocks, bind themselves to the historical tools; author with the students: Lazzari l. Macchia M., Miggiano A., Pezzarossa L., Sicuro A., Phd student Leone T. 2023.*

## Conclusions:
## For a new relationship between project and labor

The challenge is that precisely from the Mezzogiorno comes a way of interpreting technologies by bypassing ideological dualisms, "privileging micro-social analysis, minute and situated ethnographies [...] in a diversified materiality, within a narrow social group" (Dei & Meloni, 2015, p. 887). From this analysis thanks to the new Utensilia©, the material and immaterial connections they are able to generate, this minute and fragmented world becomes part of larger networks of knowledge of contexts and productions, opening to an intercultural logic. Maps thus understood not only tell us what is there, what history reveals to us and what the project interrogates, but also how all this can enter without ideological bias into this world we inhabit "in every technically organized part of it" (Galimberti, 1999, p. 34) regardless of our possibility of choice "we inhabit technique irretrievably and without choice this is our fate as advanced Westerners" (p. 34). Mapping craft processes does not mean wanting to live outside of technical conditioning, but, as Sennet teaches, having the opportunity to construct a critical-operational reflection on the human condition of man at labor. The power that design has, in approaching mapping processes, we believe lies precisely in its capacity for analysis and project prediction of possible futures, fueled by the acquisition of the necessary and minute expertise of territories. The context of the South, its apparent economic-technological subalternity, stands in

critical terms in front of deterritorialized technological macrosystems (Bassi, 2017, pp. 76-77).

Utensilia©, is situated between the model of development that Cresci thought of as necessary long ago, in his relationship with the artisans of Matera, and the one that Tomàs Maldonado presented in Bari in the late 1980s, also collaborating with Formez, for the opening of the first post-graduate school in design in Italy (Carullo & Labalestra, 2020, pp.180-190). Precisely in the South, there could be realized that possibility of bypassing the ideological dualisms we have outlined in this paper, not least, that between design and work, which most of all contrasts craftsmanship and industry: precisely in the South, there could be realized that possibility of bypassing the ideological dualisms we have outlined in this paper, not least, that between design and work, which most of all contrasts craftsmanship and industry:

> unlike, however, what has always happened with craftsmanship, industrial design does not act in our society as an integral part of the work process. Ideation and execution, in this view, would be two different things called upon to perform two different functions. In fact, so far the distance between ideation and execution, between project and labor, has been exaggerated, but nothing today prevents us from imagining a future in which this distance can be drastically reduced. In other words: a future in which, as we shall see, the role of the project might change, in the interest of greater creative participation of laborers. (Maldonado 1976-2001, p.14)
>
> in other words in a challenge from the South for "a more complete and precise understanding of the process by which people produce things." (Sennet p.16)

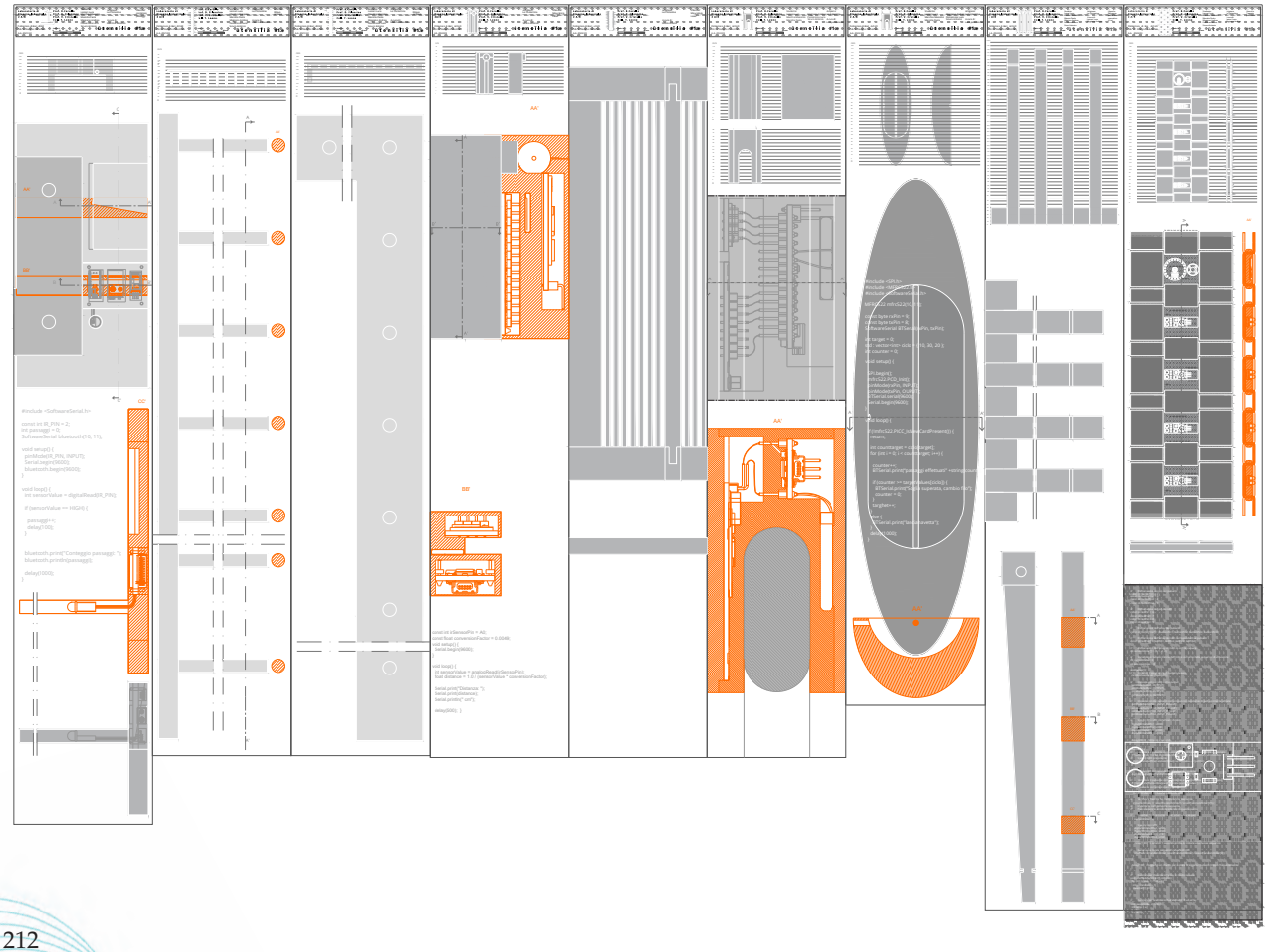


*Figure 6. The 4.0 workspace that becomes the intangible site of the transmission and emancipation of a knowledge embedded in the histories and techniques of the mapped processes of making; author with the the students: Lazzari l. Macchia M., Miggiano A., Pezzarossa L., Sicuro A., Phd student Leone T. 2023.*

## Acknowledgments

I would like to thank all the students of the 2017-2023 academic years, the collegue Donato Filannino who started this adventure with me; Phd Student Tania Leone for her fundamental contribution in the critical use of digital technologies for design; all the artisans who generously lent their time and expertise, Phd Student Nicoletta Faccitondo and colleague Vincenzo Bagnato, for sharing part of the training activities, and the colleagues Ivo Caruso and Vincenzo Cristallo who shared in the Utensilia@ studio an ongoing discussion on the discipline of design and its challenges in the contemporary world.

## Footnotes

1. Part of the research refers to the project founded EU - NextGenerationEU – Piano Nazionale di Ripresa e Resilienza (PNRR) - Missione 4 Componente 2 Investimento 1.3 – Avviso N. 341 del 15/03/2022 del Ministero dell'Università e della Ricerca. Protocollo dell'istanza PE00000004, decreto di concessione del finanziamento n. 1551 del 11/10/2022, CUP D93C22000920001, Made in Italy Circolare e Sostenibile MICS. SPOKE 7 "New and consumer-driven business models for resilient and circular SCs" P. 5 - WP4: "Textile supply chain. A cultural approach to innovation" (coordinator Rossana Carullo)
2. The author uses the terms technology and technique in the following relationship: "by the 'term 'technique' we mean both the universe of means (the technologies) that as a whole make up the technical apparatus, and the 'rationality' that presides over their use in terms of functionality and efficiency." (Galimberti, 1999, p.34.)
3. The author has extensively explored these issues from a critical historical perspective in the reference bibliography. Here he specifies that the Formez was the body that supported the Cassa del Mezzogiorno for aspects of sustaining the social and educational development of the South. As sociologist Aldo Musacchio, who worked there for 30 years, recalls, Formez continued to make its contribution even with the demise of the Cassa del Mezzogiorno and still exists today although with different objectives.
4. The convention was unanimously approved at the 32nd session of UNESCO's General Conference in Paris on October 17, 2003
5. "The Faro Convention emphasizes the important aspects of cultural heritage in relation to human rights and democracy. It promotes a broader understanding of cultural heritage and its relationship to communities and society. The Convention encourages us to recognize that objects and places are not, in themselves, what is important about cultural heritage. They are important because of the meanings and uses people attach to them and the values they represent." https://www.coe.int/it/web/venice/faro-convention [febbraio 2024].

# References


1. Arendt, H. (1958). The Human condition, The University of Chicago Press, Chicago. trad. it., (1964-2003) Vita Activa. La condizione umana. Milano: Bompiani,
2. Irace, F. (2013). “Design e Cultural Heritage: un’introduzione”, in Irace, F., Immateriale, Virtuale, Interattivo Milano: Electa, pp. 7-9.
3. Bassi, A. (2017). Design contemporaneo, Bologna: il Mulino, pp. 76-77.
4. Bulegato, F. (2018). “La formazione del designer: il corso superiore di disegno industriale di Venezia, 1960-72”, in QuAD, Quaderni di Architettura e design, pp. 261-277. [Online] avalaible at: http://www.quad-ad.eu/wp-content/uploads/2018/07/25_QuAD_I_Bulegato_Pastore.pdf
5. Carullo, R., Labalestra, A. (2020). Il design nelle politiche di sviluppo del meridione d’Italia. I lavori del gruppo «mezzogiorno 2000» per l’accrescimento a livello meridionale di un diffuso tessuto di democrazia reale. Proceedings of the conference AIS/Design 2019 Italia: design, politica e democrazia nel XX secolo, Torino: Politecnico, pp.180-190.
6. Carullo, R. (2019). “Design di processo e imprese artigiane. Verso la costruzione di un modello meridiano”, in (a cura di): Russo, D., Tamborrini, P., Design e territori. Università e aziende tra sperimentazione e innovazione, Palermo : New Digital Frontiers srl, pp. 51-66.
7. Carullo, R., Pagliarulo, R., (2013). “Matera anni Settanta: Cooperativa Laboratorio Uno S.r.l. Design e formazione nel Mezzogiorno d’Italia”, in AIS/DESIGN. Storia e Ricerche, pp.1-14.
8. Carullo, R. (2020). “Da terreni fertili a semenzai: design e formazione” in SI Southern identity, n.10, pp. 61-81.
9. Carullo, R. (2023). Autarchie contemporanee e modelli di sviluppo meridiano. Design e fibre naturali come patrimoni di cultura materiale, in Design e fibre naturali. Territori, materiali, tecnologie, Md Journal Dossier, pp. 29-42.
10. Carullo, R. (2024). “Dal territorio ai corpi. Diacronie meridiane dei processi manifatturieri e nuove percezioni del Made in Italy”, in PARD Prospettive del Made in Italy, Melfi: Libria, pp. 294-303
11. Cresci, M. (1977). Introduzione, 2Dimensioni, p.17.
12. Cristallo, V. (2018). “Note sul linguaggio del progetto per il territorio”, in Parente M., Sedini C., Design per I territori. Approcci, Metodi, esperienze, Listlab, pp.33-39.
13. Dal Lago, S., (2003). “La città perduta”, in Harendt, H., Vita Activa. La condizione umana, Milano: Bompiani, pp. VII-XXXIII.
14. D’avossa, A. Picchi F. (1999). Enzo Mari, il lavoro al centro, Milano: Electa.
15. Dei, F., Meloni, P. (2015). Antropologia della cultura materiale, Roma: Carocci.
16. Esposito, F., (2014). “Sono Comunista”, Klatmagazine, 7 febbraio 2014, [online] Available at http://www.klatmagazine.com/design/enzo-mari-sono-comunista-interview/11567 [accessed 21 febbraio 2024]
17. Galimberti, U., (1999). Psiche e Techne. L’uomo nell’età della tecnica, Milano: Feltrinelli.
18. Laurenzi, E., (2018). Fili della trasmissione. Il progetto delle donne De Viti de Marco - Starace nel Salento del Novecento, Lecce: Grifo Edizioni.
19. Lupo, E., (2013). “Percorsi e scenari dell’intangible. Le filiere del progetto e il potenziale di innovazione del patrimonio immateriale come “open-endend knowledge system,” in a cura di, Irace, F. Seassaro, A., Design&culturalheritage. Immateriale Virtuale Interattivo, Milano: Mondadori Electa, pp. 79-91.
20. Mari, E., (1999). “Enzo Mari”, Triennale. Notizie 6. Ottobre, pp.1-15.
21. Parente, M., Sedini C., (2018). Design per I territori. Approcci, Metodi, esperienze, Unione Europea: Listlab.
22. Riccini, R., (2013). “Cultura della tecnica e storia del design / storia della tecnica e teoria del design”, in Il Design e la sua storia, Primo convegno dell’associazione degli storici del design. Triennale di Milano 1-2 dicembre 2011, Lupetti editore Milano, pp. 61-74.
23. Sennet, R., (2008). The Craftaman, Yale Univeristy Press, New Haven-London, it transl. L’uomo artigiano, Milano: Feltrinelli, 2008.
24. Villari, B., (2018) “Design e valore territoriale. Il progetto con per e guidato dal design”, in Parente M., Sedini C., Design per I territori. Approcci, Metodi, esperienze, Listlab, pp.63-74.
25. Maldonado, T., (2001). Disegno industriale un Riesame, (prima edizione 1976), Milano: Feltrinelli.
26. https://www.coe.int/it/web/venice/faro-convention [febbraio 2024].
27. https://unesco.cultura.gov.it/convenzione-2003/ [febbraio 2024].

# Color loci placemaking: Color and processes of place appropriation

*Cristina Boeri*
*cristina.boeri@polimi.it*

*Color Lab, Department of Design, Politecnico di Milano, Italy*

***Keywords:***
*Color Placemaking*
*Environmental Color Design*
*Color Planning*
*Urban Color*

## Abstract

The definition of Color loci placemaking was introduced in the context of urban color planning and design to summarize a mode/possibility of understanding and approaching urban color that recognizes the dynamic and transient nature of color as a privileged means to support both the needs of resignification and reappropriation and those of conservation and enhancement of the vital identity of each single place. In this contribution these concepts are explored in the light of some case studies, concerning color-based transformation of existing built environments, that contribute to fuel the discussion on the social role of color in urban environmental design. While the advantages connected to the search for color continuities with respect to the historical, traditional, and functional features of places have been widely discussed, the aim of the paper is to show how color, and color transformations.

## Introduction

In the sixties, a renewed interest in the use of color invested all design aspects and in particular urban environment (Porter, 1982; Nemcsics, 1992; Lenclos, 2009). Two new phenomena, typical of the time, helped to redefine the relationships between color, architecture, and the city. On the one hand, between the end of the sixties and the beginning of the seventies in the United States, Supergraphics experimented mural art as a fast and economical means of revitalization of the most degraded areas of the city. On the other hand, since the sixties in Europe, and especially in France, new color specialists worked both on the color connotation of new urban developments and the perceptual requalification of existing built environment. These new urban experiments were characterized by an intensive use of color intended in a social rather than aesthetic meaning of improving the quality of life.

Prieto (1995) in presenting the new profession of color consultant, taking place especially in France, underlined its social role and social impact. Further to deal with existing or new built environments, Prieto (1995) underlined the role of color consultant in advising on the use of color in ancient districts and town to contribute to preserving and enhancing traditional architecture heritage. Among the most well-known approaches especially addressed to the recognition and preservation of a consistency and continuity with the historical identity matrices of the city, there are the Turin's

color plan by Giovanni Brino, at the end of the seventies (Brino & Rosso, 1980; 1987), and the geography of color developed since the late sixties by Jean-Philipphe Lenclos (Lenclos & Lenclos, 1982; 1995; 1999). Together with the theoretical implications and methodological developments offered by Brino and Lenclos, numerous experiences of urban color planning and design have taken place in Europe (Taverne & Wagenaar, 1992). Compared to the search for color continuities related to the historical and local features, they contributed to frame urban color in a dynamic process of coexistences made up of invariants and changes (Efimov, 1992; Lancaster, 1992; Nemcsics 1992).

Prieto (1995) also stressed on the differences between the work of color consultant with its rigorously developed methodologies and the phenomenon of murals taking place especially in United States. Despite the differences in the approaches, methods, and results, to distinguish both the work of the new color specialists in Europe and Supergraphics was the desire to respond to the problems of urban quality and identity through the color too. Color appeared a means to create or preserve the place identities.

Although, as McMorrough (2007) pointed out, Supergraphics was a minor occurrence, the critical attention of the time framed it as an aesthetic and social response to the problems facing the man-made environment. Smith in a 1970 article titled Urban Renewal with Paint exemplified the social use of Supergraphics presenting a series of applications in which Supergraphics is intended as a fast and cheap means of revitalizing the ghettos. As Herdeg (1978) observed, compared to previous experiences, these "animated walls" were different for both the new dimensional relationships with the building and the unusual colorfulness. These huge murals participated directly in the urban architectural experience and, again according to Herdeg (1978), by quasi-architectural means, rendered an eminently social service.

Since the Supergraphics experience, mural art evolved in United States in an urban, economic, and social regeneration strategy, through programs administered and funded by municipalities (Greaney, 2002). As Greaney (2002) observed, both in community-based mural projects and urban environmental works the process is a collaborative civic experience. Yet differences are in the visual output, murals painted for urban environmental purposes usually do not contain social or political messages and their style is frequently abstract or decorative (Greaney, 2002).

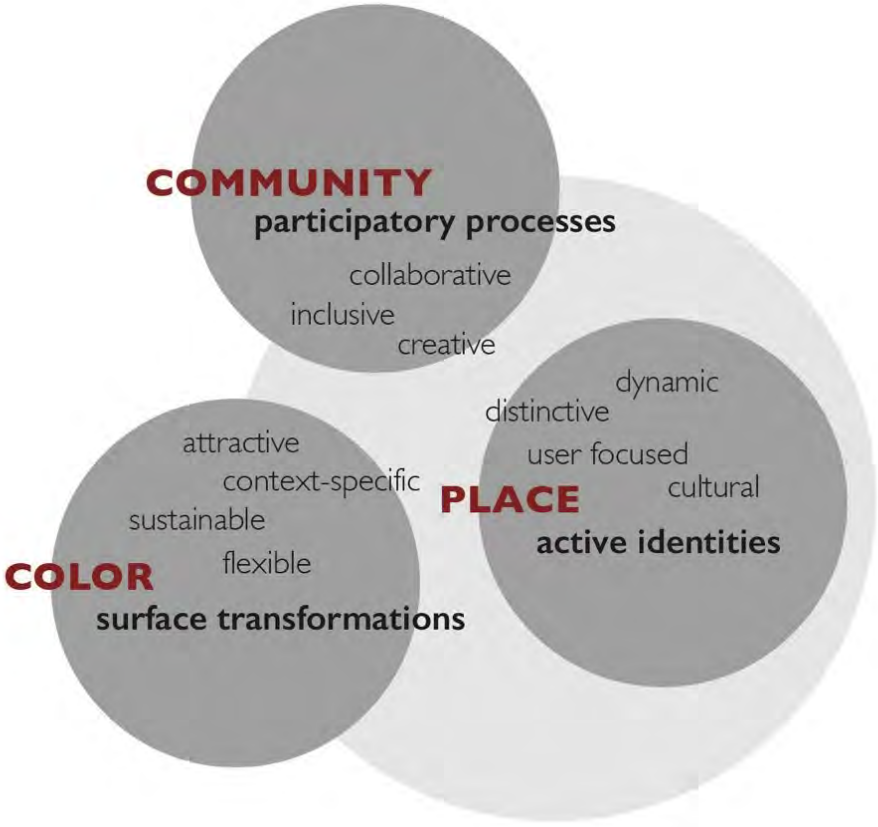
Nowadays, the use of public art in urban regeneration has been increasingly advocated worldwide, but what is peculiar to murals is the collaborative process. As Greaney (2002) said, murals are not simply art but action, and must include community participation. Aspects that find, in the last few years, new elements of reflection looking at those urban color projects that move within the concepts of placemaking, that is, taking the definition of the Project for Public Spaces, the collective reimagination and reinvention of public spaces as the heart of every community (http://www.pps.org).

The definition of Color loci placemaking evolved looking at both these approaches. On one side the methods developed in search for color continuities with respect to the historical, traditional, and functional features of places and on the other the processes developed in search for social based color transformations. In fact, as already discussed (Boeri, 2016; 2017; 2018), if the term "color loci", on the wake of the "genius loci" concept developed by Christian Norberg-Schulz (1979), refers to the chromatic spirit or distinctive features of each place that must be preserved in a new key of interpretation, without interfering with the inevitable and necessary transformations, the term "placemaking" refers to the way in which the human factor transforms the spaces into living places. This action of construction, transformation, and renovation, which is innate in human expression, as underlined by Schneekloth and Shibley (1995), not only strengthens the relationships of

people to places, but also among people in places (Figure 1).

While the advantages connected to the search for color continuities have been widely discussed and recognized, the aim of the paper is to show how color-based transformations can be an effective means of place appropriation. In particular, three case studies, previously already taken into consideration (Boeri, 2017; 2018), serve to define how color can be understood in a social, cultural and educational meaning, as the facilitator of a community process of transformation, adaptation and appropriation of places, and therefore, in definitive, as a tool for a placemaking action.

*Figure 1. Color loci placemaking scheme (Boeri)*




## Color driven transformation processes

The selected case studies concern urban transformations based on the color repainting of existing buildings. While the differences are remarkable, all the three cases contribute to define some aspects of color driven processes of transformations in search for new relational and affective dynamics with places.

The first case concerns the approaches developed since 1986 by the Aristotle University of Thessaloniki Color Semiosis Group, under the direction of Theano Fannie Tosca, for the rehabilitation of the Greek contemporary urbanscape based on the use of color (Tosca, 1997; 2002). In particular the redevelopment of the city of Thessaloniki in Greece through the color repainting of the buildings. As Tosca (2002) pointed out, the aims of the group were the aesthetic and functional reorganization of the existing mixed-style built environmental in view of continuous change and remodeling processes to accommodate the new needs of a basically shifting populations, as well as new technologies, new land uses, and new regulations. Color, due to its limited permanence and affordability, was intended as an efficient, fast and flexible means of periodical reorganization of the built environment (Tosca, 1997). The most important aspects in the conception of the color scheme

identified for Thessaloniki was in the search for flexibility both in the color palette and pattern. Possible color areas rather than specific colors and zones aimed at defining degrees of relationship (Tosca, 1997). Flexibility appeared the key to giving an overall and controlled structure to transformation and, moreover, legitimacy to the large-scale transformation. The survey on population's color preferences, adopted in order to define the color scheme, strengthened the relationships with the context specificities: place, time, and population (Tosca, 1997). The color scheme was not applied, due mainly to lack of funding, and the group moved to an even more flexible design tool such as lighting-color design (Tosca, 2002).

The second case is the renewing process occurred in Tirana, Albania, since 2000, started with the color program promoted by mayor-artist Edi Rama. Rama entrusted color with the task of awakening the public interest in citizens and starting a process of perceptual redevelopment of the city, even before than aesthetic, social and cultural (Rama in Di Nardo, 2008). As Rama himself used to say explaining his color strategy: Tirana was like a sick girl and color was her makeup, which alone won't heal her, but it will give her the strength to fight against the illness (Shkreli, 2008; Bulleri, 2012). The grey uniformity of communist era was replaced by a new colorful and multiform variability on the existing facades, but, unlike similar color re-styling interventions that affected the countries where during the socialist period mass construction created new extensive housing ensembles (Urland, 2012), in Tirana color followed a spatial and urban organizational logic. Di Nardo (2008) observed as color surrounded the city's most important urban spaces (Figures 2-3), and, as reported in the study by Abazi and Dervshi (2014), the type of color intervention was oriented on the basis of the architectural value recognized to the buildings (Figure 4). Furthermore, the color interventions on the existing buildings were followed by other cultural projects of great impact, such as the foundation of the Tirana Biennial in 2001 and the activation of several international competitions, which led to enlarging the participation and the discussion on the city revive. During the second edition of Tirana Biennial, world-famous artists were invited to work directly on the facades of former socialist housing blocks contributing to improving the quality of living (Kushi, 2008). In the 2009 Tirana Biennial the so-called Façade Project was continued inviting other artists to work on it (http://tica-albania.org).

*Figure 2. Mapping the concentration and distribution of the colored building along the main streets in Tirana (AND 11- Paolo Di Nardo, 2008, Traces of the future, graphics by Davide Ciaroni).*

The chromatic transformations carried out in Tirana have had an aesthetic, social and economic impact. As argued by Bulleri (2012), Tirana has negotiated its own identity, changing from the capital city of the poorest country in Europe in 1985 to the European capital city of the future in 2010. The social impact of Rama's painting action was partially analyzed by Abazi and Dervshi (2014) through a questionnaire involving 450 people, in the majority residents. As emerged from the results of the questionnaire, most of the participants agreed that the process adopted revived the feeling of belonging to the city's new color identity (Abazi & Dervshi, 2014).

*Figure 3. Tirana, Albania, Colorful houses along the Lana River (Photo by Albinfo).*

Tirana is an emblematic case of highly centralized creative renewal of the urban image capable of generating consensus both in citizenship and on the international cultural scene. As Triantis (2009) pointed out, the case of Tirana can be read precisely within the theory of change in the production of urban space. Referring in particular to the color program, the change made in Tirana raises and re-proposes some questions on the ease of creating transitory identities through color, producing new perspectives and discussions on the urban space as well as affective involvement.

In the context of the correlations between color transformations and public mobilization, the third and last case study can be considered representative of some recent urban redevelopment and revitalization interventions that act within an involvement of local communities. The Philly Painting project, launched in 2010 by the Philadelphia Mural Arts Program, involved one of the most disadvantaged neighborhoods in the city. The facades of 51 commercial buildings were chromatically redeveloped according to a unitary project with the contribution of the artists Jeroen Koolhaas and Dre Urhahn, Haas & Hahn - former authors of the Favela Painting project in Brazil - and the active participation of the residents (Figures 5-6). As observed by Gilmore (2013), Philly Painting is an unprecedent mural project, an example of how the practice of the Mural Arts Program is evolving within a new terrain of intersection between creative placemaking, social practice and community public art. The experimental project involved many partners with

*Figure 4. An example of restoring building façade by preserving its initial basic colors but brighter (Abazi and Dervshi, 2014).*

the aim to create a social transformation in public sphere that not only had to looks differently, but function differently (Gilmore, 2013). The collaborative and participatory process included the hiring and training of residents to assist in the production of the work, community members recruitment in order to participate in the project documentation and marketing, and other informally people engagements (Gilmore, 2013). Both the palette of 35 "native" color combinations and the facade unique patterns developed by Haas & Hahn for Philly Painting were discussed with the building owners and merchants. As Gilmore (2013) underlined, the result was individual designs for each building and one collective unified vision for the commercial corridor.

While the long-term impact of the project still needs to be understood, Gilmore (2013) noticed the short-term goals achieved. The murals have transformed the area in a new colorful attraction improving the public image, otherwise negative, of this section of Germantown Avenue (Gilmore, 2013). In addition, the participatory design process led to a strong sense of ownerships along the area. Finally, Philly Painting achieved much towards the stated goals of building connections among merchants, increasing social capital, repairing the relationships between the city and the community, and reconnecting it to city services (Gilmore, 2013).

The three case studies, as we said, were selected on the basis of their different contributions in defining some aspects of color driven transformation processes and then place appropriations. Firstly, the need to act within a plan. The aims of color planning could be both the search for continuity and renewal. If the change is the mainly goal, an even stronger social acceptance is required. In order to obtain collective consensus, color should be intended less as a means to achieve aesthetic purposes, as the visual improvement of the built environment, and more in its social, cultural and educational meanings. The color transformation is in itself a reason to renew the collective participation and discussion on the urban space. This last consideration introduces the second aspect aroused by the cases considered, that is the relationship can be established between color transformation and sense of place belonging. Color, due to the ease of producing a strong communi-

cational and emotional impact, can represent an effective tool for community engagement. Color driven transformations can then represent a way to strengthen and educate the sense of belonging of a community. People consultation and direct involvement in color design processes aim to reinforce the connections between people and places and also between people in the places, producing an action of color placemaking. As we said, indeed, placemaking is about the relationships of people to places, and also among people in places (Schneekloth & Shibley, 1995).


*Figure 5. The Philly Painting project by Philadelphia Mural Arts Program and Jeroen Koolhaas and Dre Urhahn, Haas & Hahn (Photo by Steve Weinik for the Mural Arts Program).*


*Figure 6. The Philly Painting project by Philadelphia Mural Arts Program and Jeroen Koolhaas and Dre Urhahn, Haas & Hahn (Photo by Jon Kaufman).*

## Conclusions

This contribution explored some concepts already faced in the Color loci placemaking definition (Boeri, 2016; 2017; 2018), in the light of some case studies concerning color-based transformation of existing built environments in order to provide a new visual and social reorganization. While the advantages connected to the search for color continuities with respect to the historical, traditional, and functional features of places have been widely discussed, radical color transformations have been often framed as exceptional solutions in disadvantage contexts. The aim of the paper was to show how color, and color transformations, can be understood in a social rather than aesthetic meaning as effective means of place appropriation. Within the current demand for greater short-time and low-cost urban design solutions as well as social involvements, undertaken especially by the Tactical Urbanism and the Lighter, Quicker, Cheaper approaches (Lydon et al. 2012; Wyckoff, 2014), color-based transformations can play an important role. The apparatus of theoretical implications, methodological developments and practical experiences gained in environmental color design, could be placed to the service of these new perspectives.

# References


1. Abazi, E., & Dervshi, S. (2014). Colour and Participative Process in Urban Requalification of Tirana. Proceedings of the 2nd ICAUD International Conference in Architecture and Urban Design, Tirana, Albania, Epoka University, 142-1-142-12.
2. Boeri, C. (2016). Planeamento e projecto da cor urbana. [Doctoral dissertation, Universidade Lusiada de Lisboa].
3. Boeri, C. (2017). Color loci placemaking: The urban color between needs of continuity and renewal. Color research and application, 42(5), 641-649. https://doi.org/10.1002/col.22128
4. Boeri, C. (2018). Color loci placemaking. La pianificazione e la progettazione del colore urbano tra continuità e rinnovamento. Santarcangelo di Romagna: Maggioli.
5. Brino, G., & Rosso, F. (1980). Colore e città: Il piano del colore di Torino: 1800-1850. Milano: Idea Editions.
6. Brino, G., & Rosso, F. (1987). Colore e città: I colori di Torino 1801-1863. Milano: Idea Books.
7. Bulleri, A. (2012). Tirana: Suspended contemporaneity. Macerata: Quodlibet.
8. Di Nardo, P. (2008). Traces of the future. And, (11), 30-35.
9. Di Nardo, P. (2008). Give me colors! Interview to Edi Rama. And, (11), 36-39.
10. Efimov, A. (1992). The colour of Moscow. In E. Taverne, & C. Wagenaar (Eds.), The Colour of the City. Laren: V+K Publishing, 30-55.
11. Gilmore, J. (2013). Philly Painting: A case study. https://www.muralarts.org/wp-content/uploads/2016/03/CaseStudy_FINAL.pdf
12. Greaney. M.E. (2002). The Power of the Urban Canvas: Paint, Politics, and Mural Art Policy. New England Journal of Public Policy, 18.
13. Herdeg, K. (1978). Supergraphics and Animated Walls. In W. Herdeg, Archigraphia. Architectural and Environment graphics. Dufourstrasse: Graphis, 162-215.
14. Kushi, A. (2008). Planning the city. Looking for a new identity. And, (11), 52-55.
15. Lancaster, M. (1992). Norwich: a colourful city. In E. Taverne, & C. Wagenaar (Eds.), The Colour of the City. Laren: V+K Publishing, 12-29.
16. Lenclos, J.P., & Lenclos, D. (1982). Les couleurs de la France: Maisons et paysages. Paris: Le Moniteur.
17. Lenclos, J.P., & Lenclos, D. (1995). Couleurs de l'Europe: Geographie de la couleur. Paris: Le Moniteur.
18. Lenclos, J.P., & Lenclos, D. (2004). Colors of the world: The geography of color. New York, London: W.W. Norton & Company (orig. Couleurs du Monde, Le Moniteur, Paris, 1999).
19. Lenclos, J.P. (2009). The Globalization of Colour. In T. Porter, & B. Mikellides (Eds.), Colour for Architecture Today. Oxon: Taylor & Francis, pp. 84-86.
20. Lydon, M., Bartman, D., Woudstra, R., Khawarzaed (2012). Tactical Urbanism 1. https://issuu.com/streetplanscollaborative/docs/tactical_urbanism_vol.1
21. Lydon, M., Bartman, D., Garcia, T., Preston, R., Woudstra, R. (2012). Tactical Urbanism 2. https://issuu.com/streetplanscollaborative/docs/tactical_urbanism_vol_2_final
22. McMorrough, J. (2007). Blowing the Lid off Paint: The Architectural Coverage of Su-

pergraphics. In P. Dean (Ed.), Rethinking Representation. episode publishers, 64-75.
23. Nemcsics, A. (1992). Budapest: The Coloroid system: The colour scheme of the Buda Castle district. In E. Taverne, & C. Wagenaar (Eds.), The Colour of the City. Laren: V+K Publishing, 56-67.
24. Norberg-Schulz, C. (1980). Genius Loci: Towards a Phenomenology of Architecture. New York: Rizzoli (orig. Genius Loci: Paesaggio, Ambiente, Architettura. Electa, Milano, 1979).
25. Porter, T. (1982). Colour outside. London: Architectural Press.
26. Prieto, S. (1995). The Color Consultant: A New Professional Serving Architecture Today in France. Color research and application, 20(1), 4-17. https://doi.org/10.1002/col.5080200104
27. Schneekloth, L.H, & Shibley, R.G. (1995). Placemaking: The Art and Practice of Building Communities. New York: John Wiley & Sons.
28. Shkreli, A. (2008). Tipo & Molteplicità. And, (11), 44-47.
29. Smith, C.R. (1970). Urban Renewal with Paint, cited in McMorrough, J. (2007), Blowing the Lid off Paint: The Architectural Coverage of Supergraphics. In P. Dean (Ed.), Rethinking Representation. episode publishers, 64-75.
30. Taverne, E., & Wagenaar, C. (Eds.). (1992). The Colour of the City. Laren: V+K Publishing.
31. Tosca, T.F. (1997). In the name of light, come to life: Reviving a City by Colour. https://www.academia.edu/562247/In_the_Name_of_Light_come_to_Life_Reviving_a_City_by_Colour
32. Tosca, T.F. (2002). Environmental Colour Design for the Third Millennium: An Evolutionary Standpoint. Color research and application, 27(6), 441-454. https://doi.org/10.1002/col.10097
33. Triantis, L. (2009). Urban Change and the production of space: The case of urban renewal in Tirana (2000-2008). http://tiranaworkshop09.pbworks.com/f/loukas+triantis+tirana+urban+renewal.pdf
34. Urland, A. (2012). Large-scale transformations of urban colour schemes – lost opportunities or lessons learnt?. In M. Rossi (Ed.), Color and Colorimetry: Multidisciplinary Contributions, Vol. VIII B. Proceedings of the Eighth Color Conference, Bologna 13-14 September 2012, Santarcangelo di Romagna: Maggioli, 217-223.
35. Wyckoff, M.A. (2014). Definition of placemaking: Four Different Types. http://www.canr.msu.edu/uploads/375/65824/4typesplacemaking_pzn_wyckoff_january2014.pdf

# Editorial Design and the Influence of Racism on Black Representation in Brazilian Magazines and Newspapers: The Panorama Before and after George Floyd and João Alberto Silveira Freitas

*Gustavo Orlando Fudaba Curcio, João Vitor Pereira Moura*
*curcio@usp.br, joaovitor.pmoura@usp.br*

*Faculdade de Arquitetura e Urbanismo e de Design da Universidade de São Paulo, Brasil.*

***This research was funded by Fundação de Amparo à Pesquisa do Estado de São Paulo - FAPESP, Process: 2021/08587-7***

***Keywords:***
*Editorial Design*
*Racial Justice Brazil*
*Black Representation*
*Newspapers*
*Magazines*

## Abstract

This paper presents data on Black representation on the covers and front pages of the most visible printed newspapers and magazines in Brazil. The analyses observe composition and visual syntax concepts on editorial design. Considering the murders of George Floyd (05/2020) and João Alberto Freitas (11/2020) as a time frame, data were collected in the following categories: (1) number of newspaper and magazine covers in which Black representation is founded between the year before and the year after the death of George Floyd; (2) the quantification of cases of violence against Black people compared to cases against white people; (3) the representative character on newspaper covers according to its place of distribution; and (4) the comparison between cases of murders of Black people in Brazil and in the United States. The results of the research bring to light the urgent discussion of design in the process of racial justice.

## Introduction

This study aims to understand Black representation in Brazilian magazines and newspapers. The Brazilian Black population (56.2%), according to the Pesquisa Nacional por Amostra de Domicílios (PNAD, 2019), is made up of 46.8% self-declared mixed-raced Black and 9.4% self-declared Black people.

The time frame was obtained from two homicides where racism was identified as the main cause. George Floyd, an African-American man murdered by white police officers in the city of Minneapolis, United States, after he was accused of passing a counterfeit bill in a local market. João Alberto Silveira Freitas, an Afro-Brazilian man murdered by police officers at the Carrefour supermarket, in the state of Rio Grande do Sul.

Based on these milestones – occurring on May 25 and November 19, 2020 – 2019 (one year before the events) was taken as the starting point for the analysis of newspapers and magazines and the year 2021, more precisely, November 20th, Black Awareness Day in Brazil –, one year after the death of João Alberto Freitas, as the final point of the time frame.

The specific time frame of the analysis begins on February 14, 2019, when Pedro Gonzaga, another young Black man, aged 19, was strangled to death by a security guard at the Extra hypermarket, in Rio de Janeiro. The event became a key-piece in the beginning of the research not only because it oc-

curred about a year before the deaths of Floyd and Freitas, but also because of its similarity with the other cases: Gonzaga, such as Floyd, was immobilized and killed by asphyxiation; Like Freitas, Gonzaga was murdered by security guards at a market.

The aforementioned facts are extremely important for the development of the research, as, based on them, it was possible to analyse:

- The number of magazine's covers and front pages of printed newspapers in which graphic-editorial elements (texts, headlines, photographs, illustrations, etc.) related to blackness and racial issues were found, regardless of whether they dealt with cases of racism or not;
- The way in which cases of racism and racial intolerance, when reported in the Brazilian press, influenced/contributed to the (possibly opportunistic) representation of Black people on magazine covers;

*Figure 1. Beating of João Alberto Freitas, published by A Gazeta do Povo newspaper on 21 November 2020.*

## Sample space and procedures

The selection of publications was based on the average monthly circulation of each newspaper and the average sales per edition considering magazines, both printed. Even though the sample space highlights the southeastern region – highest demographic density in Brazil –, there was a concern to choose highly remarkable media in other regions, such as the newspaper Zero Hora (Rio Grande do Sul), O Povo (Ceará), A Tarde (Bahia) and A Crítica (Amazonas). Tables 1 and 2 present the publications selected as the sample space.

*Table 1. Printed Newspapers that are part of the research sample space.*

| Printed Newspapers | Frequency | State of Brazil | Circulation (average) | Availability in online collection |
|---|---|---|---|---|
| **Super Notícia** | Daily | Minas Gerais (MG) | 99535 (2020) | Available |
| **Estado de S. Paulo** | Daily | São Paulo (SP) | 80382 (2020) | Available |
| **O Globo** | Daily | Rio de Janeiro (RJ) | 78167 (2020) | Available |
| **Folha de S. Paulo** | Daily | São Paulo (SP) | 65385 (2020) | Available |
| **Zero Hora** | Daily | Rio Grande do Sul (RS) | 55521 (2020) | Available |
| **O Povo** | Daily | Ceará (CE) | 6492 (2020) | Partial |

| | | | | |
|---|---|---|---|---|
| **Correio Braziliense** | Daily | Distrito Federal (DF) | 14451 (2020) | Available |
| **Estado de Minas** | Daily | Minas Gerais (MG) | 10148 (2020) | Available |
| **A Tarde** | Daily | Bahia (BA) | 8862 (2020) | Available |
| **A Crítica** | Daily | Manaus (AM) | Not available | Available |
| **Extra** | Daily | Rio de Janeiro (RJ) | Not available | Available |
| **Correio do Povo** | Daily | Rio Grande do Sul (RS) | Not available | Available |
| **O Dia** | Daily | Rio de Janeiro (RJ) | Not available | Available |

| **Magazine** | **Subject** | **Frequency** | **Circulation (average)** | **Availability in online collection** |
|---|---|---|---|---|
| **Veja** | News | Weekly | 217.083 (2019) | Available |
| **Época** | News | Weekly | 82.164 (2019) | Available |
| **IstoÉ** | News | Weekly | Não disponível | Available |
| **Carta Capital** | News | Weekly | 15.196 (2019) | Instagram |
| **Exame** | Business | 15 days | 41.556 (2019) | Available |
| **Caras** | Gossip | Weekly | Não disponível | Available |
| **Claudia** | Lifestyle | Monthly | Não disponível | Available |
| **Ana Maria** | Lifestyle | Weekly | 48.000 (2017) | Available |
| **Tititi** | Gossip | Weekly | Não disponível | Available |
| **Minha novela** | Gossip | Weekly | Não disponível | Available |
| **Vogue** | Fashion | Weekly | 53.915 (2019) | Available |
| **Glamour** | Lifestyle | Monthly | 50.500 (impr. + digital, 2019) | Instagram |
| **Marie Claire** | Lifestyle | Monthly | 75.000 (impr. + digital, 2019) | Instagram |

*Table 2. Printed Magazines that are part of the research sample space.*

The sample space definition followed the concepts presented by Naresh Malhotra on Marketing Research (2011) and by Ian Noble and Russel Bestley on Visual Research (2013). For the analysis of the collected material and the data obtained, the following steps were carried out:

- Search for covers and first pages, following the frequency of the media outlets;
- Verification of images and texts that are characterized as representative;
- Analysis of quantitative data;
- Categorization of representative images;

**Sample collection**

The collection of material for the analysis was mainly based on the website "www.vercapas.com.br". The covers were downloaded as shown in Figure 2.

The vehicles should make at least 80% of their collections available considering the time frame.


*Figure 2. Screenshot – collection of material for analysis. Font: author's gallery.*

**Analysis criteria: newspaper and magazine covers**

The first pages of newspapers and magazine covers were analysed individually following the chronological order. Not only images dear to Black were sought, but also letterings, headlines that, in some way, are representative. For data to be as faithful as possible, it was necessary to check all the graphic elements present on the covers (headlines, texts, images, captions, etc.) –, as well as caution, since Black representation can be implicit or subjective.

## Black representation in Newspapers

The time frame was divided into 3 moments, year by year, 2019, 2020 and 2021. After analysing each period, data was compared to generate the comparative data that follow.

**Newspapers | 2019**

In 2019, 3424 covers were collected. The period was divided into two: 1st period, from February 14th (date of Pedro Gonzaga's murder) to June 30th; and 2nd period, from July 1st to December 31st. In the 1st (table 3) from 1479 covers, 934 presented some graphic-editorial element representative (headline, illustration, photograph, etc.) In the 2nd period (table 4), 1210 covers (among 1945) were considered representative.

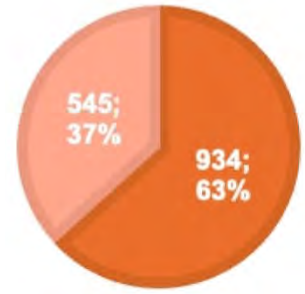
*Table 3. Black representation in printed newspapers - 1st Period of 2019 (Feb. – Jun.)*

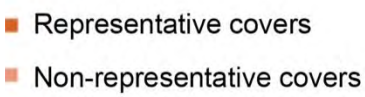
| Journal | July | | August | | September | | October | | November | | December | | 2019 (2nd Period) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Repr | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total |
| **A tarde** | 25 | 30 | 27 | 31 | 26 | 29 | 26 | 31 | 25 | 30 | 26 | 28 | 155 | 179 |
| **C. Braz.** | 14 | 30 | 20 | 31 | 20 | 29 | 27 | 31 | 30 | 30 | 26 | 31 | 137 | 182 |
| **C. do Povo** | 13 | 31 | 13 | 31 | 12 | 30 | 7 | 31 | 10 | 30 | 10 | 30 | 65 | 183 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Estado de SP** | 18 | 31 | 14 | 31 | 18 | 30 | 9 | 31 | 13 | 30 | 20 | 31 | 92 | 184 |
| **Estado de MG** | 21 | 31 | 15 | 30 | 20 | 30 | 8 | 31 | 18 | 29 | 19 | 31 | 101 | 182 |
| **Extra** | 23 | 31 | 28 | 30 | 29 | 30 | 24 | 28 | 28 | 30 | 30 | 31 | 162 | 180 |
| **Folha SP** | 13 | 31 | 14 | 31 | 19 | 30 | 8 | 30 | 15 | 30 | 19 | 31 | 88 | 183 |
| **O Dia** | 19 | 31 | 23 | 31 | 25 | 29 | 26 | 31 | 28 | 30 | 27 | 30 | 148 | 182 |
| **O Globo** | 15 | 31 | 18 | 31 | 19 | 30 | 16 | 31 | 21 | 30 | 14 | 31 | 103 | 184 |
| **Super Noticia** | 18 | 25 | 11 | 20 | 12 | 21 | 16 | 29 | 17 | 28 | 15 | 28 | 89 | 151 |
| **Zero Hora** | 13 | 26 | 14 | 27 | 13 | 24 | 9 | 27 | 10 | 26 | 11 | 25 | 70 | 155 |
| **Total** | 192 | 328 | 197 | 324 | 213 | 312 | 176 | 331 | 215 | 323 | 217 | 327 | 1210 | 1945 |

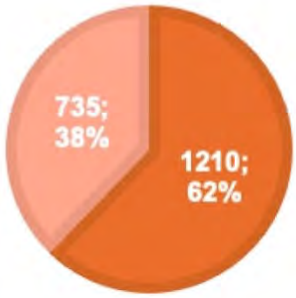
*Table 4. Black representation in printed newspapers - 2nd Period of 2019 (Jul. – Dec.).*

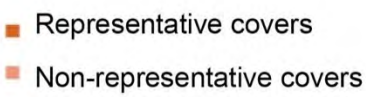
| **Journal** | **July** | | **August** | | **September** | | **October** | | **November** | | **December** | | **2019 (2nd Period)** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Repr** | **total** | **Repr.** | **total** | **Repr.** | **total** | **Repr.** | **total** | **Repr.** | **total** | **Repr.** | **total** | **Repr.** | **total** |
| **A tarde** | 25 | 30 | 27 | 31 | 26 | 29 | 26 | 31 | 25 | 30 | 26 | 28 | 155 | 179 |
| **C. Braz.** | 14 | 30 | 20 | 31 | 20 | 29 | 27 | 31 | 30 | 30 | 26 | 31 | 137 | 182 |
| **C. do Povo** | 13 | 31 | 13 | 31 | 12 | 30 | 7 | 31 | 10 | 30 | 10 | 30 | 65 | 183 |
| **Estado de SP** | 18 | 31 | 14 | 31 | 18 | 30 | 9 | 31 | 13 | 30 | 20 | 31 | 92 | 184 |
| **Estado de MG** | 21 | 31 | 15 | 30 | 20 | 30 | 8 | 31 | 18 | 29 | 19 | 31 | 101 | 182 |
| **Extra** | 23 | 31 | 28 | 30 | 29 | 30 | 24 | 28 | 28 | 30 | 30 | 31 | 162 | 180 |
| **Folha SP** | 13 | 31 | 14 | 31 | 19 | 30 | 8 | 30 | 15 | 30 | 19 | 31 | 88 | 183 |
| **O Dia** | 19 | 31 | 23 | 31 | 25 | 29 | 26 | 31 | 28 | 30 | 27 | 30 | 148 | 182 |
| **O Globo** | 15 | 31 | 18 | 31 | 19 | 30 | 16 | 31 | 21 | 30 | 14 | 31 | 103 | 184 |
| **Super Noticia** | 18 | 25 | 11 | 20 | 12 | 21 | 16 | 29 | 17 | 28 | 15 | 28 | 89 | 151 |
| **Zero Hora** | 13 | 26 | 14 | 27 | 13 | 24 | 9 | 27 | 10 | 26 | 11 | 25 | 70 | 155 |
| **Total** | 192 | 328 | 197 | 324 | 213 | 312 | 176 | 331 | 215 | 323 | 217 | 327 | 1210 | 1945 |




*Graph 1. Percentage of representative co-vers (1st period of 2019).*




*Graph 2. Percentage of representative covers (2nd period of 2019).*

As represented on the graphs 1 and 2, while the first period presented 63% of representative covers, the second period, with a percentage of 62%, demonstrates that, during 2019, Black representation did not change. November and December presented the highest (consecutive) rates.

Such rates can be explained due to Black Awareness Day (Dia da Consciência Negra). Historically it has been the celebration of Zumbi, an African slave, on November 20th in Brazil. Several Brazilian newspapers dedicated part of their editorials publishing Black issues. "Correio Braziliense" published on its cover tributes to the Black community, as can be seen in figure 3. Given this, it is important to analyse the same period in the following years to check whether this phenomenon is something specific to 2019 or whether it also occurred in 2020 and 2021.

*Figure 3. Representative covers of the Correio Braziliense newspaper, November 2019.*

*Figure 4. Covers of the Estado de São Paulo newspaper, the least representative, November 2019.*

The simple verification of the data obtained in both periods leads us to the mistaken understanding that there is effective Black representation in Brazilian newspapers – which would corroborate the thesis that, in Brazil, there is a racial Democracy (Freyre, 2001).

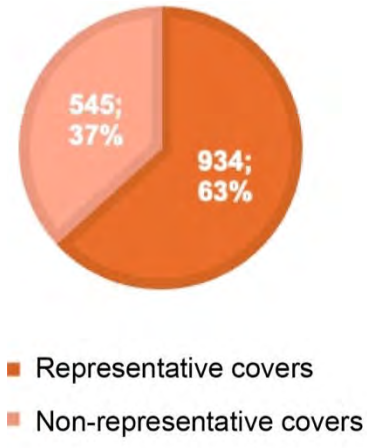
The importance of design for representativeness in printed communication vehicles is evident, as, in addition to quantifying data, a syntactic-visual analysis must be carried out with all representative elements so that they are categorized hierarchically – according to according to its size, color, framing, cropping, etc. – demonstrating, in this way, how effective Black representation is.

**Newspapers | 2020**

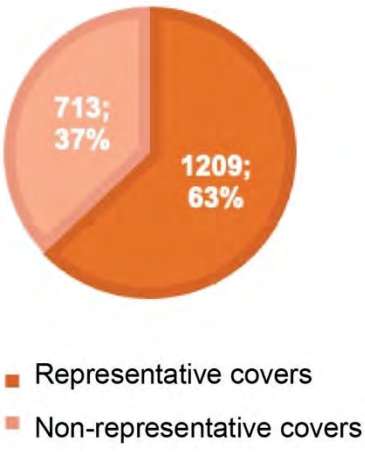
2020, in addition to the spread of the new corona virus pandemic (sarscov2), was also marked as an anti-racist struggle and racial equality year in different parts of the world. After the death of George Floyd, thousands of people took to the streets – struggling the risk of becoming infected – not to fight against the virus, but against racism.

What was once a memorable reality of the 1960s, especially with the Black civil rights marches, led by Martin Luther King, has also become a reality of the 21st century, mainly with the "Black Lives Matter" (BLM) movement. Floyd's death and BLM affected Black representation indexes in Brazilian newspapers in 2020. In the first half of the year, there was a decrease in the rates of representation on newspaper's covers. What in 2019 reached an average of 62.5% of representative covers, in the first period of 2020 reached only 50%.

It is also observed that during this period, on June 2, a Black boy called Miguel Otavio, 5, died after falling from the 9th floor building in Recife, Pernambuco. Even though Miguel's case was publicized by the press – which contributed to the representation rates in June –, there was no considerable increase that would allow such data to reach the preview's year percentage of 62,5%.




*Graph 3. Percentage of representative co-vers (1st period of 2020).*




*Graph 4. Percentage of representative co-vers (2nd period of 2020).*

In 2020, 3845 covers were analysed, 1923 pages related to the first semester and 1922 to the second semester. It is also observed that in the second period, even though it presents a similar number of total covers to the first, a higher number of representative covers was found (1209) when compared to the first half of 2020 (964).

*Table 5. Black representation in printed newspapers – 1st Period of 2020 (Jul. – Dec.).*

| Journal | January | | February | | March | | April | | May | | June | | 2020 (1st Period) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Repr | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total |
| **Total** | 150 | 331 | 166 | 312 | 160 | 330 | 150 | 313 | 142 | 321 | 196 | 316 | 964 | 1923 |

| Journal | July | | August | | September | | October | | November | | December | | 2020 (2nd Period) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Repr | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total |
| **Total** | 163 | 324 | 197 | 321 | 197 | 314 | 222 | 325 | 222 | 318 | 208 | 320 | 1209 | 1922 |

*Table 6. Black representation in printed newspapers - 2nd Period of 2020 (Jul. – Dec.).*

As it was observed in 2019, November and December 2020 presented the highest rates of Black representation of the year. The phenomenon also occurred due to the Black Awareness Day (November 20). During this period, on November 19 occurred the murder of João Alberto Silveira Freitas, 40, who was beaten to death by guards from the company Vector, an outsourced company that provided services to a unit of the Carrefour hypermarket chain, located in Porto Alegre, Rio Grande do Sul. During this period of there was a commitment by Brazilian newspapers to report the case and its consequences.

The research considers representation per cover. It means that even if the same cover presents more than one representative element, as founded in Folha de São Paulo, published on November 21st, this will only be counted once (Figure 5).


FOLHA DE S.PAULO

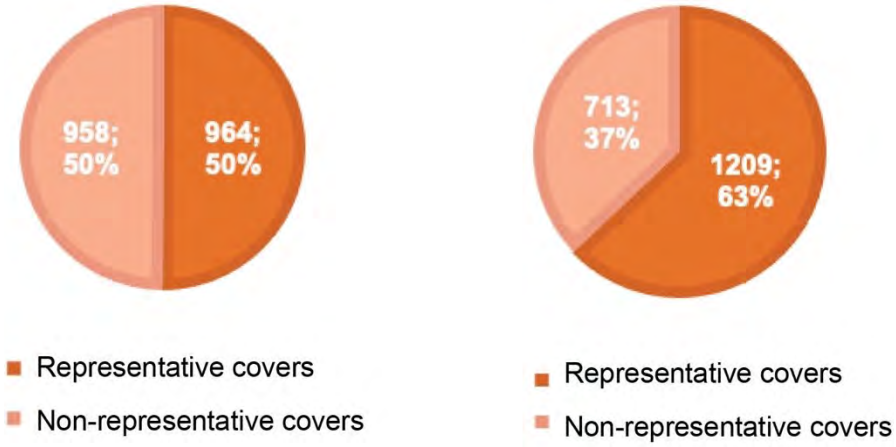
DIA DA CONSCIÊNCIA NEGRA

Homem negro morre espancado por seguranças do Carrefour no RS

*Figure 5. Cover of the Folha de São Paulo newspaper, November 21, 2020 with representa-tive elements highlighted in red.*

**Newspapers | 2021**

For 2021, it was expected that, as a result of the murders of Floyd and Freitas, the rates of Black representation would be more expressive. In fact, considering data by semester, it is evident the increase of 6% in the second period compared to the first, rising Black representation rates from 63% to 69%. The percentage reached in the second period of 2021 (69%) was the highest among the time frame. Such an index would indicate a possible effect of the aforementioned facts on the publishing market, leading us to believe that there was an awareness about the importance of representation in the anti-racist fight and for racial equality in Brazil.




*Graph 5. Percentage of repre-sentative co-vers (1st period of 2021).*

*Graph 6. Percentage of represent ative co-vers (2nd period of 2021).*

Even though November 20 (Black Awareness Day) contributed to the increase in data, it should be noted that this was not the only one, nor the determining factor for such an occurrence in the second period of the year.

| Newspaper | January | | February | | March | | April | | May | | June | | 2021 (1st Period) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Repr | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total |
| **Total** | 208 | 322 | 193 | 299 | 186 | 328 | 180 | 316 | 203 | 325 | 226 | 315 | 1196 | 1905 |

| Newspaper | July | | August | | September | | October | | November | | 2021 (2nd Period) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Repr | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total | Repr. | total |
| **Total** | 243 | 320 | 229 | 319 | 189 | 310 | 212 | 324 | 148 | 211 | 1021 | 1484 |

*Table 7. Black representation in printed newspapers – 1st Period of 2021 (Jul. – Dec.).*

*Table 8. Black representation in printed newspapers - 2nd Period of 2021 (Jul. – Dec.).*

Due to the pandemic in 2020 the Tokyo Olympic Games were postponed to 2021, from July 23rd to August 8th. Not only did newspapers used their platforms to report on the progress of the Olympic Games, but also that there was in this competition a large number of Black athletes participating.

Among 309 Brazilian athletes that were classified to the games, 143 declare themselves Black. Brazilian Black in Tokyo were also responsible for around 43% of country's awards (21 medals, 9 won by Black). The months of July and August – the period in which the Olympic Games took place – had two of the highest representation rates of the year, arriving in July at 76%.

Only considering the second period of 2021, among 1021 representative first pages, 138 (13.5%) contained some editorial element referring to Black athletes related to the Olympics.

A possible catalyst for the increase in data between the months of July and November was the Black criminal Lázaro Barbosa who, for 20 days, was on the run in the rural area of Goiás (center of Brazil). During this process, which culminated in Lázaro's death, there was a great effort by Brazilian media to publicize the fact, as a kind of reality show. Such spectacularizing not only harmed the progress of the criminal's search operations, but also contributed, pejoratively, to Black representation, placing Lázaro as a villain to be eliminated.

**Newspapers | Before and after Floyd**

Taking as a reference the day Floyd was killed, May 25, 2020, the previous period extends from February 14, 2019 – the date marked by the death of the young black man, Pedro Henrique Gonzaga – until May 24, 2020. The later period focuses on the analysis of covers published from May 26, 2020 to November 20, 2021, the one-year anniversary of João Alberto's death. The following table contains data not only on the number of representative covers published by newspapers in both periods, but also the percentage of these in relation to the number of total covers.

| Newspapers | Before | | | After | | |
|---|---|---|---|---|---|---|
| | Repr. | Total | Percentage (Total) | Repr. | Total | Percentage (Total) |
| **A tarde** | 372 | 451 | 82% | 443 | 522 | 85% |
| **C. Braziliense** | 314 | 464 | 68% | 370 | 543 | 68% |
| **C. do Povo** | 167 | 464 | 36% | 225 | 522 | 43% |

*Table 9. Black representation in newspapers (before and after Floyd).*

| | | | | | | |
|---|---|---|---|---|---|---|
| **Estado de SP** | 211 | 466 | 45% | 244 | 544 | 45% |
| **Estado de MG** | 230 | 463 | 50% | 314 | 541 | 58% |
| **Extra** | 367 | 462 | 79% | 442 | 513 | 86% |
| **Folha SP** | 206 | 465 | 44% | 343 | 542 | 63% |
| **O Dia** | 371 | 463 | 80% | 453 | 537 | 84% |
| **O Globo** | 253 | 466 | 54% | 326 | 542 | 60% |
| **Super Noticia** | 225 | 409 | 55% | 309 | 448 | 69% |
| **Zero Hora** | 152 | 386 | 39% | 195 | 435 | 45% |
| **TOTAL** | 2868 | 4959 | 58% | 3664 | 5689 | 64% |

Considering the sample space of the research, 10,648 newspaper front pages were analysed. 6532 covers presented some representative element for Black people, almost 61.3 %. Despite this, 3664 refer only to the period after Floyd. As the period before Floyd's death presents a lower number of total covers compared to the second period, there is, in absolute numbers, a lower number of representative covers. However, when analysing both periods by their representative percentages, it is still possible to verify that, after Floyd's death, there was an increase in Black representation, rising rates from 58% to 64% of total covers. The 6% increase in representation rates after Floyd's death occurred not only due to the repercussion of the case, or a possible racial awareness of editorial media, but as a result of a series of other factors, such as João Alberto's case and the Olympics.

## Black representation in Magazines – 2019 to 2021

The analysis of printed magazines was carried out the same methods of newspaper. From 13 available magazines, it was possible to verify in 2019 almost 361 covers, where 99 covers (27.4%) represented Black.

While in the first period 45 covers were found representing a total of 141 (32%), the second period, with 54 covers representing a total of 220 (24.5%), demonstrated an opposite phenomenon to that which occurred with newspapers. Even though the second period presented lower rates compared to the first, it is possible to consider, such as the newspapers, that magazine issues published between November and December were the most representative during the period.

In 2020, among the 449 magazine covers, 128 were considered representative (28.5%). Between 2019 and 2020 there was an increase of approximately 1.1%, which, in theory, indicates almost stability.

The first period of 2020, with 29%, also presented a slightly higher Black representation rate than the second (26.8%). 2020 differs from the previous year, as it did not present a significant increase in the months of November and December, the latter being the least representative (5 covers, circa 12.8%). The cover of IstoÉ, published on June, is worth highlighting, where there is the phrase "I can't breathe", in reference to the death of Floyd. The magazine was the only one that mentioned the news of the murder on its cover.


*Figure 6. Cover of IstoÉ magazine, published on June 10, 2020. "I cannot breathe".*

With an incidence of 107 covers among a set of 297 (26.95%), 2021 was the least figurative for the Black representation. Although it does not characterize a drop in representation rates – just 0.45% lower than 2019 –, 2021 indicates a stable scenario. The number is far from Black participation on Brazilian racial pyramid, where 56% of population are Black (IBGE, 2022). The obtained index of 26.95% shows that Brazilian magazines still do not represent the society in which they are inserted.

Despite the low representation rates in magazines calculated throughout 2021, this one differs from previous years by presenting a higher figurative percentage in the second period than the first – a fact that is constant in the study of newspapers. While in the first period 24.88% of covers were representative – the second lowest among the three years – the second had a rate of approximately 29.5%. The number can also be explained, among other factors, by the Olympics.

*Figure 7. Vogue and Marie Claire magazines featured Black athletes on their covers: Rebeca Andrade (gold medal in artistic gymnastics) and Rayssa Leal (silver medal in skateboarding).*


**Magazines | Before and after Floyd**

With 27.72% of representation in the period before Floyd and 27.19% in the period after, there was a stagnation in the rates of figurative covers, which demonstrates the little influence of cases of racism and Black murders on Brazilian magazines. Even though some magazines have obtained rates above the average (27.42%), cases such as the weekly "Caras" and "Tititi" draw our attention because they both reach practically identical representative rates in both the first and second periods, as if there was a kind of "racial quota" for the inclusion of Black. As Yolanda Zappaterra (2014) states, the design of a magazine cover involves a series of professionals, including editors, writers and designers. This leads us to the perception that not only the graphic-editorial elements, but also the people (black or not), inserted on the first pages, are selected (on purpose) according to image aspects. Despite this, considering that professionals in the Brazilian editorial field are inserted in a structurally racist context (Almeida, 2018), the (non) selection of Black personalities to the covers is, indeed, related to criteria of colour and race, since the African phenotype carries (historically and pejoratively) an inferior connotation (Devulsky. 2021). Despite this, the study highlights the identification of several cases in which Black representation is presented in a multifaceted and inconsistent way. As observed in newspapers, there are also magazine covers in which Black representation is presented in a secondary way, often inserted by small references relating to Afro personalities.

*Table 10. Black representation in magazines (before and after Floyd).*

| Magazines | Before | | | After | | | Period | | |
|---|---|---|---|---|---|---|---|---|---|
| | Repr. | total | Percent. | Repr. | total | Percent. | Repr. | total | Percent. |
| **Anamaria** | 4 | 58 | 7% | 15 | 78 | 19% | 19 | 136 | 14% |
| **Caras** | 26 | 66 | 39% | 30 | 77 | 39% | 56 | 143 | 39% |
| **Claudia** | 2 | 13 | 15% | 11 | 20 | 55% | 13 | 33 | 39% |
| **Exame** | 2 | 31 | 6% | 3 | 30 | 10% | 5 | 61 | 8% |
| **Glamour** | 8 | 23 | 35% | 11 | 21 | 52% | 19 | 44 | 43% |
| **IstoÉ** | 31 | 63 | 49% | 82 | 77 | 10% | 39 | 140 | 28% |
| **JP** | 2 | 14 | 14% | 4 | 10 | 40% | 6 | 24 | 25% |
| **Marie Claire** | 12 | 18 | 67% | 15 | 35 | 43% | 27 | 53 | 51% |
| **Minha Novela** | 14 | 41 | 34% | 19 | 77 | 25% | 33 | 118 | 28% |
| **Tititi** | 16 | 35 | 46% | 31 | 68 | 46% | 47 | 103 | 46% |
| **Veja** | 7 | 64 | 11% | 5 | 78 | 6% | 12 | 142 | 8% |
| **Veja SP** | 11 | 65 | 17% | 12 | 78 | 15% | 23 | 143 | 16% |
| **Vogue** | 10 | 32 | 31% | 22 | 35 | 63% | 32 | 67 | 48% |
| **TOTAL** | 145 | 523 | 27,72% | 186 | 684 | 27,19% | 331 | 1207 | 27,42% |

Although exceptionally, it is still possible to highlight covers in which Black representation is carried out in a proud and intentional way, with the aim of bringing visibility to personalities and, therefore, debating issues relating to race, gender, etc. A great example of this are the special editions of Glamour, published in November 2021, featuring the writer Rayane Leão, the TV presenter Luana Xavier and the actress Jeniffer Dias. Not coincidentally, because they portray lifestyles and trends, this category was best identified in fashion magazines, especially foreign ones, such as Vogue and Marie Claire, for example.

*Figure 8. Covers of "Glamour" magazine, published in November 2021.*


The research proved to be larger and denser than planned by the proposal initially presented. Even though it is known about the immense amount of material to be analysed which, as we have seen, exceeded eleven thousand units, newspaper covers, unlike magazines, have shown to be the biggest challenge of the project, not only because of the quantity, but also due to the countless amount of information presented on a newspaper's front page. Considering that 10,648 first pages were collected with an average of general elements 12.68 elements per cover, around 135,017 different elements were analysed.

The second stage of the research – the semantic analysis of Black representation –, was based on the first pages of the newspapers. In addition to the quantitative and semantic analysis, the project also aimed to verify the representative elements – individually – so that visual patterns were identified that, therefore, would classify whether the representation present on a given cover is "high", "low" or "average". The initial idea of this stage was based on a "score scale" which proved to be unfeasible not only due to the amount presented here, but also because this scheme does not take into account semiotic aspects of the images – a fact that would corroborate to the inaccuracy of the data that would be obtained.

The covers considered representative did not provide precise information about the way in which such elements presented the Black people. In theory, as it was possible to observe after the semantic classification stage, not everything that "presents" the Black actually "represents" it. The following new, published by the Folha de São Paulo on April 25 is an example.

The previous image, even though it shows a woman smiling, from the words exposed by the headline – "Orphan and former crack user who lived 37 years in shelters and prisons" – says more about the way in which the news see the Black population than the way it really is. Therefore, if the objective was to present a black woman in a "positive" way, the evocation of several demeaning phrases, to, only at the end, report an achievement – with intentions of exalting meritocracy – does not suggest representativeness,


FOLHA DE S.PAULO

Família Bolsonaro costura rede de proteção na Justiça

*Figure 9. Folha de São Paulo newspaper and news about meritocracy. April 25, 2021.*


Cotidiano B5

As muitas vidas de Xal

Conheça a trajetória da órfã e ex-usuária de crack que viveu 37 anos em abrigos, prisões e ruas e agora lança livro

Adriana Graças Pereira, conhecida como Xal, que conta sua história em obra

*Figure 10. News published in the Folha de São Paulo newspaper on June 23, 2019 and September 8, 2019*

but rather selectivity. The following images were used in an empirical test. Showing only the portraits – without the information from the headlines – different people were asked what these images were about. The answer, most of the time, was "work analogous to slavery". However, the surprise came when learning that, while the first image was about sustainable agriculture, the second depicts an immigrant model and actor. Such examples ratify once again the idea – historically constructed on racist bases – of the image of subalternity that is not only seen, but reproduced on the idea of being Black in Brazil.


30 ANOS APÓS PRAGA DIZIMAR LAVOURAS E ARRUINAR REGIÃO, CACAU DA BAHIA SE REINVENTA

Robson Santos de Oliveira mostra cacau da região de Ilhéus; com foco em cultivo sustentável e seguindo padrões modernos, produtores tentam retomar produção em larga escal


Ilustríssima p. 4

Pan-Américas de Áfricas utópicas

Histórias de imigrantes africanos em São Paulo, em fotos de Bob Wolfenson

O modelo e ator Vensam Iala, de Guiné-Bissau, veio para o Brasil há nove anos

For a newspaper or magazine to reach readers, they pass through different professionals responsible not only for the information people consume, but for the way information is presented. Before consuming information, it is essential to consider that reader's choices were previously determined by the decisions of editors (including visual editors, that are mainly designers).

Therefore, if the information we consume is based not only on our own, but also on the decisions of other individuals, the question arises: to which ethnic-racial group do these individuals belong? There is no concrete data that elucidates the racial rates of Brazilian publishing professionals. However, since the publishing market and the media are, historically, controlled by white people, it is naive to think that the Black population is represented both on the front and behind the covers of newspapers and magazines.

# References

1. Bestley, R; Noble, I (2013). Pesquisa Visual. Porto Alegre, Brazil: Bookman
2. Devulsky, A. (2021). Colorismo. Belo Horizonte, Brazil: Jandaíra
3. Freyre, G. (2001). Casa-grande & Senzala. Rio de Janeiro, Brazil: Record
4. Malhorta, N. (2011). Pesquisa de Marketing. Porto Alegre, Brazil: Bookman

# Playing as a cultural dissemination strategy. Eco-bab: designing collaborative, playful and educational experiences

*Nicolò Ceccarelli, Nađa Beretić*
*nceccare@uniss.it, nberetic@uniss.it*

*Department of Architecture, Design and Urban Planning, University of Sassari, Italy*

***Keywords:***
*Engagement*
*Playful Experience*
*Collaborative Experience*
*Gamification*
*Scientific Heritage*

## Abstract

On the grounds of the outcome of a recent project about ecology based on collaboration and interaction, in this paper we explore the contribution that design can bring to the development of memorable playful experiences to informing, communicating, and engaging the public in complex topics. Within the broad and emerging realms of 'gamification' – a domain in which we have been lately increasingly engaged with several projects – our effort is to gain knowledge and skills in understanding how applied games and interactive technologies can be put to work to enhance the public's understanding and appreciation of cultural and scientific heritage. In order to cope with such 'wicked', complex issues, and aiming at giving life to unique experiences through design, the paper discusses the steps that have lead us to develop "Eco-bab". A playful collaborative experience that blends elements from the physical and the digital dimensions to spark the public engagement, the project aims at creating awareness about on the seminal role of phytoplankton in keeping our planet in ecological balance. In doing so, and on the grounds of the results gathered in a series of user-testing sessions, which proved the "Eco-bab" experience as functional and engaging, we will discuss how the design culture can foster the development of highly interactive and engaging informative experiences.

## Introduction

Over the last few years gamification has gained increasing interest as a strategy for promoting scientific and cultural dissemination and engaging the public in museums and exhibits. "Cultugame", a research program funded by the Italian Ministry for Research and University specifically addresses this emerging area of expertise. It aims to investigate how new knowledge and skills in applied games and interactive technologies can enhance understanding and appreciation of cultural and scientific heritage.

Part of a wider partnership involved in the project our design unit, in collaboration with a team of ecologists, professional game developers and with managing support from a private company specialized in experience design and digital transformation, has developed the conceptual core of a playful experience, further elaborating it into a working prototype. Our "Eco-bab" project was finally publicly exhibited in the historical science museum of our University – mUNISS in October 2023.

The gaming simulation we have devised introduces the public to the discovery of the aquatic environments' ecology, addressing the role of phytoplankton in the planet's ecological balance. Exploring how gamification can support scientific dissemination, the project aims at improving the public's awareness in a domain that is as invisible, abstract and, apparently remote, as it is crucial to life itself.

In line with the research work that our research unit has carried out over the last few years in a series of different projects, the 'Eco-bab' experience relies on a few key points.

The first, which aims at exploring the potential of the collaborative dimension (Fig. 1) within the idea of gaming, is based on a two-pillars original concept: the development of a direct, tactile, physical experience and the enabling power of interpersonal group dynamics taking place in actual on-site presence. In addition to enabling social constructs, the relevance of the physical dimension led to the need to develop not only sensory playful experiences based on the design of the physical artefacts – the actual game board and the elements that users need to interact with and 'compose' as they carry on their game – but also an engaging environment that stimulates collaboration, a gaming environment capable of encouraging interaction and empowering a spirit of togetherness.

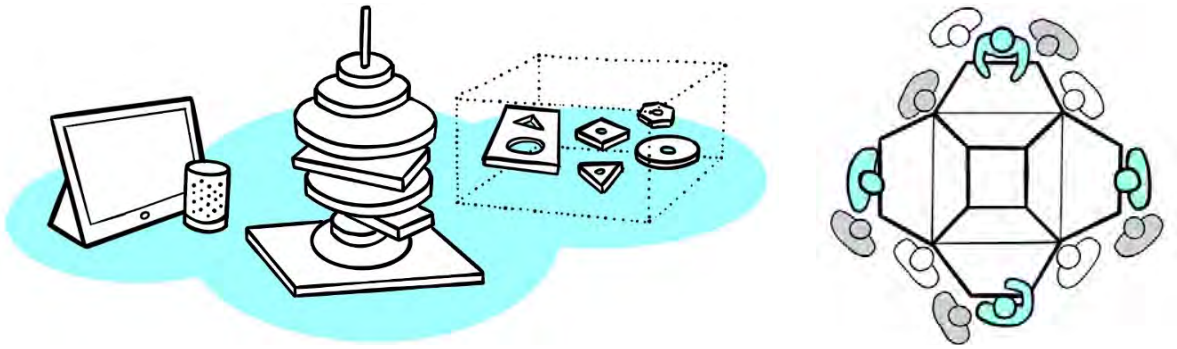


*Fig. 1 - The first sketch illustrating the combination between some of the project's conceptual tenets and its preliminary formal implementations; Lab. AnimazioneDesign (2022).*

The second conceptual pillar of our project is based on the idea of exploring the power offered by the interconnections between the physical and digital realms – what, after the first introduction of the term in the realm of marketing, has been increasingly defined as 'phygital' – in promoting the public's engagement (Fig. 1).

In the case of our project the phygital dimension played in fact a "threshold" key role to bridge the abstract and real dimensions. "Eco-bab" is an experience in modelling reality: we cannot see phytoplankton but we can simulate - almost like in a scientific experiment - its behavior in a set of given conditions. The simulation dimension thus can become a powerful drive for discovery end engagement. A founding aspect that we integrated, seamlessly and simultaneously, in both the narrative and game dynamics. The kebab-like interface we devised as the core of the game play then the role of a metaphor, a simplified interface through which players simulate and experiment, testing their previous knowledge and their intuition, real conditions: an activator that can lead to new knowledge through exploration and discovery.

Finally, numerous researchers characterize gamification as the application of game-like elements and principles in non-game contexts (Deterding et al. 2011, Werbach and Hunter 2012, Burke 2014). Our project resides on the outskirts of this definition. This is because it uses gamification as a playful strategy, employing game-like elements for the purpose of knowledge dissemination in a museum context.

With this paper, we therefore present the results of our project, reflecting on how a complex scientific topic can be made accessible to a large public through the careful combination of the above two main components, in order to achieve a playful and memorable experience and to promote the utterly underrated relevance and role of phytoplankton in our ecologic system.

## Scientific Dissemination through Collaborative Playful Experience

Heritage and scientific dissemination share the fundamental role of direct experience when it comes to communicating values. By quoting different cases taken from "natural and manmade heritage", Tilden (1957) has stressed the importance of the visit as a direct experience and as an opportunity for learning, where connecting with the "thing itself" becomes superior to schooling. In the first of his six communication principles, he describes the connection between the sublime value of heritage and the visitor's personality, experience, and ideals. In his vision, given the sometimes undefined and intangible dimensions of heritage, storytelling can play a crucial role as long as it respect the visitor's identity by using a simple - not simplistic - language.

This simplification facilitates understanding, making people feel proud of themselves pushing them to do their best in learning, and stimulating further curiosity.

Considering the remote and microscopic dimension of phytoplankton, the combination of such a simplification approach with storytelling strategies can effectively improve the dissemination of a complex scientific topic such as the ecology of marine environments, which despite its importance for making life possible on our planet, remains widely unknown.

Direct, hands-on experience is crucial in communicating both heritage and scientific dissemination. The strategies we have followed in designing our gaming experience, not only require but largely depend upon the users' direct experience, and are thus coherent with Kolb's definition of a learning cycle in which "learning is the process whereby knowledge is created through the transformation of experience" (Kolb 1984, p. 41). This approach implies the use of a 'Problem-Based-Learning' model – as the problem is solved, knowledge is gained automatically. Within this model a key aspect lies in the definition of sequence of problems, otherwise, the big 'wholes' in gaining knowledge will remain (Reese 2011).

In line with the idea, endorsed by many scholars, for which (Dillenbourg, et al. 1996) collaborative learning is an effective way of learning, and in which when children work on their social skills, achieve better results and enhance critical thinking (Gokhale 1995), the implementation of collaborative learning within a playful experience based on the user's engagement and enjoyment has been a key aspect in our design. For "enjoyment", we here mean a positive appreciation of the player's experience and emotional intensity throughout the game. As enjoyment itself is, in contemporary gaming terminology, the main goal and outcome of playful activities (Juul 2003, Sweetser and Wyeth 2010), it has become for us a key element in our quest for scientific dissemination.

Among the key elements that guided us in tracing the project's general structure is a firmly established pedagogical tradition that emphasizes the pivotal role of playful experiences as elements of the learning continuum. This approach traces a conceptual trajectory throughout the educational philosophies of figures such as Maria Montessori, John Dewey and Johann

Heinrich Pestalozzi ("Learning with head, hands and heart"). A trajectory which further extends to Bruno Munari finding and ultimately realization in the foundational contributions in the domain of childhood education by Fröbel. Credited with having firstly introduced the idea of the kindergarten, the prominent early nineteenth century German educator Friedrich Fröbel envisioned a complex and dedicated environment for the education of young children. Shaped by a pedagogical philosophy that prioritized experiential learning and growth, deriving nourishment from the stimulation of cognitive skills through tactile, chromatic, and compositional exploration, Fröbel implemented a system of playful activities. Very well known as the Fröbelgaben, (Fröbel's gifts), this was a tangible set of manipulable experiences specifically crafted for children to accompany and enrich their developmental journey.

## Designing "Eco-bab"

Within the frame of the necessary inter-play between the general educational scopes of the research effort within the Culturgame project and the design solutions taken to achieve them, the act of playing is subordinated to the degree to which the public will be engaged by the experience we have designed. Playing becomes in this perspective the element capable of triggering a meaningful degree of understanding and awareness of the topic in question in the participants.

The approach we have devised to achieve this goal pivots around two keywords: graduality and affordance.

A common strategy in videogames is that of allowing users to familiarize themselves with the playing environment in a gradual way. Users are expected to start playing right away, without the need of a preliminary formal introduction. This line of reasoning, which obviously implies very careful design, relies in the fact that they will become familiar as they play with the gaming environment and with its 'rules', features and formulas.

The other almost paradigmatic, element into play, is that of affordance. Introduced by the American psychologist James J. Gibson – and later widely popularized through its extension in the realm of human-computer interaction by Donald Norman (1988) – the principle states that we perceive objects (and interfaces, in Norman's extended perspective) in terms of what we can do with them. The active, attentive relationship with our surroundings allows therefore our cognitive system to interpret constantly it in terms of what it allows us to do. Considering this while designing both elements: things – in the physical realm – and interfaces and experiences – in the digital one – eases users in understanding how to find one's way, and ultimately, behave in a given environment. In our experience, and more specifically in the context of a gaming environment, these guiding principles need to be carefully orchestrated.

While other projects developed within Culturgame were intended to be hosted in a traditional Museum setting – the National Archeological Museum in Naples, for instance – ours is located in a rather unique context—mUNISS, the small scientific historical museum of our University. This close 'academic' association distinguishes this specific venue not only in terms of operational aspects, like opening hours and management, but also in its engagement with specific target groups.

The initial target group (Fig. 2) comprised lower secondary school students, our approach involved therefore a guided gaming experience tailored for them. This entailed providing these students with prior knowledge about phytoplankton before engaging in the game. To facilitate this, a series of lectures on phytoplankton were conducted within their school environ-

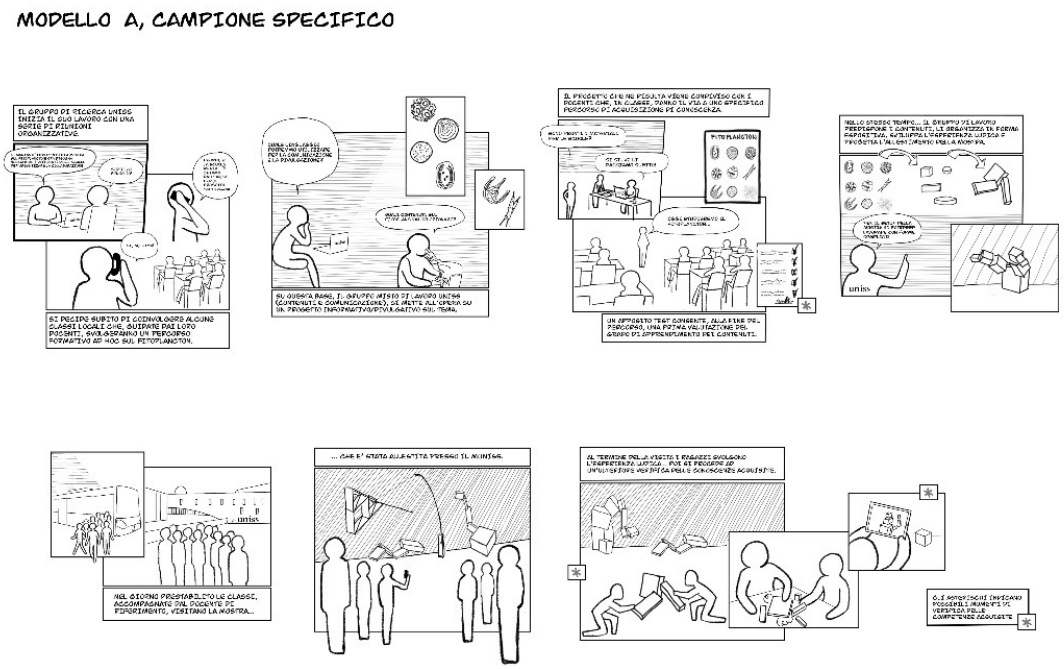



*Fig. 2 - In order to comply with the request of a formal delivery (project storyboard) we came up with a preliminary cartoon-like describing the interactions between the eco-bab experience – at the time still in progress – and its potential users (target groups). Lab. AnimazioneDesign (2022).*

ment before they visited the actual installation. The second target group encompasses a more general public, the public of mUNISS' visitors regardless of their background or familiarity with phytoplankton.

## Description of "Eco-bab" experience

The playing environment we have come up with in order to respond to the above questions has taken the form of a vertical-shaped puzzle, roughly inspired by a kebab (Fig. 3), where the players have to stick a series of physical elements onto a central pole. A project previously developed, in a totally different context, by some of our students presenting an installation in which a notorious step-shaped coffee machine was used to allude to a toddler-looking game of constructions, and its association with a mock-up kebab model photographed in Napflio, Greece, presented as an effective metaphor for what we had in mind. The reference appeared both functional and scientifically coherent: while the idea of assembling in vertical order different elements was functional to the idea of the 'levels' in a game, is was also perfectly consistent with the principle of the 'water columns' the vertical systems in which phytoplankton moves in the Ocean's depths its search for light and nutrients. We decided hence to carry on our design along this conceptual track.

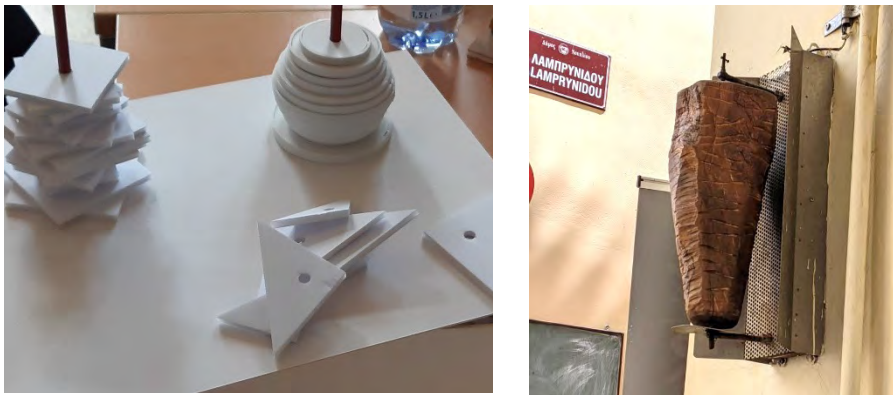



*Fig. 3 - Two key original references for the actual development of the project. A kebab shop-sign in Greece and an experiment previously carried out with students. Authors (2023).*

In order to simulate and test various aspects of the game – its dynamics, the average time required to carry out the intermediate levels as well as the whole game, rule sets, feedback mechanisms, and player learning experiences, an early prototype in cardboard was developed (Fig. 4). This prototype made possible to collaborate with two game designers from the Turin based 'Mixed Bag' studio to test the idea, refining and iterating, through multiple sessions, the game's mechanics and features.


*Fig. 4 - Early prototyping of some of the game components and tentative early abacus of the set of pieces to be developed for testing. Authors (2023).*

Each gaming level begins by positioning a tray on a 'kebab' pole (Fig. 5). Arranged to host some basic shapes, the main trays represent a given environmental set of conditions. After having positioned a tray, the player has to pick some smaller shapes that, in a jigsaw-like way, correspond to those missing in the tray. Such selection process is 'blind' as players have to probe the pieces by hand from a bag placed under the gaming main board. Tray by tray - level after lever, in a gaming perspective - players are confronted with an increasing level of complexity: as the conditions become stricter, players get to understand that the different shapes represent – through their textures and other tactile components – potential functionalities characteristic of different species of phytoplankton. The growth of difficulty in "solving the puzzle" aims at simulating natural processes of evolution in which only the species capable of adapting to a new set of conditions can survive.

*Fig. 5 - Further prototyping of the game's physical components and mechanics, to be tested in live sessions. Authors (2023).*

Parallel to the development of this general scheme is the implementation of the digital framework that supports the game flow, keeping track of the player's moves in the physical realm and supporting a smooth development of the game phases (Fig. 6). This component is crucial as a background informative interface, providing hints, rewards and informative elements that support the game flow while structuring the experience itself (Fig. 7). This interface component also presents the players with the appropriated narrative context: a key contextual backbone for the tasks to be performed. Designwise, the most crucial task for turning the gaming experience into a powerful learning opportunity, is reaching a balanced blend between scientific accuracy, the gaming 'mechanics' and the ability to keep the players attentive, alert, and ultimately engaged.

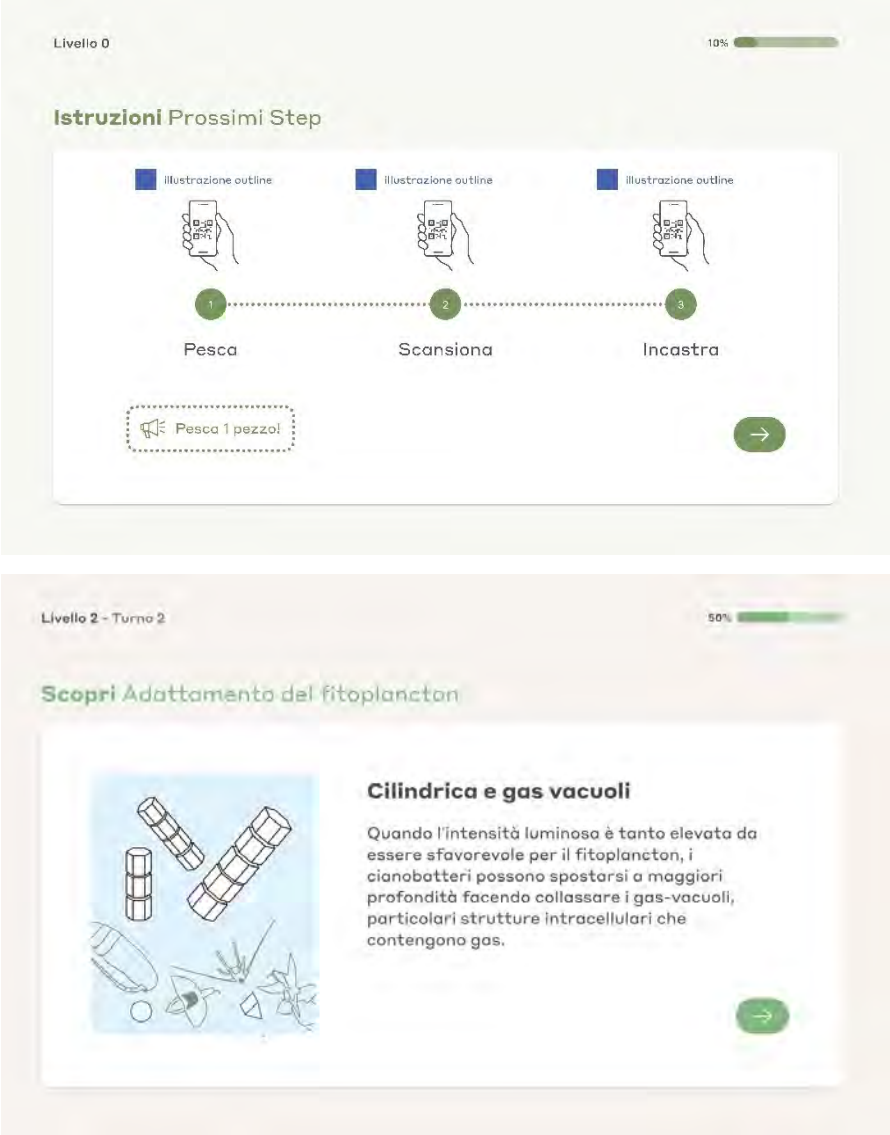



*Fig. 6 and 7 - The development of the physical elements was matched by a careful design and implementation of the game's digital interface; ETT/Lab. AnimazioneDesign (2023).*

The third cornerstone of the "Eco-bab" experience is the gaming environment, whose more tangible manifestation is the game board – the spatial arrangement hosting both the physical and the digital elements. This table is shaped as a four-leaf clover-like structure, where each of the four 'petals' is a full PlayStation. The design solution facilitates a collaborative setting, enabling participants to adopt a somewhat circular formation and maintain eye-to-eye contact during gameplay and providing an integrated and dynamic space for the interactive experience.

In conceptualizing the design of this key physical element we envisioned our players embarking on an imaginary voyage aboard a futuristic vessel, a fantasy ship equipped for the exploration of the realm of phytoplankton. The objective being supporting the general atmosphere of exploration in order to enhance the experiential and educational aspects of the project. Through game the players ideally embark on a discovery journey by delving into a world fundamental to our lives yet imperceptible to the naked eye. This concept of discovery parallels the experiences of explorers from the past who, through their expeditions, "discovered"; lands that, although existing, were unknown. Much like these intrepid adventurers armed with ingenious analog tools, our project positions itself between the ancient and the modern, prompting its players to enter a new world that has silently existed throughout time. In an era where the frontiers of exploration have diminished, "Eco-bab" offers a modern voyage, akin to boarding the futuristic underwater Nautilus vessel with Nemo at the helm. After years of dormancy, it sets forth in search of a new Atlantis, bridging the gap between the ageless past and the future of exploration (Fig.8).


*Fig. 8 - Reference boards for the design of the game's physical deck in the effort of exploring combinations between the idea of a fictional discovery journey with the atmosphere of early Arcade videogames. Lab. Animazione-Design (2023).*

This gaming environment offers thus a gateway into an inaccessible realm: the unseen world of phytoplankton, invisible and yet crucial to our existence. In our design, this dimension was carefully envisioned as a sci-fi medium a portal granting access to the marine universe that eludes conventional exploration. Unlike any known vehicle, this fantastical medium serves as our vessel, propelling us to where no human has ventured before. It is akin to embarking on the Star Trek astro-ship Enterprise, charting new worlds, albeit submerged in water.

Within this marine domain, microscopic organisms populate the landscape striving to survive and defending against competitors. Unity emerges as a fundamental principle, echoing the collaborative strength exhibited by phytoplankton cells as they join into colonies, fortifying themselves against external threats. In our gaming simulation success hinges upon teamwork, mirroring the cohesion essential for survival in the quest for balance peculiar to every ecosystem.

A further dimension pursued by our project is that of spatial dynamism. Players are immersed in a new world inhabited by minuscule organisms, each characterized by unique shapes and attributes, determining their resilience and ability to navigate challenges and competitors. Phytoplankton, ubiquitous in all water surfaces, become the focal point of exploration within

the game, allowing players to traverse the globe in search of new species. This expedition defies conventional space-time constraints, necessitating movement through utopian and science-fictional means. Players encounter various spatial gateways akin to 'Stargates', enabling instantaneous transport to diverse marine environments. Just as peering through a microscope unveils the intricate world of phytoplankton, "Eco-bab" offers a similar immersive experience, transcending spatial boundaries and unlocking the mysteries of this microscopic realm.

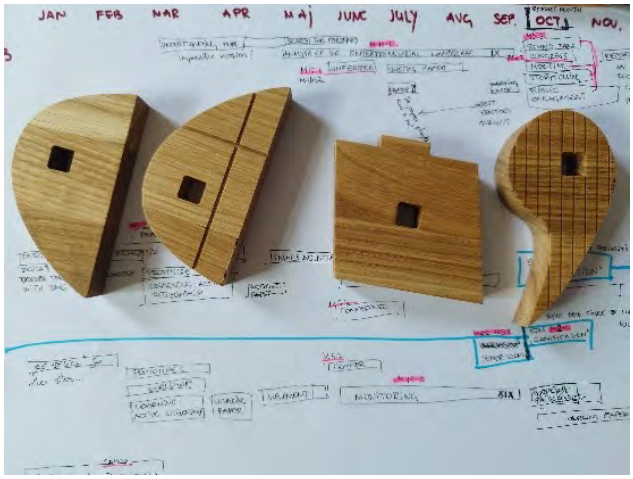
The intend of conveying the fascination of the journey to the world of phytoplankton into the physical reality of the actual gaming environment lead us to look for inspiration in the elementary atmosphere of early arcade video games.

The result of this further step opened the way to the development of a further level of detail – with an explicit reference to the decorative style of classic early video-games' chassis – in form of a series of adhesive stickers that were applied to the board surface to evoke spatial dynamism and enhance the background sci-fi atmosphere we wished to project on the general experience.

Another step worth mentioning in the design process, was the fine-tuning of the physical interface. All its components – the gaming board with its 'kebab' pole, the trays and the smaller pieces they host – had to be given a final texture and shape and to be associated with specific materials.

The careful selection of the appropriate type of wood, as well as the texture, density, and finish (Fig. 9) was crucial in order to assign the desired tactile sensation to the pieces representing marine environments and phytoplankton characteristics that the players had to select and put in place in the kebab trays.

*Fig. 9 - A last round of prototyping for testing the tactile attributes of some of the game's components. Authors (2023).*




Various others aspects had to considered in the design of the game board: as we wanted the playground to be inclusive and highly accessible, special care was devoted to combining the optimization of space with the accommodation of the functional requirements dictated by the game elements and dynamics. Keeping in mind issues of layout and ergonomics throughout the deign development allowed us to craft a game board that eases interaction and enhances the overall gameplay experience for each player (Fig.10).

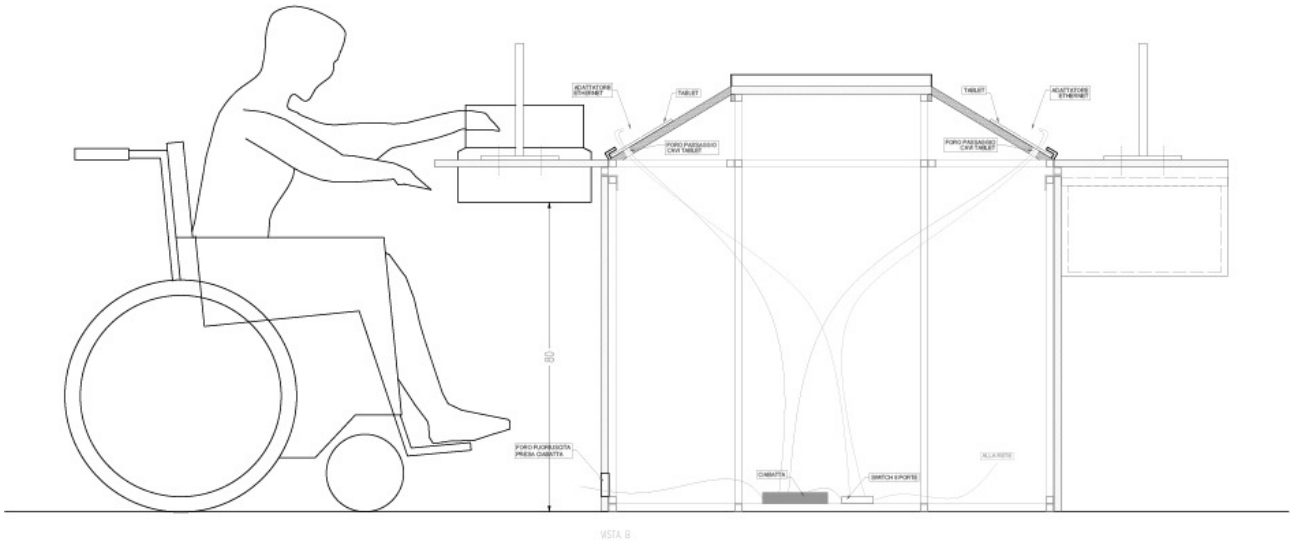


*Fig. 10 - Final blueprint for the production of the actual playstation. The development of the game's goals in terms of an 'engaging environment', need to be combined with other important objectives, such as the ergonomy, accessibility and inclusivity of the final installation. ETT (2023).*

Once the executive project drafted, graphics elements evoking spatial dynamism and a futuristic atmosphere to the world of phytoplankton were designed and applied on the boards' surfaces.

## Prototype testing

Due to the specific context of the CulturGame program: a vast research project founded by our Ministry for Research the project underwent thorough testing procedures – managed by a specific unit from the University of Milano-Bicocca, a partner in the research project – throughout each of its development phases. Two main Alpha and Beta rounds of intermediate testing, conducted at the installation's actual location, involved approximately 100 participants. The game's target group consists of secondary school students aged 12/13, who participated in a special introductory program about phytoplankton lasting over one semester. Less than 10 percent of all participants in the "Eco-bab" testing sessions belonged to the general public target group, with no specific prior knowledge on the subject (Fig. 11).

The outcome of the testing sessions, either with the project's primary target group and with 'expert' groups, were rather positive. Such results, ccombined by direct observation of 'actual' gaming sessions taking place onsite, one "Eco-bab" was eventually made available to the public in October 2023, went well beyond providing precious insights about the gaming environment, in terms of structure, mechanics, and in its ability to trigger a collaborating atmosphere between the players. "Eco-bab" players seem to enjoy the game and appear to find their way into the gaming experience easily and fast. The project was completed (Fig. 12) and implemented in October 2023, and it has been since then in use (Fig. 13).

*Fig. 11 - A taste of the beta testing sessions at mUNISS, ETT (2023).*

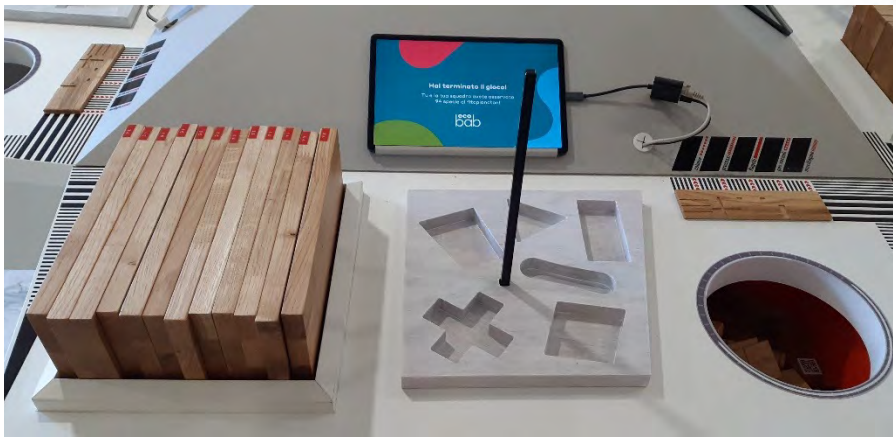



*Fig. 12 - After its actual implementation, Eco-bab is ready to run. Authors (2023).*

*Fig. 13 - Playing with Eco-bab. Authors (2023).*

## Conclusions

To us, the project proved how a careful design orchestration can lead to the development of a complex learning environment in which a wide set of design components interplay both at the individual and group level, to present the public with playful and memorable experiences. This that not only represents the ultimate goal of the Culturgame research endeavor, but can be seen as an extremely promising example on how design can actively contribute to scientific dissemination and to the development of social and environmental awareness in the field of gamification.

# References

1. Burke, B. (2014). Gamify: How gamification motivates people to do extraordinary things. Bibliomotion, Inc.
2. Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From Game Design Elements to Gamefulness: Creating Interactive Leisure with Gameful Design. In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments (pp. 9-15).
3. Dillenbourg, P. (1999), "What do you mean by collaborative learning?", in Dillenbourg, P. (ed) Collaborative-learning: Cognitive and Computational Approaches, Elsevier, Oxford, 1-19.
4. Gibson, J.J. (2014). The Ecological Approach to Visual Perception: Classic Edition (1st ed.). New York: Psychology Press.
5. Gokhale, A.A. (1995). Collaborative Learning Enhances Critical Thinking. Journal of Technology Education, 7, 22-30. doi: 10.21061/jte.v7i1.a.2
6. Juul, J. (2003). The Game, the Player, the World: Looking for a Heart of Gameness, in Copier M. and Raessens J. (Eds.), Level Up: Digital Games Research Conference Proceedings, Utrecht: Utrecht University, 30-45.
7. Kolbs, D. (1981). Learning styles and disciplinary differences, in Chickering, A. (ed.) The modern American Colledge, San Francissco, CA: Jossey Bass, 232-255.
8. Lovelock, J.E. (1972). Gaia as seen through the atmosphere. Atmospheric Environment (1967). 6, 579–580. doi: 10.1016/0004-6981(72)90076-5
9. Norman, D. (1988). The Design of Everyday Things. New York: Basic Books.
10. Reese, H. W. (2011): The Learning-by-Doing Principle. Behavioral Development Bulletin, 11, available at: http://psycnet.apa.org/journals/bdb/17/1/1.pdf (acceded May, 2016).
11. Sweetser, P. and Wyeth P. (2005). GameFlow: a model for evaluating player enjoyment in games, Computers in Entertainment, 3(3), 1-24.
12. Tilden, F. (2007). Interpreting our heritage. US: The University of North Carolina Press Chapel Hill, (first edition 1957).
13. Werbach, K., & Hunter, D. (2012). For the Win: How Game Thinking Can Revolutionize Your Business. Wharton Digital Press.

# Functionality and significance in the design of tourist and community interaction structures in Laguna de Colta

*Sandra Núñez[1], Claudia Balseca[1], Eliska Fuentes[2]*
*sandranunez@uti.edu.ec*
*claudiabalseca@uti.edu.ec*
*e.fuentes@uta.edu.ec*

*[1]Universidad Indoamérica, Ecuador*
*[2]Universidad Técnica de Ambato, Ecuador*

***Keywords:***
*Design Strategies*
*Tourist and Community*
*Interaction Structures*
*Laguna De Colta*
*Lagoon*

## Abstract

Laguna de Colta is one of the most visited places in the Chimborazo province, in Ecuador. Around 110 thousand visitors come to this place to live tourist experiences every year. However, the condition of the lagoon is increasingly affected by the abundance of totora (from Quechua tutura; Schoenoplectus californicus is a species of sedge) and their sediments. In addition, there is a high rate of migration of the inhabitants of the communities surrounding the lagoon, especially the young population due to the absence of sufficient employment opportunities lack of job opportunities, which limits the socioeconomic development of social actors. The relationship between the dynamics of the context and the lagoon is practically non- existent, which has caused a lack of identification of its inhabitants and, therefore, the disappropriation of the place. From that perspective, this work intendents to make an approach to sustainable tourism from the social dimension of design, promoting and enhancing the community's own cultural resources (representations and imaginaries) and natural resources (totora and lagoon water); consequently, tourist and community interaction structures are proposed as a means to solve problems linked to the social, economic and productive development of the community. Finally, the proposed methodology is based on qualitative tools, that enable understanding the relationship between each of the context variables, and the conditions of the place; this is achieved with the implementation of interpretive processes in order to find meaning or significance in these relationships, an insights matrix and design strategies.

## Introduction

Laguna de Colta is a large and elongated shaped body of water. Additionally, is surrounded by abundant vegetation, where totora (one of the native aquatic plants that grows in the shores of the lagoon) predominate in the landscape. The residents have built a series of representations and imaginaries around its origin and mythological events. In fact, is considered a community tourist destination since it generates additional resources to the daily economic activities of the residents of the sector. Participatory and community actions are developed to promote social and economic development. Among the traditional activities carried out in this place, "caballitos de totora aquatic race" is one of the most important. In Heredia's opinion,

totora is considered a natural and native material, due to it has identity significance This fact leads to thinking about the use of totora as a cultural expression, and a basis for the cultural industry (crafts) in its context of heritage revaluation, as a tourist-cultural attraction (Heredia, 2014, p.12).

The landscape valorization as heritage and the social appropriation by the inhabitants enable economic, social and environmental sustainability of the territory, due to culture constitutes the fundamental axis for the integral development of the people (Gómez, 2015, p.117). Using as a design strategy, the valorization of the natural and cultural landscape of Laguna de Colta could promote sustainable tourism in the area. Likewise, it is necessary to mention that "the landscape in its sustainable dimension is not only what it is, but also what it is not or has ceased to be and what it can become" (Gómez, 2015, p.124). From this perspective, when talking about the landscape of Laguna de Colta and its sustainable dimension, one could think about recovering part of its history, maintaining what it is and of course devising what it could be based on of tourism development, revaluing its cultural and natural resources. That is, think about the construction of identity from the landscape (morphology, spatiality), think about a design that considers the relationship between social actors and their landscape for the construction of a place.

For Martin Heidegger "place is something where something begins to show us its presence", in that way the notion of place is directly related to the identity (Giordano, 2018). In this sense, the design process would be oriented to the relationship between 'thinking & doing' from community participation, and socially resignifying archetypal conditions in the relationship between 'artifacts & places' (Fernandez, 2011). Consequently, the proposal seeks to consider design from a social and interdisciplinary approach, since it is a socially constructed discipline; and therefore, it appeals to cultural and natural resources to enhance the generation of sustainable tourism in that lagoon. In principle, it is necessary to consider the identification and interpretation of sustainable community development needs, the identification and analysis of cultural and natural resources present in the context to determine their perspective of use, expressive and symbolic values; and finally, thinking about the project dimension of the design from of the generation of sustainable tourism models that enable the economic, social, and productive development of the community. Martin Juez (2002) states that "projecting is how to think; even more: it is why and for what to think about a problem and a solution" (p. 140). In this way, the project is always a strategy.

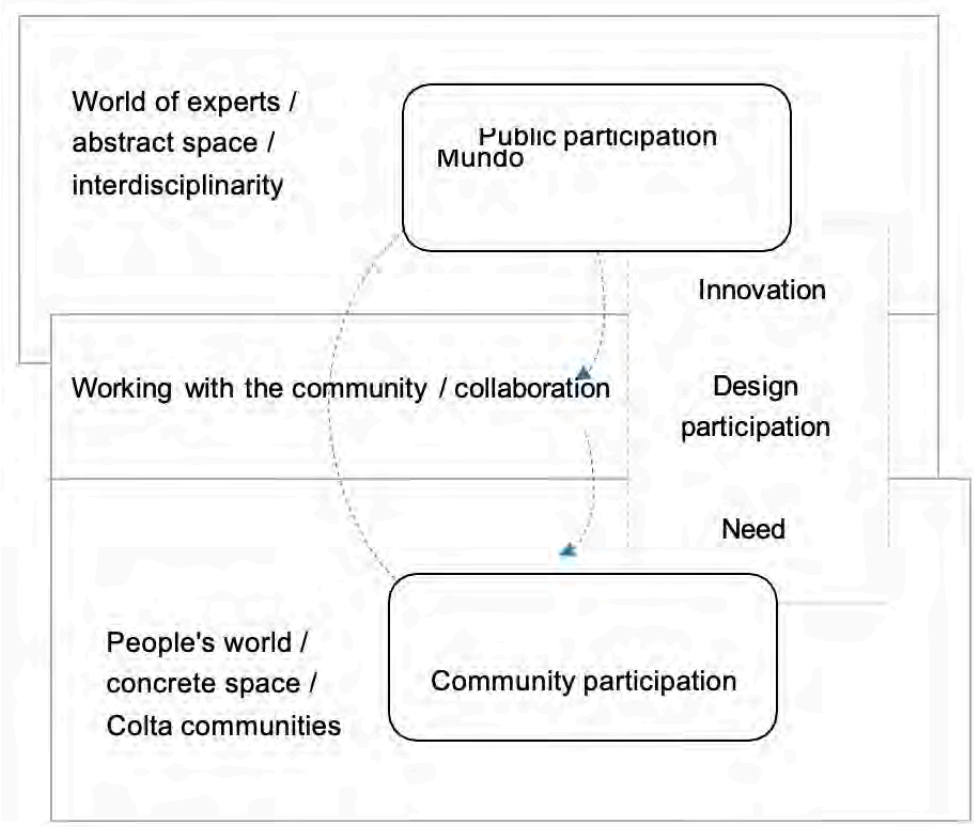
Through the appropriation of resources that materialize the environment, the possibility of thinking about functional structural models of tourist and community interaction is proposed. Design, according to Manzini (2015), is concerned to give meaning to thingsin order to create significant morphological structures; that is, the design practice collaborates actively and passively in the social construction of meaning. Thus, conceiving design as a problem solver, implies locating it in the human and material order, as well as in the social order where it produces meaning. In Laguna de Colta there are resources that can be used as elements with expressive and symbolic potential that contribute to the construction of innovative design strategies to generate sustainable tourism models; this is the case of water, and totora (which exist in abundance and have invaded a large part of the lagoon). In addition to imaginaries, cultural and symbolic manifestations that prevail over time.

In this sense, design has been considered as a discipline that contributes to the social creation of meaning, from a physical and biological level to the social level, where it produces meaning through language.

Manzini also states that community participation is the most important factor in the paradigm shift towards a sustainability model. In this context, communities seek better living conditions; and to do this, collaboration and community practice are used. In this sense, Manzini proposes the "design mode map", which consists of two dimensions:

(1) actors and competencies, that is, expert design (design professionals) and diffuse design (people/everydayness); and (2) motivations and expectations that include solving problems and the construction of (Bastías Castillo, Lutz Riquelme, & Navas, 2021).

*Figure 1: Design Model Map*




## Research Methodology

Design thinking and design doing involves solving problems, and therefore giving meaning. In this context, design as discipline, begin to play a leading role in the definition of language and meaning. That is, it creates new significant entities, from logical and systematic processes (Manzini, 2015).

> *"The approach is interpretive to understand the core meanings of the daily experiences of social and institutional actors (phenomenological). The construction of meaning is an individual act and has its origin in social interaction that is characterized by the continuous process of interpretation and negotiation of meanings" (Peralta Duque & Villescas Guzmán, 2020, p. 112) .*

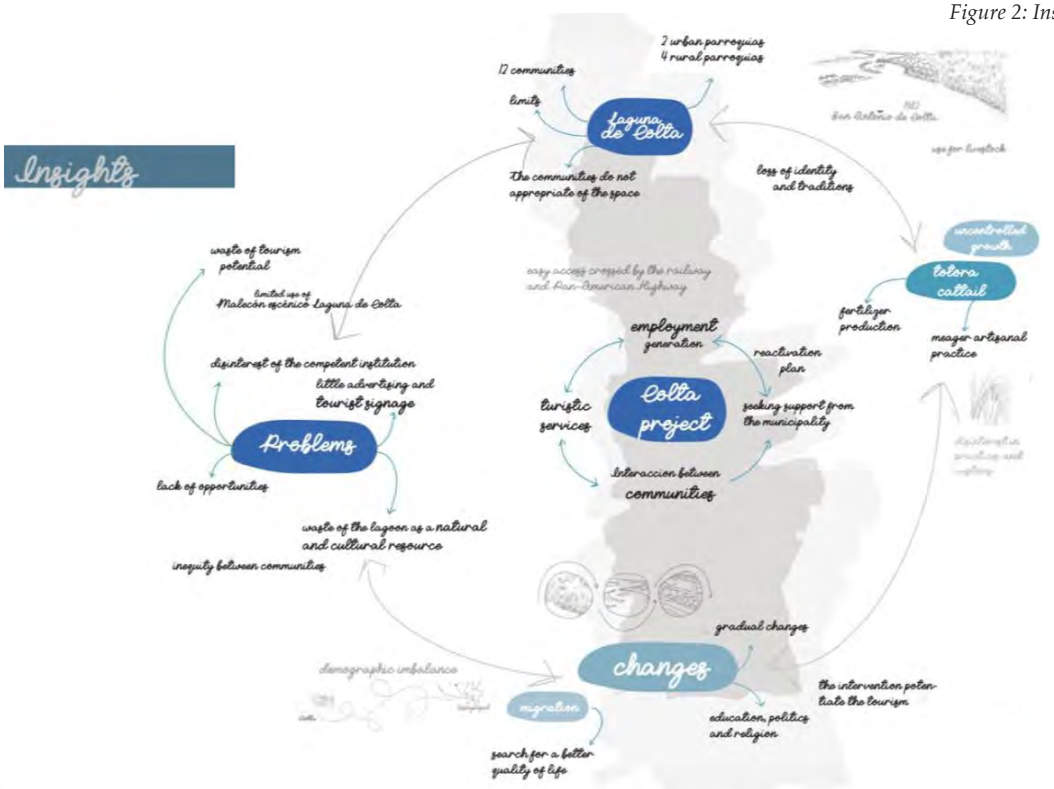
Everydayness, in the context where Laguna de Colta is developed, is full of meanings, which must be understood to establish various possibilities for proposing design strategies that contribute to the construction of language and meaning.

From this perspective, the proposed methodology is based on a qualitative approach, where ethnographic tools are used. In this sense, the project begins by understanding each of the contextual variables (social, cultural, technological, environmental), to subsequently relate them with the conditions of the place and social actions. In a second moment, interpretive processes are developed, in order to find meaning or significance to these relationships. For this purpose, visual narratives and insights matrix are designed as processing tools to synthesize and interpretate the information collected from interviews, participatory observation and focus groups in the different on-site visits.

*Tab. 1: Methodological matrix*

| Activity | Result/activity |
|---|---|
| Defining of contextual variables | Ethnography of community sense / ethnographic tools |
| Defining of tourist/community possibilities | Insights Matrix/Synthesis and Interpretation Tools |
| Graphic representation and synthesis | Visual narratives/Synthesis and interpretation tools |
| Identification of possible lines of action | Design strategies |
| Definition of tourist and community experience | Scheme of tourist/community experiences |

*Figure 2: Insights*



Among the opportunities detected, the tourism potential of both the lagoon and its surroundings is evident. Additionally, other important qualities are the proximity and accessibility, the possibility of being a meeting point, the representation of social, historical, cultural, and natural resources, as well as collective memory and the sense of ownership of the place by the inhabitants of the communities.

*Figure 3: Identified opportunities*


In addition, 4 possible lines of action are also identified for proposing design strategies:

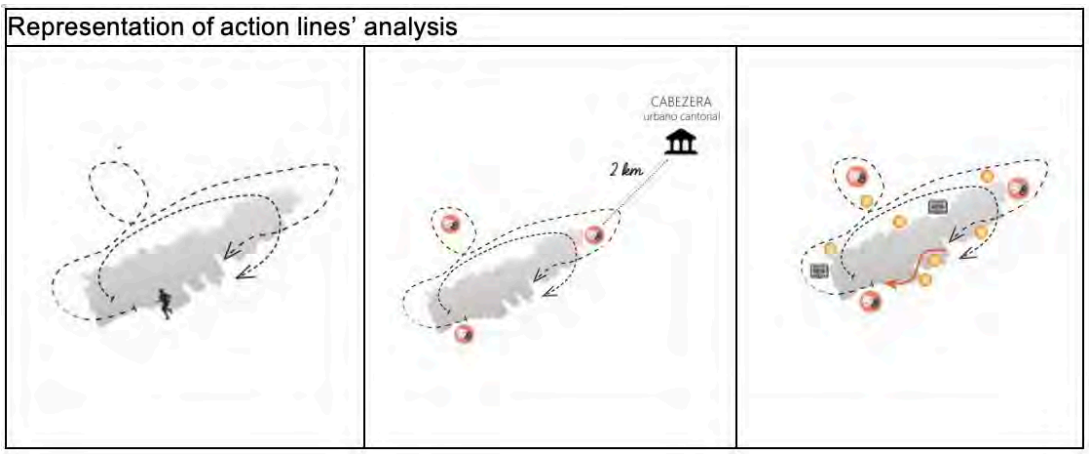
(1) physical-sports line (hiking, cycling, tracking, races, games and children's areas);

(2) sociocultural line (cultural events, fairs and festivals)

(3) educational line (craft workshops, totora processing and production, value chain - preparation of materials as well as products - ancestral knowledge and techniques and their application in industrial design and architecture); and finally,

(4) the recreational and gastronomic line, which considers proposals for leisure structures (viewing points, docks and street furniture for the site).

*Figure 4: Lines of action*



## Conclusions

Among the design strategies proposed for the generation of tourist and community interaction structures in Laguna de Colta are:

The application of participatory processes to distribute attractions more equitably around the lagoon, taking advantage of its morphology and the diversity of resources it has. From this approach, it is assumed that designed artifacts will be accepted and integrated into the community, versatile in use, accessible to a greater number of individuals, and much more adaptable to changing situations over time (Gros, 2019). Likewise, the use of natural resources such as totoras and their traditional technical processes (woven and knotted) for the materialization of tourist and community interaction structures is also proposed as a strategy, since it is a sustainable, unique material with symbolic and expressive content.

Heredia states that totora is considered a natural and native material, since it has identity significance, which leads us to think about its use as a cultural expression, which is the basis for the cultural industry (crafts) in its context of heritage revaluation, as tourist-cultural attraction (Heredia, 2014, p.12). The landscape valorization as heritage and the social appropriation by its inhabitants enable the economic, social, and environmental sustainability of the territory, since culture constitutes the fundamental axis for the comprehensive development of the towns (Gómez, 2015, page 117). Using the valorization of the natural and cultural landscape of the laguna de Colta as a design strategy could promote sustainability in tourism in that sector. Likewise, it is necessary to mention that "landscape in its sustainable dimension is not only what it is, but also what it is not or has ceased to be and what it can become" (Gómez, 2015, p. 124); from this perspective, when talking about the landscape of Laguna de Colta and its sustainable dimension, might be thought about recovering part of its history, maintaining what it is, and of course devising what it could be based on of tourism development, revaluing its cultural and natural resources.

Helena Bartolo (2013) mentions that sustainability has become a determining concern for government policies. For this reason, the practice of design, materiality and manufacturing processes are intended for transdisciplinary teams (social actors, experts, organizations) that actively participate in the progress of science and technology for the design of efficient and sustainable products. In the opinion of Margolin (2012, page 64), although there are several products that are offered in the market and satisfy certain social needs, they do not always explore communities and contexts that need to be attended to develop socially and economically and at the same time, be linked to the demands of the global context. According to Auge, (2018) the designer thinks about ways that can captivate a very limited or broader audience.

That is, he translates expressions of culture and landscape to stage them through the intervention of design. Sustainable design practices can promote tangible results to the living conditions and well-being of local communities. Meanwhile, to achieve efficient praxis, it is necessary to consider aspects that are linked to the existing built environment (materiality, construction methods, historical and cultural aspects) (William, 2016, 2).

To conclude, each of the proposed strategies aims to contribute to the conception of a tourist-community interaction system that considers the socio-economic, scientific- technical structure and morphological semiotics to achieve an equitable distribution of tourism, and thus, a place appropriation and construction of meanings through the design of an experience that integrates the community with visitors.

*Figure 5: Tourism and community experience*


The design of the tourist-community experience is based on the understanding of contextual needs to recreate the transmission of knowledge about the productive links and the opportunities of the resources that Laguna de Colta has.

# References


1. Auge, M. (2004). No places public space. The role of design. In Cuadernos de diseño (pp.
2. 107-125). Barcelona : Instituto Europeo di Desing.
3. Bastías Castillo, Lutz Riquelme, M., & Navas, S. (2021). Aplicación del Diseño Social en una experiencia local orientada al mejoramiento de políticas públicas de envejecimiento poblacional, Valparaíso-Chile. Kepes, 75-109.
4. Fernandez, R. (2011). For a critical theory of the total project. Buenos Aires: Universidad Nacional del Litoral .
5. Giordano, D. (2018). Design issues. Unstable equilibrium on imprecise fields. Buenos Aires: Diseño.
6. Gómez, A. (2015). Design Model for the valuation and social appropriation of Heritage in El Paisaje Cultural Cafetero Colombiano. Kepes , 117-138.
7. Gros, B. (2019). Research on participatory design of learning environments. University of Barcelona, 1-70.
8. Heredia, F. (2014). Re-signification of Totora, through design and innovation of techniques, uses and forms. Retrieved from http://pa.bibdigital.uccor.edu.ar/133/1/TF Heredia. Resignificacion de la totora.pdf.
9. Juez, F. M. (2002). Contribuciones para una antropología del diseño (Contributions to an anthropology of design). Barcelona: Gedisa.
10. Manzini, E. (2015). When everyone designs. An introduction to social innovation. Madrid : Experimenta .
11. Peralta Duque, B. d., & Villescas Guzmán, L. M. (2020). Social and institutional meanings of public space use. Kepes , 109-139.
12. 
13. Nuñez,Torres, S; Fuentes-Pérez, E. Freire-Valdiviezo, P. and Balseca-Clavijo, C. "Methodological guide for the design of structures for tourist and community interaction in the Laguna de Colta", CienciAmérica, vol. 11, no. 2, pp. 54–70, Nov. 2022, doi: 10.33210/ca.v11i2.395.

# A journey into social innovation through the tombolo of Mirabella Imbaccari, from history to project perspective and the first workshop of the community Fondation of Messina via the Tombolo Academy

*Luca Fois, Camilla Guerci*
*lucafois49@gmail.com, camillaguerci@polimi.it*

*Scuola del Design, Politecnico di Milano, Milan, Italy*

***Keywords:***
*Heritage innovation*
*Product service system*
*Design approach*
*Tombolo*
*Regione siciliana*
*Design for cultural heritage*

## Abstract

In the early 1900s, Angelina Auteri, who married the last heir of Sicilian princes Biscari, Ignazio Paternò, spent summers in Palazzo Biscari, Mirabella Imbaccari. Struck by local poverty, she focused on improving women's lives through lace-making ("tombolo"). She founded "Opera del Tombolo", later given to the Dorotean Sisters. Agriculture and lace production sustained the area until globalization marginalized them. To honor the couple's promise, the Dorotean Sisters donated the property, archives, and lace-making school to the Messina Foundation in 2014. The Foundation aims to preserve and innovate the heritage. It organized a workshop on Product Service System Design for Heritage Innovation, seeking sustainable solutions to valorize the inherited legacy while innovating the intangible aspects for future generations.

## Introduction

### Design for Heritage Innovation, the narrative of an ongoing project

Drawing from an authentic narrative that has involved and continues to engage individuals committed to real activities within a tangible territorial context, whose social impact is real and enduring; this paper will explore the concept of cultural heritage innovation. The intention is to conceive heritage, as defined by F. Benhamou (2020), as a social construct with mutable and blurred boundaries.

A leap into the past will be taken to recall a pioneering example of "social innovation" predating the systematic use of such term. Moulaert et al. (2013) highlight that social innovation encompasses all initiatives aimed at addressing pressing social issues through changes in the actions of individuals and institutions; necessarily connected to local development (Klein et al., 2013).

We will revisit an era where attention to the needs of disadvantaged classes was manifested through organizational efforts, grassroots struggles, or philanthropic initiatives promoted by wealthy individuals or religious institutions. The context of this narrative is Sicily in the early twentieth century, an inland region, predominantly agricultural, characterized by profound

economic disparity between an impoverished peasant class and a latifundia aristocracy exploiting local resources to their advantage. This social backdrop evokes literary works such as those of Giovanni Verga or "The Gattopardo", highlighting the contrast between privilege and poverty, between the educated class and rural laborers.

Innovation during that period was primarily a matter of existential approach, based on empathy, curiosity, and intelligence in grasping the meaning and potential of surrounding phenomena. In the early twentieth century, Angelina Auteri, a young woman from Catania, distinguished herself in empowering the women of Mirabella Imbaccari through the art of lace-making, the tombolo, transforming this practice into an identity tradition for the Sicilian village. Motivated by her Christian faith and guided by an existential and intellectual approach, Angelina Auteri embarked on a path of social transformation through culture, focusing her actions on improving living conditions and promoting a more inclusive culture. This commitment, characterized by altruistic choices, testifies to a genuine desire to innovate for the common good, without profit motives or personal ambitions of power, and falls within what today would be defined as social innovation.

The story of Angelina Auteri echoes the words of Father Davide Turoldo of the 1970s, who spoke of existential discomfort as a catalyst for critical thinking and transformative action (Maraviglia 2013). This dimension of "knowing to transform", which extends beyond individual benefit to embrace the improvement of social, environmental, and economic contexts, represents the essence of 360 design and social evolution.

In this context, past voluntary choices and the role of volunteering in the contemporary third sector will be discussed, a sector often misunderstood but fundamental for social innovation and societal evolution. These stories not only testify to the beauty of altruistic actions but also underscore the importance of the nonprofit sector in promoting social progress, with a significant economic impact that often goes unnoticed.

## 2. The Art of "Tombolo" Lace: A Centennial System

The practice of "tombolo" lace is an ancient form of textile art that focuses on creating lace using a traditional frame called "tombolo." The technique of "tombolo" lace is associated with great aesthetic and artisanal value, with deep roots in many European cultures, leading to regional variations that result in distinct styles and techniques.

### 2.1 Definition of the "Tombolo" Technique and Difference from Embroidery

The art of "tombolo" lace consists of the interweaving of threads manipulated by bobbins on a circular drum, called "tombolo," and supported by a stand, usually a wooden pedestal (Fig.1).

The tools for "tombolo" lace can be defined in four categories:

A wooden support on which the circular drum is placed;

A circular drum (the actual "tombolo"), filled with horsehair, sawdust, foam rubber, lined with a soft fabric and colorful cloths, serves as the base on which lace is made by interweaving threads and properly fixing them with pins;

A base for the design, usually made of cardboard with ornamental motifs to replicate with thread;

The bobbins, tapered in shape, with the top part designed for thread storage and the bottom part serving as a handle during work; their number can vary from a few to over 100 for more complex designs.

*Figure 1. Tombolo components. Photo by Redazione (2020, September 30) on Siciliafan.*

At the end of the lace-making process, the supports and the design base are removed, resulting in a fine lace.

In comparison to embroidery, "tombolo" lace involves the interweaving of threads or cords on a specific structure (the "tombolo") to create designs and patterns, while embroidery involves the addition of threads onto an existing fabric to create designs or decorations. Essentially, while "tombolo" lace entails creating fabric from scratch, embroidery modifies an existing fabric through the addition of threads.

### 2.2 The Origins of "Tombolo" in the Past

The roots of "tombolo" can be traced back to the early manufacturing emerged in Italy. The movement of embroiderers began in the Veneto region around 1870 and quickly spread to other provinces. The aim was to emancipate women from extreme poverty and backwardness by introducing them into a broader production system. In each region, small embroidery and lace workshops emerged where young women learned techniques passed down by older workers. Noblewomen supported production by purchasing or acting as intermediaries in sales. From the 1600s, high-quality needle and bobbin lace spread throughout Europe: in Flanders, Spain, France, and England. From the late 19th century until the early 1930s, Italian and foreign noblewomen promoted the establishment of workshops with the aim of recovering ancient patterns and specific techniques from each locality, thus contributing to the enhancement and preservation of the ancient art of embroidery and other female works.

In the 1980s, interest in the recovery of manual techniques considered "marginal," typically practiced by women, intersected with gender issues inherited from the feminist struggles of the 1970s. Embroidery, weaving, and the use of fabrics became tools of identity expression and self-narration for women (Stevanin, 2019).

### 2.3 Present Existence

Twentieth-century embroidery practices foreshadowed what would be defined in 2003 as "craftivism" by writer Betsy Greer, a political activism that also involved domestic activities such as sewing, knitting, and embroidery (Fitzpatrick, 2018).

The art of "tombolo" or lace-making is widespread in various countries

worldwide, each with its own traditions and distinctive styles. Some examples include Belgian lace, Alençon lace in France, Tenerife lace in Spain, Bedfordshire lace in England, Vologda lace in Russia, and Suzhou lace in China.

In Italy, the tradition of "tombolo" holds a place of honor, with various communities keeping alive the techniques and styles passed down from generation to generation. Particularly in Sicily, the craft of bobbin lace has deep roots, and several communities consider it an integral part of their cultural identity. The tradition of bobbin lace-making has survived in various areas of the island, becoming a symbol of Mirabella Imbaccari and spreading to Marsala, Mazzaro del Vallo, Modica, Sortino, Aragona, Piana degli Albanesi, Santa Domenica Vittoria, and Santa Ninfa.

### 2.4 Criticisms of the Art of "Tombolo"

Current criticisms of tombolo can include various factors: high costs: the lace-making process requires specific materials and a considerable commitment of time and skills, making the finished products expensive to produce; lengthy process: the process can be laborious and require many hours to complete even a small piece, affecting productivity; modern technologies: modern textile technologies may offer faster and more efficient alternatives to the traditional "tombolo" process; globalization and localism: maintaining local traditions may be threatened by globalization and declining interest in traditional craft practices.

Addressing these criticisms may require a balance between preserving craft traditions and adopting technological innovations, as well as strategies to make the process more accessible in terms of costs and time. The Messina Foundation has set the goal of finding solutions to these challenges.

## 3. The "Tombolo" of Mirabella Imbaccari: an exploration of the territory and its history

The tombolo has become a symbol of the municipality of Mirabella Imbaccari, located in the hilly hinterland of Sicily in the province of Catania. The practice of "tombolo" in Mirabella Imbaccari has deep roots in the history and local culture and has been passed down for centuries as an important part of Sicilian craft heritage. What would later become a cultural and identity tradition of this territory originated from the desire of a noblewoman from Catania, Angelina Auteri, to make the women of the town of Mirabella independent.

### 3.1 The History of Mirabella Imbaccari: from the norman period to present

Mirabella Imbaccari is a small municipality nestled in the province of Catania, in the Sicilian region, Italy. Its history dates back to antiquity, tracing its roots to the medieval era. The name "Mirabella" derives from the Latin words "Mira" and "Bella", meaning "beautiful view," due to its panoramic geographical location.

During the Norman period, Mirabella Imbaccari was part of the fiefdom of Ugone di Aidone, later passing under the dominion of the Altavilla and Aragonese families. Over the centuries, the town has experienced various dominations and periods of prosperity and decline, mainly linked to agriculture and the production of bobbin lace, which became one of the region's main economic activities. Throughout the twentieth century, the town underwent several socio-economic transformations, including emigration to other Italian regions and the decline of rural communities.

Today, Mirabella Imbaccari is renowned not only for its history and architectural heritage but also for its natural beauty and authenticity. The town attracts visitors interested in Sicilian culture, tradition, and cuisine, offering them an authentic and evocative experience.

### 3.2 The Art of "Tombolo": Angelina Auteri, the Order of Dorotea Sisters, and the donation to the Messina Community Foundation

The art of "tombolo" in Mirabella Imbaccari originates from the vision of the noblewoman from Catania, Angelina Auteri (with her husband Ignazio Paternò), with the aim of making the women of the village independent. The couple founded the "Opera del Tombolo," and through lace-making courses and Palazzo Biscari, their property, it became a reference point for the city. After Ignazio's recovery from an illness, they chose to dedicate their lives to their faith and moved to a convent, donating the building in 1928 to the sisters of the Order of Dorotea. Angelina made them promise to continue this technique to provide dignity and work for the women of the village.

In the early 1900s, the "Opera del Tombolo" was thus established, an association where this precious art was taught. Since 1986, Mirabella Imbaccari has hosted a "Permanent Exhibition of Bobbin Lace" where lace, as well as garments and furnishings made with this technique, symbol of local craftsmanship and characterized by its very dense weave and the presence of curls and roses in the design, can be admired.

In 2014, the sisters generously donated Palazzo Biscari to the Messina Community Foundation, with the intention of making it a common good and continuing the work started by Angelina Auteri. Since then, the Foundation has been committed to preserving and promoting the art of "tombolo" in Mirabella Imbaccari through cultural initiatives and territorial development projects.

In 2015, the Foundation established a fund dedicated to the territorial development of Mirabella Imbaccari, with the aim of countering the demographic and economic decline afflicting the region. This decline is due to the decline of traditional agricultural economies, the expulsion from the market of crucial sectors, and the aging and exodus of local communities. The main objective of the fund is to enhance and preserve local craft traditions, including the precious bobbin lace, recognized as an integral part of Sicilian cultural heritage.

On June 23, 2022, the bobbin lace of Mirabella Imbaccari was officially nominated as Intangible Cultural Heritage of Humanity, a recognition of the importance and beauty of this ancient craft practice.

## 4. Messina Community Foundation: a complex and heterogeneous ecosystem

The Messina Community Foundation (Foundation of Sustainable and Solidarity Mediterranean Communities for Inclusion and Welcome) is a non-profit organization founded in 2010 that has developed a wide cluster of social economy in Sicily, the Evolved Social District. The Evolved Social District pursues goals of social justice and sustainable human, economic, and social development.

### 4.1 Statute and mission

The Me.S.S.In.A. Foundation has a strategic vision that goes beyond traditional philanthropy. Its goal is to promote urban and social changes through innovative policies that address inequalities and climate change.

The Foundation works to foster sustainable human development by creating connections between welfare, culture, production, research, and technology transfer. It operates on a non-profit basis to promote systemic development policies that counter economic, social, and climate inequalities, especially in the Metropolitan Area of Messina (Messina Community Foundation 2024).

### 4.2 Vision

The vision of Founder Gaetano Giunta (2023) is that there can be no citizenship construction unless it starts from the last, because only in this way citizenship is truly universal, summarizing the vision of the Messina Community Foundation.

### 4.3 System-Oriented actions

The Foundation promotes meaningful connections between the welfare system, the cultural system, the production system, and research and technology transfer programs. This includes actions to attract creative and scientific talents, urban regeneration programs, social housing initiatives, and the requalification of common goods, as well as the enhancement of the social capacities of territories. They are committed to identifying sustainable development strategies capable of generating alternatives in various fundamental areas of people's rights.

### 4.4 Tombolo Academy

Among the activities of the Foundation, there is the establishment of the Tombolo Academy, dedicated to the promotion, conservation, and transmission of lace traditions and techniques, particularly through education and training.

Having received a donation from the Dorotee Sisters, the Foundation has simultaneously taken on the task of studying and managing a realistic process of requalification of the tangible and intangible heritage of the received properties, finding sustainable solutions at three levels: environmental, social, and economic.

The Academy responds to the need to reclaim skills and know-how translatable into artisanal abilities, in line with the UNESCO Conventions for the safeguarding of intangible cultural heritage and the Faro Convention (Tufarelli, 2019). Finally, the Tombolo Academy aims to be a system for heritage innovation, a structured cultural project based on territorial specificities and vital rhythms.

## 5. Initiatives of the Tombolo Academy

The commitment of the Messina Foundation to rethink the challenges presented and generate new solutions through lace-making constitutes the driving force of a comprehensive 360-degree project, which combines Design Thinking and Product Service System design with architecture and landscape. The goal is to redefine not only objects like lace-making but also the spaces, forms, and functions of the place so that they can accommodate new activities, not only surviving but thriving in contemporaneity, starting from a small inland center in Sicily.

The Foundation has laid the foundations of its work on three fundamental pillars, indispensable for a holistic and ethical approach to Design: Social, Environmental, and Economic Sustainability, interconnected and indivisible.

The initiatives of the Academy began with an international workshop held in Mirabella Imbaccari in July 2022, which saw the collaboration of various entities: the Messina Community Foundation, the Design for Kids and Toys course by Poli.Design with its national and international students, established by the Polytechnic University of Milan, and the company The Playful Living. This event marks the first step towards achieving these ambitious goals.

## 5.1 Beyond global and local: niche glocalisms

The context of the Tombolo Academy's initiatives can be considered an expression of "niche glocalism," a combination of elements of "glocalism" and the concept of "niche". The initial conceptions of this term are found in Edward Goldsmith and Jerry Mander's book "The Case Against the Global Economy and for a Turn Toward the Local" (1996), among the pioneers in addressing this issue. Here, glocalism is primarily interpreted as a form of resistance to the globalizing tendency that threatens to homogenize and overwhelm everything, being considered an alternative and a defense of identity.

Today, the concept of glocalism necessarily incorporates that of globalization. Glocalism is fueled by both the global and the local, in a reciprocal intertwining and a continuous exchange between the two dimensions. Local realities enter the global context and emerge transformed, acquiring a new dimension. Roland Robertson (1995), among the first to conceptualize glocalization, conceives it as a vast matrix of possibilities, in which a multitude of highly differentiated solutions and combinations develop, giving rise to distinct and interconnected identities.

### 5.2 International Workshop on Tombolo in Mirabella Imbaccari

The workshop held in July 2022 aims to explore the relationship between design and craftsmanship, pushing the boundaries of local traditions and reinterpreting lace-making as an ancient art to be transformed into a playful experience. Students develop product-service system concepts based on lace-making techniques, with the goal of creating new toys, games, and services, targeting both the global market and the Sicilian community.

The project, outlined in general terms, aims to regenerate Mirabella Imbaccari, leveraging the properties made available by the Foundation. It intends to create a System of Activities and Economies that embraces both the present and the future, drawing inspiration from the "genius loci" that has characterized the place over the years. This "genius loci", rich in potential, suggests that the link between culture/education and niche markets can stimulate new creative and design energies, as well as targeted economies.

In an era where global tourism seeks authentic experiences, Mirabella Imbaccari emerges as a place rich in material and immaterial heritage, capable of attracting demanding and curious personalities who fully respect its current and future economic, social, and environmental impacts, while respecting the host community (UNEP, UNWTO 2005).

The tradition of lace-making can become a universal artistic language and an engaging activity for all ages and genders, stimulating the brain in multiple facets.

This Heritage Innovation approach can generate niche economies, supported by a mix of creativity and manufacturing, and fueled by modern communication and distribution through digital technologies. The establishment of a Tombolo Academy, rooted in the local territory but also open

to the digital realm, could catalyze these activities, promoting a holistic vision of craftsmanship and innovation.

The method and culture of the 360 project prove to be particularly effective in the challenge of Heritage Innovation, promoting increasingly intense cultural and commercial relationships between different communities and cultures.

*Figure 2. Some sketches of workshop participants in the design process.*

### 5.3 Methodology

The workshop methodology provided students with a stimulating and interactive environment to explore the art of lace-making, develop innovative ideas, and transform them into tangible prototypes, with particular attention to the participation and involvement of local communities.

The workshop involved 10 groups of students, each composed of 4 or 5 participants from both national and international backgrounds. Initially, a detailed brief was presented outlining the project objectives and challenges to be addressed.


*Figure 3. Prototype analysis phase with children by team 1, composed of Alice Zecchin, Ernesto Avogadri, Haitham Othman and Karen Ip.*

The workshop was structured into distinct phases, spanning a total of 4 weeks. During this period, students attended lectures conducted by professors and tutors, providing both theoretical and practical context to address project challenges. In particular, an intensive introductory session on lace-making was included to familiarize participants with the art and techniques involved.

Throughout the four weeks, students had the opportunity to develop concrete concepts based on the initial brief. Through brainstorming sessions, research, and conceptual development, participants refined their ideas and transformed them into tangible projects (Fig. 2).

Following the conceptual development phase, students translated their concepts into physical prototypes.

Using various prototyping techniques, participants brought their ideas to life, exploring materials and forms to actualize their projects. A significant portion of the workshop was dedicated to evaluating prototypes through testing with children (Fig. 3). These tests allowed for the collection of valuable feedback and assessment of the effectiveness and appeal of the developed projects.

*Figure 4. Tombolo as a tool for the nests of migratory birds in Sicily, a project by workshop team 7, composed of Menglu Yu, Binbin Chen, Suyan An, Yichen Dong, Yuting Cheng, Xiaohong Gao, students from the China Academy of Art.*

### 5.4 Most Significant Outcomes

The workshop results generated a series of significant products and experiences, outlined below across different fields of action:

- Local tourism experiences: new tourist experiences were developed, offering visitors the opportunity to immerse themselves in local culture and traditions through guided tours and experiential activities;
- Food products, restaurants, and laboratory experiences: culinary experiences at local restaurants and experiential workshops showcasing traditional cuisine and gastronomic craftsmanship;
- Innovations for local wildlife: stimulating awareness of the need to protect and preserve small animals, promoting empathy and environmental responsibility for the characteristic elements of the area (Fig. 4);
- Art installations in museums: ideas for installations to enrich the cultural experience of Mirabella Imbaccari's visitors; education at the lace academy: basic and advanced educational courses, allowing students to learn and master lace-making techniques and pass down this knowledge from generation to generation;
- Beginner courses and progressive learning: beginner courses introducing lace-making practice, as well as progressive learning paths

leading to mastery in the field; health and therapy sessions: utilizing lace-making for therapeutic purposes, offering health and wellness sessions that leverage the benefits of artisanal practice;
- Global tourism through the internet: online experiences, including online learning courses, subscription boxes offering materials and instructions for lace-making, and an online community dedicated to sharing experiences and knowledge.

In conclusion, the workshop results contributed to diversifying local tourism offerings, promoting the traditional craft of lace-making, and offering new opportunities for learning, entertainment, and well-being for both the local community and international visitors.

## 6. Conclusions

The outcomes derived from the Workshop have paved the way for new approaches to fully exploit the potential of bobbin lace. The Messina Community Foundation envisages initiating specific projects focused on bobbin lace art and its practitioners, acknowledging its value creation. Artisans are not only capable of producing aesthetically pleasing works but also of proposing innovative solutions that meet the needs of a diverse clientele. This implies a constant commitment to experimentation and cultural elaboration, as the project recognizes and embraces the diversity of individual visions and experiences.

### 6.1 Systemic Design and the Product Service System Design Method

Systemic design and the Product Service System Design (PSSD) method can play a key role in the development and valorization of bobbin lace art. Systemic design, through a holistic approach, considers the social, cultural, and economic context in which bobbin lace operates, identifying the interconnections between various factors and actors involved in the production process and its consumption. Systemic orientation is a mindset that recognizes and values the interaction among components (Bistagnino, 2011).

On the other hand, PSSD focuses on designing integrated systems of products and services, offering opportunities for innovation and differentiation in the market. These approaches can be adapted to develop new modes of production, distribution, and consumption of bobbin lace, promoting its economic, social, and cultural sustainability in the contemporary context.

### 6.2 Social and economic impact

The adoption of new approaches and methodologies, such as systemic design and PSSD, could lead to significant positive social and economic impacts for the communities involved in bobbin lace art. This could include the creation of new job opportunities and income for artisans, the enhancement of cultural identity and social cohesion through the valorization of local traditions, and the increase in the attractiveness of tourism in the involved areas. Furthermore, innovation in the bobbin lace sector could generate new markets and distribution channels, contributing to economic diversification and the resilience of local communities.

# References


1. Benhamou, F. (2020). Heritage. In Handbook of Cultural Economics, 3rd ed.; Edward Elgar Publishings: Cheltenham, UK; pp. 279–286 [Online] Retrieved from https://doi.org/10.4337/9781788975803 [Accessed 18 February 2024].
2. Bistagnino, L. (2011), Design sistemico: progettare la sostenibilità produttiva e ambientale, Slow Food Editore, Bra, Retrieved from https://iris.polito.it/handle/11583/2411513.
3. Fitzpatrick, T. (2018). Craftivism: A Manifesto/Methodology: 33, Print [Online] Retrieved from https://www.academia.edu/36194312/Craftivism_A_Manifesto_Methodology [Accessed 13 February 2024].
4. Fondazione di Comunità di Messina (2016). Finalità e Statuto [Online] Retrieved from https://fdcmessina.org/lo-statuto/ [Accessed 30 February 2024].
5. Giunta, G. (2023). Cittadinanza Nuove Forme Di Partecipazione. Periodico delle fondazioni di origine bancaria in Fondazioni [Online]. Retrieved from https://fondazioni.acri.it/wp-content/uploads/2023/07/Fondazioni_giu23.pdf [Accessed 12 February 2024].
6. Giumelli, R. (2010). Oltre il locale e il globale: il senso glocale dell'appartenenza contemporanea, European Diversity and Autonomy Papers - EDAP [Online]. Retrieved from https://www.researchgate.net/publication/49600636_Oltre_il_locale_e_il_globale_il_senso_glocale_dell%27appartenenza_contemporanea [Accessed 10 February 2024].
7. Goldsmith, E., Mander, J. (1998). Glocalismo. L'alternativa strategica alla globalizzazione. Arianna Editore, Bologna.
8. Klein J-L., Fontan J-M., Harrisson D., Lévesque B. (2013), The Québec Model: a social innovation system founded on cooperation and consensus building, in Moulaert F., MacCallum D., Mehmood A., Hamdouch A. (eds.), The International Handbook on Social Innovation: Collective Action, Social Learning and Transdisciplinary Research, Edward Elgar Publishing, Cheltenham. pp. 371-383.
9. Meraviglia, M. (2013). David Maria Turoldo. Ricognizione bibliografica su un protagonista della chiesa italiana del Novecento. in Cristianesimo nella Storia 34, pp 905-906, Fondazione per le scienze religiose, Bologna [Online]. Retrieved from https://www.academia.edu/27298605/David_Maria_Turoldo_Ricognizione_bibliografica_su_un_protagonista_della_chiesa_italiana_del_Novecento_in_Cristianesimo_nella_storia_34_2013_3 [Accessed 12 February 2024].
10. Moulaert F., MacCallum D., Hillier J. (2013). Social innovation: intuition, precept, concept, in Moulaert F., MacCallum D., Mahmood M., Hamdouch A. (eds.), The International Handbook on Social Innovation: collective action, social learning and transdisciplinary research, Edward Elgar Publishers.
11. Robertson, R., (1999). Globalizzazione: teoria sociale e cultura globale, Asterios, Trieste.
12. Stevanin, F. (2019). Marginale, personale, politico: il ricamo e il tessuto nell'arte degli anni Ottanta del Novecento. ZoneModa Journal, 9 (1), 181–192. [Online] Retrieved from https://doi.org/10.6092/issn.2611-0563/9689 [Accessed 19 February 2024].
13. Tufarelli, M. (2019). Futuro del patrimonio, patrimonio del futuro. Un'esplorazione sul significato del Cultural Heritage digitalizzato, Dottorato di ricerca in Architettura, Università di Firenze [Online]. Retrieved from https://flore.unifi.it/retrieve/e398c37f-976f-179a-e053-3705fe0a4cff/MTufarelli_Futuro%20del%20patrimonio%2C%20patrimonio%20del%20futuro_%20XXXIIciclo.pdf [Accessed 20 January 2024].
14. UNEP and UNWTO United Nations Environment Programme e World Trade Organization (WTO), (2005). Making Tourism more Sustainable: A Guide for Policy Makers [Online] Available at: https://wedocs.unep.org/20.500.11822/8741 [Accessed 30 February 2024].

# Urban interiors. The domestic space and the city/the street as a living room.

*Tiziano Aglieri Rinella*[1]
*tiziano.aglieririnella@iuav.it*

[1]*IUAV University of Venice, Italy*

***Keywords:***
*Cities*
*Threshold*
*Public space*

## Abstract

Urban dynamics affect cities' architecture, where the relationship between interior and exterior, public and private realm, are part of a single design process. The design of the threshold, transitive interface-space connecting different spatial conditions, changes according to the operative context. The aim is to investigate the inter-relationality of spatial phenomena, from the higher scale to the smaller one and vice-versa. In this scenario, the street plays a fundamental role, being considered, according to the Italian and Mediterranean tradition, as a social and public space belonging to the community. The street is the place towards which the architectural space is projected, establishing relational relationships often without a net distinction between interior and exterior. Giò Ponti, in the first issue of DOMUS in 1928, asserted that in the Italian architecture there was not great difference between interior and exterior: with its arcades, loggias, verandas, terraces, the interior extends towards the exterior and both are melt as a single architectural whole. The relationship interior-street has been therefore strong and direct. As Le Corbusier had complained in URBANISME in 1925 the sudden appearance of cars in the early XX century was a disruptive event that put in crisis the relationship between man and street in European cities. As a consequence of this, since then this relation has been slowly but constantly neglected and alienated, till its dramatic negation affecting many contemporary towns. This very need of re-appropriation of the public space by pedestrian-citizens had led Louis Kahn to define the street as a "living room", belonging to the community. Thus, this restates the significance, in the social and connective fabric of our cities, of the urban public space, with its squares, streets and alleys. Places not predominantly reserved to the vehicular traffic but dedicated to citizens, and that keep a closer relationship with the interior life of the surrounding buildings.

## Introduction

This essay investigates the inter-scalar role of threshold spaces as a connective interface between architecture and cities, where the street plays a fundamental role as a tool of social effectiveness in the urban fabric. Starting from the first attempts of governance of the presence of cars in XX cent. cities, the paper explores the theoretical conditions and some significant attempts to face the alienation of the individual in contemporary towns.

## The heritage of Modernism. The house, the car and the City.

In the course of his career, Frank Lloyd Wright spent a lot of time developing significant visionary projects for the ideal city of the future. In 1927 he used for the first time the word Usonia (Watson, 2017) to describe an ideal egalitarian society that, according to him, should have arisen in the US.

In 1932, in his book The Disappearing City, Frank Lloyd Wright presented is idea for an ideal city: Broadacre city, a perfect balance between town and countryside, or, better, between architecture and countryside. His idea was a low-density city, with buildings scattered in the countryside and connected by a road network. It was a city based on the use of car (United states with the diffusion of Ford models had been a pioneer country in the automotive industry) as a democratic means of transport, and its main principle was urban decentralization, or better "urban dispersion", reorganizing inhabitants on a very low density agricultural grid immersed in the green at a regional scale.

More than a "garden city" Broadacre city was a "farm city", given the important role of agriculture in this utopic city. This model should have solved the issues of urban congestion of XX cent. Cities, and was, ahead of times, a sustainable and self-sufficient model. To promote his ideal city, he made a large model of a portion of Broadacre City (3m x 3m) that he exhibits all around the United States in 1934.

He continues to work to the project and in his 1958 book The Living City he presents a set of visionary perspectives of the city immersed in the natural landscape where, besides the road network for the car traffic, other means of transport are drone-taxis and barges powered by atomic energy. Scattered in the landscape we recognize some of Wright's buildings such

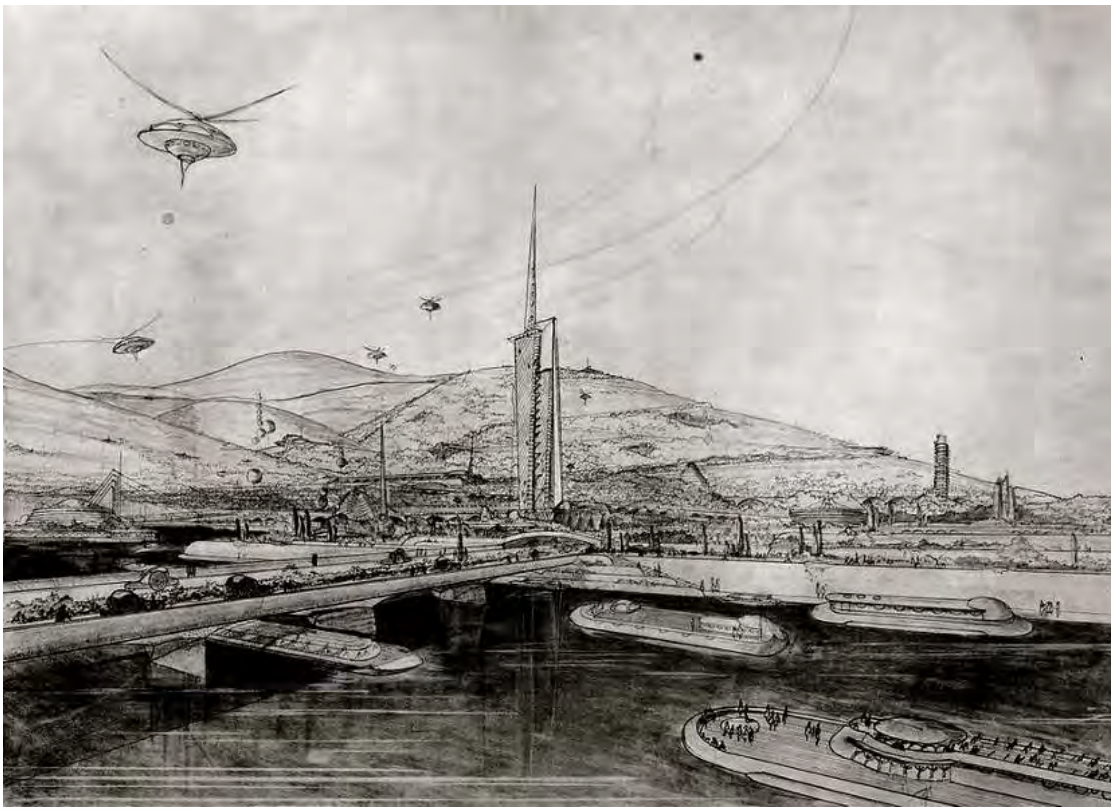


*Figure 1. View of Broadacre City (from F.L. Wright, The Living City, 1958)*

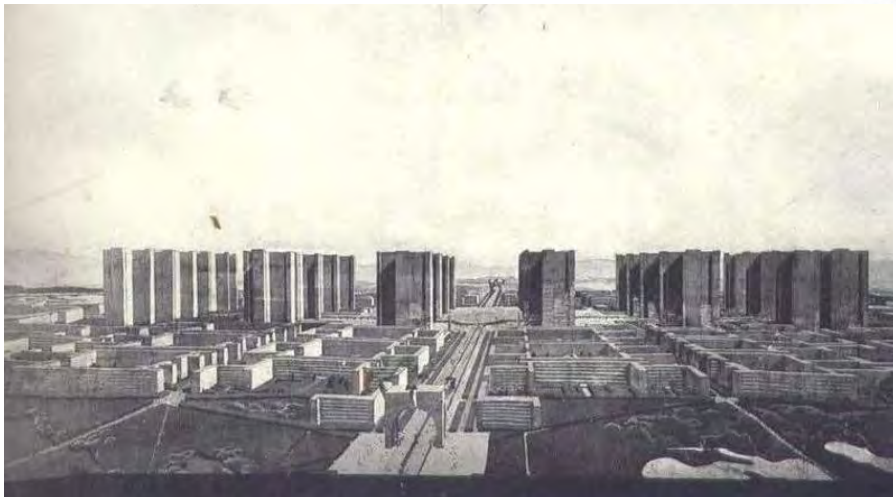


*Figure 2. Ville Contemporaine pour trois millions d'habitants (from Le Corbusier, Urbanisme, 1925)*

as the Price Tower, the Civic entre of Marin County, the Beth Sholom Synagogue and some other unbuilt ones.

In Europe, during the 20s, also Le Corbusier develops his plans for the town of the XX cent., and his major concern was actually the sudden appearance of the car in old European Cities. According to Le Corbusier European cities, with the narrow streets of their old city centers, were unfit for car circulation. In his 1925 book Urbanisme he complains that Paris' citizens had lost the ownership of the street: "20 years ago (..) the street belonged to us: we were singing on it, we were chatting there, the horsecar was slowly riding.". Suddenly, in the mid-twenties Paris was flooded by the disruptive invasion of car traffic: "its strength is like a torrent swollen by storms: a destructive fury. the city is crumbling, the city can't last any longer, the city is no longer good, the city is too old" (Le Corbusier, 1925). He was literally obsessed by the invasive presence of vehicle traffic in the city. The Parisian urban landscape was quickly shifting from the calm of horses –drawn carriage traffic to the terrible and disturbing noise of automobiles and trucks.

This concern, imagining a further future worsening for European cities, led him to design his first ideal urban plan for a contemporary town: the plan for a Ville Contemporaine pour trois millions d'habitants presented at the Salon d'Automne in 1922. At the centre the railway station, with platforms for the air-taxis on the roof . Around it a green area with 24 60-storey cruciform skyscrapers (mainly used as offices and hotels). Around the skyscrapers, arranged according to an orthogonal grid, a series of lower 6-storey open horizontal buildings (à redént) and in the external area 5 storey courtyard buildings (immeblue villas). This last group of buildings featured shared facilities and was the first core concept of the future Unite d'habitation with hanging gardens and at the ground floor a number of common spaces such as a laundry, supermarkets, and other essential services. In order to solve the traffic issue, Le Corbusier organizes the circulation on three overlapping levels: the heavy traffic of trucks on an underground level, regular urban traffic at the ground level and two one-way roads crossing the city at an elevated level for the fast traffic. The industries were dislocated in a remote suburban area and connected to the city centre by the highway (from east to west).

In 1925, at the Exposition internationale des arts décoratifs et industriels modernes (International Exhibition of Modern Decorative and Industrial Arts) in Paris, Le Corbusier presented his well-known urban plan for Paris,

the Plan Voisin. It's a radical proposal providing the demolition of a large area of the old city centre of Paris (the rive droite, on the northern bank of the Seine river). A system of large linear roads for vehicle circulation is overlapped to the historical urban fabric. Here, the abstract ideas conceived for the plan of Ville Contemporaine pour trois millions d'habitants are applied on a real urban site: the core of the plan is a symmetric system of cruciform skyscrapers, articulated in a composite layout with lower linear buildings "à redents". Only the most representative monuments, such as the Louvre, the Royal Palace and the Jardin des Tuleries and the Madeleine are preserved from demolition. The name Plan Voisin is issued from the car maker Voisin, a famous car brand that founded the project (Amado, 2011). As the purpose of the project was to find a solution for the problem of car traffic in Paris, Le Corbusier asked the most important French automakers for fundings. Le Corbusier had presented the plan to Peugeot and Citroen, who refused (André Citroen said that he didn't understand the relation between Le Corbusier's plan and the car). Fortunately, Voisin's manager was a friend and a client of Le Corbusier. He had designed plans for an unbuilt house for him and Le Corbusier succeeded in convincing him to finance the project (Le Corbusier himself was owner of a Voisin C7 10 HP car).

Even considering the historical and artistic value of old city centres, Le Corbusier was doubting that a balance and an integration between old city and modern needs was possible. Great estimator of Haussmann, the promoter of the radical urban renovation of Paris in the second half of XIX cent. achieved by the disembowelment of Old Paris, he refuses and destroys the historical city, disregarding any balance between the scale of modern intervention and the urban fabric of the old city, with its massive skyscrapers looming on historical buildings without intermediation. Le Corbusier's mistake was to consider the modern city just as "a (large) machine to live in" for the community –like he intended the modern house as a machine à habiter (a machine to live in)– not paying attention to the value of historical urban space, and to the relation between the modern house "the machine to live in" -thus the Domestic (private) Space- and public space of the city. Another negative aspect we have to consider is that introducing skyscrapers in the centre of Paris would have decreased the surface covered by buildings (increasing free and green areas) but also increased the population density, as tall buildings would have hosted much more occupants, therefore increasing the car traffic! Which actually was the problem Le Corbusier intended to solve.

The last theoretical design of Le Corbusier for an ideal city is the "Radiant City" (ville Radieuse) designed between 1929 and 1930, a plan for a contemporary city of 3 million inhabitants (Le Corbusier, 1964). The founding urban principle of the "Radiant City" was its typical residential model: the "Rédent" building. Residential units were joined to form a linear super-building of 11 floors, folding with 90 angles every 400m along the north-south and east-west directions, with indefinite length and an inner connecting street. Apartments are oriented towards both sides and the facades are at least 200m distant one from each other. So there were vast open spaces between the buildings. Both buildings and roads are raised on pilotis, so the ground level is left free and become a pedestrian park with public services. The plan of "Radiant City" was based on a radical zoning, with a net separation among the different functions and related connecting paths. Separate zones were dedicated each to housing, offices, industries, administrative, educational and cultural functions. The different zones were connected by a road network, and served by the railway station and the airport. Only the 12% of the city surface was covered by buildings, while the remaining

land was free and mainly intended as green areas.

Despite of the initial good intentions, this drastic separation of functional zones will be the reason of the dramatic failure of urban planning in the following decades, creating separate dormitory zones and working zones. Totally forgetting the public space of the city (as it was historically intended: the street or the square (piazza), meeting places and points of social aggregation). The mixed use areas of the traditional town disappearing.

O

ne should point that, in this period, many European architects such as Le Corbusier himself or even Adolf Loos were fascinated by America, seen as the country of progress and innovation, where a new model of dwelling and urban planning was possible. The idea of America in the European imaginary was associated with the concept of "bigness", the very large dimension of the spaces and buildings of the new world. This may explain the fascination in the old continent the skyscrapers of Manhattan may have had.

*Figure 3. A virtual representation of Plan Voisin. Le Corbusier's buildings looming over the Louvre (Clemens Gritl, image exhibited at Sagmeister & Walsh: Beauty, 10/05/2019 - 15/09/2019 at MAK Frankfurt / Museum Für Angewandte Kunst)*

## Semantic matters and cultural perception: Road vs Street

German philosopher Ludwig Wittgenstein affirmed: "Words are like windows through which we see the world", and further continued: "Concepts are at a certain point in the use of words.(...) The limits of my language mean the limits of my world" (1953). He meant that every language is the natural expression of the culture of the community it belongs to. Therefore, if in a certain language there is not a word to express a given concept, it means that this concept is not yet clearly defined and understood by the reference community. Starting from this statement, it is interesting to reflect on the meaning of two terms particularly significant in urban planning: Road and Street. According to the English dictionary the term "road" refers to "a hard surface built for vehicles to travel on" (Oxford Advanced Learner's Dictionary). It is therefore clearly intended for the vehicle traffic, to move from a point to another. The noun "street", on another hand, is defined as "a public road in a city or town that has buildings on one side or both sides". The same dictionary mentions the possibility for a pedestrian to walk along the street: "I was just walking along the street".

In the Mediterranean culture, the perception of space of the urban and suburban landscape features some differences, that are clearly expressed in the language. In Italian language, for example, there is no difference between "road" and "street", there is only one term for both, that are translated as "strada". According to the dictionary, the definition of "strada" is: "A public area, properly delimited and paved, used for the passage and transit of people and vehicles. Also: Path (walk), itinerary". The noun "strada" indeed, clearly states that it is used both by pedestrians and vehicles, whereas the presence of the firsts is not at all considered in the English term "road". The absence of a proper noun to translate "road" in Italian, should not be disregarded and should be put in relation with the different cultural and environmental context: because of the higher urban density in the Italian peninsula, often there is no substantial difference between a "road" and a "street". As a matter of fact, the term "strada" can be used both in urban or suburban context. A few examples of translation from Italian to English and vice versa, can exemplify the matter. Award-winning Federico Fellini's movie "la Strada" (casting Anthony Queen and Giulietta Masina) has been translated as "the Road" (incorporating the concept of movement across different places, where the street life of Italian villages played a fundamental role). On the other hand, the world-famous Jack Kourac's novel "On the road", that is telling of a long travel across the united states has been always translated as "Sulla strada", using the same term (Fig.4).


*Figure 4. Translations of the term "strada" both as "road" or "street" in Fellini's movie La Strada and Kerouac's novel On the Road.*

These differences in language- and the absence of an equivalent term for "Road" in Italian- are the evidence of a deep-rooted cultural difference. In the Italian culture indeed, as well as in the European and Mediterranean context, the Street has historically been a place of social relations, a meeting and conversation place, a place where to work together or to play games. Since ancient times people is used to spend most of the time outdoor, and the street has been a gathering place where people meet and gets together.

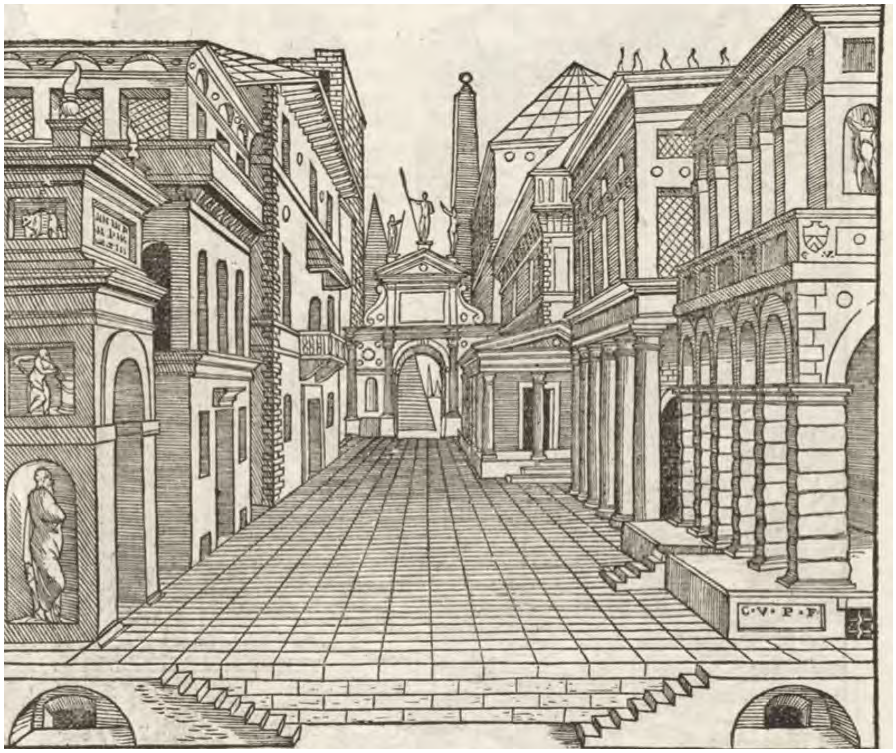


*Figure 5. Sebastiano Serlio (1475-1554), set design for a tragic scene (Illustration, page 69, from De architectvra libri qvinqve, 1569).*

During the renaissance, architect Sebastiano Serlio designed streets as background for his theatre stage settings: a street flanked by elegant buildings for the upper classes was the setting for theatre tragedies – dramas- whereas a street with poor popular architecture was the setting used for comedy scenes (Secchi & Bochicchio, 2020). This confirms how the street is the scenario of people's life, of everyday reality, of history (Fig.5).

But the street can be also a place of fear, of uncertainty. This may generate the need of protection from the street, searching for a shelter in our own home, away from the street, maybe inside gated communities. The house as a place for our family's intimacy, our "home". As French philosopher Gaston Bachelard said - the house as a "shell" or, as Rudolf Arnhaim stated, as a primordial shelter protecting us and our family from the dangers of external world (Bassanelli, 2015).

Polish sociologist and philosopher Zygmunt Bauman affirmed that with the diffusion of Internet, of remote working, social networks, entertainment platforms like Netflix, etc, our home becomes the main point of connection and interaction with the external world (Bauman 1999; 2000). This brought new models of integration between the material and the virtual space, and increases the detachment from the city and its urban space. As a consequence, for a certain point of view, this means that the contemporary society is increasing this distinction, this separation between the interior of the domestic space and the exterior (the city), establishing borders and creating a dichotomies/barriers and oppositions between what is included inside and what is left outside. This is a further step towards the isolation and aliena-

tion of the individual. Regarding this, it is interesting to mention Sygmund Freud concerns following his trip to America in 1909 (Kaye, 1993). Freud had been a great estimator of the US during his youth. He considered America as a land of freedom, and even considered to move there to escape from the prejudices and discriminations of European society against Jews. During his stay, however, he changed his mind, and started to express some negative criticisms. The reasons of this change of opinion are several, but one was certainly related to the experience of space. Coming from Wien, so used the dense urban space of old Europe, he was shocked by the sudden change of scale. The "bigness" of the American country, with his immense land and the countryside scattered of single individual houses isolated and dispersed in the landscape, distant form each other and far away from any point of aggregation, the lack of public space and urban density, all this scared Freud. He though that this urban dispersion, because of the lack of social contacts and human relations generated the individual's isolation and loneliness. Similar to the feeling expressed by Edward Hopper's paintings, where the individual alienation and the metaphysic loneliness of the American landscape is effectively represented.

A similar feeling had been expressed by German philosopher Walter Benjamin regarding the radical transformation of European towns following industrial revolution, when large crowds of people moved from the countryside to the industrial towns to work (1962). These people, de-rooted from their rural environment and displaced to the large urban spaces of the new industrial tows, generated a feeling of disorientation and frustration, which

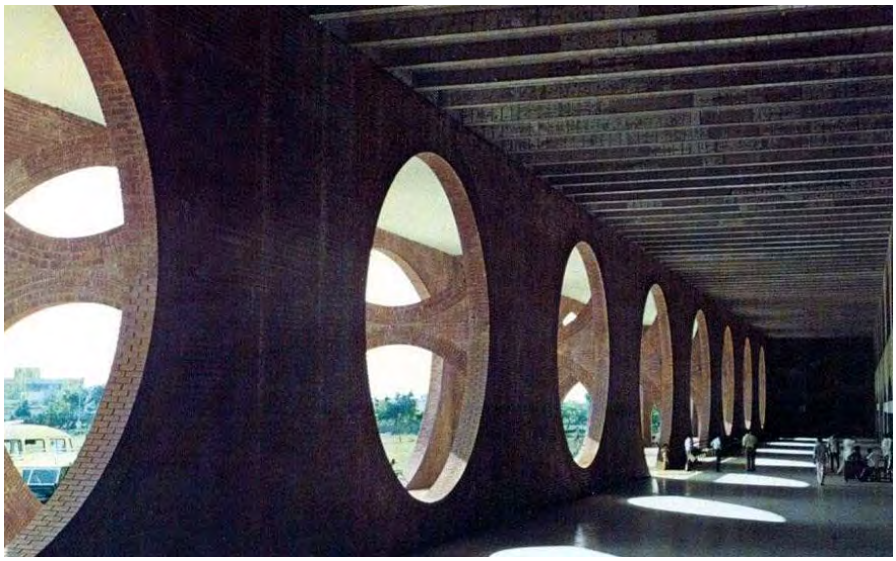


*Figure 6. Louis Kahn, Dhaka Hospital (photo Anwar Hosain, published on Domus 548 / luglio 1975)*

originated the individual's alienation as a modern collective pathology. The sudden transformation of the urban landscape, with the huge empty spaces and the heterogeneous crowds of modern cities, produced in their inhabitants some psychological pathologies, expressed by phobias associated to the space's experience such as agoraphobia and horror vacui, fear of large open spaces and fear of the void, generating a disturbing feeling of metropolitan uncanny, which we find with different characteristics in the wide metaphysic spaces of the American countryside.

## An interface between Interior and exterior: the threshold space.

A different approach on the relation between the interior (domestic space of our home) and the exterior (public space of the city) is the one that has been supported by architects caring of a relationship between man and built environment respectful of the human scale.

Milanese architect Giò Ponti, since his very first architectures, expresses an idea of domestic space as a inter- penetration of rooms in very direct relation with the exterior, which he achieves by the use of large windows, as a filter between the external and the internal space: "an room, by default, has 4 walls. A room with a total glass window has, instead, 3 walls and a void" (Ponti, 1954). In the editorial of the first issue of Domus, in 1928, he accurately defined the main characteristics of the "Italian house", as a confortable place that welcomes us and communicate with the nature. He particularly focuses on the relation between interior and exterior:

*«In the Italian house, there is no great difference in architecture between exterior and interior: if somewhere else there is even difference of forms and materials, here outdoor architecture enters inside, not omitting to use stone, mortar or frescoes; in vestibules and galleries, in rooms and stairs, with arches, niches, vaults and columns it controls and orders with ample spaces the environments of our life. From inside, the Italian house goes outdoor with porches and terraces, pergolas and verandas, loggias and balconies, altanas and belvederes, all very comfortable inventions for a peaceful home and so Italian that in every language they are called with Italian names»*

Therefore, the threshold space is an interface between interior and exterior, a space of interaction and connection between the intimacy of the inner domestic space and the external public space of the city. Louis Kahn is one of the architects that since the beginning express more interest for the relation interior/exterior. During his youth journeys he learns the lesson of the Mediterranean space, where the threshold acts as a transition space from inside to outside. During his travels in the Mediterranean, Kahn grasps from the archetypes of classic architecture the order and the hierarchy between spaces in the passage from interior to exterior, from shadow to light. This interest for the threshold is evident in his travel sketches, often featuring views from "inside" the threshold space towards the exterior with views taken from under a porch or an arcade, from a shadowed place towards the light. In his mature years, he will apply this concept of three-dimensional threshold as a tool for climate control, to face the climate conditions of India and Bangladesh, and this will contribute to enhance the threshold space with new functions and characteristics. It is significant to compare the photo of Athens's Parthenon with the porches of the Dhaka hospital, where the space of the threshold is a sequence of spaces ordered by light (Fig.6). The threshold space is a constant presence in Kahn's work, sometimes coinciding with the servant spaces, like in the project for the Salk Institute meeting room, otherwise just as an interstitial void space in between a double-façade serving as a device for climate control, like in the project for the Angola Consulate. The different ways to treat the wall of a building to arrange the threshold "servant" spaces are well exemplified in his sketch describing "the wall theory" (Rowan, 1961) (Fig.7).


*Figure 8. Louis Kahn, Drawings for City/2 (Exhibition: The Street is a Room. 1971. Philadelphia Museum of Art).*

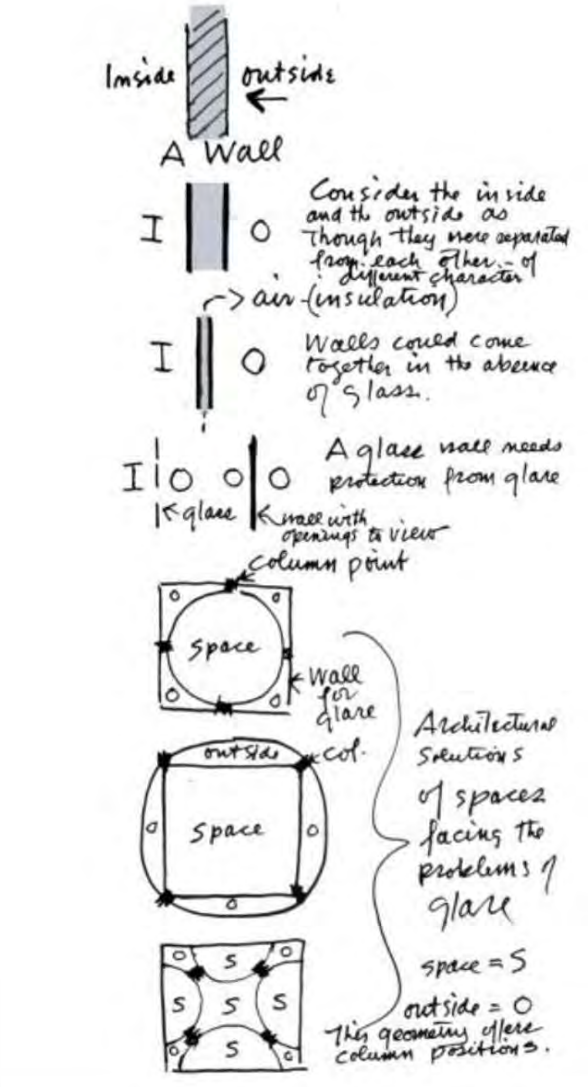



*Figure 7. Louis Kahn, "Theory of Walls" (published in Jan C. Rowan, Wanting to be...The Philadelphia School, in «Progressive Architecture», 1961, n.4, p. 141).*

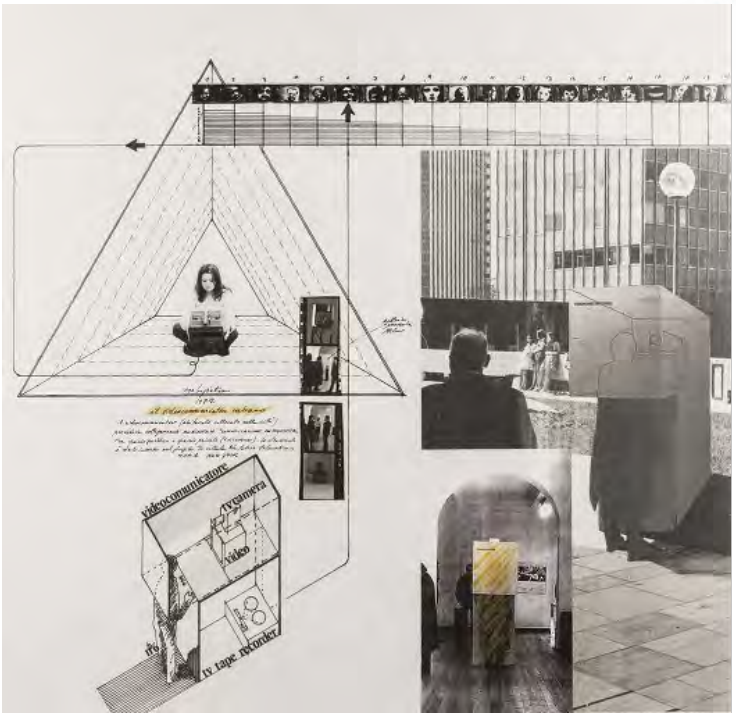



*Figure 9. Ugo La Pietra, The telematic house: the housing unit. Videocommunicator. (exhibition "Italy: the new domestic landscape", MoMA, New York, 1972)*

However, it's the exterior space that mainly grasps Kahn's interest and the reason it clearly explained in his statement regarding his definition of "The street as a living room":

*In a city the street must be supreme. It is the first institution of the city. The street is a room by agreement, a community room, the walls of which belong to the donors, dedicated to the city for common use. Its ceiling is the sky. From the street must have come the meeting house, also a place by agreement. Today, streets are disinterested movements not at all belonging to the houses that front them. So you have no streets. You have roads, but you have no streets. (Fig.8).*

Therefore, Kahn was aware of this dichotomy existing in modern cities generating an opposition between space exclusively reserved to cars and spaces for pedestrians, and this awareness was certainly reinforced by his experience of the Mediterranean and European space. He stresses on the need of re-appropriation of the urban space as a public space, considering indeed the street as a place to live in, where people can dwell and experience social life.

## The subversive experimentations of radical architecture: Ugo La Pietra's struggle for a social design.

This subject of the relation between indoor and outdoor, private and public was one of the topics on which the movement of radical architecture was active between the 60s and 70s. One of the major exponents of this movement, Ugo La Pietra, was a subversive provocative artist and designer attempting to reverse the relationship between inside and outside. La Pietra's concern was the individual's isolation in the modern society. He attempted to break this isolation, eliminating the borders between the interior of the house (domestic space) and the exterior (the street) in order to foster the need of socialization of the human being, the need to "stay together" with other people, which is a shared need across cultures. As a consequence, his projects of the 70s overwhelmed social conventions, proposing architecture able to "communicate". He charges his architectural creations with common

*Figure 10. Steven Holl and Vito Acconci, Storefront for Art & Architecture, New York, 1993*

elements issued from the domestic environment, bringing them from the interior to the exterior of the building. This action alludes to overcoming the private/public barrier, a theme that becomes his persona struggle for a more open and responsive society. In a series of performances and provoking artworks, he also brings outside to the street functions and behaviours belonging to the interior domestic space. For this purpose, with his series of provocative projects "Urban facilities for the community" (La Pietra, 2013) he proposes the ironic reuse of a number of common objects found in the urban landscape, to demonstrate his challenging statement "inhabiting means being at home everywhere".

Inviting people and architects to look at the city "from a different point of view" with his unbalancing system "the commutator", with the project for the Telematic house, presented at the exhibition "Italy: the new domestic landscape" held in 1972 at MoMA in New York, La Pietra was an astounding visionary anticipator of nowadays technological advancement many decades before the global widespread of internet (La Pietra, 2014). In his vision, the evolution of the communication network was a mean to increase people's social connections, predicting the phenomenon of today's social networks (Fig.9).

## Threshold spaces in recent architecture

The definition of "threshold" embodies the one of "change", of transition from a condition to another. According to the common definition of English dictionaries, in architecture a threshold is "the floor of an entrance to a building or room" (Cambridge Dictionary), but also, on a more general sense, "the level at which something starts to happen or have an effect" (Longman Dictionary). In both cases, the threshold marks a change of state. In the physical world, a threshold is usually a three-dimensional space, but can be also, in some cases a two-dimensional surface, a border or a limit that can be trespassed. A significant project, which encompasses both conditions is the Storefront for Art & Architecture, designed by Steven Holl with Vito Acconci in 1993 in New York. Here, the concrete front is made of revolving elements that open the facade allowing the passage and forming tables, seats and shelves. The façade therefore, here acts as a two-dimensional threshold that can be trespassed if open. The inner space, when the façade is open, can be considered as a porch or a loggia, a prosecution of the outdoor space inside, which therefore belongs also to the exterior and becoming as well a three-dimensional threshold space.

In architecture, the threshold can also be concerned with transparency. In MVRDV's Double House Utrecht, built in 1997, two residential units are embedded one into another in parallelepiped volume, like two pieces of a puzzle. The articulated transparency of the facade declares this inner separation to the building's exterior surface, revealing the interior cross-section. In this case, the threshold is a virtual separation that cannot be physically trespassed, but that allows a direct look across the building from the outside to the inside and vice versa, delimiting the border between public and private realm.

Another significant case-study is the Curtain Wall House by Shigeru Ban in Tokyo (1995). In this building the curtain, an element traditionally belonging to the interior domestic landscape, is brought to the exterior, wrapping the terrace and becoming the external envelope. The inside and the outside of the building are merged and confused together, and the terrace becomes a threshold space acting as an exterior or interior according to the case. This reversal of sense and function of elements issued from the interior domestic space is significantly mindful of Ugo La Pietra's 1977 provoking work "Interno-esterno", where he actually had brought the curtain outside to wrap the building, in his effort to erase the borders between the private realm of the domestic space and the social community of the outdoor city. La Pietra's statement "inhabiting means being at home everywhere" and Kahn's idea of "the street as a living room" both lead to bring out, towards the external public space part of the typical functions of the domestic environment. In SANAA's Moriyama House (Tokyo, 2011), the interstitial spaces in between the buildings are dwelling rooms acting as an external extension of the internal spaces. The residents use these spaces for a number of functions, which spread also towards the roof surfaces. The interior of the domestic space is disarticulated in separate blocks, and the voids among them are intertwined with the urban fabric of the surround-

*Figure 11. Ugo La Pietra "Interno-esterno" (1977) and Curtain Wall House by Shigeru Ban in Tokyo (1995)*

ing context, becoming transition elements between the house and the city. A last innovative project is MVRDV's Mixed-Use Development in Abu Dhabi. In a cultural context that is not familiar with outdoor life, here the designers propose a new model of urban compound of mixed residential, offices and commercial spaces integrated in tall buildings connected at the ground floor by a public space, considering pedestrian streets and plazas as a proper "living space". In addition to the outdoor public space, an innovative system of threshold spaces connects the outdoor space with the buildings: a prolifera-

tion of semi-open elements climbing the buildings from the lower level up, acting as an interface between the outdoor environment and the interiors of the buildings, where a variety of functions open to the community takes place. With shadowing systems and outdoor refreshing systems this projects foster a sustainable way of living, in a country that for decades has overused AC in building's interiors and that has neglected outdoor living.

## Conclusions

This essay attempted to present a critic reading of the nowadays condition of most of contemporary towns, particularly the ones which urban development has followed the Anglo-Saxon model of free capitalistic economic growth. In terms of urban planning, this led in the U.S. and in countries of recent development (e.g. some Arab or Far-East countries) to the widespread of a misunderstood "American model" based on a net separation between residential areas, often enclosed inside "gated communities", and working places. In this model the only meeting places are often shopping malls, placed along the road network, in proximity of residential areas (often grown around malls). This is the consequence of the radical functional zoning affecting urban planning, issued from the heritage of modernist culture that has led to the disarticulation of nowadays city's fabric and to urban sprawl phenomena.

In these low-density urban networks, the street and the "piazza" have lost the function of social gathering historically belonging to the urban public space. According to Marc Augé, «the old public square tends to shift towards the computer and Television screens, in the heart and home (...) nowadays the most frequented public spaces, where real social life takes place, are increasingly circulation and consummation spaces, from stations of any kind to malls» (Augé, 2007). This assertion brings back to Zygmunt Bauman's concern about the appearing of a virtual border separating the physical and virtual space, fostering a further detachment of the inner domestic space from the city. The physical threshold, place of interface between these two entities, tends to disappear, replaced by the virtual threshold of the Metaverse, with social networks and the Internet. This process of virtualization of social life is bringing again inexorably towards the alienation of the individual, which spends his time in a dystopian fictional dimension where any contact with the material living space is progressively disregarded.

Marc Augé initially (1992) had defined circulation spaces and malls as "non-places", places without identity and avulsed from social life. However, later on, he recognized how those places were becoming for the new generations the only new gathering places, therefore realizing some changes occurring in the contemporary society. The concept of threshold as a "space", and not as a border separating different entities, has been widely treated by Walter Benjamin in his Passagen-Werk, and reconsidered by Georges Teyssot particularly in his essay Soglie e Pieghe. Sull'intérieur e l'interiorità published in 2010 in Casabella.

Concerning this, it is noteworthy that Benjamin, looking at the covered passages of Paris, considered the transit and circulation places of the bourgeois city of the nineteenth-century, as a unitary whole with commercial and residential spaces integrated in the city's historical fabric. These places belong to the community and are conceived as wide "interiors" inhabited by citizens. The fact to have the different functions intertwined with a dense urban fabric (and not separated with a rigid zoning between residential and

commercial areas in low- density urban agglomerates) determines the social effectiveness of the city. In addition to this, Benjamin clearly notes that a threshold must be carefully distinguished from a boundary: a "schwelle" (threshold in German) is a zone (1999). The word Schwellen includes the meaning of transformation, passage, movement. Consequently, a threshold shouldn't be considered as a two-dimensional dividing border but as a joining space. In addition to this, Till Boettger also notes that thresholds are spatial conditions that create openings in boundaries allowing for movement and transition in space, therefore a passage between inside and outside the boundary (2014).

In conclusion, in architecture a threshold is a connecting space, between the interior and exterior of a building, the domestic and the public dimension. It is an interface between the interior private spaces and the external street that is, moreover, a further threshold connecting the domestic interior space with the city. In architectural terms, this generates a need for a transcalar design able to link the different hierarchic design scales from the highest dimension of the city to the smallest interior scale of the human being. All functions related to the everydays' life of citizens (residential and working places, commercial, leisure etc.) should be integrated in mixed-use compact urban conglomerations, which built density should be compatible with human scale and needs, in a harmonic balance as in the successful experience of the dwelling culture of the Mediterranean tradition.

*Figure 12. MVRDV, Pixel, a Mixed-Use Development in Abu Dhabi (2017).*

# References


1. Amado, A. (2011) Voiture Minimum: Le Corbusier and the Automobile. The MIT Press
2. Augé, M. (1992,1995) Non-places. An introduction to supermodernity. London-New York: Verso
3. Augé, M. (2007) Estia e Hermes. Lo spazio pubblico nella società globale. Domus. 900
4. Bassanelli, M. (2015) Interno | Esterno: lo spazio soglia come nuovo luogo della domesticitá. BDS – Towards the implementation of the science of the city. 15
5. Bauman, Z. (1999) La società dell'incertezza. Bologna: Il Mulino
6. Bauman, Z. (2000) Liquid modernity. Cambridge: Polity Press
7. Benjamin, W. (1962) Angelus Novum, Turin: Einaudi
8. Benjamin, W. Tiedemann, R. (1999) The Arcades Project, Cambridge, Mass: Belknap Press
9. Boettger, T. (2014) Threshold Spaces: transitions in architecture. Analysis and design tools. Basel: Birkhäuser
10. Kaye, H. L. (1993) Why Freud Hated America, The Wilson Quarterly. Vol. 17, No. 2 pp.118- 125. Retrieved from https://www.jstor.org/stable/40258702
11. La Pietra, U. (2013) Attrezzature urbane per la collettività. Corraini: Mantova,
12. La Pietra, U. (2014) Interno/Esterno. Abitare è essere ovunque a casa propria 1977-2013. Corraini: Mantova
13. Le Corbusier (1925) Urbanisme. Paris: ed. Crés, pp. II-III
14. Le Corbusier (1964), La Ville Radieuse. Editions Vincent Fréal et Cie
15. Ponti, G. (1928) La casa all'Italiana. DOMUS. 1
16. Ponti, G. (1954) Progetto di una finestra arredata. Architettura d'interni ed arredi; Concorsi, progetti e proposte. Retrieved from https://www.gioponti.org/it/archivio/scheda-dell-opera/dd_161_6227/progetto-di-finestra-arredata
17. Rowan, J. C. (1961) Wanting to be...The Philadelphia School. Progressive Architecture. 4
18. Secchi, R. Bochicchio, (2020) L'architettura della strada. Forme Immagini Valori. DiAP Print, Quodlibet: Macerata
19. Teyssot G. (2010). Soglie e pieghe. Sull'intérieur e l'interiorità. Casabella, 681
20. Watson, J. M. (2017). The Antinomies of Usonia: Neil Levine's The Urbanism of Frank Lloyd Wright. The Avery Review, 25. Retrieved from http://www.averyreview.com/issues/25/theantinomies-of-usonia.
21. Wittgenstein, L. (1953, 2011) Ricerche filosofiche. Torino: Einaudi
22. Wright, F. L. (1932) The Disappearing City. William Farquhar Payson
23. Wright, F. L. (1958) The Living City. Horizon

# TECHNOLOGY APPLICATIONS

# The 'New Morphologies': When Technology Becomes Gender-Neutral

*Matteo O. Ingaramo, Martina Labarta*
*matteo.ingaramo@polimi.it, martinamaria.labarta@polimi.it*

[1]*Department of Design, Politecnico di Milano, Italy*

***Keywords:***
*Sustainability*
*Gender-Neutral*
*Morphological Analysis*
*E-Mobility*

## Abstract

The ongoing global environmental crisis compels us, as a society and a community of professionals, to actively seek new solutions to address it. Driven by the urge to address sustainability issues holistically, this paper delves into an emerging morphological transformation of products for sustainable mobility. Influenced by the integration of electric-powered systems, these products have undergone a fundamental aesthetic shift towards a gender-neutral design trend, advocating for inclusivity and diversity. To illustrate this paradigm change, we present a morphological analysis that showcases how a product category has evolved to embody gender-neutral characteristics, thereby challenging pre-established traditional norms and advancing sustainability goals. Our research offers valuable insights into the potential of electric gender-neutral technologies to contribute to interpreting a new generation of products and positively impact sustainability.

## Introduction

The contemporary environmental landscape urges us to reconsider widespread consumption patterns to mitigate the escalating global crisis. In this context, the adoption of electric technologies emerges as a solution to free us from finite resource dependency and alleviate the effects of air pollution, especially in urban areas (Anfinsen et al., 2019; Gautam, 2023; Murugan & Marisamynathan, 2022; Shanmugavel et al., 2022). Electric mobility—and micro-mobility—comes as a solid, sustainable alternative to traditional transportation methods. Integrating electric technologies into traditional mobility has led to a new generation of products, rewriting the script on user experience and product architecture. Furthermore, this category of products has the potential to address environmental issues while contributing to the ever-evolving social fabric (Nigam et al., 2020).

Since the beginning of modern transportation, vehicles have carried specific meanings that mirror and reinforce the politics and ideologies of their times (Cox, 2019), thereby shaping social relationships and cultural dynamics. The agency initially present in traditional mobility products has been passed onto their zero-emission counterparts. We argue that sustainable mobility products provide a platform for designers and stakeholders to reimagine deeply ingrained artefacts and their imbued meanings, aligning them more closely with contemporary social values while considering economic

and environmental sustainability goals. For instance, the evolution of the iconic modern human-powered bicycle illustrates the intersection between gender norms and technological innovation. Starting off with a clear gender division based on frame geometry, the bicycle underwent an evolving journey towards gender neutrality. Initially, diamond-shaped bicycles were exclusively for men, whereas the later introduced comfort waved-shaped frames were tailored for women (Hadland & Lessing, 2016). Over time, a unisex cross-frame option emerged as a competitive alternative, eliminating the need to manufacture two separate products and reducing costs and material usage. However, the crossed beam supporting the unisex model catastrophically failed to facilitate its use by female users (ibid.). A successful attempt at gender-neutral design came with the Itera bike, designed for Volvo in the late 20th century (Figure 1). It featured an overall "female geometry" and embraced a technology-driven and innovative design in terms of manufacturing processes and material selection (ibid.). This successful design approach can be easily recognised in contemporary electric bikes. Sustainability and technology markers merge into new aesthetic features to target users indistinctively of sex identity, no longer making gender stereotypical distinctions but uniquely ergonomic-based. Various urban electric bicycle models and brands share new morphologies characterised by smooth surfaces, neutral colour palettes, futuristic formal language, and full integration of technological components such as the battery.


*Figure 1 All-plastic Itera bike prototyped in 1980 for Volvo*

From this perspective, our aim is to investigate whether the morphologicFrom this perspective, our aim is to investigate whether the morphological strategies observed in electric bicycle design—striving towards gender neutrality, i.e., the absence of any specific gender cues (Esfahani, 2020)—can also be extended across other categories within the e-mobility sector. We argue that this gender-neutral design intent can pave the way for narrowing the profound and prevailing gender mobility gap, promoting equality and sustainable consumption behaviours across the whole gender spectrum (Stilma, 2010; Vinz, 2009). Moreover, the existing gender gap, the ability to convey sustainable values, and specific user preferences regarding vehicle attributes intrinsically relate to a positive affective attitude (Sovacool et al., 2018).

This paper explores the interconnection of aesthetics, sustainability, and gender in the context of sustainable mobility. We have conducted a comprehensive morphological analysis to identify a new design trend across products that now depend on electric technology. Our focus was on sustainable mobility products that still coexist with their conventional counterparts and present themselves as an ecological advantage (i.e., e-scooters and e-cars). Our outcome will provide insights that can inform and guide design practices and theory towards a more eco-socially sustainable future.

## Literature Review

Our literature review aimed to uncover connections between sustainability issues, a morphological evolution associated with sustainable mobility products, and gender concerns. While conducting our research, we noticed a significant gap in understanding the impact of specific aesthetics and morphologies on either encouraging or discouraging sustainable behaviours. Nevertheless, a widespread consensus emerged regarding a gender mobility gap and gender differences in sustainable patterns and preferences. We searched for publications juxtaposing keywords such as "electric technologies", "electric vehicles", "gender", "unisex", and "sustainability". Our final data set consisted of 68 documents.

**Gender mobility gap**

The literature on gender dynamics in sustainable mobility shows how social constructs, cultural norms, and individual preferences influence each other. Kawgan-Kagan's (2015) study of the "socially constructed gender meaning of sustainable gender mobility" (p. 1) underlined the relevance of traditional societal rules in shaping gendered behaviours and perceptions related to mobility. She advocated for a gender-equitable approach to address the gender gap in the sustainable mobility discourse, highlighting the oversight of demographic factors, particularly gender, in previous research (2020).

Studies consistently emphasised the influence of gender on the adoption—or rejection—of sustainable mobility behaviours (Anfinsen et al., 2019; Kawgan-Kagan, 2015, 2020; Kawgan-Kagan & Popp, 2018; Rose, 2012; Shanmugavel et al., 2022; Sovacool et al., 2018, 2019; Vivi & Hermans, 2022). Vivi & Hermans (2022) observed that "incompatibilities of values between environmentalism and hegemonic scripts of masculinity threaten masculine endorsements of sustainable consumption" (p. 623). On the other hand, research indicates that women generally express greater concern for sustainability issues and are more receptive to adopting electric mobility practices (Anfinsen et al., 2019; Shanmugavel et al., 2022).

Kawgan-Kagan (2020) and Rose (2012) elaborated further on this gender disparity, emphasising men's inclination towards technology and innovation over sustainability issues, while women historically tend to prioritise practicality over functionality aspects (Cox, 2019). Fan's (2017) analysis attributed this gender imbalance in sustainability behaviours to women's inclination towards "travel-minimising attitudes and lower preferences towards power and performance in their vehicles than men" (p. 288, as cited in Sovacool et al., 2019), with some exceptions (Sovacool et al., 2019).

Hence, we can state that the primary factors influencing the acceptance of sustainable mobility are "environmental awareness, technology affinity, and innovation as a lifestyle" (Kawgan-Kagan, 2020, p. 3), all dependent on gender identity. Nevertheless, while it is evident that gender significantly influences attitudes and behaviours regarding sustainable mobility, there is still much to uncover about the mechanisms triggering these differences. More profound research into these underlying factors could guide the

development of gender-inclusive design strategies to promote sustainable transportation practices.

**Product attributes and self-expression**

Narayan et al. (2022) outlined that beyond the practical benefits of electric mobility, such as reducing environmental impact, consumers also view it as a way to express their personal values and aesthetic preferences. In other words, they suggested that individuals who purchase technologically advanced eco-friendly products often attribute symbolic meanings to them that align with their self-identity and social status. In addition, Hamzah & Tanwir (2021, p. 3) identified "altruistic obligation and self-interest" as the predominant indicators for sustainable purchase intention. On the same viewpoint, Shanmugavel et al. (2022) proposed the existence of a connection between value expression and the intent to purchase "green" products, especially among the new generations. "Value expression" means conveying personal values, beliefs, or identity through consumer choices (ibid.). Hence, the decision to buy environmentally conscious products is not solely driven by practical considerations but is also influenced by the desire to align consumption habits with personal values and ideals.

Moreover, the value-product alignment is also tied to product appearance. Tristiyono et al. (2021) explained how products' formal language could channel the user's self-identity, supporting specific styling choices. However, when it comes to urban mobility, these choices are likely gender biased. Sovacool et al. (2018) observed gender differences in vehicle feature preferences, and Li et al. (2013) found that women usually pay more attention to product shape. In contrast, men primarily focus on functionality and performance (ibid.).

Studies suggest designers rethink sustainable mobility products' appearance, bearing users' needs and demands in mind to encourage their uptake of sustainable consumption habits and advance the transition towards a more sustainable mobility system (Liu & Ma, 2021). Wu et al. (2013) stated that visual perception can potentially increase sustainable mobility adoption if aligned with consumer's aesthetic preferences.

Therefore, to extend sustainable behaviours across a broader audience, designers need to approach products' language and morphology in a way that brings together ecological concerns and technological advancement, overcoming the existing gender dichotomy in electric mobility. However, the literature does not discuss mobility products' specific aesthetic attributes—shapes, forms, and formal language—dependent on electric technology beyond quantitative elements such as performance and efficiency.

## Methodology

We chose a morphological analysis as a methodological framework to identify and explore the emergent and evolving aesthetic trend across a specific category of products—e-mobility vehicles—and extract and interpret their distinctive traits (Diaz Tena et al., 2021).

According to Zwicky, a morphological approach serves to unravel and examine the underlying structures and relationships within tangible and intangible entities:

> […] the morphological approach was conceived which concerns itself with the development and the practical application of basic methods which will allow us to discover and analyse the structural or morphological interrelations among objects, phenomena and concepts, and to explore the results gained for the construction of a sound world. (Zwicky, 1967, p. 3)

Moreover, among the powerful methods available, he highlighted the generalisation method as helpful to getting a comprehensive overview of a particular complexity by looking at the bigger picture (Zwicky, 1967). Hence, we conducted a morphological analysis following a step-by-step approach, starting from a general perspective and gradually moving towards more specific aspects.

**Visual collection**

Having an overview of the current state of the e-mobility market regarding aesthetics and portfolio was essential for our research. Our focus was on electric-powered sustainable products for urban mobility that coexist with their conventional combustion-powered counterparts. Therefore, our objects of study were the electric car (e-car) and the electric scooter (e-scooter). By limiting our research to urban mobility, we gained an augmented perspective on the influence on social and cultural shaping, given its utilitarian purposes and democratic character. We collected fifteen different models from diverse brands of e-cars and the equivalent quantity of e-scooters.

**Visual categorisation**

After compiling our data sample, we developed a set of categorisation criteria. Undoubtedly, product appearance and components significantly impact user perceptions (Hsiao & Ko, 2013). In the same way one mentions the frame, wheels, handlebar, and saddle when considering the most distinctive design elements that confer such an iconic object as the bicycle its identity (Hsiao & Ko, 2013; Liu & Ma, 2021) when analysing e-cars and e-scooters we should consider their bodywork, tyres, interiors and ergonomic elements. Nevertheless, because we aimed to identify traces of practices for assigning or removing gender connotations from e-mobility products, we focused our analysis on the most distinctive elements, i.e., bodywork and lights.

**Visual analysis**

The semiotic approach to product analysis aided us in defining and interpreting our cases of study systematically. A. J. Greimas introduced this methodology in 1987, and Floch elaborated on it within the realm of manufactured objects in his work "Visual Identities" (2000). He proposed tackling the following components of the object to gain a comprehensive understanding of its intrinsic values and meanings:

- Configurative component, i.e., breaking down the object into its primary components and then putting them back together as a single entity.
- Taxic component, i.e., articulating why the object stands out from other manufactured objects by its distinctive features.
- Functional component, i.e., identifying the roles and functions that different elements play within a system.

To identify the gender-related features across our data collection, we explored the objects'—e-cars and e-scooters—components (i.e. configurative, taxic, and functional) with a comprehensive and general approach.

## Analysis

Our morphological analysis began by analysing the distinctive aesthetic elements of products designed for sustainable mobility, whose propulsion principle is based on electric-dependent technology, discussing taxic and configurative perspectives to uncover embedded meanings.

The architecture of e-mobility products has its own distinctive traits compared to traditional internal combustion engine products. The adoption of batteries instead of conventional fuel-powered systems leaves space for in-

creased flexibility in component distribution and, consequently, shape definition. For instance, this shift is represented by the absence of traditional front outlets for engine cooling and the transition from rigid mechanical circuits to flexible electrical circuits. Technical solutions that were translated into aesthetical elements are now reinterpreted in sustainable mobility products (SMPs). In the words of Pasat (2002), SMPs differ from combustion mobility products (CMPs) "similar to the fact that the system architecture of quartz-based electronic watches is very different from that of spring-based mechanical watches" (p. 225). Diving into the plastic analysis of SMPs, i.e., focusing on abstract qualities like texture, shape, or composition ( emaityte, 2017), a consistent formal language embodying futuristic aesthetic features emerged. Our analysis focused on the elements affected by the power system transition.

First, the design philosophy of e-cars centres on creating a dynamic visual appeal and enhancing aerodynamic efficiency. This shift towards sleekness and efficiency represents an updated approach, where such characteristics are no longer exclusively associated with sporty, high-performance CMPs typically favoured by male drivers. Instead, sleek design elements are recognisable across nearly the whole product range. These products display prominent and pronounced spoilers, seamless contours with integrated door handles, and continuous bodywork surface from front to rear, regardless of car category (e.g. SUV, city car, sedan, and hatchback), as illustrated in Figure 2. All these elements blend with soft and smooth shapes, while a wider chassis provides increased stability (Tesla, 2024).


*Figure 2 Visual comparison between fully and non-full electric models, illustrating the aerodynamic-driven design prevalent in e-cars.*

Looking closer at specific elements of e-cars, a consistent blend of aesthetic feminine and masculine markers becomes evident. For instance, as anticipated, the reduced presence of frontal outlets for engine ventilation has created new design opportunities to experiment. These outlets often aid in brand representation and are distinctive for each manufacturer. However, large and intricate grill designs are typically associated with masculine markers. By removing them, apart from improving the aerodynamic efficiency, the overall appearance becomes sleeker and easily adaptable to a broader range of consumer preferences (Figure 3).


*Figure 3 Comparison of front grill design in four different brands depending on the propulsion system.*

Furthermore, the headlights, often responsible for conferring a humanised appearance, adopt more stylised and narrow forms. This design choice aligns with a perception of speed, resembling an intimidating and daring gaze ready to accelerate. This design approach repeats across the complexion of many e-car models, some illustrated in Figure 4, contributing to combining bold and gentle cues within the same product.

*Figure 4 Headlight design displays both aggressive and stylised aesthetic features.*

In addition, unified linear rear lights add up to a futuristic and technologically advanced dimension, as displayed in Figure 5. They feature thin, interconnected rear lights that align closely with popular cyberpunk imagery.

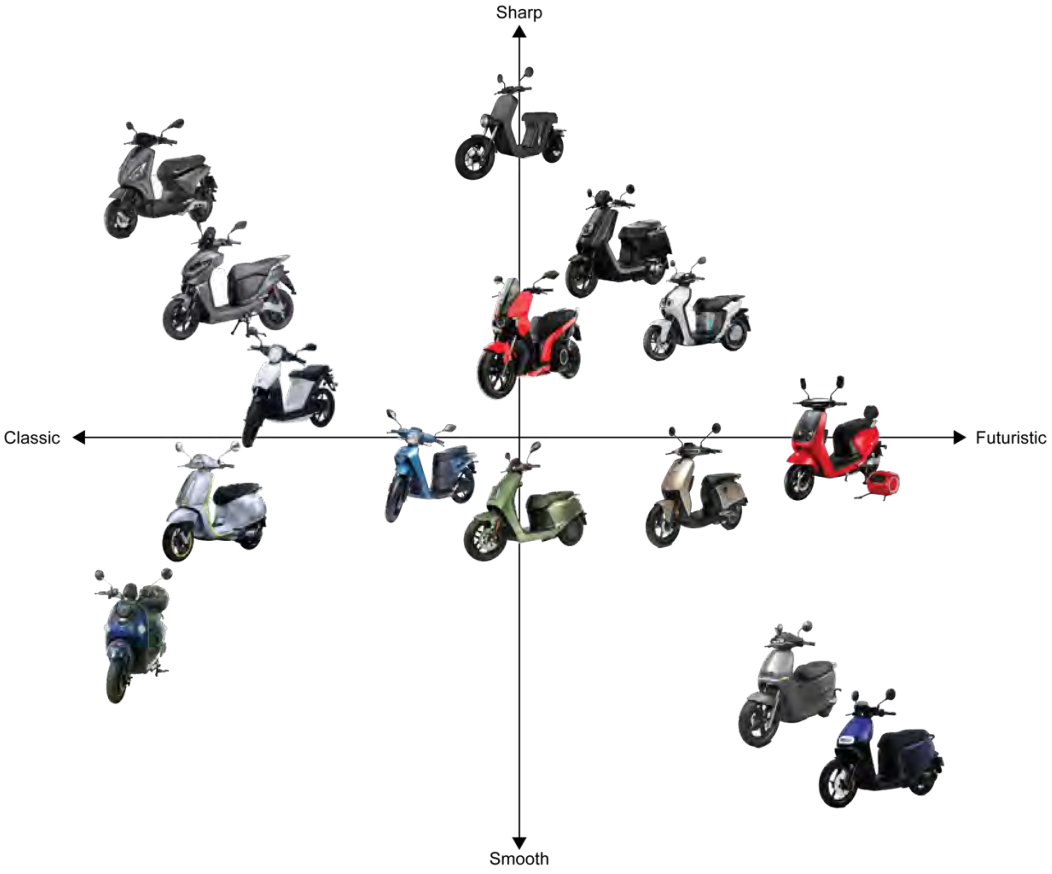
*Figure 5 Rear light design in e-cars.*


Regarding colour portfolio, neutral colour palettes dominate, offering limited alternatives in terms of hue. White and black tones with matt finishes and grey and silvery shades with metallic finishes evoke a sense of purity and cleanness or luxury and cutting-edge technology, respectively. In addition, vibrant red and blue hues are also present, aligning with the "energised" character of the vehicle and meeting users' preferences through a familiar approach.

Moving on to e-motor scooters, a shift towards the same futuristic design language emerges. However, there is a more significant contrast between each brand depending on their focus on electric technology. For instance, brands born as CMP producers are constrained by the need to maintain their own design identity for recognisability, while those emerging as e-scooter precursors have the freedom to create a marked divergence from traditional morphologies.

Unlike e-cars, where aerodynamics drove the morphological evolution, e-scooters are most valuable for their comfort, practicality, and ability to increase accessibility for urban commuters, emphasising compactness (Mesimäki & Lehtonen, 2023). Their body morphology leans towards a contemporary, futuristic design that aims to seamlessly blend with the evolving urban landscape or inspire innovative trends. However, our visual analysis highlighted an aesthetical spectrum ranging from chubby forms and smooth sweeping lines to sharp edges and minimal primary shapes (Figure 6).

*Figure 6 The map categorises fifteen e-scooter models from different brands according to morphological traits. Along the vertical axis, products are distributed from sharp to smooth shapes. Along the horizontal axis, products are distributed from classic and archetypical aesthetics to futuristic or atypical formal language.*




We identified an interesting resemblance to androids, where technology acquires human appearance without losing the sense of advanced technology. In this regard, the design of the headlight and headset play a crucial role, stepping away from the conventional front bulb to more atypical forms and contributing to the overall forward-looking design (Figure 7). The e-scooter transmits a sense of high performance that traditional mini-scooters, initially engineered for women (Wong & Wu, 2010), generally lacked.

*igure 7 The e-scooters showcase a recurring innovative approach to frontal light design and headset, aligning with cyberpunk aesthetics.*

About the colour palette, the scenario is similar to e-cars. Neutral shades like white, black, and grey are frequent, accompanied by metallic finishes accentuating a sophisticated and sleek design to appeal to a tech-savvy audience. Several brands also display a colourful and vibrant palette (e.g., lime electric green, bright yellow, or orange) that opens the door for users' self-expression. Unlike cars, scooters are at the same level as riders, and thus, they literally contribute to their public image by aligning with their personal style and amplifying their self-identity (Tristiyono et al., 2021).

Despite variations in size and functionality, both vehicle categories share a common goal: to contribute to urban mobility with innovative designs and sustainable solutions, blurring previous persistent dichotomies regarding aesthetic perception (i.e., safety versus performance and technological innovation versus sustainability) and creating a unified utopian vision.

## Discussion

The morphological analysis of e-mobility devices offered insights into their integration of sustainability principles and technological advancements. We gained a deeper understanding of how SMP design reflects societal trends and addresses environmental and social challenges. Two significant findings resulted from our analysis: a widespread attempt to merge opposite concepts to address a wider range of consumers and the rise of a design trend striving for gender neutrality.

**Unifying gender preferences**

Recent research highlighted a gender mobility gap evident in sustainable mobility behaviours, with men and women traditionally expressing divergent preferences towards vehicle attributes (Kawgan-Kagan, 2015, 2020; Li et al., 2013). Moreover, studies confirmed that safety and reliability were priorities among women, whereas performance and design were the main concerns for men (Vrkljan & Anaby, 2011). However, the emergence and rising popularity of SMPs presented an opportunity to bridge this gap by outgrowing conventional gender norms.

Products designed for sustainable mobility have the potential to blur the rigid division between safety and reliability on one hand and design and performance on the other, unifying male and female cues (Vrkljan & Anaby, 2011). Through innovative morphological approaches, SMPs integrate these seemingly opposing values into a cohesive design language embodying sustainability and technological advancement. Combining these diverse preferences can inspire and reach a more heterogeneous audience, expanding the coverage of a positive affective attitude (Sovacool et al., 2018). Moreover, by embracing such hybrid formal languages that blend innovation with familiarity, sustainability with performance, and comfort with technology, SMPs pave the way for a more inclusive and sustainable future of mobility, encompassing environmental consciousness, technological advancement and innovation as a lifestyle (Kawgan-Kagan, 2020).

**Gender-neutral meso-trend**

A trend is the repeated occurrence of an event over time, characterised by increasing popularity and shared attributes among a group of entities (Postma & Papp, 2020). Studying two micro-groups within electric mobility in-depth, we identified a gender-neutral meso-trend. A meso-trend refers to changes observed across various sectors, adapting to specific circumstances, and influenced by societal and cultural shifts, identifiable by analysing patterns of events and phenomena at a micro level (Postma & Papp, 2020). Therefore, the gender-neutral trend emerges as a response to cultural and social changes demanding the inclusion of a broader range of consumers in

several fields (Esfahani, 2020; Vieira, 2019), including sustainable mobility.

E-bikes, e-cars, and e-scooters designs, they all display an innovative approach to aesthetics, merging typically feminine attributes with more aggressive features, creating a sense of gender neutrality, supported by neutral and bland colour palettes (Funk & Oly Ndubisi, 2006; Prochner, 2018; Wu et al., 2013). SMPs redefine traditional notions of gendered transportation through sleek contours, high-tech features, and neutral colour options. Futuristic design elements blend seamlessly with evolving urban landscapes, appealing to a diverse range of riders regardless of gender. Moreover, gender-neutral design embodies both sustainable and technological innovation values through a mixed morphology and aesthetic character, contributing to the macro-trend of sustainability.

## Limitations

Despite the valuable insights gained from this research, we acknowledge some limitations. Firstly, the study could benefit from a more extensive collection of e-mobility devices for analysis. While the selected sample provided valuable insights, a higher quantity of models could offer a more comprehensive understanding of design trends and their implications. In addition, the absence of an analysis of the historical evolution of these vehicles limits our ability to contextualise current design trends within a broader historical framework.

## Conclusion and future research

By conducting a comprehensive morphological analysis of products dependent on electric technologies, we uncovered implications beyond the ecological advantage of design approaches to products for sustainable mobility. We observed that for a design to be sustainable and broadly embraced, designers must leverage circular design strategies with user inclination towards sustainable behaviours. Addressing how consumers perceive sustainable products alongside ecological guidelines is essential. In this regard, we identified a change towards a gender-neutral design trend to enhance product acceptance and promote sustainable mobility patterns. We found that gender-neutral design blends technological innovation and sustainability attitudes, mediating between previously clashing concepts and reconciling high-performance principles and the sustainability cause.

Our standpoint is that future collaborative research initiatives could facilitate the co-creation of gender-neutral technology that equally fulfils the needs and preferences of diverse user groups. By involving users throughout the design process, designers can ensure that sustainable technology brings value not just in emissions reduction but also in the social sphere. Nevertheless, further research on the economic and ecological consequences of removing gender divergence in product portfolios should be conducted to ensure compliance with sustainability goals. Moreover, a more thorough study aimed at identifying a gender-neutral trend across various product categories would provide a comprehensive understanding of how these products are interpreted and translated according to their purposes, functions, and context, opening new design streams for spreading sustainable consumption patterns.

# References


1. Anfinsen, M., Lagesen, V. A., & Ryghaug, M. (2019). Green and gendered? Cultural perspectives on the road towards electric vehicles in Norway. Transportation Research Part D: Transport and Environment, 71, 37–46. https://doi.org/10.1016/J.TRD.2018.12.003
2. Cox, P. (2019). Bicycle design history and systems of mobility. Mobilising Design, 48–61. https://doi.org/10.4324/9781315560113-5
3. Diaz Tena, A., Schoeggl, J. P., Reyes, T., & Baumgartner, R. J. (2021). Exploring sustainable product development processes for a circular economy through morphological analysis. Proceedings of the Design Society, 1, 1491–1499. https://doi.org/10.1017/PDS.2021.410
4. Esfahani, B. K. (2020). Bridging gender and human-centred design: A design verification study. Procedia CIRP, 91, 824–831. Elsevier. https://doi.org/10.1016/j.procir.2020.02.241
5. Floch, J.-M. (2000). Visual identities (1st ed.). London: Continuum.
6. Funk, D., & Oly Ndubisi, N. (2006). Colour and product choice: A study of gender roles. Management Research News, 29(1/2), 41–52. https://doi.org/10.1108/01409170610645439
7. Gautam, V. (2023). Investigating relationship between environmental knowledge and attitudes towards electric vehicles: An emerging economy context. Environment and Social Psychology, 7(2), 62–83. https://doi.org/10.18063/ESP.V7.I2.1527
8. Hadland, T., & Lessing, H.-E. (2016). Bicycle design: An illustrated history (1st ed.). Cambridge, Massachusetts: The MIT Press. Retrieved from https://mitpressbookstore.mit.edu/book/9780262529709
9. Hamzah, M. I., & Tanwir, N. S. (2021). Do pro-environmental factors lead to purchase intention of hybrid vehicles? The moderating effects of environmental knowledge. Journal of Cleaner Production, 279(123643), 1–14. https://doi.org/10.1016/J.JCLEPRO.2020.123643
10. Hsiao, S. W., & Ko, Y. C. (2013). A study on bicycle appearance preference by using FCE and FAHP. International Journal of Industrial Ergonomics, 43(4), 264–273. https://doi.org/10.1016/J.ERGON.2013.04.003
11. Kawgan-Kagan, I. (2015). Early adopters of carsharing with and without BEVs with respect to gender preferences. European Transport Research Review, 7(4), 1–11. https://doi.org/10.1007/S12544-015-0183-3/FIGURES/3
12. Kawgan-Kagan, I. (2020). Are women greener than men? A preference analysis of women and men from major German cities over sustainable urban mobility. Transportation Research Interdisciplinary Perspectives, 8(100236), 1–14. https://doi.org/10.1016/J.TRIP.2020.100236
13. Kawgan-Kagan, I., & Popp, M. (2018). Sustainability and gender: A mixed-method analysis of urban women's mode choice with particular consideration of e-carsharing. Transportation Research Procedia, 31, 146–159. https://doi.org/10.1016/J.TRPRO.2018.09.052
14. Li, K., Li, H., & Liu, J. H. (2013). The analysis of categories of users in car design. Advanced Materials Research, 706–708, 2124–2127. https://doi.org/10.4028/WWW.SCIENTIFIC.NET/AMR.706-708.2124
15. Liu, M., & Ma, X. (2021). Appearance design method of "new mandatory standard" for electric bicycle based on online comments. In C. S. Shin, G. Di Bucchianico, S. Fukuda, Y. G. Ghim, G. Montagna, & C. Carvalho (Eds.), Advances in Industrial Design. AHFE 2021. Lecture Notes in Networks and Systems (Vol. 260, pp. 1042–1048). Cham: Springer. https://doi.org/https://doi.org/10.1007/978-3-030-80829-7_127
16. Mesimäki, J., & Lehtonen, E. (2023). Light electric vehicles: The views of users and

non-users. European Transport Research Review, 15(1). https://doi.org/10.1186/S12544-023-00611-3
17. Murugan, M., & Marisamynathan, S. (2022). Estimation of two-wheeler users' mode shift behaviour and policy analysis to encourage electric-bike adoption in India. Case Studies on Transport Policy, 10(3), 1673–1685. https://doi.org/10.1016/J.CSTP.2022.06.006
18. Narayan, J. J., Rai, K., Naidu, S., & Greig, T. (2022). A factor structure for adoption of hybrid vehicles: Differing impact on males, females and different age groups. Research in Transportation Business & Management, 45 (Part C)(100897), 1–14. https://doi.org/10.1016/J.RTBM.2022.100897
19. Oudshoorn, N., Saetnan, A. R., & Lie, M. (2002). On gender and things. Reflections on an exhibition on gendered artefacts. Women's Studies International Forum, 24(4), 471–483. https://doi.org/10.1016/S0277-5395(02)00284-4
20. Pasat, A. (2002). The state of the art of electric and hybrid vehicles. Proceedings of the IEEE, 90(2), 247–275. https://doi.org/10.1109/5.989873
21. Postma, A., & Papp, B. (2020). Of trends and trend pyramids. Journal of Tourism Futures, 7(2), 162–167. https://doi.org/10.1108/JTF-11-2019-0129/FULL/PDF
22. Prochner, I. (2018). Feminist contributions to industrial design and design for sustainability theories and practices (PhD diss., Universitè de Montréal). Universitè de Montréal. Retrieved from https://papyrus.bib.umontreal.ca/xmlui/handle/1866/21680
23. Rose, G. (2012). E-bikes and urban transportation: Emerging issues and unresolved questions. Transportation, 39(1), 81–96. https://doi.org/10.1007/S11116-011-9328-Y/FIGURES/6
24. Shanmugavel, N., Alagappan, C., & Balakrishnan, J. (2022). Acceptance of electric vehicles: A dual-factor approach using social comparison theory and technology acceptance model. Research in Transportation Business & Management, 45 (Part C) (100842), 1–9. https://doi.org/10.1016/J.RTBM.2022.100842
25. Sovacool, B. K., Kester, J., Noel, L., & de Rubens, G. Z. (2018). The demographics of decarbonising transport: The influence of gender, education, occupation, age, and household size on electric mobility preferences in the Nordic region. Global Environmental Change, 52, 86–100. https://doi.org/10.1016/J.GLOENVCHA.2018.06.008
26. Sovacool, B. K., Kester, J., Noel, L., & Zarazua de Rubens, G. (2019). Are electric vehicles masculinised? Gender, identity, and environmental values in Nordic transport practices and vehicle-to-grid (V2G) preferences. Transportation Research Part D: Transport and Environment, 72, 187–202. https://doi.org/10.1016/J.TRD.2019.04.013
27. Stilma, M. (2010). Product design and gender as example of a research-based styling master course. Proceedings of the 12th International Conference on Engineering and Product Design Education - When Design Education and Design Research Meet (E&PDE 2010), 62, 522–527. Cambridge: Cambridge University Press.
28. Tesla. (2024). Model S. Retrieved January 29, 2024, from https://www.tesla.com/en_eu/models
29. Tristiyono, B., Iskandriawan, B., Estiyono, A., & Kurniawan, A. (2021). Development of electric bicycle design for middle school students with feminine concepts. Proceedings of the 2nd International Conference on Business and Management of Technology (ICONBMT 2020), 175, 109–114. Atlantis Press. https://doi.org/10.2991/AEBMR.K.210510.020
30. Vieira, S. I. A. (2019). The influence of unisex labels on consumers' purchase intention (Master's thesis, Escola Brasileira de Administração Pública e de Empresas). Escola Brasileira de Administração Pública e de Empresas. Retrieved from https://bibliotecadigital.fgv.br/dspace;/handle/10438/27869
31. Vinz, D. (2009). Gender and sustainable consumption: A German environmental perspective. European Journal of Women's Studies, 16(2), 159–179. https://doi.org/10.1177/1350506808101764
32. Vivi, M., & Hermans, A. M. (2022). "Zero emission, Zero compromises": An intersectional, qualitative exploration of masculinities in Tesla's consumer stories. Men and Masculinities, 25(4), 622–644. https://doi.org/10.1177/1097184X221114159
33. Vrkljan, B. H., & Anaby, D. (2011). What vehicle features are considered important when buying an automobile? An examination of driver preferences by age and gender. Journal of Safety Research, 42(1), 61–65. https://doi.org/10.1016/J.JSR.2010.11.006
34. Wong, J., & Wu, Y. (2010). The gendered motorbikes. How does history make motorcycle/scooter masculine/feminine? Proceedings of the Kansei Engineering and Emotion Research International Conference 2012, 1810–1822. Paris, France: Arts et Métiers Paris Tech.
35. Wu, X. L., Wang, Y. X., & Yao, Y. Y. (2013). Industrial design and engineering analysis of multi-function bicycle on children factors. Applied Mechanics and Materials, 364, 817–821. https://doi.org/10.4028/WWW.SCIENTIFIC.NET/AMM.364.817
36. emaityte, G. (2017). Plastic semiotics: From visuality to all the senses. Sign Systems Studies, 45(1–2), 152–161. https://doi.org/10.12697/SSS.2017.45.1-2.10
37. Zwicky, F. (1967). The morphological approach to discovery, invention, research, and construction. In F. Zwicky & A. G. Wilson (Eds.), New Methods of Thought and Procedure. Berlin: Springer. https://doi.org/10.1007/978-3-642-87617-2_14

# UX Design in The Context of Navigation Aid Equipment Maintenance. A new approach to Monitoring and Control System Design

*Elie Barakat[1], Venanzio Arquilla[2], Maximilian James Arpaio[1]*
*elie.barakat@external.thalesgroup.com, venanzio.arquilla@polimi.it, maximilian.arpaio@thalesgroup.com*

*[1]Thales Italia Spa, Italy*
*[2]Design Department, Politecnico di Milano, Italy*

***Keywords:***
*UX Design*
*Monitoring and Control System*
*HMI*
*Interaction Design*

## Abstract

This paper addresses the role of landing structures in ensuring safe aircraft operations through systems such as the Monitoring and Control System (MCS). The research project focuses on existing user interfaces, conducting a comprehensive system assessment and interviews with diverse user profiles. The findings catalyzed a redesign aimed at alleviating mental fatigue of airport operators.

The study unfolds within the operational framework of Thales Group, where User Experience Designers collaborated with internal staff for the first time. This collaboration marked a paradigm shift from a tech-driven approach to a Human-User Centered one.

The collaboration between Thales Group's internal expertise and external User Experience Designers underscores the potential for innovation when technology development is rooted in the needs and experiences of end-users. This paper opens avenues for further exploration into the integration of Artificial Intelligence, paving the way for more efficient landing support systems in the aviation industry.

## Introduction

The design activity that served as the basis of this research proposal was done in coordination with the aviation department of Thales Group located in the city of Gorgonzola, Italy. The task was to investigate a product offering that is used by airport operators and technicians to ensure safe flying conditions and air traffic control management and assess how it can be improved in terms of user experience. It is important to mention that this product was initially brought to the market by teams of software developers and engineers without the input of any kind of designers. This means that everything from the information architecture to the user interface has been drafted without taking into consideration user needs and usability principles, but only focusing on the technical functionalities provided by the tools. The purpose of this research and design activity is to highlight user needs that have not been taking into consideration during the initial development of the MCS and then establish a set of interventions in the interface of the software that meet those needs.

## Methodology

The methodology followed for this assessment started by studying the technical manuals and training sessions given to the end users, followed by a heuristics evaluation of the existing interface coupled with a shadowing session conducted at Malpensa airport in Milan, Italy. This would give a clear understanding of what users have been working with. After that, a series of semi-structured interviews have been scheduled with end users with different levels of experience (operators and technician officers). Findings from literature reviews would be then used to guide how the interface should be revisited while taking into consideration cognitive limitations associated with mental fatigue that result from the long shifts airport operators need to complete.

**Interface Assessment**

The tool to be evaluated is called the Monitoring and Control System (MCS). This system is used to monitor, control, and ensure the proper timely maintenance of navigation aid equipment (this includes a long list of devices that supports the plane during its take-off and landing stages to guarantee smooth and safe flying operations). The interface is typically installed on a computer desktop and on a front panel display (smaller touch screen) that is attached to the specific navigation aid equipment cabinet. Inside of the equipment cabinet, there is a third analogue interface that enables operators to bypass restrictions in case of emergencies. It can be operated remotely (in a control room for example) or locally (on site) through the desktop version of the interface that enable users to utilize all possible functionalities, as opposed to the front panel display that is limited to the site and has a read only configuration that only enables users to receive some information about the status of the equipment.

For the end users, the interface provides three different login levels that come with different granularities of responsibilities depending on the internal organization of the customer organization that purchased the MCS. 'Monitoring' is the lowest level in terms of agency granted and can be logged in without a password, it allows the user to check the status of the piece of equipment and to look at some technical parameters. The second level of login 'Operational Control' requires a password and has limited advantages

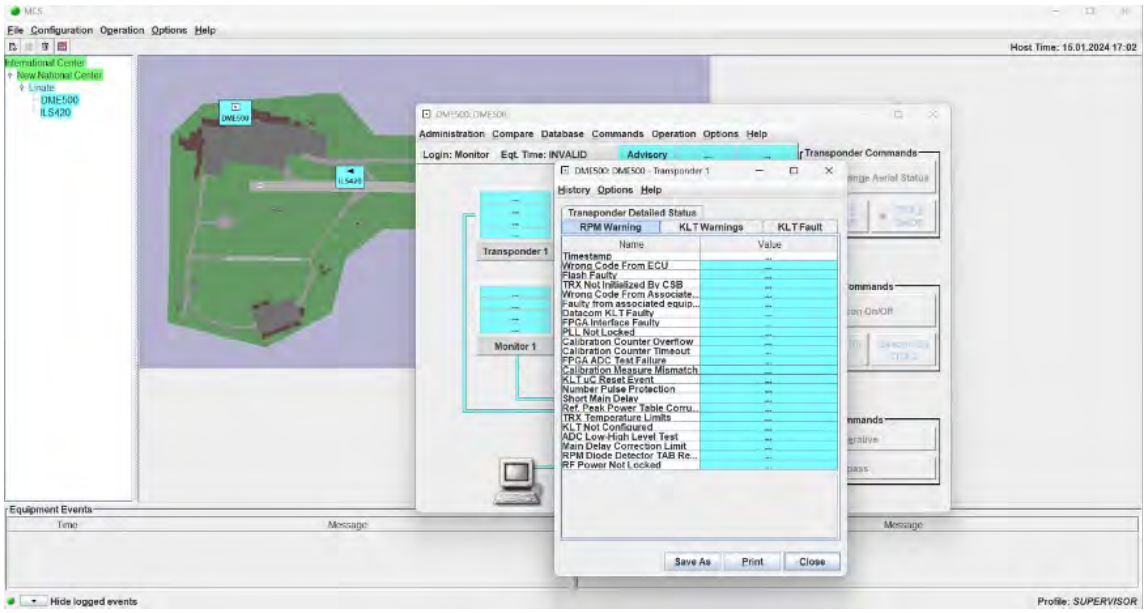



*Figure 1. Screenshot of the existing graphical user interface of the MCS.*

over 'Monitoring' as it only allows technicians to turn on the beacon of the specific piece of navigation aid equipment (simply turning it on and off). These first two login levels are mostly related to the monitoring aspects of the product while the third and highest in terms of authority, 'Maintenance', also requires a password and gives users unrestricted control over the interface and the equipment it is managing. It should be noted that each client has its own internal structure, and the distribution of these login levels depends on both the scale of the operations and the allocation of duties within the team of technicians and their supervisors.

**Cognitive Load**

Information is transmitted to users according to the following hierarchies listed in chronological order:

- Equipment status within the initial landing screen: the status of equipment is made evident to users through the usage of colors that are noticeable at first glance. This needs to be the first thing users notice. The same structure is adopted for the first equipment level window where the same color coding is utilized to indicate the status of specific components within the circuit that makes up the individual piece of equipment.
- Log of many types of alarms explaining to users what the problem is in the case there is a system error or any kind of issue that requires intervention (immediate or not).
- Remaining functionalities (such as running tests, monitoring geolocations, taking measurements, making recordings…) are more nested within the interfaces and require users to complete more steps since they are more case specific.

The cognitive load placed on the brains of users is heavy as in their default states, the interface shows a lot of information that does not technically need to be presented to users all the time. By looking at a first glance, the feedback given to users is relatively clear and follows typical conventions (green is normal, orange is risky and red is critical…). However, users need to take on additional steps to figure out how to solve the problem as the system does not inform how to do so, increasing the time for resolution of the issue.

It should be highlighted that users only receive feedbacks from channels of communication pertaining to the system of the equipment (interfaces on the computer or on the front panel display of some equipment) and never through other devices (mobile phones, tablets, smart watches…). This is due to the fact that the data flow of these networks takes place within a closed circuit therefore needs to be carefully managed and can only be transmitted within authorized devices for security reasons, given the sensitivity and the risks associated with the aviation operations.

By that point in the interaction, users need to know if something is wrong/requires their intervention, and the interface conveys that information either through the interfaces on the computer or on the front panel display. However, this exchange can be made more comfortable to users if the information on the interface can be more adaptive to specific situations, depending on what users need to know and what they need to do to achieve certain tasks or fix specific issues/alarms. A reduction of the cognitive load would also lead to a reduction of mental fatigue that users might suffer from, especially after long shifts.

**Heuristics Evaluation**

The heuristic evaluation (based on Jakob Nielsen's ten general principles

of interaction design) conducted to assess these interfaces highlighted issues that can be grouped in according to these categories:

- Information architecture & Navigation: some sections are too nested within the interface and it might take users a long time to find them to complete their tasks.
- Affordances: some visual elements are not well presented on the interface and it is unclear whether some elements are clickable or not especially that these elements do not follow any visual guidelines.
- Aesthetic: There is no consistency across the interface of the MCS (this is due to the fact that different sections of the interface were coded using different libraries). That aside, there are some serious usability issues including low color contrast and visibility problems.

Following the ten different categories of violations related to the design of interfaces (Nielsen, 2020), a total of twenty-eight violations have been reported.

**User Interviews**

Overall, 26 operators and technicians were interviewed for this assessment. These users come from different corners of the world (Kenya, Brunei, Netherlands, Bulgaria…) and belong to different age groups (ranging between thirty and sixty years old). All of these interviewees are Males (perhaps because of the physical requirements of the job), come from different cultures, have various mental models, and differ in terms of experience with this software and equipment. It is important to note that operators receive a training session from Thales representatives before they start using the MCS. This is required due to the complex technical knowledge that is required for the tasks. The training sessions (which last somewhere between a week or two) include technical training for the equipment that is being monitored through the MCS in addition to a technical walkthrough of the interface (sort of a detailed step-by-step tutorial) in which operators learn how to use the interface and then do some practice exercises that consist of running monitoring tests while connected to the equipment. Some users were interviewed after they had the initial training sessions for the interfaces while other interviewees had much more experience with the software as they have been using them for years.

At the beginning of every interview, participants were asked to give their consent to the recording of the conversation. The results of the interviews can be summarized in the following pain points:

- Some interviewees didn't feel confident enough to operate the software autonomously after the training sessions because they thought the interfaces were too complex to handle after the initial contact they had with it. These interviewees were convinced that they would need to practice more using the interfaces so that they could develop the expertise needed to confidently operate all the software and equipment.
- Whenever users required assistance the initial step to do would be to go through a really long technical manual to find the solution. This is not always practical as users don't always know what to look for or don't have the time to do the search because of the criticality or time sensitivity of the issue.
- Some information and actions are too nested within the interface and users have to go through many steps/click many things to reach what they need to do. This is not effective especially for tasks that users must frequently repeat.

- Users cannot communicate with each other through the interfaces, meaning that users with low login levels cannot ask their superiors for modifications/permissions on the software unless they do so in person or through another communication channel excluding the interface itself (such as calling on the phone).

**Shadowing Session**

On September 6th 2023, a user shadowing session was held at Malpensa airport in Milan, Italy. The session took place over several floors in the control tower of the airport where operators monitor the status of various navigation equipment and not only Thales products. Due to privacy and security concerns, no photographs from within the Malpensa control tower could be published in this document.

Listed below are the main observations that came from the user shadowing sessions:

- At night the rooms become very dark and the main source of light comes from the monitors which is dangerous for the eyes of the operators especially since they have to complete long shifts where they are exposed to these screens.
- Operators multitask across different monitors and different user interfaces which could have a heavy toll on their mental fatigue after several hours.
- Sometimes operators need to compare the circuit scheme of two different equipment at the same time however in the current version of the MCS they would need to individually open each equipment window and then manually arrange the layout to view the schemes side by side.
- Operators manage their scheduled tasks for the MCS using external tools (notepads for example), which is counterproductive as these raise the risks of human error or could even be misplaced.

## Literature Review

The following section of the research paper will present findings coming from various fields of knowledge ranging from cognitive sciences to interaction design.

**Human Attention**

Having to interact with these complex systems requires mental effort that only increases in direct proportion to the duration of the working shift of the operator. In a typical scenario, these operators would be based in a office in front of several screens that monitor numerous equipment and operations (related to Thales products in addition to other devices that have to do with air traffic control) and they only need to intervene and physically make adjustments to machinery whenever there is a problem or a scheduled maintenance activity.

One of the most notable cognitions that plays a role in how humans and machines communicate with each other is attention. Attention is the capability to follow through a task without being affected by external stimuli coming from the surrounding environment through the allocation of mental resources. Attention gives people the ability to select which signals coming from the outside world to focus on which ones to block out to be able to focus on particular things and to achieve specific goals. It is also enables humans to select when and how they can interact with their surrounding environment (Roda, 2011). At a high generalized level, attention can be divided into two clusters: exogenous (top-down) and endogenous (bottom-up).

Exogenous attention is when humans consciously decide what to target their attention on (whether an object or person) in detail within a broad environment that might have many other stimuli. Endogenous attention is the inverse of exogenous attention because it takes place whenever a strong stimuli in the environment hijacks the attention of the person without their conscious engagement (Theeuwes, 1991).

**Mental Fatigue**

Mental fatigue has an impeding effect on attention and specifically top-down attention whereas no significant effects were on bottom-up attention were observed (Holtzer et al., 2010). Other experimentations showed that mental fatigue brought on by long visual attention tasks (the completion of tasks while exposed to visual stimuli) resulted a higher number of errors, lower levels of attention, and increases in the reaction time of participants (Csathó et al., 2012). The increase in reaction time of participants can be particularly dangerous in scenarios in which the operators have to attend to time sensitive matters and act quickly.

Operators must deal with different tasks depending on what stage in the schedule they are at or on what the airplane flight operations (take-off or landing for example) requires them to do. These tasks require a mental effort (in addition to some physical effort in certain situations depending on the type of activity and on the rank of the operator within the team) and therefore users need to have high levels of uninterrupted attention to successfully complete their activities while limiting the effects of mental fatigue to reduce the risks of any potential errors. Focusing on one prioritized/primary task can be challenging enough as it is, and it only increases in difficulty after several hours of continuous mental effort. This process becomes much trickier when operators receive alerts throughout their shifts instigating them to take action on something that may or may not be related to the task they are currently working on. This flow of alarms will interrupt the attention of the users, impede their ability to properly focus on the activity they are doing, and increase their level of mental fatigue which will in return have a negative effect on their attention as well. If these alerts contain information that are not related to the task the operator is working on and if they are presented to him/her in an overriding manner (intense visual or auditory signal), endogenous (bottom-up) attention mechanisms might predominate over exogenous (top-down) attention mechanisms and disrupt the allocation of mental resources to the primary task (Roda, 2011). Unfortunately, the sensitivity and urgency of air traffic control procedures require that operators receive these alerts because in some situations they might be related to a critical event and require immediate interference. It is necessary to find a balanced effective way of delivering the time sensitive information to operators without interfering with the attention that is allocated to their prioritized task.

**Notifications Management**

Notification systems can act as mediators between the information that is delivered and the human's susceptibility to be distracted by it. The ideal ratio in this exchange between information and cognitive resources would be a combination of low levels of disruption and high amounts of knowledge. Literature in notification systems delineates three categories of notification systems: pure notification, awareness mechanisms, and complete switch of context. Pure notification systems do not explicitly convey to users the information within the alert that is sent to them but rather contain a hint to the actual information or action that is required from them. Awareness mechanisms systems however communicate to users the information explicitly instead of just giving them a hint on what it is. Complete switch of context

systems are the most disruptive as they cause the opening of new popup windows and in some cases even take users to different screens belonging to different interfaces (other websites, software, or mobile applications). These systems have no task cueing meaning that users have limited control over deciding how to deal with the alert since the system automatically makes the choice for them by redirecting them somewhere else. Pure notification systems and awareness mechanisms are comparable in the sense that they suggest to users about the availability of new information or actions they might be required to do, however these systems differ in the load of information they contain. Awareness mechanisms systems can convey alerts that require more cognitive resources because of the complex data they might contain. This is not the case for pure notification systems that only give pointers to users as to what the alert is rather than clearly stating the message as awareness mechanisms systems do (Roda, 2011). The notification/alert operators receive need to contain just the right amount of information to allow users to decide whether they want to interrupt the task they are working on and immediately deal with the alert or if they want to finish what they are currently doing and then attend to it based on their own schedules and priorities, without actually disrupting their focus on the task. The cueing aspect of having to deal with the alert enabled by these notifications systems let users make an informed decision regarding what to allocate their attention to. When confronted with this kind of decision, users have two options: intentional dismissal and intentional integration. Intentional dismissal takes place when users ignore the alert and shelf it for later while intentional integration sees the user stopping the activity they are currently engaging with and completely shifting their attention to the alert on the spot (McFarlane & Latorella, 2002). These findings point to the need to tailor the information that is delivered (and how it is delivered) to operators through the alerts that are displayed on the interface in a way that facilitates making the educated choice between intentional dismissal and intentional integration while minimizing the cognitive efforts needed to make the decision.

Some literature brings up the concept of timing the interruptions to change how they are perceived by users and how they can be delivered to have a less disruptive effect on the task users are doing. However, legal regulations for the design of equipment for air traffic control might require users to receive alarms the moment they take place for security and safety reasons (especially that these notifications might signal the malfunctioning of equipment that will prevent the safety of the operations of the aircraft). For this reason, notifications/alarms will be delivered to users the moment they are flagged by the system and operators will have the freedom of deciding whether to deal with them instantly or not depending on the specific situation.

**Alert Fatigue**

The frequency of the notifications is also something that needs to be discussed. A high exposure to alerts can lead to alert fatigue, that is defined as the apathy towards alerts that develops in users with time (mostly throughout long working shifts) after they have been receiving these notifications in a tedious way (Cash, 2009). Therefore, the system should filter out the unnecessary or repeated alerts or even group them based on their urgency to prevent the operators from developing a numbness to these alarms that can be brought on by alert fatigue. Managing the frequency of the alerts should be done in accordance with the regulations for the design of equipment for air traffic control taking into consideration the notion of alert fatigue that could prevent operators from properly attending to their tasks.

**User Needs Articulation**

The hints that derived from the research methods just presented shed light on important issues that are impeding the effectiveness of the interactions with the interface and the employees of the company that are responsible for it. Listed below are generalized guidelines to be followed in order to enhance the user experience of the operators and internal support processes for some company employees:

- Improve user autonomy and agency over the interfaces: users do not always feel confident in working the systems as they might be lacking some of the technical knowledge needed for operating the equipment.
- Easier paths for users to navigate: given the procedural complexity of the tasks at hand, it is normal that the information is nested into different sections based on some technical conventions, however the navigational structure of the interface can be modified to make it easier for users to find their way. Making clearer paths (either through creating shortcuts, modifying the grouping of elements / restructuring the information architecture, or by introducing different semantics) would reduce the risk of users having to memorize paths to reach certain functionalities hence reducing the risk of error that can be critical in time sensitive situations.
- Reduced cognitive load: users are flooded with a lot of information that is not always necessary for them, increasing the risk of mental fatigue and hence raising the danger of committing mistakes. Since certain bits of information cannot be fully removed for technical, security, or legal reasons (there are some imposed conventions to be followed) the solution could be to adopt an approach that enables the adaptability of the interface. This would provide users with the exact amount of information that they need to know at specific points in the interaction.
- Clearer feedback that users can quickly act on: at the first layer of the interaction it is enough for users to just see the status of the system and if there are any alarms however the next immediate step after that in an alarm scenario should be to concisely indicate to users the procedure to fix the issue.
- Error prevention: in cases where user actions have a strong influence over how the interface or configuration operates, make it evident to users that their actions have strong consequences and add a step that they need to overcome to successfully complete this action to reduce the risk of error.
- Context Adaptation: users would benefit from a dark mode version of the user interface so that they can more conveniently interact with the MCS in dark environments (specifically during night shifts) while reducing their exposure to harmful light coming from the screen.

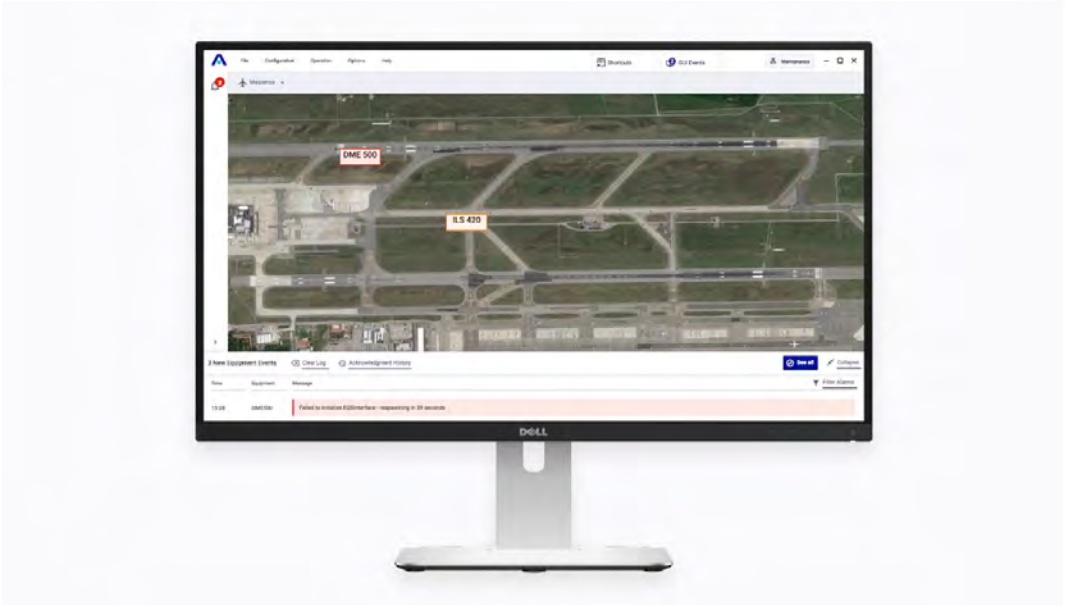
*Figure 2. Mock-up of the user interface created by the authors. Airport level view provided in the redesigned version of the interface where notifications are delivered in a clearer manner to reduce the cognitive load on users.*

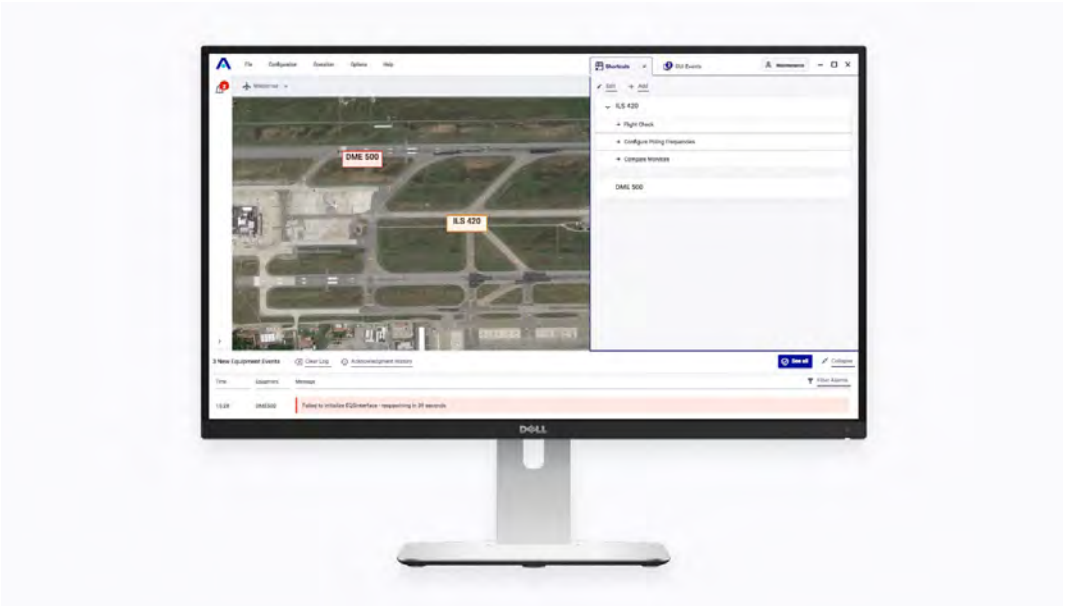
*Figure 3. Mock-up of the user interface created by the authors. New shortcut feature provided in the redesigned version of the interface lets operators access sections more quickly while reducing the risk of mis-navigating the interface.*

## Prototype

The interventions just listed needed to be translated into tangible elements that would compose the revised version of the user interface of the MCS. An initial version of wireframes was drafted before moving on to the development of a high-fidelity prototype. A process of iteration and revision led to a finalized version of the wireframes that was validated by internal company engineers and that included all of the modifications proposed to the MCS. These wireframes would then serve as the basis for a high-fidelity prototype of the graphical user interface of the MCS that was built using the official Thales Group Quantum Design System.

*Figure 4. Mock-up of the user interface created by the authors. Sample screen of the dark mode version of the redesigned version of the interface to cater for the night shifts of airport operators.*


DME 500
ILS 420


DME 500
ILS 420

## User Testing Protocol

The high-fidelity prototype developed then underwent usability testing by four airport operators from the Dominican Republic who were just getting introduced to the MCS through a training session at Thales. These are different participants than the operators that have participated in the preceding user interviews. Again, all participants were males and belonged to different age groups (ranging between thirty and fifty years old) however they shared a similar cultural background and work environment. The purpose of this test was to assess the usability of the interface, the ability of operators to navigate it efficiently, and the perceived added value of the new features that have been proposed.

The following protocol has been administered for the test:

Part I: Brief explanation of what an operator with a maintenance login level can do with the MCS.

This was needed because not all operators have that high clearance to do the maintenance activities that come with that login level. It should be mentioned that the prototype was developed with all the potential functionalities the MCS could include meaning that the interface used for the testing contained sections only an operator with the maintenance login level would have clearance for.

It was done on purpose to ensure that any of the operators (regardless of their experience and clearance level) would be able to efficiently operate the graphical user interface of the MCS.

Part II: Participants were asked to complete the following six tasks:

- Go to the DME 500, check the values in transponder 1 and then compare them to the values of the Transponder 2.
- Set up equipment time for the DME 500, then close the window.
- From within the DME 500, go to the standard measurement transponder on antenna and run the test, then close the window.
- Find the values for the integrity test wavelength for the ILS 420.
- Compare the ILS 420 and the DME 500 from the DME 500 window.
- You have already added a shortcut to configure the poling frequency for the ILS 420. Find it and launch the test.
- For clarification, DME stands for Distance Measuring Equipment and ILS stands for Instrument landing system. Both are examples of navigation equipment that is monitored through the MCS.

## User Testing Results

The results of the test were overall positive because the operators were able to successfully complete almost all of the tasks. Two operators faced difficulties with the fourth task however they disclosed that they did not have any experience with the ILS and this could be the reason as to why they were confused by the task, especially that the task itself contained terminology that required a certain type of knowledge. These two participants belonged to different age groups, implying that it would be improbable to correlate the inability to complete the task with a specific age bracket. Besides the difficulties with the fourth task, the participants stated that the revised version of the interface is much more practical and easy to use. They also expressed their appreciation for the new features that were introduced (especially the shortcuts and compare equipment features) as they said that these changes could significantly accelerate their daily workflows. The results of the usability testing administered validate the effectiveness of the changes proposed to the existing version of the graphical user interface of the MCS.

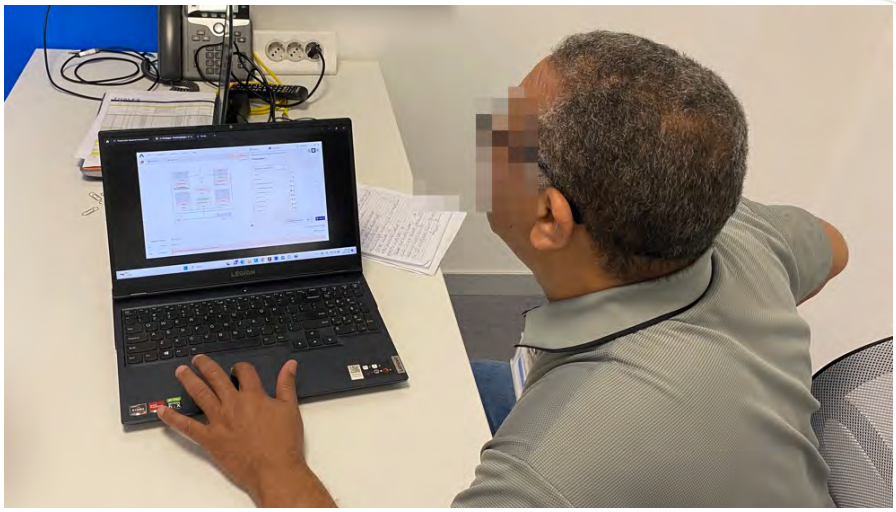


*Figure 5. Photograph taken by authors. Airport operator participating in the user testing conducted in the offices of Thales Group Gorgonzola, Italy.*

## Conclusion

This design activity was the result of a collaboration with Thales Group and consisted of identifying how an interface used for air traffic control and navigation aid equipment maintenance could be improved in terms of usability and user experience while also considering user needs. The investigation brough up pain points that users suffer from while operating this kind of equipment. The company that initiated this research activity is not using artificial intelligence for this line of products yet, however there is a high possibility that this will change in the upcoming future. It is necessary to evaluate what kind of benefits implementing such technology could bring to the stakeholders involved (from the end users up until the company financing and developing this project). Investing in artificial intelligence requires a big financial commitment and it is therefore necessary to assess what advantages it can bring as opposed to engaging in such an expensive venture solely as part of the latest trend. In addition to that, infusing digital products like the MCS with artificial intelligence will drastically change the way end users interact with these tools. For that reason, it is crucial to ensure a proper and comfortable transition for users who are most probably have not had direct exposure to artificial intelligence before, keeping in mind that the products they were working with were crafted not taking into consideration any kind of user experience design principles as they were developed by computer scientists and engineers.

This switch from operating a non-intelligent and passive (in the sense that it cannot make any initiatives/proposals to users) graphical user interface that is not user-friendly towards a new active one that is defined by the intelligence it has and by the new responsibilities it can take on must be handled with attention. Failing to do so might alienate users who have low aptitude to learn new skills or even those that have a predisposition against artificial intelligence.

Moving forward, future research should focus on the optimization of user experience and interaction design principles of high-stakes systems like the MCS and how they will evolve to accommodate the integration of artificial intelligence into these products, which is no longer a future possibility but rather an inevitable reality.

## Acknowledgments

The authors of this research paper would like to thank Anna Negrisoli, Alessandro Bosoni, and Natalia Rocabado Cueto in their ongoing support during the research and design activities.

# References

1. Cash, J. J. (2009). Alert fatigue. American Journal of Health-System Pharmacy, 66(23), 2098–2101. https://doi.org/10.2146/ajhp090181
2. Csathó, Á., Van Der Linden, D., Hernádi, I., Buzás, P., & Kalmár, G. (2012). Effects of mental fatigue on the capacity limits of visual attention. Journal of Cognitive Psychology, 24(5), 511–524. https://doi.org/10.1080/20445911.2012.658039
3. Holtzer, R., Shuman, M., Mahoney, J. R., Lipton, R., & Verghese, J. (2010). Cognitive Fatigue Defined in the Context of Attention Networks. Aging, Neuropsychology, and Cognition, 18(1), 108–128. https://doi.org/10.1080/13825585.2010.517826
4. McFarlane, D. C., & Latorella, K. A. (2002). The Scope and Importance of Human Interruption in Human-Computer Interaction Design. Human–Computer Interaction, 17(1), 1–61. https://doi.org/10.1207/S15327051HCI1701_1
5. Nielsen, J. (2020, November 15). 10 Usability Heuristics for User Interface Design. https://www.nngroup.com/articles/ten-usability-heuristics/
6. Roda, C. (Ed.). (2011). Human Attention in Digital Environments (1st ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511974519
7. Theeuwes, J. (1991). Exogenous and endogenous control of attention: The effect of visual onsets and offsets. Perception & Psychophysics, 49(1), 83–90. https://doi.org/10.3758/BF03211619

# Enhancing User Experience in Autonomous Driving Levels 4 and Above: A Novel Seat Concept for Motion Sickness Mitigation.

*Venanzio Arquilla, Shangyi Bai*
*venanzio.arquilla@polimi.it, shangyi.bai@mail.polimi.it*

*Politecnico di Milano, Italy*

***Keywords:***
*Automotive UX*
*Motion Sickness Mitigation*
*Future Cockpit*
*Automotive Seat Design*

## Abstract

The rapid advancement of technology, particularly in autonomous driving, has brought about a profound transformation in the automotive industry. This paper introduces a research-driven strategy aimed at tackling emerging challenges related to non-driving activities in autonomous vehicles, with a specific focus on mitigating motion sickness. Recognizing the growing prevalence of light usage in the cockpit and the expected rise in non-driving engagements, this study underscores the urgent necessity for innovative solutions. Through comprehensive research on future mobility trends, levels of driving automation, and user experiences, this paper proposes a novel automotive seat concept tailored to alleviate motion sickness arising from increased non-driving activities in autonomous vehicles.

The proposed seat design features a wrap-around structure to facilitate enhanced privacy and flexibility in both personal and group activities. A key component of this solution is the Anti-motion Sickness Light Warning System, strategically integrated into the seat's backrest. Leveraging ISELED technology, this system offers real-time synchronization with autonomous driving systems, issuing light warnings to passengers prior to unexpected movements, thereby minimizing the likelihood of motion sickness. While demonstrating promising outcomes, the paper acknowledges certain limitations. These include the necessity for further exploration of interactive elements within the seat design, research to exploit the potential of advanced lighting effects using ISELED technology and ergonomic considerations for the seat itself. By shedding light on the impact of autonomous driving on user experiences, this study contributes to the ongoing discourse and underscores the pivotal role of technology in shaping the future of automotive design.

## Introduction

In recent years, vehicle interior lighting has undergone significant advancements owing to rapid technological progress and evolving user preferences. The 2022 Mercedes-Benz EQS integrates innovative lighting solutions throughout its interior. With up to 13 strategically positioned functional lights (see Figure 1), this model not only enriches the driving and passenger experience but also underscores the pivotal role of lighting in automotive design.

Currently, lighting design has shifted from being supplementary to essential within the cockpit, significantly enhancing the driving and passenger experience. This trajectory is expected to continue, with future automotive lighting applications becoming even more innovative and diverse.

*Figure 1. Interior of Mercedes-Benz EQS 2022 (Drive, 2022)*

## Literature Review

The literature review of this paper primarily focuses on future mobility and cockpit design. It commences by examining future transportation scenarios and delves deeply into potential changes in cockpit configurations.

### 1. Future Mobility

The future of mobility will witness significant changes in the role of automobiles, particularly with the emergence of autonomous vehicles. The discussions are summarized in three main aspects: driving automation, new contexts, and new scenarios.

**Driving Automation**

Autonomous driving technology has witnessed rapid advancement, necessitating standardized taxonomy and definitions to classify the various levels of automation. Society of Automotive Engineers International has established a widely recognized standard with its classification of autonomous driving into five levels (SAE International, 2021).

*Table 1. SAE J3016 Levels of Driving Automation (SAE International, 2021)*

SAE INTERNATIONAL

**SAE J3016™ LEVELS OF DRIVING AUTOMATION™**

**Learn more here:** sae.org/standards/content/j3016_202104

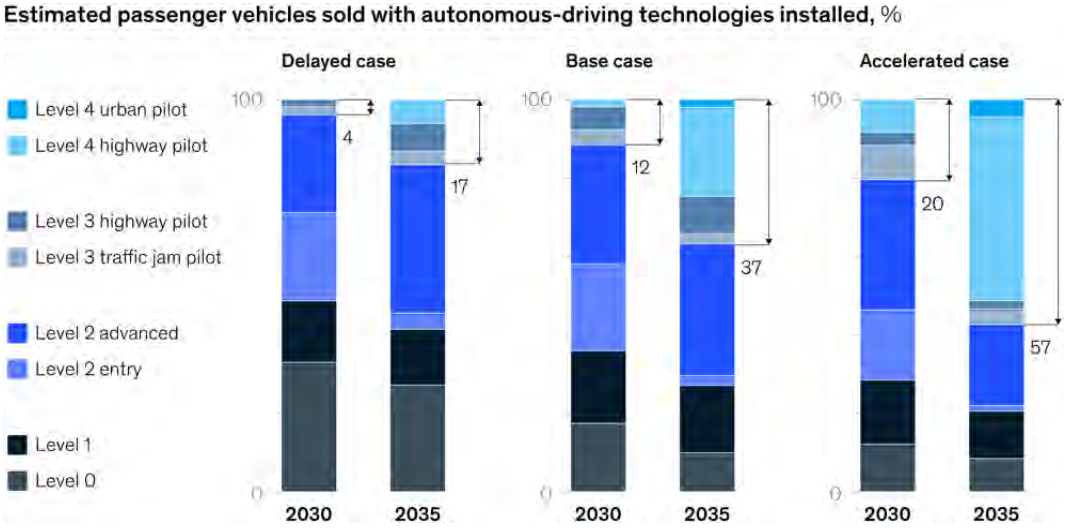


| | SAE LEVEL 0™ | SAE LEVEL 1™ | SAE LEVEL 2™ | SAE LEVEL 3™ | SAE LEVEL 4™ | SAE LEVEL 5™ |
|---|---|---|---|---|---|---|
| What does the human in the driver's seat have to do? | **You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering | | | **You are not driving** when these automated driving features are engaged – even if you are seated in "the driver's seat" | | |
| | **You must constantly supervise** these support features; you must steer, brake or accelerate as needed to maintain safety | | | When the feature requests, you must drive | These automated driving features will not require you to take over driving | |

Achieved — Transition — **Practical** — Unrealistic

Through the comparison of various levels of autonomous driving technologies and assessing the current market adoption, the author contends that Levels 0 to 2 autonomous driving have nearly achieved widespread application in real-world scenarios. Even Level 3 autonomous driving, despite its capability to take over most driving tasks from human drivers, still requires human drivers to remain fully engaged in vehicle operation, presenting a technical challenge (see Table 1).

*Table 2. Estimated passenger vehicles sold with autonomous-driving technologies installed, % (McKinsey, 2023)*




Through the comparison of various levels of autonomous driving technologies and assessing the current market adoption, the author contends that Levels 0 to 2 autonomous driving have nearly achieved widespread application in real-world scenarios. Even Level 3 autonomous driving, despite its capability to take over most driving tasks from human drivers, still requires human drivers to remain fully engaged in vehicle operation, presenting a technical challenge (see Table 1).

Table 2 illustrates the projection that vehicles will ultimately achieve SAE Level 4, or driverless control under certain conditions (McKinsey, 2023). Level 4 autonomous driving has found extensive applications, particularly in the field of autonomous taxis, highlighting its broader potential as a future mainstream autonomous driving technology. The author holds high expectations for the significant potential that Level 4 autonomous driving technology can demonstrate in future transportation scenarios.

**New Context**

In the evolving landscape of future mobility, the role of automobiles is poised for significant transformations. Autonomous vehicles, in particular, will redefine concepts of ownership and sustainability, leading to new behavioral patterns, evolving demands, and the emergence of innovative urban mobility systems centered around vehicles.

One relevant concept in recent years is Mobility as a Service (MaaS), which embodies a novel idea that redefines our perception and engagement with mobility. It can be seen as a concept, a contemporary phenomenon accompanied by emerging behaviors and technologies, or even as a revolutionary transport solution that seamlessly integrates various modes of transportation and mobility services (Jittrapirom, P. et al., 2017).

Additionally, a new approach known as "Mobility as a Feature (MaaF)" considers mobility services as inputs into a broader activity-based paradigm of service delivery. It acknowledges that transport and travel stem

from broader needs, emphasizing the importance of integrating non-transport services to effectively meet these needs (Hensher, D. A., & Hietanen, S., 2023).

The emergence of both Mobility as a Service (MaaS) and Mobility as a Feature (MaaF) is poised to profoundly impact the future landscape of mobility. The convenience of this ecosystem will further reduce the demand for private transportation, blurring the boundaries between private and public transportation, presenting a unique scenario for future mobility.

**New Scenario**

Dannemiller, K. A. et al. (2023) introduced intriguing concepts - travel-based activities (TBAs) and activity-based travel (ABT). This represents the first comprehensive exploration of the kinds of activities that individuals are likely to pursue when relieved from the task of driving in the era of fully automated vehicles (AVs). They refer to such activities as travel-based activities or TBAs. The results indicate that the highest impact of AVs will likely be on the number of long-distance trips, with such trips increasing.

## 2. Future Cockpit

Given the changes in future mobility, the role of the future cockpit becomes flexible and diverse with the advent of the driverless era. Therefore, there are four challenges to be faced when researching and designing the future cockpit: privacy, safety, activities, and driving experiences (Kun, A. L. et al., 2016). Among them, the latter three are the most widely concerned.

**Driving and Safety**

Under the premise of L4 autonomous driving, artificial intelligence can address most driving safety concerns for humans. However, three main security issues persist: Taking over Requests (TORs), visualization of speed, and lane change decisions (Shah, A. H., & Lin, Y., 2020). This emphasizes the necessity of traffic warning systems in the era of autonomous driving. Even though driving behaviors are no longer the primary focus, passengers still require access to pertinent traffic information in specific situations.

**Driving and Activities**

The study of non-driving behavior of drivers and passengers under L4 autonomous driving conditions primarily focuses on two main aspects: individual behavior and group interaction.

For individual behaviour, several surveys have highlighted some primary activities, including sleeping, listening to music, browsing mobile phones, reading, and admiring the scenery outside the window (Hecht, T. et al., 2020; Parida, S. et al., 2020; Pfleging, B. et al., 2016; Pollmann, K. et al., 2019; Russell, M., 2011).

What's more, group interactions in the context of autonomous driving primarily revolve around communication (Ive, H. P. et al., 2015). However, it's important to note that there is still a relatively limited amount of research in this area. Nevertheless, these studies lay the foundational groundwork for subsequent design endeavors.

**Driving Experience**

In the era of L4 autonomous driving, the driving experience, also known as the ride experience, presents two significant aspects that deserve attention: psychological experience and physical experience.

Psychologically, when users are no longer in control of the car's operations, understanding the vehicle's intentions becomes essential for them to feel safe and secure. Löcken, A. et al. (2016) point out that the transition

from human drivers to automation raises complex issues. One of the key challenges, particularly in Level 3 automation, is the "Increasing complexity" of the automation systems. With the growing complexity of automation, it becomes harder for drivers to understand and monitor the car's actions.

*Table 3. Frequency and severity of motion sickness for adults while watching video or reading in a moving conventional vehicle (Sivak, M., & Schoettle, B., 2015)*

| Measure | Activity | |
|---|---|---|
| | Viewing video | Reading |
| Frequency:<br>*Often, usually, or always* | 15% | 26% |
| Severity:<br>*Moderate or severe* | 15% | 32% |

Physically, it is posited that an increasing number of non-driving activities will make motion sickness a more significant concern in self-driving vehicles compared to traditional, human-driven vehicles (Sivak, M., & Schoettle, B., 2015) (see Table 3). This expectation arises from the fact that the three primary factors contributing to motion sickness, namely conflicts between vestibular and visual inputs, the inability to predict the direction of motion, and the absence of control over the direction of motion, are heightened in self-driving vehicles. However, it's worth noting that the frequency and severity of motion sickness are influenced by the specific activities that individuals engage in while in the vehicle, rather than the act of driving itself.

## Design Opportunity

In the context of driving automation, considerable attention has been given to the sense of safety, and various solutions have emerged. However, in the context of Level 4 autonomous driving, non-driving activities are poised to significantly expand and diversify within the cockpit, potentially leading to increased occurrences of motion sickness among passengers. Therefore, the author contends that motion sickness arising from non-driving activities in the era of autonomous driving presents a promising design opportunity.

### 1. Motion Sickness

**Causes**

Spencer Salter et al. (2019) underscore the increasing prevalence of rearward-facing seats in automated vehicles (AVs). However, adopting a rearward orientation in AVs may compromise the passenger experience, particularly with regard to motion sickness. Meanwhile, Michael J. Griffin and Kim L. Mills (2002) noted that the direction of motion (fore-and-aft or lateral) did not significantly impact the occurrence of motion sickness.

Michael J. Griffin and Maria M. Newman (2004) further emphasize the importance of the visual scene in motion sickness within cars. They recommend mitigating motion sickness by providing visual information while deepening understanding of the various factors influencing its occurrence or relief.

In addition, research by Ouren X. Kuiper et al. (2020) indicates that unpredictable motion induces motion sickness more significantly compared to predictable motion. These findings suggest that motion sickness arises from the disparity between sensed and expected motion, rather than simply being unprepared for the motion.

**Existing Solutions**

Addressing motion sickness stemming from the aforementioned causes,

*Figure 2. Illustration of prototypical LED feedback system (Bohrmann, D. et al., 2022)*

several potential solutions have emerged. For instance, Dominique Bohrmann et al. (2020) explored the efficacy of active seat belt retractions as a countermeasure against motion sickness. Millard F. Reschke et al. (2006) attempted to alleviate motion sickness-related gastrointestinal symptoms and motor disorders while inhibiting vestibular-autonomic pathways by using stroboscopic light synchronized to the motion pattern.

It is noteworthy that Bohrmann, D. et al. (2022) demonstrated, through a prototypical LED feedback system visualizing longitudinal driving dynamics in the passenger's peripheral visual field (see Figure 2), that integrating peripheral visual information in automated vehicle experiences could potentially enhance users' situation awareness and reduce the occurrence of motion sickness.

In summary, the prevalence of motion sickness is expected to rise significantly with the widespread adoption of autonomous driving, attributed to unique seating orientations and unpredictable motions. While various methods exist to alleviate motion sickness, providing users with visual stimuli that align with their expectations and anticipated motion appears the most promising and practical approach. Light, therefore, emerges as a favorable medium to intervene in this process.

## 2. User Research

To gain a deeper understanding of the characteristics of individuals suffering from motion sickness and to identify the final target demographic for the design, the author developed the following questionnaire and distributed it to a broad spectrum of respondents (see Table 4).

***Research on Motion Sickness Phenomenon***

*1. Your gender [single choice question] **
○Male
○Female

*2. Your age*
*[Enter a number from 15 to 60]**
_____

*3. Do you often get motion sickness? [Single choice question] **
○Yes
○No (please skip to the end of the questionnaire and submit your answer sheet)

*4. In which scenario are you more likely to get motion sickness?*
*[Single choice question] **
○Long-distance travel
○Short commute
○Others _____ *

*5. Your travel companions are usually [single-choice question] **
○Family
○Companion
○Friends
○Traveling alone
○Others _____ *

*Depends on option 1 of question 4*

*6. What type of vehicle do you usually ride in [Single choice question] **
○Car
○SUV/MPV
○Others _____ *

*7. What do you usually do on a car ride? [Multiple choice questions] **
☐Listen to music
☐Playing with mobile phone
☐Chat with peers
☐Diet
☐Call
☐Look at the scenery
☐Others_____ *

*8. What may cause you to get motion sickness [Multiple choice questions] **
☐Closed space/poor ventilation
☐Poor shock absorption/poor road conditions
☐Many turns/many stops
☐Seat comfort
☐Seating position
☐Others_____ *

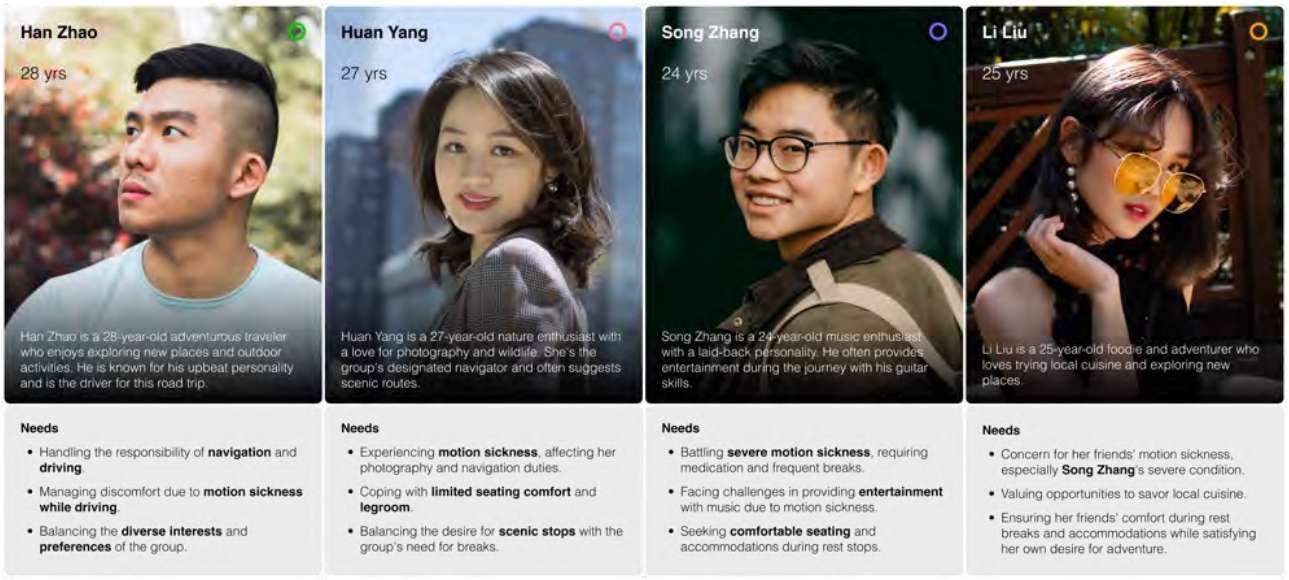
*Table 4. Research on motion sickness phenomenon*

A total of 117 questionnaires were collected for this survey, with 71 of them deemed valid. The research results indicate that the majority of surveyed individuals experience motion sickness during long-distance trips (59.15%) with family (42.86%) or friends (30.95%), primarily due to unpredictable traffic conditions (71.83%). This offers the author a clear design focus and scenario, which will be reflected in the construction of user profiles and user journeys in the next phase.

## 3. Design Approach

*Table 5. Persona in long-distance travel with friends (Photo retrieved on Unsplash)*

Based on the research findings, the author has chosen the scenario of long-distance travel with friends to create personas (see Table 5) and user journeys for the target users.



In the scenario of friends traveling together, it is crucial to consider both the need for privacy for individual passenger behaviors and the flexibility required for group interactions. However, paramount considerations remain the demand for comfortable seat configurations and the mitigation of potential motion sickness risks (see Table 6).

*Table 6. User journey of long-distance travel with friends*

| Planning | Departing | Travelling | Arriving |
|---|---|---|---|
| Discussing | Planning / Planning / Set Route / Packing | Chatting Together | Gaming / Reading / Watching |
| Friends Gathering | Internet / APP / Map | APP / Car Interface | Suitcase / Car Interior | Car Interior | Devices / Car Interior | Car Interior |
| Comfortable And Safe Way To Travel | Comfortable Environment In The Car | Comfortable And Stable Activity Environment | Relieve Motion Sickness |
| Looking Forward To More Interactive Time | Comfortable Seats And Interior Design | Reduces Motion Sickness During Activity | Motion Sickness Solution |

The analysis suggests that the seat is the closest and most effective touch point with passengers. By offering flexible and comfortable seating options, combined with a well-designed lighting system, there is an opportunity to enhance the overall riding experience, including alleviating motion sickness.

*Figure 3. Cockpit layouts research (Photo retrieved on Pinterest)*

# Project

## 1. Space Design

In preparation for designing the seats, thorough research and analysis are essential to accommodate potential non-driving activities for both individuals and groups within Level 4 autonomous driving cockpits. Various cockpit layouts from existing and conceptual designs have been examined by the author (see Figure 3).

*Figure 4. Graphical illustration of researched cockpit layouts*

After compiling and organizing numerous relevant conceptual designs, the author meticulously categorizes and analyses them based on seat number, form, and layout (see Figure 4) with the aim of identifying designs that meet specified requirements.

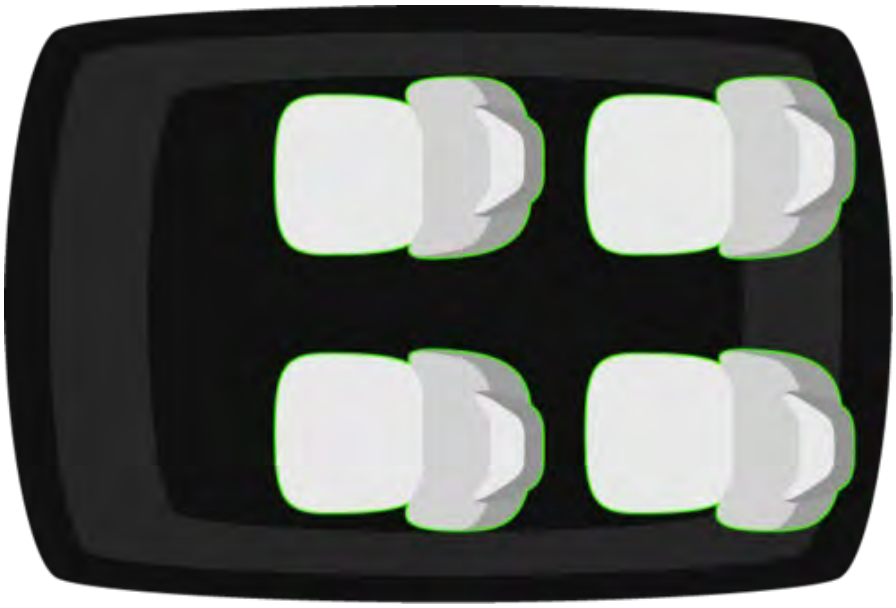


*Figure 5. Final design decision of cockpit layout*

Considering the configuration requirements of L4 autonomous driving (such as the retention of driver's seats), the selected design concept offers a balanced approach, enhancing traditional cockpit layouts by replacing fixed seating with four rotating seats (see Figure 5). This modification maintains

basic functionality while enabling seats to rotate 90 degrees sideways, facilitating group interactions and significantly reducing motion sickness risks. Such design ensures cockpit passengers' flexibility and potential for interaction.

Moreover, the uniform and interchangeable design of all four independent seats expands market possibilities, reduces maintenance and storage costs, and lowers potential manufacturing expenses.

## 2. Product Design

*Figure 6. The Egg Chair (Arne Jacobsen, 1959)*

**Inspiration**

Among various case studies, "The Egg chair" by Arne Jacobsen (1959) stands out as a significant source of inspiration (see Figure 6). This Danish design masterpiece, crafted through experimentation with wire and plaster in Jacobsen's garage, profoundly influences the author's design process. The enveloping shape of The Egg Chair not only ensures ample privacy and comfort but also provides an ideal location for integrating the lighting system in later stages.

| | |
|---|---|
| **single car seat,** | *Product Definition* |
| **industrial design,** | *Domain Definition* |
| **white color,** | *CMF Constraint* |
| **Arne Jacobsen,** | *Style Constraint* |
| **pure white background,** | *Image Background* |
| **studio lighting,** | *Lighting Configuration* |
| **right angle shot** | *Camera Setting* |
| **--s 50** | *Stylizing Strength* |
| **--c 0** | *Chaos Strength* |
| **--ar 1:1** | *Image Specification* |
| **--v 5.2** | *Core Version* |

*Table 7. Prompt for references generation with Midjourney*

**AI-facilitated Design**

This project endeavors to explore how Artificial Intelligence Generated Content (AIGC) can optimize workflows for industrial designers. The chosen AI tool, the well-established Midjourney image generation platform, aids in generating a series of visual references.

The author utilizes the prompt "single car seat, industrial design, white color, Arne Jacobsen, pure white background, studio lighting, right angle shot" (see Table 7). Despite minimal design-related terms beyond image quality constraints, the inclusion of the somewhat biased term "Arne Jacobsen" ensures consistent and controllable style in the generated results, particularly concerning the later integration of the lighting system.

*Figure 7. Generated references (Photo generated by Midjourney)*

Ultimately, the author successfully generates numerous design references using Midjourney (see Figure 7). However, the existing cues proved insufficient for selecting and finalizing the design concept. The absence of consideration for the lighting system's positioning in the generation process suggests utilizing this constraint to refine and approach the final design concept.

**Design Refinement**

Given the necessity for the lighting system to coexist with passengers' non-driving activities and convey specific informational content, the precise placement is paramount.

Referencing Spector, R. H. (1990), who introduced the concept of peripheral vision, it's noted that signals appearing within passengers' peripheral vision are still noticeable. Additionally, research by Strasburger, H. et al. (2011) highlights humans' ability to reconstruct and interpret compressed and distorted information perceived peripherally, facilitating appropriate information delivery during focused non-driving activities.

Consequently, three potential locations for the light—near the head, shoulder, and body—were identified to effectively convey driving information to passengers (see Figure 8).

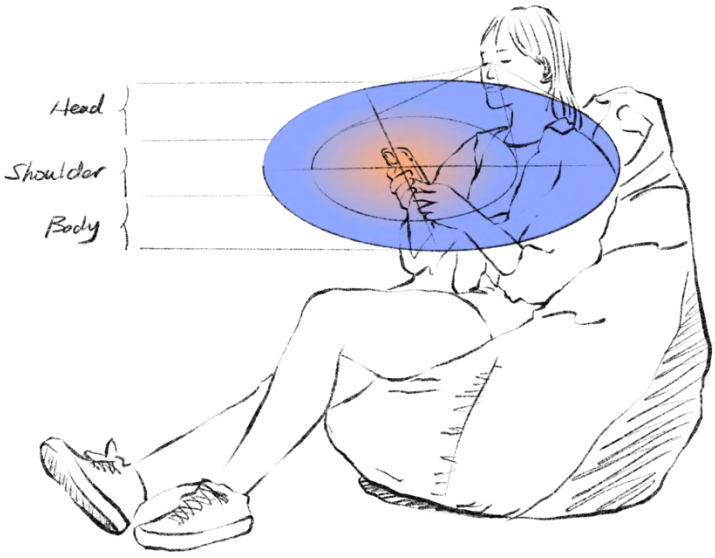



*Figure 8. Potential location for lighting system*

**HOODIE - Seat Design for Motion Sickness**

As a result, the author developed HOODIE, a car seat designed to mitigate motion sickness resulting from Level 4 autonomous driving (see Figure 9). Enveloping passengers within a large shelter enhances privacy while the anti-motion sickness light warning system, integrated into the shelter, reduces motion sickness occurrences through preemptive warnings.


*Figure 9. HOODIE - Seat Design for Motion Sickness*

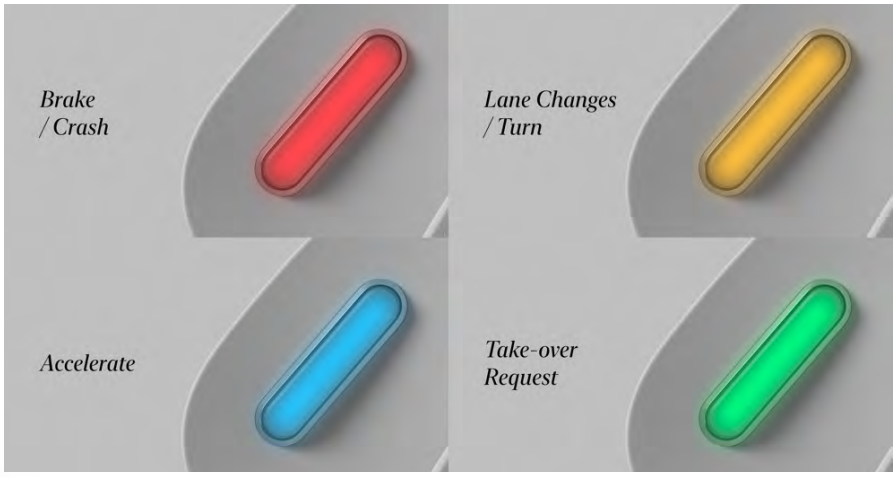



*Figure 10. Examples of anti-motion sickness light warning system*

The anti-motion sickness light warning system alerts users before the autonomous driving system detects motion trends. For instance, red lights indicate braking or imminent collision, while yellow lights signal lane changes or turns (see Figure 10). Furthermore, warnings are provided for accelerations or take-over requests . This design also addresses passengers' security concerns regarding driving conditions.

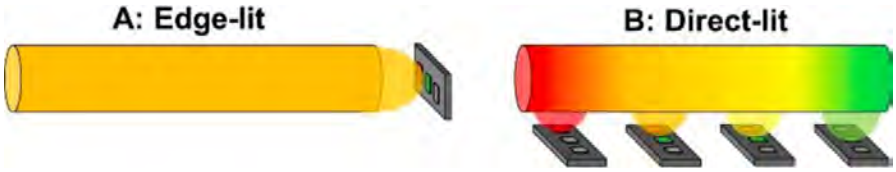



*Figure 11. Left (A): Static edge-lit system. Right (B): Dynamic direct-lit system (Blankenbach, K. et al., 2019)*

To ensure rapid light signal responsiveness to vehicle motion, the author selected ISELED technology (Blankenbach, K. et al., 2019) as the technical foundation. This technology addresses challenges associated with maintaining luminance and color uniformity across various temperature conditions in direct-lit light guides, which could synchronize effectively with in-car entertainment systems, offering rich lighting effects and potential for developing more complex animations (see Figure 11).

As previously discussed, HOODIE's cockpit layout features four independently rotatable seats, facilitating passengers' mobility and communication and supporting various scenarios. For instance, the four scenarios depicted in Figure 12 demonstrate passengers' ability to choose and configure seat layouts according to different situations, allowing for individual activities or face-to-face communication.

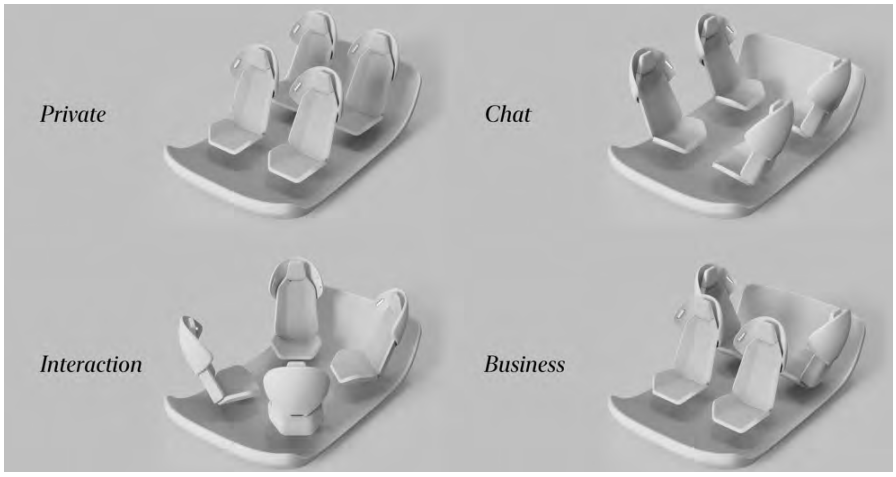



*Figure 12. Flexible cockpit layouts in different scenarios*

## Conclusion

In summary, extensive literature exploration supports the imminent widespread adoption of Level 4 autonomous driving technology, which will significantly impact urban transportation systems. The study underscores the potential for personal transportation in long-distance travel scenarios and addresses challenges posed by increased motion sickness through innovative solutions like HOODIE.

Moreover, by analysing automotive cockpit layouts, the study proposes a visionary concept tailored for Level 4 autonomous driving. This design features four independently swivelling seats, aiming to prevent motion sickness while accommodating diverse passenger activities.

## Limitation

While the proposed concept may mitigate motion sickness in future L4 autonomous driving, further exploration is needed regarding interactivity, ergonomics, market analysis, and user strategies to enhance implementation comprehensively. These areas present opportunities for future research and development, building upon this foundational exploration to create stronger and more effective solutions for motion sickness in autonomous driving scenarios.

# References

1. Blankenbach, K., & Isele, R. (2019). 57.1: Invited Paper: Automotive Interior Lighting: Challenges and Solutions for Uniformity. SID Symposium Digest of Technical Papers, 50(S1), 618–621. https://doi.org/10.1002/sdtp.13589
2. Bohrmann, D., & Bengler, K. (2020). Reclined Posture for Enabling Autonomous Driving. In T. Ahram, W. Karwowski, S. Pickl, & R. Taiar (Eds.), Human Systems Engineering and Design II (pp. 169–175). Springer International Publishing. https://doi.org/10.1007/978-3-030-27928-8_26
3. Bohrmann, D., Bruder, A., & Bengler, K. (2022). Effects of Dynamic Visual Stimuli on the Development of Carsickness in Real Driving. IEEE Transactions on Intelligent Transportation Systems, 23(5), 4833–4842. https://doi.org/10.1109/TITS.2021.3128834
4. Dannemiller, K. A., Asmussen, K. E., Mondal, A., & Bhat, C. R. (2023). Autonomous vehicle impacts on travel-based activity and activity-based travel. Transportation Research Part C: Emerging Technologies, 150, 104107. https://doi.org/10.1016/j.trc.2023.104107
5. Egg™ Chair—Lounge chair with timeless design. (n.d.). Fritz Hansen. Retrieved 8 November 2023, from https://www.fritzhansen.com/en/categories/products/popular-series/egg
6. Griffin, M. J., & Mills, K. L. (2002). Effect of frequency and direction of horizontal oscillation on motion sickness. Aviation, Space, and Environmental Medicine, 73(6), 537–543.
7. Griffin, M. J., & Newman, M. M. (2004). Visual field effects on motion sickness in cars. Aviation, Space, and Environmental Medicine, 75(9), 739–748.
8. Hecht, T., Feldhütter, A., Draeger, K., & Bengler, K. (2020). What Do You Do? An Analysis of Non-driving Related Activities During a 60 Minutes Conditionally Automated Highway Drive. In T. Ahram, R. Taiar, S. Colson, & A. Choplin (Eds.), Human Interaction and Emerging Technologies (pp. 28–34). Springer International Publishing. https://doi.org/10.1007/978-3-030-25629-6_5
9. Hensher, D. A., & Hietanen, S. (2023). Mobility as a feature (MaaF): Rethinking the focus of the second generation of mobility as a service (MaaS). Transport Reviews, 43(3), 325–329. https://doi.org/10.1080/01441647.2022.2159122
10. Ive, H. P., Sirkin, D., Miller, D., Li, J., & Ju, W. (2015). 'Don't make me turn this seat around!': Driver and passenger activities and positions in autonomous cars. Adjunct Proceedings of the 7th International Conference on Automotive User Interfaces and

Interactive Vehicular Applications, 50–55. https://doi.org/10.1145/2809730.2809752
11. J3016_202104: Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles - SAE International. (n.d.). Retrieved 21 April 2023, from https://www.sae.org/standards/content/j3016_202104/
12. Jittrapirom, P., Caiati, V., Feneri, A.-M., Ebrahimigharehbaghi, S., González, M. J. A., & Narayan, J. (2017). Mobility as a Service: A Critical Review of Definitions, Assessments of Schemes, and Key Challenges. Urban Planning, 2(2), 13–25. https://doi.org/10.17645/up.v2i2.931
13. Kuiper, O. X., Bos, J. E., Schmidt, E. A., Diels, C., & Wolter, S. (2020). Knowing What's Coming: Unpredictable Motion Causes More Motion Sickness. Human Factors, 62(8), 1339–1348. https://doi.org/10.1177/0018720819876139
14. Kun, A. L., Boll, S., & Schmidt, A. (2016). Shifting Gears: User Interfaces in the Age of Autonomous Driving. IEEE Pervasive Computing, 15(1), 32–38. https://doi.org/10.1109/MPRV.2016.14
15. Löcken, A., Heuten, W., & Boll, S. (2016). AutoAmbiCar: Using Ambient Light to Inform Drivers About Intentions of Their Automated Cars. Adjunct Proceedings of the 8th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, 57–62. https://doi.org/10.1145/3004323.3004329
16. Parida, S., Abanteriba, S., & Franz, M. (2020). Digital Human Modelling, Occupant Packaging and Autonomous Vehicle Interior. In T. Ahram, W. Karwowski, S. Pickl, & R. Taiar (Eds.), Human Systems Engineering and Design II (pp. 202–208). Springer International Publishing. https://doi.org/10.1007/978-3-030-27928-8_31
17. Pfleging, B., Rang, M., & Broy, N. (2016). Investigating user needs for non-driving-related activities during automated driving. Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia, 91–99. https://doi.org/10.1145/3012709.3012735
18. Pollmann, K., Stefani, O., Bengsch, A., Peissner, M., & Vukeli , M. (2019). How to Work in the Car of the Future? A Neuroergonomical Study Assessing Concentration, Performance and Workload Based on Subjective, Behavioral and Neurophysiological Insights. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, 1–14. https://doi.org/10.1145/3290605.3300284
19. Reschke, M., Somers, J., & Ford, G. (2006). Stroboscopic vision as a treatment for motion sickness: Strobe lighting vs. shutter glasses. Aviation, Space, and Environmental Medicine, 77, 2–7.
20. Russell, M., Price, R., Signal, L., Stanley, J., Gerring, Z., & Cumming, J. (2011). What Do Passengers Do During Travel Time? Structured Observations on Buses and Trains. Journal of Public Transportation, 14(3). https://doi.org/10.5038/2375-0901.14.3.7
21. Salter, S., Diels, C., Herriotts, P., Kanarachos, S., & Thake, D. (2019). Motion sickness in automated vehicles with forward and rearward facing seating orientations. Applied Ergonomics, 78, 54–61. https://doi.org/10.1016/j.apergo.2019.02.001
22. Shah, A. H., & Lin, Y. (2020). In-Vehicle Lighting and its Application in Automated Vehicles: A Survey. 2020 Fifth Junior Conference on Lighting (Lighting), 1–4. https://doi.org/10.1109/Lighting47792.2020.9240585
23. Sivak, M., & Schoettle, B. (n.d.). MOTION SICKNESS IN SELF-DRIVING VEHICLES.
24. Spector, R. H. (1990). Visual Fields. In H. K. Walker, W. D. Hall, & J. W. Hurst (Eds.), Clinical Methods: The History, Physical, and Laboratory Examinations (3rd ed.). Butterworths. http://www.ncbi.nlm.nih.gov/books/NBK220/
25. Strasburger, H., Rentschler, I., & Jüttner, M. (2011). Peripheral vision and pattern recognition: A review. Journal of Vision, 11(5), 13. https://doi.org/10.1167/11.5.13
26. The future of autonomous vehicles (AV) | McKinsey. (n.d.). Retrieved 17 December 2023, from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/autonomous-drivings-future-convenient-and-connected#/

# Digital Manufacturing of Tactile Maps to Improve Accessibility at Archaeological Sites

*Alfonso Morone, Edoardo Amoroso*[2]
*alfonso.morone@unina.it, edoardo.amoroso@unina.it*

*Università di Napoli Federico II, Italy*

***Keywords:***
*Accessibility*
*Archeological Sites*
*Inclusive Tourism*
*Digital Fabrication Techniques*

## Abstract

The paper presents interdisciplinary research conducted on tactile maps, focusing on their application in archaeological contexts. Through a design-driven process involving designers, archaeologists, interaction experts, and partners from IOT and communication sectors, the study explores innovative approaches to tactile map prototyping using additive digital manufacturing. It emphasizes the importance of universal design principles for enhancing accessibility to archaeological sites, particularly for elderly and disabled individuals. The research, centered on the archaeological areas of Paestum and the Campi Flegrei, incorporates rapid prototyping techniques and integrated sound systems to aid tactile and auditory navigation. Collaboration with the Italian Union of the Blind and Visually Impaired (UICI) ensured the effectiveness of the maps, with feedback from youth testers shaping the outcomes. The paper underscores the critical role of interdisciplinary design in addressing complex accessibility challenges, highlighting its significance in contemporary discourse.

## Introduction

The human body, with its needs and limitations, has always been a reference, both evocative and functional, in industrial design. Already at the dawn of functional discourse on technical products, an assimilation developed between human anatomy and industrial design, particularly evident in orthopedic furniture, prosthetics, and surgical instruments, serving as referen\ces for a new industrial aesthetic developed in the early decades of the last century. This idea matured to the point of formulating an assimilation of industrial tools as artificial limbs, through the theorization of "prosthetic objects" by precursors of the Modern Movement (Guidot, 1994).

In more recent years, the relentless advancement of technology and an increasingly open attitude towards disability issues have led to a new disciplinary openness (Shinohara et. al., 2016). The concept of design-driven processes has expanded towards goals that enable an enhancement of cognitive abilities for individuals with disabilities. A particularly promising field in this regard is the accessibility of cultural assets to people with disabilities. In this context, we will explore the role of "unexpected subjects" (Bernardini, 2022) and the impact of technological progress supporting ongoing transformations through the experience of the Mapper Research Project. This project

involved companies and university research institutions to develop a methodological process in the field of mapping capable of reproducing a tactile exploration of archaeological sites for visually impaired individuals.

This activity engaged user associations, along with companies, institutions, and researchers, to produce a replicable example in its methodological assumptions and operational applications.

## Ergonomics and Social Inclusion as drivers of cultural development

Ergonomics, in its journey towards establishment as a scientific discipline, has undergone considerable evolution, transitioning from resolving simple issues such as physical aspects of the work environment to a broader perspective that considers the complexity of interactions between humans and the surrounding environment. This development has led to the awareness that this discipline can provide a significant contribution to optimizing human and environmental resources, exerting a positive influence on the quality of life of various user categories and promoting usability, safety, psychophysical well-being, and healthy lifestyles for all potential users (Tosi et. al., 2022). The origin of this science dates back to the early stages of the Industrial Revolution when attention was primarily focused on productivity and efficiency. However, over time, the scope of application has expanded to embrace a more inclusive vision, taking into account the complexity of human diversity in terms of physical dimensions, abilities, and cognitive capacities. This evolution has led to the understanding that, in a society defined by the image or 'realm of the eye' (Maldonato, 1994) fundamentally anchored to visual content as a source of information, entertainment, and education (Packer & Kirchner, 1997), people with severe impairment or absence of vision risk being culturally and cognitively excluded (Braun, 2008).

Therefore, designing ergonomic products and services not only improves the performance and health of individuals but can also play a crucial role in addressing social inequalities as well as issues related to disabilities. In fact, environments, public places, and everyday objects that meet the needs of disadvantaged user categories not only improve their quality of life but also represent an important step towards breaking down social and cognitive barriers. In this perspective, principles go beyond ensuring compliance with norms or providing ad hoc solutions but, rather, promote an approach that values human diversity as a resource, encouraging the design of products that meet the needs of everyone, regardless of their abilities and skills. Through thoughtful choices, the ergonomic approach to design becomes a catalyst for the creation of environments and product systems in which every individual has equal opportunities to participate actively based on a structured process of evaluation and interpretation of needs (Rinaldi & Tosi, 2013).

## Conceptual evolution of disability and ergonomic implications in the context of Accessible Cultural Heritage

In contemporary times, the concept of disability has undergone significant transformations, especially since the 1970s, with the adoption of initiatives and services aimed at facilitating both the inclusion but also the integration and inclusion of people with disabilities. In this regard, it is crucial to make a distinction between these two terms. Integration, used in the past, indicated the inclusion of people with disabilities in a context without full participation in activities. Inclusion, on the other hand, aims

to engage, educate and develop an individual's potential, enabling him or her to participate fully in activities and develop autonomy, interpersonal and communication skills. In 1980, the World Health Organization drafted the document titled International Classification of Impairments, Disabilities and Handicaps (ICIDH), with the aim of providing a conceptual framework and common terminology for assessing the consequences of disease, trauma and other conditions on people's health, which introduced three main categories: impairment, disability and handicap. This is an early milestone whose foundations are all to be found in the 1970s and 1980s disability rights movements, which called for equality, accessibility and full participation in society thus promoting, a growing awareness of the need to shift the focus from an isolated medical condition to an approach that considered social and environmental impacts. This led to a revision of existing conceptual models, giving rise to new approaches that consider disability as the result of complex interactions between the individual and his or her environment. However, this classification did not consider an individual's time duration or level of disability, focusing only on pathological and environmental factors that influence autonomy. Subsequently, in 1999, the International Classification of Functioning and Disabilities (ICIDH-2) was introduced, which provided the basis for the International Classification of Functioning, Disability and Health (ICF) in 2001 being strongly affected by technological advances given by assistive technology and in assessment methodologies. These advances provided a more solid basis for understanding human functioning and made it possible to adopt a more detailed approach to classifying the consequences of disease and disability. The advancement of these issues, in an increasingly globalized scenario, has led to the realization that the adoption of conscious terminology is crucial to reflect on the human condition without emphasizing a general disadvantage. The term "person with a disability" emerges as the most appropriate, as it focuses on the individual rather than their condition. This expression emphasizes that disability is a social liability and develops only under certain conditions, indicating that it is not individual characteristics that create disadvantage and exclusion, but rather the interaction with behavioral and environmental barriers. So disability, itself, should not be interpreted as a simple impairment or deficit, but as a complex set of limitations and potentials that requires an ergonomically conscious approach in promoting accessibility to spaces, services, and products. Accurate understanding of these concepts is essential to ensure an inclusive environment that respects and values human diversity. In this context, a focus on accessible cultural heritage has developed more specifically.

## The different forms of disability: the blind

There are many different disabilities, and the different types are generally classified into: Hearing, motor, psycho-cognitive, and visual disabilities.

Specifically, regarding visual disabilities, the term "blind" denotes persons who have a total or partial absence of vision. This definition, designed to replace the older "blind," is regulated by provisions that stipulate how much a person must see to be considered blind. According to Article 2 of Law No. 155 of March 5, 1965, "Regulations for the Assistance and Social Integration of the Blind," anyone who has absolute blindness or residual sight of not more than one-tenth in both eyes, with any corrections, falls into the category of blind. Law No. 138 of April 3, 2001, titled Classification and Quantification of Visual Impairments and Standards for Eye Examinations, adopts the World Health Organization (WHO) classification. This classification recognizes different forms of visual impairment, providing a normative framework for quantifying low vision and blindness. The law distinguishes between totally and partially blind, severely, moderately severely, and mild-

ly visually impaired, outlining three macrocategories of visual impairment. The first category includes people with mild visual impairment, may have trouble in reading text or signs not designed according to principles of legibility. The main sensory channel for this category is vision, with the aid of glasses and lenses. The second category includes visually impaired persons with a reduced visual field; these individuals face difficulties in daily activities and moving in unfamiliar environments, even large ones. The visual channel is predominant, but touch and hearing can be used for support. The third category involves blind people with total lack of vision. These people face challenges in mobility and performing daily activities independently.

A distinction is made between the congenitally blind and those who have lost their sight during their lifetime. This category relies mainly on the senses of touch and hearing and uses advanced technologies such as voice systems, screen readers, and Braille displays as specific aids. INPS data for 2016 indicate that there are about 117 thousand blind people in Italy, representing 0.19% of the total population. This overview provides a concise but clear foundation on understanding the specific challenges and needs of this diverse audience in the context of designing inclusive environments and implementing resources for ergonomic strategies and approaches.

## Universal design principles: the tactile perception of the environment

In this regard, access to cultural heritage should not be considered a privilege, but rather, a fundamental right that contributes to individual and collective development, an issue not only of expertise but also of institutional vision as reflected in the recent ICOM pilot survey (Atzori et. al., 2023). The interaction between individuals and the traces, whether tangible or intangible, recognized as cultural and landscape assets forms the basis for their development and existence. Accessibility to heritage, in its various physical, economic, sensory, cognitive, and cultural forms, must be guaranteed by custodial institutions, scholars and mediators without being underestimated, especially taking into account how pervasive technology is in the contemporary world of those who experience a temporary or permanent condition of "dis-ability" (Pagano 2023). This, however, must be done with attention to preservation needs, recognizing the crucial role of culture in processes of social inclusion and actively involving the public in the construction of heritage-related knowledge. The issue of accessibility is intrinsically linked to the relationship between preservation and enjoyment. This involves overcoming architectural, physical, and perceptive barriers to guarantee access in all its forms to a wider audience, adopting an ergonomic approach to resources and following the founding principles of the Universal Design discipline.

Accessibility must be an integral part of the project, like other aspects such as safety, structural aspects, and thermo-hygrometric comfort. However, it is recognized that in its most generic sense it could put conservation at risk and in some cases, make compensatory measures such as multimedia stations, cameras, publications and three-dimensional models crucial. The concept of 'architectural barrier' has expanded over time, now considering not only motor obstacles, but also deficiencies in measures and signals that affect orientation, especially for the blind, visually impaired and deaf. In this regard, a crucial aspect is the recognition that these barriers constitute an obstacle for anyone, not only for disadvantaged categories of users and, for these reasons, the involvement of a design that focuses on man and his heterogeneous peculiarities is necessary to highlight the longevity of the product. The introduction of Universal Design, with principles formulated by

Ronald L. Mace along with a group of collaborators, pushes towards an approach that adapts to the various needs of people with the aim of overcoming the logic of standardized design, considering above all the human being in its various changing and unchanging conditions. Mace, who has had polio since childhood and therefore forced to move around in a wheelchair, defined this category in 1985 as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design." This type of barrier-free and accessible design for everyone draws inspiration from seven fundamental principles, including equity, flexibility, perceptibility, and error tolerance. While this principle found concrete applications in the United States as early as the early 1960s with the publication of the first barrier-free design standard, American National Standard A117.1, in Europe it received greater attention only thanks to the intervention of the European Commission, which has repeatedly emphasized the need to build a more user-friendly society. Universal Design then becomes a method to ensure that environments, products, services, and education, with technology as a supporting tool (Rose et. al., 2010), are accessible to people of all ages and abilities, in different situations and circumstances. However, designing for accessibility is not only about regulatory compliance, but also about the intuition of systems and products that are usable by anyone, at sustainable costs compared to specialized technologies. Ergonomic design focuses on adaptability, ensuring that spaces are safe, comfortable, and of high quality for all potential users. Therefore, overcoming the ideal model of the past is essential to address current and future challenges, promoting full participation in a cultural heritage accessible to all.

The tactile perception of the environment requires careful attention on multiple fronts: the characteristics of the sense of touch, as well as the mental processes of information memorization by those who are visually impaired, for example, are essential requirements in the design of a tactile map. They must meet the needs of the visually impaired using appropriate luminance contrasts, easily perceptible font sizes and types, both by touch and by limited residual vision, and may also include path and location schemes, simplified symbols for architectural elements and services, Braille texts, raised characters, and enlarged high-contrast characters for the visually impaired. Generally, a map consists of a header, a legend, and the plan of the place, and, depending on the represented environment, they are divided into path maps or location maps. The former provide information for autonomous orientation, while the latter represent necessary references for walking in environments with more complex morphological details.

## Access to aesthetic experience by blind and visually impaired individuals.

In Italy, various associations such as sections of the Italian Union of the Blind and Visually Impaired (UICI) have promoted several initiatives to facilitate access to the world of art for visually impaired individuals. These initiatives include the creation of dedicated tactile museums, such as the Tactile Museum of Ancona and the Aptico Museum of Palermo, as well as integration interventions in traditional museums, such as guided tours and information in Braille. These efforts are aimed at making works of art accessible to everyone, with particular attention to people with visual disabilities. The dispersal of artworks that are of interest to scholars or the personal curiosity of blind individuals, often difficult to reach or inaccessible for various reasons, has led to the creation of dedicated tactile museums organized ac-

cording to different historical or aesthetic interpretative categories. Visiting a tactile museum requires careful preparation, with a preliminary study of the works to be "seen" through touch. These museums, fully accessible to the blind, are designed to offer meaningful sensory experiences. They are also places of education that provide cognitive tools to appreciate different experiences of cultural heritage enjoyment. It is important to note that the memory of a tactile image is more fragile than a visual one and requires updates over time, and in this regard, technologies such as 3D printing or sound reproductions offer the opportunity to discover new experiences by calibrating the most significant information to be transmitted within these spaces.

The increase in museum structures is evident, demonstrating how, in Italy and throughout the Mediterranean region, total enjoyment of cultural heritage can finally be achieved not as isolated episodes but as a widespread practice, which, supported by technological innovations, contributes to breaking down the invisible barriers of social exclusion. Within this macro-category, there is a particular focus on archaeological sites: at the Museum of the Excavations of Pompeii, for example, a path for the blind was inaugurated with a dedicated synthetic model of the famous fresco of "Hercules as a Child" from the House of the Vettii. An experimental perception service that uses a sophisticated computerized system and the aid of sounds and audioguides capable of experimenting with various types of audiences, promoting participation in these museum experiences of inclusion and social equity (Sandell & Nightingale, 2012) focuses on adaptability, ensuring that spaces are safe, comfortable, and of high quality for all potential users. Therefore, overcoming the ideal model of the past is essential to address current and future challenges, promoting full participation in a cultural heritage accessible to all.

## The Mapper Case: How to Intervene on the Use and Management of Resources for Cultural Heritage

Within the outlined context, it is of utmost importance to introduce examples that, beyond the case itself, can serve as models for the advancement of a discipline in constant and incessant evolution in relation to the progress of digital technologies. In particular, the aim is to illustrate the realization process and the design-driven methodological structure activated in the research project "Mapper - Online maps and 3D tactile maps to innovate the modes of tourist enjoyment and cultural heritage," a research project promoted by Gruppo FOS S.p.A. articulated in two sessions: "Mapper – Online Maps" designed to create and share a repository of maps, itineraries, and suggestions, alongside common tools, and "Mapper – 3D Tactile Maps" which aims to create three-dimensional reproductions of places, works, and artifacts, accompanied by interactive audio extensions of two map prototypes for a visually impaired audience. The main objective of the design experimentation was to rework and communicate spatial information through the senses of touch and hearing, thus trying to bypass the visual limitations of blind or visually impaired individuals, allowing them, even in the presence of deficits, to understand the environment independently and informatively.

The major challenges to be faced concerned the difficulties experienced in autonomous navigation, which leads to less frequent traveling. This affects the lives of people with visual disabilities personally and professionally, leading to forms of social exclusion. However, orientation, the component, often proves difficult when a person relies on non-visual sensory informa-

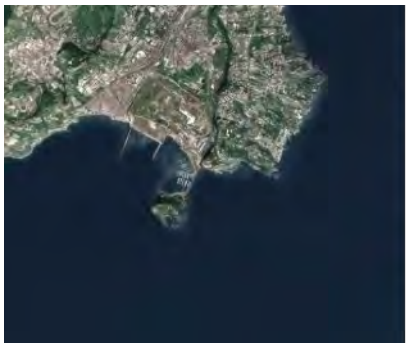


*Figure 1. Satellite view of Campi Flegrei, 2023: Image by Google Earth pro*

*Figure 2. Aerial view of the archaeological area of Paestum, 2020: Photo by Paestum&Velia*

tion, as sight conveys more spatial information simultaneously than other sensory modalities. Orientation involves processes such as spatial updating, mental rotation, shortcut finding, and deviation calculation, which are also linked to the formation of cognitive maps. These processes, however, are often considered difficult in the absence of visual information. Therefore, it is important to address map formation based on non-visual sensory information. The design team, leveraging the principle of the human brain's ability to form such "mind maps" of a spatial environment, focused on the tactile sensory mode, starting with the identification of two sample geographical areas to map: the Campi Flegrei (figure 1) and the archaeological area of Paestum (figure 2).

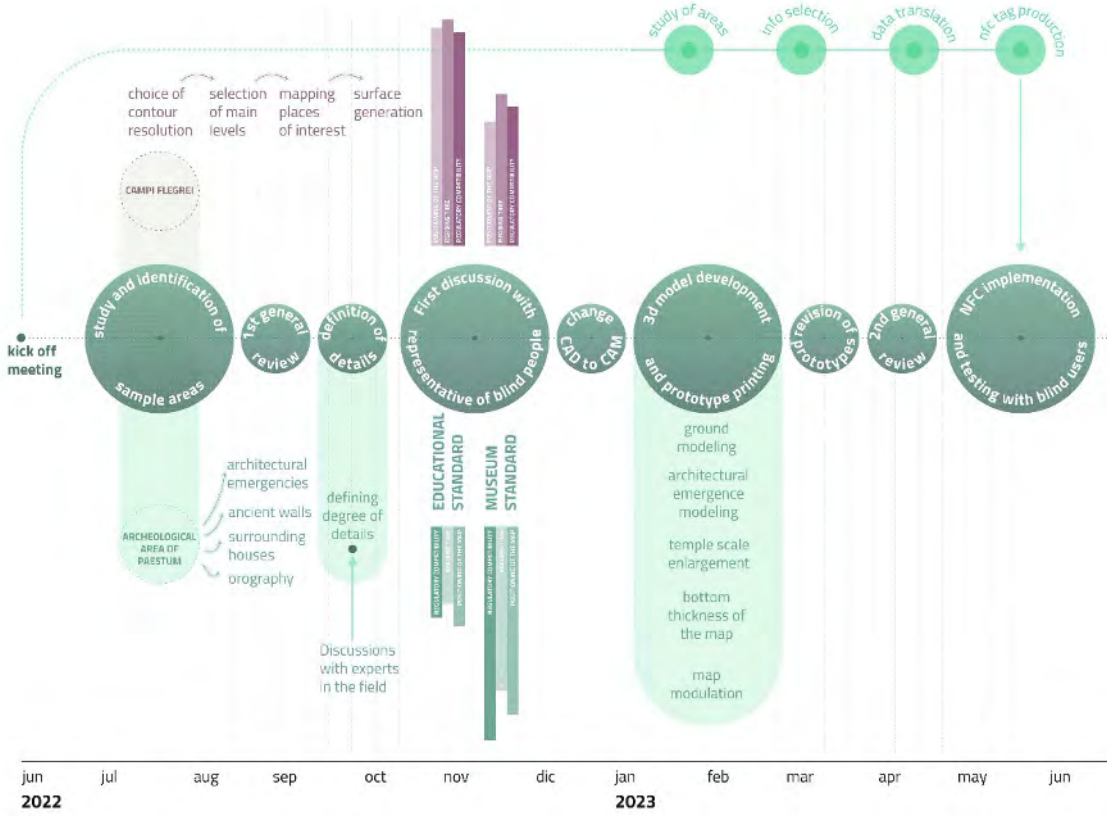



*Figure 3. Design process map and implementation steps by Edoardo Amoroso*

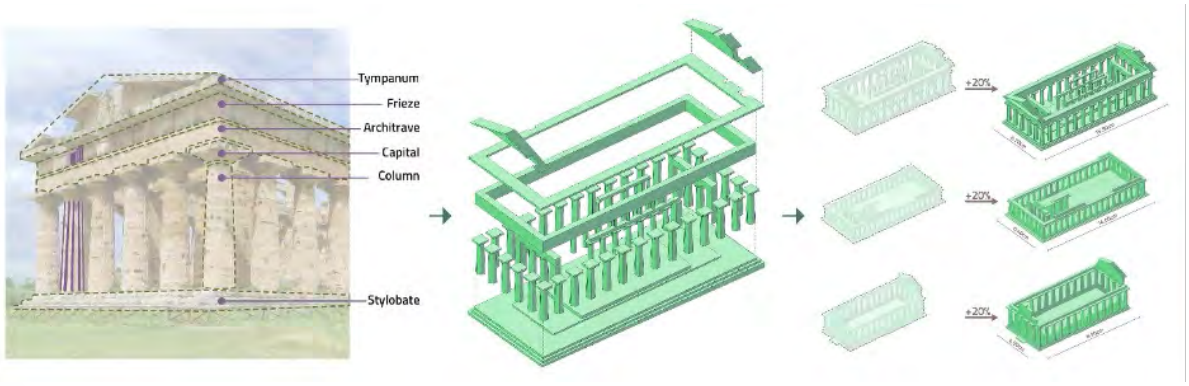
Given the specificity of the archaeological areas, experts in the field were also involved in the design process to guide the hierarchical selection of elements to be represented, which necessarily underwent a reduction process compared to what is present. This phase was followed by the creation of a

three-dimensional digital model of the areas of interest and the production of tactile maps through additive manufacturing technology. The prototypes produced include an integrated system to accommodate a sensor capable of activating sound streaming through a smartphone, providing additional information on the map, thus complementing the cognitive orientation already provided by the base map. The design team initiated its activities by identifying the sample geographical areas, the Campi Flegrei and the archaeological area of Paestum, as zones of genuine interest for the experimentation of tactile maps. The choice fell on these two areas because they offer different challenges and opportunities in terms of size and detail, which could be of extreme interest for a methodological definition of the adopted process (figure 3), for the purpose of its desirable generalization.

In this first phase, topographic, geographic, and archaeological data were collected for each area to generate an indispensable database for the creation of an accurate and detailed three-dimensional digital model considering places, areas and distances. This initial data collection was accompanied by a phase of area framing, considering, for each elaboration, the elements characterizing the places. Indeed, preparing an area on which to develop a tactile map means, first, questioning oneself about the levels of information that can potentially be transmitted to users. Therefore, based on critical judgment, in the case of the Campi Flegrei map, the numerous monogenic volcanic craters defining the orographic singularity of the super volcano were considered, while, in the case of the archaeological area

*Figure 4. Contour line extrapolation by Edoardo Amoroso*


*Figure 5. Calibration of printing details by Edoardo Amoroso*



of Paestum, attention was focused on the archaeological emergencies that characterize the entire park based on their historical and cultural relevance. For each area, a three-dimensional digital model was developed using geospatial data and topographic surveys. From these data, in the form of point clouds or digital elevation models (DEMs), accurate virtual representations of the areas were developed using three-dimensional modelling software that, including elevations and structures in elevation, as well as emerging geomorphological structures and geographical features, returned surfaces and accurate meshes. For the Campi Flegrei, the model highlighted the volcanic zones, the volcanic lakes, and other distinctive geomorphological features of the territory, as well as the islands of Procida and Ischia, representing the entire Phlegraean territory on a large scale (figure 4).

For the archaeological area of Paestum, the model emphasized the archaeological emergencies with a high level of detail, accentuating the main temples and decreasing secondary features of minor archaeology (figure 5), adapting to the scale at which the map was conceived. These digital reproductions, formalized using specific modelling software, formed the basis for the maps. In fact, on these models, a series of adjustments were made to calibrate the detailed reproductions into calibrated 3D maps with respect to the information to be transmitted. In the Campi Flegrei map, to emphasize minor reliefs and the basins of the volcanic lakes, a dotted pattern was applied to the sea surfaces, thus preventing potential perception errors regarding the boundaries of the coastline. A completely different approach was taken for the archaeological area of Paestum where, to better understand the

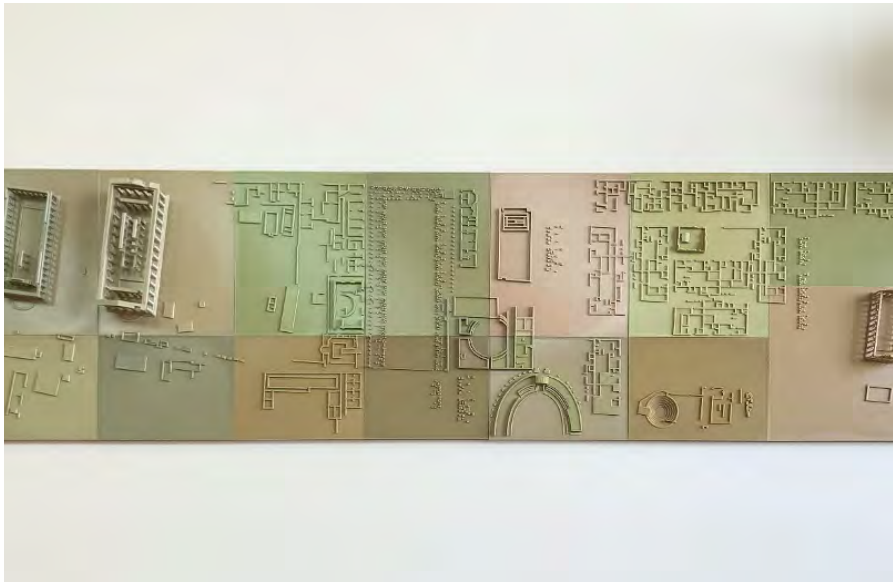


*Figure 6. Top view of the printed Paestum map: Photo by Edoardo Amoroso*

architectures, there was a slight percentage increase in the overall volume, thus allowing for easy exploration of the inter-column spaces of the map, for example, the intercolumniation of the temples. Here, being a predominantly flat area, it was chosen not to represent the minimum changes in elevation, once again filtering out less significant details to communicate.

## Designing maps, the integrated sound system, production, and testing

Using the digital model as a reference, tactile maps were created through additive manufacturing technology, commonly known as 3D printing. The

design team used the digital models created in the previous phase to generate 3D printing files. Topographic, geographic, and archaeological details were translated into tactile reliefs on the surface of the maps. This synthesis process allowed for the translation of digital information into a tangible

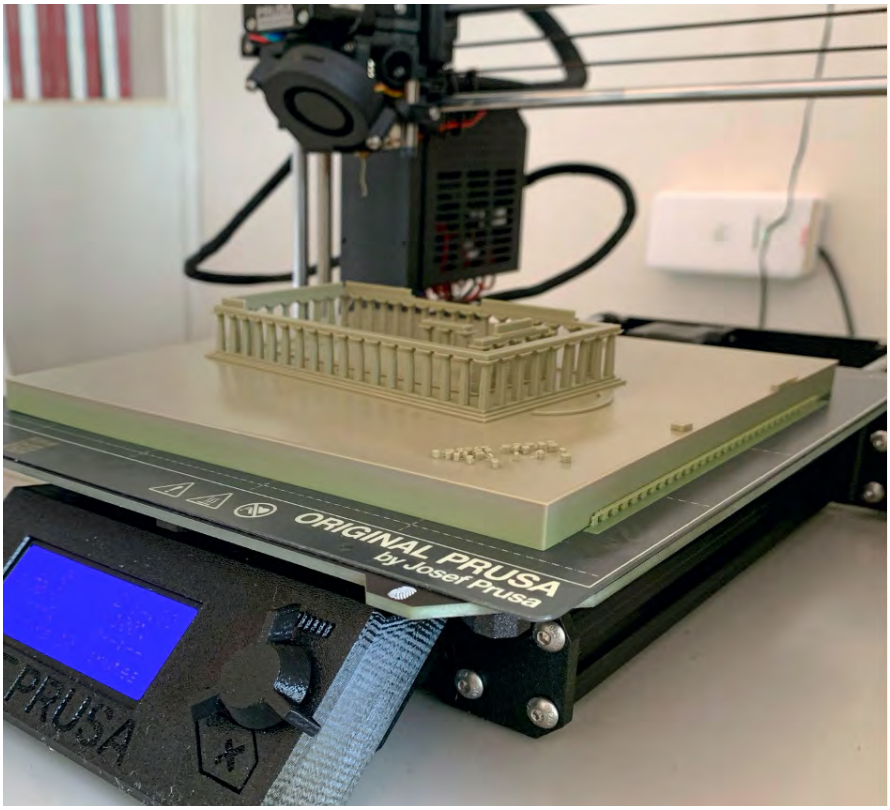



*Figure 7. Form B1 during the printing stage: Photo by Edoardo Amoroso*

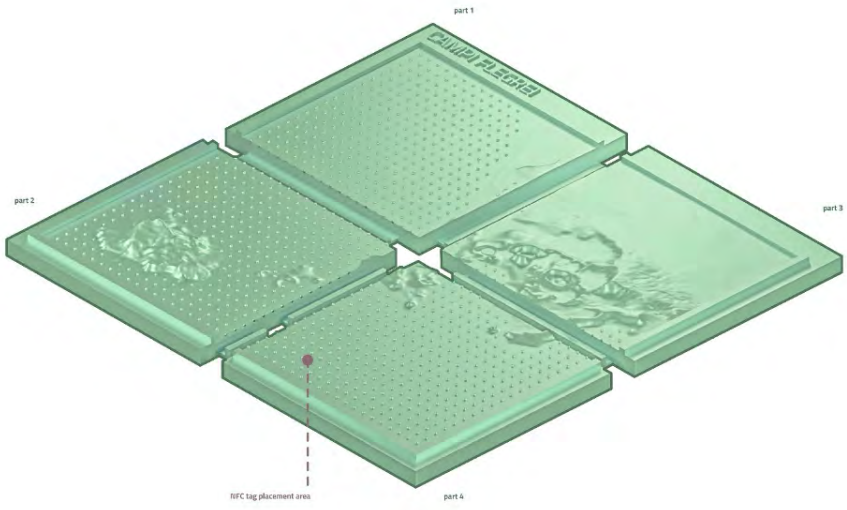



*Figure 8. NFC module and tag identification diagram by Edoardo Amoroso*

*Figure 6. Top view of the printed Paestum map: Photo by Edoardo Amoroso*

physical representation, ensuring that the salient features of the area were clearly perceptible to touch. The scale of the maps was selected based on the specific needs of each area: broader for the Campi Flegrei, in order to render its peculiar geomorphological characteristics, and more detailed for Paestum, in order to accompany the tactile visitor into a more properly architectural and archaeological dimension (figure 6).

Each tactile map was designed to accommodate an integrated sensor (figure 7). When activated via smartphone, this sensor generates an audio stream of information related to the map and provides an additional audio experience to support blind and visually impaired users. For this purpose, the design team developed an intuitive interface for the activation and management of the system, ensuring a user-friendly experience for users.

A crucial aspect of the design was the definition of an efficient methodology for translating the digital model into the physically printed 3D map. Both maps were adjusted relative to the printing beds and divided into multiple parts. Then, was developed a connection and attachment system between the modules and the conversion phase from CAD to CAM model (Computer Aided Manufacturing) was carried out, through which data are directly acquired from the 3D model to organize Numerical Control (NC) applications and govern tool movement (Empler 2023). The process was iterative, with regular testing and feedback to ensure the accuracy and usability of the tactile maps (figure 8).

Several representatives of the Italian Union of the Blind and Visually Impaired were indeed involved in a testing chamber that consolidated the research work carried out and resolved several questions regarding some choices made during the design phase (figure 9). Having the opportunity to work in direct continuity with entities representing the potential users of a product emerged as a valuable opportunity to elevate and optimize the resources deployed.

## Future innovations and challenges

Digital manufacturing and advanced technologies such as 3D printing have revolutionized the production of customized components. The Mapper project was born with the aim of positioning itself within this technological revolution, setting out to intervene ergonomically on cultural heritage

by designing and implementing strategies tailored to user comfort while preserving the authenticity of the environment in which these products are to be inserted. Rapid prototyping has played a key role in this context. It has allowed for testing and refining solutions in a short time, facilitating the co-design process with the involved stakeholders.

The concept of personalized comfort, in this regard, encompasses various dimensions, including physical accessibility, sensory enjoyment, and emotional interaction. Rapid prototyping has also enabled the experimentation of different sensory solutions, such as lighting models or tactile materials, to ensure a rich and inclusive experience for all. The potential of this research lies precisely in this resource management. The creation of these models, through digital replicas first and then printed reproductions, becomes a potential subject of study for cross-cutting issues: restoration interventions, educational or exhibition purposes. In this way, by adopting an ethical and responsible approach, we also take on the responsibility of preserving heritage in the long term, as well as addressing an accessibility and enjoyment challenge in the immediate future. This is achieved through continuous dialogue with industry experts, conservators, communities, and local authorities, enabling a conscious management of resources and guiding designers and the technologies they employ towards a greater harmonious balance between innovation and conservation.

## Acknowledgments

Although this paper is the result of joint work by the two co-authors, it is specified that Alfonso Morone wrote paragraphs 1,3,4 and 6, while Edoardo Amoroso wrote paragraphs 2, 5, 7, 8. Conclusions are attributed to both co-authors.

# References

1. Blankenbach, K., & Isele, R. (2019). 57.1: Invited Paper: Automotive Interior Lighting: ChalAtzori, I., Ballor, C., Barbuti N., Bonacini, E., Paolo, C., De Bari, M., Faccini, M., Farroni, L., Fiore, F., Genova, G., Guerzoni, E., Magliano, V., Maniello, D., Mannucci, M., Marras, A.M., Pagano, A., Santagati, C., Schettino, P., & Tonelli, A. (2023). Report dell'indagine pilota su Digitale e digitalizzazione nei musei italiani (2020 – 2021): un'analisi e prospettive future. ICOM Italia. https://doi.org/10.5281/zenodo.8074816.
2. Bernardini, M.G. (2022). Imprevisti. La "lotta per i diritti" delle persone migranti con disabilità, in «Sociologia del diritto», vol. 3, pp. 77-89.
3. Buxton, W. 2007. Sketching user experiences: getting the design right and the right design. Elsevier/Morgan Kaufmann.
4. Cook, A.M. and Hussey, S.M. 2002. Assistive technologies : principles and practice. St. Louis: Mosby
5. Empler, T. (2023). Voce" CAD"-Computer Aided Design. In L'ARCHITETTURA-Architettura Progettazione Restauro Tecnologia urbanistica (direzione scientifica di G. Carbonara e G. Strappa). UTET Scienze Tecniche.
6. Guidot 1994 Raymond Guidot Histoire du Design 1940-1990, Hazan, Paris, 1994.
7. Mace, R. (1985). Universal design: Barrier free environments for everyone. Designers West, 33(1), 147-152.
8. Marras, A. M. (2023). Processi di digitalizzazione e accessibilità digitale negli istituti MAB. Orizzonti di accessibilità. Azioni e processi per percorsi inclusivi. Accessibilità e patrimonio culturale, 69.
9. Pinnelli, S., & Fiorucci, A. (2013). Accessibilità e inclusione. Kirikù e la strega Karabà-AD: una ricerca intervento in classe. Learning & Teaching with Media & Technology, 607.
10. Rinaldi, A., & Tosi, F. (2013). Design, Ergonomia e Sanità. In L'Ergonomia verso un modello di città sostenibile: fattore umano, tecnologie, inclusione sociale, comunicazione (pp. 08-14). SIE-Società di Ergonomia.
11. Rose D., Gravel J., Domings Y. (2010). UDL Unplugged: The role of Technology in UDL. Estratto da National Center on UDL: www.udlcenter.org
12. Sandell R., Nightingale E., 2012.Museum, equality and social justice. Routledge, New York, 320 pp.

13. Shinohara, Bennett, Wobbrock, (2016) .How Designing for People With and Without Disabilities Shapes Student Design Thinking, Kristen Shinohara, Cynthia L. Bennett, Jacob O. Wobbrock, Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility October 2016 Pages 229–237 https://doi.org/10.1145/2982142.2982158
14. Tosi, F., Brischetto, A., Iacono, E., & Rinaldi, A. Design, inclusione e sviluppo sostenibile.

# TREELOGY: Preserving Urban Forests through IoT Monitoring Data of Greenery

*Alfonso Morone, Mariarita Gagliardi, Silvana Donatiello*
*alfonso.morone@unina.it*
*mariarita.gagliardi@unina.it,*
*silvana.donatiello@unina.it*

*University of Naples Federico II, Naples, Italy*

***Keywords:***
*Urban Forests*
*IoT sensors*
*AdditiveManufacturing*
*Data Monitoring*

## Abstract

The aim of the paper is to explain the methodology and outcome of an R&D project involving designers, data scientists and botanists along committed in the field of Nature Based Solutions, with the goal of creating new systems (Cabinets) to monitor the health and stability of urban forests. They offer opportunities and risks related to the stability and development in anthropic environments. Therefore, a new interdisciplinary approach to managing and monitoring this emerging problem is essential. The Treelogy project represents an important step forward in this field through IoT multisensory systems that collect data in a cloud, allowing targeted mitigation and remediation choices to be made. Additive manufacturing methods are used to make monitoring system prototypes. It is therefore clear that the transdisciplinary approach of design, computer science and botany is essential for the development of new research processes aimed at solving complex problems.

## Introduction

Urban forests play a crucial role in addressing challenges related to climate change within increasingly complex urban areas. In addition to creating connectivity between urbanized land, agricultural land and forest land, it is evident that trees have a mitigating function on urban air temperatures. The temperature difference between urban and suburban areas with forest cover show differences exceeding 10 C. This finding characterizes the urban heat island. As a consequence of thermal regulation by evapotranspiration, a tree, for each cubic meter of wood, can release about 150 cubic meters of water vapor into the atmosphere, contributing significantly to regulate temperatures in the microenvironment surrounding it (Daina, 2017). This reactive capacity is amplified by the tree density of urban forests, which also have a crucial impact in combating air pollution through the reduction of particulate matter (Salbitano, 2020).

To ensure the effectiveness of these responsive systems, it is necessary to carefully understand and monitor their health and stability through the collection and interpolation of a wide range of parameters related to plant physiology, environmental conditions and structural stability of elements integrated into the urban context. In 2018, the Italian Ministero dell'Ambiente e della tutela del Territorio e del Mare (currently the Ministry of Envi-

ronment and Energy Security) through the Strategia Nazionale del Verde Urbano (National Urban Green Strategy) focused on the topic of environmental monitoring. Taking correct information on plant health status (biomonitoring) and monitoring environmental data on air quality are essential for the identification of urban and peri-urban soils where management intervention is a priority in order to improve the potential of tree systems in the phytoremediation (Atelli et al., 2018).

Data acquisition systems and their integration into widespread networks that enable the selection and diffusion of environmental information turn out to be an emerging aspect in the so-called Nature Based Solutions. This field explores new interaction forms between industrial design and socio-technical innovation processes, involving social communities, service systems and production, interconnected through IoT processes (Baek et al., 2018).

A critical perspective is able to recognize and avoid the risks of contemporary data-driven technologies by acting within the emerging processes of formalizing the digital collective (Tactical Technology Collective, 2017). Research has developed data-driven solutions that can help take in a critical mass of information that is also extremely useful for implementing environmental policies and building collective awareness of the effectiveness of urban forests in dealing with environmental problems and their maintenance status. In this context, it is possible to refer to codified processes of developing, producing and visualizing the communicative language of data, data set desk; data set field; data set full (Sicat et al., 2018). Within this perspective, the implementation of strategies involving the use of advanced IoT sensor systems is crucial for the sustainable and digital development of the urban environment. The design, management, and monitoring of urban forests is only possible through an interdisciplinary approach, where expertise in design, computer science, and botany converge.

This paper explores the interdisciplinary R&D project Treelogy and its impact in promoting advanced urban forest monitoring and management solutions that can address environmental challenges in future cities. It will also illustrate the design process of prototypes intended to specialized measurement cabinets, made through the use of additive manufacturing technologies.

## Urban Forests

More than half of the world's population lives in urban areas and by 2030 one out of three people will live in a city with more than one million inhabitants (United Nations, 2016). Building resilience against urban stresses has become a major priority for both local governments and citizens. It is crucial to make Smart Cities healthy and attractive places for the long-term development of societies. Trees and forests in the rural-urban continuum can play a distinctive environmental, social and economic role. In this perspective, Urban Forests can offer a key tool for maintaining environmental balances and a wide range of benefits for the well-being of citizens (Figure 1). Interaction with nature has a positive impact on physiological functions and health, psychological and spiritual well-being and improved cognitive functions (Fuller et al., 2007).

Urban Forests represent an urban green infrastructure (UGI) that meets the need to preserve and continuously improve the environmental quality of cities (Pearlmutter et al., 2017). Trees act as environmental engineers, providing benefits that are indispensable to both human inhabitants and all other living organisms in the urban ecosystem. These benefits, known

as ecosystem services, arise from the need to balance the impact of human activities on the environment and include moderation of microclimate and thermal stress, mitigation of air pollution, CO2 capture, water regulation and purification, improvement of soil quality and biodiversity (Economy, 2014). The sustainable development of smart cities requires transdisciplinary strategies, ensuring collaboration among the various disciplines involved, such as urban planning, local economic development, design, botany, accompanied by the digitalization of forests. The implementation of cutting-edge technologies used for monitoring, acquisition and analysis in the field of Urban Forest research and development is necessary, as it enables detailed data on the health of the tree components of the urban ecological network, enabling cities to make thoughtful decisions and develop targeted strategies to ensure a healthy and sustainable urban environment. Technologies that can be used effectively to achieve these goals include the Internet of Things, wireless sensor networks and the Internet of Trees. (Singh et al., 2022)

The urban scenario represents an element of pressure on the health and stability of these interconnected ecosystems and added to this are the ongoing dynamics regarding climate change with the dramatic consequences that accompany it (Figure 2). The combination of these factors can lead to

*Figure 1. The Forestias project by Foster+Partners in Bangkok, 2016: Image by TK Studios on LandscapeArchitecture.*

*Figure 2. Bosco Verticale Project by Boeri Studio in Milan, 2014: Image by Boeri Studio on StefanoBoeriArchitetti.*

the deterioration of the health status of urban forests resulting in the loss of their ecosystem functionality (reduced provision of ecosystem services for the population) and increased risks related to the physical stability of structures (increased chances of tree collapses resulting in damage to people and property). It is therefore essential to work on projects that aim to integrate technological and advanced solutions through IoT and AI sensor systems in order to preserve and accurately manage Urban Forests.

## Design-Driven approach

Within the project, design plays the crucial role of mediating and catalyzing between knowledge, activating interdisciplinary contributions, through a design-driven approach, such that design can be placed at the centre of the transition and innovation management process (Lotti, 2022). This approach embraces an iterative design cycle. Designers develop prototypes, gather feedback from users, make changes and iteratively refine the product or solution. This continuous cycle allows for dynamic adaptation to emerging needs. Another distinctive feature of this approach is interdisciplinary collaboration: design is able to involve professionals from different disciplines who collaborate together to ensure a comprehensive and integrated perspective during the development process.

This type of approach is effective in solving complex problems, implementing innovative solutions that go beyond the application of conventional methods, often introducing new patterns of thinking and creative approaches. By using a systemic approach where different disciplinary fields intersect, it is possible to develop a structured system that forms the basic methodology for implementing the design phases (Figure 3). It is a new design space, in which design methods can be profitably applied, through the participation and coordination of multidisciplinary project teams that work on system and product definition by working synergically on the physical and information planes, the forms of matter and data. In this way, the approach becomes organic, multidisciplinary and elastic, challenging classical design categorizations (Mincolelli, 2017). The design-driven approach, given its aptitude for solving complex problems, is particularly effective within a methodology aimed at fighting climate change and pursuing a sustainable, digital future. Constant reflections on Nature Based Solutions (NBS) and environmental monitoring through IoT demonstrate how design, as a process director, produces innovation by including within theoretical and scientific pathways hybridizations of available technologies, activating a

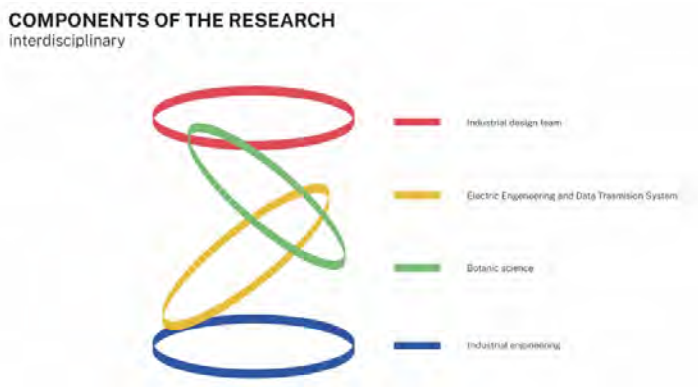



*Figure 3. Multidisciplinary processing diagram by design team.*

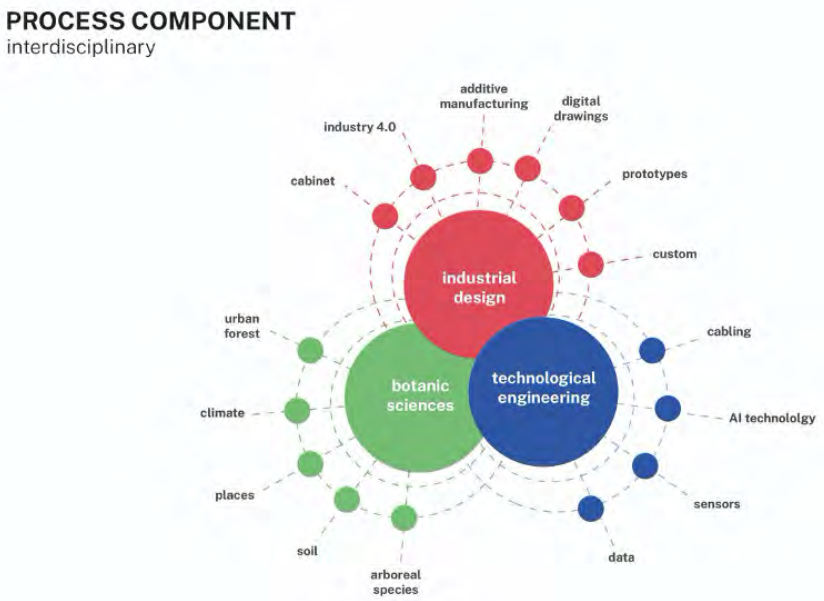



*Figure 4. Components of the research diagram by design team.*

system in which creativity, technology and multiple disciplines combine into a solution that is readily available (Figure 4). This concept is well summarized in the catalogue of Nature collaborations in design exhibition by Cooper-Hewitt Museum through the statement:

*The approach is transdisciplinary and involve scientists, engineers, advocates for social environmental justice, artists, and philosophers, who apply their conjoined knowledge toward a more harmonious and regenerative future... The challenges to our planet today are so complex that they cannot be solved by one discipline. Design is the bridge. It translates scientific ideas and discoveries into re-la-world applications. (McQuaid, 2019, pp. 6-9)*

## The project

The main objective of the project is the implementation of IoT sensor systems that are useful for monitoring urban forests in order to obtain the necessary tools for proper and thoughtful management of greenery in urban context. Specifically, eco-physiological parameters, photosynthetic efficiency, evapotranspiration and water stress, carbon sequestration, biomass and woody growth and canopy health status of sample individuals of the urban forest were monitored, determining their health status and predicting the occurrence of systemic distress of the entire urban forest related to biotic agents such as fungal pathogens, pathogenic pests, and defoliating insect pulls, and abiotic agents such as drought, extreme or unseasonal thermal events and air pollution. Another key aspect relates to the stability of trees in urban settings, reporting in advance warning situations that in extreme weather events could lead to collapses that would undermine the safety of property and people. Particular attention is paid to capturing data on environmental safety and health levels related to air quality, airborne particulate matter and gaseous pollutants, extreme weather events, heat peaks in the summer season and the occurrence of forest fires.

These functional requirements are fulfilled by three different systems, each composed of multiple sensors, working in synchrony to provide an accurate picture of the health, efficiency and stability of urban forests. The idea is to design and implement systems that are as compact and manageable as

possible for easy installation anywhere in urban forests.

Sensor systems, through IoT technology, communicate with each other and with a cloud. The collected data, through the use of AI, offer predictive

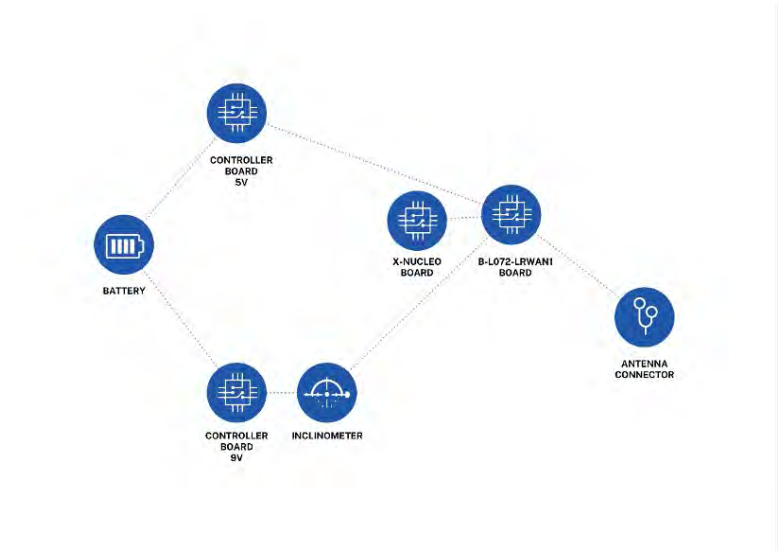



*Figure 5. Node 1 stability diagram by design team*

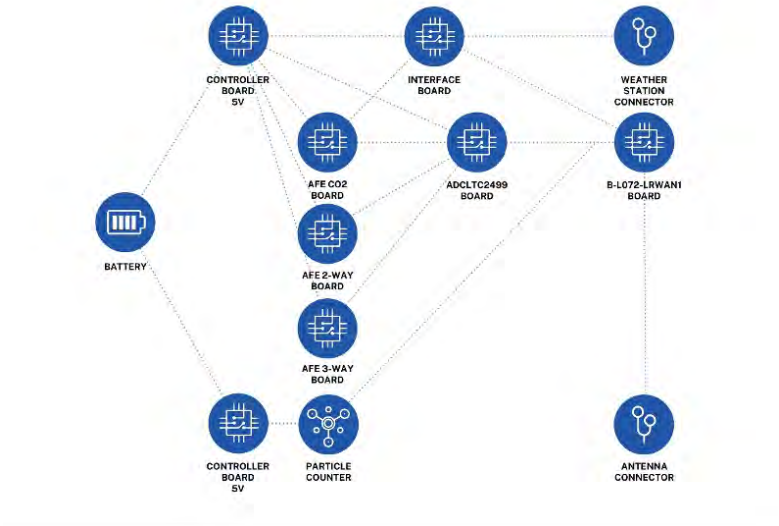



*Figure 6. Node 2 physiology diagram by design team.*

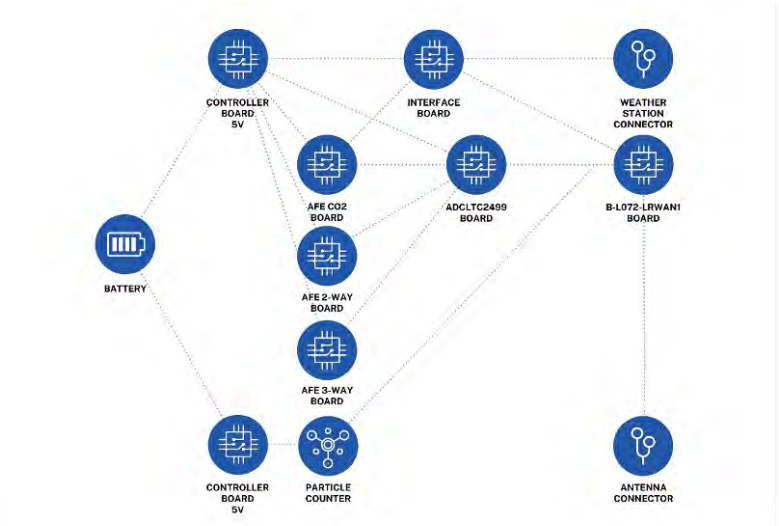



*Figure 7. Node 3 environmental quality diagram by design team.*

scenarios that provide the basis for making choices and performing specific mitigation and corrective actions. The design team specifically dealt with all phases of the design of the sensor systems, which consists of three main nodes, each dedicated to specific functionalities, defining: the stability node, the ecophysiology node and the environmental monitoring node. The first two nodes will be placed at a variable height along the tree trunk (stability and physiology), so as to directly monitor the status of the specific tree species (Figure 5 and 6). On the other hand, the last node is placed on a stand within the urban forest space to monitor its general condition related to environmental quality (Figure 7). This project was realized thanks to the collaboration between the design team of the University of Naples Federico II and the DST of the University of Sannio, for the botanical and Data Science components ensuring an integrated approach. Through the sharing of mechanical and functional specifications related to the various nodes, it was possible to optimize the study of the different components of these systems.

## Methodology and Additive Manufacturing

The Cabinets are designed to monitor various ecophysiological, stability and environmental parameters within an urban and forest context. In this regard, the design team played a crucial role in conceiving the Cabinets and making the prototypes through the use of additive manufacturing technologies.

The use of additive manufacturing (AM) in creating sensor protection units dedicated to environmental monitoring represents an innovative and effective approach. Additive manufacturing, commonly known as 3D printing, offers a number of advantages that can be crucial in this specific context. One of the main advantages of AM is the speed of this technology. The speed advantage is not just about the time it takes to build parts. The acceleration of the entire product development process relies heavily on the use of computers through the smooth transition from 3D CAD to AM. Just as 3D CAD is becoming what you see is what you get, so is AM, and we could safely say that what you see is what you build (Gibson et al., 2021).

The key aspects that make this technology the most suitable solution for the realization of Treelogy Cabinets are primarily derived from personalization and optimization. Additive manufacturing allows the creation of highly customized control units tailored to the specific installation needs and surrounding environmental characteristics (Figure 8). This design flexibility enables the optimization of control units to enhance sensor accuracy and ensure greater resistance to adverse environmental conditions. 3D printing also enables the production of components with high geometric complexity, facilitating the integration of multiple sensors and protective devices into a single unit (Figure 9). This approach allows for increased functionality in a limited space, improving the overall efficiency of the Cabinets. In addition to these principles, additive manufacturing offers the possibility of using advanced materials, such as specialized polymers or weather-resistant additives. The targeted selection of materials contributes to ensuring the long-term durability of the product, especially considering continuous exposure to external agents. 3D printing enables more efficient production, reducing production times compared to traditional methods. This not only contributes to the rapid implementation of control units but can also reduce pro-


*Figure 8. 3D printing phase of the cabinet prototype: Photo by design team.*

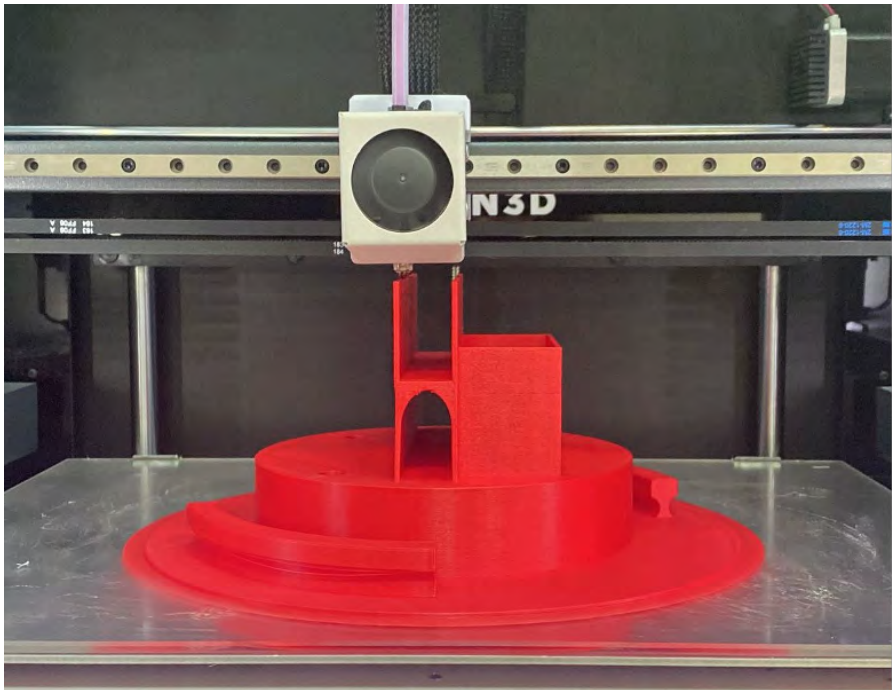



*Figure 9. 3D printing phase of the cabinet prototype: Photo by design team.*

duction costs, especially in small-scale production or prototyping scenarios.

The flexible nature of additive manufacturing allows easy adaptability of control units in response to technological advancements or changing environmental needs. The ability to make changes quickly and cost-effectively ensures that control units remain at the forefront in terms of functionality and performance. Some additive manufacturing techniques allow the use of recyclable materials, reducing the overall environmental impact of the production process. The application of additive manufacturing in creating protection units for dedicated environmental monitoring sensors offers a flexible, efficient and highly customizable approach, contributing to improving the reliability and effectiveness of monitoring systems.

## Process

The methodology of the project involves the division of work into phases, one propaedeutic to the other. All phases of the project process leading to the realisation of the cabinets will be described in detail. The phases include:

needs analysis, conceptual design, detailed design, simulation and virtual testing, assembly and integration and prototypes testing.

6.1 Needs analysis

The needs analysis was essential to fully understand the requirements of each of the three monitoring system: ecophysiology, stability and environmental monitoring. This approach allowed a complete and integrated view of the needs of the system. A detailed analysis of the parameters to be monitored was carried out. The variables studied concerned plant ecophysiology, soil or structural stability indicators, as well as environmental parameters such as temperature, humidity and other relevant factors. Identifying these parameters was crucial to guarantee that the monitoring systems were able to capture and record all the information necessary to monitor and control the system. Subsequently, the environmental conditions in which the cabinets are to be located were examined. Factors such as exposure to sunlight, the presence of atmospheric agents, ambient temperature and other elements that could influence the performance of the system were evaluated.

## Conceptual Design

The conceptual design for the cabinets involved several key aspects, considering the specifications gathered during the needs analysis phase.

The dimensions of the cabinets were considered to guarantee that they would be adequate to accommodate the sensor systems used by the project. The internal layout was, therefore, designed to maximise space efficiency, while providing easy accessibility for maintenance and monitoring. The fixing systems were chosen from those most suitable for mounting the control units on the trunk of the trees and on supports (poles) fixed to the ground. The design team provided a system with slots on the back of the cabinets to anchor the prototypes directly to the trunk by means of sturdy straps, with the possibility of choosing the most suitable height for the different situations to be monitored (Figure 10).

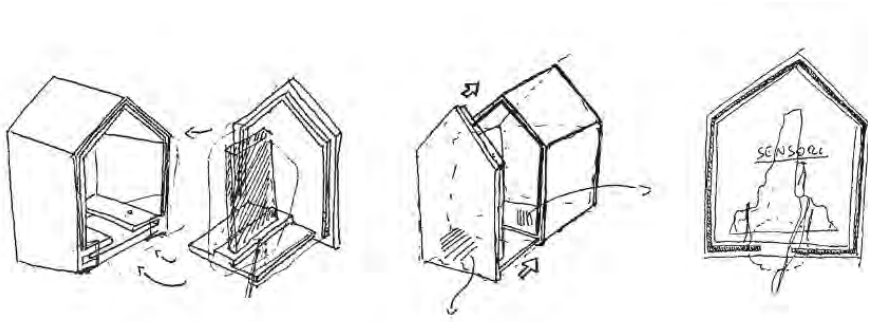



*Figure 10. Conceptual design sketches by design team.*

The choice of materials took into account the need to resist the adverse environmental conditions. Therefore, materials resistant to corrosion, various atmospheric conditions and deterioration caused by UV radiation were selected to guarantee a long-life cycle. The materials chosen are compatible with additive manufacturing technology. The cabinets were designed with the intention of encouraging environmental integration. The design concept aims therefore to simulate existing bird house with a typical sloping roof shape, in order to avoid accumulation of water and other materials. The use of bright colours for the cabinets (red and blue) not only provides a visually appealing appearance, but also serves functional purposes; it can provide, for example, clear visual indications of the specific function of the cabinets (Figure 11).

Overall, the conceptual design aims to guarantee that the cabinets not only fulfill strict technical and functional specifications, but are also harmoniously integrated into the environment, paying attention to both functionality and aesthetics.

## Detailed Design

The technical details of the cabinets were developed considering the cable access arrangement, ventilation, sensor openings, security locks and hermetic closure systems to prevent water and dust infiltration. The most appropriate solution was the construction of a fixed body and a central core (Figure 12) with a circular base that fits inside it by a bayonet joint at the bottom of the cabinet. In this way, all sensors are assembled on the central core

*Figure 11. Project render by design team.*

and can be easily removed for maintenance by rotating the bayonet joint. In addition to being functional for mounting the sensors inside the cabinet, this solution is also functional for preventing water and dust infiltration, as the joint is located at the bottom.

The detailed design phase involved the in-depth development of the technical aspects and details of the cabinets, with the aim of guaranteeing optimal system operation and a long-life service. Particular attention was paid to the arrangement of the cabling entrances to simplify installation and maintenance and to reduce the risk of damage to the feed-through cables. The chosen solution also includes an efficient ventilation system, which is necessary to prevent overheating of the technological components and its stable operation. In addition to the openings for ventilation, openings were provided for the sensors, in order to maximise the efficiency in the measurement of the different parameters and guarantee the necessary exposure of the environmental sensors.

During the design process, the design team took into account the security of the system, providing strong security locks to protect against unauthorised access and hermetic sealing systems to prevent water and dust infiltration, thus ensuring adequate environmental protection for the internal components.

## Simulations and virtual tests

During the post-development process, extensive simulations and virtual tests were conducted in order to evaluate the effectiveness of the Cabinet design in a variety of environmental scenarios. This approach aims to guarantee that the Cabinets can successfully withstand adverse conditions such as torrential rain, high temperatures and strong winds and maintain their performance reliably over time.

The results of the simulations and virtual tests provided valuable data to further optimise the design through changes in the shape of the body and the need to insert structural reinforcements to prevent the central core from breaking. This enabled the design of the cabinets to be optimised before production, reducing post-production modifications and, consequently, costs.

## Assembly and integration

The different components were produced through additive manufacturing technology. After assembling the sensor systems and the subsequent cabling on the central core, special attention was paid to the assembly of the core with the outer body in order to ensure the safety of the system. The missing parts were subsequently integrated, i.e. locking systems, safety locks, cooling fans and cable guides.

6.6 Prototypes testing

The prototype cabinets were subjected to extensive testing in the laboratory by simulating real conditions and directly in the field, in the places where they will later be installed. The tests carried out verified the functionality, the correct functioning of the sensors, data management, connectivity and, more in general, the compatibility of the system. Strength tests were also carried out to assess the structural robustness of the cabinets in response to mechanical stress. These tests guaranteed that the system could withstand external stress without significant damage. During the testing, detailed data was collected on the performance of the prototypes. These data are then analysed to identify any anomalies or improvements needed.

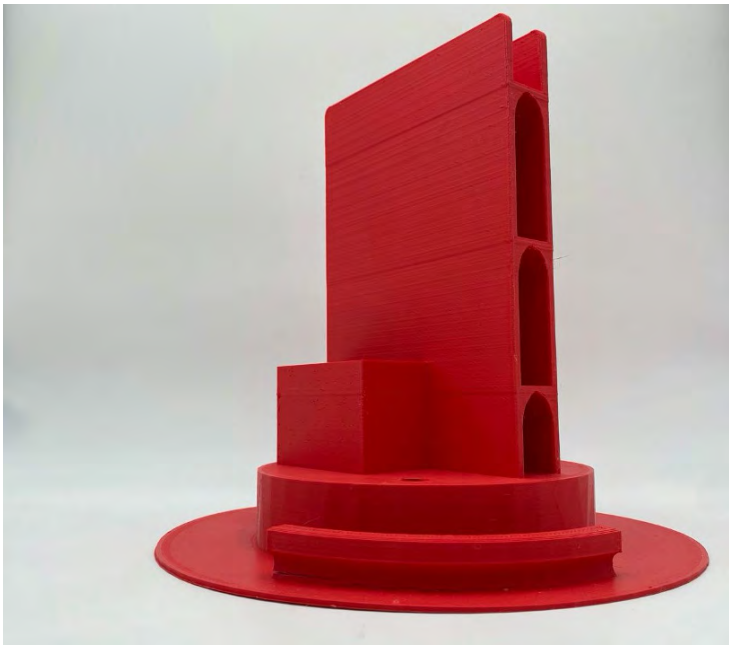


*Figure 12. 3D prototype of the central node: Photo by design team.*

During the various design phases, the design was continuously optimised. Additive manufacturing made possible numerous tests, producing scale prototypes and testing the possibilities of assembling cabinet components and sensor technology within the cabinet. The interdisciplinary approach allowed a continuous exchange with teams of data and computer scientists who directly assembled and tested the cabinets. In this way, the design team was able to obtain step-by-step feedback in order to optimise the product realised in the best possible way to make it as functional as possible with respect to the set objective.

## Expected results

The project aimed to develop IoT sensor systems for monitoring urban forests, in order to provide essential tools for wise and accurate management of green areas in urban context. Expected results include the ability to collect continuous data on key eco-physiological parameters, such as photosynthetic efficiency, evapotranspiration, water stress, carbon sequestration, biomass and woody growth, as well as assessing the health of tree crowns. These systems would allow preventive evaluation of potential systemic threats to urban forest health, arising from biotic agents such as pathogenic pests and insect infestations, as well as abiotic factors such as drought, extreme heat events and air pollution. The implementation of such advanced tools will contribute significantly to the sustainable and careful management of urban green areas, promoting the conservation of biodiversity and improving the quality of life in urban centres.

## Conclusion

The Treelogy project is a NBS example of the contribution given by urban forests and the need for integration with the dimension of data generation and dissemination, specific to smart cities. The project develops a projection in the methodological ambit of interdisciplinary design-driven processes in areas of environmental action in urban forests. In this specific example, design has worked in connection with disciplines such as botany and data science, coordinating the development of complex systems related to human interactions with the environment in its physical and digital dimensions. The design team was involved in product design, as well as digital representation and interfacing with digital manufacturing processes, together with data visualisation through the aspects of infographics. In particular, Cabinet systems were designed, capable of housing collecting cells and sending data. In the production of the systems, additive manufacturing processes were adopted allowing the production of scale prototypes and testing the possibilities of assembling cabinet components and the sensors within them.

At the same time, in facilitating the diffusion of data, risks due to forms of techno-solutionism were faced, acting within the emerging processes of formalising digital democracies that, through of specific operational tools, allow the widespread diffusion of environmental monitoring data.

## Acknowledgments

Although this paper is the result of co-authors' combined work, it is specified that Mariarita Gagliardi drafted paragraphs 2-4, Silvana Donatiello drafted paragraphs 3-5, while Alfonso Morone drafted paragraph 6. Introduction and conclusion are attributable to all the authors.

# References


1. Goala, S., & Sarkar, P. (2023). Selection methodology for additive manufacturing processes considering design, material, and manufacturability. Rapid Prototyping Journal, (ahead-of-print).
2. Gibson, I., Rosen, D. W., Stucker, B., Khorasani, M., Rosen, D., Stucker, B., & Khorasani, M. (2021). Additive manufacturing technologies (Vol. 17, pp. 160-186). Cham, Switzerland: Springer.
3. 
4. Yang, S., & Zhao, Y. F. (2015). Additive manufacturing-enabled design theory and methodology: a critical review. The International Journal of Advanced Manufacturing Technology, 80, 327-342.
5. Mincolelli, G. (2017). Fabbrica digitale e innovazione. MD Journal, (4), 86-99.
6. Scalera G. (2015), Il design nella società estemporanea, List, Trento, pp. 160.
7. McQuaid, M., Lipps, A., Condell, C., & Bertrand, G. (2019). Nature: Collaborations in Design. Cooper Hewitt, Smithsonian Design Museum.
8. Lotti, G. (2022). design 4.0 per la sostenibilità. Ricerche. Architettura, Pianificazione, Paesaggio, Design, 17.
9. Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (2017). Nature-based solutions to climate change adaptation in urban areas: Linkages between science, policy and practice. Springer Nature.
10. Atelli, M., Blasi, C., Boldini, G., Cignini, B., Cosenza, G., Emiliani, V., ... & Villari, P. (2018). Strategia Nazionale del Verde Urbano." Foreste urbane resilienti ed eterogenee per la salute e il benessere dei cittadini".
11. Pearlmutter, D., Calfapietra, C., Samson, R., O'Brien, L., Ostoi , S. K., Sanesi, G., & del Amo, R. A. (2017). The urban forest. Cultivating green infrastructure for people and the environment, 7.
12. ECONOMY, E. L. G. (2014). LE INFRASTRUTTURE VERDI I SERVIZI ECOSISTEMICI.
13. Singh, R., Gehlot, A., Akram, S. V., Thakur, A. K., Buddhi, D., & Das, P. K. (2022). Forest 4.0: Digitalization of forest using the Internet of Things (IoT). Journal of King Saud University-Computer and Information Sciences, 34(8), 5587-5601.
14. Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. Biology letters, 3(4), 390-394.
15. Daina, P. (2017). Foreste urbane e cambiamento climatico (parte II).
16. Salbitano, F. (2020). Urban forests at the time of COVID-19 protect us from fine dust. Forest@, 17, 48-51.
17. Baek, J. S., Kim, S., Pahk, Y., & Manzini, E. (2018). A sociotechnical framework for the design of collaborative services. Design Studies, 55, 54-78.
18. Tactical Technology Collective (2017). Efficiency and Madness. Using Data and Technology to Solve Social, Environmental and Political Problems. https://tacticaltech.org/projects/efficiency-and-madness/
19. Sicat, R., Li, J., Choi, J., Cordeil, M., Jeong, W. K., Bach, B., & Pfister, H. (2018). DXR: A toolkit for building immersive data visualizations. IEEE transactions on visualization and computer graphics, 25(1), 715-725.
20. Manzini, E. (2018). Autonomy, collaboration and light communities. Lessons learnt from social innovation. Strategic design research journal, 11(2), 162-166.
21. Manzini, E., & Vezzoli, C. A. (2002). Product-service systems and sustainability: Opportunities for sustainable solutions. UNEP-United Nations Environment Programme.
22. Mancuso, S. (2017). Plant revolution–le piante hanno già scritto il nostro futuro. Giunti.
23. Morone, A., Parlato, S., Sarno, I., & NICOLAU ADAD, G. (2021). AURA "Green & Smart Urban Furniture" Integration of urban furniture IoT and phytoremediation. MD JOURNAL, (MD Journal 11/Luglio 2021, Anno V Design for Smart Cities,), 62-75.
24. Morone, A., Guilherme, N. A., Parlato, S., & Sarno, I. (2020). AURA: Green and Smart Urban Furniture. The essays in this publication provide a set of ideas, reflections, positions and proposals that, in the context of the epistemological crisis that affects the reasons, the meaning and the very structures of the project, can contribute to understand how the digital shift is deeply transforming the role of design culture in the relationship between technology and nature in a historical transition affected by climate and social changes with enormous political, economic and productive consequences.
25. 
26. Ratti, C., & Claudel, M. (2017). La città di domani. Giulio Einaudi Editore.
27. Morgenroth, J., & Östberg, J. (2017). Measuring and monitoring urban trees and urban forests. In Routledge handbook of urban forestry (pp. 33-48). Routledge.
28. Montori, F., Bedogni, L., & Bononi, L. (2017). A collaborative internet of things architecture for smart cities and environmental monitoring. IEEE Internet of Things Journal, 5(2), 592-605

# Research into the exterior walls of residential buildings in the context of sustainable construction based on bio-based materials and waste

*Alberto Reaes Pinto[1], Marlene Canudo Urbano[2], Carlos Oliveira Augusto[3]*
*reaespinto@lis.ulusiada.pt*
*marlene.urbano@gmail.com*
*carlosoliveira.7@gmail.com*

*[1]Full Professor, Coordinator CITAD / Universidade Lusíada, Portugal*
*[2]Architect PhD Candidate, Research Fellow CITAD / Universidade Lusíada, Portugal*
*[3]Engineer PhD Candidate, Research Fellow CITAD / Universidade Lusíada, Portugal*

***Keywords:***
*Housing,*
*Sustainable Construction*
*Bio-Based Materials*
*Circular Construction.*

## Abstract

This paper points to our ongoing research into modular prefabricated construction elements for exterior walls of low-rising housing buildings made of renewable and bio-based materials with low environmental impact, such wood, straw, cork, or other materials, like hemp and coconut fibres, olive pomace, rice husks and sheep wool. These are materials with low embodied energy in their whole life cycle, high energy efficiency, good hygrothermal and acoustic performance, as well as easily recyclable and reusable. In this context, a research project was developed for the use of prefabricated panels filled with straw or cork between waterproof engineered wood boards. A new version is currently being developed based on mycelium, including waste substrate from various sources. This research also considers the building`s deconstruction and selective dismantling, which allows the extension of its life span and the reuse and the recycling of materials, in accordance with the circular construction principles.

## Introduction

The aim of this paper is to present some of the research that has been carried out in the field of Sustainable Construction (and Circular Construction) on constructive elements, mainly for the exterior walls of small and medium sized buildings in low-density areas, which can play a fundamental anchoring role, especially for a younger population, thus contributing to their development. The constructive elements developed in this research are low-carbon plug-in blocks and prefabricated modular panels, incorporating renewable materials, biomaterials with low environmental impact, preferably of local origin, such as wood, straw, cork, or other materials like hemp and coconut fibres, olive pomace, rice husks, pine wood or sheep wool. More recently, we are developing a research project on prefabricated building modules based on fungi, which grow very quickly, not excluding the use of waste from various sources, that have substrate functions.

Materials that use low levels of fossil energy in their exploitation, manufacture, and transport, have high energy efficiency, good performance in terms of hygrothermal and acoustic comfort, and are easily recyclable and reusable, are therefore part of a system of circular production and consumption. In this sense and given that the planet's natural material resources are

finite, this research also considers selective deconstruction and dismantling at the end of a building's life cycle, which allows materials to be reused and their lifespan to be extended, as well as the recycling of materials which, when integrated into a circular construction process, give rise to non-extractive materials.

In the current context, areas of Portugal's interior are gradually being deserted by the exodus of their populations to other places with better lifestyles, the non-use or depletion of their natural resources, without being able to create their own dynamics that could attract their population. It is necessary to develop conditions that lead to people's well-being which includes more opportunities as regards housing. It is also necessary to create better conditions for job-creation in industry or even in a better developed small-scale local agriculture, for better mobility as well as for other innovative and creative activities, including those related to culture, that can retain the younger generations. To reverse this situation, housing is seen as a fundamental support factor necessary for the development and settlement of populations in the interior of the country.

Existing housing, generally dilapidated and of poor quality, does not fulfil people's human, social and economic needs. There are already signs of demand for housing in the outskirts of medium-sized cities, on the outskirts of rural areas or even in rural areas, where people feel more comfortable, far from the big cities and where an accessible network of contacts allows them to live better.

In this context, solutions aimed at evolving and flexible single-family housing are considered viable, in areas of low population density, even on family plots, with larger and cheaper houses, relatively close to workplaces or on the same site.

Evolutive Modular Housing [EMH]

The aim of this research project is to study an Evolutive Modular Housing, sustainable, multipurpose that can also meet the needs of a low-income population in low-density areas in Portugal or other countries with housing shortages.

It is intended that it can be increased over time, according to economic conditions and the growth of the family, in accordance with the principles of sustainable construction, allowing for innovative forms of construction and even for self-construction and self-finishing. The use of renewable energy, energy efficiency and sustainable materials, preferably local materials that can be integrated into a circular economy, are fundamental to the sustainability of buildings.

This housing unit consists of two modules that can be connected in parallel or in an L-shape (Figure 1):

- Module A, for day functions, of T0 typology and the expanding Module B, initially of T1 typology, with nocturnal functions;

- Module B, growing, with an initial typology of T1 and night functions. The typology of this module can grow from a T1 and evolve into a typology

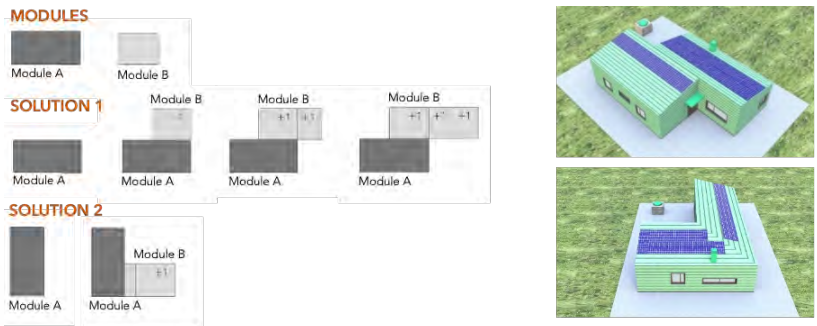



*Figure 1. Growing solutions for housing units: Photos by Reaes Pinto.*

*Figure 2. Some typologies of EMH referring to solution 1: Drawings by Reaes Pinto.*

with more bedrooms.

The construction of this housing can thus begin with the 1st Module and grow later, according to the economic possibilities and the growth of a given family (Figure 2).


The house will be energy self-sufficient, with photovoltaic panels on the roof, and rainwater can be collected in a cistern for non-potable uses. A small composting facility is planned.

Regarding the materials chosen and their application technologies for the construction of this single-family housing, the main materials considered are natural, renewable, preferably local, with low embodied energy, non-polluting in terms of toxic emissions or waste, recyclable and reusable, with a common characteristic, which is that they act as carbon dioxide sequestrators, becoming allies in mitigating the effects of anthropogenic climate change, unlike conventional products (Pinto, 2018).

These materials include wood and its derivatives, cork, rock wool (hemp, coconut fibres, flax), materials that are largely of plant origin, come from forests or rotational crops for non-food purposes, tend to be abundant and generate local wealth.

## Low Carbon Plug-In Blocks for Exterior Walls

In the design of these blocks it is considered, in addition to environmental issues, the achievement of high productivity, by its size (500 mm in length, 200 mm in height and 300 mm in width), by its weight (lightness of the bonded materials), by its locking system (which facilitates the alignment of the blocks in the construction and the strengthening of the exterior wall), by economizing of the laying mortar (which is placed only peripherally on both sides of the block, cancelling the hygrothermal transmission through the mortar) and also because of the possibility of the construction of the walls without using mortar between the blocks (which can be reinforced at certain points) (Pinto, 2018) (Figure 3).

These blocks, with which the exterior walls are constructed are mainly made of local materials, with a high level of thermal insulation, such as hemp, cork, coconut fibre and other materials can also be considered such as olive bagasse, bark of rice, and all use lime as binder.

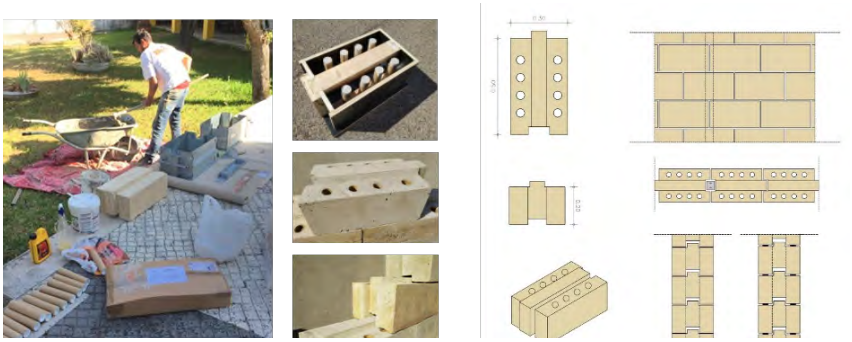


*Figure 3. Low carbon plug-in blocks to exterior walls: Photos and drawings by Reaes Pinto.*

*Figure 4. The exterior wall finishings: flat ceramic tile, wood slatted panel, bamboo or reed panel, cork panel and reused stone panel. Photos by Reaes Pinto*

The exterior wall finishings, of various types (Figure 4), are previously built off-site (prefabricated) and mechanically fixed, dry, to the rigid support, in the sense of an application with a high laying productivity and waste reduction at the construction

site. The aim is for them to be reusable or recyclable at the end of the building's life cycle, thereby reducing the negative environmental impacts of their exploitation and manufacture and enabling them to be included in a circular economy. In the Day Module, in the living area, there are options for window openings, which differ in their shape and placement (Figure 5).

## Prefabricated Exterior Wall Module

The aim of the project was developing, in the scope of sustainable construction, a prefabricated modular panel system, essentially for exterior walls of small and medium sized buildings, using renewable materials, with low environmental impact, such as wood, straw and cork or other materials, like hemp and coconut fibers.

Materials with low incorporated energy in their extraction, manufacture and transport, high energetic efficiency, good hygrothermal and acoustic performance, and easily recyclable and reusable, being integrated, therefore, in a circular economy system. The module can be integrated in an existing structure with filling functions or can have resistant functions, by participating in a structural mesh wall (Pinto & Dias, 2018) (Figure 6).

*Figure 5. Door and window openings and exterior wall finishings: flat ceramic tile, wood slatted panel and bamboo or reed panel. Photos by Reaes Pinto.*

*Figure 6. Panel structure, straw bale, and panel structure filling: straw and cork: Photos by Reaes Pinto.*

## Panel improvement

After the analysis of the first tests, it is concluded that the solution could be improved:

- A wooden structural board was applied from the panel exterior to obtain more resistance to bracing.
- The application of the board from the exterior of the panel allows the utilization of other types of thermal insulation materials, such as cork, rice husk, sheep wool, textile waste, hemp or coconut fiber, among others.
- This solution enables the use of locally available materials (with thermal insulation capacity), such as cork waste from Alentejo or rice husk from Ribatejo;
- The elimination of exterior plaster, speeding up the panel construction (Pinto & Dias, 2018) (Figure 7).

It was considered that the use of prefabrication, partial, light and little mechanized, which these panels represent, presents considerable advantages, namely, in comparison with traditional/conventional construction, in terms of execution times on site, the reduction of specialized labor, the

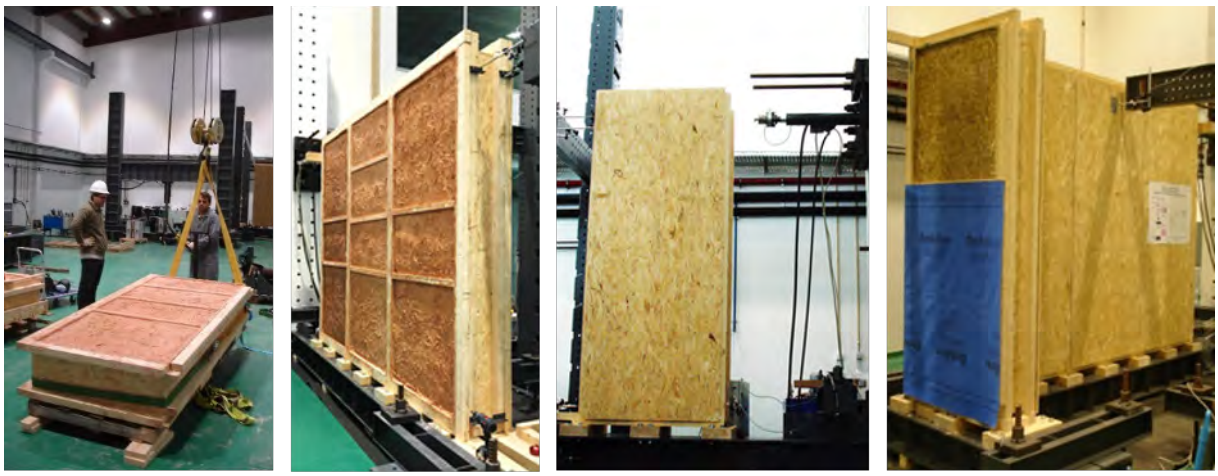


*Figure 7. Elevating the panel and assembling the panel on the base element: Photos by Reaes Pinto.*

reduction of waste on the work fronts and costs, thus obtaining a solution with better environmental performance. Also significant is the fact that prefabricated, dry-connected components can be reused or recycled at the end of the life cycle of buildings (Pinto, 2018).

The constructive solution enables several different finishings, both indoor and outdoor. It should be noted that we have considered types of finishings that may be applied in the buildings with mechanical fixing, in order to reuse and also recycle. This is not possible when plaster is applied in indoor and outdoor walls. Different types of mechanical fixing finishing were considered: external coating installation tests were performed with plasma ceramic tile from CS, which is detachable e can be reused (Figure 8).


*Figure 8. Exterior finishing assembly test with flat ceramic tile: Photos by Reaes Pinto.*

Regarding the Research Project "Prefabricated exterior wall module", the tests demonstrate the technical feasibility of the construction system. The materials used either in their structure, in their filling (with thermal insulation functions) or even in coatings, are renewable, with little embodied energy, no toxic emissions during their life cycle, possible to reuse and recycle, and produce little waste on site (Pinto & Dias, 2018).

Regarding energy efficiency, the energy involved most often concerns only the operation and maintenance of buildings, and the energy embodied in the materials and construction systems integrated in them is also not important. From this point of view, materials of fossil origin with thermal insulation functions were not considered.

## Selective Deconstruction and Dismantling [SDD]

**Case Study: EMH**

In Portugal, according to Coelho and Brito (2007), annual waste production is of something in the region of a 4,4 thousand million tons and the Environment Agency estimate it at about 7,5 thousand million tons (Torgal & Jalali, 2010).

Selective Deconstruction and Dismantling, (with sorting and recycling), has in mind the recovery and acquisition of the maximum number of the materials and elements that make up the different parts of a building at the end of its life cycle. This recuperation is carried out on the understanding that these materials can be used in the construction of new buildings through reutilization and recycling processes (Figure 9), thus reducing the negative environmental impacts of its exploitation (extraction of raw materials), its fabrication and its production of waste.

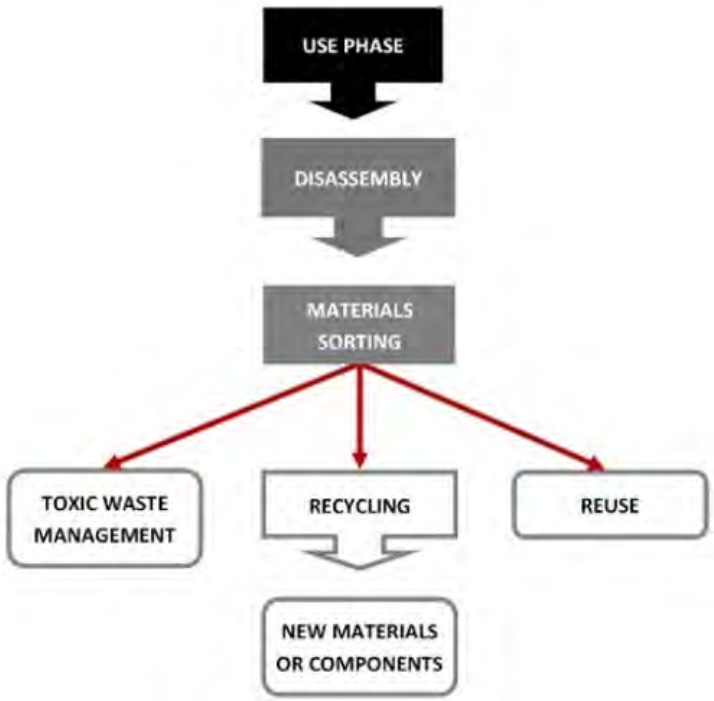



*Figure 9. Materials selection at the end-of-life cycle of buildings: Flow diagram by Reaes Pinto.*

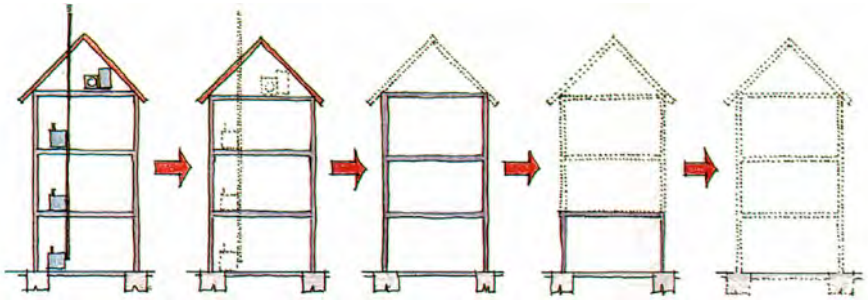
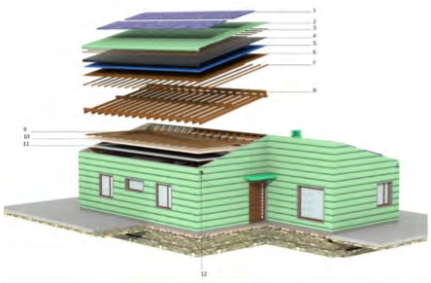


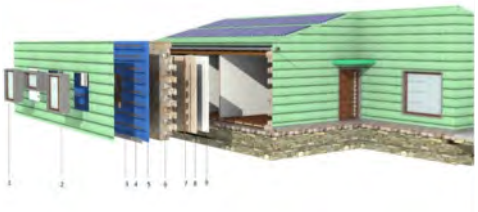
*Figure 10. Phases of building dismantling (Generalitat de Catalunya et al.,1995).*

Selective dismantling (Figure 10), although a slower process than conventional demolition, optimizes the recuperation and recycling of materials, and demands, according to Charles Kibert (2008), that the plans for the structure should respect certain principles to the end of deconstructing the building (Figure 11).



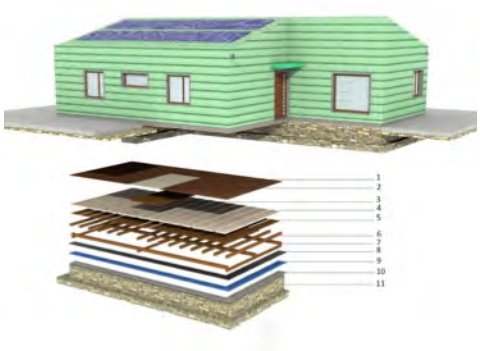
**Dismantling of the roof:**

1. Photovoltaic panels
2. Flat Ceramic Tile
3. Wooden Lath
4. Waterproofing cloth of vegetable origin
5. Physical separator
6. Plywood with 20mm thick
7. Timber substructure
8. Wooden structure
9. Sub-frame for secondary ceiling
10. Rock wool 100mm thick
11. Plasterboard with 17.5 mm thick
12. Gutter



**Dismantling of the exterior walls:**

1. Frames and stonework
2. Flat Ceramic Tile
3. Stone Punch
4. Wooden Lath
5. Physical Separator
6. Low Carbon Plug-in Blocks
7. Wooden substructure
8. Rock wool with 25 mm thick
9. Plasterboard 17.5mm thick



**Dismantling of the pavements and foundations:**

1. Hardwood flooring
2. Ceramic tiles with 5mm thick
3. OSB board with 12mm
4. Rock wool with 80mm
5. Plywood boards with 12mm thick
9. Plasterboard 17.5mm thick
6. Structural floor beams
7. Peripheral wooden beam
8. Waterproofing cloth of vegetable origin
9. Geotextile blanket
10. Levelling mortar
11. Stone Footing

*Figure 11. Selective deconstruction/dismantling: roof, exterior walls and, floors and foundations: Photos by Reaes Pinto.*

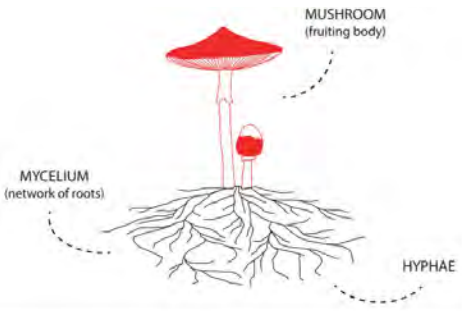
## Prefabricated Exterior Wall Module with Mycelium-based material

In the context of the "Prefabricated Modular Housing" research project, a new project is underway to develop a prefabricated exterior wall module that uses materials derived from fast-growing fungal mycelium cultivated on organic, biodegradable substrates as filler. However, it can also use other substrates, organic or not, such as waste or sub-products from various sources, transforming them into new non-extractive materials.

The aim is to obtain a prefabricated exterior wall module solution that preferably uses renewable materials with a low environmental impact, with a low carbon footprint, local if possible, and based on sustainable construction techniques, such as prefabrication in housing, seeking to contribute to resolving housing shortages and preventing the desertification of interior areas with low population density, in order to encourage their consolidation and development for the sustainability of the area.

In this sense, this new project also aims to develop a new building material with insulating characteristics, using fungal mycelium as a base. A living organism that will act as a binder, in association with totally biological substrates, or not, such as waste substrates or industrial by-products of various origins, always, where possible, local.

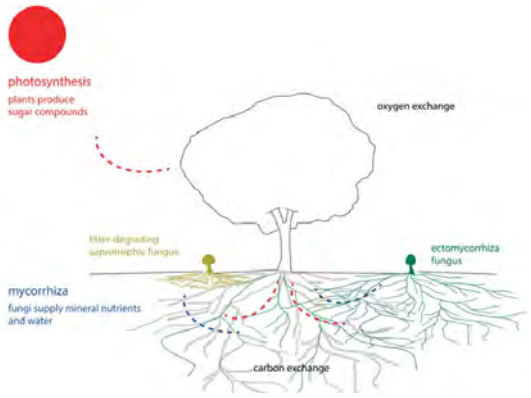
*Figure 12. Constitution of the fungus [mushroom] (Al-Qahtani et al., 2023).*



In the world of biology, fungi are beings that constitute a natural kingdom of their own, distinct from plants and animals (Schwartzberg, 2019). The science that studies the fungal kingdom, mycology, encompasses moulds, yeasts and various types of mushrooms (Wu et al., 2019). The fungi being studied for this project, according to researcher and biologist Susana Gonçalves, are called macrofungi because they are composed of: an outer reproductive fruiting body, which produces and releases the spores, the mushroom; the filaments of the fungus, called hyphae (Jardim Gulbenkian, 2023); and the mycelium, which constitutes the fungi's network of filaments (hyphae), resulting in an extensive mass of hyphaes ramifying, similar to wires, which collect food, water and nutrients (Figure 12) (Critical Concrete, 2023).

In contrast to cities, there is no waste in nature, as circularity is part of the natural functioning of ecosystems, where fungi have a crucial function. Fungi are natural decomposers and recyclers, regulators of carbon flows, because during their natural growth, their mycelium sequesters CO2 in order to survive (Schwartzberg, 2019). They have biochemical capacities (enzymes) capable of decomposing and transforming organic matter, such as dead plants and animals, into nutrients for a new generation of plants and animals to assimilate and grow (Stamets, 2005). They establish links with plants through their micellar networks, thus providing a way of communication and supplying nutrients (Figure 13) (Jardim Gulbenkian, 2023).

*Figure 13. Mycelium network: natural recycler, CO2 sequester, and way of communication and nutrient carrier between plants/ trees. (Critical Concrete, 2023).*




Fungi are natural builders and their mycelial networks are highly efficient, reducing the toxicity of materials while transforming them through bio-absorption, bio-conversion and biodegradation (Biomimicry Institute, 2023). Its mycelium is made of a natural material that resists fire and water, has insulating properties, is durable and lightweight. It is a raw material with extraordinary capacities and unique properties, which are very valid for use in the construction industry, in order to achieve new, non-extractive, low-carbon materials (Ecovative, 2023).

Just as happens in nature, in our cities we can also convert the materials we discard into new materials. It is common practice when a building is demolished for the resulting waste to be incinerated or taken to a waste dump, not only polluting the soil but also contributing negatively to climate change by producing a high level of greenhouse gases into the atmosphere (Biomimicry Institute, 2023).

Transforming construction waste and other industrial waste into new non-extractive materials will contribute significantly to the environment. It is possible to produce materials with mycelium, capable of consuming and eliminating toxins from waste such as construction waste, producing safe and healthy construction resources. Allowing the transition from the construction model of conventional linear waste to the circular model,

reducing CO2 emissions, reducing industrial waste and giving it value. Replacing the need to extract new resources from nature, offering a low embodied carbon alternative for the construction industry (Figures 14-16).

*Figure 14. Growing mycelium in a substrate (Ecovative, 2023).*

*Figure 15. Mycelium-based bricks (Mycocycle, 2023).*

*Figure 16. Building blocks based on mycelium and textile waste (Mycocycle, 2023).*

In conventional construction, the majority of insulation solutions derived from petroleum are used, which is a finite extractive resource with a high carbon footprint and a high level of embodied energy consumption, from extraction to the transformation of the finished product.

The composite created using fungal mycelium and agricultural waste results in an insulating biomaterial for construction and other purposes. Its combination with bio-based materials makes it biodegradable, contrary to most conventional materials available on the market.

In this sense, the production of biomaterials based on mycelium requires its properties to be analysed specifically according to the application the material is to be used for, as its characteristics vary according to the substrate and species used. However, due to its unique properties, studies have revealed that mycelium composites as thermal and acoustic insulation are a viable alternative to conventional petroleum-based insulation (Figure 17) (Mycocycle, 2023).

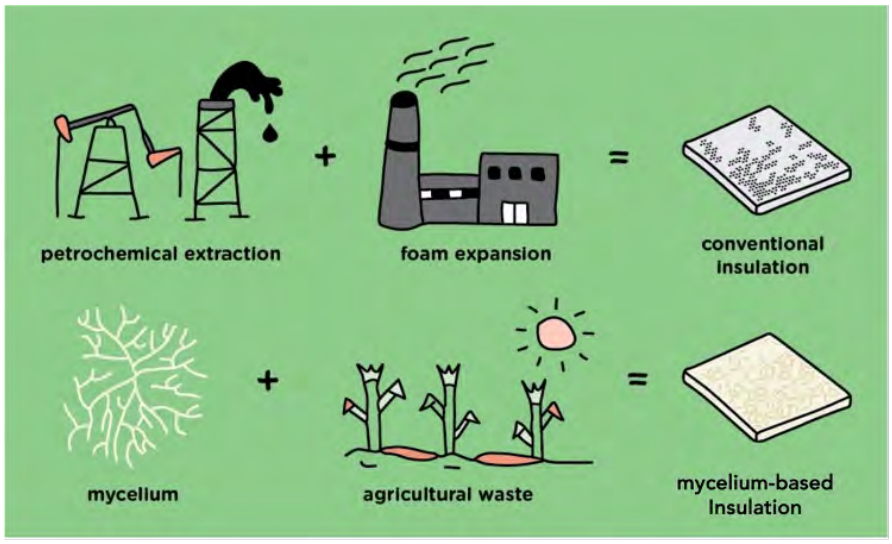



*Figure 17. Petroleum-derived insulation materials versus mycelium-based insulation materials (Adapted from Mycocycle, 2023).*

There are many different types of waste or by-products available from certain industries in Portugal that could be used to produce this fungal mycelium composite. They can be biological, of animal origin, such as sheep's wool, or of vegetal origin, such as straw, stalks, rice husks, hemp, olive pomace, and non-biological waste, resulting from the construction

industry, such as plasterboard, concrete, asphalt, or from other industries, such as textiles, rubber, among others.

As part of the project, prefabricated external wall modules were developed, consisting of a wooden structure, where the fungus, previously inoculated in the prepared substrate, was deposited in the compartment of the structure reserved for isolation and the mycelium was cultivated in a dark, humid and warm environment. This whole process of mycelium growth takes around 2 to 4 weeks, as its growth depends essentially on the choice of fungus species and the type and size of the substrate used (Figure 18) (Ghazvinian et al., 2019).

*Figure 18. Prefabricated exterior wall module with fungal mycelium insulation: Photos by Reaes Pinto*

As it is a living organism, when it reaches the desired shape and density, and before it starts producing mushrooms, its growth cycle must be interrupted through a drying/heating process (Figure 19). This process means that when the material reaches the desired maturity, it must be dried/heated to stop its growth/development (Ghazvinian et al., 2019). However, an attempt is being made to see if the interruption of the fungus's life cycle can also be resolved through biochemical action, such as the use of an enzyme that reacts chemically in the mycelium's structure.

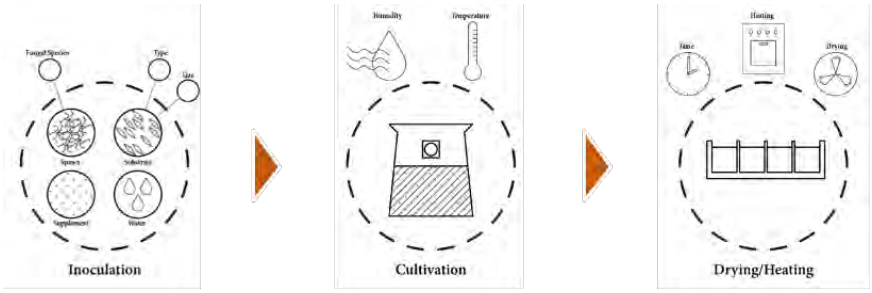



*Figure 19. Diagram of the cultivation process for mycelium-based composites (Adapted from Ghazvinian et al., 2019).*

## Circular Construction

Circular Economy (CE) is an industrial system that is "…restorative and regenerative…" (Ellen MacArthur Foundation, 2015, p. 2) distinguishing between technical and biological cycles aiming for delink economic growth from the consumption of finite resources (Ellen MacArthur Foundation, 2015).

In a linear economy, natural resources are extracted, transformed into products, and devalued technically and economically, as waste. Circular

Economy promotes the design out-waste and the flow of materials by sharing, reusing, recycling, repairing, and remanufacturing, enabling value creation and leading to a significant reduction in emissions and waste (Figure 20) (Davey, 2021).

According to the UK Green Building Council (2020), Circular Construction is the application of the Circular Economy principles to the construction sector (UK Green Building Council, 2020). In the case of architecture, several regenerative approaches have recently been developed, namely the "cradle-to-cradle", which is closely associated with the concept of circular economy (Geldermans, 2016).

In order to achieve a regenerative economy, it`s crucial that the technosphere must be supplied from bio based (renewable) materials. The world's population is expected to reach 9.3 billion by 2050, concentrated mainly in cities and megacities and carbon emissions from built environment could affect 35 to 60% of the emissions budget for limiting the increase in global average temperature to + 2º C, according to the Paris Agreement (Churkina et al., 2020).

Therefore, the selection of appropriate building materials is a critical factor tackling climate change. Buildings and infrastructures may turn a key tool for drastically reducing emissions and sequestering carbon (human-made carbon pool) if they are designed and built with bio-based construction materials instead of mineral based ones (Churkina et al., 2020).

We propose to exploit this projected demand for urban buildings as a means to mitigate climate change. By employing bio-based materials, technologies and construction assemblies with high carbon storage capacity and low embodied carbon emissions, we can create a durable, human-made global carbon pool while simultaneously reducing CO2 emissions associated with building sector activities. (Churkina et al., 2020, pp. 269)

This is an example of how sustainability should not be treated as something extrinsic and independent of architectural design, but deeply connected (Figure 21).


*Figure 20. "Scheme of Linear and Circular Economy" (Palmitessa, 2019)*

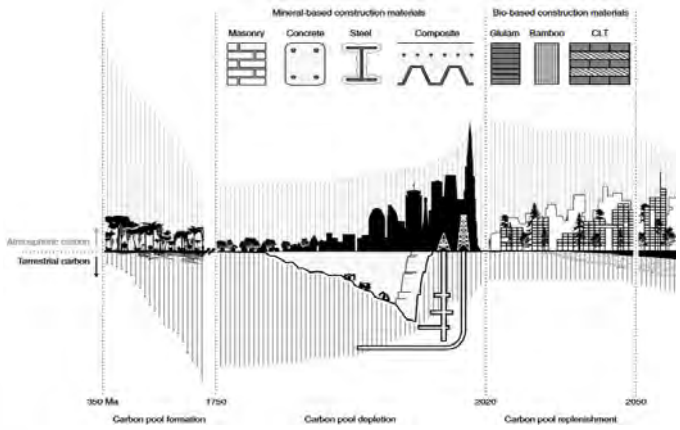



*Figure 21. Carbon sequestration by buildings and the role of bio-based construction materials (Churkina et al., 2020).*

According to Dyson et al. (2023), the incremental and massive use of renewable materials for structural, insulation, cladding or any other building element is one main strategy to decarbonize the construction sector, as suggested by the "avoid – shift – improve" roadmap:

- avoid the extraction and production of raw materials by promoting the circularity of construction, meaning the use of fewer materials and products, as well as the use of recycling and reuse whenever possible.
- shift to regenerative materials and practices through the prescription and application of low-carbon and renewable materials that are ethically and environmentally responsible.
- improve production methods for conventional, non-renewable and carbon-intensive materials and products, and only use them as a last resort (Dyson et al., 2023).

An example of these principles is the ongoing project Atlassian headquarters (Sidney), with approximately 40 stories high of mass timber construction hybrid prefabricated structure, halving the embodied carbon and the carbon footprint (50% less than a conventional new building) and totally operated by renewable energy.

The engineered wood structure together with a steel exoskeleton allows the integration of solar panels (Building Integrated Photovoltaic – BIPV) into the façade and the existence of large green terraces and roofs featuring energy-efficiency, natural ventilation and the indoor contact with nature (Figure 22) (D'Angelo, 2020; Harrouk, 2020; Blok, 2020).

*Figure 22. Mass Timber Construction (MTC) at Atlassian HQ Sydney towards net-zero carbon emissions (D'Angelo, 2020).*

## Final Considerations

In the context of this work, the research project " Evolutive Modular Housing HME" was used as a case study, for low-density regions, based on two Modules (day and night), using materials, preferably local and applied technologies, with significant use of low-carbon interlocking blocks for exterior walls, whose finishes are prefabricated and mechanically fixed to the rigid support, being reversible and reusable. Regarding the realisation of this HME, it is also envisaged that it will be built increasingly and that it will be possible to self-build, according to the economic and growth needs of families.

Following on from this research, which was more traditional and local in nature, further research has been carried out in the area of industrialised construction, particularly prefabrication, into the possibility of applying modular building elements for exterior walls, which can be produced and applied with greater productivity and speed of construction, made of biomaterials (from plant, animal and fungal sources). Materials with a low

environmental impact, if possible local, highlighting, more recently, and still in the area of these materials, research into the use of fast-growing fungi in the constitution of these constructive elements.

The choice of materials and their wise use in the construction of sustainable buildings is fundamental, considering that natural resources are finite, a situation that will be exacerbated by the large increase in the world's population predicted for the middle of this century. Buildings also have a significant negative impact on the environment, accounting for about 50% of the world's consumption of material resources, producing about 40% of carbon dioxide, and generating large amounts of waste, which requires replacing a linear construction process that consumes the product with a circular one that produces new, non-renewable materials. In this context, we should also bear in mind the Paris/COP21 agreement and the recommendations to limit global warming to no more than 1.5 degrees compared to pre-industrial times.

## Acknowledgments

This work was supported by FCT - Fundação para a Ciência e Tecnologia, I.P. by project reference <UIDB/04026/2020> and DOI identifier <10.54499/UIDB/04026/2020 (https://doi.org/10.54499/UIDB/04026/2020 )>.

# References

1. Al-Qahtani, S., Koç, M., & Isaifan, R. J. (2023). Mycelium-Based Thermal Insulation for Domestic Cooling Footprint Reduction: A Review. Sustainability, 15(17), Article 17. https://doi.org/10.3390/su151713217
2. Biomimicry Institute (Director). (2023, Mars 7). Bioremediation breakthrough: mimicking forests to transform construction waste into usable materials. https://www.youtube.com/watch?v=6awn1qzV6hw
3. Blok, I. (2020, July 8). SHoP Architects and BVN design world's tallest hybrid timber tower for Atlassian in Sydney. Dezeen. https://www.dezeen.com/2020/07/08/shop-architects-and-bvn-design-worlds-tallest-hybrid-timber-tower-for-atlassian-in-sydney/
4. Churkina, G., Organschi, A., Reyer, C. P. O., Ruff, A., Vinke, K., Zhu Liu, Reck, B. K., Graedel, T. E., & Schellnhuber, J. (2020). Buildings as a global carbon sink. Nature Sustainability, 3(4), 269–276. https://doi.org/10.1038/s41893-019-0462-4
5. Coelho, A., & Brito, J. (2007). Construction and demolition waste management in Portugal. Lisbon, Portugal: Instituto Superior Técnico, Universidade Técnica de Lisboa.
6. Critical Concrete (2023, January 30). Natural Insulation - What do You Need to Know? Critical Concrete. https://criticalconcrete.com/natural-insulation-what-do-you-need-to-know/
7. D'Angelo, M. (2020, July 6). Atlassian Sydney Headquarters. Architect Magazine. https://www.architectmagazine.com/project-gallery/atlassian-sydney-headquarters_o
8. Davey, R. (2021, November 24). Incorporating the Circular Economy Model in Architecture. AZoBuild. https://www.azobuild.com/article.aspx?ArticleID=8448
9. Dyson, A., Keena, N., Mae-ling Lokko, Reck, B. K., & Ciardullo, C. (2023). Building materials and the climate: Constructing a new future. United Nations Environment Programme. https://wedocs.unep.org/xmlui/handle/20.500.11822/43293
10. Ecovative (2023). Growing Sustainable Products From Mushroom Mycelium To Save The Planet. Ecovative. https://www.ecovative.com/pages/why-mycelium
11. Ellen MacArthur Foundation. (2015). Towards a circular economy: Business rationale for an accelerated transition. Ellen MacArthur Foundation. https://ellenmacarthurfoundation.org/towards-a-circular-economy-business-rationale-for-an-accelerated-transition
12. Geldermans, R. J. (2016). Design for change and circularity – accommodating circular

material & product flows in construction. Em Energy Procedia: Proceedings of SBE16 Tallinn and Helsinki Conference. (Vol. 96, pp. 301–311). https://doi.org/10.1016/j.egypro.2016.09.153
13. Generalitat de Catalunya, Medi Ambient, & Junta de Residus (1995). Manual de desconstrucció. [Deconstruction manual]. Barcelona, Spain.
14. Ghazvinian, A., Farrokhsiar, P., Rocha Vieira, F., Pecchia, J., & Gursoy, B. (2019, September 12). Mycelium-Based Bio-Composites for Architecture: Assessing the Effects of Cultivation Factors on Compressive Strength. https://doi.org/10.5151/proceedings-ecaadesigradi2019_465
15. Harrouk, C. (2020, June 29). The World's Tallest Hybrid Timber Tower is Under Construction in Sydney, Australia. ArchDaily. https://www.archdaily.com/942496/the-worlds-tallest-hybrid-timber-tower-is-under-construction-in-sydney-australia
16. Jardim Gulbenkian (2023, April 17). Como assegurar a diversidade de cogumelos (e outros fungos) num espaço verde. [How to ensure the diversity of mushrooms (and other fungi) in a green space]. https://gulbenkian.pt/jardim/read-watch-listen/como-assegurar-a-diversidade-de-cogumelos-e-outros-fungos-num-espaco-verde/
17. Kibert, C. (2008) – Sustainable construction: Green building design and delivery. (2nd ed.). New Jersey, USA: JonhWiley&Sons, Inc.
18. Palmitessa, F. (2019, November 27). Circular Economy and Tourism. The Ecobnb's Guide. Ecobnb. https://ecobnb.com/blog/2019/11/circular-economy-and-tourism-the-ecobnbs-guide/
19. Pinto, A. R. (2018). Contribuições para a construção sustentável. [Contributions to sustainable construction]. Lisbon, Portugal: Universidade Lusíada Editora.
20. Pinto, A. R., & Dias, B. D. (2018). Módulo de parede exterior pré-fabricado: A contribuição dos materiais e das tecnologias para a construção sustentável. [Prefabricated exterior wall module: The contribution of materials and technologies to sustainable construction). Universidade Lusíada Editora.
21. Schwartzberg, L. (Director). (2019). Fantastic Fungi: the magic beneath us [Film]. Moving Art.
22. Stamets, P. (2005). Mycelium running: how mushrooms can help save the world. Berkeley, USA: Ten Speed Press.
23. Torgal, F. P., & Jalali, S. (2010). A sustentabilidade dos materiais de construção. [The sustainability of construction materials]. (2nd ed.). Vila Verde, Portugal: TecMinho.
24. UK Green Building Council. (2020). Practical how-to guide: Build circular economy thinking into your projects. UK Green Building Council. https://www.greencycle.si/wp-content/uploads/2018/03/business_guide_to_circular_consruction.pdf
25. United Nations (2013). World Population. Prospects: the 2012 revision. New York, USA: United Nations.
26. Wu, B., Hussain, M., Zhang, W., Stadler, M., Liu, X., & Xiang, M. (2019). Current insights into fungal species diversity and perspective on naming the environmental DNA sequences of fungi. Mycology, 10(3), 127–140. https://doi.org/10.1080/21501203.2019.1614106

# Design, cultural heritage and technologies: new forms of dialogue between the user and museum spaces.

*Giusi Castaldo, Mario Buono, Elena Laudante*
*giusi.castaldo@unicampania.it*
*mario.buono@unicampania.it*
*elena.laudante@unicampania.it*

*Università degli Studi della Campania "Luigi Vanvitelli", Italy*

***Keywords:***
*Technological innovation*
*Cultural heritag fruition*
*Museum spaces*
*Museum experience*

## Abstract

The dialogue that is established between the user, museum space and artwork is constantly evolving to the point that it has become a new opportunity to understand, to enhance and to improve the experience of enjoying cultural heritage. In contemporary society, the dissemination of new technologies is influencing people's daily habits, and in particular - within the cultural heritage field - it is changing the ways of participation within physical museum spaces, increasing the interest of the user and the search for new forms of experiential dialogue in cultural places, which are now identified as spaces of cultural interchange, means of knowledge dissemination and interactive places. In fact, technological innovations are employed to support the enjoyment of exhibition spaces by providing more information about new ways of promoting, knowing and experiencing cultural heritage. Augmented reality, virtual reality and artificial intelligence are some of the examples that generate new forms of interactions between the user and the physical space. Through the multidisciplinary approach, the contribution provides a summary of the main methodologies and methods adopted for the construction and definition of innovative forms of experiences for the enjoyment of spaces dedicated to culture. Through the critical-analytical analysis of the identified methodologies and methods, it will be possible to define new scenarios that through the tools and methods of design define creative processes and participatory experiences of museum spaces in order to improve visitor involvement in relation to cultural heritage.

## Introduction

In contemporary society, museums are identified as places to "entrust" art, generate continuous knowledge and an engine of development and social cohesion. According to the new ICOM - International Council of Museums definition, museums represent a permanent nonprofit institution serving society, open to the public, accessible and inclusive that conducts research, collects, preserves, interprets and exhibits cultural heritage, tangible and intangible.

They also offer diversified experiences for education, enjoyment, reflection and knowledge sharing. The result is the need to implement effective "transformation strategies" in museum environments for sharing and promoting cultural heritage.

As a matter of fact, the "classical" exhibition of artworks is no longer sufficient to meet the heterogeneous needs of cultural users who, in different ways, seek elements that make them experience the museum visit as a broader and more diverse cultural and social, free, real and unreal experience.

Art and its spaces designed to contain it thus turn out to be an invitation to knowledge and reflection to the point of exploring emotional and cognitive states that are very often overlooked. The relation of "complicity" and "contemplation" that is established between the user, the work of art and the spaces of fruition, seems almost to have become so fundamental that it is now considered as a tool capable of promoting people's well-being and health.

Visitors are no longer content to passively enjoy the collections on display; they want to interact with them actively to better understand them. Museums, therefore, have become multidimensional means of knowledge, geared toward offering visitor experiences as comfortable, rewarding, and engaging as possible, becoming "places for people."

The first part of this article will briefly address the main references in the literature on the "museum experience" model, examining in particular the meaning of cultural "experience." Subsequently, the relation between user, artwork and space of fruition will be analyzed as well as framing the role of technology through a summary of the main methodologies and methods adopted for the fruition of spaces dedicated to culture.

## Experiential Museum Models

In recent years, the renewed focus on "experiential museums" is demonstrated in the literature by numerous studies and models that define and contextualize the experience of visitors to cultural places. In line with the previously mentioned definition of a museum, museums, in fact, are able, through processes of interaction and enjoyment of works of art, to simplify and enrich the dialogue with institutions and the public through the active participation of the user.

According to Kotler (2004) museums can offer six different modalities of experiences depending on the types of activities and in particular (I) the recreational experience characterized by the moments of entertainment and fun and playful activities; (II) the socializing experience during which it is possible to perform group activities, meet new people; (III) the educational experience to stimulate curiosity about certain subjects, learn new knowledge and skills; (IV) the aesthetic experience that allows immersing oneself in various perceptual and sensory forms; (V) the celebratory experience by participating in the memory of a moment or reflecting on human history; and finally (VI) the exciting experience that allows one to experience new emotions and stimulate the imagination.

In the recent study carried out by Calvi & Vermeeren (2023), the thinking of Marc Hassenzahlm, whom they described as one of the leading researchers in the field of experience design, is highlighted, who states that an experience represents an episode, a fragment of time that a person has experienced. In this context, sights and sounds, feelings and thoughts, motivations and actions are closely linked, and stored in memory. An experience therefore represents a story, emerging from a person's dialogue with his or her world through action. (Calvi & Vermeeren, 2023) (Hassenzahl, 2010).

From the analysis of the Museum Experience Model (Falk & Dierking, 2013), the museum user's experience results from the overlap of physical, social and personal context, and in particular, the model suggests that each visitor's experience is different (Figure 1). Each visitor (i) brings with them their personal and social contexts, (ii) is influenced differently by the phys-

ical context, and (iii) makes different choices about which aspects of that context they want to focus on. (Harada et al., 2018)

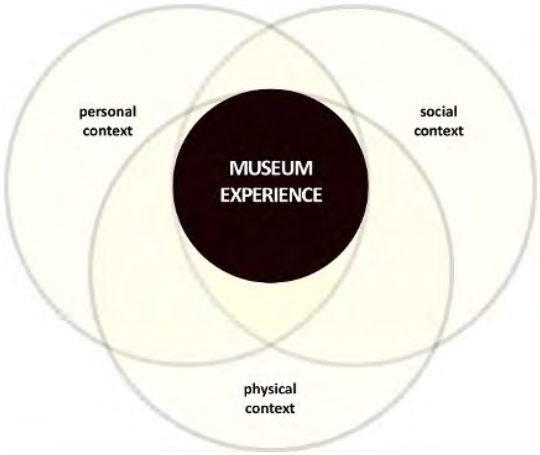



*Figure 1. The Museum Experience Model (Falk & Dierking, 2013).*

Another model of experience analyzed is by Packer & Ballantyne (2016) who, on the other hand, define several key factors in the conceptual scheme of visitor experience, including the "opportunity for an experience," the "immediate subjective experience," and the "remembered experience." These factors are mediated by visitors' perceptions before the visit in terms of motivations and experiences and during the visit in terms of interpretations, narratives, and transformations. (King et al., 2023)


*Figure 2. A conceptual scheme of key factors associated with the user experience (Packer & Ballantyne, 2016).*

This conceptual scheme (Figure 2) also takes into account a "management element," which includes activities and events that bring the experience to life, and a "transformation element," a process through which visitors interpret and give meaning to their experience (Packer & Ballantyne, 2016). In fact, stimulating the empathic relationship between visitor and museum becomes the main goal of a visit with "experiential" characteristics from the needs of the user/visitor, the museum understood as an institution, place of culture and space (Germak et al., 2017).

The visit process and its motivations are changing to the point that it is further a recurrent field of investigation. Specifically, this process can be generically divided into three stages: before, during, and after the visit (Yang et al., 2023) (Anto´ n et al., 2018; Kuflik et al., 2015). Before the visit, the visitor's knowledge, plans, attitudes, and motivations are of primary importance (Falk & Dierking, 2000; Hein & Alexander, 1998; Yang et al., 2023).

During the visit, visitors obtain learning, entertainment and aesthetic experiences through various participatory behaviors (Pine & Gilmore, 1998; Yang et al., 2023), which are central to the process of co-creating the value of the museum experience. Finally, after the visit, visitors reflect on the experience enjoyed and engage in content generation by sharing perceptions and feedback.

The positive experience may also induce visitors to seek further information about the museum or participate in additional cognitive activities, through the "experience intensification" approach (Anton et al.,2019; Yang et al., 2023). In addition, the visit process to the museum is directly proportional to motivation, such as exploring new art forms, spending quality time, escaping from reality. In particular, Allan & Al Tal (2016) identify five motivations for visiting a museum: exploring unfamiliar territory, increasing one's knowledge through new experiences, enjoying a moment of escapism, visiting with friends and family, and simply relaxing. (Yang et al., 2023)

## The fruition of the artwork

Art museum have always been considered places in which the relation between the user and the artworks on show is "traditional and direct," taking the form of a one-way communication from the artist to the user. According to Iotti & Culcasi (2024), art, in this contemporary scenario, stands as a transversal tool, as a universal and inclusive language that involves every sphere of knowledge and becomes a means of communication for society. In the process of artwork fruition, sensations, perceptions, memories and emotions are activated at the basis of user involvement without which the artwork would be devoid of narrative meaning. Through such a relationship, the art object directly and indirectly transfers sensory stimuli, which are active only at the work-user fruition stage. Each stage of fruition can be called an action of the artist that adds meaning and consequently experience.

In the work of Calcagno & Faccipieri (2011), it is shown how experiences that are more open to user participation are indispensable to sustain visitor flow and activate more effective "knowing" (learning) processes. The authors argue, in fact, that there is a widespread need to propose and encourage fulfilling forms of installations for the emotional and cognitive involvement of the user, through practices of fruition with the artwork, such as to involve the user in processes of co-production of meanings with the work and its perceptual space.

With each artistic expression, therefore, different types of enjoyment, interaction times with the work and perceptions can be identified, which can define the artwork-user relationship, which becomes an interactive experience. According to d'Alfonso (2017), art can be classified into seven categories: contemplative art, kinetic art, dynamic art, semi-immersive art, immersive art, interactive art, and performative art. In each category, the user can define as an integral part of the work; while interaction times can be free or undefined and perceptual stimuli can be shared or personal (Figure 3 ).

From d'Alfonso's study it emerges that "the identification and combination for each work of the different principles [...] thus allows us to assess their main fruitive value at the time of their exhibition and to set them up in the best possible way.'" (d' Alfonso, 2017)

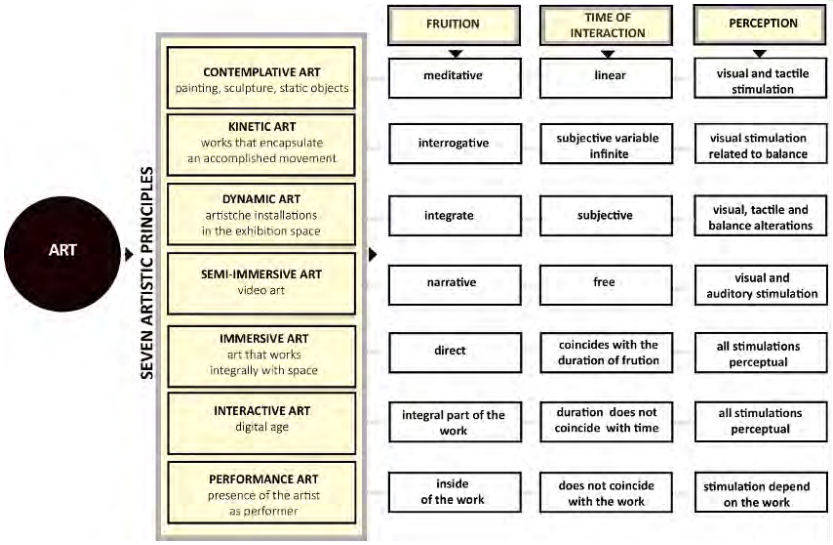



*Figure 3. A research conceptual scheme of key factors associated with the art experience (d'Alfonso, 2017).*

## The fruition of space for the artwork

In the essay titled "Cinema and Architecture" in 1955, Sergio Bettini focuses on the problems of fruition of the architectural object and states that for the understanding of an architectural work, it is not only necessary to stand in front of it and contemplate it, but it is necessary to enter the spaces and experience them, walking through them by spending time useful for the development of the space. For this reason, the role of "space" and its arrangement turn out to be of fundamental importance at the stage of artistic fruition.

For this reason, according to d'Alfonso (2017), space and architecture turn out to be the object of creative experimentation toward disused places, which can create a rupture with the space and setting recognized and assigned to contemporary art. Architectural space and proper design are indispensable factors in understanding artworks.

According to Falk & Dierking (2000), the design of space, understood as form, volume and colour, influences the learning of museum settings in which visitors seem to constantly "depend" on their surroundings to receive information and understand the works on display.

Furthermore, according to Dean (1996), in his book "Museum Exhibition, theory and practice," three spatial principles must be adhered to for the proper design of museum space: (I) personal space, (II) spatial space, and (III) transactional space. With reference to transactional spaces-common in museums and fundamental to the designer (Dean, 1966) a series of subspaces delimited by the types of activities carried out and in particular distributive spaces, gathering spaces and transitional spaces are defined.

In order to understand how exhibition spaces should be properly designed, it is appropriate to briefly go back to the beginnings of modernity, when major and minor arts merged into contemporary art and the tendency to consider the White Cube as the ideal space for art was defined.

According to d'Alfonso (2017), the White Cube, considered as a type of exhibition space, cannot be defined as a "neutral space," as it is defined by margins, volumes, lights, and configured by direction, temporality, and orientation.

It is inevitable to see that in the "White Cube" are concentrated timelessness, sacredness, strangeness, typical of contemplative art understood as the archetype of modern exhibition spaces. In contrast, however, it is possible to find the "Black Box," which is based on "conventions" similar to the white box exhibition space, with possibilities of moving through the space

in contact with the artwork. As Bishop (2018) asserts, both "White Cube" and "Black Box" exhibition spaces, through the implementation of the latest technological innovations, are converging into hybrid spaces that can attract more audiences.

Author Bishop (2018) defines a new typology - the "Gray Zones" - usually considered for temporary installations-that does not represent a well-defined exhibition space, as the artwork or performer represents the predominant subjects of the space. In his article, he goes on to state that spectoriality has always acted as a mediator but today it is no longer just an individual factor but projects outward, "online."

## Technology for museum spaces. Case-studies

Technology has always played a predominant role in providing experiences within routes and sites dedicated to culture. Consider as early examples, audioguides and early websites initially used to provide basic information such as accessibility and reachability of cultural spaces, to the introduction of innovative digital systems. In recent years, museums have begun to reorganize their spaces of enjoyment and interaction, including rethinking technologies and web content to implement people's engagement even remotely.

Viola & Cassone (2017) specifically address the issue of engagement by considering three different dimensions: attraction, interaction, and experience. The first component is closely related to the aesthetic impact of an object or situation, which can generate feelings of fascination, pleasure, obsession, or seduction, while the interaction component is more closely related to the physical contact, attunement, and functionality of the object or situation itself; experience, on the other hand, is related to particular objects that arouse feelings and evoke memories.

Therefore, new digital technologies are the useful tools for developing these aspects and making museums state-of-the-art institutions in line with current European and national directives. Some international standards highlight the need for museums to become reference institutions, with the aim of " promoting the role and value of sites for learning and research, education and culture, social and economic life" (ISO 21246:2019) or "to define and describe methods for assessing and measuring the impact of museums on individuals and society" (ISO/AWI 16687).

In a context in which there is a general trend perceived in museum theories and practices to improve actions aimed at accessibility and reception in general, to improve the participation of the public understood in its diversity (Miglietta, 2020), it is necessary to understand the potential of new technologies that, offer the answers to the many challenges that the sector is facing.

According to Amoruso et al. (2019), new technologies are changing the user-space relation of museum fruition by transforming such environments into "virtual extensions" and enabling the definition of personalized experiences related to content selection. In order to highlight the importance of technologies in museum contexts to improve heritage knowledge and enjoyment, some representative case studies were analyzed.

In particular, virtual museums, defined as communicative projections of the real museum (Antinucci, 2007), have become the "putting into practice" of now more common technologies such as Virtual Reality, related to cultural heritage "which allows one to appreciate paintings and sculptures in their real size within realistic environments, with the aim of reproducing the museum experience" (Cecotti, 2022, p.85).

The first case-study analyzed is the "Mona Lisa: Beyond the Glass" (Figure 4), which is the first Virtual Reality (VR) experience presented to the

public by the Louvre Museum, part of the museum's seminal exhibition on Leonardo da Vinci, organized in collaboration with HTC VIVE Arts.

It is an immersive experience that brings together moving images and sound to enhance the involvement of the visitor who is transported through time and space through creative storytelling.

The surrounding environment is transformed into a three-dimensional space, capable of rendering new details and information of the artwork.

*Figure 4. Mona Lisa: Beyond the Glass. Left: Photo by Vive Arts on artnet . Right: Photo by - by Vive Arts on vivearts*

Specifically, "Mona Lisa: Beyond the glass" corresponds to the category of semi-immersive art (video art), immersive (artwork integrated with the space), and interactive (art in the digital age) in the museum space that responds in characteristics to the "Black Box" setting, using Virtual Reality technology through the use of the latest generation of visors (HTC ViVe, Emissive).

The fruition experience turns out to be direct, narrative and integral part of the work, the free interaction time coinciding with the fruition but not with the interaction time with the artwork. For this visit, therefore, all perceptual stimuli are interrogated. Despite the use of cutting-edge technology capable of "activating" user knowledge and actions, participation can be described as "passive" because the visitor receives notions, information and details without being able to interact directly with the artwork.

The second case study entitled "Living Architecture: Casa Batlló" (Figure 5) by artist Refik Anadol highlights the possibility of "generating" art through the use of artificial intelligence (AI). In the current digital context, Anadol reflects on the importance of AI technology by producing experimental works since 2018.

The artist, in fact, combines data paintings and installations with architectural structures by transforming every piece of data he deals with into color pigments (Soner,T., 2022).

For that project, Anadol collected data for about one billion images

*Figure 5. Living Architecture: Casa Batlló. Left: Photo by Refik Anadol on refikanadol. Right: Photo by Casa Batlló Gaudì Barcelona on casabatllo.*

and sketches of Gaudí, visual archives of the building's history, academic archives, and photos of the UNESCO World Heritage site available publicly on various online platforms.

The works created by the artist highlight the synergy between art, architecture and technology and define the new perspective beyond space and time, connecting past, present and future and creating digitizations of memories, architecture and digital narratives.

"Living Architecture: Casa Batlló" corresponds, again, to the category

of semi-immersive, immersive and interactive art. The work is realized on "a heritage façade," outside the museum, responding to the characteristics of hybrid "Gray Zone" exhibit. For this purpose, the innovative technology of artificial intelligence was used and through a sophisticated process of video-mapping, the experience of fruition turns out to be direct, narrative and integrated with the work, the time of interaction to be considered free, coinciding with the fruition but not with the time of interaction with the artwork. For this experience, therefore, all perceptual stimuli are activated.

For this case study, the investigation focused on the potential of the innovative technology used (artificial intelligence) and how much the latter, a few years later, was still capable of delineating human-machine boundaries. In fact, thanks precisely to it, the user can feel involved in the process of data collection and the use of historical resources, capable of returning a narrative "memory" experience.

The case-study "Every Wall is a Door" (Figure 6) highlights artist James Turrel's investigations into the perception of light and space and the ways through which they "generate experience." In fact, in the inaugural exhibition at "Superblue Miami Museum", James Turrell manipulates light and vision to investigate the power of perception.

Turrell, in fact, does not make use of figurative images, but seeks interior

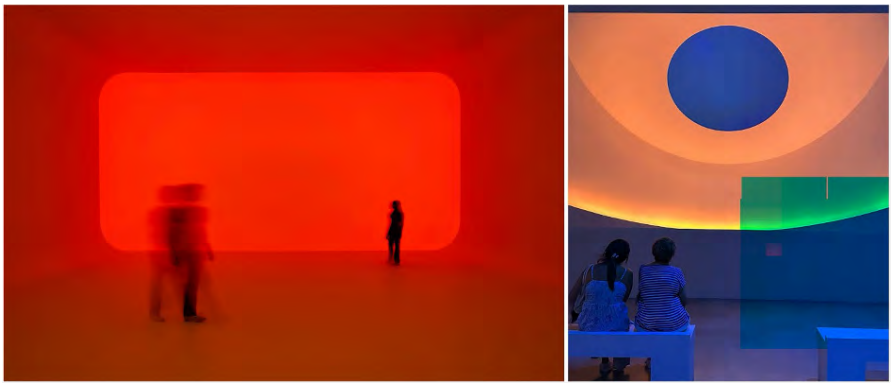


*Figure 6. Left: James Turrell Installation view of Every Wall is a Door, Superblue Miami. Photo by Oriol Tarridas Photography on margotmottaz.*
*Right: Installation view on superblue.art.*

vision through the study of the psychological processes of visual perception by creating effects of two- and three-dimensionality using light. His installations create the "Ganzfeld Effect," which, in psychology, indicates the total loss of perception. As stated by Adcock, James Turrell's light works are "so fundamentally integrated with perception that it becomes foolish to separate the works from the physiological and psychological processes they reveal" (Adcock, 1990 in Edensor, 2015, p.141).

"Every Wall is a Door," on the basis of literature research, corresponds to the category of immersive and interactive art. The work was created inside a museum, meeting the characteristics of hybrid "Gray Zone" installation. Through digital light processing technology, the user is totally immersed in the light installation (light installation).

The experience of fruition, therefore, turns out to be direct and totally integrated with the artwork, with the interaction time coinciding with the fruition but not with the interaction time with the artwork. All perceptual stimuli are activated.

In this case, what is readily apparent is the ability on the part of the author to engage the visitor in a totalizing perceptual experience, without the support of cutting-edge or state-of-the-art technologies and tools.

From the case studies analysed, data and considerations emerged that define the modalities of fruition, interaction and user perception when contemplating the work ("Mona Lisa: Beyond the Glass"), with the use

of innovative digital technology ("Living Architecture: Casa Batlló") and within a modified exhibition space ("Every Wall is a Door") (Figure 7).

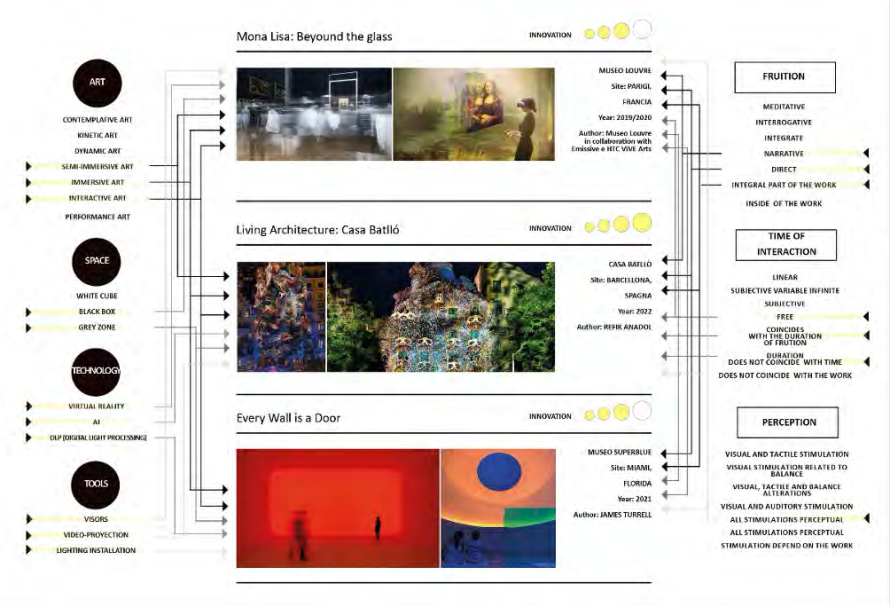



*Figure 7. A conceptual scheme to search for key factors associated with the artistic experience based on the analysed case studies. (Authors, 2024)*

## Designing the museum experience between art, space and technology

The recognition conducted of the references in the literature and the descriptions of the case studies identified showed how technological innovations are changing the ways in which artwork is enjoyed and enriching the experience of the active user. The types of fruition, the timing of interaction with artworks, and the perceptions elicited establish relationships between the artist's mind and the user.

In fact, the physical presence of the user within an exhibition space takes on connotative significance becoming a determining factor in the design of such museum spaces that not only meet the need to preserve and pass on information (documents, works) and memory (cultural values, knowledge) but in relation to architecture and artwork, they can enrich the museum experience. Based on the scientific literature, it was necessary to identify and schematize the reviewed types of exhibition spaces, starting with the relationships that occur from the perspective of fruition, interaction times and perceptions (Figure 8).

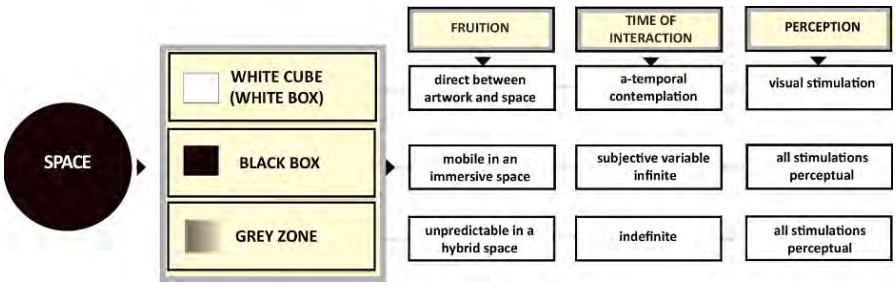



*Figure 8. A conceptual scheme for researching the key factors associated with the user experience within a museum space (Authors, 2024)*

The exhibition space, therefore, "welcomes" the user and the artworks, thus influencing the relational relation and contributing to the definition

of effective cultural communication. Museum fruition, therefore, is contextualized both artistically and spatially, and the new languages introduced by technological and digital culture respond to the need to create comprehensive and multisensory experiences.

In detail, it emerged that the technologies employed in the previously mentioned case studies produce (I) action ("active experience") in the first case-study of "Mona Lisa: Beyond the Glass" in which a direct action with the artwork takes place through the use of virtual reality; (II) memory ("memory experience") in the second case-study "Living Architecture: Casa Batlló" in which numerous unknown Gaudi sketches are "brought to life" with digital and technological skills; and finally perception ("perceptual experience") in the third case-study "Every Wall is a Door" by James Turrell for the Superblue art gallery in Miami, which highlights the total loss of spatial and temporal perception by the user.

Finally, from the analysis carried out, it emerged how the museum experience can be closely related to (I) the artwork, understood as the "object of experience" and with which the individual or collective relationship is created; (II) the space and the "subject" who enjoys the exhibition environment, whether defined by margins or hybrid; (III) the technologies, understood as opportunities for the user, able to make the experience "access" and "capture" the cultural essence.

As defined by Russoli (2017, p.63), the museum, as "custodian" of artistic and expressive language, can become a strategic place for cultural storytelling. Indeed, the museum can no longer respond to general principles of standardization, but must take on the character that its heritage and history demand.

## Conclusions

The literature review of museum experiential models and visitation processes identified highlighted the importance of the relation between artwork, user and exhibition space understood as a place of creative experimentation for understanding the artwork itself and for defining new design and participation scenarios. In addition, the selected case studies highlighted how technologies in museum contexts are now indispensable for improving the enjoyment of cultural heritage.

The fruition, interactions and perceptions of works of art are becoming the "new targets" for the construction of innovative processes that can improve the multisensory experience of users in sites dedicated to culture.

Artworks, exhibition spaces and the use of technologies, therefore, turn out to be among the first key indicators for defining museum experience design strategies and, in this context, through established tools and methods proper to the discipline, design is called upon to explore the new modes of user-work-space interaction through which to convey the new cultural contents. From the studies carried out, it is clear, therefore, that museums are evolving into dynamic and experiential places, such as to fascinate a more heterogeneous and broad audience, intrigued by the new opportunities offered by "cultural institutions."

# References


1. Amoruso, G., Mironenko, P., Peruzzetto, A., & Salvetti, F. (2019). "Design Esperienziale per il Patrimonio Culturale. Un'applicazione partecipativa per il Museo Cola Filotesio di Amatrice". Paesaggio Urbano, (1), 90-99.
2. Antinucci, F. (2007) "The virtual museum." Archeol. Calc., 1, 79–86.
3. Bettini, S., (1956) Cinema e architettura, Lumen, II, 2,177-179
4. Bishop, C. (2018). "Black box, white cube, gray zone: Dance exhibitions and audience attention." TDR/The Drama Review, 62(2), 22-42.
5. Calcagno, M., & Faccipieri, S. (2011). Nuove forme d'interazione nella fruizione di prodotti culturali (No. 1). Department of Management, Università Ca'Foscari Venezia.
6. Calvi, L., & Vermeeren, A. P. (2023). "Digitally enriched museum experiences–what technology can do." Museum Management and Curatorship, 1-22.
7. Cecotti, H. (2022, September). "Cultural heritage in fully immersive virtual reality." In Virtual Worlds (Vol. 1, No. 1, pp. 82-102). MDPI.
8. Clow, A., & Fredhoi, C. (2006). "Normalisation of salivary cortisol levels and self-report stress by a brief lunchtime visit to an art gallery by London City workers." Journal of Holistic Healthcare, 3(2), 29-32.
9. D'Alfonso M., (2016) Come lo spazio trasforma l'arte, come l'arte trasforma lo spazio. Silvana Editoriale.
10. Dean,D. (1996) Museum Exibition, Theory and practice. Routledge.
11. Edensor, T. (2015). "Light art, perception, and sensation." The Senses and Society, 10(2), 138-157.
12. Falk, J. (2016). "Viewing the Museum Experience through an Identity Lens." Davis, Ann; Smeds, Kerstin (Hg.): Visiting the visitor. An Enquiry into the Visitor Business in Museums. Bielefeld, 71-88.
13. Finocchi, V. (2011). "Il valore performativo della fruizione artistica." Mantichora. Italian Journal of Performance Studies, 1, 277.
14. Germak, C., Giuliano, L., & Khan, S. (2018). Il Design per il museo su misura. Design su Misura Atti dell'Assemblea annuale della Società Italiana di Design.
15. Gobbato, V. (2023)." Illuminating Museums. From Design to Experience." Ambiances. Environnement sensible, architecture et espace urbain.
16. Harada, T., Hideyoshi, Y., Gressier-Soudan, E., & Jean, C. (2018). "Museum experience design based on multi-sensory transformation approach." In DS 92: Proceedings of the DESIGN 2018 15th international design conference (pp. 2221-2228).
17. Hekmat, M., & Partovi, P. (2019). "Conceptual Model and Analytical Framework of museum visitor experience." In Journal of Visual and Applied Arts, 12(25), 25-46.
18. International Council of Museums, Museum definition [Online] Available at: https://icom.museum/en/resources/standards-guidelines/museum-definition/ [Accessed 02 February 2024].
19. ISO 21246:2019 Information and documentation. Key indicators for museums Available at: https://www.iso.org/standard/70231.html
20. ISO/CD 16687 Impact assessment for museums. Under Development. Available at: https://www.iso.org/standard/84795.html
21. Ingold, T. (2015) "Reach for the Stars: Light, Vision and the Atmosphere." In D. Gunzburg (ed.), The Imagined Sky: Cultural Perspectives. Sheffield: Equinox.
22. Iotti, A., & Culcasi, I. Il museo come processo di partecipazione. Laboratori d'arte per una cultura diffusa e inclusiva.
23. King, E., Smith, M. P., Wilson, P. F., Stott, J., & Williams, M. A. (2023)." Creating Meaningful Museums: A Model for Museum Exhibition User Experience." Visitor Studies, 26(1), 59-81.
24. Kotler, N., Kotler, P., (2004) Marketing dei musei. Obiettivi, traguardi, risorse, cit., p.48 Biblioteca Einaudi.
25. Miglietta, A. M. (2020). Accessibilità culturale nei musei. Barriere e strategie di miglio

# Environmental Impact of Wood, Steel, and Concrete in Residential Buildings

*Sonsoles Vela Navarro, Ruben Garcia Rubio*
*svela@tulane.edu1, rgrubio@tulane.edu2*

*Tulane School of Architecture, United States of America*

***Keywords:***
*Life cycle assessment*
*Timber*
*Low-carbon material*
*Embodied carbon*

## Abstract

There is a global consensus that reducing our energy consumption and dependence on carbon-emitting fossil fuels is essential to prevent irreversible harm to our planet. By recognizing the significant contribution of buildings to the climate crisis, we can take steps towards mitigating their impact.

Focusing on the building structure and sub-structure can be a great starting point, as they account for more than 50% of the total carbon footprint. Although steel and concrete have been the go-to materials for constructing buildings, there is growing interest in using mass timber due to its potential to reduce embodied carbon and sequester carbon. This shift towards sustainable building practices is a positive step towards a greener future.

Therefore, this paper aims to introduce an assessment model that compares and evaluates the environmental impact of using wood framing, sheet metal framing, and concrete structures in a five-story, 24-unit residential building. The same linear typology design will be assessed with three different material options, including the benefits of using new low-carbon technologies, such as green concrete and recycled steel, to reduce carbon emissions.

## Introduction

### 1.1 Use of Steel, Concrete, and Wood

The materials utilized in building construction are responsible for approximately nine percent of energy-related CO2 emissions (UN Environment Programme, 2022), and it is predicted that the use of raw resources will double by 2060. The two primary culprits responsible for this predicament are steel and cement, which significantly contribute to greenhouse gas emissions.

The use of concrete and steel, separately or in combination, has become the most common structural system for medium and large-sized buildings in the past century. In many countries, buildings taller than four to seven stories are required to use non-combustible materials, which makes it difficult to use timber for such structures due to its inherent fire risk. Therefore, the use of wood in construction has been limited traditionally to small-sized buildings.

Nonetheless, architects and engineers worldwide are increasingly considering using mass timber as an alternative to traditional building materi-

als due to its potential to reduce embodied carbon and act as a carbon sink. This is especially important in the context of the current decarbonization efforts aimed at achieving net-zero emissions by 2050. However, the success of such efforts will largely depend on the ability of countries to adapt their building codes, among others.

Eurocodes are widely enacted throughout Europe and provide a common approach to the structural design of buildings. Still, they do not address occupancy or building fire safety, which are fundamental pieces. Instead, if any, height, area allowances, and fire resistance ratings for all types of construction are addressed by EU country-specific building regulations. According to a survey conducted in 2020, out of 40 countries, some European countries do not have specific limits on the number of stories for wooden buildings, while others have a limit of seven stories or less (Östman, 2022).

The International Building Code (IBC) is the predominant model building code in the United States. Recently, a set of proposals was approved to allow taller wooden buildings as part of the 2021 International Building Code. The code includes provisions for up to 18 stories of Type IV-A construction for Business and Residential Occupancies.

With these changes, it seems that the United States will soon reduce its carbon footprint. Nevertheless, some European countries still need to adjust their code compliance to the new carbon emissions scenario.

### 1.2 Life Cycle Assessment

The concept of the entire carbon cost of a building was developed based on the Life Cycle Assessment (LCA), which was first introduced in the 1960s (Bjørn et al., 2018). This approach emerged as a response to concerns about environmental degradation and limited access to resources.

Life Cycle Assessment (LCA) is a commonly used method to evaluate the environmental impacts of products and services. This assessment includes collecting and evaluating quantitative data on the material, energy, and waste flows linked with a product throughout its entire life cycle. ("Life cycle assessment and embodied carbon," 2024)

An LCA essentially comprises three steps:

Compiling an inventory of relevant energy and material inputs and environmental releases (outputs) associated with a defined system. Releases can be solid wastes or emissions to air or water.

Evaluating the potential impacts associated with these inputs and releases, e.g., the global warming impact from CO2 and other greenhouse gas emissions.

Interpreting the results to help make informed decisions.

In the last few decades, the majority of a building's carbon footprint was attributed to operational emissions such as lighting and heating. However, with the advent of decarbonization efforts and increased energy efficiency standards, the focus has shifted to tackling embodied carbon.

ble mobility products provide a platform for designers and stakeholders to reimagine deeply ingrained artefacts and their imbued meanings, aligning them more closely with contemporary social values while considering economic

In the 1920s, Buckminster Fuller, the creator of the Dymaxion House, used to ask his critics: How much does your house weigh? The term Dymaxion was widely used by Fuller in his experiments designing homes, houses,

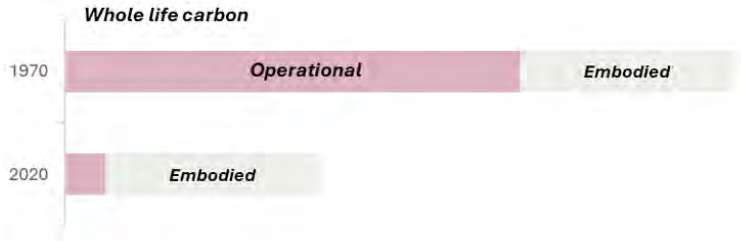



*Figure 1. Buildings Whole Life Carbon Timeline (Authors).*

and mapping and it is a portmanteau of the words dynamic, maximum, and tension (Sieden, 2000, p. 132). This concept sums up the goal of his study: "maximum gain of advantage from minimal energy input" (McHale, 1962, p. 17).

Today, architects should reembrace this concept and ask ourselves: How much embodied carbon does your house weigh? This inquiry holds significant importance as the addition of weight to a building requires an increase in the consumption of energy and resources during the manufacturing, transportation, and assembly stages of construction, having a direct impact on the overall environmental footprint of the project.

According to Fuller's previous quote, there are two main ways to reduce the embodied carbon of a building: designing it to minimize structural materials and using less carbon-intensive materials.

### 1.3 Embodied carbon distribution in a building

According to several studies, we can establish that the building's structure is responsible for around 40-60% of its total embodied carbon emissions, depending on its use typology. For example, Takano, Hughes, and Winter (2014) found that buildings' support structure and framing components contribute to 44% of GHG emissions in residential buildings and 64% in office buildings. Hence, by carefully selecting the materials used in the substructure and superstructure of the building, we can significantly reduce emissions, as a significant portion of embedded carbon is contained in these areas.

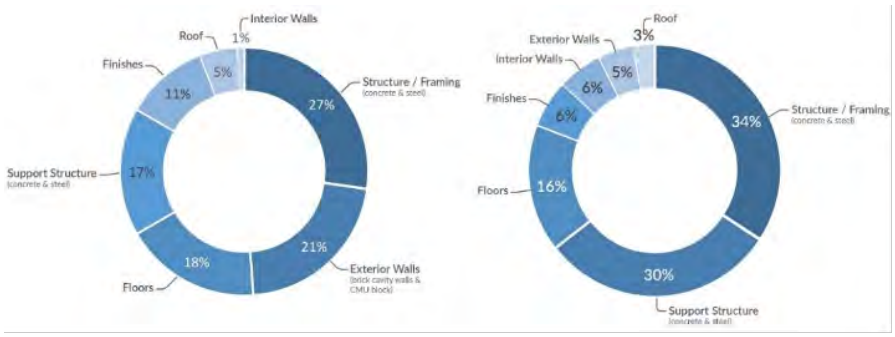



*Figure 2. Embodied Carbon per Building Element: Apartments (left) and Office (right) (cove. tool).*

In a 50-year lifecycle for conventional buildings, about 10 to 20% of the total greenhouse emissions will be associated with the materials used ("The 2030 Challenge," 2024). However, in the case of low-energy buildings, where the heating-related load is less and the materials use is higher, this proportion can exceed 50% (Gielen, 1997; Berge, 2009).

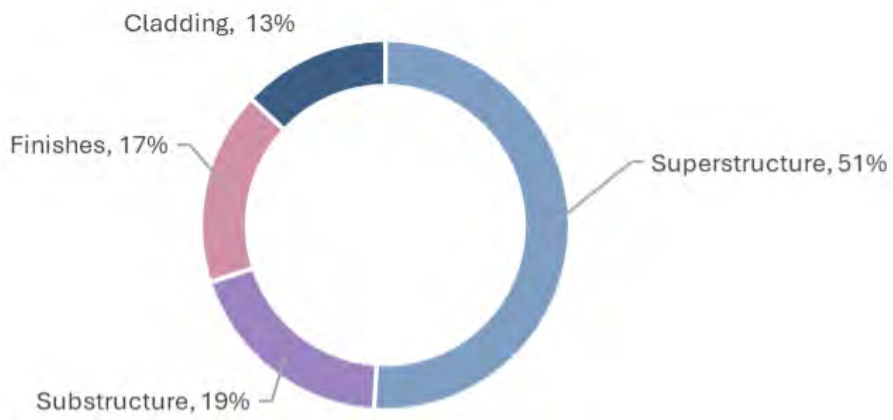



*Figure 3. Embodied Carbon: Average across multiple schemes of buildings KtCO2e (Kaethner & Burridge, 2012).*

## 2. Overview

This paper aims to analyze the potential environmental impact of three primary materials - concrete, steel, and wood - used in the structural system of a medium-rise residential building. The study will explore the benefits of using new low-carbon technologies, such as green concrete and recycled steel, to reduce carbon emissions. It is intended to be used as an initial investigation into the matter during the early stages of the design process and to assist in determining design options with a reduced carbon footprint.

An embodied carbon assessment will be conducted using the Life Cycle Assessment to carry out this research. The focus will be on the embodied material emissions for each structural system in categories from A1 to A5. These greenhouse gases (GHGs) released before the building begins to be used are known as the Upfront Carbon Emissions, which include material emissions associated with producing a material (A1-A3) and the construction phases of the cycle life (A4-A5) before the building or infrastructure begins to be used.

Finally, the study will compare the carbon footprint of the same building's wood, concrete, and steel structural systems. It is important to note that the study focuses solely on the impact of carbon sequestration on the embodied carbon footprint of the wood structural system. While some experts suggest that all materials should be taken into account when considering carbon sequestration, this particular case study only analyzes three materials, and the ability of concrete to sequester carbon is not regarded as significant due to the required optimal conditions such as temperature and humidity.

## 3. Methodology

### 3.1. Case study description

The case study is a 5-story residential building. Each floor has dimensions of approximately 35.4m x 12.8 m and spans between 4-5.4m. The building comprises 24 residential units, with six units on each floor. It is expected to have a lifespan of 50 years. Architectural plans and representative structure of the residential building are provided in the figures (4 and 5).

The proposed concrete, steel, and timber structural system will be compared to evaluate the benefits of using different materials and the impact of using recycled steel or low-carbon concrete in a structural system.

*Figure 4. Typical Architectural Plan (Authors).*

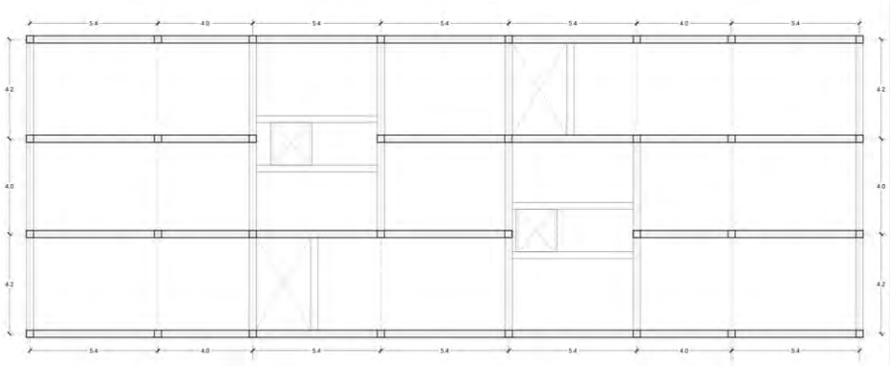


*Figure 5. Building Framing Plan (Authors).*

### 3.2. Approaches

Two approaches were utilized to compute the outcomes. The initial approach involved adhering to the guidelines and recommendations outlined in the published guide by The Institution of Structural Engineers (Gibbons & Orr, 2022) on stages A1-A5 to establish a solid foundation for the process. This method entailed utilizing Excel tables and selecting from reliable sources environmental product declarations (EPDs) that were more representative of the case study to guarantee precision and effectiveness. Some adjustments were made to accommodate the specific situation.

The other methodology uses Cardinal LCA v0.0.1, a plugin for Grasshopper to analyze the embodied impacts (Global Warming Potential, kgCO2e) by using the EC3(US) and ICE 2019 (UK) databases with the flexibility to add your custom EPD for detailed analysis ("Cardinal LCA, a product by Pathways," 2024). This approach entails developing a three-dimensional model of the structure or design to leverage the geometry and calculate the amount of materials required for each component. It is beneficial for initial design phases, specifically stages A1-A3, as it facilitates the early study of the structure and facade.

Both methodologies are appropriate for early stages of the design process, and their combination leads to optimal results in advanced stages.

### 3.3. Structural System Description

Structural systems play a crucial role in minimizing the material and weight of a building. Choosing an optimal system requires careful consideration of available options for each material to find the most efficient one that suits the building's typology and required spans.

For concrete, the selected option is the one-way ribbed slab, which uses hollow concrete blocks to create ribs parallel to each other. The voids in the slab are filled with these blocks, providing more depth for reinforcement

while reducing the amount of concrete required.

The major advantage of this floor is the reduction in weight achieved by removing part of the concrete section below the neutral axis and replacing that with lighter-weight materials. These types of construction are suitable for buildings with long spans, typically between 5m to 6m, and light to moderate live load (1.5 - 3kN/m2), such as residential houses. They would not be suitable for floors with heavy loads.

Concrete is a very strong material when it comes to compression, but it can be weak when it comes to tension. To overcome this weakness, steel reinforcement is added to concrete structures to help carry tensile forces and create a durable structure that can withstand various potential stresses. The reinforcement estimates that steel used in concrete typically ranges from 40 to 200 kg per m3 of concrete.

Some typical average weight of reinforcement (kg/m3) in concrete building elements -these numbers might be used only as guidelines because they may vary depending on the specific project- (Janicki, 2024):

Footings: 80-90 kg of normal rebar steel.
Reinforced concrete beam/slabs: 100 -110 kg of normal rebar steel.
Column: 150-180 kg of normal rebar steel.

For steel, structural steel framing and composite concrete slabs are used. Wide flange shapes are used for the gravity columns.

Composite slabs comprise reinforced concrete cast on top of profiled steel decking, which acts as formwork during construction and external reinforcement at the final stage.

The manufacturing of metal products is often associated with increased environmental pollution and energy consumption. However, both aluminum and steel components can be recycled, which can help reduce the environmental impact of their production. When reusing metal structural elements, it is important to assess the risk of material fatigue to ensure their structural integrity.

For Timber, the system chosen consists of structural timber framing glulam (GLT) and composite cross-laminated timber (CLT) floor planks.

Cross-laminated timber CLT and glulam (GLT) are two types of engineered wood products used in construction. CLT is created by bonding several layers of solid wood panels together at alternating right angles using a structural adhesive. On the other hand, Glulam is made by gluing several solid pieces of lumber together lengthwise, creating strong beams and columns.

Moreover, timber acts as a carbon sink, which means it absorbs carbon dioxide from the atmosphere while growing. It is estimated that for every kilogram of wood, 1.5 to 1.8 kilograms of carbon dioxide is absorbed and stored until the building burns or decays. Therefore, using timber as a building material is a much more environmentally friendly option than steel or concrete, as long as responsible forest management ensures the replenishment of this valuable resource.

### 3.4. Material Take-Offs - Structure Calculations

The following software tools were used to design structural elements of buildings according to Eurocodes (EC), optimize their dimensions, and extract material quantities. Acca EdiLus software was utilized for concrete-steel structures, while Calculatis by Stora Enso was used for timber

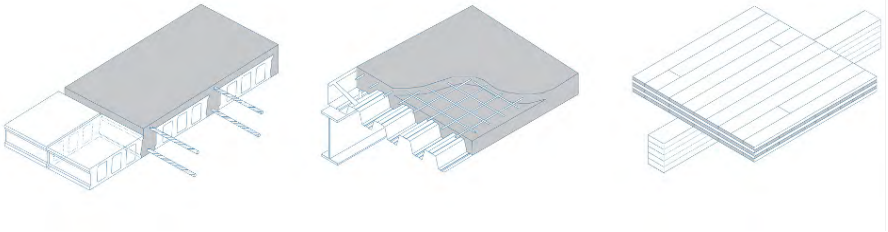


*Figure 6. Typical One-way Ribbed Slab: Hollow concrete pot (left); Typical Composite Steel Slab (centre); Typical CLT Timber Deck (right). (Authors)*

*Table 1. Building elements (Authors).*

| Concrete Structure | Steel Structure | Timber Structure |
|---|---|---|
| Superstructure | | |
| One-way Ribbed Slab (Hollow concrete pot) | Composite slab | CLT Slab |
| Concrete Beams | Steel Beams | GL-24h Beans |
| Concrete Columns | Steel Columns | GL-24h Columns |
| Substructure | | |
| Waffle raft slab foundation | Waffle raft slab foundation | Waffle raft slab foundation |

study cases. Note that the timber structure design has a fire resistance class of R-90.

After the structural calculations were completed, the material quantities were extracted and classified to be used in each approach. The resulting data was then simplified for 3D modeling and analyzed using the LCA plugin methodology.

*Table 2. Material take-offs Concrete Structure (Authors).*

**CONCRETE STRUCTURE**

| Quantities | area m2 | units | volume m3 | density | mass kg | mass Tn |
|---|---|---|---|---|---|---|
| **CONCRETE: Foundation+Frame** | | | | | | |
| C20/25_Foundations | | | 55.58 | 2400 | 133392 | 133.39 |
| C25/30_Columns | | | 72.00 | 2400 | 172800 | 172.80 |
| C40/50_Beans | | | 106.12 | 2400 | 254688 | 254.69 |
| **CONCRETE: slab floor** | | | | | | |
| Hollow blocks 60x25x30 | 2075.7 | 13838 | | | 401302 | 401.30 |
| C25/30_Concrete Layer - 4cm | 2075.7 | | 83.028 | 2400 | 199267 | 199.27 |
| C40/50_Beans | 249.6 | | 74.88 | 2400 | 179712 | 179.71 |
| **STEEL REBAR B450C: Foundation+Frame** | | | | | | |
| Foundations-B450C | | | | | 8381 | 8.38 |
| Columns-B450C | | | | | 10803 | 10.80 |
| Beans-B450C | | | | | 14205 | 14.21 |
| | | | | | 33389 | 33.39 |
| **STEEL REBAR B450C: slab floor** | | | | | | |
| Steel Reinforcing Mesh - 1,867 Kg/m² | | | | | 4151 | 4.15 |
| Steel Reinforcing Beans | | | | | 13478 | 13.48 |
| | | | | | 17630 | 17.63 |

Note : Hollow blocks - weigh per unit 29Kg

**STEEL STRUCTURE**

| Quantities | area m2 | units | volume m3 | density | mass kg | mass Tn |
|---|---|---|---|---|---|---|
| **CONCRETE: Foundation** | | | | | | |
| C20/25_B450C - Foundation | | | 62.31 | 2400 | 149544.00 | 149.54 |
| C25/30_Waffle raft slab foundation | 372.79 | | 55.9185 | 2400 | 134204.4 | 134.20 |
| C40/50_Beans | 41.6 | | 12.48 | 2400 | 29952 | 29.95 |
| **REBAR B450C : Foundation** | | | | | | |
| Foundation | | | | | 5607.9 | |
| Steel Reinforcing Mesh - 1,867 Kg/m² | | | | | 695.99893 | |
| Steel Reinforcing Beans | | | | | 2246.4 | |
| | | | | | 8550 | 8.55 |
| **S235 STEEL: Frame** | | | | | | |
| Columns. HEB 180 | | | | | 25883.76 | |
| Beans HEB 240 IPE 220 | | | | | 95969.24 | |
| | | | | | 121853 | 121.85 |
| **S235 STEEL : Plates ,Joints** | | | | | 5260.92 | 5.26 |
| **ISO CLASS 8.8 STEEL: Screws** | | | | | 710.93 | 0.71 |
| **COMPOSITE: Slab floor** | | | | | | |
| Concrete Slab - Volume m3/m2 -> 0.077 | 1749.55 | | 134.72 | 2400 | 323316.84 | 323.32 |
| Galvanized profiled sheet 1mm-> 11,68Kg/m2 | 1749.55 | | | | 20434.74 | 20.43 |
| Steel Reinforcing Mesh - 1,867 Kg/m² | 1749.55 | | | | 3266.41 | 3.27 |

Note: Galvanized profiled sheet EDP->2.8134 kgCO2e/kg (The Norwegian EPD Organization, 2024)

*Table 3. Material take-offs Steel Structure (Authors).*

**TIMBER STRUCTURE**

| Quantities | length ml | area m2 | units | volume m3 | density | mass kg | mass Tn |
|---|---|---|---|---|---|---|---|
| **CONCRETE : Foundation** | | | | | | | |
| C20/25_B450C - Foundation | | | | 62.31 | 2400 | 149544.00 | 149.5 |
| C25/30_Waffle raft slab foundation | | 372.79 | | 55.92 | 2400 | 134204.40 | 134.2 |
| C40/50_Beans | | 41.6 | | 12.48 | 2400 | 29952.00 | 30.0 |
| **REBAR B450C : Foundation** | | | | | | | |
| Foundation | | | | | | 5607.90 | 5.6 |
| **GLULAM : Frame** | | | | | | | |
| Columns gl-24 22*24 | 3.5 | 0.053 | 160 | 29.57 | 476 | 14074.37 | 14.1 |
| Beans gl-24 20*26 | 34.6 | 0.052 | 20 | 35.98 | 476 | 17128.38 | 17.1 |
| Beans gl-24 20*26 | 12.3 | 0.052 | 16 | 10.23 | 476 | 4871.19 | 4.9 |
| **CLT: Slab floor** | | | | | | | |
| CLT panel 160 L5s -C24 | | 1749.55 | | 279.93 | 470 | 131566.16 | 131.57 |
| **S235 STEEL : Plates ,Joints** | | | | | | 2505.20 | 2.51 |
| **ISO CLASS 8.8 STEEL : Screws** | | | | | | 309.10 | 0.31 |

*Table 4. Material take-offs Timber Structure (Authors).*

### 3.5. Calculation

In the construction industry, the majority of carbon emissions occur during the initial stages of production, which are referred to as Life Cycle Modules A1 to A3 (from cradle to gate).

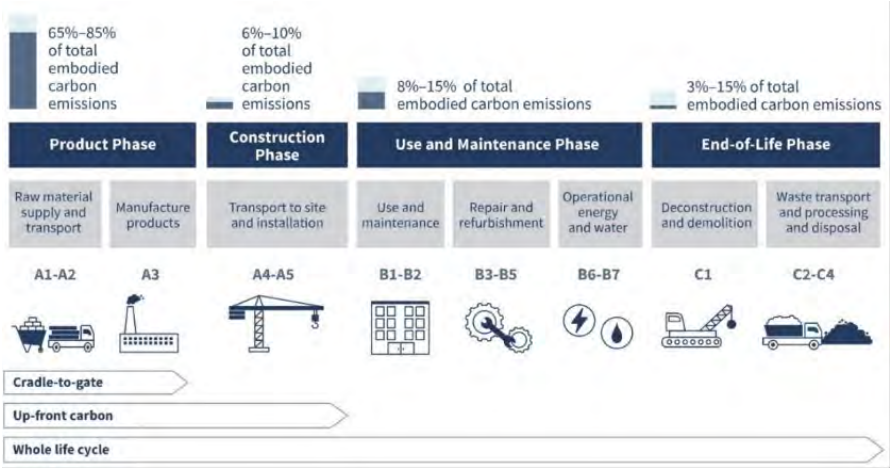



*Figure 7. Life-Cycle Assessments Phases (Weir et al., 2024)*

The carbon emissions associated with the product stage of items in the A1-A3 period must be determined by assigning appropriate embodied carbon factors to the elemental material quantities. It is recommended to refer

to EPD (Environmental Product Declaration) as a good source for this information, especially in the early stages of the design process when a full understanding of the product specifications may not be available: A1-A3 = Material quantity  Material embodied carbon factor.

The emissions from A1 to A5 will have extra carbon factors that will take into account the transportation of materials to the construction site (A4), considering whether it is local, national or international and the type and fuel of transportation. Additionally, the waste of materials on-site (A5w) will also be factored in. All of these calculations will include emissions that are associated with general construction activities.

### 3.5.1 Methodology 1

To ensure accuracy and efficiency, Excel tables were used for the calculations, and carefully selected environmental product declarations (EPDs) from trustworthy sources more representative of the case study. This allowed us to achieve a high level of precision, contributing to the effectiveness of our approach 1 by following the published guide by The Institution of Structural Engineers (Gibbons & Orr, 2022) for stages A1-A5. Finally, the carbon stored in the timber structure was also calculated as Biological Carbon Sequestration.

*Table 5. Methodology 1 – GWP A1-A5: Concrete Structure (Authors).*

| CONCRETE STRUCTURE | | carbon factor | carbon factor | carbon factor | Upfront carbon (A1–A3) | Upfront carbon (A1–A5) |
|---|---|---|---|---|---|---|
| Quantities | mass | A1-A3 | A4 | A5 | tCO2e | tCO2e |
| | Tn | (production) | (transport) | (waste) | | |
| **CONCRETE: Foundation+Frame** | | | | | | |
| C20/25_Foundations | 133.39 | **0.1206** | **0.005** | **0.00761** | 16.09 | 17.77 |
| C25/30_Columns | 172.80 | **0.1285** | **0.005** | **0.00803** | 22.20 | 24.46 |
| C40/50_Beans | 254.69 | **0.1722** | **0.005** | **0.01035** | 43.86 | 47.77 |
| **CONCRETE: slab floor** | | | | | | |
| Hollow blocks 60x25x30 | 401.30 | **0.0768** | **0.005** | **0.02495** | 30.82 | 42.84 |
| C25/30_Concrete Layer - 4cm | 199.27 | **0.1285** | **0.005** | **0.00803** | 25.61 | 28.20 |
| C40/50_Beans | 179.71 | **0.1722** | **0.005** | **0.01035** | 30.95 | 33.70 |
| **STEEL REBAR B450C: Foundation+Frame** | | | | | | |
| Foundations-B450C | 8.38 | | | | | |
| Columns-B450C | 10.80 | | | | | |
| Beans-B450C | 14.21 | | | | | |
| | 33.39 | **0.876** | **0.032** | **0.00926** | 29.25 | 30.63 |
| **STEEL REBAR B450C: slab floor** | | | | | | |
| Steel Reinforcing Mesh - 1,867 Kg/m² | 4.15 | | | | | |
| Steel Reinforcing Beans | 13.48 | | | | | |
| | 17.63 | **0.876** | **0.032** | **0.00926** | 15.44 | 16.17 |
| | | | | | **Upfront carbon (A1–A3)** | **Upfront carbon (A1–A5)** |
| **TOTAL tCO2e** | | | | | **214.21** | **241.53** |
| **TOTAL kgCO2e/m2 GIA** | | | | | **107.38** | **121.07** |

Note: EPD source. Hollow concrete blocks - 76,8 (Tn CO2 eq) (ANCEDE, 2020).

| STEEL STRUCTURE | | carbon factor | carbon factor | carbon factor | Upfront Carbon (A1–A3) | Upfront Carbon (A1–A5) |
|---|---|---|---|---|---|---|
| Quantities | mass Tn | A1-A3 (production) | A4 (transport) | A5(waste) | tCO2e | tCO2e |
| **CONCRETE : Foundation** | | | | | | |
| C20/25_B450C - Foundation | 149.54 | 0.1206 | 0.005 | 0.0076 | **18.04** | **19.92** |
| C25/30_Waffle raft slab foundation | 134.20 | 0.1285 | 0.005 | 0.0080 | **17.25** | **18.99** |
| C40/50_Beans | 29.95 | 0.1722 | 0.005 | 0.0103 | **5.16** | **5.62** |
| **REBAR B450C : Foundation** | | | | | | |
| Foundation | | | | | | |
| Steel Reinforcing Mesh - 1,867 Kg/m² | | | | | | |
| Steel Reinforcing Beams | | | | | | |
| | 8.55 | 0.876 | 0.032 | 0.0093 | **7.49** | **7.84** |
| **S235 STEEL : Frame** | | | | | | |
| Columns. HEB 180 | | | | | | |
| Beams HEB 240 IPE 220 | | | | | | |
| | 121.85 | 2.64 | 0.032 | 0.0269 | **321.69** | **328.87** |
| **S235 STEEL : Plates ,Joints** | 5.26 | 2.64 | 0.032 | 0.0269 | **13.89** | **14.20** |
| **ISO CLASS 8.8 STEEL : Screws** | 0.71 | 2.64 | 0.032 | 0.0269 | **1.88** | **1.92** |
| **COMPOSITE: Slab floor** | | | | | | |
| Slab -Volume m3/m2 -> 0.077 | 323.32 | 0.1285 | 0.005 | 0.0080 | **41.55** | **45.76** |
| Galvanized profiled sheet | 20.43 | 2.8134 | 0.032 | 0.0286 | **57.49** | **58.73** |
| Steel Reinforcing Mesh - 1,867 Kg/m² | 3.27 | 0.876 | 0.032 | 0.0093 | **2.86** | **3.00** |
| | | | | | **Upfront Carbon (A1–A3)** | **Upfront Carbon (A1–A5)** |
| **TOTAL tCO2e** | | | | | 487.26 | 504.85 |
| **TOTAL kgCO2e/m2 GIA** | | | | | 244.25 | 253.06 |

Note: Source EC3. Product EPDs (" *EC3 Material Search*," 2024)
Reinforcement bars. Product epds:23|achievable: 0.498 kgco2e|**average: 0.876 kgco2e** ± 103%|conservative: 0.943 kgco2e
Structural steel framing.Product epds: 12|achievable: 1.41 kgco2e|**average: 2.64 kgco2e ± 45.7%** |conservative: 3.88 kgco2e

*Table 6. Methodology 1 – GWP A1-A5: Steel Structure (Authors).*

| TIMBER STRUCTURE | | carbon factor | carbon factor | carbon factor | Upfront Carbon (A1–A3) | Upfront Carbon (A1–A5) |
|---|---|---|---|---|---|---|
| Quantities | mass Tn | A1-A3 (production) | A4 (transport) | A5 (waste) | tCO2e | tCO2e |
| **CONCRETE: Foundation** | | | | | | |
| C20/25_B450C - Foundation | 149.5 | 0.1206 | 0.005 | 0.0076 | **18.04** | **19.92** |
| C25/30_Waffle raft slab foundation | 134.2 | 0.1285 | 0.005 | 0.0080 | **17.25** | **18.99** |
| C40/50_Beans | 30.0 | 0.1722 | 0.005 | 0.0103 | **5.16** | **5.62** |
| **REBAR B450C : Foundation** | | | | | | |
| Foundation | 5.6 | 0.876 | 0.032 | 0.0093 | **4.91** | **5.14** |
| **GLULAM : Frame** | | | | | | |
| Columns gl-24 22*24 | 14.1 | 0.356 | 0.043 | 0.0061 | **5.01** | **5.70** |
| Beams gl-24 20*26 | 17.1 | 0.356 | 0.043 | 0.0061 | **6.10** | **6.94** |
| Beams gl-24 20*26 | 4.9 | 0.356 | 0.043 | 0.0061 | **1.73** | **1.97** |
| **CLT: Slab floor** | | | | | | |
| CLT panel 160 L5s -C24 | 131.57 | 0.142 | 0.043 | 0.0023 | **18.68** | **24.64** |
| **S235 STEEL : Plates ,Joints** | 2.51 | 2.64 | 0.032 | 0.0269 | **6.61** | **6.76** |
| **ISO CLASS 8.8 STEEL : Screws** | 0.31 | 2.64 | 0.032 | 0.0269 | **0.82** | **0.83** |
| | | | | | **Upfront Carbon (A1–A3)** | **Upfront Carbon (A1–A5)** |
| **TOTAL tCO2e** | | | | | 73.20 | 96.53 |
| **TOTAL kgCO2e/m2 GIA** | | | | | 36.69 | 48.39 |
| | | | | | **BIOGENIC Carbon** | |
| GLULAM Sequestered biogenic Carbon | 36.1 | -1.46 | | | **-52.82** | |
| CLT Sequestered biogenic Carbon | 131.6 | -1.62 | | | **-213.31** | |
| **TOTAL Biogenic Carbon tCO2e** | | | | | -266.13 | |
| **TOTAL Biogenic Carbon kgCO2e/m2 GIA** | | | | | -133.40 | |

Note: Stora Enso EPD CLT (" *EC3 Material Search*," 2024)
Assume Nationally manufactured CLT slab - GI24 : ECF A4 =400*0.10749/1000

*Table 7. Methodology 1 – GWP A1-A5 Biogenic: Timber Structure (Authors).*

After analysing the results, we can identify the hotspots of embodied carbon and opportuni-ties for reduction. Steel and concrete, both materials, have a significant impact on carbon emissions. Therefore, it is worth exploring the use of recycled steel materials and low-carbon concrete as a means of reducing the carbon footprint and determining the savings percentage.

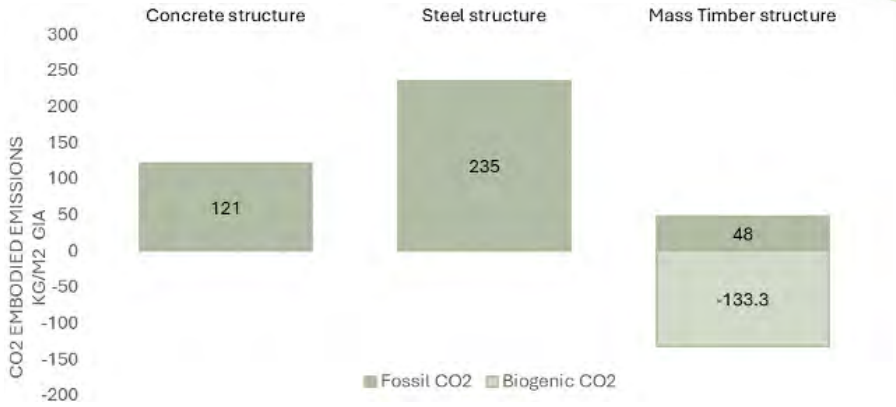



*Figure 8. Case Study- Mid-rise residential building Comparison of CO2 embodied emissions for concrete, steel and mass timber under different carbon factor accountings (Authors)*

| LOW-CARBON CONCRETE STRUCTURE Recycled Steel | | carbon factor | carbon factor | carbon factor | Upfront carbon (A1–A3) | Upfront carbon (A1–A5) |
|---|---|---|---|---|---|---|
| Quantities | mass | A1-A3 | A4 | A5 | tCO2e | tCO2e |
| | tn | (production) | (transport) | (waste) | | |
| **CONCRETE: Foundation+Frame** | | | | | | |
| C20/25_Foundations | 133.39 | ***0.1004*** | **0.005** | **0.00654** | 13.39 | 14.93 |
| C25/30_Columns | 172.80 | ***0.1123*** | **0.005** | **0.00717** | 19.41 | 21.51 |
| C40/50_Beans | 254.69 | ***0.1485*** | **0.005** | **0.00909** | 37.83 | 41.42 |
| **CONCRETE: slab floor** | | | | | | |
| Hollow blocks 60x25x30 | 401.30 | 0.0768 | **0.005** | **0.02495** | 30.82 | 42.84 |
| C25/30_Concrete Layer - 4cm | 199.27 | ***0.1123*** | **0.005** | **0.00717** | 22.38 | 24.81 |
| C40/50_Beans | 179.71 | ***0.1485*** | **0.005** | **0.00909** | 26.69 | 29.23 |
| **STEEL REBAR B450C: Foundation+Frame** | | | | | | |
| Foundations-B450C | 8.38 | | | | | |
| Columns-B450C | 10.80 | | | | | |
| Beans-B450C | 14.21 | | | | | |
| | 33.39 | ***0.3460*** | **0.032** | **0.00396** | 11.55 | 12.75 |
| **STEEL REBAR B450C: slab floor** | | | | | | |
| Steel Reinforcing Mesh | 4.15 | | | | | |
| Steel Reinforcing Beans | 13.48 | | | | | |
| | 17.63 | ***0.3460*** | **0.032** | **0.00396** | 6.10 | 6.73 |
| | | | | | **Upfront carbon (A1–A3)** | **Upfront carbon (A1–A5)** |
| **TOTAL tCO2e** | | | | | 168.19 | 194.23 |
| **TOTAL kgCO2e/m2 GIA** | | | | | 84.31 | 97.36 |

Note: EPD source EC3 (" *EC3 Material Search*," 2024)

*Table 8. Methodology 1 – GWP A1-A5: Low-Carbon Concrete Structure and recycled steel (Authors).*

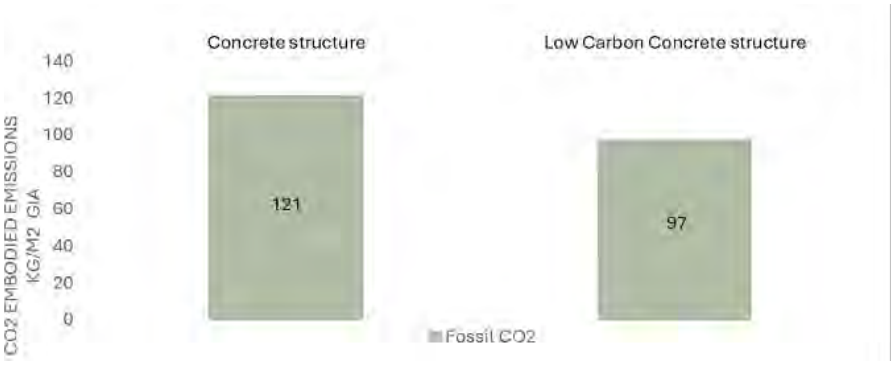



*Figure 9. Case Study- Mid-rise residential building Comparison of CO2 embodied emissions for concrete steel and low-carbon concrete structure under different carbon factor accountings (Authors).*

| RECYCLED STEEL STRUCTURE<br>Low Carbon Concrete | | carbon factor | carbon factor | carbon factor | Upfront Carbon (A1–A3) | Upfront Carbon (A1–A5) |
|---|---|---|---|---|---|---|
| Quantities | mass Tn | A1-A3 (production) | A4 (transport) | A5(waste) | tCO2e | tCO2e |
| **CONCRETE : Foundation** | | | | | | |
| C20/25_B450C - Foundation | 149.54 | ***0.1004*** | 0.005 | 0.0065 | **15.02** | **16.74** |
| C25/30_Waffle raft slab foundation | 134.20 | ***0.1123*** | 0.005 | 0.0072 | **15.08** | **16.71** |
| C40/50_Beans | 29.95 | ***0.1485*** | 0.005 | 0.0091 | **4.45** | **4.87** |
| **REBAR B450C : Foundation** | | | | | | |
| Foundation<br>Steel Reinforcing Mesh<br>Steel Reinforcing Beans | 8.55 | ***0.3460*** | 0.032 | 0.0040 | **2.96** | **3.27** |
| **S235 STEEL : Frame** | | | | | | |
| Columns. HEB 180<br>Beans HEB 240 IPE 220 | 121.85 | ***0.6707*** | 0.032 | 0.0072 | **81.73** | **86.50** |
| **S235 STEEL : Plates ,Joints** | 5.26 | ***0.6707*** | 0.032 | 0.0072 | **3.53** | **3.73** |
| **ISO CLASS 8.8 STEEL : Screws** | 0.71 | ***0.6707*** | 0.032 | 0.0072 | **0.48** | **0.50** |
| **COMPOSITE: Slab floor** | | | | | | |
| Slab | 323.32 | ***0.1123*** | 0.005 | 0.0072 | **36.32** | **40.25** |
| Galvanized profiled sheet | 20.43 | ***1.0050*** | 0.032 | 0.0106 | **20.54** | **21.41** |
| Steel Reinforcing Mesh | 3.27 | ***0.3460*** | 0.032 | 0.0040 | **1.13** | **1.25** |
| | | | | | **Upfront Carbon (A1–A3)** | **Upfront Carbon (A1–A5)** |
| **TOTAL tCO2e** | | | | | 181.22 | 195.24 |
| **TOTAL kgCO2e/m2 GIA** | | | | | 90.84 | 97.87 |

Note: EPD source EC3 (" *EC3 Material Search*," 2024)
ArcelorMittal Products: XCarb®Recycled and renewably produced Reinforcing steel in bars. Uncertainty-Adjusted GWP: 0.3460 kgCO2e / 1 kg. XCarb®Recycled and Renewably Produced Hot Rolled Coils.Uncertainty-Adjusted GWP: 0.6707 kgCO2e / 1 kg. XCarb®Recycled and Renewably Produced hot dip galvanized steel with Magnelis® coating .GWP: 1.005 kgCO2e / 1 kg

*Table 9. Methodology 1 – GWP A1-A5: Recycled Steel Structure (Authors).*


*Figure 10. Case Study- Mid-rise residential building Comparison of CO2 embodied emissions for steel and recycled steel structure under different carbon factor accountings (Authors).*

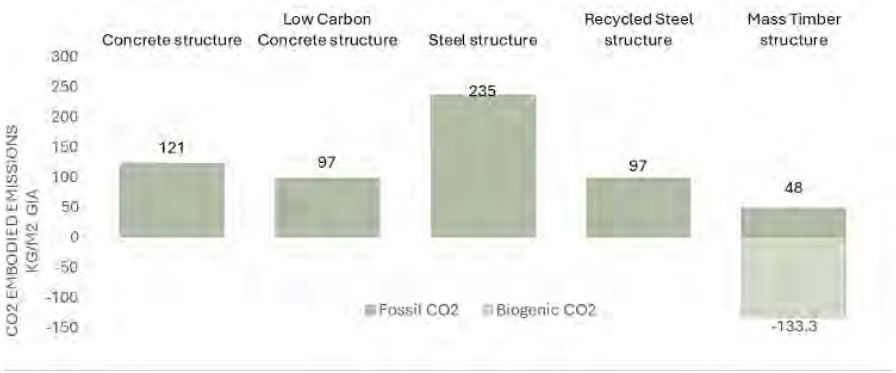



*Figure 11. Case Study- Mid-rise residential building Comparison of CO2 embodied emissions for con-crete, low-carbon concrete, steel, recycled steel and mass timber structure under different carbon fac-tor accountings (Authors).*

According to the comparative chart, it can be inferred that utilizing recycled steel and low-carbon concrete presents an eco-friendly alternative to mass timber frames. Thus, using these emerging low-carbon steel and cement or hybrid systems combined with timber mass could significantly contribute to reshaping and reducing the carbon footprint of the construction industry.

### 3.5.2 Methodology 2

This methodology uses the Cardinal plugin, which performs initial Life Cycle Assessment (LCA) calculations within Grasshopper. The tool analyzes the embodied impacts in terms of Global Warming Potential (GWP) in kilograms of CO2 equivalent, using either the EC3 (US) or ICE 2019 (UK) databases. Additionally, the user can input their own Environmental Product Declaration (EPD) data and develop a library. The LCA Cardinal tool integrates the geometry created in Rhino and instantly visualizes the Embodied Carbon of each construction in Rhino by performing real-time visualizations. This allows multiple alternatives to be tried out to determine the best solution.

The figure below shows the script used to calculate the Global Warming Potential for a typical structural system. It involves importing the geometry, assigning materials and environmental declarations to each layer. Once the information is merged, the results can be visualized.

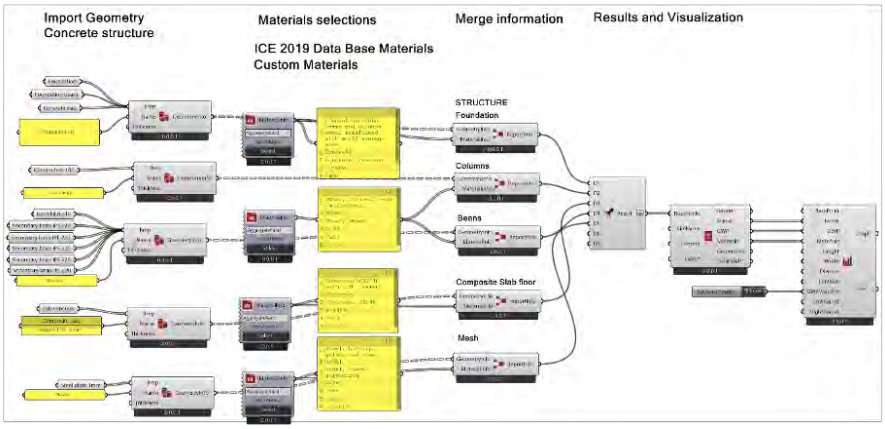



*Figure 12. Methodology 2 – Script LCA Cardinal GWP A1-A3: Concrete Structure (Authors).*

This methodology only covers stages A1 to A3 because the plugin only provides carbon factors for those phases. During these phases, 65%-85% of the total embodied carbon emissions will be released, and around 6-10% will be related to phases A4 to A5, making it a good portion of the total upfront carbon.

In the following figures, we can observe the impact of different materials on carbon emissions for each structural system.

### 3.5.3 Comparative Methodologies

Both methodologies provide accurate results in the early stages of design if the selected EPD sources match the type of material being used.

Although there are minor variations between the two approaches, within the range of 4% -5%, the guide results methodology provides a better understanding of the overall process, as it can be calculated from A1-A5 (from

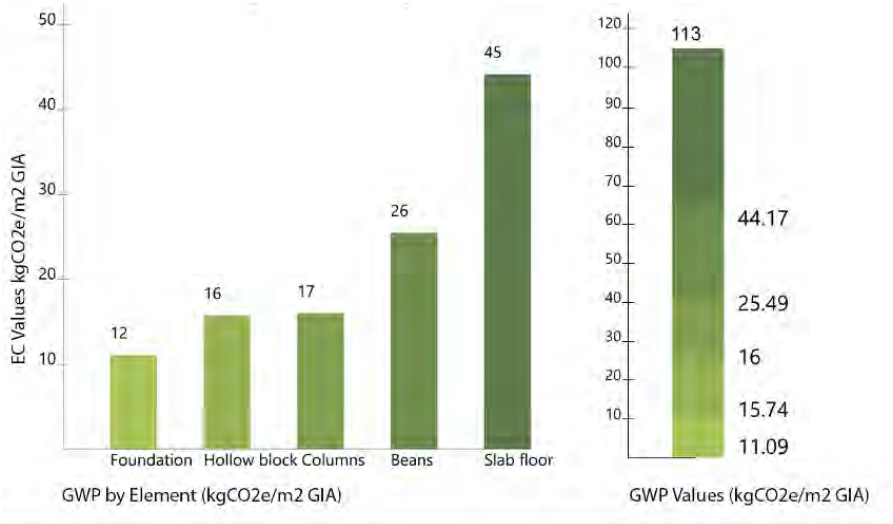



*Figure 13. Cardinal LCA Plugin Results KgCO2e/m2 A1-A3: Concrete Structure (Authors).*

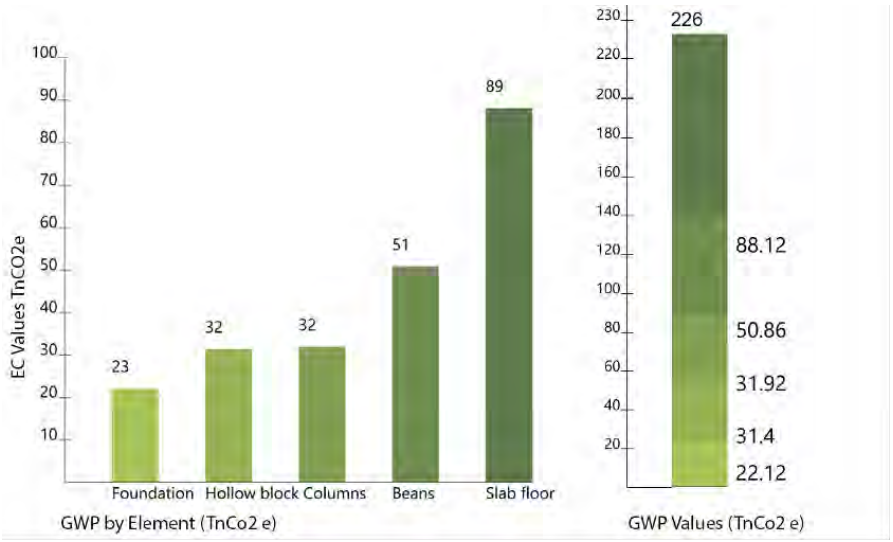



*Figure 14. Cardinal LCA Plugin Results TnCO2e/m2 A1-A3: Concrete Structure (Authors).*

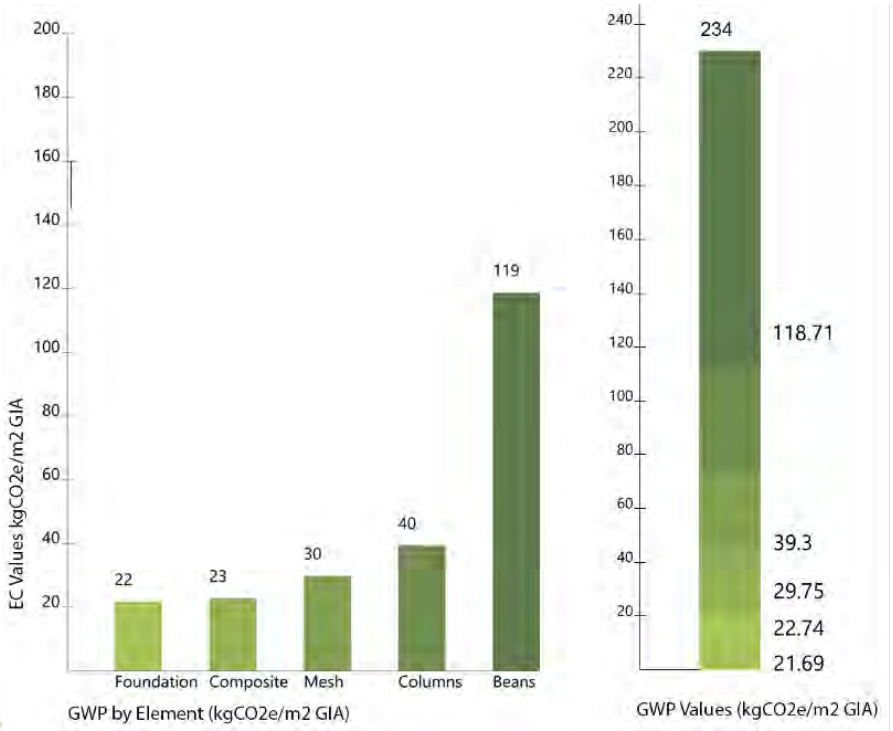



*Figure 15. Cardinal LCA Plugin Results KgCO2e/m2 A1-A3: Steel Structure (Authors).*

*Figure 16. Cardinal LCA Plugin Results TnCO2e/m2 A1-A3: Steel Structure (Authors)*

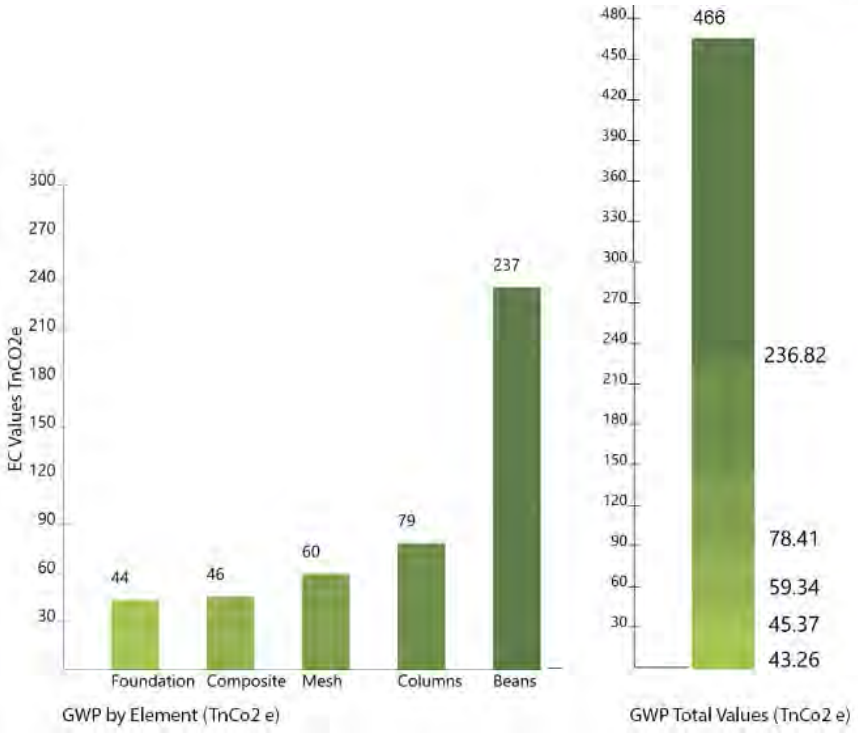
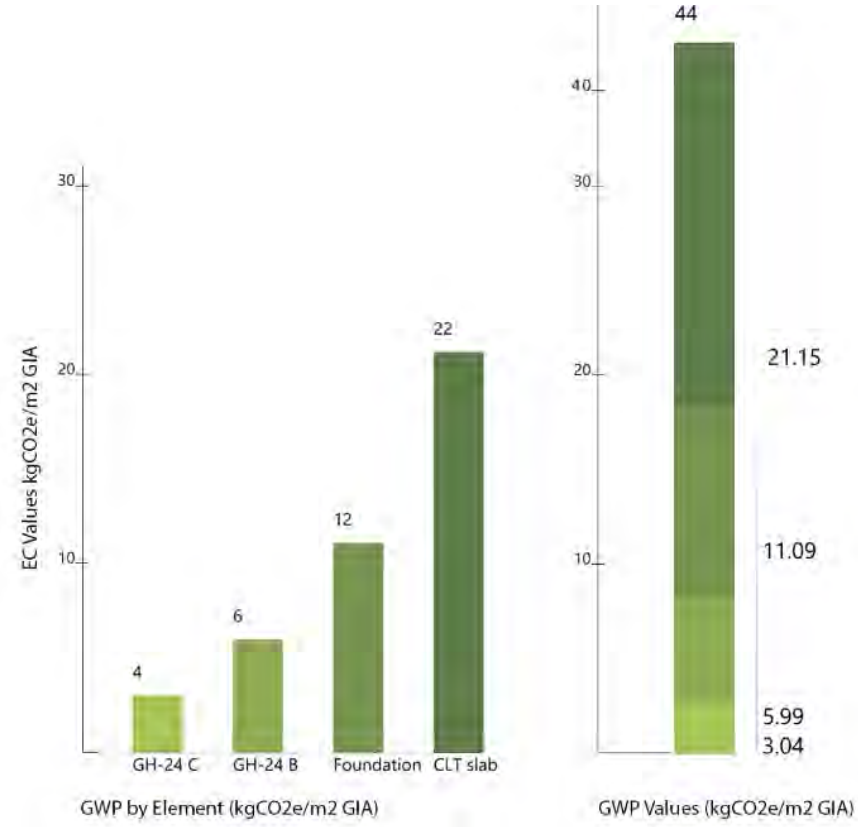



*Figure 17. Cardinal LCA Plugin Results KgCO2e/m2 A1-A3: Timber Structure (Authors).*



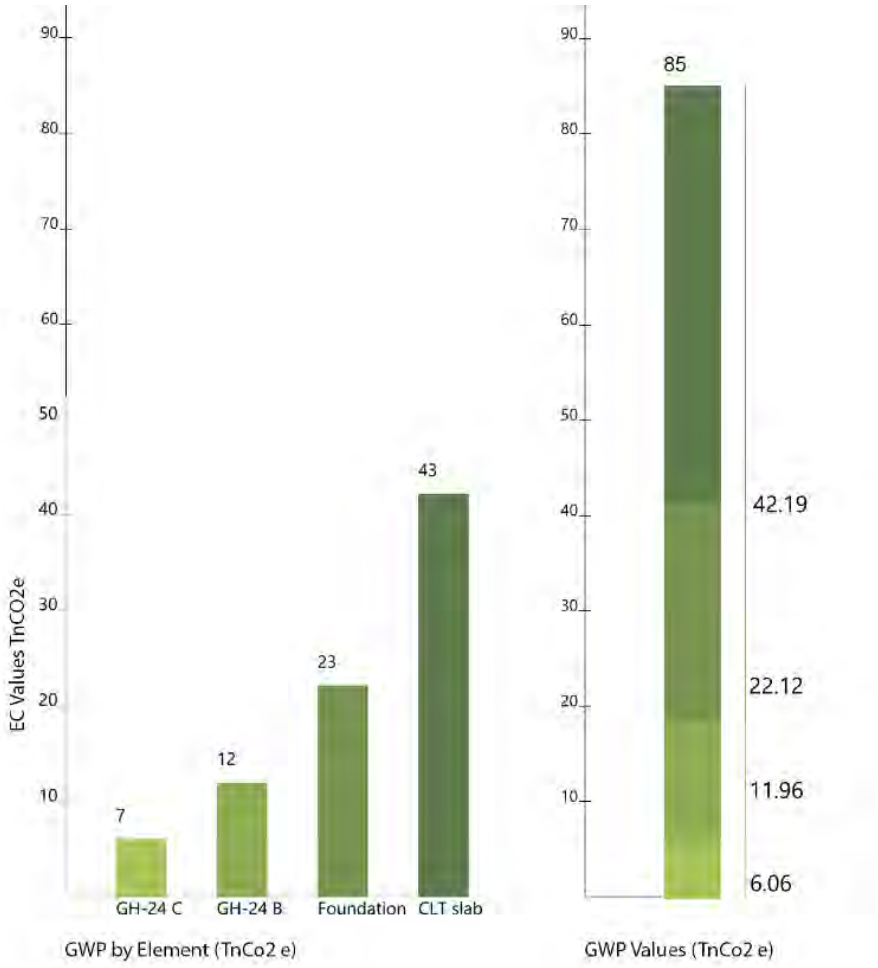



*Figure 18. Cardinal LCA Plugin Results TnCO2e/m2 A1-A3: Timber Structure (Authors).*

cradle to site)

## 4. Results: Global warming potential for structural frame options

We can observe a considerable difference between wood and steel materials when we analyze their overall effects. Steel structures have a carbon impact on the environment that is equivalent to more than five mass timber structures, making it one of the most harmful materials for our planet.

However, using techniques such as recycled steel can make a significant difference and can be compared to low-carbon concrete structures. Therefore, we can only achieve our goal of zero emissions by 2040 if we are mindful of the materials we use and continue developing new technologies.

The emissions results can be represented in various ways. A normalized way of representing them and making them more understandable and easier to benchmark is by giving the emissions per square meter of gross internal area. This helps to understand the intensity and values of each element within other elements. It is also important to consider the typology as the structure is calculated with certain loads typical from the residential use,

*Figure 19. Comparative chart GPW results. A1-A3 LCA Cardinal Plugin and Guide Methodology (Authors).*

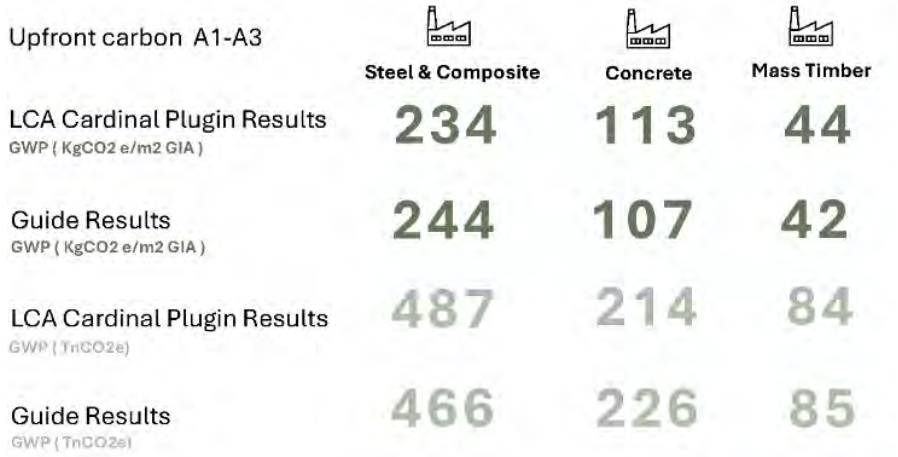



*Figure 20. Case Study- Mid-rise residential building: Comparison of CO2 embodied emissions Structur-al Systems contributions - Global Warming Potential GWP (A1-A5). (Authors).*

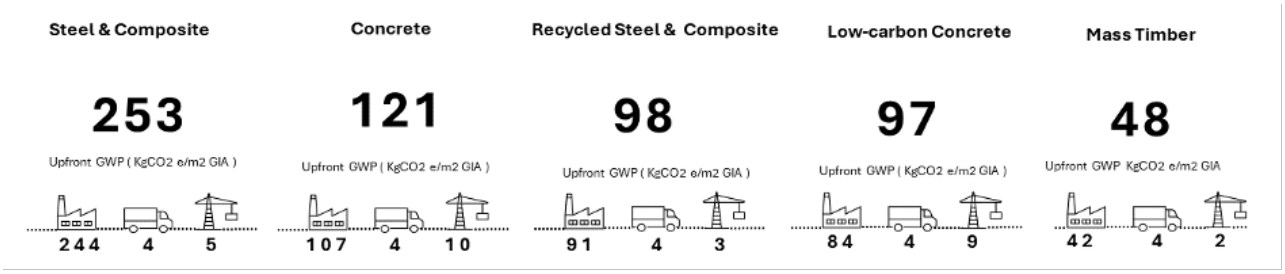



*Table 10. Top structural systems contributions (Authors).*

| **Top structural systems contributions** | | |
|---|---|---|
| Upfront Carbon<br>Embodied Carbon | (A1–A3)<br>kgCO2e/m2 GIA | (A1–A5) |
| 1. Steel structure | 244.25 | 253.06 |
| 2. Concrete structure | 107.37 | 121.07 |
| 3. Recycled steel structure | 90.84 | 97.87 |
| 4. Low-carbon concrete structure | 84.31 | 97.36 |
| 5. Mass timber structure | 36.69 | 48.39 |

*Table 11. Savings through top structural System substitution (Authors).*

| **Savings through top structural systems substitution** | | | |
|---|---|---|---|
| Upfront Carbon<br>Embodied Carbon | (A1–A3)<br>kgCO2e/m2 GIA | | (A1–A5) |
| 1. Steel structure | **244.25** | | **253.06** |
| | 56% | ⇩ | 52% |
| 2. Concrete structure | **107.37** | | **121.07** |
| | 66% | ⇩ | 60% |
| 5. Mass timber structure | **36.69** | | **48.39** |

*Table 12. Savings through material substitution (Authors).*

| **Savings through material substitution** | | | |
|---|---|---|---|
| Upfront Carbon<br>Embodied Carbon | (A1–A3)<br>kgCO2e/m2 GIA | | (A1–A5) |
| 1. Steel structure | **244.25** | | **253.06** |
| | 63% | ⇩ | 61% |
| 3. Recycled steel structure | **90.84** | | **97.87** |
| 2. Concrete structure | **107.37** | | **121.07** |
| | 21% | ⇩ | 20% |
| 4. Low-carbon concrete structure | **84.31** | | **97.36** |

| Savings through material substitution | | | | |
|---|---|---|---|---|
| Upfront Carbon<br>Embodied Carbon | (A1–A3)<br>kgCO2e/m2 GIA | | (A1–A5)<br>kgCO2e/m2 GIA | |
| 1. Steel structure | **244.25** | | **253.06** | |
| | 63% | ⇩ | 61% | |
| 3. Recycled steel structure | **90.84** | | **97.87** | |
| 2. Concrete structure | **107.37** | | **121.07** | |
| | 21% | ⇩ | 20% | |
| 4. Low-carbon concrete structure | **84.31** | | **97.36** | |

*Table 13. Savings through structural material substitution A1-A5 (Authors).*

so these values may not be as accurate when compared to other typologies such as office or retail.

The following graphs showcase different elements and their respective intensities. It's important to note that slabs in structural systems release a high percentage of emissions, except for the metal structure that mainly bears the weight of the frame. Additionally, the graphs demonstrate that timber has a storage capacity per square meter that is almost thrice as much as its emissions. With these biogenic carbon values in mind, it's crucial to incorporate hybrid timber structures that can help our design as carbon sinkers.

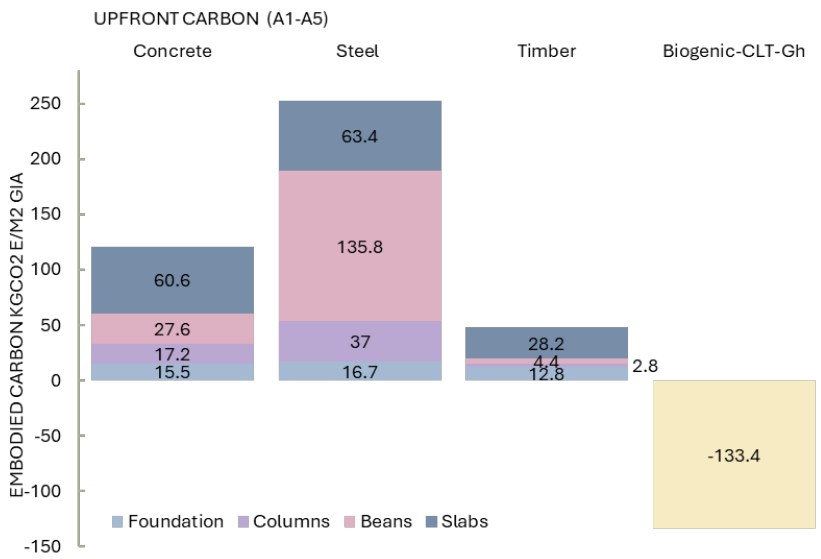



*Figure 21. Case Study- Mid-rise residential building: Embodied carbon emission. Intensity by element. Kgco2/ m2 GIA – Biogenetic carbon (Authors)*

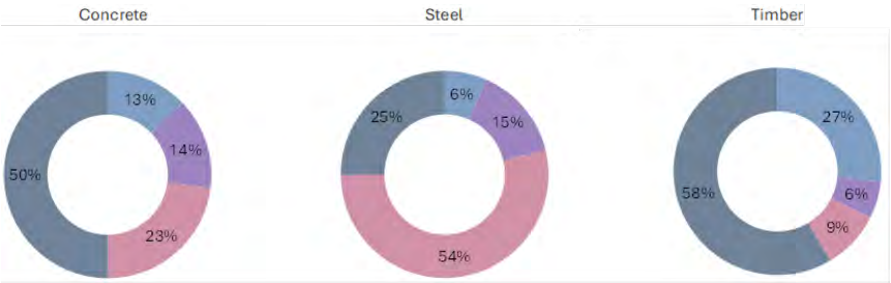



*Figure 22. Case Study- Mid-rise residential building: Embodied carbon emission. Total proportion by el-ement (%) (Authors)*

## 5. Conclusions

The study concludes that, based on the available data, there is a significant difference in the embodied CO2 of the diverse types of structural frames. Design and building professionals can use technical data available in many open sources that will guide them in the process of selecting the most suitable materials. The results showed that the wooden system is more efficient and reduces weight, resulting in optimal resource utilization.

The choice of structural materials is a decisive factor in a building's environmental profile because of their large volume and weight If concrete and steel are substituted by wood constructions, the emissions of greenhouse gases in material production are reduced by approximately 60 and 80%, respectively.

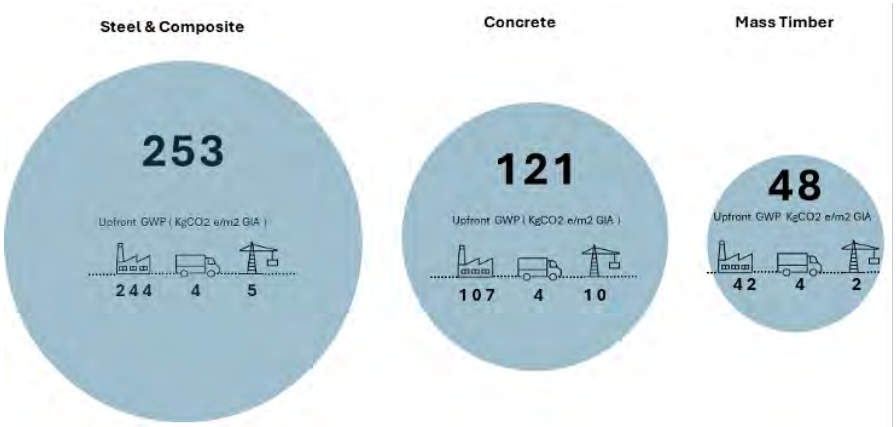



*Figure 23. Global KgCO2/ m2 GIA. Steel and composite - Concrete Mass Timber structural system. (Authors)*

Moreover, the study emphasizes the significance of utilizing recycled materials in construction. The environmental impact can be significantly decreased by incorporating materials like recycled steel, green concrete, or low-carbon concrete in the structural system. Steel can see a reduction of 60% in environmental impact, while concrete material can see a reduction of 20%. It is highly inefficient to oversize beams, columns, and slabs as it leads to a significant waste of resources and an increase in emissions. When desi-

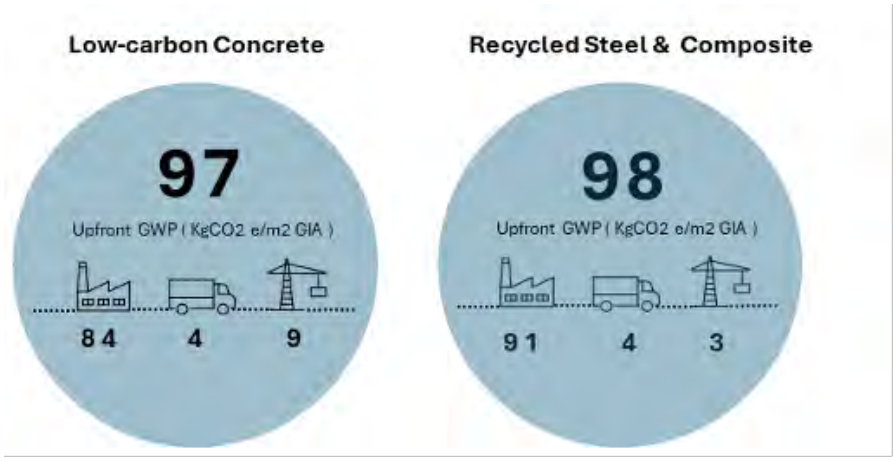



*Figure 24. Global Warning Potential per m2 GIA. Gross Internal Area Low carbon concrete structural System. Recycled steel and composite structural system. (Authors)*

gning a building, it's important to minimize loads (within code allowance), set realistic SLS criteria, reduce structural grids and spans, select efficient structural forms, and adjust its dimensions to ensure efficiency while main-

taining stability. It's important to note that the use of weighting factors in each building regulation already considers potential structural risks hence there is no need to oversize.

Building designs should prioritize lower embodied carbon from the outset. The goal should be to achieve low-carbon, carbon-neutral, or even negative-carbon outcomes. This can be achieved by incorporating materials that have the least embodied carbon, hybrid structures are also worth considering reducing the amounts of materials used and optimizing their use.

Other strategies include exploring opportunities to reuse and renew existing structures so as not to waste the energy already expended (and carbon dioxide already emitted) to create them.

# References


1. (n.d.). Cardinal LCA, a product by Pathways. Food4Rhino. Retrieved February 29, 2024, https://www.food4rhino.com/en/app/cardinal-lca-product-pathways
2. (n.d.). Life cycle assessment and embodied carbon. SteelConstruction.Info. Retrieved February 29, 2024, https://www.steelconstruction.info/Life_cycle_assessment_and_embodied_carbon#cite_note-No11-1
3. (n.d.). The 2030 Challenge. Architecture 2030. Retrieved February 29, 2024, from https://www.architecture2030.org/2030_challenges/2030-challenge/
4. ANCEDE (2020). Autodeclaración ambiental de producto de elementos ligeros huecos de hormigón prefabricado (September 2020). Asociación Nacional de la Industria del Prefabricado de Hormigón. https://www.andece.org/wp-content/uploads/2020/07/A-DAP5_Elementos-ligeros-huecos-ANDECE.pdf
5. Berge, B. (2009). The Ecology of Building Materials. Oxford: Architectural Press.
6. Bjørn, A., Owsianiak, M., Molin, C., Hauschild, M.Z. (2018). LCA History. In Hauschild, M., Rosenbaum, R., Olsen, S. (Eds), Life Cycle Assessment (17-30). Cham: Springer.
7. Building Transparency Organization (2024). EC3 Material Search. Retrieved February 29, 2024, from https://rmi.org/embodied-carbon-101/
8. Gibbons, O. P., Orr, J. J. (2022). How to calculate embodied carbon. London: The Institution of Structural Engineers.
9. Gielen, D. J. (1997). Technology Characterisation for Ceramic and Inorganic Materials. Input Data for Western European MARKAL, ECN-C-97-064. Netherlands.
10. Janicki, D. (2024). YourSpreadsheets. YourSpreadsheets. Retrieved February 29, 2024, from https://www.yourspreadsheets.co.uk/
11. Kaethner, S.C. & Burridge, J. a. (2012). Embodied CO2 of structural frames. The Structural Engineer, 90(5), 33-40.
12. McHale, J. (1962). R. Buckminster Fuller. Hoboken: Prentice-Hall.
13. Östman, B. (2022). National fire regulations for the use of wood in buildings – worldwide review 2020. Wood Material Science & Engineering, 17(1), 2-5. https://doi.org/10.1080/17480272.2021.1936630
14. Sieden, Ll. S. (2000). Buckminster Fuller's Universe. New York: Basic Books
15. Takano, A., Hughes, M. & Winter, S. (2014). A multidisciplinary approach to sustainable building material selection: A case study in a Finnish context. Building and Environment, 82, 526-535.
16. The Norwegian EPD Organization (2024). Process Data set: Lindab High Profile - Galvanised (en). EPD Norway. Retrieved February 29, 2024, from https://epdnorway.lca-data.com/datasetdetail/process.xhtml?uuid=951ce65d-122c-46f4-bae5-73b64fe77d81&version=00.04.003&stock=PUBLIC&lang=en
17. UN Environment Programme (2022, November 9). CO2 emissions from buildings and construction hit new high, leaving sector off track to decarbonize by 2050: UN [Press release]. https://www.unep.org/news-and-stories/press-release/co2-emissions-buildings-and-construction-hit-new-high-leaving-sector
18. Weir, M., Rempher, A., & Esau, R. (2024). Embodied Carbon 101: Building Materials. RMI. Retrieved February 29, 2024, from https://rmi.org/embodied-carbon-101/

# A sustainable territorial development

*Luca Bullaro*
*lbullaro@unal.edu.co*

*Associate Professor, "Universidad Nacional de Colombia". Medellin.*

***Keywords:***
*Self-sufficient architecture*
*Organic architecture*
*Sustainable development*
*Social responsibility*
*Ecological pedagogy.*

## Abstract

The article presents the process that was implemented in Medellín, in the first-year project laboratories of our School of Architecture. Some important topics were discussed and implemented win our pedagogy: intimate respect for the natural territorial systems; harmonious relations between natural and artificial elements; application of ancient constructive methods; local resources and materials; development of a productive and self-sufficient architecture; implementation of bioclimatic systems to adequately respond to particular climatic conditions.

Themes related with ecology, self-sufficiency, social and environmental responsibility have been present for years within the theoretical and practical research of the contemporary architects: we are convinced of its importance in the teaching methodology, from the beginning of the pedagogical program.

## Introduction

This paper is part of "Nuevos enfoques" research, of the School of Architecture, Universidad Nacional de Colombia. "Transepto" research group.

In recent years, the meaning of the word "development" has opened up widely to multiple interpretations: what kind of development do we expect and encourage, regarding architecture and territory, for our countries and cities?

The current economic expansion in Latin America is producing dizzying positive and negative changes: among the latter we can include the enormous demographic increase, the uncontrolled and unplanned expansion of cities and the destruction of ancient ecosystems. Contemporary urban planning reflects and analyses these current issues, trying to propose intelligent solutions.

Same themes must be debated within the Project Laboratories in the Architecture and Engineering Faculties. Considerations of the scarcity of resources, the use of ecological materials, producing green energy and food with integrated systems, reuse of rainwater, treating and purifying waste waters, will give life to a different territorial project that will bring into focus a wise integration between natural and artificial connections.

Themes related with ecology, self-sufficiency, social and environmental responsibility have been present for years within the theoretical and practi-

cal research of the contemporary architects: we are convinced of its importance in the teaching methodology, from the beginning of the program.

The article presents the process that was implemented in Medellín, in the first-year project laboratories of our School of Architecture. Some important topics were discussed and implemented win our pedagogy:

. intimate respect for the natural territorial systems;
. harmonious relations between natural and artificial elements;
. application of ancient constructive methods;
. local resources and materials;
. development of a productive and self-sufficient architecture;
. implementation of bioclimatic systems to adequately respond to particular climatic conditions.

## Current urban expansions

If the old metropolis of Europe and the USA have recently seen their populations decrease, in Latin America the smaller cities, which until a few years ago were surrounded by greenery, and provided a good quality of life, are developing extremely quickly, and often without any smart urban planning and political projects.

Once in a holistic relationship with surrounding nature, cities now are becoming polluted places, where greenery is becoming scarce, with limited public spaces, disconnected neighbourhoods, enormous suburbs built from the accumulation of slums, with highways that cross them, causing noise, pollution, and interrupting the system of urban pedestrian paths in a drastic and inhumane way.

## Harmonious territorial development

There is an urgent need for a new kind of territorial planning that can help change the focus: that is not expansive, but regenerative; that focuses on the rights of natural and biological structures, and on the harmonious integration between artificial and human systems.

This point of view is applicable both to a sympathetic and more gentle type of urban expansion -as Giancarlo De Carlo states- and to the internal ecological regeneration of the city.

For several years, precisely to avoid the inhuman growth of towns, we have been reflecting on the possibility of generating, in the surroundings of old cities, a system of small cores well connected -through public and ecological transport- with the main city.

## Teaching proposals

In the teaching exercises at the Universidad Nacional de Colombia, young students were asked to develop a combination of small, self-sufficient and ecological cities, which reinterpret more human ways of living, where citizens live a few steps from work, and can go walking or by bicycle, without using private transport systems. Urban structures that enjoy a democratic public heart with integrated production of green energy and rainwater purification.

Educational and creative cities, surrounded by the exuberant Latin American nature, recreating traditional construction techniques, with an architecture merging artificial and natural elements, green building that takes into account a high quality of life for everyone.

Thereby the students can acquire the ability to propose ecological and self-sufficient small urban projects, located in the surroundings of Girardota, a few kilometers from Medellín. Each group of students developed the "Forma urbis" on the basis of specific connective, democratic and morphological rules: the conceptual basis for the configuration of the specific architecture. The second phase of the educational project was focused on what Josep Lluis Sert defined as "the heart of the city": main square, with the cardinal institutions and public buildings, gardens and spaces for outdoor activities.

In the third phase, small groups of students developed the public buildings design, with functional mix generation, that allows us to preserve vitality and active role of the town heart at various times of the day and night, avoiding the typical zoning of the modern Athens Charter.

Each student, in the development of specific projects, shares the basic methodology contained in the "urban masterplan", the connective rules of pedestrian and mechanical public flows, and the formal organic rules, established at territorial level.

Despite being a complex exercise -which aims to bring young architecture students closer to urban problems, to social space, to dialogue between designers, and between natural and artificial systems- results was interesting: students proved to be deeply enthusiastic, interested in ecology, production of food and clean energy, reuse and recycling.

One of the premises for the development of urban structures was the inclusion of active systems with the aim of achieving self-sufficiency, in terms of energy, and food produced in urban gardens, fish farming, organic chicken coops…

Structures have been inserted for the collection and purification of rainwater, for the transformation of organic wastes into compost, recycle of inorganic waste, such as plastic, glass, aluminium and paper.

Some groups of students introduced the topic of energy production both through biomass and with photovoltaic pergolas: which produce shade and energy at the same time. Another group of students implemented a micro wind farm positioned on the roofs of the higher public buildings, and also through small turbines in the river waters, which produce energy by exploiting the natural current.

Another cluster has applied a system of generators integrated into the games of kindergarten children, and into the tools of the public gym, which generates energy with the movement of the human body.

Various actions have also been implemented to avoid energy consumption and waste, for example by designing common kitchens and laundries integrated into housing architecture: this highlights the importance of transformations in the lifestyle, to collaborate can conceive new ways of socializing, working and producing, contributing to a social, urban and territorial metamorphosis.

The student's experiments are an attempt to encroach in the current debate of the bio-city, free of polluting transportation. 4 This is an important conclusion in the Tropics, where modern and contemporary urban development are not providing the best architectural and urban solution to a social and climate problems, using imported materials and obsolete methods, forgetting the knowledge of pre-Hispanic cultures and indigenous architecture.

Analysing these and the proposed projects, can help to amend and strengthen the identity of many communities who have been colonized for a long period of time economically, politically and culturally.

Universities have the duty to encourage students, from the beginning of their careers, to form an ecological and sustainable mindset. The "Pro-

ject Laboratories" can develop new conceptual paradigms linked to environmental respect, bioclimatic, reuse and recycling, green and integrated production, the priority of inclusive pedestrian spaces, wise combination between architecture and nature, with the intention of transmitting students an environmental consciousness committed to the sustainable future of our territories.

Final thoughts

New buildings must not impose themselves, but must caress the geography: merge delicately and wisely with the natural environment. The greenery must penetrate the built space and occupy the roofs, which should be green, alive and productive: to generate energy, food and water.

The orchards will be part of the architectural materials; in the water gardens there will be the option of implementing simple fish farming systems: water frames of modern architecture, made for contemplation, will also be useful and productive.

Vitruvius triad can be integrated with a new ecological ethic: respect and conservation of the environment. Design can also be conceived as a mean to preserve the planet.

Teachings that are still current come from the analysis of the ancient constructions for example the Maya and Inca societies. They venerated natural elements, and respected them by building with great attention and care. They caressed the hills with advantageous and elegant walls of local stone, leaving delicate and subtle traces. They reinterpreted the shapes of the mountains in the development of the wooden structures that covered houses and palaces. They used few colours: that of the stone, the wood and the bamboo canes that made up the roofing. 5

Analysing pre-Hispanic buildings has allowed us to learn wise lessons and intervention methodologies that contributed to make sensitive architecture, capable of increasing the quality of citizens life, preserving the geographical characteristics of natural areas.

Academic exercises developed in recent years within the Universidad Nacional de Colombia are based on an experimental and didactic intention: to give young students awareness of the responsibility to figure new urban environments in which architectural and organic clusters can be linked with respect.

Based on the conceptual fusion between construction, ecology and ethics, our profession can have an intellectual and political role in the coming years for the construction of more human and democratic cities, increasing the ecological responsibility, creating a kinder future for our territories and cities.

*Figure 1. BIG, "Europacity", France, 2013. Urban section.*

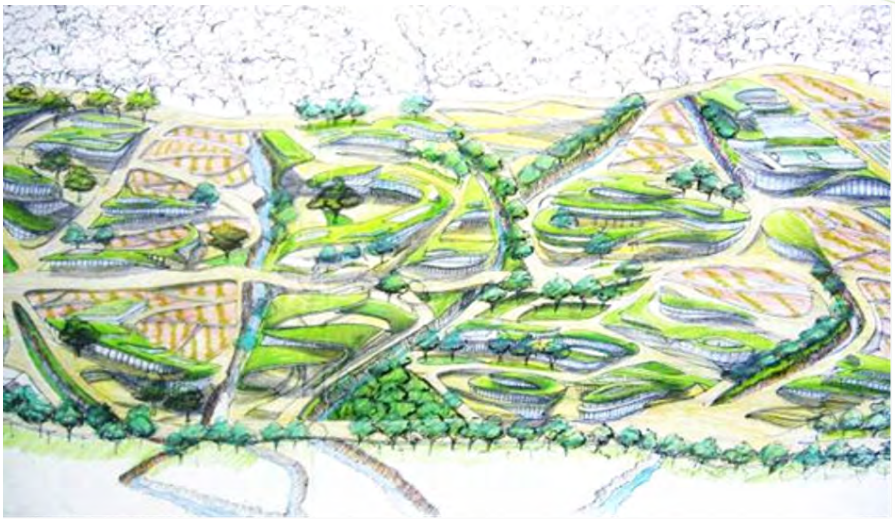


*Figure 2. Holistic concatenation between architecture and nature in the "Nutabe" BioCity project. Proyectos II, Unal Colombia. Photo by Luca Bullaro.*

# References


1. ROGERS, Richard (2003). "Ciudades para un pequeño planeta", Barcelona, Gustavo Gili.
2. An interesting exchange and chain of knowledge in relation to the dialogue between natural and artificial elements is explained clearly and forcefully in the collaboration between the Brazilian masters Oscar Niemeyer and Burle Marx. The interest in the analysis of landscape elements appears very clear in several pages of Niemeyer's autobiography, "As curvas do tempo" (2000). Lisbon, Campo das Letras. (pages 37-38).
3. See also the chapter dedicated to Roberto Burle Marx in ABALOS, Iñaki, "Atlas Pintoresco" (2005). Barcelona, Gustavo Gili; and the reflectaos written by the mexican architect Javier Senosiain in "Bioarquitectura: en busca de un Espacio" (1998). Mexico, Ed. Noriega.
4. SERT, Josep Lluis, NATHAN ROGERS, Ernesto, TYRWHITT, J. (1955), "El corazón de la ciudad: por una vida más humana de la comunidad", Milano, Hoepli.
5. Among the most recent examples is the project by the Danish studio BIG, for the construction of a new town on the outskirts of Paris, Europa city. The project by Bjarke Ingels, winner of the competition, announced by the Auchan Group, for the creation of a sustainable city of 800,000 square meters in the municipality of Gonesse, 16 kilometers from the center of Paris, developed under a large green roof, which -according to Luis Fernández-Galiano, director of the magazine "Arquitectura Viva"- "it combines Parisian urban density with the bucolic character of life in the suburbs".
6. "BIG, Hot to cold: an odyssey of architectural adaptation" (2015), Koln, Tashen ed. (pp. 280-287).
7. See "Cover" chapter of the book "Km3" (2005, Barcelona, Actar ed.) by the dutch studio MVRDV: it's analizedthe development of an architecture generated by the topography reinterpretation of the mountains, through a system of artificial hills that contain at various functions and green public spaces on the roofs. (pp. 656-671).


# Bibliography


1. PEARSON, David, Arquitectura orgánica moderna: un nuevo camino para el diseño urbano y rural (2002). Barcelona, Blume.
2. SENOSIAIN, Javier, Arquitectura orgánica (2008). México, AM Editores.
3. SENOSIAIN, Javier, Bioarquitectura En busca de un Espacio (1998). México, Ed. Noriega.

4. RAND, Harry, Hundertwasser (1992). Colonia, Tashen.
5. LE CORBUSIER, Mensaje a Los Estudiantes de Arquitectura (1971). Buenos Aires, Infinito.
6. SERT, Josep Lluis, Can our cities survive? And ABC of urban problems, their analysis, their solutions (1942). Cambridge, Harvard University Press.
7. SERT, Josep Lluis, NATHAN ROGERS, Ernesto, TYRWHITT, J., El corazón de la ciudad: por una vida más humana de la comunidad (1955), Milano, Hoepli
8. ROVIRA Josep Maria, Sert 1928-1979. Medio siglo de arquitectura, Obra completa (2005). Barcelona, Actar.
9. FREIXA, Jaime, Josep Lluis Sert (2005). Barcelona, Santa&Cole.
10. BASTLUND, Knud, José Luis Sert; architecture, city planning, urban design, (1967). New York, Praeger.
11. ABALOS, Iñaki, Atlas Pintoresco (2005). Barcelona, Gustavo Gili.
12. MONTEYS, Xavier, Le Corbusier, Obras y Proyectos (2005). Barcelona, Gustavo Gili.
13. FRAMPTON, Kennet, Tettonica e architettura. Poetica della forma architettonica nel XIX e XX secolo (2005). Milano, Skira.
14. AALTO, Alvar, De palabra y por escrito (2000). Madrid, El Croquis Editorial.
15. WRIGHT, Frank Lloyd, La ciudad viviente (1961). Buenos Aires, Compañía General Fabril Ed.
16. WRIGHT, Frank Lloyd, Autobiografía (1998). Madrid, El Croquis Editorial.
17. WRIGHT, Frank Lloyd, Arquitectura Moderna (2010) Madrid, Paidos iberica.
18. MUNARI, Bruno. Como nacen los objetos (1993). Barcelona, Ed. Gustavo Gili.
19. ALFIERI, Massimo. La Ciudad Abierta de Valparaíso (2000). Roma, Editrice Librerie Dedalo.
20. ZEVI, Bruno, Frank Lloyd Wright (1985) Barcelona, Gustavo Gili.
21. BASSEGODA I NONELL, Joan (2002). Gaudí, espacio, luz y equilibrio. Madrid, Criterio ed.
22. CRIPPA, Maria Antonietta (2007). Gaudí. Köln, Taschen.
23. ZERBST, Rainer (1985). Antoni Gaudí. Köln, Taschen.
24. PUIG I BOADA, Isidre (2004). El pensament de Gaudí. Barcelona, Ed. Dux.
25. MVRDV, (2005) Km3, Excursions on capacity. Barcelona, Actar.
26. BIG (2015) Hot to cold: an odyssey of architectural adaptation. Köln, Taschen.
27. Ecology, recycling, bioclimatic and alternative energy
28. IZARD, Jean Louis, Arquitectura Bioclimática (1983). México, Gustavo Gili.
29. AA. VV., La gestió municipal dels residus sòlids urbans (1993). Barcelona, Diputación de Barcelona.
30. MC HARRY, Jan, Reducir, Reutilizar, Reciclar (1995). Madrid, Ángel Muñoz Editor.
31. OLGYAY, Victor, Arquitectura y clima, (1998). Barcelona, Gustavo Gili.
32. ROGERS, Richard, Ciudades para un pequeño planeta (2003). Barcelona, Gustavo Gili.
33. HIGUERAS, García, Esther, Urbanismo bioclimático (2006). Barcelona, Gustavo Gili.
34. PHYLLIS, Richardson, Xs Ecológico: Grandes ideas para pequeños edificios (2007). Barcelona, Gustavo Gili.
35. Energy Research Group, Un Vitruvio ecológico. Principios y práctica del proyecto arquitectónico sostenible (2007). Barcelona, Gustavo Gili.
36. RUDOFSKY, Bernard, Arquitectura sin arquitectos (1976). Buenos Aires, Eudeba.
37. RUDOFSKY, Bernard, Constructores Prodigiosos. (1984). México, Conceptos S.A.
38. FRIEDMAN, Yona, Pro Domo (2006). Barcelona, Actar.
39. FRIEDMAN, Yona, L'architettura di sopravvivenza. Una filosofia della povertà (2009). Torino, Bollati Boringhieri.
40. LACHMAN Gary, Rudolf Steiner (2012), Girona, Atalanta.

# HEALTHCARE AND WELLNESS

# Textures design for Augmentative and Alternative Communication (AAC) for people with deaf-blindness and multi-sensory impairment

*Denise Dantas[1], Lia Sossini[2] and Barbara Del Curto[3]*
*dedantas@usp.br, lia.sossini@polimi.it, barbara.delcurto@polimi.it*

[1]*Universidade de São Paulo, Brazil*
[2]*Politecnico di Milano, Italy*

***Keywords:***
*Textures design*
*AAC*
*Multi-sensory impairment*
*Inclusive design*

## Abstract

This paper introduces designed maps (Del Curto et al., 2010) for innovative Augmentative and Alternative Communication (AAC) applications tailored for children and adolescents with deaf-blindness and multiple sensory impairments. Deaf-blindness, a complex disability with varying hearing and visual impairments, requires diverse communication modalities to facilitate interpersonal connections and environmental navigation. Multiple Sensory Impairment involves Visual Impairment coexisting with other disabilities, global developmental disorders, or communication impediments (Maia et al., 2013). Within this context, design is crucial in understanding and leveraging material attributes to create innovative user products. Specifically, the texture involves sensitising surfaces through graphic signs, incisions, reliefs, and more (Del Curto et al., 2010). Focusing on AAC in educational and rehabilitation settings, this research lays the foundation for developing an in-depth study to investigate new possibilities in texture design. This research contributes to advancing assistive technology and inclusive design, offering valuable insights for educators, designers, and practitioners.

## Introduction

Materials are responsible for our understanding of the world. They shape our material culture, enabling us to live and express ourselves through natural and industrial objects. In this context, design has the task of comprehending, exploring, and applying the characteristics of materials to create new products and experiences for users. (Del Curto et al., 2010). When associated with inclusive design principles, the correct material selection for assistive products and augmentative and alternative communication systems becomes crucial. Historically, design has been associated with good aesthetic solutions, and the sense of sight prevails over others, from education to creating new products (Del Curto et al., 2010). However, there exists a 'design for those who cannot see': individuals with visual impairments, deaf-blindness, or multiple sensory impairments require tactile resources to understand and use products, as well as to communicate effectively. Within this context, design is crucial in understanding and leveraging material attributes to create innovative products for these users. Numerous haptic requirements must be considered to develop assistive products for this user profile, their caregivers and teachers to improve their quality of life.

This paper introduces designed maps (Del Curto et al., 2010) for innovative applications in AAC tailored for children and adolescents with deaf-blindness and multiple sensory impairments. These maps serve as a guide for educators, offering precise criteria aligned with predefined communication objectives. Tactile characteristics, particularly, become essential in broadening communication avenues for individuals with deaf-blindness who lack reliable visual or auditory anchors to comprehend their surroundings (Maia, 2013). Texture, in this context, involves sensitising surfaces through graphic signs, incisions, reliefs, and more (Del Curto et al., 2010). Focusing on AAC in educational and rehabilitation settings for those with multiple sensory impairments and deaf-blindness, this research integrates considerations on texture descriptors into expressive-sensory material dimensions. There is also a focus on Tactile Alternative Communication described by (Downing & Chen, 2003; Moreira, 2021), specifically in characterising textures for application in textured symbols.

## Inclusive design and materials

Inclusive design involves different aspects of the product, from the most abstract and conceptual aspect of the product system to the form, production choices and materials (McDonagh, 2010). An inclusive approach must consider the end user, their capabilities and emotions to provide an adequate response to everyday needs.

Within this framework, the material becomes the medium through which the designer's action can take place to reach the end user (Patrick, 2021). In this context, a good choice of material must consider the technical and performance aspects and the sensorial ones. Communication established with people with disabilities must try to speak to users with all the senses, emphasising sensory characteristics that can sometimes be secondary.

A design approach that focuses on a multisensorial approach offers opportunities to enhance communication. In this sense, materials can facilitate communication through multisensory feedback, guiding the user in interacting with the product or its environment (Bandini Buti, 2010). Multisensory integration has been structured in humans because it has advantages in adapting to our habitat. Therefore, having a multisensory mind allows an organism to continue interacting relatively autonomously with the world, even if it loses a fundamental part of perception.

Innovation in materials has brought new opportunities in this regard, both in research into new materials and in enhancing the use of stimulation in treating specific pathologies. One example among many is smart materials. The possibilities offered by these materials are varied. They can become carriers of design opportunities both on a more functional level, activating themselves to compensate for specific functions that various types of disabilities do not guarantee, and on a more practical level, increasing sensory stimulation since specific inputs can be followed by active outputs (e.g., mechanochromic, thermochromic, SMA, etc.).

Another example of how materials and their physical and perceptual characteristics can make a difference in the treatment of various diseases is multisensory stimulation (MSS). This approach to therapy is increasingly popular due to the limited alternatives available and the belief that MSS is a friendly and highly humane approach (Cheng, 2019).

As argued in the article 'Effects of multi-sensory stimulation for people with dementia' (Baker, 2003), multisensory stimulation (MSS), also known as Snoezelen (Pagliano, 2017), originated as a leisure activity for people with learning disabilities. This approach aims to stimulate the senses through unmodified visual, auditory, olfactory, and tactile stimuli, thus providing

an alternative to cognitive activities. Investigations have suggested that MSS is beneficial for people with severe learning disabilities and people with dementia. The risks of sensory deprivation increase with age, so as these people are usually elderly, some degree of sensory impairment can be expected. An attempt is therefore made to revive the dementia patient's life with a rehabilitation activity consisting of light, colours, music, scents and tactile experiences. Materials thus become the protagonists of inclusive design, providing numerous possibilities for interaction and managing variables that can meet the accessibility needs of people with disabilities. With a design approach that considers individuals' needs and requirements, the designer can exploit materials to communicate values to enrich and democratise the user experience.

## AAC for children with Deaf-blind and with multiple sensory impairment

Children who are deaf-blind or have multiple sensory impairments require special resources to communicate and participate in the world around them. Deaf-blindness is defined as a condition in which a person experiences both deafness and blindness simultaneously, either congenitally (from birth) or acquired in early childhood, before speech acquisition. In these cases, it is referred to as pre-lingual deaf blindness. Deaf-blindness can also be acquired, referring to individuals who become deaf and blind after acquiring language, known as post-lingual deaf-blindness. (Dammeyer, 2014). Multiple Sensory Impairment implies the "association, within the same individual, of two or more primary impairments (mental/visual/auditory/physical), with impairments resulting in delays in overall development and adaptive capacity" (SEESP, 1994, p. 15). In most cases, Visual Impairment involves coexisting with other disabilities, global developmental disorders, or communication impediments (Maia, 2013). Dammeyer (2014) says that "People with congenital deaf-blindness have to develop language and communication abilities without vision and hearing". In both cases, efforts are required to establish a communication system that allows for a better quality of life for children and adolescents with these disabilities. For this purpose, AAC is utilised.

AAC is defined by the International Society for Augmentative and Alternative Communication (ISAAC, 2024) as "a set of tools and strategies that an individual uses to solve everyday communicative challenges". Complementing this definition, AAC is also understood as any form of complementary communication that substitutes or supports speech to improve interaction with individuals with limitations in acquiring oral language or those with other expressive limitations that hinder their understanding by their interlocutors (Chen et al., 2001; Manzini et al., 2016).

AAC is particularly important for improving communication and, consequently, the quality of life of children and young people with deaf-blindness and/or multiple sensory impairment since, in both cases, cognitive impairments pose enormous challenges to understanding their needs and desires.

With AAC being a highly flexible approach, it can utilise resources of various types, ranging from No-Technology systems to Low-Technology (Low-tech) or High-Technology systems (High-tech) (Hanline et al., 2007) (Fig.1).

In this communication process, input can be provided through visual, auditory, or tactile channels (Moreira, 2021). Considering the obvious limitations of children with deaf-blindness for visual and auditory inputs, the tactile communication input channel assumes great importance for

AAC. In fact, the act of "tactile exploration" is one of the eight functional communication categories indicated by Skinner and considered by Moreira (2021) as a communicative action.

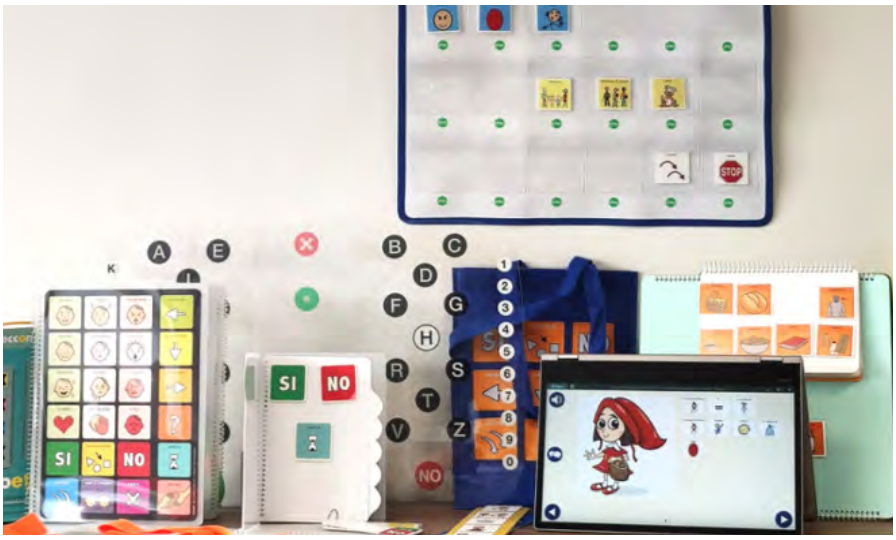



*Figure 1 - AAC kit Comunikit® CAA V2 by Leonardo Ausili (IT). (Ausili, 2024)*

## Textures in design

Over the years, the term 'texture', initially used in textiles to refer to the fabric's weave (Djonov, 2011), has been borrowed from other fields, first and foremost, design. Conscious and thorough design is also aware of all the possibilities of textures. Textures and materials in design take on a fundamental connection that guarantees various options at both the microscopic and macroscopic levels.

Indeed, working with textures at the nanoscale allows surfaces to be functionalised to achieve characteristics such as self-cleaning, non-stick, filters, catalysts, and anti-reflection (Moronuki, 2016). Similarly, on a much larger scale, on an architectural level, textures influence the perception of a space, its dimensions and the sensations it generates (Wang, 2020).

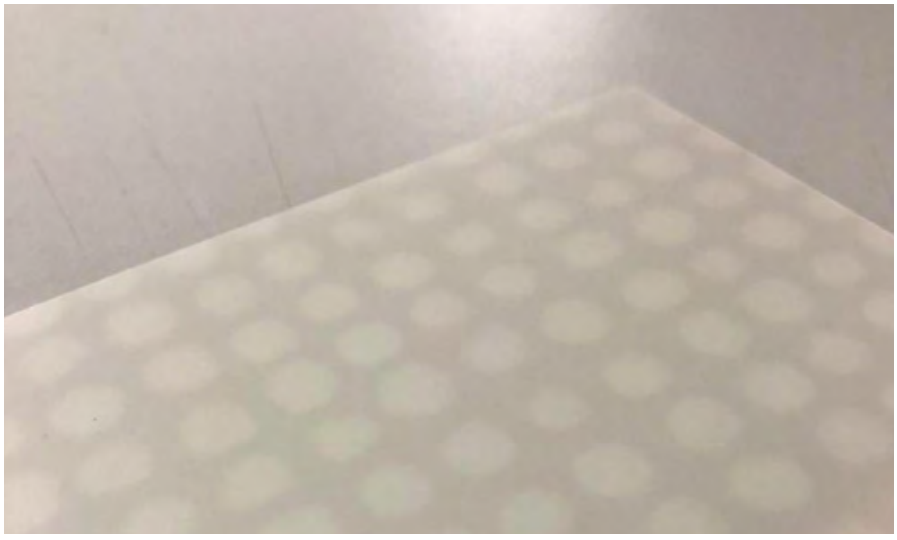


*Figure 2 – Example of smooth or visual texture. Photo by the authors.*

The subject of this research, specifically product design, stands at an intermediate scale, at which surfaces and textures are visible and perceptible through touch. The book 'La Pelle del Design' (Del Curto, 2010) defines three texture types: smooth, superficial and deep. Smooth textures act in a

two-dimensional way, affecting sight; superficial and deep textures are related more to the dimension of touch and have a three-dimensional scale.

*Figure 3 – Example of deep and superficial or tactual texture. Photo by the authors.*

Zuo (2005), on the other hand, distinguishes texture types into two-dimensional or three-dimensional. Although there are slightly different readings and classifications, one can generally identify mainly visual and haptic textures. Visual textures work primarily with colour, transparency, homogeneity of textures and patterns, and information read by sight. Haptic textures, related to the perception and three-dimensional modification of the surface, are closely linked to materials and processing technologies (Djonov, 2011). Zuo (2005) also distinguishes another reading level by distinguishing between texture and perceived texture or texture perception. Texture, in general, is something objective, the result of design and subsequent material processing technologies that can objectively respond to physical measurement parameters. On the other hand, perceived texture is subjective, depending on the sensitivity and synaesthetic perception of the person interacting with it. This implies that in the perception of visual or tactile textures, both senses influence each other along with the context surrounding the object itself, creating a unique experience for the user.

Textures can be categorised according to different aspects, depending on their nature (Zuo, 2005):

- Natural texture and artificial texture (according to the formation of texture);
- Regular texture and random texture (according to the pattern of texture);
- Visual texture and tactual texture (according to the perceptual modality);
- Virtual texture and real texture (according to the representation of texture).

Considering the development and objective of this research, it is essential to define both objective and subjective aspects in the design of a tactual texture.

Roughness is an essential property concerning the objective and, therefore, physically measurable aspects of textures (Del Curto, 2010). The presence of roughness implies that there are irregularities of indented or protruding volumes in the surface that may be constant or non-constant. Roughness can be measured with a roughness tester that defines the surface profile with an accuracy down to a thousandth of a micron.

The technologies that allow the creation of more or less deep textures, and thus more or less accentuated roughness, are (Del Curto, 2010):

- Coatings. Adding material to the surface, such as paints, which, in addition to the visual appearance, can create surface grains, is considered.
- Moulding processes. Moulding can transfer aesthetic or functional textures to the final product, whether in polymers, metals or glass.
- Surface modification. Depending on the nature of the material, it is possible to act with milling, engraving of various types, satin-finishing and sandblasting.

The aspects more related to the perception of texture, on the other hand, can be grouped by descriptive typologies, which, starting from Zuo's reflections, become descriptive typologies of materials in Karana (2009):

- Use description. Use descriptions of materials refer to a specific product or a unique environment in which a material is employed for a particular purpose.
- Manufacturing process. Expresses the characteristics attributed to the material or texture closely linked to the method of production or processing.
- Technical description. Refers to the directly measurable properties of the material.
- Sensorial description. This category includes all characteristics that can be described via the five senses. In the case of touch: soft-hard, hot-cold, smooth-flowing.
- Emotional description. Emotional descriptions of materials are defined as people's subjective feelings towards a material that can be either conscious or unconscious.
- Associative description. Characteristics are attributed to the material by associating it with other contexts or products in the memory or part of the collective culture.
- Expressive semantic description. The semantic meaning we attribute to a material or texture after the initial sensorial input.

Textures are, therefore, a fundamental part of the definition of the material and must be considered not only for the production and technological aspects but also in the communication of emotions and values (Zuo, 2016). Textures are integral to the design process, offering endless possibilities for expression and sensory engagement.

## The textures in AAC and ATC

Within AAC, Tactile Alternative Communication (TAC) stands out, defined as "a set of resources, techniques, and strategies that focus on tactile modalities intended to promote functional communication and provide meaning to various daily situations through elements discerned by touch" (Moreira, 2021, p.78). (Fig.4 and Fig.5)


*Figure 4 – Example of Teaching Age-Appropriate Academic Learning via Communication (TAALC) Core Board by Paths to Literacy, 2024.*

The author highlights three resources of TAC: tactile symbols, also known as "touch cues", tangible symbols, and textured symbols, based on the definitions provided by Project SALUTE (Success full Adaptations for Learning to Use Touch Effectively) (Salute Project, n.d.).

Tangible symbols are defined as "A communication system that includes three-dimensional symbols (objects) and two-dimensional symbols (photographs and drawings) for children who do not understand the meaning of abstract symbols" (Salute Project, n.d.). In Figure 4, touch cues are concrete representations intended for individuals who are blind or have severely compromised visual functioning, serving the same purpose as images for sighted individuals while also being standardised and based on linguistics (Moreira, 2021 apud HAGOOD, 1997; Salute Project, n.d.).

*Figure 5– Examples of TAC by Fonner, 2018.*

On the other hand, textured symbols (Fig.7) are "tactilely salient, three-dimensional and artificial representations associated with people, objects, and activities and used for receptive and expressive communication. These symbols can be abstract or closely related to their referent" (Salute Project, n.d.).

*Figure 6 - DIY Tangible object symbols by Galvin-McLaughlin, 2018.*


To ensure that textures function as symbols, it is necessary, as emphasised, for them to establish themselves as codes associated with objects or activities. For textured symbols to become a communication tool, it is imperative to work with "active/intentional touch," as described by (Murray-Branch & Bailey, 1998, p. 2) "... the ability to actively explore or feel something with one's hands (haptic perception)."


*Figure 7 - Example of a textured symbol associated with the day of the week (Sunday) in a school calendar by (Maya, 2023)*

The authors elucidate the role of textures as communicative symbols, accentuating four key factors: stimulating "intentional touch," reducing cognitive demand, and finally, ease of recognition and consistency, irrespective of scale.

The pivotal aspect underscored in the research pertains to the effortless recognition of diverse textures "through direct contact with the skin" (Murray-Branch and Bailey, 1998), a factor closely linked to the seamless correlation of specific textures with objects and activities, contingent upon the consistency of texture irrespective of scale.

> *First and most importantly, many textures are easily recognized through simple contact with the skin. Second, a texture paired with an activity or object remains the same symbol, even if its size is reduced to be made more portable. (Murray-Branch and Bailey, 1998, p. 3)*

The investigation into the utilisation of texture symbols stems from the educational domain. It showcases the substantial endeavour undertaken by these practitioners over time to methodically organise and codify their empirical insights, facilitating their accessibility to fellow professionals. However, upon analysing the primary studies, it becomes apparent that the principles advocated by the authors could benefit from increased precision and could be further refined through a more comprehensive investigation into the essential distinctions between textures.

The authors underscore the significance of saliency in facilitating the straightforward recognition of textures. However, they note that as a consequence of these salient features, textures exhibit uniformity across the entirety of the sample. Nonetheless, this assertion doesn't fully encompass all the nuances in which textures can manifest. Within a single sample, textures may display patterns varying in size or direction, as illustrated in Figure 8.

*Figure 8 – Example of irregular tactual texture. Photo by the authors.*

Another aspect worth noting pertains to the matter of scale. When considering the reduction of the sample's scale to enhance the portability of the textured symbol, it is essential to grasp that the authors are referring to an analog resizing process of the physical sample. Herein, the texture itself remains unchanged.

A critical aspect to emphasise in texture selection is the sample's size. The authors suggest starting with samples measuring 8" x 10" (equivalent to 203.2 x 254 mm), then transitioning to 2" squares (approximately 1290 $mm^2$, or 35.9 x 35.9 mm). It's worth noting the lack of concern in maintaining the rectangular proportion initially proposed for the subsequent stage, which could lead to inconsistency in understanding the scale of the textured symbol when downsizing is applied. Leaving the suggestion as an area rather than specific linear length and width measurements keeps the approach open-ended.

## Criteria for designing new textures for AAC

The aforementioned aspects bring us to the comprehension of several key considerations for crafting new textures and formulating designed maps to be employed in this process. As fundamental principles intrinsic to inclusive design and materials, it is imperative to recognise the significance of incorporating the multisensory attributes of materials to stimulate all senses, mirroring practices already utilised in various therapeutic contexts. In the case of children who are deafblind or have multiple sensory impairments, it's essential not to overly prioritise visual or auditory aspects of materials, yet they shouldn't be entirely disregarded either. It's crucial to acknowledge that some users may retain residual vision, which mustn't be overlooked. This entails considering the chromatic, contrast, and reflective qualities of the chosen material, aiming to avoid highly reflective surfaces that could cause discomfort to users with residual vision due to glare.

It's also imperative to consider the tactile characteristics inherent in the selected material, aiming to explore the extremes of sensory experiences, such as warm/cold contrast or smooth/rough textures. It's worth noting that varying the types of materials used for texture creation, such as wood (a "warm" material) and metal (a "cold" material), or polymers, is desirable.

In regard to the design of the texture itself, it's important to consider haptic textures and their classifications into surface and deep textures, which encompass a three-dimensional scale. As previously discussed, the perception of visual or tactile textures is mutually influenced by both senses, along with the surrounding context of the object, resulting in a unique user experience.

Concerning the pattern design, it's crucial to consider aspects related to perception, drawing parallels with Gestalt principles. Specifically, addressing "ease of recognition by touch" and the scale reduction, followed by the size of the sample to be used. The principles of good form advocated by Gestalt, when adapted for haptic communication, offer a framework for establishing initial parameters for the analysis and creation of new textures specifically intended to function as texture symbols (Katz, 1992). Despite being rooted in understanding the whole rather than the parts, given that vision is a synchronous process, some principles can be adapted and effectively apply to haptic understanding, which is asynchronous. Gestalt theory elucidates how diverse stimuli are perceived by sighted individuals, among which we will underscore perceptual constancy and the principles of proximity, similarity, closure, and experience (Katz, 1992). Some of these points were further emphasised by (Murray-Branch and Bailey, 1998) when discussing aspects related to the saliency or characterization of textures, as well as when highlighting the use of textures as an element that "reduced learning and memory demands on an individual using textures when compared to recognizing objects or Braille through touch." For this to truly happen, it is essential that

the proposed textures inherently maintain perceptual constancy. Perceptual constancy refers to the consistency of dimensions and colours (Katz, 1992, p.26). The change in texture scale can compromise perceptual constancy, so it's advisable to maintain the internal structure of the texture without scale variation, even if the perceptual field may undergo changes, as suggested by (Murray-Branch and Bailey, 1998). Additionally, preserving the shape of the perceptual field is crucial to uphold this constancy and reduce cognitive and memory efforts for users. The square is established as a perceptual field that minimises cognitive strain. By maintaining constant width and length dimensions, it avoids ambiguity, facilitating comprehension of closure and ensuring constancy of shape. Thus, a square perceptual field tends to minimise user cognitive effort.

Concerning the sizes proposed by Murray, it is recognised that a revision could be beneficial, taking into account ergonomic and usability aspects of handling the samples to better suit the size of people's hands. Perceiving the entire field assumes that the user can run their hand and fingers over the entire field.

It should also consider creating a distinct and recognizable rhythm by arranging the field based on the proximity of its minimal units, ensuring they are easily perceived as tactile elements while maintaining uniformity among their constituent parts. The proposed textures should take into account the defined perceptual field to clearly establish tactile elements for closing the shape to be experienced, leaving no ambiguity regarding the texture boundaries and the end of the perceptual sample. As emphasised by (Katz, 1992, p.46), although Gestalt theory does not attribute a central role to experience in perceptual organisation, it acknowledges that associations from prior experiences can influence the perceptual process. It's essential to consider the user´s prior experiences with textures in everyday life. These experiences, ranging from textures of various objects may evoke mnemonic associations for these users. Therefore, it's crucial to include a diverse array of everyday textures on the map.

## Final considerations

The use of textures holds significant importance in AAC, as highlighted in literature emphasising the crucial role of textured symbols in ATC By integrating inclusive design principles, material considerations, and technical and sensory aspects of textures, alongside perceptual processes, we aim to contribute to the development of new textures specifically tailored for use as textured symbols.

The parameters established for texture creation draw upon interdisciplinary literature spanning design, inclusive education, and materials. The utilisation of design maps will provide designers the visual aids to guide the creation of new proposals. Additionally, experimenting with various materials and technologies will enable exploration of alternative approaches that may enhance AAC beyond conventional materials found in everyday life.

## Acknowledgments

This study was financed by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

AHIMSA - Associação Educacional para Múltipla Deficiência [Educational Association for Multiple Disabilities]

# References


1. *Antonelli, P., Aldersey-Williams, H., Hall, P., Sargent, T. (Eds) (2008). Design and the elastic Ausili, L. (2024, February 29). Comunikit® CAA V2. https://www.leonardoausili.com/kit-di-comunicazione-comunikit/816-comunikit-caa-.html*
2. *Baker, R., Holloway, J., Holtkamp, C., Larsson, A., Hartman, L. C., Pearce, R., ... & Owens, M. (2003). Effects of multi□sensory stimulation for people with dementia. Journal of advanced nursing, 43(5), 465-477.*
3. *Bandini Buti, L., Bisson, M., Boeri, C., Gellini, G. & Zingale, S. (2010). Progetto & multisensorialità. Come gli oggetti sono e come ci appaiono. Milano: Franco Angeli*
4. *Chen, D., Downing, J., & Rodriguez-Gil, G. (2001). Tactile learning strategies for children who are deaf-blind: Concerns and considerations from Project Salute. Deaf-Blind Perspectives, 8(2), 1-6.*
5. *Cheng, C., Baker, G. B., & Dursun, S. M. (2019). Use of multisensory stimulation interventions in the treatment of major neurocognitive disorders. Psychiatry and Clinical Psychopharmacology, 29(4), 916-921.*
6. *Dammeyer, J. (2014). Deafblindness: A review of the literature. Scandinavian journal of public health, 42(7), 554-562.*
7. *Del Curto, B., Fiorani, E., & Passaro, C., (2010). La pelle del design. Progettare la sensorialità. Milano: Lupetti.*
8. *Djonov, E., & Van Leeuwen, T. (2011). The semiotics of texture: From tactile to visual. Visual Communication, 10(4), 541-564.*
9. *Downing, J. E., & Chen, D. (2003). Using tactile strategies with students who are blind and have severe disabilities. Teaching Exceptional Children, 36(2), 56-61.*
10. *Fonner, K. (2018, January 16). Communication Matrix: Core Vocabulary with Tangible Symbols. https://communicationmatrix.org/Community/Posts/Content/12020*
11. *Galvin-McLaughlin, D. (2018, December 3). Communication Matrix: DIY Tangible object symbols. https://communicationmatrix.org/Community/Posts/Content/22759*
12. *Hagood, L. (1997). Communication: a guide for teaching students with visual and multiple impairments. TSBVI, Austin.*
13. *Hanline, M. F., Nunes, D., & Worthy, M. B. (2007). Augmentative and alternative communication in the early childhood years. YC Young Children, 62(4), 78.*
14. *International Society for Augmentative and Alternative Communication [WWW Document] (2024). URL https://isaac-online.org/english/home/ (accessed 2.4.24).*
15. *Katz, D., 1992. La psicologia della forma. Bollati Boringhieri, Torino.*
16. *Karana, E. (2009). Meanings of materials.*
17. *Light, J. (1988). Interaction involving individuals using augmentative and alternative communica-*

*tion systems: State of the art and future directions. Augmentative and Alternative Communication 4, 66–82.*

18. *Maia, S.R. (Ahimsa) (2013). Aspectos importantes no uso da Comunicação Alternativa com pessoas com Surdocegueira e com Deficiência Múltipla Sensorial. In: Passerino, L.M., Bez, M.R., Pereira, A.C.C., Peres, A. (Eds.), Comunicar Para Incluir. CRBF, Porto Alegre, pp. 47–60.*
19. *Manzini, M. G., Almeida, M. A., & Martinez, C. M. S. (2016). Análise da produção científica brasileira no campo da comunicação suplementar e/ou alternativa. Revista Teias, 17(44), 173-190.*
20. *McDonagh, D., & Thomas, J. (2010). Disability+ relevant design: Empathic design strategies supporting more effective new product design outcomes. The Design Journal, 13(2), 180-198.*
21. *Miles, B., & Riggio, M. (1999). Remarkable conversations: A guide to developing meaningful communication with children and young adults who are deafblind. Perkins School for the Blind, Watertown.*
22. *Moreira, F.D. dos S. (2021). PACT : Programa de comunicação alternativa tátil para crianças com deficiência múltipla sensorial, 1a. ed. ed. Instituto Benjamin Constant, Rio de Janeiro.*
23. *Moronuki, N. (2016). Functional texture design and texturing processes. International journal of automation technology, 10(1), 4-15.*
24. *Murray-Branch, J., Bailey, B.R. (1998). Textures as Communication Symbols. 1st. ed. Indiana State University.*
25. *Pagliano, P. (2017). Multisensory environments. Routledge.*
26. *Paths to Literacy (2024, February 29). The Power of Communicating with Tactile Symbols. https://www.pathstoliteracy.org/power-communicating-tactile-symbols/*
27. *Patrick, V. M., & Hollenbeck, C. R. (2021). Designing for all: Consumer response to inclusive design. Journal of consumer psychology, 31(2), 360-381.*
28. *Salute Project, n.d. SELECTED DEFINITIONS Adapted sign.*
29. *SEESP (1994). Política Nacional de Educação Especial - Educação Especial, um direito assegurado. SEESP. https://midia.atp.usp.br/plc/plc0604/impressos/plc0604_aula04_AVA_Politica_1994.pdf*
30. *Wang, C., Lu, W., Ohno, R., & Gu, Z. (2020). Effect of wall texture on perceptual spaciousness of indoor space. International journal of environmental research and public health, 17(11), 4177.*
31. *Zuo, H., & Jones, M. (2005, May). Exploration into formal aesthetics in design:(material) texture. In Proceeding of 8th Generative Art Conference, Milan (Vol. 220).*
32. *Zuo, H., Jones, M., Hope, T., & Jones, R. (2016). Sensory perception of material texture in consumer products*

# Design against cancer. Topics and projects for a new culture of prevention.

*Erminia Attaianese, Ivo Caruso, Carla Langella*
*erminia.attaianese@unina.it, ivo.caruso@unina.it, carla.langella@unina.it*

*University of Naples "Federico II", Italy*

***Keywords:***
*Social health*
*Cancer prevention*
*Ccience-based design*
*Community design*
*Design nudges*

## Abstract

The contribution reports the theoretical framework, experiments and results of the "Design for AIRC" research conducted in partnership between the Department of Architecture of the University of Naples "Federico II" (DiArc) and the Italian Foundation for Cancer Research (AIRC). Specifically, the research analyzes the evolution of the role and the social responsibility of design culture in relation to medical research in the oncology field. In relation to this macro-theme, the research develops specific projects capable of disseminating and activating young users by exploiting, in a broad way, the fascination of science, research, health and well-being. The challenge we shared with the Foundation was, ultimately, to create products, services, actions and nudges designed by young designers for their peers, to disseminate and stimulate a possible debate about the importance of adopting lifestyles useful for maintaining health. Specifically, the research operates on three thematic pillars: not smoking, eating in a healthy and balanced manner, adopting an active and non-sedentary lifestyle. The role of Design was to "stitch" necessary external interdisciplinary contributions and to experiment, through new artefacts and related services, viable and synthetic solutions capable of producing and testing new possible semantics of prevention, based on a shared language, friendly, pleasant, engaging, serene, scientifically correct; that is, capable of replacing the concepts of "fear", "death", "doubt", "solitude", "passivity" and "illness" with those of "reassurance", "life", "knowledge", "sharing", " proactivity", "wellbeing". New objects, new relationships, new words for a new culture of prevention.

## Introduction

The conditions that facilitate the onset of cancer may be genetic, environmental or related to lifestyles. On this third group of factors, in particular, it is considered strategic to initiate new communication actions capable of acting on people who, by implementing pro-prevention indications on a daily basis, can, in the long run, really reduce their exposure to cancer risks. It is estimated, in fact, that between thirty and fifty per cent of cancers can be prevented through screening activities and healthy choices, behaviour and habits. Traditionally, actions, initiatives and communications to raise awareness of cancer-fighting issues are addressed to an audience of people belonging to age groups considered sensitive to cancer risks because they are statistically more affected. In recent years, in an innovative and experimental way,

AIRC has decided to include among its strategic objectives the reaching of new audiences, with a special focus on the younger generations. To achieve these objectives, the Foundation has set up two specific macro-projects: AIR-Campus (dedicated to university students) and Wonder Why (for the 20/35 age group). These projects inevitably require a new grammar, new tools, new communication media and, in general, a broadening of the range of contents to be conveyed. With the DESIGN for AIRC project, the challenge set by the Foundation to the Department of Architecture of the University of Naples 'Federico II' was to design tools for these new targets. Products, services, nudges designed to disseminate and stimulate a possible debate on the importance of adopting correct lifestyles to stay healthy. To support the macro-objective of this 'new culture of prevention', it was requested to work on three thematic pillars: not smoking, eating a healthy and balanced diet, adopting an active and non-sedentary lifestyle. In order to provide further insight into the focuses proposed in the brief, a dense cycle of seminars was organised with experts and scholars from the world of scientific research (pulmonologists, psychologists, communicators, designers), who further characterised the project pathway by providing fundamental interdisciplinary input.

## Design for society

The main purpose of design for the market is to create products for sale. In contrast, the main intent of social design is the satisfaction of human needs. However, we do not propose the 'market model' and the 'social model' as binary opposites, but instead see them as two poles of a continuum. The difference is defined by the priorities of the task rather than by a method of production or distribution. Many products designed for the market also satisfy a social need, but we argue that the market does not, and probably cannot, take care of all social needs, as some relate to populations that do not constitute a consumer class in the market sense" (Margolin & Margolin, 2002). More than a social design, we aspire, in this sense, to a 'design for society' (in some cases even practicable 'with' society) that, however responding to the needs of the individual, is capable of understanding the evolutions and dynamisms of the communities themselves, and that is capable of acting pragmatically, taking into account the contextual limits, and the plausible timeframes for obtaining real impacts both in the immediate and medium term (and in any case before the changing characteristics of the context or the problem itself). These products, services or technologies are shaped by the object culture of a society, but, at the same time, they themselves take on the capacity to 'shape' individual daily lives, shared values and, therefore, desirable models of society. Societies that can be represented as "(...) an ecosystem of people, organisations, places, products and services that, as a whole, express a reciprocal capacity for care" (Manzini, 2021) and that, in fact, are characterised by local, specific and collective needs. "It would therefore be time to conceive and implement vast and far-sighted design programmes, which encompass the needs of society, and stop being concerned with the creation of exemplary but isolated objects.

The designer's function is not to increase irrational devotion to commodities but - first and foremost - to give structure and content to the human environment' (Maldonado, 1974). It is interesting to note that the social impacts of technologies can be identified at different levels of social analysis: at the minimum level of individuals and their interactions, at the meso level of groups and organisations, and at the macro level of social structures, cultural systems and social institutions and their dynamics (Misa, 1994). The experiments carried out with the Design for AIRC research resulted in a model of 'extended multifunctionality', i.e. capable of acting on different scales and


*Figure 1. Breast Cancer Simulator Pad, VML, Sabina, 2020.*

times. All the objects designed at the instigation of the Foundation have a function that is immediately comprehensible and experiential (playing, carrying or eating a meal, listening to music, peeling an orange, etc.). They, however, experiment with different possible languages and solutions useful not only in disseminating scientifically correct information on pro-prevention behaviour, but also in inviting users to adopt virtuous lifestyles with reference to physical activity, proper nutrition and the rejection of smoking. Prevention, then, also means, on different levels, working on a new risk culture (Piscitelli & Angari, 2020). A society characterised by risk as a dominant condition and by emergency as a structural dimension of contemporaneity runs the risk of conveying a fatalist type of culture of danger and of imposing a common lexicon, a certain way of 'organising the collective memory' (Nora, 1978) characterised by social panic and a sense of powerlessness. Yet, as the German sociologist Ulrich Bech suggests, understanding and accepting the constant exposure to risk and its inevitability would not only be a gesture of collective responsibility but would entail a strategic advantage since it would lead to the prefiguration of a new, desirable utopia: "a positive change in the modalities and practices of strategic decision-making" (Bech, 2020). Learning to live in the society of risk thus entails, on the one hand, challenging even the most unshakeable certainties and, at the same time, "opening up to significant changes by triggering new energies" (Bech, ibid.). The culture of Design has, here, the role of accompanying a progressive process of refinement of individual and collective needs, offering itself as an instrument of design synthesis oriented to the scientific mediation between different disciplines necessary for the definition of solutions capable of standing out for efficiency, sustainability, systemic awareness and replicability. In this sense, "design can and must become a means by which young people can participate in the transformation of society" (Papanek, 2022 [1970]). These products, then, are designed to be "embedded in a dense network of inter-subjective and inter-objective relationships and are active in relation to the subject, acting on the body, mind, time and space. This is why, for them (ed.), the logics of use, appropriation strategies, experiences, and relational networks that objects allow us to create tend to come to the fore, and their shaping is also inspired by them" (Fiorani, 2001). Correct communication, inclusiveness, freedom of choice, support and research for a truly shared, eco-environmental and social impact thus become priorities and project objectives for these small artefacts that go beyond the status of "shiny trinkets", of futile disposable gadgets, becoming seed-objects, triggers of ways of behaving and being, friendly nudges that intend to instil in the user a new model of awareness and care for himself and, consequently, for society.

## Design that translates scientific research into artefacts

In recent years, design culture has shown a growing interest in scientific disciplines, particularly those related to health and well-being. This trend is part of a broader phenomenon of ethicalisation of design induced by the ecological transition, whereby designers are increasingly engaged in demonstrating a social commitment that balances the use of resources for the production of new goods in an already saturated and constantly emerging world (Gray & Boling 2016). Especially among young designers, there is a growing focus on issues such as social equity, environmental sustainability and well-being (Cenci & Cawthorne, 2020). The idea of proposing solutions to urgent or unresolved problems in society gives design a character of usefulness, counteracting the criticism of vacuity that sometimes strikes a discipline that in the past was more oriented towards aesthetic than ethical qualities. The search for an ethical justification in science by design recalls the association between scientific values, morality and democracy that emerged during the debates on Darwinism at the end of the 19th century, becoming a dominant theme in the 20th century (Lelas, 2000). In current scientific knowledge, designers identify principles of clarity and accountability and seek opportunities to collaborate with scientists for the common social good through cooperative rather than competitive actions (Langella, 2018). The rapid progression of scientific knowledge related to health and well-being requires accessible and rigorous communication to counter misinformation. Designers are turning to the medical sciences to act as a bridge between knowledge and society, especially in response to the growing demand for scientific disclosure highlighted during the pandemic emergency (Matta, 2020). The achievements of life sciences produce significant changes in people's lifestyles. Design possesses the communicative and interpretative tools to shape these changes, transmitting them to society through products, services and devices that interpret scientific knowledge in an accessible way (Antonelli, 2008). Designers engaged in this field, which can be called Science Driven Design, collaborate with doctors and scientists, adopting tools and principles such as the scientific method and data verification.

*Figure 2. My UV patch, Fuseproject, L'Oréal's Technology Incubator, 2018.*

They act in unusual contexts, moving from conventional markets to places such as galleries or science museums, reaching a wider audience. Adapting the universe of artefacts to the evolution of health-related scientific knowledge is a challenge and an ethical responsibility for design (Pentz, 2004). This implies a rigorous and conscientious approach involving a deep understanding of scientific content before translating it into goods and services useful to society. The 'Design for AIRC' project is an example of collaboration between design and medical sciences to promote healthy lifestyles, taking root in people's consciousness and integrating into everyday contemporary living. Right from the initial conception phase of the course

described, it was decided to avoid the design of medical diagnostic or therapeutic devices, which are too complex for design students to deal with. Design, when dealing with medical and health issues, must be aware of its own limits of knowledge and work within these limits by enhancing its own potential. The students of the Community Design degree course chose to interpret medical and scientific research through metanarratives that put knowledge and its potential to improve the world in terms of quality of life, equity and well-being at the centre. They proposed themselves as mediators between scientific research and society, seeking to conquer spaces of awareness in people's consciences. To do so, they investigated the interactions between human nature and scientific themes, extrapolating visions that aim at emotional involvement (Nabi, 2015) through poetic, allegorical, polemical, interrogative and, in some cases, even ironic interpretations. If medical sciences confront the human being with his precariousness and the consequences of his choices, design can convey the indications and prescriptions related to prevention through forms of persuasion that act in a light and natural way, inducing beneficial actions and lifestyles almost spontaneously. In order to enable students to face such a complex challenge, an appropriate methodological approach has been proposed, centred on scientific knowledge and on the individuals the project addresses: young people like themselves whose needs, experiences, attitudes, constraints and desires have been mapped (Ku, B & Lupton, 2022). The collaboration with AIRC and the interaction with the professionals involved in the training course enabled the students to orient themselves in research, find scientific references, identify languages that can be shared with other disciplines and build paths of common interest with scientists and the association. The future designers had to develop the ability to assimilate complex scientific concepts, understand specialised languages and overcome disciplinary barriers. They learnt to consult and select the most up-to-date, most reliable scientific bibliographic sources with the greatest impact on the scientific community, and were able to extrapolate useful information to be translated into the design of artefacts.

## Design and everyday life

Behaviours and lifestyles significantly influence health and well-being. This is particularly relevant in relation to cancer risk, the prevention of which depends to a large extent on individual and collective habits and behaviour (ISS, 2014). Design, behaviour and lifestyles are intimately linked. The use of products, environments and services not only supports the fulfilment of conscious or unconscious needs, but always elicits the assumption of particular attitudes and ways of responding in users. Moreover, according to Latour, objects are never neutral: human action is directly linked to artefacts, which play a mediating role, actively contributing to the way in which the purposes for which they were conceived are realised. This mediation translates the characteristics of the artefact into an action programme (Latour, 2002), which invites or inhibits the activation of specific behaviours in the users. In their essence, objects thus incorporate prescriptions and behaviours that lead people to act more or less automatically, in a predetermined and predeterminable way (Craig & Chamberlain, 2017). The structured relationship between design and behaviour can be traced back to the studies in design psychology (Norman 1988), which investigated the intuitive use of objects and the unconscious responses they elicit in users, emphasising the decisive role of design. In recent years, there has been a shift in emphasis towards approaches that aim to enhance, in a more explicit manner, the potential of design for the development of artefacts with somewhat persuasive effects.


*Figure 3. Smart Pink, Mi Hyun Ryu and So Ra Park, 2010.*

Strategies that have been deployed have mainly been tried out to intentionally shape people's behaviour towards more sustainable environmental practices. These relate to models that combine active, conscious tactics with approaches that focus on activating responses based on unconscious reactions. The former rely mainly on the rational mind, which is responsible for reasoned decision-making processes and conscious, deliberate behaviour. The latter involve the unconscious and unconscious components, responsible for quick and automatic choices, which predominantly guide the habits, reactions and decisions that people make on a daily basis (Nielsen, Daalhuizen & Cash 2017). The aim of design for behavioural change is to intentionally and explicitly and ethically develop positive behaviour for both the individual and the community. In this case, the object of the design is the behaviour itself, which is explicitly defined and designed with the support of artefacts whose characteristics are specifically designed to push users towards desired behaviour (Khadilkar & Cash 2020). In behavioural economics, these features are referred to as nudges (Thaler & Sunstein, 2009), which take the form of 'gentle nudges' embedded in artefacts, which direct the choices individuals make towards a given goal, without prohibiting any options, but emphasising the most desirable ones (Vlaev et al. 2016). Applied behavioural product design (Fogg and Hreha, 2010) focuses on understanding the psychological, social and emotional factors that drive user behaviour and applying this knowledge to create more engaging, effective and satisfying experiences. The aim is to optimise product features, interfaces and the overall user experience in order to promote positive behavioural changes, foster engagement to improve success and adoption.

## Design for AIRC project: objectives and methodology.

The role of Design in the Design for AIRC project was to "sew" these external contributions (input) and to experiment, by designing related artefacts and services, viable and synthetic solutions (output) capable of repre-

senting a possible new semantics of prevention, based on a shared, friendly, pleasant, involving, serene, scientifically correct language; i.e. capable of replacing the themes of "fear", "death", "doubt", "loneliness", "passivity" and "illness" with those linked to the concepts of "reassurance", "life", "knowledge", "sharing", "proactivity", "well-being". New objects, new relationships, new words for a new culture of prevention. According to Fogg (2003), in order to be persuasive, an artefact must operate on three fronts: to act as a tool, increasing the user's ability to achieve a certain objective; to act as a media, involving the user in a complete physical, sensory, cognitive and emotional experience of use; to act as a social actor, stimulating interpersonal relationships through its use. Therefore, the design of objects that encourage users to engage in healthy behaviour must necessarily be based on a deep understanding of human factors and context (Irizar-Arrieta, 2020; Tosi, 2020). Human-centred design methodologies apply ergonomics to design (ISO, 2010), to strive for a global quality of the systems with which people enter into relation, involving the totality of the user experience. From an ergonomic point of view, every artefact-product, environment, service-is configured as a tool, a device necessary to carry out a given operation or perform a given activity efficiently, guaranteeing the best psycho-physical conditions for the user. The supportive nature, which the artefact must exert, derives therefore, on the one hand, from the extent to which it is suited to the tasks to be performed by the user, and on the other, from the extent to which its characteristics of use are consistent with the capabilities and limitations of the user, and respond to his needs and expectations, even implicit ones. To do this, it is necessary to accurately assess and design all the variables that define the context in which the user-artefact relationship takes place, the users, the activities, the behaviours, their reciprocal conditioning and their variability over time (Tosi, 2020). The result will be a system that is usable, friendly in interaction, safe, easy and satisfying in use and, for this reason, intrinsically healthy, because it is specifically designed to improve the user's well-being and quality of life.

## State of the art

The research collects and analyses international experiences in which the various expressions and practices of creativity and design are asked to interface with the disciplines of the biomedical area, traditionally engaged in the fight against cancer specifically understood as research for a cure. The various possible applications of design, as well as art, events and social advertising campaigns may in fact prove to be unique and new strategic tools for generating 'soft links' between the scientific world and ordinary people (individuals or entire communities), pretexts for a dialogue that, while always remaining scientifically exhaustive and correct, may be more friendly, empathetic and suitable for broader audiences. Design can, therefore, experiment with new languages useful in making the messages that medical science needs to disseminate truly public and comprehensible; and it can do so not by playing an ancillary or subordinate role, but by becoming an effective driver of research and innovation. The aim of these interdisciplinary collaborations is then to generate, over different time spans and on different scales, real impacts with the common goal of generating social debate, keeping public attention on health and wellbeing issues high, and ultimately helping to save lives. This condition is probably not determined by a kind of shyness or inability of design culture to manipulate the theme of cancer, but rather by a general reluctance on the part of clients (public or private) to concretely include design among the disciplines that can rightfully be counted among those that are decisive in defeating cancer.

Instead, design can objectively prove to be a novel and attractive strat-

egy towards new audiences and new possible ways of doing prevention and treatment. Thanks to its natural propensity for visualisation, problem solving and synthesis, design can indeed stimulate innovative processes in different fields of action. It can support the design of spaces, artefacts and machines for care, it can find application in communication and multimedia products, it can transfer new technologies, it can act on the social scale with services and actions capable of working even on the urban dimension and, increasingly, in a hybrid form between analogue and digital.

For example, among the innovative communication campaigns capable of exploiting different channels and languages in a cross-media way, it is worth mentioning the projects Comic sans for cancer by Vincent Connare (UK, 2014), #CHECKYOURSELF born from the collaboration between the company Dove and the Swedish Cancer Society's Pink Ribbon (Sweden, 2020),Toilet, Teeth, Tits (TTT) which saw the collaboration between Stella McCartney and the Netflix series Sex Education (UK, 2021) and the digital platform The Oncology Guide (UK, 2023) designed by Design Bridge to help and inform families and patients on paediatric oncology issues. With more than 1,800 children diagnosed with cancer each year in the UK, the guide was created to reduce the confusion and stress experienced during this time. Inspired by the personal experience of Charley Scott (founder of Design Bridge), whose daughter was diagnosed with lymphoma at the age of two, the guide brings together patient-centred insights and scientifically certified information in one easily accessible, clear and empathetic information tool to manage users' access to this sensitive information.

Among the case studies from the action-research field of product design, it is worth mentioning the Smart Pink self-palpation stickers by Korean designers Mi Hyun Ryu and So Ra Park (2010), the Philips Skin Scan concept by Austrian Rebecca Eveline Daum (Umeå Insitute of Design , Sweden, 2015), the wearable or integrated technology of Fuseproject's (Yves Béhar) My Skin Track UV project for L'Oréal's Technology Incubator (USA, 2018), the Nip it in the boob concept by Jessica Williams (UK, 2019), the We wear boost prostheses by Rosie Brave and Sam Jackman (UK, 2019), the James Dyson Award-winning project The blue box by the young biomedical engineer Judit Giró Benet (Spain, 2020), the Dotplot device by Debra Babalola and Shefali Bohra (UK, 2022) or the Wearable scanner developed by MIT Boston (USA, 2023).

Completely alternative and 'lateral' proposals are the Diagnosticookies project (Portugal, 2023) and the Breast cancer simulator pad (Thailand, 2023). As a speculative tool with social engagement functions, then, there are practices that exploit the urban public environment as a field of action with events, temporary installations and artistic interventions. Examples include the street art projects Love is stronger than death promoted by the KWF Dutch Cancer Society (Netherlands, 2018-2022) and IMPERFECT (I'M PERFECT) by Yuri Catania (Italy, 2023), or the I/DEAL fashion show promoted by the Fondazione Piemontese per la Ricerca sul Cancro (Italy, 2023). Or to immersive digital shows such as DNA produced by AIRC (Italy, 2019-2023) or Outwitting cancer (UK, 2021-2022). From the selected case studies, it is possible to observe a gradual, albeit slow, increase in awareness of the possible role of design in the fight against cancer and in the willingness of organisations, public or private, to involve designers in targeted actions. This collaboration is, however, still unexplored in many geographic macro-areas, even if densely populated, such as, for example, Africa, Central and South America, the Middle East, China, Russia and India.

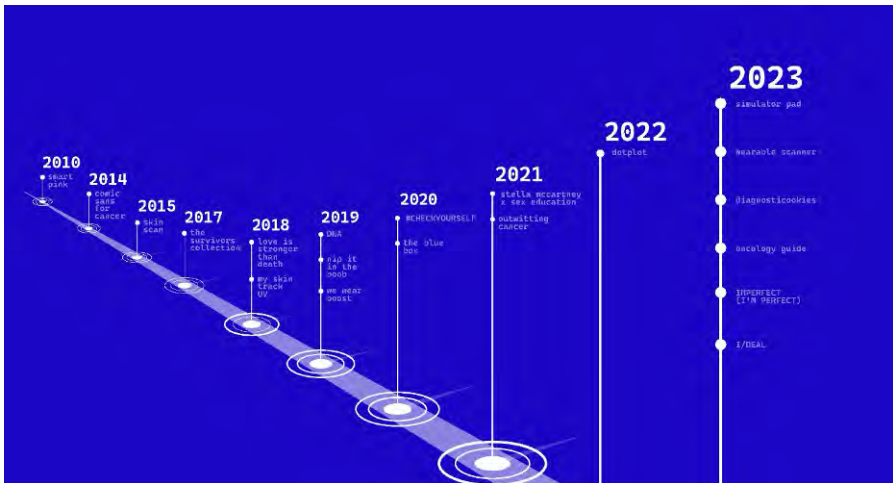



*Figure 4. Timeline of analysed best practices.*
*Image by Chiara Scarpato.*

On the other hand, the United Kingdom can be considered the main context for design-led experimentation thanks, in particular, to the sensitivity of British universities, associations and foundations involved in cancer research. The oncological theme most frequently addressed by these experiments is breast cancer. Less frequently, then, the actions conducted concern lung cancer (directly connected with the theme of tobacco control) and melanomas. There are, as yet, no relevant examples relating to forms of cancer which, on the other hand, feature strongly in the diagnosis statistics, such as colorectal, bladder and prostate cancer. An emerging theme from the good practices reviewed is, then, self-diagnosis as a fundamental tool for maximising the effectiveness of good screening practices. Unfortunately, truly conscious actions aimed at a renewed culture of primary prevention capable of acting on young targets and healthy lifestyles are insufficient.


*Figure 5. Map of analysed best practices.*
*Image by Chiara Scarpato.*

## Outcomes, observations, open topics

In agreement AIRC, the developed solutions focused on the creation of low-tech and low-cost products, to be used in daily life. Intuitive and self-explanatory products, suitable for use by a young target, consistent with the principle according to which a pleasant, comfortable and easy-to-use object, developing positive emotions, promotes learning, curiosity and well-being (Norman, 2004). Useful and fun objects, which do not impose new habits in

a prescriptive way, but insinuate themselves into ordinary life in a gentle way, making the lives of users easier and activating, even unconsciously, the adoption of behaviors that lead to a healthy life, such as eating correctly, exercise and don't smoke.

The resulting collection of small objects provides a framework of persuasive strategies that arise from the use of objects, and which mostly operate on the preliminary motivations, that is, on the conditions that trigger positive behavior in young people, sometimes discouraging risky behavior. The thrusts that the devices incorporate mainly concern the development of their informative, motivational and guiding potential. Some of them aim to develop awareness in users, activated by making the principles connected to the desired healthy behavior visible and comprehensible, in order to encourage reflection on the opportunity to practice it, suggesting the appropriate conduct to adopt (e.g. providing recipes that use seasonal vegetables; inform about the quantity of legumes to eat or how much walking is appropriate, etc.). Others encourage users through the ability to track and highlight the target actions of healthy behavior (e.g. recording how much water you drank in a day, how many steps you actually climbed in a week, etc.). Still others act by making it easier to adopt healthy behavior, even outside the context in which this traditionally occurs (for example, by encouraging, even outside the home, the use of spices to replace salt; by facilitating the preparation and transport of balanced foods or healthy drinks, etc.).

Particular attention is then paid to the playful and emotional dimension, through the creation of objects that aim to compensate for the emotional void that the abandonment of consolidated risky habits can generate, to connect the adoption of healthy behavior to sensations of joy, serenity and comfort (e.g. small games based on manipulation that reproduce the gestures of the smoker; the mirror that prefigures the effects of nicotine on the face; playing cards that motivate the adoption of good habits by leveraging fun and sociability, etc. .). The vision of design-driven prevention therefore emerges, which, through the world of objects, contributes to promoting health and quality of life, involving, entertaining and exciting.


*Figures 6-7. Wonder cards, Sara Annarumma and Jacopo De Leo, Design for AIRC, 2023.*

# References


1. *Antonelli, P., Aldersey-Williams, H., Hall, P., Sargent, T. (Eds) (2008). Design and the elastic mind. The Museum of Modern Art.*
2. *Bech, U. (2020), Un nuovo dizionario. Vivere la società del rischio: la lezione di Ulrich Bech, Cenci, A., & Cawthorne, D. (2020). Refining value sensitive design: A (capability-based) procedural ethics approach to technological design for well-being. Science and Engineering Ethics, 26(5), 2629-2662.*
3. *Linkiesta di Morning Future. https://www.linkiesta.it/2020/03/ulrich-beck-societa-del-rischio/ [Luglio 2023]*
4. *Fiorani, E. (2001), Il mondo degli oggetti, Milano: Lupetti, pp. 149-150.*
5. *Garrett, R., Popova, K., Núñez-Pacheco, C., Ásgeirsdóttir, T., Lampinen, A., & Höök, K. (2023, April). Felt Ethics: Cultivating Ethical Sensibility in Design Practice. In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (pp. 1-15).*
6. *Gray, C., M. & Boling, E. (2016). Inscribing ethics and values in designs for learning: a problematic. Educational technology research and development 64, 5 (2016), 969–1001.*
7. *Langella, C. (2018). Design and Science: traces of a new modernity. DIID. Disegno Industriale Industrial Design 64, 30-37.*
8. *Lelas, S. (2000). Science and Modernity. Springer, Dordrecht.*
9. *Maldonado, T. (1974), Noi e il mondo delle merci. In Avanguardia e razionalità. Articoli, saggi, pamphlets 1946-1974, Torino: Einaudi, pp. 200-201.*
10. *Manzini, E. (2021), Abitare la prossimità, idee per la città dei 15 minuti, Milano: Egea Editore, p. 66.*
11. *Margolin, V., Margolin, S. (2002), A "Social Model" of Design: Issues of Practice and Research, in Design Issues, Autumn, 2002, Vol. 18, No. 4 (Autumn, 2002), pp. 24-30, Boston: MIT Press, p. 25.*
12. *Matta, G. (2020). Science communication as a preventative tool in the COVID19 pandemic. Humanities and Social Sciences Communications, 7(1), 1-14.*
13. *Misa, T.J. (1994). Retrieving Sociotechnical Change from Technological Determinism. In M.R. Smith, & Leo Marx (eds.), Does Technology Drive History? The Dilemma of Technological Determinism, Cambridge: MIT Press, pp. 115-141.*
14. *Nabi, R. L. (2015). Emotional flow in persuasive health messages. Health communication, 30(2), 114-124.*
15. *Nora, P. (1978), Mèmoire collective, in Le Goff Jacques (a cura di), La nouvelle historie, Paris: Retz, pp. 398-401.*
16. *Norman, D. A. (2004). Emotional design: Why we love (or hate) everyday things. Basic Books/ Hachette Book Group.*
17. *Papanek, V. J. (2022 [1970]), Design per il mondo reale, trad. Design for the real world: Human Ecology and Social Change, Macerata: Quodlibet, pp. 137-138.*
18. *Pentz, M. A. (2004). Form follows function: Designs for prevention effectiveness and diffusion research. Prevention Science, 5, 23-29.*
19. *Piscitelli, D., Angari, R. (2020). La comunicazione del rischio. Un'opportunità di dialogo tra istituzioni e cittadini. In MD Journal, V. 10 N. 2: DESIGN FOR CITIZENSHIP, ISSN 2531-9477 [online], ISBN 978-88-85885-10-3 [print], pp.24-37.*
20. *Latour, B. (2002) Una sociologia senza oggetto? Note sulla interoggettività. In Landowski E., Marrone, G. (a cura di) La società degli oggetti. Problemi di interoggettività. Meltemi, Roma*
21. *Craig, C., Chamberlain, P. (2017). Behaviours: Design and behaviour change in health. In: Tsekleves, E. and Cooper, R., (eds.) Design for health. Design for Social Responsibility. Abingdon, Routledge, 191-203*
22. *Nielsen, C. K. E. B. B., Daalhuizen, J., Cash, P. (2017). Behavioural design workbook - an introduction to behavioral design and its application in Copenhagen Commune*
23. *Khadilkar, P., Cash, P. (2020). Understanding behavioural design: Barriers and enablers. Journal of Engineering Design, 31(10), 508-529.*
24. *Ku, B., & Lupton, E. (2022). Health design thinking: creating products and services for better health. MIT Press.Thaler, R. & Sunstein, C. (2009). Nudge, Penguin Books, New York: NY.*
25. *Fogg, B. J. and Hreha, J., (2010) Behavior Wizard: A Method for Matching Target Behaviors with Solutions.Lecture Notes in Computer Science, vol. 6137, 2010, p. 117*
26. *Vlaev, I., King, D., Dolan, P. and Darzi, A. (2016) The theory and practice of "nudging": changing health behaviors. Public Administration Review, 76 (4). pp. 550- 561. ISSN 0033-3352*
27. *ISS (2014) Lifestyles and Cancer Prevention. Retrived at: https://www.salute.gov.it/imgs/C_17_pubblicazioni_2220_allegato.pdf*

# Thriving children's perceptual learning through educational environments color and material design

*Elisa Longoni[1], Michele Zini[2], Barbara Camocini[3]*
*elisa.longoni@polimi.it*
*michele.zini@polimi.it*
*barbara.camocini@polimi.it*

[1]*Politecnico di Milano, Italy*
[2]*ZPZ Partners, Italy*
[3]*Design Department, Politecnico di Milano, Italy*

***Keywords:***
*Colour-material*
*Interior design*
*Educational environments*
*Perceptual learning*

## Abstract

Being the place where children spend most of their daily lives, the educational environment plays a crucial role in children's cognitive development. Indeed, pedagogy recognizes the role of space as the "third teacher," promoting the importance of the interior environment's multisensory quality, which can stimulate "perceptual learning," - especially considering children aged 0-6 years - which is a progressive improvement in perceptual skills, nurtured by the direct experience.

Through case study analysis and literature review, the paper aims to identify and categorize some color-material design strategies within educational interior environments, highlighting how this complexity can be related to multiple pedagogical and cultural factors.

The multisensory features of colors and materials resulting from the above-mentioned aspects bring the outside world richness into the educational environment, training children to relate to and act within the complexity of the existing world (local and global, analog and virtual), while quantifying the effectiveness of this approach remains an open field of research.

## Introduction

The educational field is currently receiving considerable international attention and financial investment, witnessed and promoted by the fourth of the 17 Sustainable Development Goals concerning Quality Education, to ensure inclusive and equitable opportunities for all. Moreover, children's spaces are increasingly becoming, especially in European countries, the places where large population movements (migrations and other nomadism) reveal themselves, sharing growth experiences and involving cognitive aspects from different cultures, offering relevant opportunities for inclusion (Maxwell, 2014). In fact, according to the *Ecological Systems Theory* (Bronfenbrenner, 1979), children's development is influenced by a series of systems, seen as concentric circles where the child is at the center. *Microsystems*, such as school and home, are the closest environments to the individual.

Nevertheless, the scientific literature often refers to *Quality Education* typically linked to the pedagogical approach, neglecting the impact of the

school environment, intended as spatial design with its color-material-shape features. Indeed, despite infant and toddler schools being the places where children typically spend most of their time, interior design is not as well supported by analytical studies on the various aspects that define educational spaces.

The overall objective of the paper is to investigate the role of interior design, and its multisensory aspects in educational environments, to observe if and to what extent it can impact a child's cognitive development. Indeed, human beings have different sensory systems that contribute to the processing of information and knowledge and that are activated, alone or combined, by the external environment, and infancy is a crucial period where multi-sensory experiences foster a person's proper cognitive development (Dionne-Dostie & al., 2015). In these early years our perceptual abilities are refined thanks to a phenomenon known as *perceptual learning*, made possible by *neuroplasticity*, i.e. the ability of our brain to adapt its structure in response to external stimuli.

Among the various sensory aspects, the preliminary literature review has shown that color is a major player in our perceptual and psycho-physiological experience as it influences various functions of the mind and human behavior, such as vision, scene perception, object recognition, aesthetics, and communication, defining a research field that touches different disciplines (Maule, Skelton & Franklin, 2023).

Therefore, the paper's specific objective is to explore how co-stimuli are managed within the 0-6 spaces, attempting to highlight possible strategies and helpful insights for advancing research in this field. The analysis is based on a literature review, which integrates pedagogical and neuroscientific components to support the design and proceeds through the examination of selected case studies.

The research efforts focused initially on the neurological aspects of child cognitive development, particularly concerning sensoriality and arising mainly from the 1970s and 1980s: the goal at this stage was to understand whether the multisensory environment could be implicated in this process. In the same years, in Italy, the sensory and immaterial aspects were explored within the Primary Design. This research was a turning point for color design, revealing that color cannot be mediated but it can impact on our spatial perception, depending on how it is applied. In addition, some perspectives, such as Frank Mahnke's one, attempting to combine design and psychology or neuroscience, note how the variety of stimuli can help children's cognitive development. Pedagogy widely recognizes the fundamental role of sensoriality in childhood education, even if it addresses it through different approaches. In particular, the Reggio Emilia Approach promotes multi-sensory environments as a result of the collaborative efforts of educators, researchers, and designers.

## Literature Review

Children, particularly in the 0-6 years, are exceptionally curious and inclined to explore the space around them and learn from it. Indeed, some pedagogical approaches define the space with the term 'third teacher' as it contributes to the cognitive development of young children (Fraser, 2000; Wien, 2008).

### Child cognitive development and perceptual learning

In the early years of life, the human brain shows incredible capacities for adaptation and inclination to learn, meaning that every experience can have an enormous effect on an individual's mind and personality. In neuroscience,

this capacity is known as *neuroplasticity*[1] consisting of the brain's ability to create, organize, and eliminate *synapses*, i.e. neural connections, between different neural regions during its development.

Within the different types of learning capabilities of our mind, *perceptual learning* consists of improving, through direct experience, our perceptual abilities, such as the possibility of distinguishing similar shades of color. Early studies date back to the mid-19th century; however, since the 1980s, this natural, unconscious phenomenon has gained increasing attention due to new knowledge in physiology and neuroscience.

The contribution of neuroscience in the design of spaces has recently been widely experimented, specifically dealing with light and colors, within the framework of facilities dedicated to adults and children affected by mental and cognitive diseases. Well-known examples are the *Snoezelen* rooms, i.e. controlled multisensory environments designed to induce well-being in individuals with learning disabilities, autism, cognitive impairment, or other pathologies (Hulsegge & Verheul, 1987). Within these rooms, widespread in the Netherlands since the 1970s, it is possible to control the nature, quantity, and intensity of sensory stimuli with the help of specialized operators, creating relaxing and optimal environments. However, the literature does not report an equal amount of attention in extending this research to other spaces generically dedicated to children.

**Primary Design and the role of soft qualities in the environment perception**

The importance of the sensorial dimension became an important design topic of practical and theoretical research, especially in Italy, concerning the Primary Design Approach. In the Seventies, Clino Trini Castelli identified the role of some aspects, defined as 'subjective' of the quality of space, characterized by a 'soft' nature and a 'low energy,' which, if used in a particular widespread modality, can strongly modify our perception of the environment. He defined 'Primary Design' as the adoption of these effects - such as smell, light, and color - at a large scale (Thomas, 1996). From these observations emerges the relevance of *soft qualities*, meaning the intangible values of space - colors and materials - as opposed to *hard qualities* - form, function, and ergonomics - considering the former no longer seen as subordinate to the latter but designed in synergy.

To better express these theories, Branzi and Castelli also adopted the metaphor of *bradyseism*[2], since its effect, as well as that of the intangible qualities of space, is imperceptible on a small scale, but very relevant on a large scale (Branzi & Castelli, 1984): for example, the same color applied in a minimum way in an environment is not able to change our perception of that environment, but it can become relevant if applied intensively.

Clino Trini Castelli also introduces the concept of *qualistic*, defined as the perception of subjective quality: unlike hard qualities, soft qualities cannot be mediated. The consequence is the need to consider how the same color can not only please one individual and not another, but also provoke different emotions.

**Environmental stimuli for cognitive development: contrast and time**

Hence, color must be an influential component to modify our perception of that space and our related emotions and physiological responses. The belief that such responses are not generalizable, as they are mediated by multiple factors, is widespread and supported by Frank Mahnke with his *pyramid of color experience*.[3]

Over the decades, many researchers have explored the topic of color in interior design and its implications at the psycho-physiological level. Hugo Kükelhaus advocates the importance of contrast and variety of stimuli within the environment, to the extent that he believes that "monotonous materials or colors can also cause dysregulation" (Meerwein, Rodeck, & Mahnke, 2007, p. 63).

> "It is important to take into consideration the amount of color stimuli (degree of colorfulness) and stimuli variations (contrasts) that are beneficial to the individual." (Meerwein, Rodeck, & Mahnke, 2007, p. 71)

Based on these and other previous theoretical research, Mahnke believes that the non-use or incorrect use of color can have major psycho-physiological implications on the person. Furthermore, he opposes the achromatism, that is mostly typical of offices and schools, where white and neutral colors are used indiscriminately, as scientific studies do not support it. Regarding preschool environments, he claims that to enable children to live different experiences and foster cognitive development, it is appropriate to create rich environments, being careful not to make them either under- or over-stimulating.

Under stimulation occurs notably in monotonous environments, as our minds demand alternating stimuli. Tornquist (1999) recalled the importance of control over color contrast between contiguous rooms, arguing that monochromatic interiors also trigger the phenomenon of adaptation: independently from the initial reaction to the color of a room, responses will decrease over time. Indeed, according to Meerwein, Rodeck, and Mahnke (2007) environments within which more time is spent require greater attention than spaces that are transitory, or of occasional and/or brief use.

> "The color schemes of spaces where people spend large amounts of time should be unobtrusive yet expressive enough to accommodate the personal design preferences, imagination, creativity, and freedom of each individual user. Instead of overpowering us, colors should serve our needs. We should find them stimulating, not annoying". (Meerwein, Rodeck, & Mahnke, 2007, p. 71)

Both Meerwein, Rodeck and Mahnke's and Tornquist's writing address some design guidelines because of their studies: all of them agree on the importance of balanced contrasts, also with light. According to the first ones, the color of the ceiling should be lighter than that of the walls, and that of the floor darker. According to Tornquist, walls, preferably opaque with medium reflection, if windowed should be light sufficient to avoid contrasting with outside light, while if opposite to windows should not be too saturated not to alter light reflection, similarly to ceilings.

**Color in interior environments through pedagogical approaches**

Despite the widespread recognition of the significance of sensory stimulation during childhood, some pedagogical models have slightly different approaches to achieving it. An internationally recognized example that focuses on the importance of the physical space in education is the Reggio Emilia Approach, introducing the concept of 'third teacher'. Indeed, conducting joint research between pedagogy and architecture over the years, Reggio Children promotes the idea of multi-sensoriality within its spaces, where every child should be able to find the stimuli he or she prefers and pursue curiosity and creativity. The authors of "Bambini, spazi, relazioni. Metaprogetto di ambiente per l'infanzia" (Ceppi & Zini, 1998), also use the

terms *soft complexity* and *rich normality*, stating that school environments should be composed of a multitude of different elements and sensorial features spread throughout the space, since children are considered as a laboratory for the senses with a synesthetic capacity (Zini, 2024) following the abovementioned metaphor of bradyseism.

The Reggio Emilia Approach, originating with Loris Malaguzzi (1920-1994) in the 70s, refers to the child as a complex and competent human being having a *hundred languages*, i.e. multiple ways of interfacing and communicating with the world, that can be translated into spatial choices as well. According to this belief, the applicative strategy of color should move away from simplistic visions of the infant, associating them only with primary or pastel tones, and developing a complex landscape with the coexistence of composite colors and materials of different natures. Malaguzzi fosters the employment of materials that capture the children's interest, encouraging their sense of aesthetics and the discovery of the surrounding space. In proposing this multisensory stimulation, he departs from the Montessori perspective, which focuses on the *single qualities* of teaching materials.

> "[…] unlike other pedagogies that can be guilty of treating early infancy as a preparation for later childhood and adulthood, and consequently seeing nursery education as a kind of antechamber to later stages of formal education, the Reggio Approach considers early infancy to be a distinct developmental phase in which children demonstrate an extraordinary curiosity about the world." (Valentine, 1999)

The Montessori Method pursued a different approach which aims to enable the child to become independent and responsible through the completion of certain tasks. In this perspective, the space is generally neutral and features the presence of wood - even if there are no precise guidelines in this sense. Montessori education prioritizes learning through materials that have a unique quality, avoiding secondary features that could deflect the child's attention away from the target of the exercise: color training, for instance, takes place through boards with nine color hues of silk thread in seven nuances each (Zuccoli, 2018). According to some pedagogists and educators, a critical issue that may emerge from this approach is indeed the risk of over-processing and selection of sensory stimuli since these isolated components are not found in the real world, which is made up of complexities, overlaps, and distractions.

## Methodology

International case studies were reviewed to explore how color is managed within 0-6-year-old environments. This analysis is intended to detect different ways of application of color that may be useful for advancing a research activity that pursues the enhancement of the design approach of educational spaces for children. The literature review found that a variety of stimuli helps promote cognitive development by fostering perceptual learning. Furthermore, different hues within a space allow all children to find their favorites (Ceppi & Zini, 1998), thus enhancing their feeling of well-being and comfort.

For the selection and analysis of the case studies, some variables that could provide sensory stimulation were derived from the reference literature and visualized in a diagram where they are ordered by an increasing relationship to physical space.

To obtain a variety of stimuli, *color combinations* can be created based on "differences in color tones (contrasts in chroma), differences in saturation (contrasts in color intensity), differences in brightness (contrastsin degree of luminosity)"; moreover, it is possible to discern dominants, subdominants, and accents based on the ratio of the different colors within a space (Meerwein, Rodeck, & Mahnke, 2007, p. 71-72): dominant colors are most present and determine the atmosphere of the space and should not overstress the eye. These features can be considered part of color presence, indicating what we find within a space and to what extent. Adopting the interior design perspective, it is also crucial to observe how color is applied in the space: for example, whether color is limited to complements, or also found in furniture and architectural elements, and whether it is applied in a blended or clustered manner.

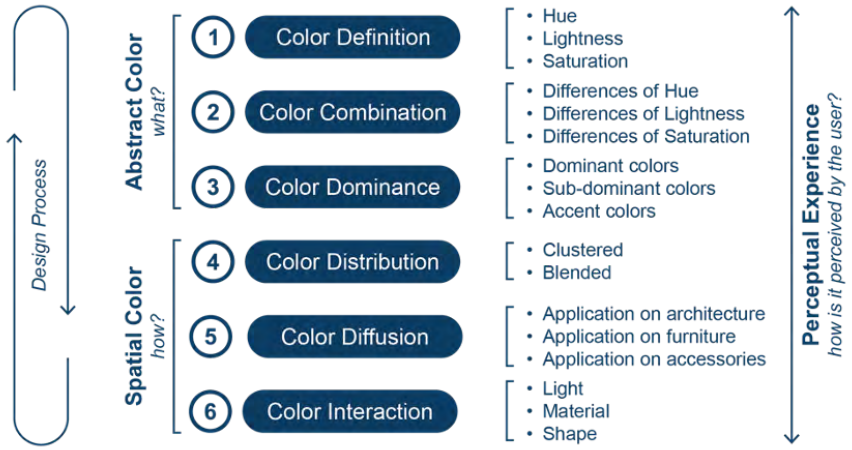



*Figure 1. Diagram of factors influencing color-material complexity*

In addition, color must always be considered in relation to light, shapes, and materials. within a space, as well as in relation to the perceptual experience of the inhabitant, since color strongly depends on the context and the perception of the observer (Boeri, 2013).

The selected case studies all concern educational environments involving the 0-6 age group, excluding other types of childcare spaces, such as playrooms or other facilities that may be used only occasionally. They do not have the same color design requirements due to less time spent there, resulting in less influence on the child's cognitive development.

**A. Daycare Centre WeltenBummler**

*Figure 2. Sensory area of Daycare Centre WeltenBummler. Design by Baukind, Photo by HEJM.*

The Daycare Centre Weltenbummler, opened in 2019 in Berlin, welcomes children aged 10 months to 6 years, while pursuing the principles of the 'Berliner Bildungsprogramm', focused on play and exploration. The interior design was conceived by Baukind, Weise Architects, and Gewers Pudewill Architects.

The white classrooms all contain a monochrome sensory area with different elements that do not have specific functions but open up multiple possibilities for use, play, and exploration. These areas feature not only furniture but also walls, ceilings, and floors in the same color. According to the educational model, children are divided into homogeneous age groups and change classrooms yearly. The chromatic concept is 'my color, my group': each classroom is identified by a specific chromatic scheme. The lower floor, housing the toddlers, has softer hues than the upper floor, which accommodates children from 4 to 6 years old, while common areas, such as bathrooms, outdoor facilities, and the changing room, combine the different colors.

The color shows mid-saturated tones with rather low blackness. Multiple tones are present on the overall scale, although only one or two hues within the single classrooms. The color distribution follows the logic of dedicated monochrome areas, having one or two dominants in each room, affecting both the furniture and the architectural envelope.

In this instance, color plays a *wayfinding function*, helping the child to recognise where he or she belongs. However, this approach lacks multi-sensoriality within the single spaces.

**B. Agora International School**

*Figure 3. Part of the 3-5 years old common area of Agora International School. Design by Rosan Bosch Studio – Photo by Kim Wendt.*

The Agora International School in Madrid provides education for children and teenagers along the principles of IB (International Baccalaureate). In 2022, Rosan Bosch finalized the children's areas, aiming to support active learning and creativity.

The architectural shell is almost entirely white, creating a contrast with the elements placed in it. The floor is divided between the 1-2-year-olds and the 3-5-year-olds, with a light blue path connecting all the elements of the common areas. There are various structures and furnishings, especially in the common areas, intended for play, marked by rather saturated and diversified shades: as a result, each area acquires a strong visual connotation. The classrooms are also recognizable by their colors, which are fainter, such as lilac and light blue, in the rooms dedicated to toddlers, and more saturated, such as blue and red, in those dedicated to older children. The color presence is composed of moderately saturated tones with mainly low blackness. Multiple tones are present overall and in the common areas, while the classrooms predominantly present one. The color distribution mainly affects the furniture and structures, presenting several dominants

and subdominants that may differ from one area to another.

This chromatic approach involves the use of primary colors, bright and iconic, disseminated and isolated on a white base: the result is a high-impact aesthetic, but limited material and multi-sensory complexity.

**C. Fjellvegen Barnehage[4]**

Fjellvegen Barnehage is one of the Tromsø kindergartens, hosting 1-5-year-olds, built in 2006 and designed by 70 N Arkitektur. The Norwegian Barnehage curriculum is also based on play and discovery.

The interior spaces of the kindergarten are flexible and equipped with playing movable walls that can create diversified and multifunctional micro-environments: each mobile structure is different and enables a variety of activities, from drawing to climbing, and has several holes of various sizes and shapes. The interior architecture is predominantly white, with some fixed monochrome walls while others highlight the organic shapes of the openings using different shades; overall, colors are combined throughout the space together with some natural materials such as wood. The color presence within the space varies, tending to present medium saturation and not excessive blackness. The distribution of color also varies, affecting furnishings and accessories as well as entire fixed walls. It is impossible to distinguish one dominant shade, but instead, several accents.

In this instance, color emphasizes the irregular shapes of the spatial components and movable walls, enhancing the design concept. The various areas present diverse varieties of stimuli, leading to differing levels of multi-sensoriality.

**D. ENI Nursery and Kindergarten**

*Figure 4. 3-6 classroom of ENI Nursery and Kindergarten. Photo by ZPZ Partners.*

The ENI Nursery and Kindergarten was opened in San Donato Milanese in 2009 because of a collaboration between Reggio Children and the University of Milano Bicocca. The project was developed by ZPZ Partners, Tullio Zini, and Lapis Architetture. The colour strategy used in this project is representative of that employed in most of the Reggio Children Approach schools.

The building embodies its pedagogical principles, including the osmosis between interior and exterior and multi-sensoriality, aimed at promoting the child's free expression and his 'hundred languages'. The design of soft qualities, and color, plays an important role in the realization of these spaces. The interiors feature wooden floors and ceilings, while some walls have different shades, never juxtaposing two complementary ones. The furniture, instead, has more saturated colors and various shades that are mixed within

the space. The only differing space is the atelier, i.e. the experimental laboratory, located in a different pavilion: in this case, the wooden ceiling is replaced by a yellow one, as well as the furniture is predominantly lighter, in white, and a few tones of yellow and orange.

The color presence is characterized by low blackness, various shades, and medium saturation, lower on the walls and higher on the furniture. The distribution of color within the space is diffuse and uniformly applied in the furniture and some walls: in this case, all the shades are equally dominant.

The project creates a variegated multisensory ecosystem involving architecture, furniture, fittings, etc, employing intrinsic and filmic colors. It also engages the synesthesia, achieved by combining different sensory aspects, such as sounds and smells.

**E. Le Blé en Herbe**

*Figure 5. Kindergarten classroom of Le Blé en Herbe. Photo by Philippe Peron.*

The 'Le Blé en Herbe' project resulted from the renovation of a school in Trébédan, to consolidate its role in the socio-cultural life of the city. It was opened in 2015 and welcomes children from kindergarten and elementary school, 2–10 years old. The educational approach is inspired by Montessori, fostering children's autonomy and movement, and Freinet, an exponent of popular pedagogy, advocating active learning that occurs through trial and error.

In this case, the floors and walls are largely tinted in bright tones such as green, blue, magenta, and orange, leaving room for a wooden floor and white on some walls and the ceiling. Furnishings are made of wood and metal, combining the natural color of the first one with the overlaid one of the second. Hence, the color presence is composed of different shades with rather high saturations, higher on the furniture than on the structural elements, and low blackness. The color distribution is extensive, leaving little space for white. Each room has one or two dominant colors which are the ones of floorings or walls, and some accent colors on furniture.

Even in this case, the color palette is articulated, composed of filmic and intrinsic colors, with a limited number of shades but applied in an immersive manner.

**F. KNO Nursery**[5]

KNO Nursery by HIBINOSEKKEI and Youji no Shiro, built in 2019, and located in Nagasaki, aims to encourage young children to read books by providing different reading corners. Most of the case studies observed in this geographical area show a reduced range of hues, opting instead for neutral tones and the use of natural materials such as wood.

This case study achieves a certain color-material complexity with the use

of natural materials, without filmic colors. Such materials, as wood, do not feature a uniform colour but different veins or shades: the range of hues is restricted, providing a greater contrast of blackness or saturation.

## Findings

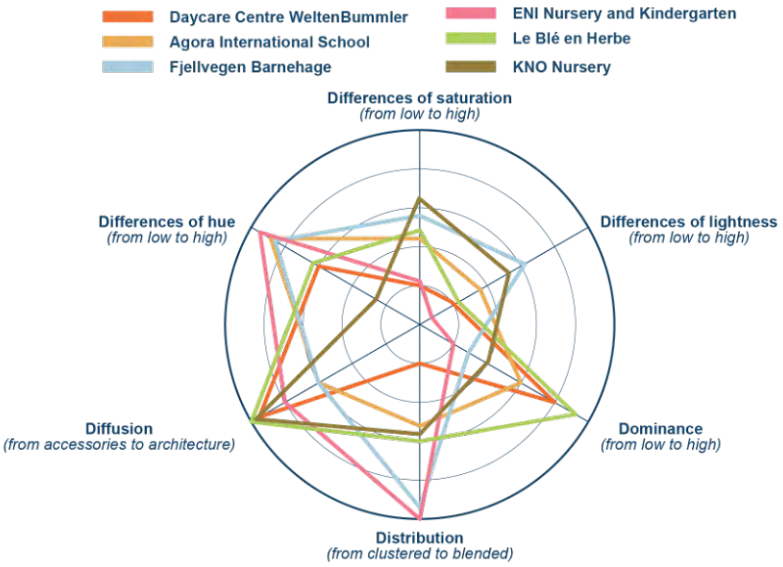



*Figure 6. Radar chart of the selected case studies*

The analyzed case studies reveal a variety of color strategies, which do not depend solely on pedagogical factors. Some quality parameters, regarding color presence and distribution, are compared and visualized in a radar chart that highlights a condition of under-stimulation at its center and of over-stimulation on the outer circumference. The reported projects show a certain balance to obtain a variety of stimuli that are neither insufficient nor excessive.

In addition to the cognitive or pedagogical function, the analysis also revealed the function of colour as a signal that instead does not guarantee the complexity that can foster the pedagogical perceptual development.

In general, a *gradient of color* diffusion within kindergartens can be discerned, starting from achromatic or neutral spaces to color-laden spaces. Some projects, mainly Montessori-inspired, use only neutral tones leading to a less active environment from a cognitive stimulation point of view. However, it is worth mentioning that even without filmic colour, a good level of complexity can be achieved by using a variety of natural materials, such as wood.

Other cases present *monochromatic sensory areas*, having less color variety within each space and greater variety considering the overall design. As mentioned in the literature review, creating monochrome areas may result in comfort or discomfort depending on the individual's preferences, as well as leading to the phenomenon of adaptation. A *polychromatic interior* provides a variety of visual stimuli for children, resulting in the absence of adaptation and the possibility of finding the stimuli that best suit everyone. In some examples, hues are arranged in rather homogeneous groups or by categories within the space, having one dominant color for each area; in other cases, the same colors are mixed randomly in the space, with all hues being equally dominant. The clustered layout may be less stimulating than a blended one, as the former is more like the monochrome area approach, although there are no specific scientific studies to support this.

A common tendency, although not always verified, is to *keep the architectural envelope more neutral or less saturated* than the furniture components. This allows spatial *transformability* in the short and long term: the application of color on furniture, or even superficially on walls, is easily reversible without architectural intervention.

Another finding worth mentioning is that this attention to color is mostly found in private schools or those with a high budget to spend on design. When directly observing various community locations, such as those run by third-sector associations, in-depth interior design that considers the perceptual implications of color is rarely found, and primary colors are often used without logic or distinction. This is also due to the market that only in rare exceptions produces furniture in multiple shades of color.

As stated by Reggio Children, and by Ceppi and Zini (1998), children discover the world through the five senses, deserving a varied and articulated environment from a sensorial point of view, in terms of colors, lights, materials, smells, temperatures, that activates synaesthesia and supports cognitive processes. Design responds to this need, considering multi-sensoriality as a qualitative requirement. It follows that some approaches (case studies D and E) take this pedagogical requirement into account, some (A) not at all, and some (B, C) only slightly.

## Conclusions

The subject of neuroscience applied to interior design deserves further study and greater dissemination to produce environments that best meet pedagogical requirements. Research about the issue of color in educational environments shows how the presence of different sensory stimuli can foster a child's cognitive development and the phenomenon of perceptual learning. Nevertheless, the lack of on-site surveys causes a shortage of data on the impact of these environmental strategies on small users, contrasting the establishment of priorities and research guidelines. Further advances in research could contribute to indicating some guidelines that can emphasize the active role of physical space in children's learning, maximizing its "third teacher" function. A possible solution could be to promote an increasing interdisciplinary approach, involving different designers, such as landscape designers, interior designers, light designers, and so on, but also pedagogists and experts in the field of child neuroscience.

## Footnotes

[1] The pioneer to use the term plasticity in this context was William James, an American psychologist, who defined it as the skill of the brain structure to be weak enough to be influenced but strong enough not to bend completely (James, 1890, cited by Gilbert, Sigman & Crist, 2001, p. 681).

[2] Bradyseism is a phenomenon that consists of tectonic movements that we are unable to perceive but which cause a lowering or raising of the ground level, from our point of view 'slow' but very rapid from a geological point of view.

[3] Mahnke define six aspects that are affecting our color perception and experience: biological reactions to a color stimulus, collective unconscious, conscious symbolism and associations, cultural influence and mannerism, trends, fashion and style, and personal factors (Meerwein, Rodeck, & Mahnke, 2007, p. 20-21)

[4] Photos: https://shorturl.at/rjqOx

[5] Photos: https://e-ensha.com/en-kno-nursery/

# References


1. *70°N arkitektur. (s.d.). Tromsø kindergartens // everyday transformation. [Online] Available at: https://www.70n.no/Tromso-kindergartens-everyday-transformation [Accessed 15 January 2024]*
2. *Aljabreen, H. (2020) "Montessori, Waldorf, and Reggio Emilia: A Comparative Analysis of Alternative Models of Early Childhood Education" in International Journal of Early Childhood, 52, p. 337-353 [Online] Available at: https://doi.org/10.1007/s13158-020-00277-1 [Accessed 18 January 2024]*
3. *ArchDaily. (s.d.). KNO Nursery / HIBINOSEKKEI + Youji no Shiro. [Online] Available at: https://www.archdaily.com/950645/kno-nursery-hibinosekkei-plus-youji-no-shiro?ad_medium=gallery# [Accessed 28 February 2024]*
4. *Baukind. (s.d.). Daycare Centre Weltenbummler. [Online] Available at: https://www.baukind.de/en/portfolio/kita-weltenbummler/ [Accessed 17 January 2024]*
5. *Boeri, C. (2013). "La percezione del colore, tra materiale e immateriale". In Geometria, spazio, colore. Ricerche per la rappresentazione e il progetto (pp. 79-87). Maggioli.*
6. *Branzi, A., & Trini Castelli, C. (1984). "Le emozioni del bradisismo". Colloquio con Clino T. Castelli sull'educazione militare, le stranezze dei nomi, il design primario e l'agopuntura. Modo, 73, 24-27. [Online] Available at: /http://www.castellidesign.it/docs/1984-10_Modo_Emozioni-Bradisismo.pdf [Accessed 15 December 2023]*
7. *Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design. Harvard University Press.*
8. *Centro Design Montefibre. (1975). "Il Design Primario", Casabella, n. 408. [Online] Available at: http://www.castellidesign.it/docs/1975_Casabella_design-primario.pdf [Accessed 3 December 2023]*
9. *Ceppi, G. & Zini, M. (1998). Bambini, spazi, relazioni. Metaprogetto di ambiente per l'infanzia. Reggio Emilia, Italy: Reggio Children.*
10. *Dionne-Dostie, E., Paquette, N., Lassonde, M., & Gallagher, A. (2015). Multisensory integration and child neurodevelopment. Brain sciences, 5(1), 32-57. [Online] Available at: https://www.mdpi.com/2076-3425/5/1/32 [Accessed 12 January 2024]*
11. *Fraser, S., (2000). Authentic Childhood: Experiencing Reggio Emilia in the Classroom. Scarborough: Nelson Thomson Learning.*
12. *Gilbert, C. D., Sigman, M., & Crist, R. E. (2001). "The Neural Basis of Perceptual Learning". Neuron, 31, 681-697. [Online] Available at: https://pubmed.ncbi.nlm.nih.gov/11567610/ [Accessed 11 January 2024]*
13. *Hulsegge, J. and Verheul, A. (1987) Snoezelen: Another World. ROMPA, Chesterfield.*
14. *James, W. (1890). The Principles of Psychology. New York: Henry Holt and Company.*
15. *Malaguzzi, L. (2010). I cento linguaggi dei bambini. L'approccio di Reggio Emilia all'educazione dell'infanzia. Bergamo: Edizioni Junior.*
16. *Matali Crasset. (s.d.). Le Blé en herbe, Trébédan. [Online] Available at: https://www.matalicrasset.com/fr/projet/le-ble-en-herbe-trebedan [Accessed 30 January 2024]*
17. *Maxwell, L. E., & Evans, G. W. (2014). Children and the Physical Environment. In R. Cooper, E. Burton, & C. Cooper, Wellbeing: A Complete Reference Guide, Wellbeing and the Environment*
18. *Maule, J., Skelton, A., & Franklin, A. (2023). "The development of color perception and cognition (Version 1)". Annual Review of Psychology, Volume 74, pp 87-111 [Online] Available at: https://www.annualreviews.org/doi/10.1146/annurev-psych-032720-040512 [Accessed 16 January 2024]*
19. *Meerwein, G., Rodeck, B., & Mahnke, F. H. (2007). Color-communication in architectural space. DE GRUYTER.*
20. *Rosan Bosch. (s.d.). Agora Madrid International School. [Online] Available at: https://rosanbosch.com/en/project/agora-madrid-international-school [Accessed 20 January 2024]*
21. *Thomas, M. C. (1996). "Clino Trini Castelli: Design Primario. Conversations on Theory and Practice". In M. C. Thomas, New Thinking In Design (p. 60-71). Van Nostrand Reinhold USA. [Online] Available at: https://www.annualreviews.org/doi/10.1146/annurev-psych-032720-040512 [Accessed 12 December 2023]*
22. *Tornquist, J. (1999). Colore e luce. Teoria e pratica. Milano: Ikon Editrice.*
23. *Valentine, M. (1999). The Reggio Emilia approach to early years education. North Lanarkshire, Scotland: Scottish Consultative Council on the Curriculum.*
24. *Wien, C. A. (2008). Emergent curriculum in the primary classroom: Interpreting the Reggio Emilia approach in schools. New York: Teachers College Press.*
25. *Zini, M. (2024). "Dialogue between Pedagogy and Architecture", Hadeeth ad-Dar, DAI quarterly journal*
26. *Zuccoli, F. (2018). "Educare al colore: una riflessione su alcuni autori tra Ottocento e Novecento in Italia. Le figure di: Corrado Ricci (1858-1934), Giuseppina Pizzigoni (1870-1947) e Maria Montessori (1870-1952)" in Marchiafava V., & Luzzatto L. (eds), Colore e Colorimetria. Contenuti Multidisciplinari, p. 302-311.*
27. *ZPZ Partners. (s.d.). Nido e Scuola dell'Infanzia ENI. [Online] Available at: https://zpz-partners.squarespace.com/nido-e-scuola-infanzia-eni [Accessed 10 January 2024]*

# Enhancing Healthcare Systems: Redefining Strategies and Stakeholder Engagement for Community Care Service Evolution

*Federico De Luca, Daniela Sangiorgi*
*federico.deluca@polimi.it, daniela.sangiorgi@polimi.it*

*Politecnico di Milano, Italy*

***Keywords:***
*Community Care*
*Primary Care*
*Service Design*
*Service Delivery*

## Abstract

The optimisation of healthcare systems has become necessary due to the impact of an ageing population and the prevalence of chronic diseases, prompting a fundamental shift in healthcare strategies. This transformation highlights a departure from traditional hospital-centric care towards territorial healthcare delivery models such as primary and community care services. These innovative models aim to broaden service provisions by incorporating preventive measures and diverse services, emphasising community centrality, adaptability, and resilience.

The focus on tailoring services to user needs has encouraged local institutions to engage various stakeholders. This inclusive approach primarily aims to expand research efforts and conduct a thorough analysis of the specific conditions prevailing within a given region. Stakeholders include healthcare organisations, local entities, universities, and other relevant parties. The ultimate goal is to foster a more comprehensive and participatory approach in evaluating and identifying community needs, ensuring diverse and multidisciplinary engagement to address local challenges and demands effectively.

However, while the concept of co-design remains integral during the initial phase of service development, its actual implementation often risks losing significance, potentially undermining shared participation and cooperation among stakeholders. This lapse might lead to a lack of ongoing dialogue essential for adapting services to evolving needs and redistributing responsibilities.

This study, centred around an Italian case, examines this gap and raises pivotal questions: What role does design assume in facilitating autonomous updates of services post the design phase? How can service design actively support stakeholder autonomy in the continuous evolution of services?

## Introduction

Over the past two decades, the engagement of patients and citizens in health and social care has gained considerable traction (Gheduzzi et al., 2021). As Osborne et al. (2015) emphasized, among various forms of public involvement, co-production has emerged as a potential solution for numerous organizational challenges, particularly within the health and social care sectors. Co-production entails the collaboration between users and provid-

ers in designing and delivering public services, fostering a partnership to enhance public value creation (Osborne et al., 2016).

Service co-production exhibits distinctive characteristics when applied to healthcare. Firstly, there is no one-size-fits-all approach to health services co-production (Farmer et al., 2018); instead, customized solutions should be devised to address the specific health needs of diverse patient populations (Palumbo & Annarumma, 2018). Additionally, implementing co-production of care services can be challenging in many instances due to either resource constraints or insufficient individual capabilities (Ibid).

The co-production of health services necessitates an empowerment process that fosters patient partnerships with healthcare professionals, moving beyond the traditional recipient-provider model (Palumbo & Annarumma, 2018). Despite its complexity, patient empowerment essentially entails equipping patients with the awareness and tools necessary to maximize the benefits of available healthcare services (Bailo et al., 2019). This heightened awareness of their role within the healthcare system naturally leads to a greater willingness among patients to actively engage in the design and delivery of care (Krist et al., 2017).

Patient empowerment entails acknowledging patients as integral contributors to the healthcare service system, functioning as 'co-producers of health' alongside healthcare professionals (Polese et al., 2016; Minheere et al., 2023). Healthcare providers serve dual functions: as enablers, encouraging patient participation in care provision, and as catalysts, stimulating patient willingness for involvement (Broadhurst & Broadhurst, 2022).

While patient empowerment has faced ambiguity, scholarly literature consistently underscores the advantages of co-producing health services (Palumbo & Annarumma, 2018). However, Plé and Cáceres (2010) offer a word of caution, suggesting that an overly optimistic view of service co-production may overlook the potential for value co-destruction rather than co-creation. Value co-destruction occurs when conflicting perspectives and incongruent inputs from both users and providers lead to the misallocation of resources during service encounters (Lumivalo et al., 2023). This misallocation can happen accidentally or intentionally, presenting significant risks in healthcare, particularly as patients may lack the requisite knowledge and expertise for effective participation (Keeling et al., 2021).

In particular, after the service is designed, co-production may become challenging to maintain and update in response to organisational, regulatory, and health changes, especially when the facilitators of the co-design process are no longer present. This paper aims to reflect on the factors that may influence service co-production both before and after the design phase.

## Methodology

This exploratory study, conducted as part of an interdisciplinary Ph.D. research initiative, involves collaboration between the design and management engineering departments at Politecnico di Milano. Ethical approval for this study has been obtained from the Ethics Committee of the ASST Spedali Civili di Brescia. The study seeks to explore the role of informal organizational structures in co-producing and innovating health services while also reflecting on critical aspects emerging from the service delivery phase.

Based on a review of literature on living labs, we conducted semi-structured interviews with key stakeholders involved in or collaborating with a local lab known as Brescia Co-Lab. This qualitative research, part of the Recovery.Net project, explores co-designed and co-produced mental health services within the local community. Brescia Co-Lab serves as a connecting platform between psychiatric services and the community, facilitating collaborative experimentation with users, family members, local actors, and

service providers. The PhD research aims to pinpoint factors that promote successful co-production between formal and informal care, offering design strategies for potential implementation in diverse settings.

This preliminary study aims to address the following research questions:

RQ1: What role does design assume in facilitating autonomous updates of services post the design phase?

RQ2: How can service design actively support stakeholder autonomy in the continuous evolution of services?

The research engaged a diverse array of participants. Initially, the director of Operational Unit No. 23 provided insights during the project's start, shedding light on the unit's structure, CoLab's role within the system, and its overarching vision. Following this, interviews were conducted with professionals such as a social and health educator, a psychologist, and a nurse coordinator from Unit No. 23. These discussions delved into their experiences in mental healthcare, involvement in CoLab's evolution, and their intermediary role with healthcare providers. Additionally, insights were gathered from a psychiatric rehabilitation technician, a psychologist within CoLab, and two Co-Lab Torre Cimabue managers, exploring operational processes, CoLab dynamics, identified gaps, and prospects.

Moreover, the study involved three "experts by experience" who had transitioned from traditional psychiatric services to Recovery within CoLab. Informal interviews aimed to foster open dialogue with these users. Conversely, semi-structured interviews were conducted with healthcare professionals, covering various aspects, including personal experiences, perceptions of CoLab, contributions to its development, involvement of formal and informal actors, and integration within Unit No. 23. The data analysis identified seven organizational dimensions that characterize CoLab's role in facilitating mental healthcare co-production with informal resources. These dimensions were further distilled into seven factors facilitating co-production with informal resources during service delivery. The discussion emphasizes the importance of these factors as a reference point for enhancing service design approaches to co-production.

We also scheduled a workshop and a survey with the clinicians to envision the CoLab within their work and explore ways to strengthen operational activities to enhance collaboration and better integrate synergies. However, despite customizing the data collection to their needs, their participation could have been more positive, as they canceled the event.

*Table 1. Role of interviewees and duration*

| **Role** | **Duration** |
|---|---|
| Director of Operational Unit No. 23 | 60 mins |
| Co-Lab manager | 90 mins |
| Community manager | 90 mins |
| Social and health educator | 70 mins |
| Psychologist (Unit No. 23) | 60 mins |
| Nurse coordinator | 60 mins |
| Psychiatric rehabilitation technician | 60 mins |
| Psychologist (CoLab) | 35 mins |
| User 1 (female) | 60 mins |
| User 2 (male) | 60 mins |
| User 3 (male) | 60 mins |

## Exploring the function of territorial laboratories in co-production: a study of the Recovery Co-Lab

The Brescia Co-Lab Torre Cimabue in Italy, one of four Recovery Co-Labs in Brescia and Mantova provinces, was created during Recovery-Net (2018-2021) to address mental healthcare challenges. Situated in the socially fragile San Polo district, Recovery Co-Labs aimed to transform mental healthcare towards community-based psychiatry. They stimulate institutional change, support innovation projects, and foster social inclusion for patients. The project identified three lab typologies: innovation labs focusing on service and cultural change (Carstensen & Bason, 2012), living labs emphasizing open innovation and user engagement (Westerlund & Leminen, 2011; Almirall & Wareham, 2008), and community hubs promoting social inclusion and cultural activities. The Recovery Co-Lab incorporates elements from these labs, fostering a recovery-oriented approach through collaborative design with users, caregivers, volunteers, and citizens. It facilitates partnerships between healthcare, social services, and the community, enhancing access to resources and developing awareness initiatives. As inclusive spaces, Recovery Co-Labs serve as hubs for mental health governance. Created through a co-design process facilitated by a design team from Politecnico di Milano (Sangiorgi et al., 2021), they continue to evolve in implementation and service delivery.

## 1.The co-design process of Co-Lab Torre Cimabue

The Co-Lab Torre Cimabue's design process consisted of four primary stages: a scenario development workshop across diverse territories, contextual research focused on San Polo to inform subsequent design based on identified needs and opportunities, a localized idea generation workshop specific to the Co-Lab in Brescia for selecting and refining the vision for this lab, and a detailed specifications workshop encompassing activities, roles, and spatial layout (Sangiorgi et al., 2021).

The choice of the Cimabue Tower in San Polo as the location for the territorial lab was informed by its diverse inhabitants, including older adults, foreign families with children, individuals supported by social services, and those with mental health concerns managed by a social cooperative. The initial co-design workshop involved various stakeholders, including service providers, patients, project partners, volunteers, and voluntary organizations, envisioning potential scenarios for future territorial laboratories based on research on different types of labs. Four scenarios were developed and visualized through storyboards.

Subsequently, an extensive two-month contextual research phase was conducted in the neighbourhood surrounding the Cimabue Tower to identify challenges and opportunities for incorporation into the co-design process. This involved interviews with local actors and contextual observations. To ensure effective engagement, a two-day training program introduced participants to design methodologies and research methods. The second workshop revisited the scenarios, aligning them with neighbourhood needs and resources. Feedback from community actors was requested, leading to the development of a unified scenario. Ongoing dialogues with local institutions culminated in a proposal to the city council for future management of the Co-Lab space. The third workshop focused on defining how Co-Lab Torre Cimabue's activities could address mental health needs effectively, resulting in a summary document outlining spatial configurations, activities, and roles. Despite challenges with tower access and bureaucratic procedures, efforts were made to design the physical space while consolidating

the governance model, integrating representatives from key stakeholders involved in the project.

## 2. Analysing the implemented co-production model: shifting from Recovery Co-Lab to Co-Lab Torre Cimabue

After the design phase, local institutions, users, voluntary organisations, and operators expressed interest in continuing the project, prompting the health provider to recognise the potential of the Recovery Co-Lab. Consequently, the initiative evolved into CoLab Torre Cimabue and began the process of integration into services, officially acknowledged by the regional government (Regione Lombardia) as an innovative psychiatry programme. Implemented by the Department of Mental Health and Addiction of ASST Spedali Civili of Brescia, specifically Psychiatry Operating Unit No. 23, CoLab Torre Cimabue serves as a flexible hub offering various services to promote mental health and psychosocial well-being, including counselling, training, and territory mapping initiatives. While some activities have become routine, others are still in early stages, like the mapping of local resources, which holds promise for service enhancement by empowering users and promoting community connections. However, integration with other healthcare services remains a work in progress, requiring adjustments to align with bureaucratic regulations. Despite challenges, CoLab Torre Cimabue has made significant strides in establishing itself within the community, offering educational courses, group activities, and workshops, thereby improving integration with formal and informal care services. Interviews have highlighted factors supporting this collaboration.

## Data analysis

The CoLab facilitates a transition from clinical to community perspectives on mental health, integrating resources beyond healthcare into the rehabilitation process, promoting a sense of community and inclusivity. Experimentation with recovery initiatives and engagement with various user groups underscore the importance of adapting services to meet diverse needs. A dedicated physical space and committed social operators foster integration and reduce stigma, while horizontal relationships and inclusive decision-making promote collaboration and mutual respect. Despite challenges, maintaining open communication channels and engaging in urban regeneration efforts enhance community participation and integration.

These dimensions highlight pivotal factors—Time, Value, Participation, Co-design, Scale, Space, and Attitude—crucial for effective co-production, bridging the gap between service design and delivery and fostering transformative impacts in mental healthcare. To address RQ1, we differentiate the various factors into two phases: co-design (occurring during project construction) and co-delivery (occurring during service delivery, post-launch).

Coordination and continuity, pivotal elements of health integration (WHO, 2018), show an imbalance between the co-design and co-delivery phases. Challenges persist during delivery phases when integrating informal co-production into a more cohesive practice. While informal relationships enhance intervention effectiveness, they're difficult to replicate elsewhere. From the health provider's standpoint, organizational structures, workforce, and task management require adjustment to accommodate a dynamic environment with limited regulatory frameworks. Integrating service design into engagement and co-creation processes can alleviate challen-

ges by enhancing communication, maintaining cohesion, and safeguarding against the dehumanizing aspects of formal organizations (Wu et al., 2021). To foster service development within Co-Labs, service design should adopt a dynamic approach that addresses contextual needs, promotes exchange, and facilitates new relationships. This approach has been most effective with volunteers, patients, and social-health professionals during both the design and delivery phases.

*Table 2. Factors of co-producing mental healthcare with informal resources during service design and service delivery*

| Factors | Co-design | Co-delivery |
|---|---|---|
| Time | Defined to specific objectives | Flexible and adaptable to the context needs |
| Value | Convergent with design objectives | Dynamic and constantly changing with respect to the diversity of actors |
| Participation | Formal design-oriented and mediated by clinicians | Informal and based on an individual engagement and relationship toward equitable relationships |
| Co-design | Functional programming activity essential for the solution | Integrated in the continuous processes of engagement and co-creation |
| Scale | Replicable tools based on contextual needs | Subjective to individual motivation and proactivity |
| Space | Dedicated and flexible spaces in the neighborhood | Fixed and reference space to the clinical services and the community |
| Attitude | Exploratory toward idea generation and service specifications | Experimental toward recovery oriented and co-produced initiatives |

## Conclusions

Emerging organizational dimensions and service delivery factors emphasize the need for ongoing, adaptive processes that respond to evolving needs and promote dynamic interactions. Achieving the potential discussed in the paper entails active community engagement and collaboration with formal resources, avoiding stagnation and isolation. While service co-production systematically occurs within the CoLab and involves the local community, extending this involvement to traditional mental health services faces challenges due to hierarchical structures and logistical constraints.

Recognizing territorial labs as integral components of clinical pathways, rather than isolated projects, requires a systemic vision that acknowledges the interconnectedness of individual roles. While contextual and personal factors influence the integration of new approaches, considering these dimensions in co-design and co-delivery integration can facilitate the establishment of territorial workshops for co-production.

However, the main challenge remains the engagement of clinicians. During our study on the service delivery, while it was easy to interact and interview the social care staff, we found a lot of difficulties in interact with clinicians. They declined the opportunity for an interview due to scheduling conflicts. Initially, a co-design workshop was planned during their weekly meeting to facilitate data collection, but it was canceled after the preparation phase in favor of conducting a survey. Despite the submission of the survey, they subsequently canceled the event altogether.

Despite employing personalized search tools and maintaining a high degree of flexibility, encouraging participation in activities aimed at experimenting with new service models remains challenging within stakeholders characterized by clearly defined responsibilities and tasks.

## Acknowledgments

We want to express our sincere gratitude to the operators and staff of Colab Torre Cimabue of ASST Spedali di Brescia and the patients who participated in this study. Their valuable contributions and cooperation have been essential in shaping and enriching our research.

## References

1. *Almirall, E. & Wareham, J. (2008). Living Labs and Open Innovation: Roles and Applicability. The Electronic Journal for for Virtual Organizations and Networks. 10. 21-46. Retrieved February 1, 2024, https://www.researchgate.net/publication/272566792_Living_Labs_and_Open_Innovation_Roles_and_Applicability.*
2. *Bailo, L., Guiddi, P., Vergani, L., Marton, G., & Pravettoni, G. (2019). The patient perspective: Investigating patient empowerment enablers and barriers within the oncological care process. Ecancermedicalscience, 13. https://doi.org/10.3332/ECANCER.2019.912*
3. *Broadhurst, K., & Broadhurst, K. (2022). Contextualising co-production and complex needs: Understanding the engagement of service users with severe and multiple disadvantages. Public Policy and Administration, 2022(0), 095207672211222. https://doi.org/10.1177/09520767221122277*
4. *Farmer, J., Taylor, J., Stewart, E., & Kenny, A. (2018). Citizen participation in health services co-production: a roadmap for navigating participation types and outcomes. Australian Journal of Primary Health, 23(6), 509–515. https://doi.org/10.1071/PY16133*
5. *Carstensen H.V., Bason C. (2012) Powering collaborative policy innovation: can innovation labs help? Innov J: Public Sect Innov J 17(1):2–25 Retrieved February 1, 2024, https://www.researchgate.net/publication/265349491_Powering_Collaborative_Policy_Innovation_Can_Innovation_Labs_Help.*
6. *Gheduzzi, E., Masella, C., Morelli, N., & Graffigna, G. (2021). How to prevent and avoid barriers in co-production with family carers living in rural and remote area: an Italian case study. Research Involvement and Engagement, 7(1), 1–13. https://doi.org/10.1186/S40900-021-00259-0/FIGURES/1*
7. *Keeling, D. I., Keeling, K., de Ruyter, K., & Laing, A. (2021). How value co-creation and co-destruction unfolds: a longitudinal perspective on dialogic engagement in health services interactions. Journal of the Academy of Marketing Science, 49(2), 236–257. https://doi.org/10.1007/S11747-020-00737-Z/TABLES/4*
8. *Krist, A. H., Tong, S. T., Aycock, R. A., & Longo, D. R. (2017). Engaging Patients in Decision-Making and Behavior Change to Promote Prevention. Studies in Health Technology and Informatics, 240, 284–302. https://doi.org/10.3233/978-1-61499-790-0-284*
9. *Leminen, S. & Westerlund, M. & Nyström, A.G. (2012). Living Labs as Open-Innovation Networks. Technology Innovation Management Review. 2. 6-11. https://doi.org/10.22215/timreview/602.*

10. *Lumivalo, J., Tuunanen, T., & Salo, M. (2023). Value Co-Destruction: A Conceptual Review and Future Research Agenda. Journal of Service Research. https://doi.org/10.1177/10946705231177504/ASSET/IMAGES/LARGE/10.1177_10946705231177504-FIG1.JPEG*
11. *Minheere, A., Lambrechts, W., Mampaey, J., Stough, T., Caniëls, M. C. J., & Semeijn, J. (2023). Patient Power and Empowerment: Mitigating Elements of Valuable Patient Participation in Healthcare Collaboratives. Behavioral Sciences 2023, Vol. 13, Page 347, 13(4), 347. https://doi.org/10.3390/BS13040347*
12. *Osborne, S. P., Radnor, Z., Kinder, T., & Vidal, I. (2015). The SERVICE Framework: A Public-service-dominant Approach to Sustainable Public Services. British Journal of Management, 26(3), 424-438. https://doi.org/10.1111/1467-8551.12094*
13. *Osborne, S. P., Radnor, Z., & Strokosch, K. (2016). Co-Production and the Co-Creation of Value in Public Services: A suitable case for treatment? Public Management Review, 18(5), 639–653. https://doi.org/10.1080/14719037.2015.1111927*
14. *Palumbo, R., & Annarumma, C. (2018). Empowering organizations to empower patients: An organizational health literacy approach. International Journal of Healthcare Management, 11(2), 133–142. https://doi.org/10.1080/20479700.2016.1253254*
15. *Palumbo, R., & Manna, R. (2018). What if things go wrong in co-producing health services? Exploring the implementation problems of health care co-production. Policy and Society, 37(3), 368–385. https://doi.org/10.1080/14494035.2018.1411872*
16. *Plé, L., & Cáceres, R. C. (2010). Not always co-creation: Introducing interactional co-destruction of value in service-dominant logic. Journal of Services Marketing, 24(6), 430–437. https://doi.org/10.1108/08876041011072546/FULL/PDF*
17. *Polese, F., Tartaglione, A. M., & Cavacece, Y. (2016, September). Patient empowerment for healthcare service quality improvements: A value co-creation view. In Proceedings of the 19th Toulon-Verona International Conference Excellence in Services, Huelva, Spain (pp. 5-6).*
18. *Sangiorgi, D., Lucchi, F., Carrera, M. (2021). Recovery Co-produzione e Design: progettare nuovi percorsi e sistemi per I servizi di salute mentale. Libraccio Editore. Retrieved February 1, 2024, https://www.libreriauniversitaria.it/recovery-co-produzione-design-progettare/libro/9788885619340.*
19. *Westerlund, M. & Leminen, S. (2011). Managing the Challenges of Becoming an Open Innovation Company: Experiences from Living Labs. Technology Innovation Management Review. 1. 19-25. https://doi.org/10.22215/timreview/489.*
20. *World Health Organization. (2018). Continuity and coordination of care: a practice brief to support implementation of the WHO Framework on integrated people-centred health services. (n.d.). Retrieved March 8, 2024, from https://www.who.int/publications/i/item/9789241514033*
21. *Wu, F., Dixon-Woods, M., Aveling, E., Campbell, A., Willars, J., Tarrant, C., Bates, D. W., Dankers, C., Mitchell, I., Pronovost, P., & Martin, G. P. (2021). The role of the informal and formal organisation in voice about concerns in healthcare: A qualitative interview study. Social Science & Medicine, 280, 114050. https://doi.org/10.1016/j.socscimed.2021.114050.*

# POLICY AND GOVERNANCE

# The Project of ethical visions for new enterprises in the South[1]

*Rosa Pagliarulo*
*rosa.pagliarulo@poliba.it*

*Politecnico di Bari, Italy*

***Keywords:***
*Research*
*Innovation*
*Environmental and Social Sustainability*

## Abstract

Many of the Southern business realities are stories of families that cherish the memory and the tradition of know-how rooted in work activities that are reiterated and handed down from generation to generation. Sometimes, however, certain stories take on embellishments that twist an already known script. The tension to bypass the localist dimension becomes the flywheel to enter a network of global exchange. Such is the case of Andriani s.p.a. The activity conducted by the company is taken as a paradigm of Made in Italy to represent the vision of an enterprise, which has been able to combine, with a crystalline attention, the local culture of an agricultural tradition devoted to the production of cereals and legumes, with national and international market demands, establishing a policy of corporate research and development consistent with cross-border policies on conscious and responsible production. Today Andriani is a Benefit company recognized among the international excellences in the Innovation food sector and is among the 20 B-Corp certified Italian companies in the agri-food sector that are part of a global community of companies with high standards of social and environmental impact.

## Introduction

The paper aims to offer a critical investigation on the how innovation processes are interpreted in peripheral territories, particularly in Southern Italy[2]. The focus is on those entrepreneurial and creative practices that have taken a new course, adherent to cross-border policies and in favor of a greater awareness of their ethical responsibilities.

The desire to testify to their culture and the tension to emancipate their original condition, with sustainable and innovative approaches, are some of the values that are animating the new entrepreneurs of the South. In re-interpreting ancient practices, such as agriculture, they are committed so that their production bypasses the localist dimension and enters a global network of exchange. The mentioned values are combined with other values related to them, defining meaning-filled relationships that bring depth and complexity to the themes of belonging, identity, and socio-cultural rescue. The theme of belonging draws together connections of meaning that refer to the recognition of a relationship with its territory and the development of a consciousness that protects it, in other words, an environmental conscious-

ness. And the environmental consciousness allows to shift the view from a simplistic vision of separation between Nature and Culture, to an integrated and balanced approach between the natural sphere and human life. The transformation of things that nature provides to make, other than their primary function, is aimed to restore a relationship with Nature and productive cycles, according to the balances and rhythms of respect protection and care of the life cycle of the plant world and living beings that does not want to be interrupted by anthropocentric actions. After cutting our connections with the natural world in a fast speed, through actions that have deforested, driven to extinction, drilled, mined, fertilized, dug up, flattened mountaintops and transformed our planet it is necessary to intervene with calibrated actions to repair those connections. And it has become necessary to express how we interpret our position in relation to the universe. A significant survey of a wide range of links that connect humans to their environments (economic, social, cultural and political) and to other species (animals, plants, microorganisms or the interrupted tree of life) has been offered by the XXII Milan Triennale, Broken Nature: Design Takes on Human Survival.

> The exhibition enhances the importance of creative practices (of design) as a way of repairing both human activities and behaviors that impact life in all its forms. Turning its attention to the existence and permanence of (human) life on the planet, the XXII Triennial enhances the importance of creative practices in analyzing our species' connections to the complex systems of the universe, and in designing repairs in the form of artifacts and concepts ranging from interfaces to objects, buildings, systems and infrastructure. (Antonelli, P.,Tannin A., 2019, p.19).

Man has always exercised his creativity practice to adapt and domesticate the universe to his goals, placing the human species at the center, according to an anthropocentric vision. The contribution intends to share attention toward enlightened entrepreneurial practices that reactivate connections in order to attempt a reconciliation in the future with the environment.

The projects of new entrepreneurs between responsible growth and sharing values. In Italy, and especially in the south, many companies are family-owned, and each one tells stories of how the choices and paths taken are intertwined with the cultural history of the area of establishment.

*Figure 1. Frame composition of Terre Bradaniche, in the southern Italy, in Apuglia, Rosa Pagliarulo, 2022, from the Thesis: Exhibit | New Enterprise Museums: Intangible visions between local culture and global production*

Many of the entrepreneurial realities of the south are stories of families who cherish the memory and tradition of a savoir-faire rooted in work activities that are reiterated and handed down from generation to generation.

Sometimes, however, certain stories take on embellishments that twist an already known writing. This is the case of Andriani s.p.a. based in Gravina di Puglia, a company with a history that is told from just two generations, father and sons, where tradition becomes acquired memory, because it is recent, but at the same time it is the bearer of values rooted in the territorial culture of the southern suburbs. The interest to the company focuses on the mindset that drives its activity, tangibly committed on making its own significant contribution in the areas of research, innovation and commitment to economic, environmental and social sustainability.

Andriani's story is now in the midst of its writing, and it is as intense as compelling, and constantly accelerating. The history of the company is first and foremost about its people, those who founded it, those who lead it today, and those who by working share its entrepreneurial project. The company is founded in 2001 by Felice Andriani, who, after training abroad, puts the experience gained in Uzwil, Switzerland at the Bühler company to good use with the work carried out in the design, construction, assembly and maintenance of the main traditional pasta factories existing in the Italian national territory. The recognition of local and national scale of market needs, brings out the need for the production of a new type of pasta: gluten-free pasta. However, there are insufficient mills for production; moreover, the products on the trade are not very tasty and have a low nutritional level.

Thus, Gravina becomes the setting for gluten-free pasta production, lacking gluten, in other words, the structural binder for which complex processing is required. In 2004 Molino Andriani was founded with the goal of designing, developing and producing a complete range of gluten-free pasta.

The first five production lines were created from supply chains traced and controlled by Andriani itself. The raw materials used in the beginning are yellow corn and white rice.

The first production is intended only for outsiders, including Barilla, the most important in the company's growth. An important stage in the company's history takes place in 2007, when Felice Andriani leaves the leadership of the company to his two sons Michele[3] e Francesco, who carefully study the international market by tracking down new consumer needs and new market trends[4].

The transfer of management from the father to the sons shifted the family-based business model toward a nontraditional model of economic development, aimed at innovation processes according to circular and sustainable entrepreneurship.

The concept of innovation, which in Felice Andriani's entrepreneurial policy is focused especially on the technology of cutting-edge machines both for the South and for Nation, in the generational transition to his sons is rooted in the thought that inspires the idea of business itself: innovation is translated into building progressively the stages of a sustainable and circular economy that is aimed to combine the benefits of economic growth with benefits for the environmental and social welfare. The enlightened vision held by Michele Andriani is aware of an education that took place in international university classrooms and is inspired by the lessons of the new economic model of Belgian Gunter Pauli, promoter and advocate of the Blue Economy. The terms of sustainability and circularity focus on actions that become the mainstay of the new policy, aimed at local area enhancement, food traceability, smart agriculture, food safety and education, and the well-being of people and local communities. As Michele Andriani declares:

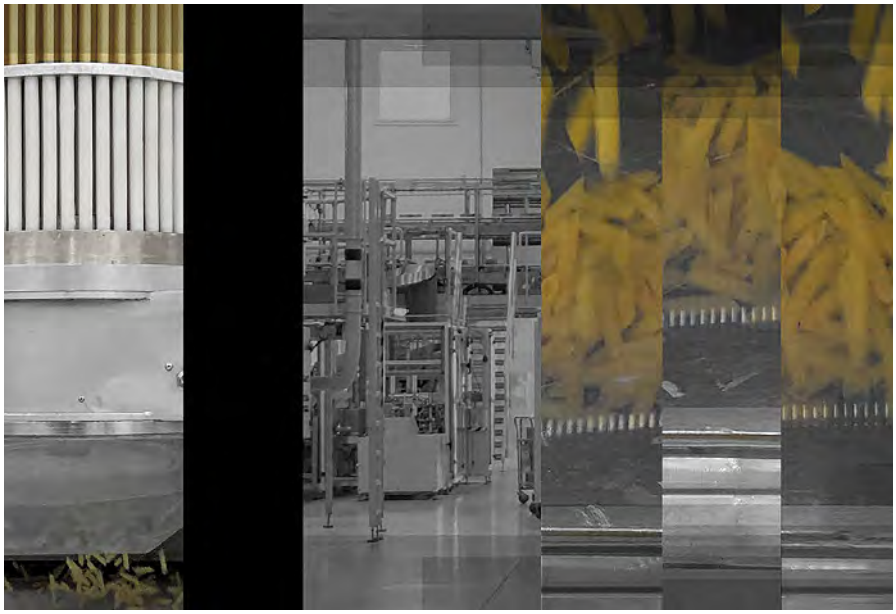


*Figure 2. Composition of frames of the production process of the Andriani company, Rosa Pagliarulo, 2022, from the Thesis: Exhibit | New Enterprise Museums: Intangible visions between local culture and global production*

> *Guided by the desire to promote the concept of protecting welfare, for consumers, for the environment, for the territory, in 2009 we launched the company, focusing on transforming into the typical and traditional pasta format some naturally gluten-free raw materials, such as cereals and legumes, to bring to the table a dish rich in valuable nutritional elements and with surprising taste. And the market has given us proof. Thanks to the technical partnership with Buhler Group, in 2013 we built the 100% allergen-free factory among the largest in Europe, and in 2016 we inaugurated our "Multi- Grain" milling plant[5]. Today we are suppliers to the world's leading brands in the industry, and we also preside over the market with Felicia, our own brand, which excels in the sector because of its wide assortment of recipes and formats and its organic identity. In addition, we export our products to more than 30 countries and preside over the most important distribution chains internationally[6].*

The company, with a deep sense of responsibility, has chosen to act in a concrete manner through projects that can redistribute value and prosperity to the territory and communities. Today the projects have a focus on 5 areas of impact, including: production chain, with monitoring of the impact of crops on the environment and biodiversity, through sustainable and precision agriculture; consumer health and well-being, through the promotion of food culture and awareness; enhancement of the territory, collaborating and supporting local realities; circular economy, through the saving of available resources such as the 800,000 liters of water recovered from the production process and reused annually for the production of Spirulina Algae; mitigation of climate change, through an ambitious path aimed at achieving Carbon Neutrality which in 2021 avoided the emission of approximately 11,000 tonnes of CO2eq; creation of group identity and positive work environment, thanks to training programs and well-being activities .

Each activity introduced by the company has opened up complex project scenarios over time that have faced the need for investments and measurable goals.

One of the first steps that stigmatizes and verifies, at the same time, the new ethical vision of the company is the adhesion in 2018 to the United Nations Global Compact as Signatory: the signing of a 'Global Pact' between

companies and United Nations in order to address, in a collaborative logic, the most critical aspects of globalization. The commitments undertaken by Andriani s.p.a. by joining the UN Global Compact are to integrate the principles into the company's strategy, culture and activities, disseminate them and communicate them to its stakeholders with the annual Communications On Progress ( COPs ). The company has also established a dense network of relationships to enhance dialogue with stakeholders by involving them in a continuous exchange of knowledge on products, production processes, production chains, sustainable and socially responsible behaviour. In 2018, one action that responds to the commitment for the Global Compact is to join the Sustainable Agriculture Initiative Platform, the largest global platform in the agribusiness supply chain, whose mission is the development of sustainable agricultural practices. It is a nonprofit organization that connects entities operating in the agribusiness sector through the sharing of best practices on sustainability implemented internationally.

At the Sustainable Agriculture Initiative Platform, Andriani joins with the project of a legume chain, controlled and sustainable: the Terre Bradaniche chain. It aims to optimize cultivation specifications, both for integrated and organic production, and to achieve sustainable production in order to safeguard the soil and the environment, ensure food safety, and optimize the profit of all operators in the food chain. Relevant fact is that the supply chain involves about two hundred agricultural enterprises especially from Puglia and has reached over five thousand hectares of land throughout Italy dedicated to the cultivation of peas, red, green and black lentils and chickpeas, as well as experimental fields of chickling peas.The Terre Bradaniche project, carried out in response to the 15th Sustainable Development Goal of the UN Agenda 2030, intervenes with a specific technical approach based on scientific parameters with a goal of reducing CO2 emissions, increasing production yields and reducing costs. Considering the growing consumption of legumes, Andriani s.p.a. has set itself the goal of alternating, on the Italian territory, cereal production with legume crops and providing the supporting tools such as Legumi.net, a system developed by Hort@. The latter is a spin-off of the Catholic University of the Sacred Heart with six offices in Italy, which provides consulting and services in the field of vegetable production, aimed at increasing the competitiveness of agricultural and agri-food enterprises. In this sense, Hort@ stands as an interlocutor capable of transferring technological innovation to productive realities operating in the field of agricultural crops. In this sense, Legumes.net aims to offer information related to crop management and consists of an integrated system for real-time environmental monitoring and data storage. Equipped with an app, the portal analyzes this data and provides real-time information to support farmers in deciding the most appropriate subsequent processing. The in-depth and widespread attention to the benefits of the environment has its correspondence in the search and implementation of social well-being for consumers and workers. From this perspective, initiatives are born aimed at the quality of life of employees as well as the structure that hosts them. The Andriani Wellness project offers a series of physical activities to reduce work stress and improve work-life balance.

Carrying out motor activities within the work environment allows for better interaction between the personal life space and the workspace. The Bike to Work project follows the same logic, according to which the company provides its employees with eighty-five e-bikes, encouraging them to have a healthy and ecological lifestyle. To encourage the use of the bicycle, based on the counting of kilometers relating to the home-work journey, the

employee is awarded a bonus which is paid directly into the pay slip. With the intention of continuing with new corporate welfare initiatives, Andriani introduces the Arts Academy in 2019. The project involves the activation of expressive arts courses aimed at the children of employees to direct children aged between four and eighteen towards the artistic forms that are most congenial to them.

The Andriani Educational project is conceived for children and their families, it is addressed in particular to elementary school in the local, and national territory. The initiative promotes a healthy lifestyle, respectful of health and the environment, at the table and in everyday life, to create "sustainable" habits aimed at generating well-being, using tools capable of arousing students' interest and curiosity. The pathway features legumes used in cooking and garden workshops, research and in-depth studies based on vegetables and oats. Also in 2020, it launches a partnership with ApuliaKundi, a young start-up from Puglia that produces spirulina algae defined by the FAO as the "food of the future." The spirulina produced by ApuliaKundi in cooperation with Andriani, which is 100 percent Italian, natural and organic, is grown in a controlled environment to ensure the highest quality standards. The microalgae, after being harvested from production tanks through very narrow mesh filters, is pressed, extruded and cold-dried in order to preserve its nutritional characteristics. Subsequently, some of the raw material is used by Andriani as an ingredient in the production of organic pasta under the Felicia brand, the other by ApuliaKundi for making other products. During 2020, another piece of the investment project on ethical sustainability was completed: the construction of the Smart Building, the new work headquarters in line with the company philosophy based on innovation and sustainability . It is equipped with eco-compatible offices which, as Michele Andriani says, "are based on the concept of Activity Based Working, to reduce stress by acting directly on the working environment, with initiatives related to time flexibility, smart working, wellness, 'balanced nutrition with personalized nutritional advice and analysis'. Thanks to the collaboration with the Innovatec Power Group, Andriani aims to achieve the self-production of energy equal to that consumed by the plant and the autonomous production of the heat necessary for the pasta making process. In the same year, the transition to a managerial company was started, adopting a new corporate governance regulation to implement increasingly efficient management, and the transformation into a Benefit Company was decided.

A choice that integrates into business activities, goals aimed at both profit and common benefit, operating in a sustainable and responsible way with the will to create and distribute value for all stakeholders. Among the ongoing and most ambitious goals Andriani is pursuing is the path to carbon neutrality: the project that will lead by 2025 to zero carbon dioxide emissions into the atmosphere derived from the plant through complex circular economy investments[7].The change of domain aimed to the common welfare implemented by Andriani over a twenty-year period has led to an extraordinary path of economic growth, dimensional but especially of values representing a significant paradigm not only for large companies but also for small and medium-sized ones, which in our territory have a central and reference role for the social fabric. Investments in innovation and sustainability, the ability to enhance human resources are the objectives that new entrepreneurs in the South and beyond must take into account so that "they are able to imprint the entire business ecosystem, at all levels, with a flexible, inclusive and collaborative mindset based on shared values.[8]"

## Footnotes

[1] The paper elaborates and deepens the Thesis work entitled: Exhibit | New Enterprise Museums. Intangible visions between local culture and global production. Coordinator: Prof. Rosa Pagliarulo. Graduates: V. D'Introno, G. Dellino, F. Farcenio, A. Liso, A. Matera, A. Roscino, G. Zezza. Bari Polytechnic University, Bachelor in Industrial Design. 2022.

[2] The issues investigated in the paper are part of the European Union-funded Project - NextGenerationEU - National Recovery and Resilience Plan (NRP) - Mission 4 Component 2 Investment 1.3 - Notice No. 341 of 15/03/2022 of the Ministry of University and Research. Application protocol PE000004, grant decree No. 1551 of 11/10/2022, CUP D93C22000920001, Made in Italy Circular and Sustainable MICS. SPOKE 7 "New and consumer-driven business models for resilient and circular SCs" P. 5 Research project "Cultural value chains: From local traditional production districts to a new country of origin effect" (coordinator Prof. Annalisa Di Roma)

3] Michele Andriani is President and CEO of Andriani s.p.a., recipient of the "EY Entrepreneur of the Year" award in the Food&Beverage category for his great commitment to sustainability, which has enabled him to combine economic growth with environmental and social protection, with a focus on innovation; Francesco Andriani is Vice President and CEO, founding partner and former executive in charge of the Sales, Marketing & Business Development division of Andriani s.p.a..

[4] https://www.andrianispa.com/wp-content/uploads/2023/10/company-profile-andriani.pdf

[5] The Multi-Grain mill is designed for grinding any grain. Globally it offers the largest number of multi-purpose flours, custom blends of multi-grain flours, bakery preparations, and grains from controlled supply chain. Multi-Grain refers to the making of pasta, flour, and the like using different grains and legumes in a single process. All kinds of naturally gluten-free raw materials such as cereals, pseudo-grains, legumes and ancient grains are processed in the mill, which can be handled on the same cleaning and milling lines. The Multi-Grain mill produces two product lines: natural and pre-gelatinized flours. The latter, are flours obtained from natural, non-chemically treated grains such as wheat, rye, spelt, oats, corn or rice. In addition, through innovative production processes such as extrusion and oven drying, they maintain the flavor and characteristics of the raw materials. Pre-gelatinized flours absorb more water than raw flours, making doughs in baked goods more textured and easily workable, replacing other thickeners and emulsifiers in sauces and soups in ready meals.

[6] https://www.csroggi.org/il-motto-di-andriani-felicita-sul-lavoro-pensiero-positivo/

[7] As Michele Andriani says, "The already completed installation of a trigeneration plant will be followed by the construction of photovoltaic plants. We plan to produce biogas from the process of anaerobic fermentation of biomass. This mixture, undergoing an upgrading process, will become biomethane, and the substances resulting from this transformation will then be reused in this way: the digestate as a fertilizer for the Sustainable Legume Chain of which we are the leader; the biomethane, in liquid form, as a fuel for the trucking of goods; and the recovered CO2, to be used for the production of Spirulina algae. Precisely for the cultivation of algae, in addition to CO2, the previously purified water from the washing of the dies will also be used. In collaboration with Italian universities and research centers, we have also initiated tests and analysis to evaluate the use of algae in food, in the pasta product, and in Pet Food, thus opening up new market segments."

[8] https://www.csroggi.org/il-motto-di-andriani-felicita-sul-lavoro-pensiero-positivo/

## References

1. *Antonelli, P.,Tannin A. (2019). Broken Nature XXII Triennale di Milano, Electa, Milano*
2. *https://www.andrianispa.com/wp-content/uploads/2023/10/company-profile-andriani.pdf*
3. *https://www.csroggi.org/il-motto-di-andriani-felicita-sul-lavoro-pensiero-positivo/*
4. *https://formafuturi.news/2022/02/24/natural-innovators*

# REMANUFACTURING ITALY.
# The role of design in the manufacturing chains of the southern contexts, for the development of territorial cultural heritage, between local archetypes and global connections.

*Domenico Colabella*
*d.colabella@phd.poliba.it*

*Politecnico di Bari, Italy*

***Keywords:***
*Remanufacturing*
*Cultural value chains*
*Process design*
*Textile archive*

## Abstract

"REMANUFACTURING ITALY" is the title of the recent debate launched by design on the prospects for the competitiveness of Made in Italy in the face of the challenges of innovation, resilience and sustainability. Principles of contemporaneity and objectives of the Recovery Plan, to which this research aligns. The metaphor of remanufacturing proposes reparative and regenerative development paradigms in which design "no longer consists in the creation of original products, systems and services, but in the design of memory and the future" (Barucco et al, 2020, p.11). Designing memory means valuing of the historical reputation of MII and its supply chains in relation to the local historical-cultural deposits, the southern contexts of Italy. Designing the future means facing the challenges posed by the connections of global networks to achieve a possible "recycling" and redevelopment of cultural value chains in the competitive contexts of digital, social and circular transition.

## Introduction

The Made in Italy industries are the result of a process of historical and cultural densification of production chains that are paradigmatic for their rootedness in society - embeddedness - which, thanks to social and cultural factors, has encapsulated specific economies of relations, reverberating the multiplicity of territorial identities; from the local production chains with the manufacturing traditions of craft districts to the global networks of modern value chains, today the multi-sense of Made in Italy suffers from problems of competitiveness in the markets, lack of circularity of resources/supply components with a view to sustainability, compromised recognisability and traceability for the protection and certification of the origin of its products. The context in which the research is rooted is that of traditional manufacturing chains that have developed over time the historical reputation of Made in Italy in relation to the territories in which they have been established and where they have inherited values of authenticity and recognisability. The reference framework of this new industrial trend of remanufacturing is one that envisages reparative and regenerative development paradigms - closed-loop-models - to guarantee economic and environmental sustainability, for the benefit of consumers and producers. Design, equipped with the capacity for interdisciplinary action, suggests re-directive practices from the

linear model (take-make-dispose model) ontologically designed on unsustainability, towards circular models (take-make-remade model) designed on future 'sustenance'; in a transdisciplinary key, design can offer meaningful reflections that allow contemporary practices of cultural post-production to be included in remanufacturing, where the project operates in the reconfiguration of the relationships between production and consumption, between virgin material and objects already 'informed' by other objects (Bourriaud, 2005) , outlining original paths between existing signs.

This research explores material culture as a contemporary and participatory production of communities. It focuses on cultural and creative productions that aim to create an open narrative space in global culture. The concept of re-manufacturing moves away from the ideas of authorship and outdated production. In the "post-production era," there is an opportunity to reconfigure existing cultural productions and create new models of representation and meaning. This is done through contextual and relational approaches in navigating contemporary reality as an "archive of information" (Bourriaud, 2010). The relationship between Design and Cultural Heritage has evolved, acknowledging the potential for innovation in industrial paradigms in design and the ability of cultural heritage to transform and adapt through design processes. This allows for the regeneration of the "life cycle of cultural heritage" (Lupo, 2009), protecting and transmitting tacit knowledge and giving cultural heritage new meaning through community practices. The research investigates the relationship between Design and material and immaterial cultural heritage (Unesco and Faro Convention) for the valorisation of Made in Italy, for which Le Costantine Foundation becomes a paradigmatic case of social sustainability. An open project of textile manufacture that from the outset took on a 'relational form' (Bourriaud, 2020) contaminated by the social, political, welfare and emancipationist contextual instances of Salento in the early 20th century. A project that structured an economy of practice rooted in the cultural, professional and friendship relational bonds of the people who lived it to pursue, not only the logic of profit and common good, but above all satisfaction, responsibility and shared memory (Laurenzi, 2018). The research on this case study intends to strengthen the archiving process underway, mapping and archiving those textile artefacts preserved in the private contexts of the heir community, textile artefacts that are widespread, in that they are spread throughout the territory, and whose precise value and difficult archiving is recognised. This is a necessary reconnaissance action to bring to light a heritage that is still not recognised-shared-reactiveted. At the same time, the interaction with the Foundation's archive, recently subject to intervention by the Archival and Bibliographic Superintendency of Apulia, offers the opportunity to deduce the archival and conservative principles and methodologies that have guided the work of analysis, recovery and formation of the fund, and allows this archive to be augmented with technical descriptions of the production processes that have no way of emerging from the simple paper archiving. The analysis and mapping of these artefacts is functional to an action of reverse engineering, the technical and scientific study backwards of the processes that determine those artefacts (Carullo, 2019; Carullo, 2023). A reverse engineering operation on these textile artefacts also intends to document and patrimonialise the production tools and techniques in order to generate an archiving of processes and thus also of tacit and intangible knowledge and their possibility of transmission.

The original methodological contribution of the research, then, would become an action of 're-manufacturing' of textile archives, traditionally structured for cataloguing on a descriptive and object-oriented basis (Craveia, 2018), methodologically implementing cataloguing through the new pro-

cess/manufacturing data that design manages to produce (Carullo, 2020). The production processes studied and re-elaborated on a technical-scientific basis through the analysis of the artefacts and their production contexts, will be able to bring an interdisciplinary value to the themes of protection, so that to the word valorization (Carullo, 2024), we can also add that of re-activation of tradition, also considering the importance of the training activity that characterizes 'La Fondazione'. This research wants to strengthen the work already underway on archiving and bring the archive itself to confront the action that many textile companies in Italy have been doing on their textile artefacts for about a decade, considering these archives also as places of technical and aesthetic reflection of new productions, considering the textile archive as a device between the "knowledge that is no longer ours, from which we are moving away, and what we are becoming and which we are not yet" (Carmagnola, 2016).

## References


1. *Barucco M.A., Bulegato F. and Vaccari A. (2020), 'Remanufacturing Italy. Italy in the age of post-production', Venezia, Mimesis.*
2. *Bourriaud N. (2005), Postproduction. Come l'arte riprogramma il mondo, Milano, Postmedia Books.*
3. *Bourriaud N. (2010), Estetica relazionale, Milano, Postmedia Books.*
4. *Bourriaud N. (2020), Inclusioni. Estetica della capitalocene, Milano, Postmedia Books.*
5. *Carullo R. (2019), Design di processo e imprese artigiane. Verso la costruzione di un modello meridiano, in Design e territori. Università e aziende tra sperimentazione e innovazione, Palermo: New Digital Frontiers srl, pp. 50-65.*
6. *Carullo R. (2020), Ri_conizzazione. From the Encyclopédie to the computational: process diachronies for the perceptual enhancement of conical textile surfaces, in Dischronie. Fashion beyond contemporary phenomena, Barcelona: LIStLab pp. 104-109.*
7. *Carullo R. (2023). Autarchie contemporanee e modelli di sviluppo meridiano. Design e fibre naturali come patrimoni di cultura materiale, in Design e fibre naturali. Territori, materiali, tecnologie, Md Journal Dossier, pp. 29-42.*
8. *Carullo R. (2024). Dal territorio ai corpi. Diacronie meridiane dei processi manifatturieri e nuove percezioni del Made in Italy, in PARD Prospettive del Made in Italy, Melfi: Libria, pp. 294-303*
9. *Craveia D. (lug.-dic. 2018), I campionari tessili: una scheda/sfida per gli archivisti, in Archivi XIII/2*
10. *Carmagnola F. (2016), Dispositivo. Da Foucault al gadget, Mimesis, Milano.*
11. *Irace F., Ciagà G.L, Lupo E., Trocchianesi R. (a cura di) (2013), Design & cultural heritage, Electa.*
12. *Lupo E. (2009), Il design per i beni culturali. Pratiche e processi innovativi di valorizzazione, FrancoAngeli, Milano.*
13. *Lupo E. (2011), Design, beni culturali immateriali e 'attivazione dell'autentico': progettare il valore delle eredità culturali come 'open-ended knowledge system', in: i+diseno 04, pp. 46-56*
14. *Laurenzi E. (2018), Fili della trasmissione. Il progetto delle donne De Viti de Marco – Starace nel Salento del Novecento, Edizioni Grifo, Lecce.*

# Re-Made in ... Locally. The empowerment of regional practice.

*Lisa Hockemeyer[1], Anna Santi[2]*
*lisa.hockemeyer@polimi.it, anna.santi@polimi.it*

*[1]Politecnico di Milano, Italy and Kingston University, UK*
*[2]Politecnico di Milano, Italy*

***Keywords***
*Cultural heritage*
*Material memory,*
*Ceramic industries*
*Inclusive futures*

## Abstract

Museums, archives, and foundations are the places for the conservation of material memory whose enlightening task starts from the objects on display which speak the creative language of making. This joint paper assesses the vital role played by cultural institutions in the preservation and communication of local and regional practices and examines their significance as breeding grounds for todays and tomorrow's industry, businesses, and consumers towards

- Preserving traditions.
- Maintaining and reviving sustainable practices in harmony with local and regional communities.
- Exploring aesthetic languages that communicate Italianness.

Ambitious in scope, this examination departs from Italy's historically vast and aesthetically most heterogenous manufacturing sector, the small and medium scale ceramic industry. Select case studies chosen for juxtapositioning local and regional productive realities with activities of cultural institutions illustrate the benefits of conserving material memory towards strengthening and maintaining cultural identities whilst, amplified by digital circulation, opening to growing communities of users, for rich geographies of exchange and continuous processes of contamination. This paper aims to inspire local, regional, and international communities to reevaluate, conserve and promote historical memory for imagining and building sustainable and inclusive futures that are beautiful for our eyes, minds, and souls.

## Introduction

Producing for the future means not only predicting and developing what does not exist, but more and more looking towards culture-historical roots. This belief is old and at the core of many designers' and business strategies but seems to have gained momentum of late.

The post-pandemic period has highlighted an ever-widening gap between the focus on unfettered, futuristic, often utopian visions that rely on the development of modern, immedi-ate, and digitally projected technologies, and the call for a return to heritages. Whereas the former vision

tends to isolate and disconnect industry, businesses, and consumers from ex-periencing traditions and a sense of community, the latter strives to provide emotional and psychological comfort rooted in history, as a source of inspiration, and viable answers for imagining and building sustainable and inclusive futures.

Many studies and exhibitions of late, including management professor Paola Dubini's study "Con la cultura non si mangia" FALSO or landscape and uban designer Julia Wat-son's Lo-TEK. Design by Radical Indigenism have emphasised the values that lie within cul-tural patrimonies or the need to return to origins to imagine a more just, and economically sustainable future (Dubini, 2018; Watson, 2023). They come from different angles but teach us the same: respect for cultural patronage. Recent exhibitions that, at their turn, packaged these interests differently include The Magnificent Obsession (MART, Rovereto, 2012), The Encyclopaedic Palace (Venice Biennale, 2013), the Fundamentals (Venice Biennale, 2014) and Broken Nature (XXII Triennale Milan, 2019). This trend concludes with last year's 18th International Architecture exhibition at the Venice Biennale, The Laboratory of the Future (2023), curated by architect and writer Lesley Lokko. Many of the proposed themes were dedicated to the restoration of national, regional, and local heritages. Exhibits highlighted themes such as the enhancement of national ethnicities, cultures and customs through visu-al and audio narratives that explored memories in form of objects or natural artifacts as well as materials, techniques, patterns, sounds, and colours rooted in the cultural heritage of the place and its people (Lokko, 2023).

This research, at the origin of a collaborative project, analyses Italian heritage and the central role played by institutional bodies and places such as museum, archives, and foun-dations associated with the geographical locations themselves as institutions dedicated to the collection, preservation, valorisation, and promotion of local material and immaterial memory. It aims to highlight the potential that cultural institutions can play in the develop-ment of regional socio-economic growth and in strengthening social and cultural identities through the preservation and promotion of tangible and intangible memory. It supports the view that cultural institutions act as vital resources to inspire and develop new, cultural, eco-nomically valuable, sustainable, and socially inclusive projects (Dubini, 2018).

The immense and nuanced history of Italy's material culture proves too vast in terms of both merchandise and geography to be considered as a whole. Therefore, this study con-centrates on Italian ceramic production, geographically the most widespread manufacturing sector in Italy and aesthetically the most heterogenous as its production reflects century old techniques and anthropological values, customs, and cultural meanings (Hockemeyer, 2014). Characterized by distinct local and culture-historical traits which are still often recog-nizable in popular, handcrafted or industrially designed and manufactured artifacts today, it makes modern Italian ceramic history an excellent field study to analyse the effectiveness of targeted preservation and promotion of local material memory for future-oriented, sustaina-ble and socially inclusive production models.

An introduction to twentieth century Italian ceramic manufacture highlights its particulari-ties, its history, tradition, varying territorial characteristics and socio-economic and cultural significance that have defined regional communities over centuries. The diversity of these have had a remarkable influence on defining the concept of 'Italianness' in the past and have considerably contributed to the becoming of the Made in Italy ideal. Traditions and lo-cal and regional diversity, it will be shown, were once highly regarded, and celebrated as they offered valuable aesthetic, technical and artistic know-how and inspiration for new yet clearly recognisably Italian products to develop. Many of these have been lost over the years to various socio-eco-

nomic and outside influences including globalisation.

With hindsight at current initiatives named above and those, proposed by the New Euro-pean Bauhaus, this paper supports the assertion that local and regional diversities still im-pact on contemporary society, not only for generating a sense of belonging but to inspire new productive models and social pattens too. This in turn throws up the following question: Are local and regional diversities recuperable, and if so, how? Following a brief insight into the socio-economic and cultural values which once have been attributed to regional and ter-ritorial diversity this contribution will take a closer look at the role played by museums, ar-chives, and foundations as containers and active promotors of culture today. Looking at dif-ferent models, it presents and questions their function towards the protection and preserva-tion of cultural and artistic heritage for showcasing past traditions, customs, and cultures to the next generation. What are their aims and how do they work?

## 1. Italian ceramic production: an inspirational landscape of local diversity

In Italy there are many regional communities, towns and cities characterized by their often centuries-old ceramic manufacture and are defined by them. The historical geography of Ita-ly's artisan ceramic production centres extends across all regions of Italy. In 2019, more than 53 cities of artisanal ceramic production were registered, of which thirteen significant centres are still awaiting official recognition (Irace, 2019, p. 65). When it comes to the number of small and medium-sized manufacturers, Sicily is at the top with 255 workshops, followed by Campania and Tuscany with 196 and 186 workshops respectively. Aesthetically speaking, most of contemporary regional artisanal and small and medium-sized ceramic production betrays centuries-old traditions and local customs, but also modern artistic languages of the twentieth century. These were the result of Italy's Renaissance in this sector post World War II, which was characterized by a synthesis of avant-garde ideals, craft traditions and popular culture, as well as an explosion of artistic activity and research characterized by optimism (Hockemeyer, 2023).

Territorial production differences, including manufacturing technologies, product typolo-gies, raw materials, glazes, and aesthetic features such as colours and decorative subject choices, reflect the vastly differing histories, customs and cultures that distinguish Italy's many societies and communities. In their artisanal and artistic exploration and in the recip-rocal relationship between local ceramists and artists lies the fingerprint of the many aes-thetic languages that characterize Italy's rich and diverse ceramic production and that consti-tute and transmit the concept of Italianness more than any other production range of material culture.

The exploration of many diverse local aesthetic languages that often have their origin in popular and vernacular traditions do not only help to express and preserve local practices and cultural identities. Showing "character, definite individuality and obvious Italianità" have, in the past, characterised the coming of age of the Made in Italy label (Gozzini,1952, pp.54-56).

### 1.1 Yesterdays' regional practices and past advice on staying local for commercialising diversity

The potential of regional and local diversity for socio-cultural and above all economic rea-sons have been promoted before. Historically, Italian ceramics from all regions have played a pre-eminent role in the post-World War II years in the creation of a national identity in ma-terial production that

transcended and brought together many different product types, mate-rials, and aesthetics under the umbrella of an early 'Made in Italy' ideal that has evolved into a well-known commercial brand (Hockemeyer,2014).

Decisive to the profitable export of Italian ceramic wares post World War II was the adher-ence to local and regional aesthetic characteristics, "the sign of tradition, the colour of earth" as Italian ceramics were likened to

"her wine, her therapeutic baths, her poetry and popular songs, all those numerous pecu-liar regional signs for which the 'Bel Pease' is truly a ka-leidoscope of stylistic difference, of ways to feel, of unrivalled richness in artistic ideas [...]" (Gozzini, 1952, p.56).

Following foreign aesthetic trends it was warned, would have adverse effects leading to a swift drop in exports.

Besides italianità and signs of tradition the features that, back in the 1950s differentiated Italian ceramics from those of other nations and which can be held responsible for their eco-nomic success, were according to the American industrial designer Walter Dorwin Teague individuality, stylistic diversity and an "unrivalled richness in artistic ideas" (Teague,1950, pp.145-149). The latter were instilled into post-World War II and later ceramic pro-duction largely by the four following facilitating factors:

1. A strong conscious reciprocal respect and favorable relationship be-tween artists and designers and local and regional centers of artisanal work-shops as well as small and medium scale manufactories that were scattered over all Italian territory. These not only acted as keepers and breeding grounds of historicized, folkloristic and vernacu-lar aesthetics and technol-ogies and product typologies but some accommodated ar-tistic movements and turned into hubs of avant-garde artistic research, too.

Among all, notable ceramic manufacturing centers included:

• The town of Faenza, city of the International Ceramic Museum and place of nu-merous traditional artisanal maiolica workshops produc-ing commercial wares in historicized styles. Faenza is also home to the avant-garde Gatti workshop which, founded in 1928 and inspired by the futurist movement has since acted as a hub for avant-garde artists profiting from the workshop's master's skills in the execu-tion of their artistic work.

• The town of Vietri sul Mare, once home to the Industria Ceramica Salernitana, a manufactory founded by the German entrepreneur Max Mel-amerson in 1927.The company was largely responsible for reviving the local ceramic industry and be-came known for its distinctive decorative iconogra-phy based on a romanticized interpretation of historical, mythological, reli-gious, and popular subjects from Vie-tri sul Mare and its surroundings. The naïve two-dimensional graphic style and folkloristic rural subject matters portraying a backward, yet serene society has played an important part in the creation and diffusion of the Mediterranean myth, exercised a consider-able stimulus on the popularity of 1950s Italian ceramics and has remained a trademark of local and regional ceramic production until today (eg. Ceram-ica Artistica Solimene) (Hockemeyer, 2008, pp.100-109).

• The towns of Albissola Marina and Albisola Superiore, Liguria, home to various historical, traditional and avant-garde small-scale manufactories and workshops producing historicized, and popular wares alongside arti-sanal artistic and avant-garde productions. The manufactory Ceramiche Gi-useppe Mazzotti 1903 for ex-ample produced traditional commercial wares decorated in characteristic Savona blue and white next to futurist wares (1920s and 1930s) and other avant-garde experiments by artists such as

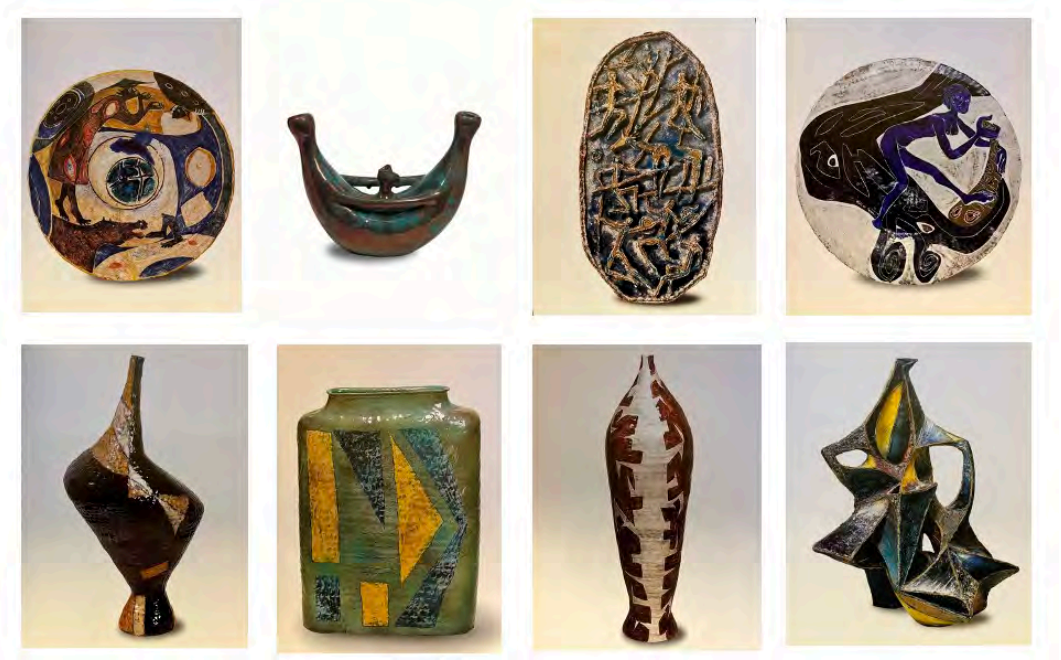
Bruno Munari and Lucio Fontana before turning in-to a significant post-World-War II center for avant-garde-artistic artists and groups.

2. Modern artistic interpretations of Italian ancestral and territorial civilizations reinvent-ing archaism, primitivism, classical, renaissance, and popular cultures in addition to other secular and religious themes (figs 1-4).

3. Artists and artistic movements appropriating the traditional ceramic medium for con-temporary avant-garde creati ve research, recuring to the themes named above or exploring new, figurative, and non-figurative abstraction. Those included artists from all over Italy in Florence, Faenza or Bassano (Nove) or those that orbited around the Roman groups of Forma 1 and Gruppo Origine. Others aimed at uniting the ideals of abstraction and concrete art such as the protagonists of the Milanese group Mo-vimento Arte Concreta (M.A.C.) (figs. 5-8).

4. An extended network of support in form of educational institutions and national and international competitions for schools, craftsmen and artists allowing for continued ar-tistic research and cross-contamination.

All these four factors produced fertile grounds for reciprocal stylistic and technical contami-nation.



*Figures 1-8 Above: Salvatore Cipolla, Charger, 1954; Domenico Matteucci, Vessel, ca. 1956; Ugo Lucerni, Relief, ca. 1954; Salvatore Meli, Plate, 1953. Below: Leandro Lega, Vase, ca. 1956; Leandro Lega, Vase, ca. 1956; Giuseppe Civitelli, Vase, ca. 1956. Marcello Fantoni, Sculpture, 1953. Photos by Heiko Aping, Courtesy of Lisa Hockemeyer.*

1.1 Fast forward: vernacular inspiration for new languages for serial production

Apart from Picassian inspiration during the late 1940s and early 1950s, Italian ceramic production has entirely relied on Italian-bred artistic avant-garde movements and aesthetic languages that betrayed centuries of regional cultural, aesthetic, and secular traditions. For many reasons, the pre-eminent role that Italian ceramic production played within the wider spectrum of Italian material culture linking the concept of Italianità to the values of diversity and individuality, anchored in local and regional cus-

toms and cultures, and which embodied Italy's' new image, combining modernity, fine art connotations and the ideals of heritage dis-integrated fast during the 1950s. The following decline of Italy's ceramic production export was caused among other factors by opening and fast changing domestic and international markets, foreign competition, and trends (new aesthetic ideals and competing innovative materials such as plastics and linoleum) which the small local workshops were inept to meet. This led to a profound identity confusion and their dissociation from both their own cul-tural heritage and the consumer market (Hockemeyer 2014, p.140).

The declining value of the crafts in the wake of the rise of a new design culture were de-scribed by critic Gillo Dorfles in 1964 defining "the point of encounter – the welded joint – between industrial design and handicraft - in the historical period in which we live – [as] one of the most delicate. He continues, that

*"soon […] industrial design will have displaced manual production everywhere, leaving to the latter only a few peculiar sectors: those where the preciousness of the material or the in-ventive capacity and technique of its creator are so great as to justify prizes and otherwise unacceptable costs. Therefore, we find ourselves in an embarrassing situation. [W] hich val-ue should we give to serial production if it suppresses every 'material quality' in the product?" (Dorfles, 1964).*

Gillo Dorfles' introduction to the exhibition of Danese ceramics designed by the architect Angelo Mangiarotti indicates the importance assigned to the relationship between the com-ing of age of a new, modern language for serial production in post-war Italy and a strong awareness for craft traditions and popular and vernacular culture. Many artists', ceramists', designers' and architects' designs, including those by Ambrogio Pozzi, Angelo Mangiarotti, Federigo Fabbrini, Franco Bucci, Gian Battista Valentini, and Roberto Pieraccini were strongly inspired by the qualitative characteristics of traditional artisanal ceramics. Ettore Sottsass jr. described his designs for Bitossi as

"the popular thread of the Italian ceramic tradition in which the material is simple and primitive, and the forms appear a little bit full and thrown (on the wheel), fun-damentally simple and pure" (Sottsass 1957).

## 2. The role of museums and archives in the preservation of patrimony, their aims, and potentials

Are the lessons learned in the past of any relevance to us today? Following a brief insight assigned in the past to the preservation of local and regional culture and traditions and their benefits towards economic growth and social inclusion this paper now turns at examining contemporary cultural institutions dedicated at preserving historical, artistic and scientific ar-tifacts and memory. What are their objectives and aims? Do they optimise their impact on lo-cal and regional socio-economic infrastructures or do they merely order, preserve, and ex-hibit relevant materials, in compliance with the legislation and recommendations for the pro-tection and for the enhancement of cultural and artistic heritage? (Baglioni R., Del Giudice F., 2012).

In the best-case scenario, the functions performed by institutions in charge include the study and research to reconstruct their history and meanings, protagonists and production processes, and to understand their creative and transformative potentials. In accordance with studies of late calling for new, viable answers to imagining and building sustainable and inclusive

futures (see above), also the expected role of museums seems to undergo fast and important changes.

Such is the new definition offered by the International Council of Museums (ICOM, 2022) describing museums as "permanent, nonprofit institutions serving society to study, collect, conserve, interpret and exhibit cultural heritage, open to the public, accessible and inclu-sive, to promote diversity and sustainability" while it is possible to increasingly witness their varied and different processes of transformation.

The synthetized concept of animated archive (Irace F., Ciagà L., 2014), on the other hand, opens up to a wide process of enhancement through transversal and dynamic func-tions. These are based on multiple aspects of the acknowledgement of tangible and intangi-ble heritages, investing archives, museums, cultural institutions at large, as well as the archi-tectural and environmental assets spread throughout the territory , as testimonies of history of local productive districts. Further, they act as tourism attractors, and development provid-ers through knowledge communication, and cultural dissemination, thanks to the ability to recognize and reinterpret the tangible and intangible traces that inform and identify the cul-tural landscape and therefore, the marketing strategies of each territory (Cerquetti, 2014).

These objectives also meet with the principles of Digital Humanities acclaimed by J. Schnapp (Burdick, Drucker, Lunenfeld, Presner, Schnapp, 2012), whereby archives and museums nowadays intend to foster sustainable and integrated valorization by trying to ac-commodate the processes of promoting local heritage and traditions with the maximum ex-pansion and dissemination of the values, integrating the territory, activating resources and social participation through:

- studies, research, censuses, photographic campaigns made accessible to citizens in various forms of dissemination, such as databases, electronic materials and multime-dia content, exhibitions, publications, meetings, conferences, thematic initiatives.
- site-specific projects, aided by broad access possibilities and fast digital interfaces that will enable new potential and renewed vitality: in situ through exhibitions and renovation of settings; online through series of highlights, thematic routes, blogs, podcasts, video animations and social media.
- educational projects as cultural activities, often open to events, celebrations, cen-tenaries, as implementation of the widespread museum concept to reinforce the en-tire territory's economy.

## 3. Museums, archives and collections put to the test. Who are they and what are they doing?

The number of archives and museums of ceramic art and production in Italy are growing and stand as testament to the enduring legacy of craftsmanship and creativity that has de-fined the nation's cultural landscape. Do any of these go beyond their primary function ca-pable to act as vital resource to inspire and develop new, cultural, economically valuable, sustainable, and socially inclusive projects?

The following museums and archives presented have been selected for their varying in-stitutional form and scale. This study, nor their presentation aims to be conclusive but to act as stimuli and food for thought as to the

means proposed to protect, recuperate and to pro-mote local and regional diversities venturing beyond preserving cultural and artistic heritage for creating new scenarios of cultural interaction.

### 3.1 Museo Internazionale Della Ceramica (MIC), Faenza: the acclaimed international mu-seum

This survey begins with the most prominent of all, The International Museum of Ceramics in Faenza (MIC). Since its founding in 1908, it has continuously expanded its collections of ceramic cultures of all times and places. It boosts collections of works from the Far East, Syr-ia, Iran, Egypt, Turkey, and South America and is home to an important collection of Italian ceramics from the renaissance until modern days. Preserving a heritage of more than 60,000 works, both ancient and contemporary, a historical library, a restoration laboratory, photographic and documentary archives it is recognized as a unique center of research on the national and international scene. It has published the specialized ceramics magazine Faenza since 1913 and, since 1938 held the Concorso Internazionale della Ceramica d'Arte - Premio Faenza, one of the most significant and prestigious biennials in the field of art ce-ramics, which highlights new artistic trends and new ceramic languages from international circles.

The cultural and socio-economic significance of the MIC is twofold: the museum holds an undisputed position within international ceramic museology and its academic scene having led UNESCO to include it among the sites promoting cultures of peace as the "MIC expres-sion of ceramic art in the world". Whilst bringing international fame (and economic re-sources) to the city of Faenza, the museum acts as a link between the local and the global and plays a vital role in the city's economic and socio-cultural landscape. Besides block-buster ceramic exhibitions, conferences, competitions, and events that bring different art forms into dialogue, it offers a variety of local educational activities from workshop experi-ences with clay at the Laboratorio Didattico Giocare con l'Arte, founded by Bruno Munari, to themed guided tours of the rooms.

### 3.2 Museo Artistico Industriale Bitossi, Montelupo Fiorentino, Firenze: a company collection

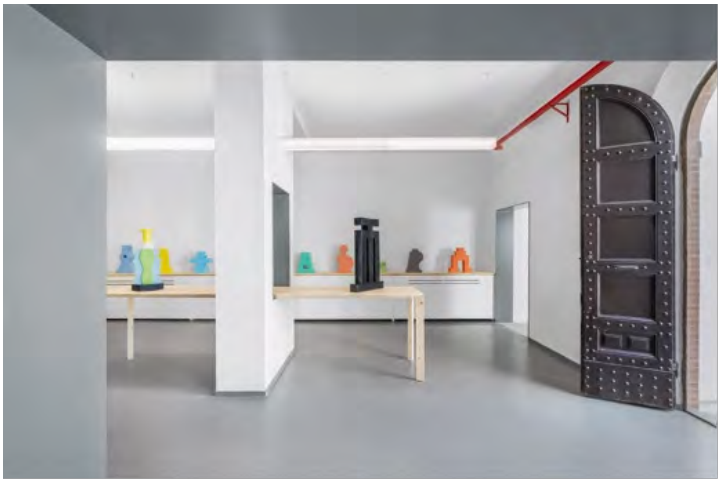
The new exhibition space Bitossi Museum Archive, founded in 2021 on the centenary of the founding of the Guido Bitossi Artistic Majolica Manufacture, on the other hand, is a com-pany museum located in its historic headquarters in Montelupo Fiorentino. It focusses on narrating the firm's history and hosts Bitossi's industrial archives, with the aim of safeguard-ing the historical documentation and creating a visual cultural repository (Galli A., Masini P., 2023).

Protagonist of the museum is the historical archive, consisting of the ceramic collection of more than seven thousand works: a selection of models, plaster forms from the second half of the 19th century to the present day, and work tools (figs. 9-10). The collection is accom-panied by a vast assortment of drawings, plans, workbooks, catalogs, and letters, exhibited in a dense interplay of cross-references between materials and stories. The archive is fur-ther augmented by a photographic fund, with vintage images, color photos and slides relat-ed to the production, sales catalogs, advertisements, and press reviews.

Whilst the museum is an integral part of Bitossi's production realty and vice versa, the museum is connected to the productive history and contemporary production reality in Mon-telupo, Fiorentino upkeeping and enrich-

ing territorial history. The new appealing setting of the museum augmented with archival materials defines a strategy to strengthen the attrac-tion as promotion of local memory and the century-old tradition of ceramic making in the ar-ea of Montelupo Fiorentino.

*Figures 9-10. Inside the Archivio Museo Bitossi - Fondazione Vittoriano Bitossi, Montelupo. Photos by Delfino Sisto Legnani, Agnese Bedini.*



### 3.3 Spazio Ilisso, Arte Archivi Museo, Nuoro: the Island museum

SPAZIO ILISSO in Nuoro, Sardinia, founded in 2019, provides access to the most significant collection of 20th-century Sardinian sculpture and ceramics. A permanent exhibition is flanked by temporary expositions on visual arts, declined in the different expressive fields of the contemporary through archival research, teaching activities, exhibitions, debates, workshops and artist residencies.

Located in the historical heart of Nuoro, Spazio Ilisso, formerly Casa Papandrea, functions as a space of memory: it remains among the few architectural testimonies of historic Nuoro and its community, linked to the writers Grazia Deledda, Sebastiano and Salvatore Satta, Antonio Ballero and Francesco Ciusa, pivotal figures of the island's culture. By documenting the artistic, archaeological, linguistic, photographic, narrative, naturalistic, ethnographic heritage and the material and immaterial culture, Spazio Ilisso is an active subject for the civil and cultural progress of the Nuoro community, flanking the activity of the historic homonymous publishing house, which has launched a systematic work of historicization of all art, to narrate Sardinia, its material culture and local productions between tradition and contemporaneity. A rich and composite archive, both photographic and documentary, collects and makes usable vast and organic collections of great identity value, extending research also to archaeology and the natural environment.

### 3.4 MuDA (Museo Diffuso Albisola) Albissola Marina, Savona: the territorial museum

MuDA (Museo Diffuso Albisola) has been founded in 2011 with the objective to "create an integrated system of conservation, mediation, management and participation of the local historical-artistic heritage, prevalent throughout the territory and characterized by a natural integration into the daily life of popular and cultural rites of the Ligurian town" (Bochicchio, 2021, p.31). It focusses on the collection, preservation, valorisation, and promotion of local material and immaterial memory. Given the town's multifaceted historical and contemporary artistic fabric ( see above), this presents a challenging task. From its very beginning MuDA did not focus on one entity but set out to "preserve, study and promote the historical and artistic heritage of all of Albissola Marina, enhancing its integration with the urban and natural environment, and strengthen its traditional synergy with local artisans, and creative and productive activities".

Developed in different phases MuDA's project began with the valuation, restauration and opening of three different cultural centres, the Casa Museo Jorn, once home of the renowned Danish painter Asger Jorn; the Fornace Alba Docilia, a historic ceramic factory dating back to the 16th century and a polyfunctional Exhibition Centre/Library (figs. 11-12). The latter serves as tourist information, a modern and contemporary civic art gallery, and a library in addition to offering spaces for temporary exhibitions, conferences, workshops and projections. In many ways it connects the former specific mentioned culture-historically sites, imbedded within and connected to the larger community of Albisola and actively engage with the local community (fig. 13). Albisola is made up of a large network of historical buildings and factories, studios and open-air artistic interventions (fig.14). The futuristic Ceramiche Mazzotti (1932), the Mazzotti 1903 Foundation and San Giorgio Ceramics (1958) still produce ceramics today preserving the history of Albissola's traditions and unique artistic avant-garde movements (figs. 15-16). Their collections and documentary material, such as photographs and drawings are enlivened by the oral memory of their owners and the possibility to visit the workspace of past and contemporary artists. MuDA also includes the promotion of facades of storefronts and hotels that have become living museums and the famous artist's promenade, a boardwalk opened in 1963 and paved with mosaics designed by twenty international and national artists, is completed by further public sculptures by Leoncillo Leonardi and Lucio Fontana to name only a few (fig.17-19).

Today MuDA has spread even further, creating an open network with other museums such as the Savona Ceramics Museum, historical sites, private collections, and factories, encouraging and coordinating integrated cultural projects such as exhibitions of local and international artists, workshops, events, and initiatives that transform these into places of meeting and participation, involving the local public and attracting international audiences. It is safe to say that only a few years after its foundation MuDA excels in enhancing local and international artistic awareness and cultural regeneration, attracting tourism and leading to community growth and an inclusive society.

## Conclusions

The values ascribed to regional practice, individuality and diversity are very different today than half a century ago. Once obstacles to a unified Ital-

*Figures 11-12. Casa Asger Jorn, Courtesy MuDA; Fornace Alba Docilia, Albisola, Photo by Lisa Hockemeyer.*

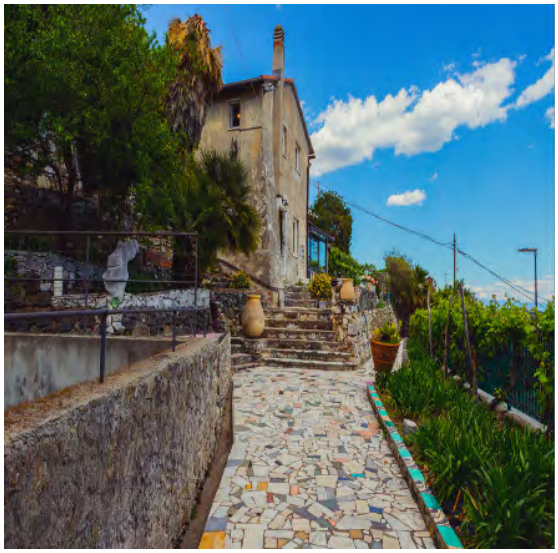


*Fig. 13. MuDA Signage in front of the Public Library, Albisola, Courtesy MuDA.*


*Figure 14. MuDA map showing the different locations of exhibition venues, workshops and factories, furnaces, spaces of archeological interest and private and public collections. Courtesy, MuDA, Albisola.*


*Figures 15-16. Ceramiche Mazzotti, Arch. Nicolaj Diulgheroff, 1932, exterior and interior exposition space, Albisola. Photos by Anna Santi.*

*Figures 17-19 Giovanno Battista de Salvo, Caccia e Pesca, 1962/63; Lucio Fontana, Concetto Spaziale, 1962/63; Federico Quatrini, Il Viaggio di Cristoforo Colombo 1962/63; Photo: Gianluca Anselmi, Courtesy MuDA.*

ian identity and aesthetic, Italy's distinct local historical patrimonies were to represent the most important assets defining the Made in Italy ideal following World War II and their differences were sought after signifiers of Italian culture. Rural and vernacular ceramic production were considered vital stimulants for innovative aesthetic languages for serial production before new, global design cultures and trends took over, causing identity confusion and communities' and maker's dissociation from their own cultural heritage.

In consideration of the damage inflicted by globalization and consequent alienation from local cultures and looking at possible, reversible solutions, the role played by museums and archives in addressing today's societal changes is relevant. This paper sustains that cultural patronage and local traditions enhance a sense of belonging and community providing the individual with emotional and communitarian comfort in an increasingly disconnected and isolated world.

Furthermore, even though the role of institutional bodies and places such as museums, archives, and foundations dedicated to the collection, preservation, valorisation, and promotion of local material and immaterial memory may seem a thing of the past and inferior to blockbuster initiatives or exhibitions of international content, this paper ascertains the vital contribution of the former to revive, enliven and challenge contemporary approaches to sustainability and inclusiveness,

Without clear guidelines in place, the range of action of museums and archives varies depending on historical, social, cultural, and surely regional and bureaucratic factors.

Spazio Ilisso in Nuoro, Sardegna, for example, provides an invaluable organic container for tangible and intangible memory to locals and to visitors safeguarding and promoting Sardinian heritage. It offers a vital contribution for strengthening collective local values generated by common cultural patrimony in dialogue with outside contributions, creating confident modern communities.

Museo Artistico Industriale Bitossi, in Montelupo Fiorentino,Tuscany, on the other hand functions as a container of valuable historical heritage from which to draw 'ceramic know-how' for contemporary design and expression for locally produced contemporary, new, yet clearly identifiable Italian production. Bitossi's collaboration with some of the most interesting voices in design in the past such as Aldo Londi, Ettore Sottsass jr., Matteo Thun and today's protagonists, including Max Lamb, Formafantasma, Dimorestudio, underlies the importance of continuity in regional practice.

This paper has indicated the magnitude of radius which museums and archives that transcend their traditional role as passive repositories of artifacts, changing and adapting their methodologies, to create growth and maintenance of communities of shared interest and support local communities might have. The most innovative example shown here is the Museo Diffuso Albissola (MuDA). Through outreach programs it serves for positive social change, empowering marginalized communities and promoting socio-economic development. By leveraging their resources and expertise, they contribute to the vitality and resilience of local economies, fostering sustainable growth and new prosperity.

## Acknowledgements

Many thanks go to Paola Gargiulo, Museo Casa Jorn, for her valuable information and prompt help in almost everything regarding the MuDA case study.

# References


1. *https://artemest.com/it-it/collections/museo-archivio-bitossi-un-secolo-di-ceramica*
2. *https://www.amicidicasajorn.it/en/jorn-house-museum/*
3. *http://www.fondazionevittorianobitossi.it*
4. *https://www.spazioilisso.it*
5. *https://new-european-bauhaus.europa.eu/about/about-initiative_en.*
6. *http://www.museodiffusoalbisola.it/en/*
7. *Antonelli, P., Tannir, A., (2019), Broken Nature. XXII Triennale di Milano, Electa, Milan.*
8. *Baglioni R., Del Giudice F. (2012), L'impresa dell'archivio: organizzazione, gestione e conservazione dell'archivio d'impresa, Polistampa, Firenze.*
9. *Bertoni Franco, Silvestrini Jolanda, (2005) Ceramica italiano del Novecento, Electa, Milano.*
10. *Bochicchio, L., (2021) Il Museo Diffuso come laboratorio di gestione dei beni culturali: il caso MuDA di Albissola Marina, in M. Migliorini, S. Poli (a cura di), L'effimero tangibile. Dal reale al virtuale: arti, spettacolo e prospettive di comunicazione digitale, GB EditoriA, Roma, pp. 31-44.*
11. *Bonacini E., (2014), I musei e le forme dello storytelling digitale, Aracne Editrice, Roma, 2020*
12. *Burdick A., Drucker J., Lunenfeld P., Presner, T., Schnapp, J., (2013), Digital Humanities, MIT Press, Cambridge, Massachussets, USA.*
13. *Cerquetti M., (2014), Marketing museale e creazione di valore: strategie per l'innovazione dei musei italiani, Franco Angeli.*
14. *Della Piana E. (2010), Il design della ceramica, Electa, Milano, p.100.*
15. *Dorfles, G., (1964), "Introduction" in Ceramiche di Mangiarotti, exhib.cat., Danese, Milan.*
16. *Dubini, P. (2018) "Con la cultura non si mangia" Falso!, 1° edizione, Laterza, Bari.*
17. *Galli A. Masini P. (2023), I luoghi del design, Baldini+Castoldi, Milano, p. 79-100.*
18. *Handmade by Bitossi. 100 years of modern tradition (2021) catalogue Fondazione Bitossi Ceramiche, Bitossi, Montelupo Fiorentino*
19. *Gozzini, L., (1952)., Espressioni artistiche in funzione dello sviluppo delle esportazioni, in Ceramica, October,1952, a.VII,n.s.,n.10,pp.54-56.*
20. *ICOM (2014) Museums, ethics and cultural heritage, London, Routledge, New York.*
21. *Hockemeyer, L. (2008), Italian Ceramics 1945-58: A Synthesis of Avant-garde Ideals, Craft Traditions and Popular Culture. PhD thesis, Kingston University, London.*
22. *Hockemeyer, L., (2014) Manufactured Identities: Ceramics and the Making of (Made in) Italy in Grace Lees-Maffei and Kjetil Fallan (eds.), Made in Italy: Rethinking a Century of Italian Design, Berg Publishers, London.*
23. *Hockemeyer, L., (2023), Just what is it that makes Italian ceramics so appealing?, in L'Italia al lavoro: un lifestyle da esportazione, (eds.) Paola Cordera, Chiara Faggella, University Press, Bologna.*
24. *Irace F. (2019), Atlante della ceramica italiana. Superfici per l'architettura e lo spazio urbano dal 1945 al 2018 - Atlas of italian ceramics. Surfaces for architecture and urban space from 1945 to 2018. Gli Ori, Faenza.*
25. *Irace F., Ciagà L. (2014) Design&culturalheritage. Archivio animato/Animated Archive, Mondadori Electa, Milan.*
26. *Le città della ceramica, Maioliche e porcellane in Italia, (2001) giude, Touring Club Italiano.*
27. *Lokko, L., (2023), The Laboratory of the Future, Biennale Architettura, Venice.*
28. *Maulini A., (2019), Comunicare la cultura oggi, Editrice Bibliografica, Milan.*
29. *Sottsass, E.jr, Nuove Ceramiche (1957), Domus, no.328, March 1957, p. 48, Milan.*
30. *Teague, W.D., Foreword, (1950) in Rogers, M.R., Italy at Work.Her Renaissance in Design Today, exhib. cat., Istituto Poligrafico dello Stato, Rome.*
31. *Watson, J., W-Estudio (2023) Lo- Tek Design by Radical Indigenism, Taschen, Stuttgart.*

# Green design for resilient urban pathways

*Davide Bruno*[1], *Felice D'Alessandro*[2]
*davide.bruno@polimi.it, felice.dalessandro@unimi.it*

[1]*Politecnico di Milano, Department of Design, Italy*
[2]*Università degli Studi di Milano, Department of Environmental Science and Policy, Italy*

***Keywords***
*Green design*
*Nature*
*Art*
*Sustainable infrastructure*

## Abstract

This article explores the strategies outlined in the Master Plan aimed at revitalizing a culturally rich and historically significant area in Milan, aligning with European directives addressing climate and environmental concerns. The focus is on fostering dialogue across disciplines to promote climate-adaptive urban design, serving as a platform for research into innovative strategies and cultural models to facilitate the green transformation of urbanized landscapes.

## Introduction

The concept of "green design" was initially introduced in Ernst Friedrich Schumacher's book "Small is Beautiful" (1973), in which the German economist, philosopher, and writer challenged the prevailing modern Western paradigm centred around consumption, large-scale industry, and centralized organization. Schumacher foresaw emerging ecological themes that would gain significance in the ensuing decades. He highlighted the unsustainable depletion of nature's resources due to humanity's unchecked consumption, warning against the illusion of infinite resources. This critique emphasized the flaws of a materialistic economy driven by the relentless pursuit of individual wealth, which disregards the finite nature of the environment.

*We could be approaching a time of crisis in urban life, and the Invisible Cities are a dream sprung from the heart of unlivable cities. Today, we insist both on the diffusion of the natural environment, and on how frail our great technological systems are, thus capable of triggering cascade failures which can paralyze entire metropolises. The crisis of too large cities is the other side of the crisis of nature (Calvino, 1973, p. 42).*

Inspired by these insights, the study discussed in this article aims to explore and implement innovative project solutions that harmonize the natural environment with urban development. It seeks to address the pressing need to integrate green spaces and ecological considerations into built environments, thereby mitigating the adverse impacts of urbanization on nature and human well-being.

Cities present an ideal arena for testing the resilience of urban systems

in the face of climate change (Kane & Shogren, 2000). While urban systems generate negative externalities that contribute to climate change, they also offer a unique opportunity to innovate and implement mitigation practices to counteract their own environmental impacts (Musco & Patassini, 2012). Thus, the urban environment serves as a distinctive stage for observing and understanding the evolving needs and aspirations of contemporary society. Recent trends in the design of public spaces and infrastructure have prioritized the integration of natural processes within urban settings, fostering a regeneration process centered on the emergence of new social and environmental functions inherent to cities (Perrone & Russo, 2019).

Within this cultural context, and by examining the provisions outlined in the Master Plan (MP) for the Cadorna area in Milan, this article revisits various design strategies aimed at revitalizing the urban fabric. It aims to propose new directives that strike a balance between preservation and the contemporary imperatives of resilience, sustainability, transformation, and the utilization of public spaces (UN General Assembly, 2015, 2017; Rockefeller Foundation, 2015). These efforts align with principles of multifunctionality, connectivity, and transcalarity as advocated by the European Commission (2013).

This article takes a "biophilic" approach to design (Marshall & Williams, 2019), offering a contemporary perspective on the concept of green spaces as multifunctional and strategic elements in fostering resilient processes within densely built environments (Forman, 2014). Emphasizing the ecological efficiency of green areas, it highlights their crucial role in performing ecosystemic functions (Rigillo, 2016) and opening new avenues for research. The need for achieving a dynamic equilibrium among various environmental factors, ecosystemic capabilities, and evolving social needs becomes apparent. Adaptive urban design presents an opportunity to rethink the relationship between human-made structures and nature, while embracing change rather than resisting it and leveraging instability and crises to create new opportunities. Concepts such as adaptability, transformability, and reactivity emerge as essential requisites that, in terms of adaptive capacity, can harmonize the ecological efficiency requirements of human habitats (Angelucci, Di Sivo, & Ladiana, 2013).

The structure of this article consists of five distinct sections. The first section introduces the project's motivations and the origin of its concept, in alignment with European and international reference models. The second section outlines the methodological and operational approach employed. The third section underscores the importance of reconnecting with nature and art within urban environments, emphasizing the significance of continuity within a contemporary design culture. Following this, the fourth section examines the identified obstacles and constraints of the project, along with its dissemination as a noteworthy example of best practices. Drawing from an analysis of selected international case studies, the fifth section centres on the validation of the project concept. Concluding the article are the final sections, which summarize key findings and insights gained, and provide directions for future visions and endeavours.

## Adopting an integrated perspective influenced by European and international frameworks

Railway stations are grappling with an identity crisis, often existing as "non-places" amidst sometimes picturesque landscapes (Augé, 1992). To

address this, they must seamlessly integrate beauty, functionality, usability, and sustainable operation. As cities strive to reclaim their identities, these "non-places" within their landscapes offer opportunities to shape communities, experimenting with the creation of new renown and reputation in the region. Evolving stations are becoming more competitive, offering users unprecedented services and diverse opportunities. Thoughtful spatial planning creates welcoming environments where a wide range of offerings permeates every corner, catering to a society with limited time. Aligned with the challenges faced by cities, the station plays a pivotal role in urban reorganization and serves as a symbol of sustainable mobility. Assuming a leadership position in the urban fabric, it functions as an interchange centre with both economic and cultural significance. Efforts are directed towards minimizing the impact of railway lines on urban areas, transforming them into assets. Train tracks transition from barriers to connecting elements within the urban landscape.

Our analysis reveals that the role of railway stations in the cities of the future will be multifaceted: they will serve as hubs of mobility, as well as dynamic spaces for experimentation and events, and as places for physical, intellectual, and cultural rejuvenation. Each revitalized station will enable the city to reshape itself and create new focal points, thus overcoming its own limitations. Cities possess a remarkable resilience, capable of evolving without outward expansion by optimizing existing, neglected, yet high-potential areas. Viewed from this perspective, the railway context emerges as a developmental model that catalyses the urban reconsideration of other parts of the city.

The railwa

y context aspires to become a new centre, a contemporary iteration of the Agora. Railway buildings represent tangible landmarks deeply integrated into the locales they serve, fostering a symbiotic relationship with the city. Their central location serves to orient travellers within the urban landscape, mitigating the disorientation caused by rapid changes in location (Giardiello, 2011). Consequently, railway buildings act as bridges between disparate worlds, offering opportunities to redefine functions, structures, strategies, and establish new focal points within the urban fabric.

The Master Plan (MP) for the Cadorna area is integrated into the broader European plan for cohesion (European Commission, 2011), focusing on collective transportation arteries and infrastructures, including local railway stations, to redefine the utilization of "non-places" at a regional scale. The scope of the MP is comprehensive, spanning from theoretical research and analysis of international case studies to practical implementation on the ground. This involves employing co-design methodologies and engaging local stakeholders in decision-making processes to ensure social inclusion and foster community participation. The overarching goal is to promote citizenship engagement and social inclusion throughout the planning and implementation stages.

The main challenge lies in revitalizing Milano Cadorna railway station in a manner that respects its inherent sensitivity and potential for creativity. The objective is to transform it into an immersive, highly communicative space, enriched with both digital and traditional elements capable of conveying several key messages to visitors:

- A balanced dissemination of media information, aiming to prevent semiotic overload.
- Innovative approaches to celebrate the local landscape and highlight the beauty of the surrounding area.

• Reinforcement of the central role of contemporary art forms within the station environment.

At the core of the project is the concept of offering visitors a dual experience. On one hand, there's a vibrant, dynamic station characterized by the precision and transparency of its industrial operations. On the other hand, there's a more contemplative, monolithic station, evoking the imagery of a docked ship, poised for departure. This dual-speed approach aims to cater to different visitor preferences and create a multifaceted experience within the station space.

The project also introduces a new architectural element, serving as a mediator between the past and the present, by incorporating novel functions, materials, and forms to establish a connection between the central part of the square and the Triennale park. This initiative aims to harmonize two distinct areas of the city, creating a unified space that serves as a gathering point and a refuge. This architectural element takes the form of a grand hydroponic green corridor, supported by a lightweight tensile structure. It features grass-covered areas and immersive pathways adorned with artworks, installations, and technological exhibits (Figure 1).

*Figure 1. The intervention area*

To address the logistical challenges posed by the flow of movement between the inner and outer areas, an overhead pathway has been designed. This elevated route, situated in the open air, re-establishes connectivity between different parts of the city.


*Figure 2. Perspective and section drawings of the buildings, the new canopy, and the underground rail system*

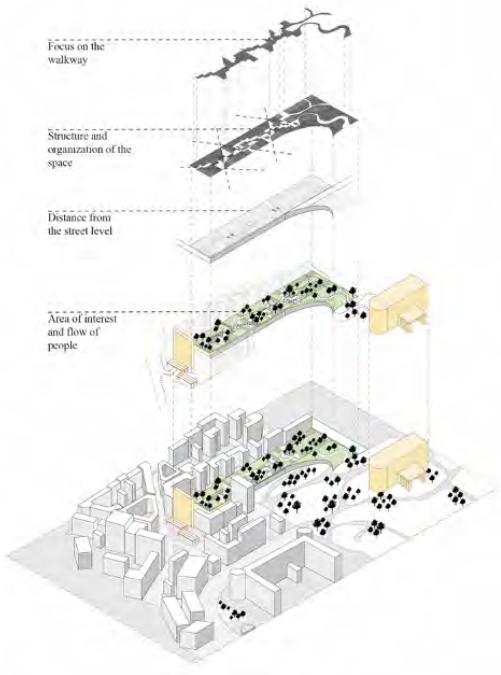
It serves as a prime example of a highly porous and open system, seamlessly linking to the Triennale gardens (Figure 2).

The canopy serves as both a functional and visually striking feature, providing coverage for the railway tracks (Figure 3).

*Figure 3. Internal view of the new canopy*


Seamlessly blending into the existing urban fabric, it assumes a fluid quality, with its unity and orientation towards the Triennale park constantly evolving (Figure 4). The station takes on the appearance of a docked ship, with six sails adorning the canopy, enhancing the impression of fluidity reminiscent of gentle waves' rocking motion. The architectural design revolves around the movement of the station and its passengers. The spaces between the sails serve as natural connectors among the various services within the building, ingeniously integrated by the architecture itself. This seamless continuity between different areas, along with an architecture that embraces its surroundings, and a cohesive material palette that ties together all elements within the structure, conveys a sense of organic unity.

*Figure 4. Main layers of the new natural and built-up environment, in relation to the status quo*



The prominent inclusion of green spaces aligns with European guidelines advocating for greener policies. The process of reconnecting two urban areas is facilitated by the construction of a 380-meter-long canopy-bridge spanning across Via Leopardi and the Triennale park, encompassing nearly 32,000 square meters over railway tracks and secondary streets. This infrastructure forms the foundation of a hydroponic green corridor, fostering immersive paths adorned with design and technology installations. Specifically, the concept of a cultural eco-systemic pathway from Cadorna station to Triennale Milano aims to strengthen the connection between the natural environment and the built environment, fostering a new symbiotic relationship. In one of Milan's most evocative, historic, and monumental contexts, this vertical garden, interwoven with green pathways, will serve as an imaginative oxygen factory for the city. Additionally, the collection and reuse of rainwater will enhance water resource management and mitigate extreme precipitation effects, reflecting a circular approach to natural processes aimed at improving both environmental and socio-economic conditions.

In the heart of the city, architecture transforms a station, previously perceived as a "non-place", into a dynamic and evolving structure, effectively eliminating the rift created by outdated urban designs. Instead, it introduces a new, highly permeable system that seamlessly integrates with the Triennale gardens and intermingles with the surrounding buildings as a fluid element (Carta, 2013). The greening intervention serves as the chosen tool to translate the guidelines of the Master Plan into tangible actions, particularly in a historical context where physical transformations of spaces are often challenging (Boeri et al., 2017; Dessì et al., 2017). This pioneering and visionary project aims to reconnect the city with its natural environment by creating high-quality, highly liveable public spaces, aligning with the accessibility goals of the revamped Milano Cadorna Station to cater to the needs of commuters. The project harmoniously combines natural elements with man-made structures, integrating biological cycles with building processes, and blending tradition with innovation. This integration results in a new standard of technological, ecosystemic, and efficient offerings, enriched by artistic and cultural influences (Figure 5).

While the focus of the Master Plan (MP) is specific and localized within the context of Milan, its multidisciplinary approach, thorough examination of state-of-the-art practices, and evidence-based design principles establish a foundation of knowledge that can be applied to various contexts, both nationally and internationally.

## Methodology

The unique contribution of this study can be discerned from its dual approach, both methodological and operational. Methodologically, it focuses on achieving balance within the framework of a "non-place", reconciling the demands for conservation with the emerging imperatives of resilience, sustainability, transformation, and the utilization of communal spaces. This is achieved through an integrated examination of the existing context, generating value through a project layer that organizes overlapping layers of urban stratigraphy, such as railway tracks, canopy structures, and green corridors. To address the research question, this study has delved into knowledge, projects, and experimentation influenced by the European context. Notably, reference cases including the pedestrian Promenade Plantée in Paris (also known as Coulée verte René-Dumont), the High Line in New York, and the overhead garden of Sants in Barcelona have been selected. These case studies represent significant projects aimed at reinterpreting the urban fabric, establishing connections between the built environment and the network of

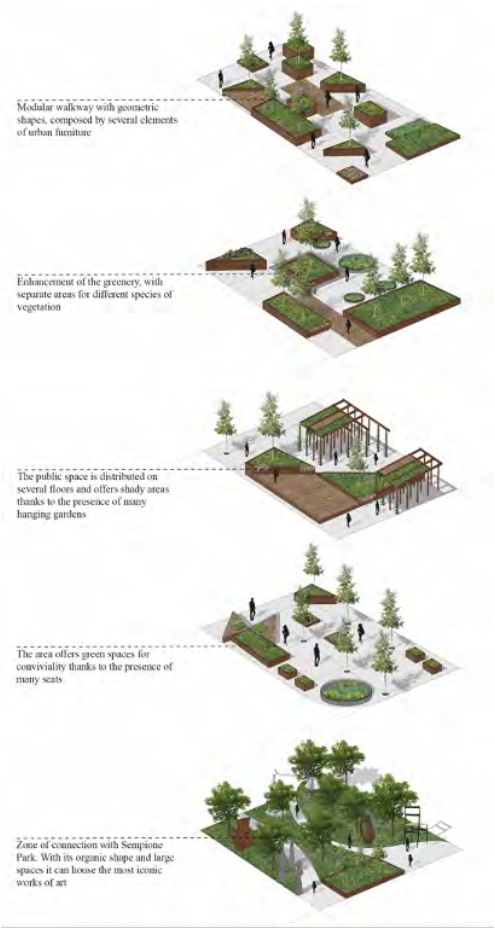



*Figure 5. Union between the natural environment and sustainable artificial elements*

environmental and social processes within cities. Through analysis, shared methodologies and design objectives have emerged, leading to the exploration of innovative solutions. Initially, an exploratory analysis examines the technical solutions employed by greening systems to promote the repurposing of grey infrastructure, foster psycho-physical and social well-being within local communities and facilitate sustainable integration between buildings and the environment.

The equally innovative aspect lies in the "operative" dimension, where the visionary depiction of the contribution manifests in the intricate design elements that transform the landscape in the eyes of observers. The project introduces a diverse array of industrial, artistic, and technological components, creating a narrative that spans from historical influences on contemporary innovations and future projections. This meticulous and continuous design process encompasses everything from the early conceptualization by master designers to the utilization of cutting-edge materials and techniques. It encompasses the transformation of raw materials into cultural artifacts, culminating in a sustainable green process.

The originality of the contribution lies in the seamless integration of cultural, green, technological, and design elements, forming a multidisciplinary approach aimed at presenting a best practice model. This model serves as a tool for prefiguration and as a reference point adaptable to various urban contexts.

## Human-nature-art concept

The relationship between humans and nature has been depicted and explored through various mediums such as literature, philosophy, and art,

reflecting both harmony and contradictions throughout history. One of the key objectives of the Master Plan (MP) is to emphasize the significance of the natural element and its social implications. Can nature, in collaboration with art, bear witness to and actively participate in human history, driving change? And if so, how? The project seeks to provide a space for contemplation on the relationship between humans, nature, and art, fostering awareness of the ethical dimensions and the shared destiny that binds nature and humanity. This stands in opposition to the notion of infinite resources, acknowledging the fragility of the ecological environment. Given this fragility, it becomes imperative and urgent to commit to conservation efforts and promote mindfulness and sensitivity within an ethics of responsibility. The green pathway leading towards the Triennale park serves not only as an outdoor museum but as a relational space where art and life intersect, where nature and human artifacts coexist. By incorporating nature as an aesthetic element, art assumes an active role, imbuing the landscape with highly symbolic works and objects that blend tradition with avant-garde Italian design, thereby anticipating future artistic revelations.

*Figure 6. Design and art elements on a hyper-scale*


*Figure 7. Integrated simulation of the new intervention in relation with the buildings and urban context*

## Limits of the project

The project faces several challenges primarily stemming from the intricate coordination of diverse competencies across various levels, both during the design and execution phases. This entails the integration of structural engineering and management engineering with aspects of civil architecture, interior design, object population design, and the establishment of an "open-air museum system" aimed at bridging and connecting two urban areas like a hinge. Without a highly qualified direction emphasizing a multidisciplinary approach, the complex interplay of these activities could pose significant constraints to the project's success.

Moreover, political and economic issues, commonly encountered in environmental and territorial contexts similar to this case study, present potential obstacles to project implementation. Additionally, the layering and integration of a new project into the existing reality pose challenges. In the execution phase, it becomes essential to develop a sustainable development model that ensures the operation of the station without compromising the quality and efficiency of the services provided.

## Conclusions

This article outlines the results of a project aimed at establishing a new eco-systemic and cultural pathway from Cadorna station to Triennale Milano, with the goal of environmentally and socially revitalizing a strategically significant area of the city, rich in historical and monumental heritage (Figure 7).

The project proposes the introduction of a new design layer as a means to honor the historical significance (artistic and monumental heritage) while integrating contemporary needs such as sustainability, well-being, and inclusion. The intention is to position the project at the forefront of an effective cultural development process. Embracing an upcycling approach, the original functions will be enhanced with new creative uses that better align with the needs of citizens and have a more pronounced impact on the economic and social dynamics of a modern city (Ferlenga, Biraghi & Albrecht, 2012).

The potential applications of the Master Plan and its associated synergies have the capacity to serve as fruitful pilot projects, stimulating the creation of new initiatives and projects aimed at adapting built environments to the challenges posed by climate change. Additionally, they can promote mitigation solutions in contexts inclined towards green regeneration. Adopting green infrastructures equipped with water-saving and reuse systems, alongside the utilization and/or provision of renewable energy supported by digital solutions, becomes imperative within an urban circularity framework (Carli & Scrugli, 2021).

Another positive aspect highlighted in the article is the collaboration between universities and institutions, enabling multidisciplinary contributions and translating research and experimentation into opportunities. This collaboration fosters scientific discourse within a vision that supports the development of solutions for urban resilience in the context of ecological transition.

While this article provides a qualitative exploration of the potential of green infrastructures, it is imperative to complement this with a quantitative analysis to present a more comprehensive understanding of their strengths and weaknesses. Implementing nature-based solutions with a high techno-

logical component could facilitate:

• Investigation of the technical aspects of plants as design materials, including their performances, durability, and maintenance requirements.
• Identification of plant species that best suit the need for shade and evapotranspiration, aligning with the climatic characteristics of the site.

In a broader context, conducting an analysis incorporating quantitative data could contribute to enhanced environmental, economic, and social sustainability by developing structural elements intricately linked to the surrounding territory. It is essential to note that the outcomes of this project do not aim to simplify the cross-disciplinary complexity of the subject, nor do they intend to exhaust the available information or establish a singular process. Instead, future studies focusing on the interplay among these aspects could reveal new disciplinary collaborations or methodological frameworks to better understand the necessity of establishing a symbiotic relationship between the natural environment and built spaces.

## Acknowledgments

This article is the results of collaborative efforts between the authors. The conceptualization of this study is credited to D. Bruno, who served as the scientific director of the project and coordinated scientific activities at the Design Department and the Foundation of Politecnico di Milano.

# References

1. *Angelucci, F., Di Sivo, M. & Ladiana, D. (2013). Responsiveness, adaptability, transformabil-ity – The new quality requirements of the built environment. Techne | Journal of Tech-nology for Architecture and Environment, vol. 5, pp. 53-59. [Online] Available at: doi.org/10.13128/Techne-12801.*
2. *Augé, M. (1992). Non lieux – Introduction à une anthropologie de la surmodernité, Ed. du Seuil. Librairie du XXIe siècle, Paris.*
3. *Boeri, A., Longo, D., Gianfrate, V. & Lorenzo, V. (2017). Resilient communities – Social infra-structures for sustainable growth of urban areas – A case study. International Journal of Sustainable Development and Planning, vol. 12, pp. 227-237. [Online] Available at: witpress.com/elibrary/sdp-volumes/12/2/1458.*
4. *Calvino, I. (1973). Italo Calvino on Invisible Cities. Columbia – A Magazine of Poetry & Prose, vol. 8, pp. 37-42.*
5. *Carli, P. & Scrugli, P. (2021). UNPARK – La seconda vita di un'infrastruttura in un contesto urbano ad alta densità | UNPARK – The second life of an infrastructure in a high-density urban environment. Agathón | International Journal of Architecture, Art and De-sign, vol. 9, pp. 72-81. [Online] Available at: doi.org/10.19229/2464-9309/972021.*
6. *Carta, M. (2013), "Il paradigma della città fluida", in Carta, M. (ed.), L'Atlante dei Waterfront – Visioni, paradigmi, politiche e progetti integrati per i waterfront Siciliani e Maltesi, DARCH, Palermo. [Online] Available at: iris.unipa.it/retrieve/e3ad8916-9305-da0e-e053-3705fe0a2b96/238%20Fluid%20City%20Paradigm%20%28Waterfront%20Atlas%2c%20 2013%29.pdf [Accessed 12 July 2022].*
7. *Dessì, V., Farnè, E., Ravanello, L. and Salomoni, M. T. (2017), Rigenerare la città con la na-tura – Strumenti per la progettazione degli spazi pubblici tra mitigazione e adattamento ai*

*cambiamenti climatici, Maggioli Editore, Santarcangelo di Romagna.*
8. *European Commission (2011). Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM(2011), 144 final. [Online] Available at: eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:EN:PDF.*
9. *European Commission (2013). Communication from the Commission to the European Par-liament, the Council, the European Economic and Social Committee and the Commit-tee of the Regions – Green Infrastructure (GI) – Enhancing Europe's Natural Capital, document 52013DC0249, 249 final. [Online] Available at: eur-lex.europa.eu/legal-content/EN/TXT/?u-ri=CELEX:52013DC0249.*
10. *Ferlenga, A., Biraghi, M. & Albrecht, B. (2012). L'architettura del mondo – Infrastrutture, mo-bilità, nuovi paesaggi, Compositori, Bologna.*
11. *Forman, R. T. T. (2014). Urban Ecology – Science of Cities, Cambridge University Press, Cambridge. [Online] Available at: doi.org/10.1017/CBO9781139030472.*
12. *Giardiello, P. (2011). Waiting, spazi per l'attesa, Clean Edizioni, Messina.*
13. *Kane, S. & Shogren, J. F. (2000). Linking Adaptation and Mitigation in Climate Change Poli-cy, in Kane, S. M. and Yohe, G. W. (eds), Societal Adaptation to Climate Variability and Change, Springer, Dordrecht, pp. 75-102. [Online] Available at: link.springer.com/chap-ter/10.1007/978-94-017-3010-5_6.*
14. *Marshall, A. J. & Williams, N. S. G. (2019). Communicating Biophilic Design – Start with the Grasslands. Frontiers in Built Environment, vol. 5, issue 1, pp. 1-11. [Online] Available at: doi.org/10.3389/fbuil.2019.00001.*
15. *Musco, F. & Patassini, D. (2012). Mitigazione e adattamento ai cambiamenti climatici – Va-lu-tazioni di efficacia di piani e politiche in Usa, in Europa e in Italia, in Pierobon, A. (ed.), Nuovo manuale di diritto e gestione dell'ambiente, Maggioli, Rimini.*
16. *Perrone, C. and Russo, M. (eds) (2019). Per una città sostenibile – Quattordici voci per un manifesto, Donzelli Editore, Roma.*
17. *Rigillo, M. (2016). Infrastrutture verdi e servizi eco-sistemici in area urbana – Prospettive di ricerca per la progettazione ambientale \| Green Infrastructures and Ecosystem Servi-ces in ur-ban areas – Research perspectives in environmental design", in Techne \| Journal of Technology for Architecture and Environment, vol. 11, pp. 59-65. [Online] Available at: doi.org/10.13128/ Techne-18402.*
18. *Rockefeller Foundation (2015). City Resilience Index. [Online] Available at: rockefeller-foun-dation.org/wp-content/uploads/CRI-Revised-Booklet1.pdf*
19. *Schumacher, E. F. (1973). Small is beautiful – A study of economics as if people mattered, Blond & Briggs, London.*
20. *UN – United Nations (2017). New Urban Agenda. [Online] Available at: habitat3.org/ wp-content/uploads/NUA-English.pdf*
21. *UN – United Nations (2015). Transforming our world – The 2030 Agenda for Sustainable Development. [Online] Available at: refworld.org/docid/57b6e3e44.html*
22.

# ALTERNATIVE FUTURES

# Design and Literature for Education: Academic and Pedagogical Transdisciplinary Integrated Lab as Innovative Project for Graduate Programmes

*Michaella Pivetti*[1], *Diana Navas*[2]
*micpivetti@gmail.com, diana.navas@hotmail.com*

[1]*Universidade de São Paulo (USP), Brasil*
[2]*Pontifícia Universidade Católica de São Paulo (PUC-SP), Brasil*

***Keywords:***
*Design*
*Literature Education*
*Transdisciplinarity*
*University Management*

## Abstract

Understanding research as a method of innovation and experimentation, this paper presents the Programa-laboratório integrado transdisciplinar para formação acadêmica e pedagógica/ PLIT, Academic and Pedagogical Transdisciplinary Integrated Lab-Program — an ongoing Brazilian graduate project financed by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Federal Agency for Support and Evaluation of Graduate Education of Brasil, according to the Strategic Postdoctoral Program promoted by the Agency. Describing the project in process through its steps, this paper tries to demonstrate how a proposal like PLIT, starting from an open Design approach, can indicate unique paths of methodological and critical conceptions based on transdisciplinarity. Doing this, the paper also brings some urgent concepts to MDA international debate, such as "common good" e "inclusion", viewed from an interesting cultural point of view: that of the Brazilian society.

## Introduction

Argan — who understood the notion of "project" with a sense of historical becoming ("The project is still an integrated process in a concept of society development as a historical becoming", Argan, p. 251) — stated that he saw in the school the only Program of Action for Design. It is an interesting statement that configures itself for our proposal as a calling.

By regarding the "program" as the only possibility of "action" by the school, the author advocates two fundamental points for this work: 1) the potential of the school for Design and 2) the social urgency of this act, operated through Design, with a sense of programmatic intervention — a kind of "call for action" for the future, which is renewed over time.

It is interesting to notice that Giulio Carlo Argan, one of the greatest art theoreticians of the second half of the 20th century, has also acted with what we call nowadays public policies by holding the office of mayor of Rome, in Italy, in the years 1976-9 and being elected Senator in 1983. To manage a city, especially the "Eternal City", which came to the end of an Era, undoubtedly corresponds to the premises of a complex Design project in the contemporary shape: a nice package of multiple questions and challenges, with a variety of wicked problems to be faced. In the experience of operationalizing theory and practices of diverse fields from aesthetics and speculating urban futures

inside the limits of reality, one may say that Argan as a historian had to adopt a Design approach to deal with the "problem".

We shall, then, grasp the Arganian calling about Design and school and resignify it for this Project. When understood through a historical perspective, the notion of project brought by the author poses an aspect of conscious and active domain upon the future: by the historical protagonism, a people that belong to the whole of humanity are the authors and responsible for the legacy built in the present time. It is interesting, therefore, to regard the program of action for Design when we discuss project, Literature, and Education — the image of the school representing the field workshop in which the transforming material we call present is forged, worked to the construction of an already ongoing future.

From these assumptions, this paper intends to dimension the transdisciplinarity characteristics that the proposal here debated presents, in terms of potentialities, originality, and also academic uniqueness, especially for the studies in Literature.

## The school as education

The school unites in itself all of the project, material, human, and methodological components that interest Design. But not only that: by school, beyond the physical, institutional, and symbolic space in which everything happens, we must comprehend education in a broad sense, regarding the cultural, health, and political aspects that intersect in it. It is by this global concept of education as an integrated system with other areas that this proposal is oriented in terms of its "project definition". Operating with a starting point in Literature, and taking into consideration all that complexity, is the challenge of the critical and methodological premise upon which the PLIT Project moves as investigative Laboratory.

## Transdisciplinarity to work concepts

The PLIT Project, which is born inside the university but is developed according to the cultural and social demands, works with this broad understanding of education from the Graduate Programmes in Literature, aiming at a social impact that can operate at and through the school, but also in other crucial environments of the communitarian organism which is society. It is, then, a work oriented to the common good.

But what is the "common good"? To discuss this concept represents, for instance, a good investigative starting point driveable in diverse ways. From the specific praxical of the school to a more theoretical and/or aesthetical-experimental approach, this matter implicates an ethical dimension with a broad spectrum that the transdisciplinary and multiformat prerogative of the Project enables to work in more fronts, always oriented by the social dialogue. That means we have a particularly critical challenge as we deal with a complex society as the Brazilian, the geo-political-cultural context of the proposal.

It is noticeable that Brazil is configured as a laboratory itself, where one can observe the most sensitive topics that are relevant to the future: on the one hand, cultural variety, composed by people of different ethnic origins, religions, sexual orientations, and, on the other, an evident social inequality that excludes the majority from the access to the universal human rights. Furthermore, the vastitude of the territory, representing another challenge

to accessibility for Communication and Education. Plus, the presence of the most diverse biome in the world, the Atlantic Forest, which denounces the predatory action on the race for natural resources on the way to scarcity.

So, how to define the "common good" from the perspective of a "Global South", specifically in the Brazilian eye? We point to contributing to bring to the international debate other possible visions of the "common good" and for the "common good" from the experiences of local cultures.

Another concept, which is connected to the previous one, is "inclusion". This has been discussed at a first cycle of events performed on the first year of the Project, in 2023, called "Diálogos Transdisciplinares PLIT" (PLIT Transdisciplinary Dialogues). In this first cycle of the Dialogues, scholars from different areas of knowledge brought their original visions about the notion of "inclusion": scientists of Anthropology, Semiotics, and Design contributed to the sense of widening the borders of critical comprehension for an education in Literature combined to urgent matters of the most recent contemporaneity. The connection between both concepts — inclusion and common good — was presented by Professor Mario Bisson from POLIMI,

Polytechnic University of Milan, at the web conference delivered at the beginning of this year, inaugurating the 2024 agenda: "Inclusive Design or Design for the common good" — which now we propose to integrate into the Pontifícia Universidade de São Paulo (PUC-SP) debates, especially regarding education in Literature, activated by the PLIT Project.

It is interesting to highlight that bringing the anthropological perspective means also exploring one more set of sensitive themes: narratives, memory, and preservation — a fundamental basis for Literature and Education, crossed by technology (which, meanwhile, is driven into its 5.0 version). The indigenous narratives, bringing the originary people culture point of view, give visibility to other forms of existence. Reflecting directly on the very construction of stories, traditionally transmitted orally, the relation to the imaginary, as well as to time-space, bring a vast repertory for the studies in Literature, displacing traditional Europe-originated western perspective. Expanding boundaries, the narrative literacy becomes environmental as well, once in the indigenous stories the relation to the environment constitutes the human existence itself, which cannot be dissociated from other elements of nature — on the contrary: it is an invited part of the hole system. In Brazil, those who deal with Children's Literature or picturebooks are usually more familiar with this repertory: precisely educators who disseminate it in schools, especially that category of teachers who directly work with Literature books. However, besides the popularization of indigenous peoples manifestations by research and art, through diffusion and circulation at large of indigenous cultural artifacts, it still is a knowledge of difficult access. Even in a hybrid-culture society such as the Brazilian, which has a tradition of merging diverse elements, the risk of idealization is always at stake.

Anthropologists become key figures to social interconnectedness, allowing us to have less distorted visions of the "other", inside and outside social groups — after all, who are the others? Who is different? — and can bring more interesting perspectives of inclusion anywhere, just like it happened at the web conference entitled "Narradores e redes: um olhar antropológico da inclusão", "Narrators and Networks: An Anthropological Look at Inclusion", by João Pacheco de Oliveira, who is also a curator of ethnographic collections. Pacheco, professor at Universidade Federal do Rio de Janeiro (UFRJ), is the head of the National Museum — which caught fire in 2018 — works strongly with the matter of preservation and memory of the originary peoples. After the historical loss caused by the

fire, the anthropologist has been rethinking the conception of "museum", discussing the rule of these spaces as well the curatorial process in the identity construction. All concerns debated internationally, as reported by the New York Times Magazine article "Can a National Museum Rebuild Its Collection Without Colonialism?", published last year. (Pacheco de Oliveira, 2023).

By the side of these literacies, we find technology, which crosses all material and non-material cultural production, particularly interfering with the problematic of conservation of assets. In the case of a museum with indigenous artifacts, for example, like the Museu Nacional, in Rio de Janeiro, when the artifacts of an extinct people disappear, as happened in the fire episode, there are no vestiges of this people left: the descendants cannot even have some awareness of their origin, once their traditions rely on oral transmission. In these cases, digital reconstitutions can help, but not fulfill the function that material objects have for the research: we know that the duration of a digital document is predictably reduced. Just like environmental preservation, knowledge preservation is a central topic for the present-future.

In this scenario, digital education is a theme for analysis when we deal with inclusion. It is interesting to listen to the perspective of someone who studies the language, once again in a fragment of other cultures and ways of living: "Pesquisa sobre a inclusão tecnológica nas comunidades indígenas", "Research on technological inclusion in indigenous communities", was the web conference by the renown Brazilian semiotician Lucia Santaella.

All the considered themes and visions help Design and Literature to elaborate hypothesis in collaborative investigation with other fields of knowledge and work on it in many ways, as we saw with the "common good" debate through the broad path of education — on the widespread terms indicated at the beginning of this paper.


*Figure 1. PLIT Project Plan*

*Figure 2. PLIT Project Plan*


## Commission and work plan

In the second semester of 2022 (in Brazil, the academic year usually starts in March and ends in December) the Programa de Estudos Pós-Graduação em Literatura e Crítica Literária — Post Graduation Program in Literature and Literary Criticism — from the Pontifícia Universidade de São Paulo (PUC-SP), was presented with a research project whose problem was thus formulated: by which means of critical and methodological conception can Design contribute to an education in Literature that, based on interdisciplinarity, can articulate thought, experience and scientific production innovatively in order to promote practices and interventions of social value, especially in the education field? The hypothesis was that, beyond the analytical and theoretical contribution, the complementarity of Design and Literature could bring significant remarks also in the sense of a strategic pedagogical architecture, launching foundations for new education programs. To base this proposal — complementing the field experience of academic investigation and professional practice, with edition and Design in Communications and Art — the concepts of project as well as fantasy/creativity, developed in previous doctorate research, came to compose the initial theoretical basis from the proposal, which had the intention to expand the critical cycle around books and reading, now turned to higher education, in the planned interrelation with other areas of knowledge. At this stage, there was a narrow link to Children's Literature, the source of the considerations regarding Design and Literature for the concept of project, between theory and practice.

From the formulation of the problem of the research proposal, from which paths of critical and methodological concepts can Design contribute to an education in Literature that, based on interdisciplinarity, can articulate thought, experience and scientific production in an innovative way in order to promote practices and interventions of social value, especially in the education field? The Postgraduate Program in Literature and Literary Criticism (PPGLCL) of PUC-SP competed in a public notice

called Edital de Programa de Desenvolvimento da Pós Graduação — Pós-Doutorado Estratégico promoted by CAPES, with the PLII FAEP LLIJ project, Programa-Laboratório Integrado Interdisciplinar para Formação Acadêmica e Pedagógica em Literatura e Livros para Infância e Juventude (Interdisciplinary Integrated Lab-Program for Academic and Pedagogic Education in Literature and Children's Book and Young People).

At the end of the same year, in December 2022, the proposal obtained excellent grades for the demanded prerequisites and was approved by CAPES, starting the Project planning on January 2023. Still maintaining the originally proposed relation with Children's Literature, it became clear to propose just Literature in the name: Literature as major area, vector of the dialogue with other areas, aiming at social impact. It was at this point that the concept of transdisciplinarity began being worked on, transforming the name of the Project into PLIT. "Programa-Laboratório Integrado Transdisciplinar" — Transdisciplinary Integrated Lab-Program — which was, then, presented to the Postgraduate Program in Literature and Literary Criticism researchers.

To make the praxical scope of the proposal tangible, the PLIT Project contemplates five products to be created during the biennium of proposal implementation, 2022 to 2024. They are: editorial project (journal) + digital platform + experimental lab + exhibition + activities of scientific interchange. Over a document that presents this structuring picture of the plan, layers of evolution were added on the first steps of the process.

The translation of the proposal into actions and products began to be debated last October (2022) in meetings with Professor Mario Bisson from POLIMI, Polytechnic University of Milan, Italy, one of the international partners that support the project — leading off the preliminary activities of the planning.

At that time, Bisson was in Brazil invited by the Programa de Pós-Graduação em Design by Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo (FAUUSP), the Post-Graduation Program in Design of USP, to consolidate an academic exchange. On that occasion, it was possible to follow along with his presentations regarding the operation of Design in transdisciplinary projects, in which research and methods for the analyses of problems that in a general way affect the common good were mobilized, presented by branches of the industry and market.

Bisson brought examples of projects developed at POLIMI, which he leads, ususally with international collaborations. It was also possible to accompany him on a visit to the Instituto SENAI de Inovação e Tecnologia, in São Caetano do Sul, São Paulo — SENAI Institute for Innovation and Technology, where over ten years before he had done the work of education for the implementation of a Design Center. From this global set of references and interlocutions, the basis for the international collaboration with Bisson/POLIMI was created, which assisted with the preliminary draft, the ideation of products, and the sketch of the general structure of the PLIT Project.

The plan for the PLIT Project is distributed over two years, planned half-

yearly.

**First year (a):**
1a) General structuring for the orientation of all of the dimensions of the Project's proposal (such as conceptual, methodological, material, systemic, and of Communication);
2a) Orientation of the first products, assuring the implementation of, at least, one;
3a) Creation of a schedule for the academic production in different formats;
4a) Curatorship for the promotion of opportunities and dialogue cycles: between peers; institutions; university and society; with diverse social segments and varied audiences.

**Second year (b):**
1b) Continuity of the items 2, 3, and 4 (a);
2b) Consolidation of the PLIT system and the networks of partnerships, investment in the construction of the Project's financial self-sustainability to keep the proposal's permanence; general upgrades and creation of new products — Exhibition and Activities of Scientific Exchange — participation of the PLIT Project in an international event and work of systematization for the production of the final report regarding the results of the biennium and first cycle of the Project (possibly as a publication).

Making use of the partial reports of the first and second semesters of 2023, it is possible to map the development of the Project so far and analyze aspects of the trajectory.

**First year, semester #1**.
Orientation of item 1) Project structuring, focused on the creation of a work routine, group setting up, and creation of a first network of partnerships. Here follows the drill-down:

- Proposal of a collective work routine for: a step-by-step creation of the constructive process for the accomplishment of the Project and the identification of the proposal's "what" and "how". Establishment of this routine with the researchers and members of PLIT;
- Setting up of a PLIT body: construction of strategies for the engagement and permanence of the researchers, counterparts proposition, and verification of the first results planned from the routine of programmed submissions;
- Recording of activities, creation of a document for the sharing of materials; creation of necessary texts and documents (ex. confidentiality agreements, quotations of the Project in outside activities, the indication of participation of the researchers on their academic resumé);
- Research: through debates and surveys of references (qualitatively) the construction of a hypothesis for the first definition of concepts from the goals of the proposal and the creation of the planned products: innovation, innovation on the university, distinctions between scientific and academic, types of editorial projects, characteristics of innovative projects and the audiences to communicate with.
- The presentation of the proposal to the community of PUC-SP, alongside the coordination of other courses for the inter and transdisciplinary collaboration, aiming at a partnership work around the products;
- Presentation of the Project and its proposal for the accomplishment

of scientific partnerships, national and international, and indications for the setting up of a scientific committee for the product journal (editorial project);
- Presentation of the Project and its proposal for financial and institutional support;
- Financial, global, and yearly planning, starting with the accomplishment of the plan of activities for the first year. Verification of the available resources and budget for the technical structuring of the products and hiring of other services;
- Construction of the communication of the PLIT Project: social networks and other vehicles;
- Planning of the activities for the second semester for the continuity of the work schedule.

To start the process aforementioned, the first call for the researchers and faculty of PUC-SP from PPGLCL was released. It happened on March 10, 2023, with a preliminary presentation of the proposal, online, preceded by the following synthesis invitation, sent by the Program's Coordination:

> *"The Interdisciplinary Integrated Lab-Program for Academic and Pedagogic Education is a project that was recently approved by CAPES at the Strategic PostDoctorate Program. Engendered in the culture of Design and project, the Labprogram is destined for the construction of inter and transdisciplinary models, proposing an approximation of Literature to other areas of knowledge, from an innovative research perspective. The project offers opportunities for engagement in many fields, and everyone is welcome to take part in this process."*

From this call, the first group of researchers was structured with those who indicated their interest via a form forwarded on the day of the presentation, and on April 1, 2023, the first morning of the PLIT Project took place.

**Semester # 2. June to December.**

In correspondence with the beginning of the development and execution steps, the activities carried out in the second semester materialized goals on different fronts of the Project and their reach can be measured by following the plan of activities projected for the first year, as shown previously:

1) General structuring for the continuity of all of the dimensions of the Project's proposal: conceptual, methodological, material, systemic, and communicational;

Summary of the surveying process between April and July of the 1st semester:

- To identify the sense of innovation, even at the thresholds between the scientific, academic x academicist, and the 'popular';
- To examine hypothesis about the products to be projected, journal and platforms, and which their characteristics are;
- To examine the hypothesis about the audiences to be reached;
- To investigate what would be the social impact starting from Literature (formulating the guiding questions of the proposal: how can Literature articulate bridges with other areas of knowledge to discuss the future? How can Literature + Design work with ways and approaches to acting regarding the common good? Which social demands could be minimized or tackled through the acting of the Project? For that, between May and June, we started to question the


*Figure 3. Plit Project 1st year agenda. Semester #2. June to December.*

sense of inclusion, seeking diverse meanings for the term — with that anticipating the theme to be debated in a more directive way at the International Congress for Inclusive Literature, promoted by the Program and held at the end of October 2023.

Taking into consideration the first conceptual guiding survey above summarized — which was debated during the routine of meetings and tasks of the first semester as well — the continuity for the implementation of Project PLIT's culture, as a global conception of the proposal, took place.

Through an agenda of activities promoted inside the Program, we sook to communicate the proposal not only with the researchers involved in the process but also with other groups — both internal and external researchers and other audiences — since all of the activities and events were planned to offer free access for a general audience, according to the vital goal of the proposal. Thus, for example, both the "Encontros de Formação PLIT" — "PLIT Education Meetings" — (minicourses), and "Diálogos transdisciplinares PLIT" — "PLIT Transdisciplinary Dialogues" — (webinars), had the purpose of discussing and investigating aspects that concert the project's agenda — such as the concept of "journal" and "innovation" when applied to editorial projects or the meaning of "inclusion" when seen through different

disciplinary perspectives. "To discuss and investigate the concept of 'journal' on the threshold between academic and scientific, contemplating normative, language, curatorial, editing and other aspects, being able to attract both a specialized audience and a general audience, assuring subsidies and education, especially for the members of PLIT." Was the outline for the presentation/release of the first mini-course.

With the purpose of educating, informing, and promoting debate and knowledge in an accessible manner, these activities aimed, as well, at assuring subsidy and education for the researchers that were members of PLIT — which means, for the proposal, to survey data for the research at the same time that content was produced for the publication of the products; methodologically, activities that work as field research.

At the same time, through these activities, the goal of engaging the researchers in the production of the academic activities was fulfilled: actively and with protagonism, which was the specific case of the minicourses and the Seminary-Event. For this, new formats were tested: it's the case, for example, of the minicourses that took place as interviews, allowing a dynamic and at the same time strategic dialogue regarding themes that interest PLIT: with the participation of guests and the elaboration of a script with questions previously discussed between the curatorship and researchers, the latter could act as interviewers, interacting by mediating the interviewed and the audience, seizing the transdisciplinary vision of the proposal — always keeping in mind that, for the most, this regards researchers from the areas of education and letters.

While on the first semester, we focused our efforts on the creation of a team and the structuring of an appointed "body" of concepts, goals, and a shared work routine, In the second, the fulfillment of the agenda of activities allowed us to give visibility to the proposal's intention and methodology(ies) by the concreteness of the programmed actions. This was performed in layers of construction, which allowed to compose an identity for the Project which also assisted its communication. This narrative, or storytelling, sewn through the release of activities via the Program's channels and profile (@plitprojeto) on social media, generated a visual communication with chromatic repertoire, typographic fonts, a typology that could mark some contrasts with the Program's patterns to produce a particular identity for PLIT as a brand, complementing the process of disseminating the culture of the project's proposal.

2) Development of the first products, assuring the implementation of one of them;

In the second semester, the implementation of two planned products was able to begin: Experimental Lab and Activities of Scientific Exchange, whose description can be verified at the beginning of this document. At the same time and as previously appointed, the performed activities generated content for the following products, Journal and Digital Platform and Exhibitions — whose contents were specially directed to creation.

3) Creation of the agenda for academic production in different formats;

Two cycles of minicourses were held — the first, divided between three days, and the second, between two. In the second cycle, the theme that marks PLIT's proposal's uniqueness was approached, in the education of Post-Graduation in Literature: the binomial Design-Literature which sustains the originality of the project. Because of that, the name Design como projeto em (trans)formação — Design as a (trans)forming object became the central thread of both cycles, being restated at the seminar-event "Dinâmicas para

projeto e intervenção a partir da literatura" — "Dynamics for projects and intervention from Literature", now Literatura e Design em projeto — Literature and Design in projects. Two webinars were also performed, both concerning the notion of "inclusion", with conferences given by specialist scholars of reference, in their respective areas of origin: the anthropologist Joao Pacheco de Oliveira and the semiotician Lucia Santaella.

The seminar-event "Dinâmicas para projeto e intervenção a partir da literatura" was the last activity of the season and had a partnership with AEL/SME since the beginning of the planning for the PLIT agenda for the second semester. The seminar's program went through the Prefeitura/ SME's approval, being afterward published at the Diário Oficial (Official Gazette) and diffused throughout the public network of education, aiming at assuring a quota of subscribers as attending audience, among education professionals and librarians. The event had the support of invitees such as artists and other professionals of reference from photojournalism, literature, theater and documental cinematography such as: @eduardonicolau, @eva.furnari.oficial, @denisestoklosoficial, @geometriasincongruentes (Emma Jovanovic), @territorio_do_brincar (Renata Meirelles e David Reeks). The curatorship of the event was thought to materialize PLIT's proposal completely, proposing to stimulate the audience's creativity for propositions of social intervention, using planned dynamics stimulated by the inspiration of the presentations and performances by the invitees. The interaction with the audience which characterized the event's format was exemplary: it accomplished the purpose of the materialization of the Project, being able to communicate the proposal and, thus, being useful to point out paths for PLIT's second year of activities.

The event also signalized a first turn in the direction of the outside world, from the university to other social sectors, as well as the goal of communicating to varied audiences — the vital purpose of the Project.

Last, always as a result of the partnership with AEL/SME — Academia Estudantil de

Letras/Secretaria Municipal de Educação (Student Academy of Letters/ Municipal Secretariat of Education —, we had the accomplishment of the aforementioned participation of the PLIT Project on the PMLLLB Seminar, Plano Municipal do Livro, Leitura, Literatura e Biblioteca (Municipal Plan for the Book, Reading, Literature, and Library), an important public instrument that acts in the City, represented, moreover, by an elected Council by the civil society, corresponding to social sectors connected to reading, including the university.

4) Curatorship for the promotion of opportunities and cycles of dialogues: between peers; institutions; university and society; diverse social segments and varied audiences.

The seminary-event "Dinâmicas para projeto e intervenção a partir da literatura", "Dynamics for projects and interventions from Literature" closed the agenda of PLIT's second semester, accomplishing most of the Project's curatorship's requisites. However, on the whole, all of the events that were carried out accomplished some of the goals and, acting in complementarity, favored the global transdisciplinary process of the proposal.

An important datum already pointed out, which is relevant to be reinforced, regards the names given to the events, translating the internationality of project of the PLIT proposal. Traditional formats, more than reconsidered, were renamed, always carrying PLIT's identity according to the function of each content. Example: Minicourses = PLIT Education Meetings or Webinars = PLIT Transdisciplinary Dialogues.

In December 2023, the first activity of scientific exchange was performed at an international event with lecturers invited from foreign institutions and post-doctorate researchers of diverse areas who study in national institutions via diverse scholarships and, in some cases, inserted in international research on a large scale.

That is the Escola Interdisciplinar FAPESP (Humanidades, Ciências Sociais e Arte), FAPESP Interdisciplinary School (Humanities, Social Sciences, and Art), a pioneering initiative in Brazil, still in its second edition and to which the PLIT Project was taken and presented in English, the language used during the whole period as a condition for participation. in this intensive dive, beyond the exchange between peers, it was possible to get to know and get compared to cutting-edge research in the areas of Anthropology, Communication, Art — theater and music — and Design, and to observe the development given to the visions of future in the scientific context.

## Conclusions

From this experience, complementarily to PLIT's first-year framework, it was possible to verify:

1. PLIT finds itself syntonized with scientific thought regarding the projections for the future: environmental concerns of physical and social orders;
2. Overall, the transdisciplinary format proposed by PLIT is still scarcely practiced in the academic sphere, presenting how Design approach that is little diffused;
3. The PLIT Proposal is a pattern of innovation that brings a Design perspective e methodology for experimenting transdisciplinary models of Literature education, as well as other disciplinary fields, starting from Graduate Program — highlighting the Project's uniqueness in University;
4. Projects with PLIT's characteristics need to operate in a perspective of outreach that allows a collaborative modus operandi between Programs, Courses, and Institutions of Higher Education, creating networks of partners with diversity of groups, both inside and outside the University;
5. Projects with PLIT's characteristics do not get fulfilled in just two or four years of work and they also need external institutional support and financial contribution;
6. To reach actions of pragmatic social impact, it is necessary to work bearing public policies in mind and alongside them.

Operating with the complex system of University, Project Thinking Design approach in PLIT's transdisciplinarity functions to ponder on the management of diverse scales and dimensions — such as political and administrative. In the university's organism we can highlight two crucial topics: the transfer of knowledge and the social impact — teaching, research, extension, innovation, and interinstitutional and international relations — all of the fronts contemplated by PLIT.

Through this scenery of marks and comprehensions and the outlined "pre-requisites of project" the PLIT Design problematics is configured to this point. Pointing to the potentialities of the proposal, this paper tried to indicate the critical and methodological extension of transdisciplinarity of the Lab-Program, currently in development by Universidade Católica de São Paulo (PUC-SP). Moreover, with that, we also hope to attract new partnerships for the PLIT Project.

## References


1. *Argan G. C. (1998). História da arte como história da cidade. São Paulo, Brasil: Martins Fontes.*
2. *Bisson, M. (2024). Design inclusivo e/ design per il bene comune. Webconferenza. São Paulo, Brasile: PUC-SP.*
3. *Bonsiepe, G. (2015). Do material ao digital: A life of Janet Frame. São Paulo, Brasil: Blucher.*
4. *Durling, D.; Friedman, Ken (2000). Doctoral education in Design: Foundations for the future. Staffordshire, England: Staffordshire University Press.*
5. *Pacheco de Oliveira, J. (2023). Retrieved from https://www.nytimes.com/2022/11/09/magazine/brazil-national-museumindigenous.html*

# What if interactive artifacts would disrupt human relations?

*Andrea Di Salvo*
*andrea.disalvo@polito.it*

*DAD – Department of Architecture and Design, Politecnico di Torino, Italy*

***Keywords:***
*Interaction Design*
*Narrative Approach Process*
*Speculative Design*

## Abstract

If the act of Designing is concerned with forthcoming future, during the last 20 years both Design Fiction researchers and Speculative Designers pointed out how Design must imagine and debate on preferrable and possible futures. To encourage this transformation, it is crucial to evaluate new approaches precisely in the educational field. The paper aims to illustrate an experimentation that links research and teaching, based on the intersection between Interaction Design based on a narrative-fictional approach and Speculative Design, in order to: evaluate the approach, the process, generate discussion within the projects and also to proactively involve the micro-community of the classroom and territory's actors. The theme of experimentation focuses on the recent drought in Piedmont, in order to design an ecosystem of interactive artifacts and speculating on what if a critical mass of people would adopt those interactive artifacts.

## Introduction

During the last 20 years Speculative Design and Design Fiction have been increasingly used not only in the academic field but also among practitioners and companies as a technique or a tool to explore possible futures linked to the massive use of technology-driven products and services. At the same time, arts, fictions, novels and movies are continuously speculating about how the next future will be, questioning even on the Design value and its role in the crucial events the world is facing. On the other side, Interaction Design (IxD) is often considered as short-term problem solver, too technology-driven, because it developed during the years of strong growth and adoption of digital products; even if IxD aims to create meaningful relations between humans and should: have an agnostic approach to technology, be grounded on users' analysis, create human-human relations as the fulcrum of the project and generating artifacts as possible relational mediators (Germak, 2022). In this context, IxD usually follows a process mainly based on the double diamond (Design Council, 2019) which is articulated through well-defined steps: user research that ends with the generation of Personas, Scenarios (mostly goal-oriented), Journey Maps, generation of the concept(s) to be consolidated and tested through prototypes and mock-ups. On the contrary, Speculative Design and Design Fiction aren't still sharing a well-established process, probably relying too much on the designer's intuition or sensitivity,

especially during the first phases. Therefore, at first the paper analyzes the possible intersections that can enable a process that is – at the same time – based on a human-centred but also narrative-speculative approach, to foster researchers and students a high degree of critical awareness acquiring the fundamental skills of IxD.

## Speculative design and design fiction methods

Starting from the 2000s, a series of approaches – which have now become real disciplines – made their way both in the academic world and among practitioners. Their aim is to shift attention not only towards problem-setting but, above all, towards a conception which sees Design as an activator of discussions (Norman, 2004), as a tool to provoke and involve communities and territories, with the desire to increase the awareness degree regarding the possible impacts of an extensive use of technological objects in daily life. These disciplines are named Design Fiction (Bosch, 2012), Speculative Design (Dunne & Raby, 2013), Critical Design (Dunne, 2005), Adversarial Design (DiSalvo, 2012) and many other branches. It is often difficult to find clear separations, to the point that Auger (2013) suggests that the chosen name derives mostly from the intentions that the project aims to put in evidence. Even the outputs can spread from artifacts, defined as diegetic prototypes (Sterling, 2009), exhibited in contexts such as exhibitions (Changeist, 2022) or used in participatory workshops open to citizens (Rüller et al, 2022), to short stories (Desjardins & Biggs, 2021), small theatrical pieces (Ventä-Olkkonen et al, 2021), short videos (Stals et al, 2019). In order to create these prototypes, artists, researchers and practitioners from the world of humanities are increasingly involved in the process. This allows not only to bridge aspects which are not characteristic of Design training, such as writing or screenwriting, but really makes the projects more open, broad, engaging, especially when the prototype refers to fields not too much covered by Design skills. These considerations derive from the awareness that art, in which we can also include fictions, novels and sci-fi movies, is able to show possible futures with a force, an engagement and a degree of verisimilitude capable of bringing spect-actors (Floridi, 2012) and designers towards a reflection on the value of Design. The design education in Interaction Design could benefit of the adoption of this approach, above all in order to experiment new relational methods (Bistagnino, 2009), even during the design process, starting from a micro-community as a design class is. The fictional-speculative approach could also provoke the debate from the very beginning of the process between designers and other actors involved. Furthermore, the elements of critique should be underlined, discussed and worked – not properly taught – in every step of the process to stress each speculative consequence of an interaction.

The fictional and speculative disciplines are relatively young, projects and articles date from the turn of the century: the cornerstone book of Speculative Design which collects previous works is dated 2013 (Dunne & Raby, 2013), the first book that praises of being a Design Fiction manual (Bleecker et al., 2022) was published very recently. Despite this, although the number of projects and scientific publications is constantly increasing – the number of publications on the scientific libraries shows exponential growth going from 5.477 in 2000 to 35.008 in 2023 (ACM Library, 2023) –, it is difficult to identify shared methods. Only three examples are reported below, the most cited in the literature, in order to show how different are the processes and even the used wording. The process described by Grand and Wiedmer (2010) includes: creation and construction of possible future worlds; materializing those possible future worlds; plurality of different

perspectives and approaches; representing, visualizing, documenting the experimentation processes; experimentation as being generated through an experimental system. Instead, in the Manual of Design Fiction, the steps are a bit different and reorganized: collect faint signals, select an archetype, present stimulus materials, extrapolate from signals, identify the "what if", know your tropes, design workshop, make the thing!, disseminate. This method includes a starting phase which is similar to a research phase, even if is not so structured, furthermore the choice of the archetype happens immediately after and depends on the skills of the designers.

On the other hand, to reconstruct the speculative design process, it is necessary to rely on its elements, its characteristics, generating: fictional worlds, utopias/dystopias, extrapolation: neoliberal speculative fiction, ideas as stories, thought experiments, reductio ad absurdum, counterfactuals, what-ifs, fictioneers in denial (Dunne & Raby, 2013). Therefore, if the motivation is clear (i.e. generating a constructive and informed debate), if the possible fields of interest are consolidated but not limited (i.e. politics, privacy, food and genetic mutations), if features continue to be explored and discussed (i.e. use of humor (Helms & Fernaeus, 2018)), if the outputs can have very different formats and often very far from the original concept of tangible prototype, the process appears to be not sufficiently explained. In this way, the possibility itself to test hypothesis stands on a debate or discussion that should generate a kind of short- or medium-term impact inside the community or all around the world. The debate is also open on some specific crucial aspects. The need to create a worldbuilding – that supports the discussion on prototypes with a sufficient degree of verisimilitude – is widely shared, however some scholars deny the need for narration and storytelling, relying on rhetoric (Coulton et al., 2017). Others, on the other hand, rely on narration or the creation of a story (Blythe, 2017). Still others, including examples of science fiction films among the case studies, use an opposite diagram based on two axes to catalog the projects, but at the same time to provide a guide for the fictional/speculative meta-design (Johannessen, 2017); the axes names are: narrative based-object based; alternative presents-speculative futures (FIG1).

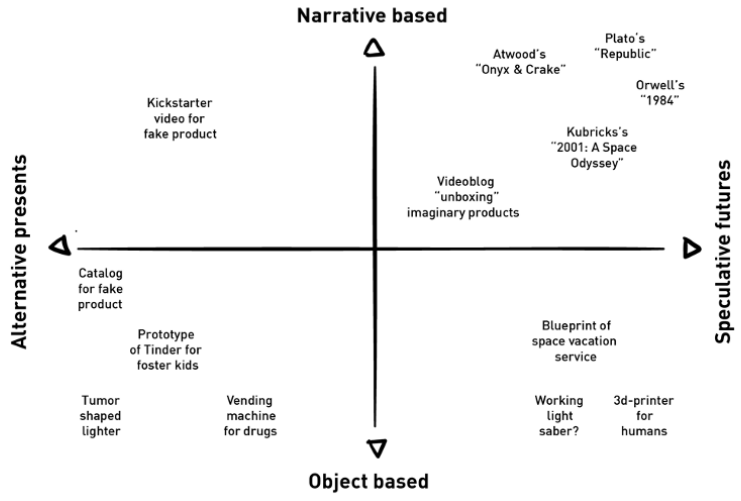



*Figure 1. Johannessen schema (2017) on practice uses scenarios in the speculative future or alternative present, which materialize as narratives or objects.*

After verifying the lack of shared methods in the research works presented in the literature, the next section focuses on the actual methods used to teach fictional and speculative approach in order to get insights on the actual situation.

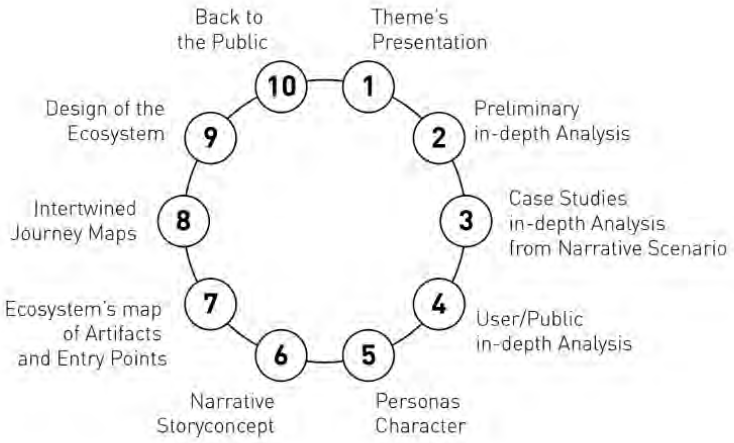
## Fictional and speculative education

In order to verify the pervasiveness of the fictional and speculative approaches and better understand the possibilities in the educational field, the author carried out a literature review on a basis of over 90 articles found on the main scientific libraries, published in the last 15 years using the queries "design fiction" + "education" and "speculative design" + "education" (list available at: urly.it/3-dnp). The 15-year period was chosen to include as much as possible the works starting from the first texts on the disciplines of Design Fiction and Speculative Design. This research joins others in progress, for example, on the role of narration which analyses over 100 papers; these reviews highlight the difficulty in finding a shared process, that is rarely expressed and described. In fact, after a declaration of the chosen approach (speculative, fictional or both the two), it is customary to describe just the mode the scholars used. The most used mode is usually a co-creation workshop (over 60 articles), in which researchers involve selected categories of people to generate new ideas and discuss on them; but sometimes scholars directly jump to the choice of the prototype to be designed without giving any information on the previous phases. This underlines how often the scientific community uses Design Fiction or Speculative Design instrumentally, as generators of new concepts without stringent constraints, as if they were a creative technique (Stein, 2016); or better as an activator of discussions on specific topics of a project. In this last way, it is possible to evaluate in advance, even on behalf of private companies, the possible reactions of the public and the buyers in the face of radical technological innovations, as happens for the IKEA Catalogue (Brown et al., 2016) or in research phases that are concerned with ethical aspects (Lupetti et al., 2018). These practices are now widespread. Dunagan et al. (2019) described one of the very few examples in the literature of a didactic process, the theme of the course refers to Experiential Future and belongs to the galaxy of future studies – not too dissimilar from Speculative Design and Design Fiction – in which Candy's experiential futures ladder is adopted (2010). In the same fields other useful suggestions come from the work by Barbara and Scupelli (2021). It is useful to also mention a specific case study worthy of note, namely the publication by the speculative.edu project (Mitrovi et al., 2021). The chapter entitled "methods, approaches and tools: ambiguity tensions and scopes" rather than highlighting methods shows how the tension between opposing elements is able to generate speculation of value and project spaces. The tensions are: exclusion (human-kind); engagement (participant-witness); use (prop-product); completion (process outcome); gain (learn-earn); perspective (local-global); time (past-future); inclusion (non-Human). If the last two sections of this paper tried to highlight the lack of shared methods in general, and in particular in education, the next section illustrates the experimental process designed by the author, in order to: include the fictional-speculative approaches inside the IxD methodology to foster IxD towards critique and awareness; to integrate speculation as a dialogue from the very beginning.

## The adopted process

The process is based on an evolution of the one proposed by the author (2024) and revised to further explore the speculative and discursive aspects in all steps within the micro-community. The process follows the steps illustrated in Figure 2.

*Figure 2. The adopted process.*




Theme's Presentation. It is not a real brief, but instead the mandatory outputs of the project are clearly declared, that is, an ecosystem of interactive artefacts prototyped in form and interaction (interaction could be simulated if the level of complexity is too high); an immersive website that tells the story of the project and the process (it is in effect one of the entry points of the narrative); a short video built in 3D animation that integrates people and artifacts (it should be a narrative video, not a descriptive one). The choice of the 3 outputs derives from the setting of the module which includes 3 courses and 3 teachers that give classes to those topics. The theme chosen for the experimentation is drought. The choice was made to avoid speculating on topics that could be perceived as too futuristic, almost sci-fi. In fact, during the course year (2023), the data was alarming, the rivers of the city where the university resides were dry, the days without rain had exceeded any previous record. Furthermore, the choice of the theme is also well suited to the attitudes and expectations of the students who expect great importance given to the theme of sustainability.

Preliminary in-depth Analysis. Each student has a week to do initial research on the topic and communicate it concisely through a podcast of 2 minutes maximum. It is a first survey to understand how students perceive the phenomenon, how they frame it and tell it using one of the most current narrative and synthetic methods. To better understand these data, the author used software (atlas.ti) for text analysis in order to track the most used words, how they were connected, find co-occurrences and sentiment analysis. The results of this analysis show a clear relevance of words related to water and the environment in general, with a clear predominance of the term "climate change" (Figure 3).

Furthermore, the software detects a neutral sentiment in almost all the 58 cases, a fact confirmed by the empirical observation that in only 2 cases students used music to underscore the words. Each student was then asked

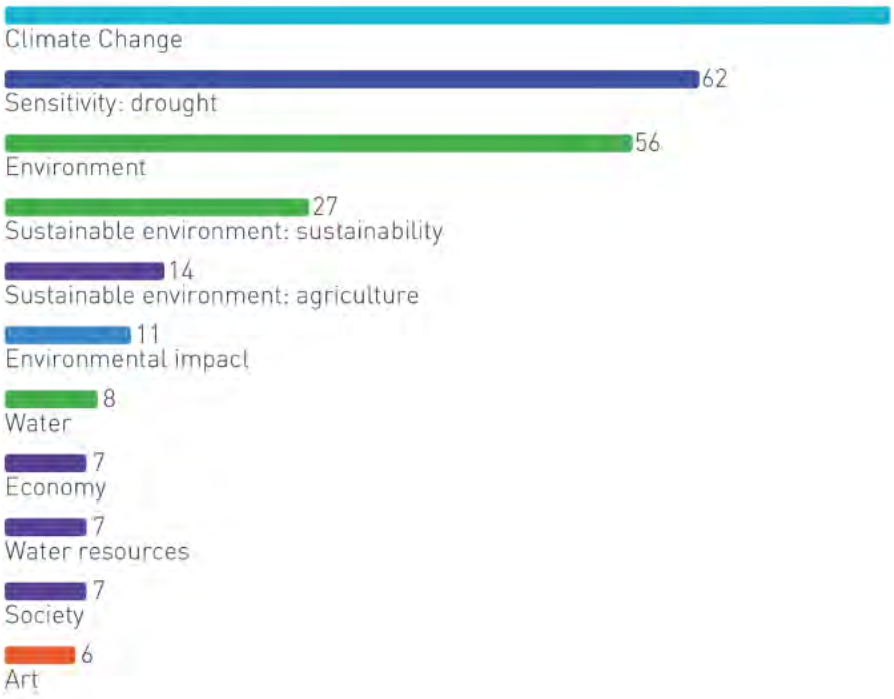



*Figure 3. Analysis made through atlas.ti to better understand the most used words and sentiment analysis.*

to analyze at least 10 podcasts of their colleagues using as criteria: the type of podcast (Catch-up, Interview, Free-talk, Narrative podcast, Scripted, Hybrid); the vision (Utopian, Positive, Neutral, Negative, Dystopian); the tone of voice (cold (technical, formal and bureaucratic), neutral (professional, dreamlike), warm (friendly, colloquial) and colorful (irreverent, provocative and ironic)); the emotions it arouses (2 at most among those proposed by Plutchik); describing the podcast through 4 keywords. The results of this analysis appear quite consistent with what was found by atlas.it, with almost all narrative podcasts (56 out of 58), a neutral or negative vision, a tone of voice that oscillates a lot between the different podcasts precisely due to different personalities of the students, a complex series of emotions highlighted in figure 4, on which interest and apprehension stand out.

Starting from this data, both teachers and students delved deeper into what had already been produced on the topic, both in a scientific and fictional-speculative way.

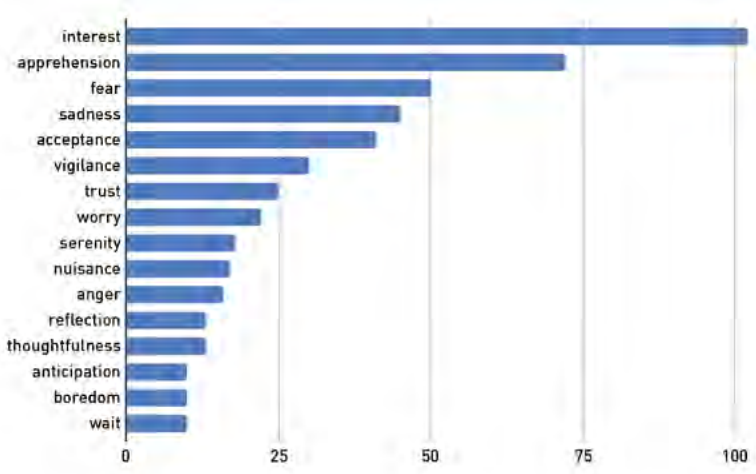



*Figure 4. Analysis of the emotions felt by students analysing podcasts.*

Case Studies in-depth Analysis from Narrative Scenario. Students divided into working groups and each group chose at least 20 case studies, including not only cases relating to design but also everything that can enable possible interpretations and representations of drought, from purely technical-technological ones, to those of Social Design, documentaries, installations, art and much more. At this time, it is not required that the case studies belong to Design Fiction or Speculative Design. Each group must then present the results of the research, collected in a digital book, to the entire class, highlighting not only the interaction but also the possible aspects of critique and trying to speculate on their hypothetical massive use. In this phase, the whole class collaborates in searching for information and generating outputs that constitute a sort of shoulders of giants to climb on. The analysis criteria agreed bottom up with the class are: the main information (year, place, author), the typology, the keywords capable of connoting the case, the writing of the story concept in reverse, the identification of the narrative form following the 7 plots of Booker (2004).

In the analysis, the author noticed how the main origin of the case studies corresponds to Italy and the USA, while for all the other nations there is a notable dispersion. This highlights how students looked for examples located in their country of origin or where those are in greater numbers. In the literature it is often noted that the speculative approach is typical of the western Europe and US, the data confirms it. The analysis of the typologies shows a dominance of films (including documentaries), a conspicuous quantity of works of art, performances and installations, with a good presence of Product Design. The data that emerges both in this analysis and in that of the keywords is, however, a low percentage of interactive artefacts.

The possible explanation is that the interaction could be often considered as part of the performances or installations without being predominant. If an analysis of the total recurrence of the keywords shows a strong impact of the term sensitization, awareness, change and sustainability, however, if a clustering is carried out into 4 categories (type of output, strategy adopted, tools, methods of connoting/describing) the most used keywords being are obviously the ones used to describe and connote the phenomenon of drought, followed by those which declare the strategies to deal with and therefore the tools. Lastly, the typologies. This highlights that drought can have multiple consequences on a territory at different scales, while possible strategies are still limited. The plots are all represented at the same level, except for Rags to riches, probably because the theme lends itself little to such a narrative arc (Figure 5).

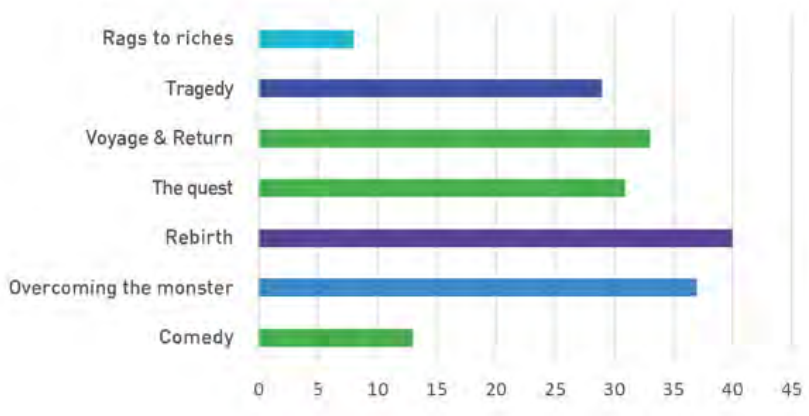



*Figure 5. Analysis of the plots used and identified by students to communicate through podcasts.*

Starting from this research, students and teachers had a clearer picture not only of the phenomenon but also of the way in which it was represented, described and addressed by disciplines similar to or more peripheral to the world of IxD.

User/Public in-depth Analysis. Starting from the observation that Speculative Design and Design Fiction do not have users in a strict sense, but users could be considered as a participating public, students and teachers drew up a questionnaire with the aim of understanding what the perception of the drought phenomenon was, what emotions it aroused, whether the people interviewed felt involved and how they would have reacted to the situation. Furthermore, each student interviewed 1:1 in a semi-structured way at least one person who had experienced the phenomenon of drought first-hand, for example in agriculture or in areas where water is rationed. The result of the quantitative analysis (647 questionnaires filled out online through a Google form to which one was invited via email, sharing the link on social groups or through word of mouth) highlights (Figure 6,7) specifically a level of information on the phenomenon that is not high, but a clear perceived importance, an overwhelming majority of negative emotions (including 50% who declare anxiety). Other very interesting data concern the possible strategies that seem to suggest a high responsibility of the administrations at all levels, which should therefore guide the population more by taking advantage of adequate education. The answers inserted to these last two items, the numbers of those who trust in technological development, but – above all – that one who would change habits to improve the lives of the next generations, strengthen the need of long-term strategy and community if guided by the administrations.

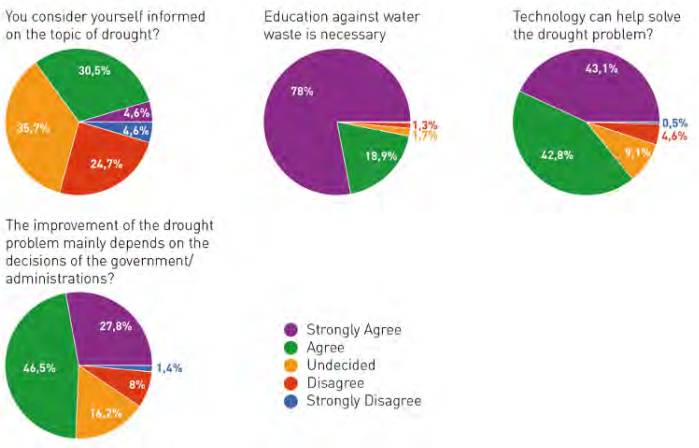



*Figure 6. Insights from the online questionnaire.*

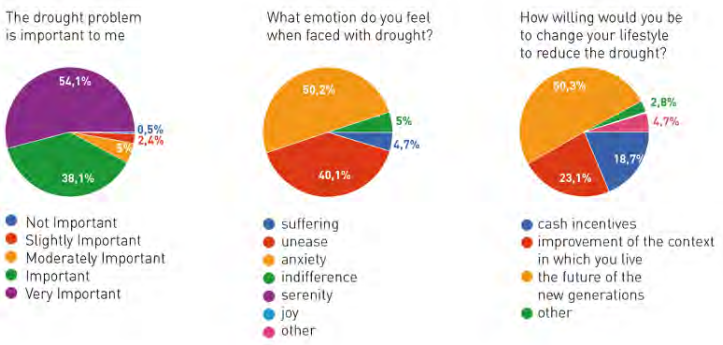



*Figure 7. Insights from the online questionnaire.*

Personas-Character. The result of the quantitative analysis and the approximately 130 interviews allowed the students to generate 3 personas per group. These personas are defined as character personas because they must be able to tell a story, avoiding not only stereotypes but also the excessive schematization that usually accompanies personas. The result therefore consists of a series of short data-driven stories which have the double role of creating and remembering the empathy found in the 1:1 interviews and of suspending disbelief precisely because of the many data obtained, but above all they allow – in meaning of the public – to be able to better identify expectations, emotions and communicative-narrative strategies typical of Speculative Design and Design Fiction which have not been explored in depth so far.

Narrative Story concept. Next, each group has to produce 5 story concepts in what-if form, also with the help of a set of cards called Dixit Journey. Each story concept is represented in the form of a sentence of up to 30 words in interrogative form, to allow open endings and an image that represents it in an abstract way, which does not derive in any way from previous research. The whole class is then asked to read and vote on the story concepts, helping each group to self-elaborate the most promising design path, that is not only the ones that includes interesting interactions but also the more engaging speculations.

The remaining points remain very similar to the characteristic aspects of IxD: map of the ecosystem of artifacts with entry points; intertwined journey maps, design / prototype of the artifacts and the interfaces; back to the public i.e. the discussion with people who demonstrated their interest during the survey and the interview. In these phases teachers act as facilitators during the discussion, giving advices only when is necessary to refers to the pillars of the disciplines, it is of course an iterative phase but teachers tend to avoid to stress errors in order to foster the discussion, the critique, the speculation.

## Process Results

The following figures show 3 of the 9 projects presented by the students; the selection aims to highlight not the best projects, but those which respected the process phases the most.

*Figure 8. Project: Helle. To survive, a new appliance is needed, which not only causes humidity to precipitate from the air but also makes it drinkable, pleasant, enriched with new flavours. A luxury product with an aesthetic that recalls some perfectly designed hi-tech products, with natural and playful interactions, but which has a service behind based on the exploitation of people, territories, precious materials and therefore of the entire society. Is the model sustainable?*


*Figure 9. Project Vision. The surgically implanted third eye is all we need to self-monitor our use of resources, to constantly question objects, products and services on their sustainability, to even be able to share the amount of water given to each person to survive. The eye communicates with our brain but also with a centralized apparatus, it seems to support sharing, but will those really be the desired outcomes?*

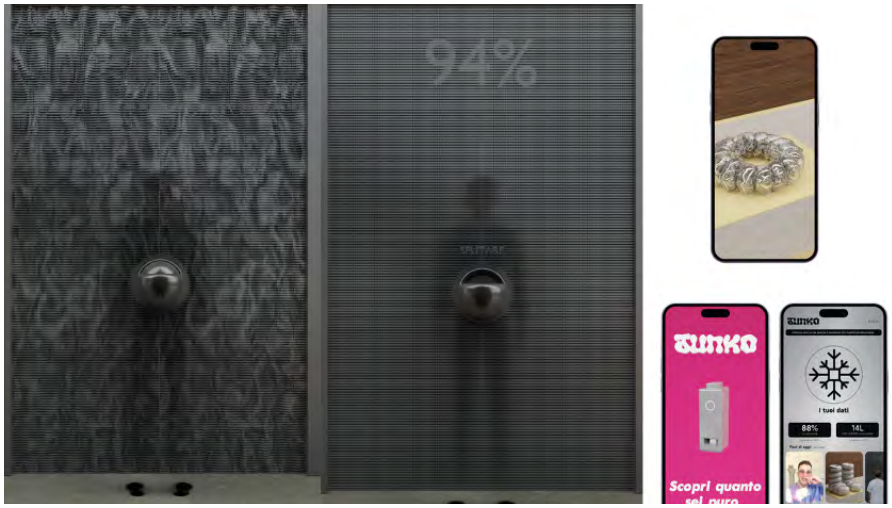



*Figure 10. Project Junko. Being hydrated with pure water is true wealth. Access to social places depends on an interactive screen that tests people's saliva and allows entry into the community. Added to this are the new models of ostentation of one's social class, i.e. water jewels and strategies to cheat tests, such as chewing gum that promises to purify saliva and digital applications that connect the accepted and the rejected. What will be the new beauty model? What is the new sense of belonging?*

## Conclusions and future work

The didactic goal succeeded in fostering the knowledge of IxD in several aspects, generating a critical awareness about technologies and behaviors throughout the Design process; instead, the research showed the main limits of narrative and fictional aspects, if applied to the whole process, mainly concerned to verisimilitude, feasibility and territory's involvement. The latter happens because people interviewed during the first phase expected a more problem-solving project, so – through semi-structured interview – they expressed interest in the projects especially from the creation of consciousness and awareness for the public, but even if they could interact with artifacts, they would like to have kind of ready to market objects.

At the end of the courses, the students filled out an anonymous questionnaire, different from the one requested by the university, in which they were asked to evaluate the process and to verify how it helped, or not, them in building the project. The results of the questionnaire confirm for 80% of the answers that the process was interesting and unusual for them (note that unusual is different from innovative), the 75% consider themselves more aware after the course about the issues of Design and technology, however they underline the difficulty in clearly distinguishing sci-fi from Design Fiction aspects. 57% of the students are convinced that they have designed in a fictional and speculative way, 35% believe that they have generated projects more oriented towards the sci-fi world. From the point of view

of teaching, it was often difficult to demonstrate to the students that this process, even if it did not have a high TRL (Technology readiness level), was able to respect all the pillars of the disciplines involved. Moreover, students evaluate the methodology as strongly based on generating relations between people (89%), capable of designing artifacts that critically address the design process (79%), this data appears encouraging regarding the process. The future work from the point of view of research is, according to the author, first to structure even better especially the steps relating to concept generation in which the narration can take over towards solutions that are too sci-fi. Second, the creation of the relations between students has been often very encouraged by teachers using online tools such as Miro, giving students time and space to free discuss without hierarchies. Sometimes it worked well, sometimes the discussion was poor; a next step to sustain the discussion – and therefore the critique and the awareness – should be the design of a process or a toolkit that could better help the students letting them free to discuss but also independent during that phase.

# References


1. *Auger, J. (2013). Speculative design: crafting the speculation. Digital Creativity, 24(1).*
2. *Barbara, A., & Scupelli, P. (2021). Teaching to dexign futures in cities. In TECHNE Special Series Vol. 2. Firenze: Firenze University Press.*
3. *Bistagnino, L. (2009). Design sistemico: Progettare la sostenibilità produttiva e ambientale. Bra, Cn: Slow Food Editore.*
4. *Bleecker, J., Foster, N., Girardin, F., Nova, N. (2022). The manual of Design Fiction. Venice: Near Future Laboratory.*
5. *Blythe, M. (2017). Research fiction: storytelling, plot and design. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems.*
6. *Bosch, T. (2012). Sci-Fi Writer Bruce Sterling Explains the Intriguing New Concept of Design Fiction. In https://slate.com/technology/2012/03/bruce-sterling-on-design-fictions.html [12.01.2023].*
7. *Brown, B. et al. (2016). The IKEA Catalogue: Design fiction in academic and industrial collaborations. In Proceedings of the 19th International Conference on Supporting Group Work.*
8. *Candy, S. (2010). The futures of everyday life: Politics and the design of experiential scenarios.*
9. *Changeist (2022). Changeist. In https://changeist.com/ [12.01.2023]*
10. *Coulton, P., Lindley, J. G., Sturdee, M., Stead, M. (2017). Design fiction as World Building. In Proceedings of the 3rd Research through Design Conference.*
11. *Desjardins, A., Biggs, H. R. (2021). Data epics: Embarking on literary journeys of home in-*

*ternet of things data. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems.*

12. *Design Council (2019). Framework for Innovation: Design Council's evolved Double Diamond. In https://www.designcouncil.org.uk/our-work/skills-learning/tools-frameworks/framework-for-innovation-design-councils-evolved-double-diamond/ [13/01/2023]*
13. *DiSalvo, C. (2012). Adversarial design. Cambridge: MIT Press.*
14. *Di Salvo, A. (2024). Interaction and Verisimilitude. How Narration Can Foster the Design Process. In: Zanella, F., et al. Multidisciplinary Aspects of Design. Design! OPEN 2022. Springer Series in Design and Innovation, vol 37. Cham: Springer.*
15. *Dunagan, J., Draudt, A., Hadley, J. J., Hogan, R., Murray, L., Stock, G., & West, J. R. (2019). Strategic foresight studio: A first-hand account of an experiential futures course. Journal of Futures Studies, 23(3).*
16. *Dunne, A. (2005). Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design. Cambridge: MIT Press.*
17. *Dunne, A., & Raby, F. (2013). Speculative everything: design, fiction, and social dreaming. Cambridge: MIT Press.*
18. *Floridi, L. (2012). La rivoluzione dell'informazione. Torino: Codice Edizioni.*
19. *Germak, C. (2022). Design mediator between humanism and technology, in technical culture and humanistic culture: the Turin case. In: ATTI E RASSEGNA TECNICA, vol. LXXVI, pp. 63-67.*
20. *Grand, S., & Wiedmer, M. (2010). Design fiction: a method toolbox for design research in a complex world. In proceedings of the DRS 2010 conference: Design and Complexity.*
21. *Helms, K., & Fernaeus, Y. (2018). Humor in design fiction to suspend disbelief and belief. In Proceedings of the 10th Nordic Conference on Human-Computer Interaction.*
22. *Johannessen, L. K. (2017). The young designer's guide to speculative and critical design. Trondheim: Norwegian University of Science and Technology.*
23. *Lupetti, M. L., Smit, I. and Cila, N. (2018). Near future cities of things – Addressing dilemmas*

# The (Un)Sustainable Future - Design and Resignification of Materials and Processes

*Maria João Barbosa[1], Benedita Camacho[2], Diogo Frias Riobom[3], Bernardino Gomes[4]*
*mjbdesigner@gmail.com, beneditacamacho@gmail.com, dfriasriobom@gmail.com, dizegomes@hotmail.com*

*[1,2,3,4] Lusíada University, Faculty of Architecture and Arts; Research Center on Technology, Architecture and Design [CITAD], Portugal*

***Keywords:***
*Sustainability*
*Product Design*
*Industry, Innovation*
*Materials*

## Abstract

The current context of design is characterised by a growing global awareness of environmental and social issues, but also by a lot of misinformation about what is sustainable. A symposium was organised to promote a critical debate on sustainability between design, academia and industry. The focus of this initiative aimed to redefine materials and processes by incorporating waste as a raw material to promote more sustainable solutions. Speakers from Lusíada University analysed the current state of the art and carried out a comparative analysis of the main authors in the field of sustainability. Speakers from the Portuguese industry presented successful examples of sustainable innovation in new materials, new products and new approaches to waste recycling. All academic and industrial projects have shown that the inherent imperfections of new materials created through recycling and upcycling give products a new ethical and aesthetic dimension linked to innovation and environmental awareness.

## Introduction

### Industry Requirements

The first symposium "The (Un)Sustainable Future" was an initiative of the research project "Identity, Innovation and Differentiation in Materials and Processes (in Portugal)" of the Center for Research in Territory, Architecture and Design (CITAD) at the Lusíada University, in Porto. It aimed to demonstrate practical cases where theory applied to industry produced concrete results with a direct impact on sustainability and the economy. The main achievements were to share knowledge and promote a critical debate on new sustainable design practices applied in Portuguese research, education and industry.

The criterion for selecting speakers from the industry field for the event was their focus on sustainability already in practice with inspiring results and who were able to motivate and ask questions (a very difficult task in an audience mainly of students), discussing the (un)sustainable future of industrial waste. These speakers presented study cases where the reuse of surplus or end-of-life materials and raw materials had led to more efficient use of resources and significantly helped to reduce the use of raw materials.

This participation of companies in the textile, polymers and footwear

sectors, representing three of the most important industrial sectors in the north of Portugal, was based on their strong connection with universities, whether through the integration of interns in their activities, co-participation in research activities (master's and/or doctorate programs) and partnership in carrying out pilot projects with universities. It is considered that strengthening the relationship between industry and universities brings several advantages. From the industry side, we highlight the direct application of content taught in class and the constant search for creative solutions that lead to innovation. On the university side, we highlight the improvement of student learning and the creation of job opportunities.

All speakers had a common goal: to identify and share new ways of thinking, teaching, designing, producing and consuming that aim to achieve greater harmony between people, animals and nature. The three first speakers examined the current state of the art and carried out a comparative analysis of the main authors in the field of sustainability, which showed a great convergence of principles, regardless of the date of their writings. At the same time, academic projects, from upcycling projects with materials from industrial surplus stocks were presented.

The symposium exhibited different physical samples of materials, prototypes, products and academic works, which were displayed in an informal exhibition to allow a better understanding of the studies presented.

In the end, this type of events contributes to strengthening a network of contacts of enormous value for both parties, which guarantees their collaboration in the future.

## Sustainability is a complex and contradictory subject

The understanding of sustainability in product design has long intrigued researchers, experts, and educators. At the symposium, Camacho speaker explores sustainability as a complex and contradictory concept, analysing its broad appeal with Lusíada University master´s design students. Sustainability has an expressive influence on contemporary discourse, spanning critiques, theorization, and knowledge production, shaping research and practice implications. However, sustainability's complexity defies no simplistic interpretations - as industry speakers will demonstrate.

Approximately 30 years ago, John Elkington introduced the "triple bottom line" concept, emphasizing interconnection among people, planet and profit, as first highlighted in the 1987 Brundtland Report.

Achieving a balance between environmental protection, social development, and economic viability remains challenging, as exemplified by the United Nations' adoption of 17 Sustainable Development Goals (SDGs).

Climate change underlines the contradiction of sustainability, balancing between economic growth and the preservation of the environment amid an unequal wealth distribution.

Criticism around sustainability arises from its perceived impracticality and the potential perpetuation of poverty, revealing the inherent contradictions between economic growth and ecosystem limitations. Eco-design aims for holistic environmental impact reduction throughout a product's life cycle (Figure 1). However, it struggles with consumerism's rise, reflecting the dual societal role of design. Pollution often arises from seemingly eco-friendly materials containing non-recyclable components, highlighting the necessity of efficient recycling and the prospect of mono-materials and zero-waste products (Lefteri, 2002). Ultimately, sustainability transcends simple definitions, embracing inherent complexity and demanding deep understanding and effective commitment.

Camacho emphasizes the importance of striking a balance in design between product aesthetics and functionality as well as ecological, social and economic concerns. An example of this balance is the Embody office chair (Figure 2 left), by Herman Miller Inc., designed for a cradle-to-cradle material cycle.

Additionally, the disposable nature of plastic carrier bags (Figure 2 right) highlights the complexity of sustainability and reminds us to consider the wider environmental and social impacts.

*Figure 1. Pollution is a design flaw (Jang, 2020, p.76)*

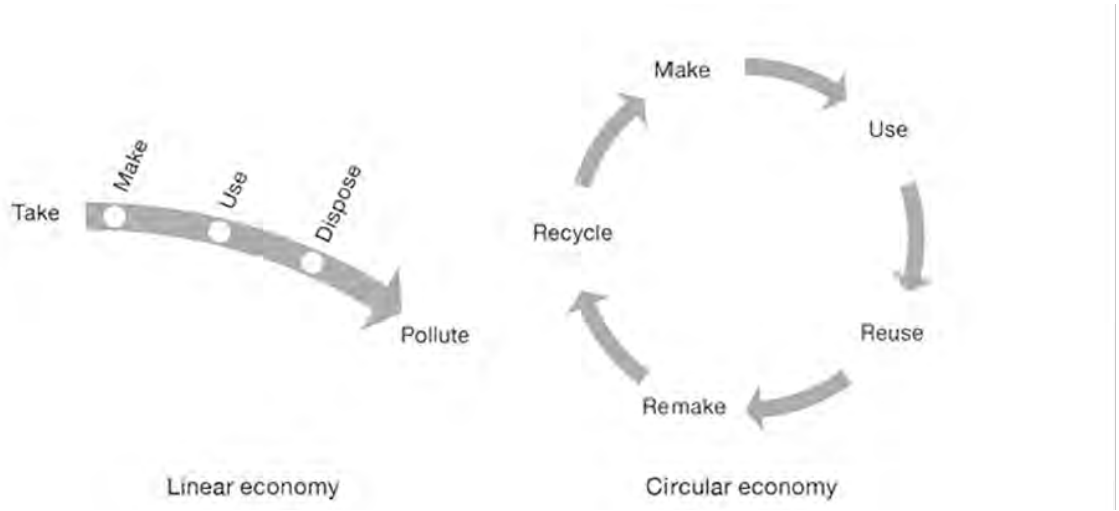



*Figure 2. (right) Herman Miller, Embody Chair (Chick, 2011, p. 110-110); (Left) "I´m not a Plastic bag" (Chick, 2011, p. 89-91)*

We are born and our first years are full of ideas, questions and worries. However, Maria João Barbosa designer, researcher and educator at Lusíada University, points out that in the first twelve years of school, we are under the pressure of predetermined answers and ideas, which restricts our natural curiosity and limits our ability to ask questions, explore and create.


With the proliferation of online resources for easier access to information, we become more passive towards knowledge and less curious, and this makes us less creative "Today's tragedy is humanity's incapacity to imagine alternative futures. We are subjected to an appalling sense of exhaustion and finitude" (Bittner, 2023, p. 139). In this scenario, the design teacher needs to become more of a mentor, motivating students to develop practical, creative and analytical skills and apply theoretical knowledge to real-life situations: "Give a man a fish and you feed him for a day. Teach a man to fish and you feed him for a lifetime" (proverb attributed to Tzu, Lao, Chinese philosopher).

Two sets of design principles were created, the first by Dieter Rams in 1976 and 30 years later, in 2006, the second by John Maeda, to guide designers to de-complicate and simplify complexity (Figure 3):

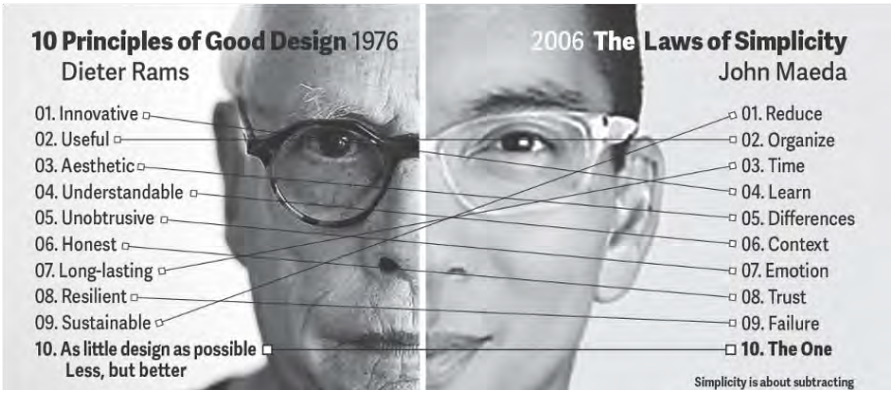



*Figure 3. Decoding Sustainable Design Principles, 2023. Infographic by Barbosa.*

In these two sets of principles, 30 years apart, there is a remarkable overlap in the emphasis on simplicity, usability, innovation, aesthetics and sustainability that is still relevant today and guides both design theory and practice.

Both emphasize simplicity as the most important principle in design. Rams says that Simplicity is consistent with sustainability by reducing the unnecessary complexity in products (Rams), while Maeda believes that simplicity can be more meaningful and profound. Both also recognize the importance of innovation and creating solutions that go beyond expectations, whether by anticipating needs (Rams) or by incorporating emotions (Maeda).

In addition to Rams and Maeda, other authors have also written important legacies for the shift from linear to circular design, since the 1970s. We are talking about Victor Papanek, Ezio Manzini, Janine Benyus, William McDonough, Michael Braungart, Nathan Shedroff and Rafael Cardoso. Among them all, we find important similarities and common perspectives in sustainable designer personal and social competencies (figure 4):

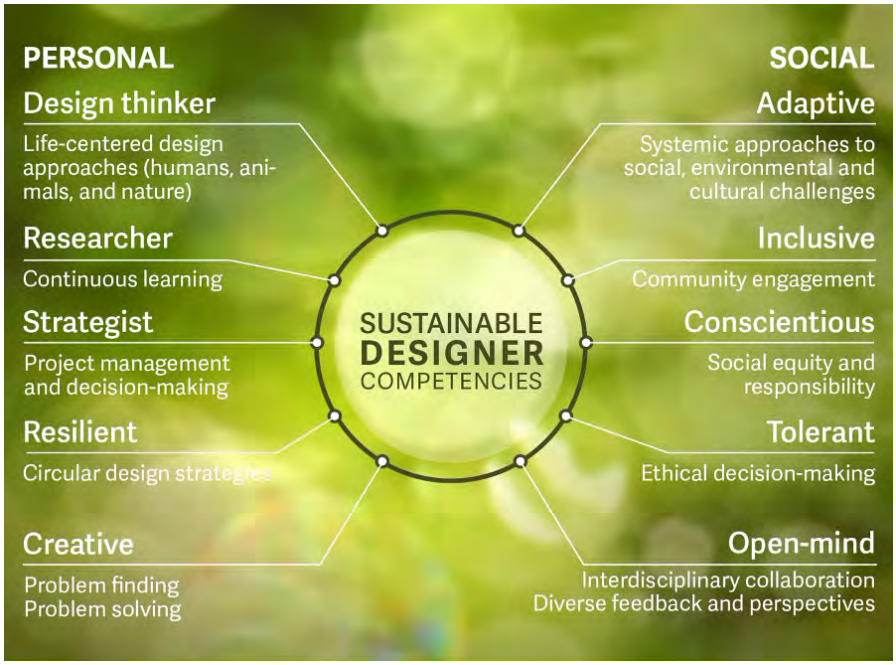



*Figure 4. Sustainable Designer Competencies, 2023. Infographic by Barbosa.*

- the importance of interdisciplinary collaboration to overcome complex challenges;
- the importance of ethics and social responsibility;
- the need for a holistic and systemic approach to address social, environmental and cultural challenges;
- design must be human-centered, inclusive and meet the needs of communities;
- nature as a source of inspiration for more sustainable practices and the consideration of biomimicry as a relevant approach;
- the role of design in innovation and influencing society and culture to drive significant changes towards sustainability;
- the circular economy and regenerative practices needed to minimize negative impacts;
- education as essential to raise awareness to promote changes in design;
- sustainability as a necessary paradigm for design.

Sustainability that focuses on materials and their life cycle is a crucial part of the vision of an alternative future that considers the health of people, animals and the planet "I believe that is precisely from the material, everyday dimension of our existence that the possibility of changing things emerges" (Manzini 2019, p. 17).

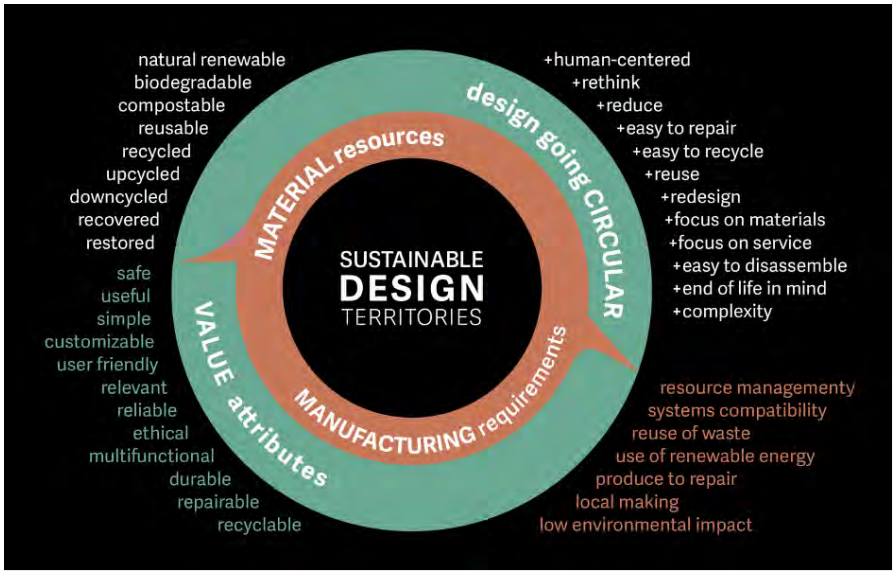



*Figure 5. Sustainable Design Territories, 2023. Infographic by Barbosa.*

> *"In the discourse on sustainability, materials play a critical role. Materials structure our society in political, economic, environmental, social and cultural terms"* (Bittner, 2023, p. 107). (Figure 5)

Barbosa has implemented these reflections with work proposals that are increasingly linked to real problems and where project materialization is more carefully thought out from the beginning with Lusíada University design students. Another goal is to promote interdisciplinary collaboration through greater involvement of organizations, industries and local communities to create respect for diversity of thought "(…) designers need to free themselves from the professional legacy that encourages them to work in isolation, in an authorial way, as if a good designer was capable of solving everything alone" (Cardoso, 2016, p. 23).

Today, it is just as important as designing something new, to work, rethink, reshape, reformulate, or adapt what already exists. Harnessing "wastes", and resignifying materials or artifacts, forces us to experiment, prototype and work with our hands. This type of approach avoids the recurring use of the computer as a solution for everything and allows us to discover the extraordinary in the ordinary. Integrating upcycling into exercises, to encourage the transformation of discarded materials or products into objects of greater value. This requires students to take a creative approach to transform existing materials into something new "The term 'unconditional design' describes the (renewed) design of a product, the main function of which has undergone change as a result of the creative process of the human mind with regard to the usefulness of that product" (Adibrata, 2023, p. 117).

One of the exercises explores three-dimensional lines applied to the recovery of an object at the end of its useful life, using the weave to create patterns. The materials used come from surplus stocks of shoelaces, sewing thread and rubber bands, from the textile company Scoop (Figure 6, 7).

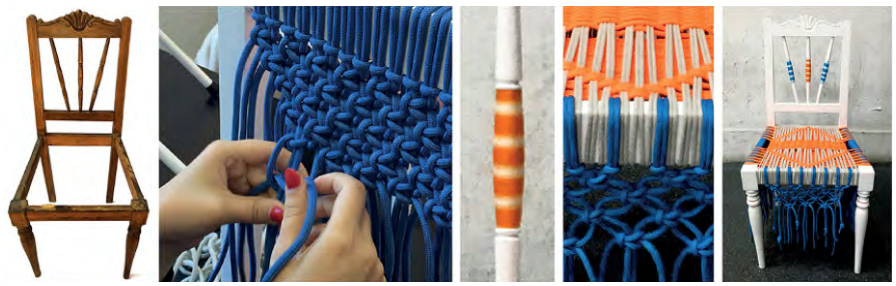


*Figure 6. Recovered chair, designed by Beatriz Rocha, 2021. Credits: Barbosa.*

*Figure 7. Recovered chairs, designed by José Ruben Silva (left) and Ana Catarina (right), 2021. Credits: Barbosa.*

*Figure 8. Self-portrait. Support: roof tiles, designed by Cláudia Silva, 2023. Credits: Barbosa.*

*Figure 9. Self-portrait. Support: wheelbarrow rims, designed by João Campos, 2023. Credits: Barbosa*

In another exercise, illustration techniques are explored to design a self-portrait using as support a three-dimensional discarded object (Figure 8, 9).

"Ancestral Techniques - Contemporary Concepts" had interesting results (for some, the topic was continued as research for a Master's degree). This new value proposition can be created through one or more strategies: a completely new product, new combinations of several existing products, updating/replacing one or more materials, a new function or multifunction of one of the existing products, etc. The aim is to promote the joint authorship of design and craftsmanship in the (re)creation of artifacts. Among these works, the study of a technique for making covos (artisanal fish traps) stands out. The innovation of this LUZO project (Figure 10) is that environmentally harmful materials (nylon rope) have been replaced by sustainable materials (sisal rope) and the original shape and dimensions of the covo were adapted for new multifunctional purposes: a table or hanging lamp and a fruit bowl.

*Figure 10. Luzo, design by Amélia Ribeiro in co-authorship with artisan Fernando Neves, 2021. Credits: Ribeiro*

To encourage curiosity and the exploration of ideas, as well as to promote critical thinking and intellectual autonomy, design thinking is a tool that should be implemented across the university curriculum, not just in design, but in all fields of knowledge. Jeremy Haefner of the University of Denver argues: "The design mindset is good for making correlations and substitutions while imagining what does not yet exist" (Justice, 2019, p. 14).

Design teaching should also be more hybrid, closer to the community and "glocal" (there needs to be a balance between universality and contextualization), more life-centered (people, animals and nature), and more circular and sustainable. As Papanek would say: closer to the real world.

## Neo-brutalism – A new aesthetics as a social metaphor for sustainability

In line with the theme of the conference, designer, researcher and lecturer at Lusíada University, Diogo Frias Riobom, presented his doctoral thesis entitled GEODESIGN - Valorization of industrial waste through the design of products with added value (Figure 11).


*Figure 11. Geodesign, 2020. Credits: Riobom.*

The starting point of his research is the enormous amount of waste produced throughout Europe, 300,000,000 tonnes, whose destination is the landfill. The research focused on the valorization of industrial waste through the mediation of design, focusing on waste produced by companies in the foundry, polishing, painting and glass processing industries.

The research and development project was supported by W2V (Waste to Value) and funded by Norte 2020. It enabled the access and treatment of around 80 tonnes of industrial waste per year from industry in the north of Portugal. This research was an integral part of a consortium sponsored by Norte2020, composed of the University of Minho, UTAD (University of Trás-os-Montes and Alto Douro), University of Aveiro, W2V (Waste to Value), CVR (Waste Valorization Centre) and Providência Design, whose focus was on the contribution of tourism to the country's development.

As indicated by Riobom, the project programme focused on the development of urban furniture and landscape solutions like vertical gardens and paving modules. This research is based on the principles of the circular economy, which have been divided into five phases: the production of waste by industry, the collection of this waste, the treatment of waste and its transformation into new materials, the development (design) of new artifacts made with new materials, and finally the transformation of materials into new products through their reintroduction into the industry.

As a means of valuing waste and as a conceptual basis, the researcher wanted to value the traces resulting from production and promote tolerance of dissimilarity, so that in this way a new inclusive and ecological aesthetic could be created as a means of changing cultural and aesthetic mentality. With these objectives in mind, it was essential to observe the laboratory activity led by Fernando Castro at the Mechanical and Materials Engineering Laboratories of the University of Minho, dedicated to the development of geopolymers, integrating industrial waste. Geopolymers consist of materials synthesized by the alkaline activation of powdered aluminosilicates, providing a variety of results in terms of their plasticity, color, texture, density, and temperature. The physical validation of the formulations (more than 200) was carried out mainly in two dimensions through artificial aging tests carried out in the Civil Engineering laboratories of the University of Aveiro and through compression tests carried out in the Mechanical Engineering laboratories of the University of Minho. The results obtained were not satisfactory compared to what was intended, as evidenced by low resistance to the elements of nature and low compressive strength (figure 12).

*Figure 12. Geodesign samples, 2020. Credits: Riobom.*

*Figure 13. Cusco Bench set – Geodesign, 2020. Credits: Riobom.*

Therefore, it was necessary to partially replace the waste with Portland cement (30%) to ensure that the percentage of waste in new mortar formulations is never below 40%. The research project's main goal was to enhance the raw expression of the materials, highlighted through the lack of finishing, thus enhancing their brown palette and robust volumes. The aesthetic inspiration for the project came from the in-depth study of Brutalist architecture, a movement that saw its heyday in the 50s of

the last century, characterized by the valorization of the constructive marks of the buildings, evident in the facades of the buildings, the exemption from finishing and the monumentality of the buildings. Brutalism, as a modernist language, is characterized by modular, cubic, or parallelepiped forms of orthogonal surfaces where the native texture of materials is valued as an ornament. From the research presented, Neo-Brutalism emerges, as an expression of the new environmental power of sustainability and ecology. The aesthetic exploration gave rise to a set of artifacts, a creative workshop was held where morphological questioning took place using low technology processes, to give rise to simple shapes, whose models and prototypes were validated in a public session at the Landscape pavilion in Guimarães.

The research resulted in a collection of Geodesign artifacts, capable of returning industrial waste to the economy in the form of new value-added products. Neo-Brutalist aesthetics then emerges as the main argument of social and aesthetic metaphor, by integrating the morphological defect or irregularity to a healthier society (figure 13).

## Precious Plastic Portugal & OPO Lab

The first industry case study presented was Precious Plastic, represented by Designer Irena Übler, followed by Architect João Feyo from OPO-Lab.

Übler began by explaining that plastic has been around since 1856, although it only went into mass production in the 1950s. It is estimated that for every ton of plastic produced, 3 tons of CO2 are released into the atmosphere, throughout the entire production chain, from oil extraction to the finished products (not including post-production). consumption). It is estimated that the amount of discarded plastic will double by 2025, and by then there will be more plastic than fish in the oceans, meaning that the equivalent of a truckload of plastic is discarded every minute. Übler points out that despite efforts (and bans) to avoid the use of plastic in certain products such as straws, cutlery, plates, etc., many plastics and single-use products are discarded at a rapid rate and end up in the oceans. This scenario has a huge impact on our lives, not only because of the pollution caused in the oceans, but also on the food chain, as the fish eat microplastics that

are later consumed by us, which means that we are indirectly consuming plastic. As mentioned by Irena plastic has already been detected in human blood, urine and even in the milk of breastfeeding women.

With this problem in mind (overconsumption of plastic, and huge waste of plastic), Dave Hakens created Precious Plastic in 2013, following on from the work he had developed at the Design Academy in Eindhoven. Precious Plastic is an open-source project consisting of four different machines that allow "anyone" to start recycling plastic and producing new artifacts after downloading the files and building the machines on a small scale. For this process, the efficient separation of the different types of plastic is crucial, and this is where OPO-Lab comes into play, as a facility that produces machines and collects, sorts and treats plastic so that it is suitable to produce new artifacts. Feyo briefly introduces the company, pointing out that it is a digital fabrication lab and was the first FAB lab in Portugal. Fab-Lab is a concept for digital fabrication workshops that was developed by Neil Gershenfeld from MIT and quickly spread around the world. As soon as OPO-Lab started producing the machines and offering them in the designated marketplace, there was a huge demand. The decision to develop the Precious Plastic Project domestically was motivated by Feyo's concern about waste production, for which he cites the example of the tanning industry, which produces an estimated 1 ton of waste per month, for which solutions need to be found.

OPO-Lab works closely with designers and architects to integrate diverse types of waste into various projects. Feyo explains that the process developed by Dave Hakkens consists of crushing the plastic, varying the particle size, and then moving on to the extrusion process, which allows different artifacts to be made depending on the mold used. The molds are made from aluminium blocks using the CNC technology available at OPO-Lab (Figure 14).

*Figure 14. Precious Plastic Alluminum Moulds. Credits: OPOlab*

Another production process consists of placing the shredded plastic in a self-built oven that has been adapted for this purpose so that it reaches the molding point. Plastic sheets can then be produced using a press driven by a car jack adapted for this purpose. Precious Plastic Portugal has invested its time in improving the process to ensure high-quality standards and thus the success of the entire process. As an example, Feyo shows a bench they produced for Figueira de Castelo Rodrigo. Finally, Übler points out the New European Bauhaus Award they recently received for their project to collect and reuse old plastic toys. (Figure 15).

## Upcycling practices introduced in the textile industry

Mafalda Mota Pinto is the founder and CEO of the clothing company Scoop. It is one of the first Portuguese companies to introduce environmental

*Figure 15. Plastic Replay team. Credits: OPOlab*

and social certifications: ISO 14001 and SA8000 and is also committed to follow the guidelines of the 2030 Agenda, the SDGs and the United Nations Global Compact (UNGC).

The textile industry leaves behind a huge environmental footprint and SCOOP is no exception. Since its foundation in 1991, the company has been collecting tons of waste and about 150 kilometres of excess fabric from production.

Pinto shared that "The main challenge is finding ways of deleting, reducing and reapplying the waste at its origin". She explains that when working with big brands, it is very important to share responsibility and involve everyone in waste reduction initiatives. Tommy Hilfiger, one of their biggest customers, was one of the main first challenges. Scoop focuses on reusing, re-make and re-style, to design an 'Upcycling Loungewear Capsule Collection' (all pieces are different) for Tommy Hilfiger, made from leftover fabrics from the brand itself (Figure 16, left). This project has been running for 3 years and has not only led to new, more sustainable approaches, but also to very positive financial results. Today, Tommy Hilfiger produces one collection per year exclusively from waste.

After this experience and seeking constantly new ideas to reuse its various wastes, Scoop has recognized that its commercial future should include these upcycling initiatives by starting various partnerships with companies, design schools and young design researchers.

One of the projects happened in collaboration with Mariah Esa, an English designer from the Faculty of Art and Design at Central Saint Martin, with whom Scoop developed an upcycling project with thousands of overproduced clothing labels. These labels from different brands were sewn together from the reverse side (so that the logos could not be identified) to create the base fabric for new clothing (Figure 16, right), which was presented at London Fashion Week as an example of textile sustainability.

In another project, 1500 jeans collected from Levi's were repurposed to produce 500 skirts (Figure 16, center) co-created with American model Bella Hadid. Pinto explained that "was through 100 percent recycled denim fabric that this upcycling collection of skirts was born, intending to give new meaning and life to leftover materials that would end up going to waste and make these a selling item".

The same principle of waste management is currently being developed, with Portuguese designer Olga Noronha, a collection of clothing made with Scoop deadstock's of metallic zippers.

*Figure 16. Tommy Hilfiger (left), Bella Hadid (center), Mariah Esa (right). Credits: Scoop*

## Sustainable soles for technical footwear

The Portuguese sole manufacturer, Pedro Castro, CEO of Aloft Lda., has always been concerned with materials, with possibilities and limitations, with innovation and above all with sustainability linked to local materials, close to the circuit of production. Graduated in mechanical engineering, Castro highlights the need to consider not only the environment, but also the teams we work with and the context in which we are inserted. Aloft arises from reflection on what it can offer the market and society, moving away from the objective of being just another sole producer in Portugal. Aloft focuses on sustainability, producing soles for sports, safety, protection and military footwear. Although it may seem simple, it is a business area that faces major challenges: from waste recycling to empowerment. Aloft recognized the necessity of addressing its rubber waste, which originated from sole production, and devised various innovative methods to repurpose it in the creation of new products.

It was not easy to find reliable and efficient recycling companies as some raised questions about the actual effectiveness of recycling. Castro says this challenge forced them to rethink the entire manufacturing process to create new solutions: transforming waste of soles into rubber boots. Computer software assisted in waste measurement, while local industry partnerships were crucial in supplying raw materials sourced from waste.

Although there were always financial and aesthetic challenges in producing recycled products, environmental awareness has been driving the Aloft team to find solutions for Material efficiency, and I&D (Figure 17). Accepting the imperfections of new materials resulting from recycling and adapting regulatory standards is crucial in recognizing their limitations and their contribution to a more sustainable future.

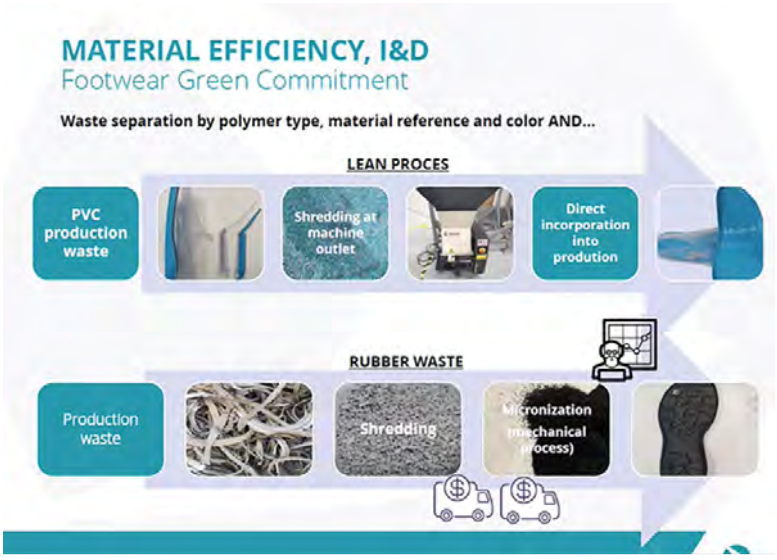



*Figure 17. Material efficiency, I&D. Credits: Photo by ALOFT*

In addition to boots, the company created a new type of footwear for firefighters that improves the solutions already on the market. This type of footwear needs to be resistant to hot temperatures without catching fire or transmitting heat, but the options available from competitors include asbestos and carcinogens in their composition, which are harmful to people and the environment. Aloft brought together multidisciplinary teams that included teachers and recent graduates to create less harmful solutions, highlighting the importance of trying, failing, and learning from mistakes within the objectives set in this development process.

Another example of great innovation that Castro shared was the production of snowshoes (Figure 18), combining moulding technology from Marinha Grande (Portugal) and 3D printing, to create geometries that would otherwise be impossible.


*Figure 18. Snowshoes, discarded snowshoes, French award. Credits: Aloft & EVVO*

Specific colours were chosen, according to the waste used from discarded snowshoes, to create more sustainable products. Again, they collaborated with universities and recent graduates, facing financial challenges with determination and family collaboration. The development of this ecological snow racket involved a partnership with Michelin to experiment with rubbers to improve the product. By recycling waste, raw materials were obtained to produce new snowshoes under a product-service system, representing forms of co-consumption, persistence in the use of waste led to recognition in a French award for best mountain product.

Another example of excellence in sustainability was the creation of an eco-friendly rubber sole for skateboard shoes, aimed at the upcoming Paris Olympic Games. With Michelin's partnership to achieve a total ecological footprint, they used natural rubber from the Amazon Forest and silica from rice husks for the new raw material. They faced technical problems, such as the generation of gas during the process (Figure 19, left), but they persisted and readapted the formula.

Today, Aloft is proud to impose more sustainable practices on brands, highlighting the importance of environmental responsibility at all levels of production.

*Figure 19. Skateboard shoe tests and final product, eco-friendly sole, Credits: Aloft & Michelin*

## Conclusions

This research addresses the pressing issues within contemporary design by presenting case studies and theoretical frameworks that confront the global awareness of environmental and social challenges while reducing the prevalent misinformation surrounding sustainability. Through the organization of a symposium, critical discourse on sustainability was facilitated across design, academia, and industry, with the primary goal of redefining materials and processes by incorporating waste as a raw material to foster more sustainable solutions.

The symposium featured academic speakers from Lusíada University who conducted a thorough comparative analysis of prominent authors in sustainability, providing insights into the current state of the field. Industry representatives showcased successful instances of sustainable innovation in materials, products, and waste recycling, underscoring the transformative potential of utilizing recycled and upcycled materials in product design.

The utilization of recycled and upcycled materials not only enhances the ethical and aesthetic dimensions of innovation, production processes, and environmental awareness but also contributes to more efficient resource management by reducing reliance on new natural resources and minimizing waste generation. These materials offer unique aesthetic qualities, characterized by variations in finish, consistency, and color, thereby infusing products with originality and authenticity while challenging the standardized aesthetics of mass-produced goods.

Furthermore, interdisciplinary collaboration emerged as a crucial factor in the systemic analysis and transformation of materials into new products. Experts from diverse disciplines collaborated to identify intervention opportunities throughout the creative and production process, leading to the development of innovative and effective solutions. This interdisciplinary approach facilitates a holistic analysis focused on transforming end-of-life materials into raw materials for new products, as exemplified by the presentations at the symposium.

## Acknowledgments

We thank CITAD, Research Center on Technology, Architecture and Design, Lusíada University; Faculty of Architecture and Arts, Lusíada University (FAA-ULN). We are grateful to the 1st, 2nd and 3rd cycle degree's students in Design at FAA, Irena Übler from Precious Plastic Portugal, and João Feyo from OPO Lab, Mafalda Mota Pinto, from Scoop and Pedro Castro, from Aloft Lda., for their availability, assistance and incredible support. This work is financed by national funds by FCT - Foundation for Science and Technology, I.P., under the Project UIDB/04026/2020 and DOI identifier 10.54499/UIDB/04026/2020 (doi.org/10.54499/UIDB/04026/2020)

# References


1. *Adibrata, JJ, et al. (2023). Decolonising Design Education. Schools of Departure No. 1. Leipzig / Dessau: Stiftung Bauhaus Dessau. pp. 117*
2. *Aloft (2023). Development and production of technical footwear, Retrieved from: http://we-aloft.com*
3. *Bakker, C., et al. (2019). Products that Last: Product Design for Circular Business Models. Amsterdam: BIS Publishers.*
4. *Banham, R. (1966). The New Brutalism: Ethic or Aesthetic? London: The Architectural Press.*
5. *Ben-Eli, M. (2015). Sustainability: Definition and Five Core Principles. The Sustainability Laboratory. New York, USA.*
6. *Bittner, Regina, et al. (2023), The New Designer: Design as a profession. Schools of Departure No. 2. Leipzig / Dessau: Stiftung Bauhaus Dessau. p. 107, p.139*
7. *Cardoso, R. (2016). Design para um Mundo Complexo. São Paulo: Editora Ubu. pp. 23*
8. *Chick, A. and Micklethwaite, P. (2011). Design for Sustainable Change: How Design and Designers Can Drive the – Sustainability Agenda, AVA Publishing.*
9. *D'Ambrières, W. (2019). Plastics recycling worldwide: current overview and desirable changes. Field Actions Science Reports. pp. 12-21. Aubervilliers, France: Institut Veolia*
10. *Delong, M.; Goncu Berk, G. (2013). What Color is Sustainability? Color and Design. New York, USA: Berg. pp. 89-100*
11. *Emas, R. (2015). The Concept of Sustainable Development: Definition and Defining Principles. Brief for GSDR 2015. Florida, EUA: Florida International University*
12. *Giovannoni, E., Fabietti, G. (2014). What Is Sustainability? A Review of the Concept and Its Applications. Berlin, Germany: Springer International Publishing*
13. *Jang, S., Thaler, M. (2020). 101 Things I Learned® in Product Design School, Published by Crown*
14. *Justice, L. (2019). The Future of Design. Boston, USA: Nicholas Brealey Publishing. pp. 14*
15. *Krippendorff, K., Butter, R. (1984). Product semantics: Exploring the symbolic qualities of form. Innovation. 3(2). pp. 4-9. Retrieved from: http://repository.upenn.edu/asc_papers/40*
16. *Lefteri, C. (2006). Materials for inspiration design. Brighton, UK: Rotovision*
17. *Lewandowski, M. (2016). Designing the Business Models for Circular Economy—Towards the Conceptual Framework. Krakow, Poland: Jagiellonian University. pp. 43*
18. *Manzini, E. (2019). Politics of the Everyday. London: Bloomsbury Publishing. pp. 17*
19. *Nidumolu, R., Prahalad, C. K., Rangaswami, M. R. (2009). Why Sustainability Is Now the Key Driver of Innovation. Boston: Harvard Business Review. pp. 57-64*
20. *OPO-LAB (2023) Fab Lab. Retrieved from www.opolab.com*
21. *Papanek, V. (2000). Design for the Real World: Human Ecology and Social Change. London, UK: Thames and Hudson.*
22. *Precious Plastic (2023). Precious Plastic Universe, the alternative plastic recycling system. Retrieved from: www.preciousplastic.com*
23. *Riobom, D. F. (2020) Geodesign: valorização de resíduos industriais pelo design de produtos de valor acrescentado, PhD Thesis, University of Aveiro. Retrieved from: http://hdl.handle.net/10773/30302*
24. *Scoop (2023). Leading the way in Portuguese Textiles for 25 years. Retrieved from: https://www.scoop.pt/*
25. *Tischner, U. (2015). Design for Sustainability, Strategies, Methods and Tools. Changing Paradigms: Designing for a Sustainable Future. Aalto, Finland: Cumulus. pp. 304-305*
26. *Wastling, T.; Charnley, F.; Moreno, M. (2018). Design for Circular Behaviour: Considering Users in a Circular Economy. Bedfordshire, UK: Cranfield University*

# Shaping the future of automotive design: the automotive experience design lab

*Venanzio Arquilla, Giorgia Ballabio*
*venanzio.arquilla@polimi.it, giorgia.ballabio@polimi.it*

*Politecnico di Milano, Italy*

***Keywords:***
*UX Design*
*Automotive UX HMI,*
*Interaction Design*
*User Research*

## Abstract

As technology continues to reshape the automotive landscape, a radical transformation is underway in the design of automobiles. The focus is shifting from the vehicle itself to the onboard experience, marking a pivotal moment where driving becomes less central, and the «passenger» experience takes center stage. The proliferation of multimedia entertainment systems, ambient lighting, interactive sounds, and other non-driving elements reflects this shift, especially in anticipation of the impending era of autonomous driving.

This paper presents a thoughtful exploration of this evolving paradigm, culminating in the establishment of the Automotive eXperience Design Lab (AXD): a dedicated space and simulator for testing new interactive systems both in physical and digital dimensions. Leveraging the lab's expertise, prototypes can be efficiently developed and tested, providing valuable insights into the complex and multidimensional nature of the onboard experience.

The Automotive eXperience Design Lab represents an initiative offering new tools and operational methods tailored for emerging professional roles in the realm of automotive design.

## Introduction

**Industry Requirements**

The automotive sector represents a constantly developing scenario. The impetus given by the growth of emerging markets, the acceleration in the implementation of new technologies, the establishment of policies related to sustainability, and changes in consumer preferences, as well as digitization and the consolidation of new business models, are forces that have long been driving the growth of technology-driven trends in the automotive world (McKinsey&Co, 2016). A clear showcase of this technological push was CES held in Las Vegas in January 2024 (Consumer Electronics Show). One of the prevailing themes concerns the integration of AI (Artificial Intelligence) within in-vehicle systems. Volkswagen collaborating with Cerence presented the integration in the software of Chat GPT to answer general knowledge questions. The company guarantees that there will be no access to vehicle data and that requests will remain anonymous (Lekach, 2024). Mercedes-Benz refers to the MBUX Virtual assistant as dialogue-

partner. The system has four personal traits: natural, predictive, empathetic and personal (Group, 2024). The CES 2024 underscored the centrality of the digital experience as a pivotal differentiation between brands. Many industry makers are creating immersive experiences close to gaming; an illustrative example is Afeela arising from a Sony-Honda joint venture, which integrates the function of streaming games from PlayStation 5 (Audoin, 2024). This phenomenon has already been investigated and it continues to embrace technological innovations. In 2023 Holoride garnered recognition from CES as an innovative product in the field of entertainment. Holoride's technology makes it possible to synchronize digital content through a VR headset with movement, and the position of the vehicle in real-time. Creating experiences close to gaming will become more and more established through the spread of electric vehicles, as a time for example to manage breaks for recharging, but also through the incremental spread of self-driving vehicles.

These technological megatrends correspond to industry requirements for the near future and are profoundly changing the mobility ecosystem, including user experience perspective. The conceptual framework known as CASE (Connected, Autonomous, Shared & Services, and Electrified), initially introduced at the Paris Motor Show in 2016, has been fundamental in steering the trajectory of industry development to follow. These trends are also particularly relevant because they align with the needs dictated by the environment surrounding the automotive world. Such as the need to implement regulations to fight climate change; the need to increase road safety by reducing accidents through automation; and the need to embrace changes in consumer values and behaviours that encourage the transition from ownership to shared service use (What Is "CASE"?, 2022). The implementation of these innovations is ensured by the increasingly massive integration of hardware and software, great computational power, and the introduction of increasingly advanced technologies, such as artificial intelligence (Fedele, 2023; John, 2023). The value of the software component in enabling these innovations is fundamental and greater than the mechanical hardware (Deloitte, 2020). This is why automakers focus on software optimization rather than hardware creation. For the same reason, collaborations with technology players often arise to offer compelling digital services. A classic example is the mirroring of the personal devices in the infotainment system that enables the use of mobile applications, which are often preferred over native apps.

The vehicle is no longer merely a marvel of mechanical engineering but is increasingly approaching a consumer electronic device. The closeness between these two worlds found visibility during CES in Las Vegas, a moment dedicated to consumer electronics products where automotive occupies more and more space (Audoin, 2024). This transition affects the way users, drivers, and passengers, experience the vehicle, bringing the user experience to the center of the design (Accenture, 2021).

**Consumer Mobility Life Area**

The boost the industry is getting comes not only from technological innovations but also from the needs and changes in consumer behavior and preferences. The ecosystem strategy map defines ten areas intended to holistically represent human life, including mobility (Ecosystemizer, 2020). All areas are deeply interconnected (Pwc, 2023). Hence, the requirements for the automotive industry are not only determined by the area of mobility, which mainly indicates needs in transportation but also by health, recreation, work, spirituality, consumption, socialization, education, entertainment, and living. Users' needs as well as consumption patterns and lifestyles are

constantly evolving and follow generational changes. Younger generations, for example, attach new values to the concept of mobility: the travel experience must be fun; it must offer the possibility of performing other activities while moving; there is a growing demand for safety; sociability must be fostered by design, for example, by sharing the route; there must be attention to reducing the environmental impact of transportation; and it is important to ensure the security of data generated during travel and personal data shared with the vehicle (Viviani & Panzeri, 2021).

**In this constantly developing scenario, user experience is the game-changer for most of the challenges in the automotive field. User Experience in Automotive**

User experience is described as ''a person's perceptions and responses that result from the use or anticipated use of a product, system, or service'' (ISO 9241-210:2010(En), Ergonomics of Human-System Interaction — Part 210: Human-Centred Design for Interactive Systems, n.d.). It is mostly affected by three factors: user status, system characteristics, and interaction context (Ebel et al., 2021). The context in which vehicle interactions occur is a dual-task environment. This means that the user must handle two tasks simultaneously: they may also undertake secondary actions, while engaged in the primary activity of driving. Before autonomous driving takes over, one of the biggest challenges in designing user experience within the vehicle, concerns refining iterations with infotainment systems (IVIS) while keeping safety as the primary objective. The number of functionalities made available to the driver for controlling the vehicle is constantly increasing. Instead of having a separate controller for each function, multifunctional systems are employed to handle this complexity. It would be impossible to imagine a dashboard with one controller dedicated to each functionality. The introduction of touchscreens reflects this trend. The digital display allows navigation within very complex and branching streams, following interaction patterns that users are already accustomed to using with personal devices. Users increasingly expect to find these kinds of interactions in the vehicle, and if the built-in operating systems are not intuitive enough, third-party services such as Apple Car Play or Android Auto are used. Designing the interaction with these systems is particularly challenging because, despite a large amount of accessible features, design aims to minimize user interaction, directing visual attention toward the road. Interactions with touchscreens, which is the preference and nearly the design standard, inexorably results in shifting visual attention to the screen to locate buttons and elements in the interface (Richter et al., 2010). This occurs because this interaction model relies much more on the visual rather than the tactile feedback. The focus on safety issues brought about by the dual-task environment not only affects the experience of the driver but also that of all other passengers. Nevertheless, the entertainment activities made possible inside the vehicle seem to know no bounds, and, with the advent of autonomous driving, will increasingly involve the driver as well. In fact, with this shift, the vehicle will become more and more intelligent and responsible for the driving activity, turning the driver first into a rider and then into a passenger. This transition allows new models of interaction to be imagined and designed.

Some critical aspects of this race towards digitisation and the increasingly invasive introduction of advanced technologies such as AI must be considered.

For example, the constant increase in functionalities, made possible by technological development and in particular the power of integrated software in the vehicle, could lead to the phenomenon called 'feature creep'. That is the accumulation of features in even greater numbers than users actually demand. This could make the experience more complex than it

needs to be. It is the result of a design that does not take users' needs into account but looks more to technology as a silver bullet.

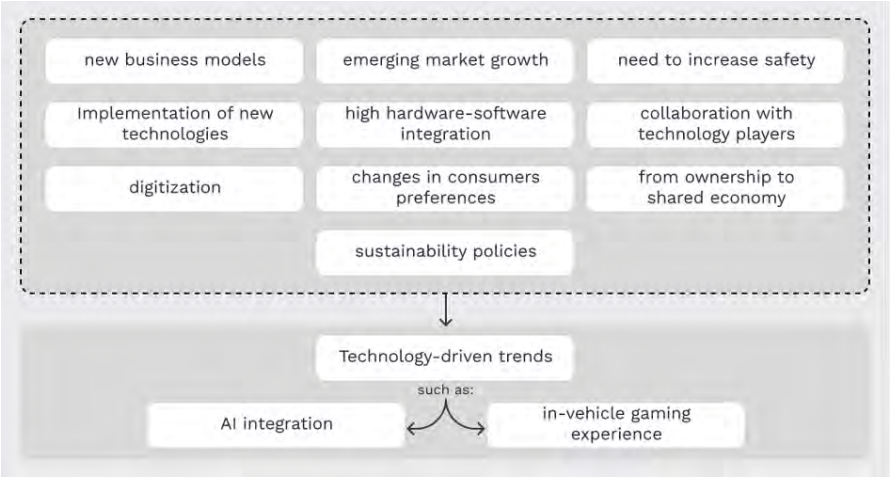



*Figure 1. Factors facilitating technology-driven trends*

Similarly, these trends appeal to users who are familiar with certain interaction patterns and digital interfaces. The risk is to move towards an increasingly less inclusive design. For example, the use of digital interfaces, especially touchscreen, does not fully consider the needs of those with reduced visibility. This condition often affects older people which, in more developed countries, also coincides with the majority of the population (Bradley et al., 2016; Young et al., 2017). A way to limit this condition could be for example using a multi-channel approach, not just relying on visual feedback. It is important to design with an inclusivity methodology, considering permanent, temporal, and situational disabilities.

Many of the trends highlighted previously will become increasingly popular as the introduction of autonomous vehicles takes hold. However, this scenario does not hide concerns and challenges to be overcome. Experts in this area mainly focus on the following points (What Self-Driving Cars Tell Us About AI Risks - IEEE Spectrum, n.d.). The issue of safety: malfunctions or errors in artificial intelligence systems can endanger the lives of drivers, passengers and pedestrians. The ethical issues involved in AI decision-making, such as in situations of choice between life and death. The issue of cybersecurity: vehicle connectivity increases exposure to possible cyberattacks. Finally, the issue of privacy of user data, since the vehicle is able to produce and collect a lot of information on preferences and behaviour.

## Literature Review

To govern the complexity of user experience study, research centers often rely on simulation platforms as tools for prototyping and user testing. These platforms also facilitate the examination of the interaction between physical and digital elements in the user experience within the vehicle, thereby fostering a comprehensive understanding of user interactions and paving the way for the development of more intuitive, user-centric interfaces.

This section aims to describe the state-of-the-art driving simulators used mostly in laboratory settings to develop and study on-board user experience

and in particular HMI. The literature around driving simulators is extensive and encompasses different kinds of platforms and associated research. Different classification models have been proposed: some researchers distinguish driving simulators according to their intended application, such as research or training (Blana, 1996), while others classify them according to fidelity level (Seropian et al., 2004). Eryilmaz and other researchers propose a four-level classification scheme taking into account: general features, motion system, visual system, and sound system (Eryilmaz et al., 2014). Following this frame, this section focuses on platforms utilized primarily for research purposes, with a medium-high level of fidelity, without motion systems, and that boast relatively sophisticated visual and auditory capabilities. Fixed-base driving simulators are the most common structures applied in research centers. The main reasons for that are cost, ease of implementation, as well as greater flexibility (Bruck et al., 2021).

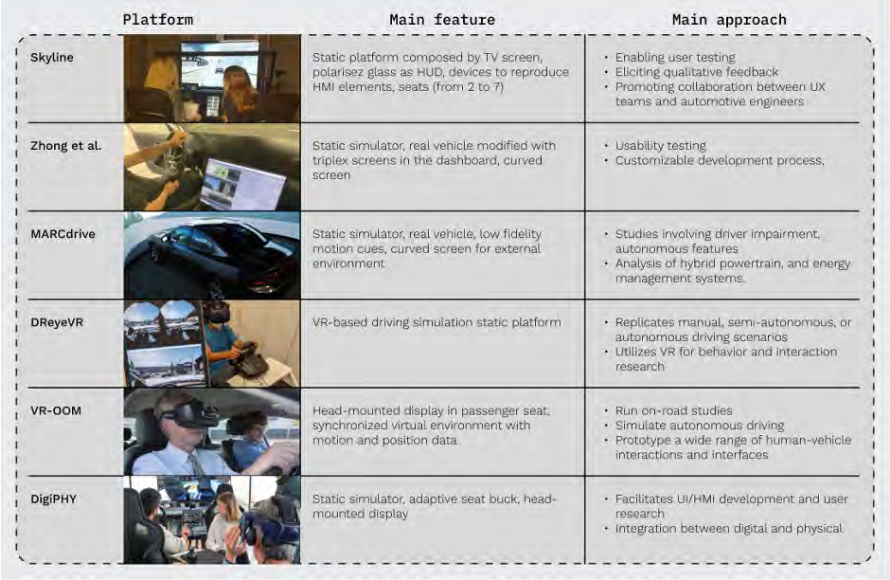
Skyline is an example of a rapid prototyping driving simulator platform, used in Intel Labs to enable iterative development of in-vehicle user interfaces through user testing (Alvarez et al., 2015; Alvarez & Rumbel, 2017). Researchers highlight the efficiency of the platform in devising research hypotheses and rapidly prototyping solutions in realistic driving environments. Skyline is mainly used to elicit qualitative feedback through user testing. In addition, the authors highlight the importance of such a platform in creating an environment of contamination between the UX team and automotive engineers.

Zhong and others in their research create a driving platform to test HMI in autonomous driving, confirming the efficiency of using driving simulators for usability testing (Zhong et al., 2022). The authors point out how customized development of driving simulators is time-consuming, highlighting the need for a more efficient process, adopting for example modularity. The simulator used in the research is composed of an existing vehicle, modified through the addition of a triplex screen in the dashboard part, and other small body components to achieve full acquisition and input of driver control signals. A similar platform used for research purposes is the MARCdrive, installed in the McMaster Automotive Resource Centre (MARC). The laboratory setting involves a real vehicle facing a curved screen with 210 degrees of field of view (Bruck et al., 2021).

Numerous studies rely on VR devices to replicate simulation environments. DReyeVR is a VR-based driving simulation platform built to facilitate research in the fields of behavior and interaction in manual, semi-autonomous, or autonomous driving situations (Silvera et al., 2022). VR-OOM system involves the use of a head-mounted display while the user is in the passenger seat. The virtual environment is synchronized with motion and position data from outside. VR-OOM supports testing exploratory design concepts graphical user interfaces, sound interfaces and motion interfaces for autonomous vehicles (Goedicke et al., 2021). In these examples, the balance between the physical and digital world is entirely shifted to the digital, and virtual aspects, reducing the focus on the physical part. In contrast, XRoom represents an example in which physical and digital worlds meet in a more balanced way; it is a mixed-reality simulator that allows virtual elements to be superimposed on unmodified vehicles (Goedicke et al., 2021).

A case outside academia is DigiPHY, a solution, proposed by GranStudio, composed of an adaptive seat buck and an open design platform. DigiPHY highly integrates the virtual and physical worlds by creating immersive experiences. User research and development of UI and HMI are among the

fields of application. The platform allows to set different devices as screens to study the interactions. GranStudio highlights the multidisciplinary of the platform, which enables collaboration between designers and engineers (https://www.granstudio.com/digiphy).



| Platform | Main feature | Main approach |
|---|---|---|
| Skyline | Static platform composed by TV screen, polarisez glass as HUD, devices to reproduce HMI elements, seats (from 2 to 7) | • Enabling user testing<br>• Eliciting qualitative feedback<br>• Promoting collaboration between UX teams and automotive engineers |
| Zhong et al. | Static simulator, real vehicle modified with triplex screens in the dashboard, curved screen | • Usability testing<br>• Customizable development process, |
| MARCdrive | Static simulator, real vehicle, low fidelity motion cues, curved screen for external environment | • Studies involving driver impairment, autonomous features<br>• Analysis of hybrid powertrain, and energy management systems. |
| DReyeVR | VR-based driving simulation static platform | • Replicates manual, semi-autonomous, or autonomous driving scenarios<br>• Utilizes VR for behavior and interaction research |
| VR-OOM | Head-mounted display in passenger seat, synchronized virtual environment with motion and position data | • Run on-road studies<br>• Simulate autonomous driving<br>• Prototype a wide range of human-vehicle interactions and interfaces |
| DigiPHY | Static simulator, adaptive seat buck, head-mounted display | • Facilitates UI/HMI development and user research<br>• Integration between digital and physical |

*Figure 2. Driving simulator platform from AXD Lab*

One area in which driving simulators are employed concerns user testing; the ability to integrate biometric data collection tools into research makes this method particularly effective for safety studies. For example, Liu and others recently recorded the EEG (electroencephalogram) signal during a test to assess differences in the workload of three different interfaces (Liu et al., 2023). Other biometrical data deeply investigated in a research study is visual attention. In their study Calvi, D'Amico and Vennarucci validate the eye-tracker system as very effective systems for evaluating driver's behaviors in simulated scenarios, demonstrating that the driver's response in real and simulated driving is the same in terms of fixation distance and duration (Calvi et al., 2023). In their study, they relied on a fixed-base driving simulator. Soares and others conducted a review of 23 studies on driving simulators developed for drowsiness and fatigue analysis (Soares et al., 2020), showing a great interest in this research field. All 23 studies considered biological data collected through technological devices. Among the biometric data that can be investigated is electrodermal activity (EDA). Khai and others analyze electrodermal activity to investigate stress and anger as primary emotions leading to possible accidents involving the driver (Khai Ooi et al., 2016).

The approach undertaken in the AXD lab underscores the importance of achieving a balanced integration between the physical and digital worlds. Considerable effort is directed toward prototyping the physical components of the simulation setting. However, within a research context like that advocated by the AXD lab, it is crucial to recognize that certain aspects of the user experience, particularly those encompassing sensory elements, may not receive adequate attention (Losada et al., 2020). This enables a focus on digital interactions without ever forgetting that they take place in a physical context, which affects their quality and perception by the user.

In addition, as the literature suggests, approaching the challenges with a multidisciplinary approach could be successful. Involving in the process at the same time design and engineering disciplines offers a more profound understanding of user experience dynamics (Kessels, 2023). Within the AXD lab, the synergy derived from the collaboration among different disciplines constituting the laboratory enables the integration between these digital and physical components. This facilitates a more holistic view of the issues and further research in various fields.

This paper aims to detail the approach underlying the operation of the AXD, positioning it as an example of research development in the context of in-vehicle user experience in the automotive realm. The composition of the laboratory encompassing human resources and technological assets will be described. The paper especially wants to emphasize the value given by the multidisciplinary work done and the integration of digital and physical experience.

## AXD (Automotive eXperience Design)

**Lab composition**

The laboratory originated within the Politecnico di Milano, proposing itself as a space where to study the user experience in the interaction with the vehicle and specifically within it, building experiences that embrace both the physical and digital worlds. The activities undertaken within the lab are developed in all phases of design: from scientific and market research to the design phase of new interactions, passing through prototyping, according to various levels of fidelity, and concluding with the user testing and data analysis phase.

The core of the lab transcends the aggregation of its physical (platform) and non-physical (software) assets; rather, it is defined by the contamination of skills and synergy derived from different disciplines, such as the world of design, mechanical engineering, and management engineering. Especially these three poles are involved due to previous experiences and validated expertise such as the eXperience Design Academy (XDA - https://xdapolidesign.com/en/). The XDA has expertise in in-vehicle user experience research and design, honed through projects such as Base5G and collaboration with the Master's in Transportation & Automobile Design (TAD) (https://www.polidesign.net/en/formazione/interior-design-and-architecture/master--transportation-automobile-design/).

The iDrive Lab (https://www.idrive.polimi.it/) affiliated with the Department of Mechanical Engineering, is co-involved in the study of behavioral aspects between vehicle, driver, infrastructure, and surroundings. especially the lab specializes in augmented, virtual, and mixed reality prototyping. The expertise of the lab often meets that of the design side, as evidenced by the collaboration with XDA on the 5G base project (https://www.base5g.polimi.it/).

Furthermore, the discipline of management engineering contributes to AXD lab the knowledge and expertise developed within the PHEEL lab (PHysiology, Emotions and Experience Laboratory https://www.polimi.it/ricerca/la-ricerca-al-politecnico/laboratori/laboratori-interdipartimentali/pheel-physiology-emotion-and-experience-laboratory), specializing in the analysis of an individual's biological and physiological signals and expert evaluation to study the behaviors of individuals in response to specific

stimuli.

The competencies derived from these three poles intermingle at every stage of the process, allowing for a holistic view of the challenges, gathering different perspectives, and creating new avenues for learning and research.

For the figure of the designer, multidisciplinary is crucial particularly during iterative phases of design and prototyping. Collaboration with mechanical engineering experts enables designers to conceptualize having the integration of hardware and software in mind, approaching technology to imagine a more complete interaction. In the prototyping phase, designers and engineers collaborate to develop HMI prototypes. A prevalent approach within the lab involves using prototyping systems that allow for the integration of hardware and software. Notably, platforms such as Protopie Connect exemplify this integration (https://www.protopie.io/blog/tag/protopie-connect), allowing to control Arduino (https://www.arduino.cc/) through commands designed with Protopie Studio, enabling seamless communication between digital and physical worlds.

During the evaluation phase, the collaboration is particularly promising since expertise from both the design world for experience evaluation and the knowledge of management engineers in biometric evaluation methods appear to be critical. Researchers within the AXD lab have various tools for the testing phase to collect biometrical data, in particular eye movements, brain activity and electrodermal activation.

The next section will describe the platform components and the tool used for research purposes.

## Platform Components

The driving simulator of the AXD lab is a flexible platform, which can respond to different needs. The objective of the platform is to recreate the user experience inside the vehicle so that design hypotheses can be tested directly with users.

For the conditions to be as close to reality as possible, the laboratory seeks a high-fidelity level, which is why the platform has been designed and created to be flexible and its configuration can be modified according to specific requirements. This level of fidelity is reached through integration between hardware and software.

The physical components include:

Structure of the platform
External instrumentation to recreate the simulation environment
Data collection equipment
Hardware required for data processing

The simulator is built over a height-adjustable platform, that allows the replicability of different car configurations: it is possible to change the trim from a sedan to an SUV. The structure features four doors with armrests and storage compartments and a panoramic roof. The interior is equipped with two front seats, that can be adjusted in backrest inclination and longitudinal position, a two-seat rear bench, and a central channel both between the front and the rear seats. The control instrumentation includes a pedalboard with throttle and brake and a steering wheel. The dashboard consists of three monitors of which the instrument cluster (IC) is located behind the steering

wheel, and two touch screens, one in the center (Central Display) and the other in front of the passenger seat. The three displays are separated from each other, the central display, protrudes slightly, while the instrument cluster and passenger display are embedded in the dashboard. Interiors also include a lighting system consisting of RGBW LED strips placed in different positions. The lights can be distinguished according to two desired effects: light diffused directly onto the material and light diffused through a diffusion sheath. The configuration of the interior lighting system is composed of three zones: the roof, the central part including the dashboard and the doors (armrests and storage compartments), and the floor. This configuration has been used for interior studies.

The external environment is recreated through a virtual simulation made visible through a 77-inch OLED television set placed one meter from the cockpit, and an immersive audio system consisting of five speakers and a subwoofer, controlled by a 5.1-channel sound card. The speakers are positioned 360  around the platform; three at the front, of which, two are placed to the right and left of the TV, 1m above the ground, and one in the middle on the floor. The other two are located on the back, 1m above the ground and approximately 2.5 m away from the platform. The subwoofer is set centrally at the front.

Physical components also include the instrumentation used to collect real-time physiological data during testing. These include eye-tracking glasses, a wearable device to monitor electrodermal activity, and a helmet to perform neuro-analysis. These instruments communicate either through a wired or wireless connection with the workstation, on which ad hoc software runs to collect real-time data.

In total, the simulation platform is controlled and made interactive by three computers, including one workstation and two on-board computers. The workstation controls the driving simulation, loading scenarios through VI-Grade software, and processing data from the pedals and steering wheel. It is connected to the on-board computer that controls the instrument cluster and central display. The third computer, on the other hand, controls the passenger display.

The workstation also controls the management of the augmented reality viewer. So does the audio system through cable connections to the sound card and the speakers and subwoofer. The workstation is also connected to the lighting system inside the vehicle, consisting of control boards and LED strips.

The onboard computer that controls the instrument cluster and central display also manages the Arduino module. This is necessary to handle the haptic feedback on the central touchscreen display – generated through 4 actuators and the steering wheel pulses that control the instrument cluster interface.

**Software Components**

When considering software utilized to create interactive prototype it is possible to identify three categories: simulation software, those used for prototyping digital interfaces, and those used in the data collection phase of testing.

For what concern simulation software the lab leverages the Vi-Grade pack as a comprehensive tool to simulate various aspect of the vehicle and of the environment (https://www.vi-grade.com/en/products/vi-worldsim/).

Graphic interface design software are used to create prototype interfaces within the vehicle at multiple levels of interactivity, such as Sketch (https://www.sketch.com/) or Figma (https://www.figma.com) and Protopie Studio. Software such as Protopie Connect and Arduino are used to make the prototypes more interactive and integrated with the physical part of the simulator. TouchDesigner is used to control the simulator's built-in lighting system (https://derivative.ca/).

The software used to collect biometric data are Pupils (https://pupil-labs.com/products/core) and iMotions (https://imotions.com/).

*Figure 3. Driving simulator platform from AXD Lab*

## Main Research Topics and Objectives

The laboratory currently focused on three main areas of interest that required different research processes and methods:

- Comparison of different interaction models in the interface to control the ventilation system.
- Study on the integration of vibrotactile feedback on the central touchscreen.
- Prototyping of a lighting system to develop research on the topic.

These project streams had different objectives, focus and implementation processes, but all involved the use of the simulation platform at different stages, highlighting the flexibility of such a tool in the field of research and design.For example, in the first case, the collaborating company presented itself with the objective of testing two different interfaces to determine which one had a more intuitive and secure interaction. The laboratory took care of the interactive prototyping part of the interfaces, the creation of the protocols for the tests, then conducting the tests and finally analysing the data.

The intervention in the second case, on the other hand, was more extensive, as it involved the downstream study of different types of haptic actuators that could be implemented in a touchscreen, with a consequent study on the creation of haptic feedback. The company's objective was to understand

whether haptic feedback could add value to the driving experience, especially from a safety perspective. Consequently, a test protocol was created involving interaction with an interactive prototype while driving and the use of eye-trackers. In this case, the sample studied consisted of 32 participants. The laboratory was then responsible for analysing the data.

The third point, on the other hand, represents a collaboration with the broader reference company. The aim is to explore the opportunities of in-vehicle lighting. The simulator was accordingly extended to integrate a controllable lighting system. Several scenarios were designed during the project, some of which were tested on a small sample for internal feedback.

## Conclusions

The paper describes the importance of having research environments in user experience design in the automotive world adequate to respond to the constant evolution this world is experiencing. Digital transformation shapes new requirements in terms of user experience, and the complexity of the levels of interaction enabled within the vehicle requires researchers and designers to have a holistic view on design. Prototyping in this scenario plays a key role because it allows shaping and testing research hypotheses, it must be based on the integration between the physical and virtual worlds that can take place at different levels.

The AXD laboratory establishment at the Politecnico di Milano was created in this context to address these challenges. Designed to support research on the user experience inside the vehicle, the lab provides a dedicated prototyping space equipped with a driving simulator. The platform represents the stage where digital and physical aspects of the experience converge, addressing equal consideration to both.

Furthermore, the lab exemplifies the importance of approaching challenges by bringing together expertise from different academical disciplines within the Politecnico di Milano. By leveraging expertise from diverse fileds, the laboratory fosters a synergistic environment where researchers from various backgrounds converge to tackle complex challenges.

## Acknowledgments

This research was supported by the AXD Lab. The authors express their gratitude to all individuals who participated in our study for their valuable time and insights.

# References

1. *Accenture. (2021). Automotive Experience Reimagined. Accenture.*
2. *Alvarez, I., & Rumbel, L. (2017). Skyline: A Platform Towards Scalable UX-Centric In-Vehicle HMI Development. International Journal of Mobile Human Computer Interaction, 9(3), 34–53. https://doi.org/10.4018/ijmhci.2017070103*
3. *Alvarez, I., Rumbel, L., & Adams, R. (2015). Skyline: A rapid prototyping driving simulator for user experience. https://doi.org/10.1145/2799250.2799290*
4. *Audoin, A. (2024, February 6). 5 top trends from CES that will drive the automotive industry in 2024. Capgemini. https://www.capgemini.com/insights/expert-perspectives/5-top-trends-from-ces-that-will-drive-the-automotive-industry-in-2024/*
5. *Blana, E. (1996). Driving Simulator Validation Studies: A Literature Review.*
6. *Bradley, M., Langdon, P. M., & Clarkson, P. J. (2016). An Inclusive Design Perspective on Automotive HMI Trends. In M. Antona & C. Stephanidis (Eds.), Universal Access in Human-Computer Interaction. Users and Context Diversity (pp. 548–555). Springer International Publishing. https://doi.org/10.1007/978-3-319-40238-3_52*
7. *Bruck, L., Haycock, B., & Emadi, A. (2021). A Review of Driving Simulation Technology and Applications. IEEE Open Journal of Vehicular Technology, 2, 1–16. https://doi.org/10.1109/*

*OJVT.2020.3036582*

8. *Calvi, A., D'Amico, F., & Vennarucci, A. (2023). Comparing Eye-tracking System Effectiveness in Field and Driving Simulator Studies. The Open Transportation Journal, 17(1). https://doi.org/10.2174/18744478-v17-e230404-2022-49*
9. *Deloitte. (2020). Software-Defined Vehicles a Forthcoming Indutrial Evolution.*
10. *Ebel, P., Orlovska, J., Hünemeyer, S., Wickman, C., Vogelsang, A., & Söderberg, R. (2021). Automotive UX design and data-driven development: Narrowing the gap to support practitioners. Transportation Research Interdisciplinary Perspectives, 11, 100455. https://doi.org/10.1016/j.trip.2021.100455*
11. *Ecosystemizer. (2020, June 1). The 10 Life Areas of the Ecosystem Strategy Map I Blog Ecosystemizer. https://www.ecosystemizer.com/blog/the-10-life-areas-of-the-ecosystem-strategy-map*
12. *Eryilmaz, U., Sancar Tokmak, H., Cagiltay, K., Isler, V., & Eryilmaz, N. O. (2014). A novel classification method for driving simulators based on existing flight simulator classification standards. Transportation Research Part C: Emerging Technologies, 42, 132–146. https://doi.org/10.1016/j.trc.2014.02.011*
13. *Fedele, C. (2023). Marking new horizons for in-vehicle interfaces with autonomous driving.*
14. *Goedicke, D., Bremers, A. W. D., Yasuda, H., & Ju, W. (2021). XR-OOM: Mixing Virtual Driving Simulation with Real Cars and Environments Safely. 13th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, 67–70. https://doi.org/10.1145/3473682.3480266*
15. *Group, M.-B. (2024, January 9). Mercedes-Benz at CES 2024. Mercedes-Benz Group. https://group.mercedes-benz.com/innovation/product-innovation/technology/ces-2024.html*
16. *John, C. (2023). AI in the Automotive Industry: The Effect and Its Future with Automobiles. https://medium.com/bestai/ai-in-the-automotive-industry-the-effect-and-its-future-with-automobiles-eeb21057818d*
17. *Kessels, C. (2023). A Guide to Prototyping Automotive Interfaces. The Turn Signal - a Blog About Automotive UX Design. https://theturnsignalblog.com*
18. *Khai Ooi, J. S., Ahmad, S. A., Chong, Y. Z., Md Ali, S. H., Ai, G., & Wagatsuma, H. (2016). Driver emotion recognition framework based on electrodermal activity measurements during simulated driving conditions. 2016 IEEE EMBS Conference on Biomedical Engineering and Sciences (IECBES), 365–369. https://doi.org/10.1109/IECBES.2016.7843475*
19. *Lekach, S. (2024, January 9). In-Car Voice Assistants Get An AI Boost In Future VW, Mercedes, BMW Vehicles. Forbes Wheels. https://www.forbes.com/wheels/news/vw-bmw-mercedes-polestar-voice-ai-features-ces/*
20. *Liu, Y.-C., Figalova, N., Baumann, M., & Bengler, K. (2023). Human-Machine Interface Evaluation Using EEG in Driving Simulator. 2023 IEEE Intelligent Vehicles Symposium (IV), 1–6. https://doi.org/10.1109/IV55152.2023.10186567*
21. *Losada, N., Jorge, F., Teixeira, M. S., Melo, M., & Bessa, M. (2020). Could Virtual Reality Substitute the 'Real' Experience? Evidence from a UNESCO World Heritage Site in Northern Portugal. In Advances in Tourism, Technology and Systems. https://link.springer.com/chapter/10.1007/978-981-33-4260-6_14*
22. *McKinsey&Co. (2016). Automotive revolution – perspective towards 2030.*
23. *Pwc. (2023). Digital Auto Report 2023—What Consumer Really Want.*
24. *Richter, H., Ecker, R., Deisler, C., & Butz, A. (2010). HapTouch and the 2+1 state model: Potentials of haptic feedback on touch based in-vehicle information systems. Proceedings of the 2nd International Conference on Automotive User Interfaces and Interactive Vehicular Applications, 72–79. https://doi.org/10.1145/1969773.1969787*
25. *Seropian, M. A., Brown, K., Gavilanes, J. S., & Driggers, B. (2004). Simulation: Not Just a Manikin. Journal of Nursing Education, 43(4), 164–169. https://doi.org/10.3928/01484834-20040401-04*
26. *Silvera, G., Biswas, A., & Admoni, H. (2022). DReyeVR: Democratizing Virtual Reality Driving Simulation for Behavioural & Interaction Research (arXiv:2201.01931). arXiv. http://arxiv.org/abs/2201.01931*
27. *Soares, S., Ferreira, S., & Couto, A. (2020). Driving simulator experiments to study drowsiness: A systematic review. Traffic Injury Prevention, 21(1), 29–37. https://doi.org/10.1080/15389588.2019.1706088*
28. *Viviani, A., & Panzeri, C. (2021, April 7). The new mobility paradigm: Evolving consumer needs and technologies - Octo Telematics. https://www.octotelematics.com/blog/the-new-mobility-paradigm-evolving-consumer-needs-and-technologies/*
29. *What is "CASE"? (2022, August 1). https://mcc-ams.com/en/article/03*
30. *What Self-Driving Cars Tell Us About AI Risks—IEEE Spectrum. (n.d.). Retrieved April 4, 2024, from https://spectrum.ieee.org/self-driving-cars-2662494269*
31. *Young, K. L., Koppel, S., & Charlton, J. L. (2017). Toward best practice in Human Machine Interface design for older drivers: A review of current design guidelines. Accident; Analysis and Prevention, 106, 460–467. https://doi.org/10.1016/j.aap.2016.06.010*
32. *Zhong, H., Hong, S., Gao, C., Liu, K., Wang, X., Zhang, Q., Zhu, K., Wang, Y., & Guo, Y. (2022). Testing Approach of HMI Designs for Vehicles with Automated Driving Systems: A Usability Test Case Based on the Driving Simulator. In H. Krömker (Ed.), HCI in Mobility, Transport, and Automotive Systems (pp. 459–471). Springer International Publishing. https://doi.org/10.1007/978-3-031-04987-3_31*

# Defining garment quality for user experience design in metaverse: the outerwear case study

*Dario Gentile, Francesco Musolino, Annalisa Di Roma, Alessandra Scarcelli, Michele Fiorentino*
*d.gentile7@phd.poliba.it, f.musolino@phd.poliba.it, annalisa.diroma@poliba.it, alessandra.scarcelli@poliba.it, michele.fiorentino@poliba.it*

*Politecnico di Bari, Italy*

***Keywords:***
*Perceived quality*
*Virtual reality*
*User experience*
*Outerwear*

## Abstract

Digital experiences in metaverse will be the next generation marketplace. The challenge is to discover and validate new narratives able to deliver Quality of products better than brick-and-mortar stores. Quality perception in metaverse is not fully addressed by literature, but is critical especially in fashion, where materials, fitting and details are key. This work investigates quality perception of garments and user experience design for metaverse applied to the outerwear case study. Findings indicate that quality is associated with durability and aesthetic greatly influences the assessment. From the state of art analysis, 11 design variables of user experiences for metaverse were identified, such as sociability, spatiality, and interactivity. Then, quality cues of the outerwear that should be communicated have been outlined, in reference to qualitative manufacturing and materials. Lastly, user experience should be product-centric, interactive, with high level of detail, to affect user's emotions.

## Introduction

One of the main challenges faced nowadays by fashion companies is the transmission of garment quality through emerging media like metaverse. The goal is to exploit the technology and surpass the experiences provided by brick-and-mortar stores and desktop e-commerce websites. Designers can explore new ways to create storytelling around the product (3D models, animation, stereoscopy, 3D sounds, particle systems, etc.), and thus generate more affection to it. The result is engaging user experiences leading to a more informative and responsible purchase, and with higher conversion rate.

The literature does not extensively cover the perception of quality in the metaverse, particularly in the realm of fashion, where crucial elements like materials, fitting, and details play a significant role. This topic has a shortage of theoretical knowledge, case studies and validations in industrial scenarios. This work investigates the quality garment presentation in the metaverse from the perspective of the outerwear case study. Outerwear is a garment worn over other clothing for warmth or protection outdoors (Dictionary, 2023). It is usually composed by multiple layers of fabrics, some with thermal properties, some waterproof, some for tactile comfort. It can have a padding fastened by a pattern of sewing. It is significant in fashion since it is the first layer of the outfit while we are outdoors and must be paired with the style of the outfit.

## Methodology

This work contributes by addressing the following research question:
RQ: How the quality outerwear in the metaverse should be presented?

To frame this topic is necessary the knowledge about quality of garments, and more specifically, what parts of the outerwear constitute its quality. To collect this knowledge, a study of the related literature is carried and advices by manufacturers of quality outerwear were registered. Moreover, a market research about existing fashion project for metaverse is made, in oder to provide baselines, as well as design variables for upcoming user experiences for metaverse. This is made by collecting a sample of case studies and performing the analysis and comparison.

## Quality perception of garments

This research is conducted on Google Scholar search engine with the following keywords: quality, perception, consumer, user, clothing, garments, fashion, quality, assessment, attitude.

Quality is a character, or nature, that belongs to or distinguish a thing that produces or provides products or services of high quality or merit (Dictionary.com, 2023). This is a generic definition that need further investigation in relation to a specific product. Although product quality is a deeply investigated subject of study, it stays an ambiguous and complex multidimensional topic (Swinker & Hines, 2006; Aakko & Niinimaki, 2021).

The quality of a garment in literature is associated with the concept of durability. Users usually choose a garment with the goal of maintaining its lifespan long, relying on the quality they perceive of the product (McNeill et al., 2020). So, product durability is a fundamental parameter of purchase choice, but since almost no label contains information on lifespan expectancy (Laitala & Klepp, 2013), users try to perceive it. The current stream of research also associates quality with environmental sustainability, since better quality is expected to extend the clothing use times and postpone the disposal (Aakko & Niinimaki, 2021).

In all domains quality is divided between objective quality and perceived quality.

«Objective quality generally refers to measurable and verifiable evaluation of certain product attributes by predetermined quality standards» (Aakko & Niinimaki, 2021).

«Perceived quality can be defined as the consumer's judgment about a product's overall excellence or superiority» (Zeithaml, 1988).

## Objective quality

The objective quality of a garment is its ability to retain original shape and colours, and results from material features objectively measured by tests, like breaking strength, tear strength, abrasion resistance, colourfastness, effects of laundering seam strength and pilling. (Aakko & Niinimaki, 2021; Cooper et al., 2014). When a garment loses its original shape or colour, it becomes obsolete. «Absolute obsolescence means that the product has failed and is no longer usable, relative obsolescence applies to products that are still functional, but discarded for some other reasons» (Laitala & Klepp, 2015). Especially garments are disposed due to relative obsolescence, as changes in shape or colour lead to a loss of appeal and social messages of lack of care.

To frame the critical components for quality, causes of disposal of garments are analysed. In a major quantitative study, Laitala and Klepp

(2015) recorded the causes of disposal of garments delivered by a sample of people. They found that most of the garments are dismissed due to a decay in shape or colour. This approach could be used in future studies for the individual category of clothing, to carry a more specific analysis and identify better what are the critical issues users must pay attention to. The items in Laitala and Klepp's work (2015) that could affect the outerwear are holes or tears, looks very used or worn, stains, worn out, colour change or fading, lost elasticity, broken seam or sewing failure, broken zipper, the material has become thin, washed out, failed mending or repair, print faded, threads drawn out, broken decoration, felting, buttons missing.

To implement this library, outerwear manufacturer from a made-in-Italy company has been interviewed. They put a focus on the padding, that contributes to the quality of the outerwear, as it behaves to stresses and preserve the original shape of the product. Another relevant aspect is the possible presence of furs, and thus their binding to the coat, which could cause them to shed.

Objective quality must always be related to use pattern. We must suppose the proper use of the product, as well as the maintenance, to exclude the occurrence of early wear and tear. Fletcher (2012) argues the dependency of longevity on user behaviour and consumption patterns, dictated by the social and experiential context.

## Perceived quality

In user experience design, perceived quality takes priority over objective quality. Technical qualities can be influenced by user goals and needs, as well as being subject to user perception and interpretation (Steenkamp, 1990). Hines and O'Neal (1995) in their study show that features may mean different things to each user. Furthermore, despite the common meaning of quality, some cues specifically may not indicate quality to the individual user. Some other research echoes this notion, arguing that who is more involved in fashion is better at determining garment quality (Aakko & Niinimaki, 2021).

Perceived quality is determined by quality cues and quality attributes. Quality cues can be ascertained through senses prior to consumption and are divided into intrinsic cues and extrinsic cues. Intrinsic cues cannot be changed without changing the product itself. Extrinsic cues are external aspects related to the product, for example, the price. A further subdivision is proposed by Swinker & Hines (2006), that identify appearance cues (aesthetics) and performance cues (regarding resistance and maintenance). Nevertheless, both these other classes fit into the definition of intrinsic cues, so we can treat them like subcategories of it (Fig. 1).

Quality attributes, that are divided into experience and credence attributes, refer directly to the functions of the product, and are submitted to psychosocial influence. Examples are durability or reliability (Aakko & Niinimaki, 2021).

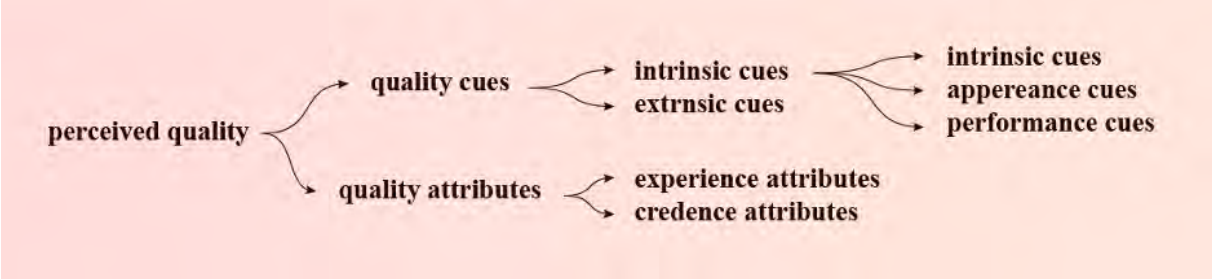
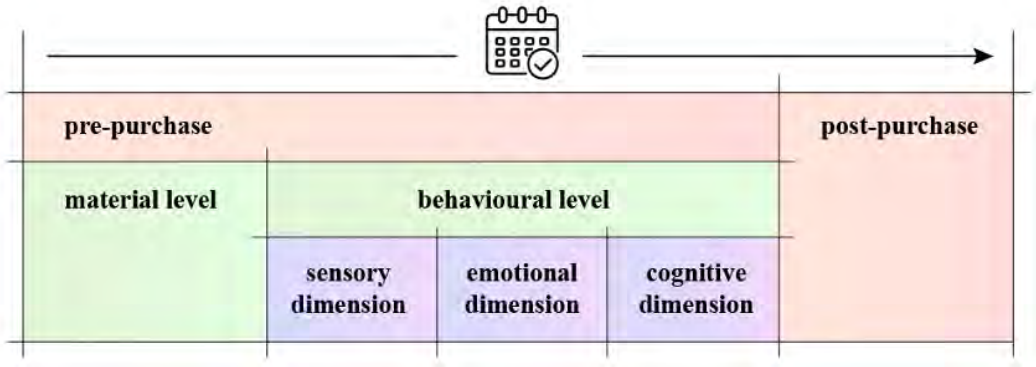



*Fig. 1. Descriptive tree diagram of quality perception.*

In the research of Swinker & Hines (2006) users mostly adopt appearance cues, and never mention intrinsic cues in their process of quality assessment. Moreover, for each cue is asked the importance for the quality assessment. It ended up that four of the five cues with higher ratings were aesthetic. This is a strong demonstration of the key role of appearance in the assessment by the users and the unfamiliarity with technical features. For the purchase choice the user evaluates first the aesthetic side of the product and then make the comparison of quality. For this reason, mass market companies usually base their communication strategy on appearance and extrinsic cues. In support of this, Laitala & Klepp (2013) found that taste-related unsuitability or changes in fashion and style are very common reasons for disposal.

The individual path leading to quality assessment (Fig. 2) goes through two levels: material level and behavioural level. The material level influences the behavioural one. The material level involves the objective features of the product and answers the question «what the item is?» The behavioural level refers to functional and aesthetic features and answers the question «What the item can and will do for me?» The behavioural level can be further subdivided into sensory dimension, emotional dimension, and cognitive dimension. They refer respectively to our abilities to perceive sensations with the five senses, feel emotions, and think within a cultural and social environment (De Klerk and Lubbe, 2008). These dimensions tend to be temporally consequential. In the sensory dimension, the sense that most contributes to generating our awareness is sight. Typically, users first visually inspect the product, creating an expectation for the other senses, which will then be confirmed or disproved (Spence, 2020). The reason of the effectiveness of sight lies in the perceptual memory we have of the shown material. Current fashion e-commerce sites work by simply requiring the sense of sight to evaluate the product.

*Fig. 2. Path of quality assessment.*




## Metaverse fashion showrooms

We conducted a state of art on fashion user experiences for metaverse as means to deliver quality of garments. Desktop metaverses, multiplayer video games, and digital marketplaces, as well as real-world products showcased through their digital twins are included. This research was conducted on online fashion magazines through Microsoft Edge search engine in September 2023. A total of 23 case studies were collected and analysed, as shown in Tab. 1. The case studies were then analysed and compared to identify the design variables of a user experience.

| | | | |
|---|---|---|---|
| **1** | "Afterworld, the age of tomorrow" videogame by Balenciaga | **13** | Journee studio |
| **2** | Fortnite skins by Balenciaga | **14** | metaverse by Pangaia |
| **3** | "Nikeland" in Roblox | **15** | Pull&Bear compatible outfits on Ready Player Me |
| **4** | Video of walking garments NFTs by Nike | **16** | Vans House in Roblox |
| **5** | Adidas NFTs with Bored Ape Yacht Club | **17** | Givenchy Beauty House in Roblox |
| **6** | Adidas Virtual Gear collection | **18** | Gucci for Otherside metaverse |
| **7** | Times New Roman | **19** | NFTs store by The Fabricant |
| **8** | Virtual stores by H&M | **20** | Online store with digital twins by Atacac |
| **9** | Gucci Garden in Roblox | **21** | Tribute brand editing service |
| **10** | "Electric/City" metaverse by Charli Cohen | **22** | Milan fashion week 2023 |
| **11** | Blankos Bock Party skin by Burberry | **23** | Burberry premium skins for Honor of Kings |
| **11** | Mobile game of Louis Vuitton | | |

*Tab. 1. Index of case studies taken for the analysis*

91% of case studies are multidisciplinary, and can involve fashion, technology, video games, social media, economic companies. Only one case study does not involve any fashion company but regards a digital asset design studios that have implemented fashion projects. Video game companies take part in 48% of case studies of the sample, whether the project consists in the development of an actual video game, thus participating from a technical point of view, or when have a large installed base of users to give visibility to the fashion brand.

With the metaverse still a new concept, few companies have decided to venture into it, so the existing cases mostly concern experimental projects by large fashion companies selling luxury. Although luxury products are related to quality, their value lies in the status symbol, so they aim to communicate extrinsic cues. Projects by non-luxury companies, that need to showcase the product and its quality, have yet to emerge. Non-luxury quality products set their value in materials and manufacturing and their price is affordable for many people.

Analysing the differences between the case studies, 11 design variables of user experience for the metaverse have been defined:

1. Sociability: the experience can be individual or social. Since it is about fashion, individual experience also considers the sociality of the phenomenon.
2. Spatiality: may take place in an explorable 3D metaverse (e.g. a virtual city) or have no space (e.g. a configurator). Experiences without a space tend to be individual, while metaverses with servers usually are accessible by multiple users at the same time. Spatiality is a largely adopted feature, that increases the engagement of the user. Users that explore environments gain enjoyment, emotional arouse and hedonic experiences (Xi & Hamari, 2021).

3. Gamification: the experience can be gamified or be part of an actual video game. Or it may not apply this mechanism.
4. Revenue: the experience can be a direct revenue stream with paid assets (e.g. skins) or having just a promotional (non-money related) function. Many case studies do not even include direct brand monetization, highlighting the promotional role of metaverse.
5. Interactivity: the experience can be passive, so just watching some content, or interactive. Interactivity is always present, apart from a few cases that include photographic or videographic content, often associated with NFT art forms.
6. Manageability: the platform (a website or a server) allows free design to the fashion company or has some limits and standards. Main platforms found in the browsing are Ready Player Me, Decentraland, VR Chat and Spatial. Their importance lies in the large group of users due to their open-source structure. They propose standards to the market, which are followed by companies interested in placing their products in as many showcases as possible.
7. Level of detail (LOD): it is related to mesh and texture of digital models (environment, avatar, and interface etc.), and can be high or low. The level of detail is made as high as possible, as a better visual makes the work qualitative and renowned. Moreover, the higher the LOD, the higher the vividness of materials. It may also be limited in favour of manageability.
8. Imagery: the 3D assets, models and materials can be realistic or fictional, depending on the concept of the collection. Many study cases present fictional products or hybrid collections, as demonstration that quality is not only a matter of materials and manufacturing, but also fashion design and styling.
9. Relation with real product: the project can provide a digital representation of a real product or exists exclusively in digital form. The experience can also have hybrid collections of digital twin and fictional outfits.
10. Content: it can be the product or the brand. We found a large use of metaverse to communicate the brand, so an extrinsic cue, rather than the intrinsic cues of their products.
11. Explicitness of the message: content can be communicated explicitly at the cognitive level (text) or implicitly at the sensory and unconscious level. Usually, the modality of implicit and emotional message is used.

*Tab. 2. Design variables of case studies. For revenue 'X' means direct revenue. For Manageability 'X' means high manageability. For level of detail 'X' means high LOD. For imagery 'X' means fictional. For real products 'X' means the presence of it.*

| Case studies | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sociability** | | X | X | | | | | | X | | X | | | | | X | X | X | | | | X | | 8 |
| **Spatiality** | X | X | X | | | X | | X | X | X | X | X | X | X | X | X | X | X | | | | X | X | 17 |
| **Gamification** | | X | X | | | | | | X | X | X | X | | | | | X | X | | | | | X | 9 |
| **Revenue** | | X | X | X | | | | | X | | X | | | | | X | X | | X | X | X | | X | 11 |
| **Interactivity** | X | X | X | | | | | X | X | X | X | X | X | X | X | X | X | X | | X | | X | X | 17 |
| **Manageability** | X | | | | X | | X | X | | X | | X | X | X | | | | X | X | X | X | | | 15 |
| **Level of detail** | X | | | X | X | X | X | X | | X | X | | X | X | | | | | X | X | X | X | X | 15 |
| **Imagery** | | | | X | | X | X | X | | | X | X | X | | | | | X | X | | X | X | X | 12 |
| **Real products** | | X | | | X | | | | | X | | | | X | | X | | | | X | | | X | 7 |
| **Product centric** | | | | | | | | | | X | | | | X | X | X | | | X | X | | | | 6 |
| **Explicitness** | | | | | | | | | | | | | | X | | X | | | | X | | | | 3 |

Tab. 2 shows for each case study the presence of certain variables in the experience and gives an idea about trends in the market. Most of the case study regards explorable environments that are highly interactive. Other minor trends are custom platform with high manageability, like experiences, and high level of detail. The promotional and branding role of user experiences is reflected by the small amount of product-centric case studies, with predominancy of extrinsic cues communication. Moreover, almost all the experiences aim at the emotion of users, conveying brand and product values implicitly and subconsciously.

## Results and discussion

From the analysis of quality perception of garments and the interview with outerwear manufacturer, parts of the outerwear that determine its quality and that should be communicated to users are outlined. Moreover, the analysis of the case studies brought design guidelines of a user experience for quality outerwear.

**Key quality cues of the outerwear**

These are the cues that should be central in the user experience. Some of these cues can be assessed by viewing the product, others need additional information.

- Shape regards the aesthetic of the product, independently from the colour. It is determined by the sum of other cues, but it is assessed even in general. Single components can even be qualitative, but the global shape is key in the evaluation. It is assessed visually.
- Colour has its relevance for users. Different colours mean even different pairings with the rest of the wardrobe, or different adhesion to trends, that leads to different patterns of use. These are not just matters of taste, but design choices that can drive the expectation of the user. It is assessed visually.
- Material declared on the label is objective information. They are the factors from which all the other features of the product derive, together with the shape and the colour. Many other cues derive strictly from this one. This information is always included in all labels, but this does not mean that users pay attention to it. This feature can be overlooked due to the lack of knowledge that users usually have of materials, as revealed by the analysis by Aakko and Niinimaki (2021). It can be assessed mainly on the label with the technical specifications. Some users could be able to recognize the material even visually.
- Solidity of components: zippers, buttons, sewing, etc. These parts are well built on quality products, avoiding loss of aesthetics and functionality, keeping the lifespan long. It is important that the buttons do not peel, or that the zippers slide well and do not break. It can be barely assessed visually.
- Waterproofing can be objectively verified. The waterproofness of the outerwear does not necessarily establish the quality of the product since it is strictly connected to the intended use. It may also be that a coat is quality without being waterproof. It should be declared in the label for more informativity, even if the user could already know the material has this feature.
- Warmth: a coat that manages to be warm despite its lightness or thinness is an indication of quality.
- Lightness concerns the actual weight of the garment. A heavy outerwear leads to a discomfortable wearing experience, but not

only, it would make it more uncomfortable to hold while not wearing it. A light jacket, especially when compared to its size, is the result of careful design and selection of materials, as well as the experience of the producers, so can be viewed as a quality indicator. It should be communicated on the label.

- Softness depends especially on the padding material, and it is a specific feature of this type of garment. A secondary function that the softness of the garment has, suggested to us by the employees of the case study company, is to make it less subject to deformation during shipping and storing, thus improving the preservation of its shape over time.
- Smoothness of the fabric is mostly an aesthetic feature that is inspected visually. It concerns the surface finish of the material and the tactile and visual sensation.
- Elasticity regards the comfort of the outerwear in the movement and in the gesture of wearing, as suggested by the company designers. It is also responsible for good fitting, as it is the ability to adapt its shape. Moreover, it contributes to the retention of the original state over time. It can be assessed by looking at the product in motion, for this reason would be better to present the animated outerwear in the experience.
- Thinness is a fundamental aspect of the padding, which helps make the user's body appear slim. If the padding is slim but performs any of the other functions, it is a quality one. Can be assessed visually.
- Sustainability refers to the raw materials and process, so what is under the control of the producers. It can be assessed from the label. For example, if natural fur is used for refinements, so coming from animals, it is less sustainable than eco-furs. Or it can be driven by the recyclability of fabrics.

**Design guidelines for quality cues communication**

First, the interface must be product-centric, providing all the functions to observe and perceive the product. The objective is the formation of an accurate user's expectation on the real product which he has not yet acquired, to minimize evaluation errors in the purchase decision phase. This is also a key aspect for sustainability as it will reduce the return rates and related cost for society and the environment. This concerns the shopping effectiveness, that is the ability of the user to find and obtain the product that most closely matches his needs and wants (Mittelstaedt & Stassen, 1990). For this reason, the most important aspect of the experience will be the level of detail of the product shown, which must be high, therefore as close to reality as possible, to inform about the real features of the garment.

Since the interaction takes place between the user and the products, the sociability of the experience is not central. Despite this, the user will still analyse the garment with respect to its social value. Even the spatiality of the virtual environment could be a redundant element, as the exploration task does not concern product assessment, on the contrary, it could shift the attention from the main task. Even (Xi & Hamari, 2021) support the possibility of the VR environment being not always well usable, as some difficulties in controlling motion can arise. This does not mean that the environment variable should be ignored, as a useful function would be the visualization of the product in a specific place, as a preview of the use.

Despite being an extrinsic aspect of the product, even a not explorable environment is fundamental to modulating the sensations and emotions of the user. The environment comes into play at the sensory and emotional levels of the assessment of quality, improving the attitude towards the product.

Even the involvement of gamification could divert the user from the main task, so it would be appropriate to opt for a less playful communication that does not involve additional stimuli, leading to a more complex experience.

Interaction is key in the evaluation process, as following an initial stimulus, the user will proceed with his investigation to learn more about the product. The interactivity, although difficult to implement, provides great advantages, allowing the user to select the information, favour some, and ignore others, making the evaluation efficient and reducing the effort. Shopping efficiency is one of the key elements of usability evaluation for a shopping system (Xi and Hamari, 2021), and is related to the cost of the shopping journey, including temporal resources and psychological effort (Yang & Kim, 2012). The other fundamental effect of interactivity is to make the user feel in control of his actions, to invite him to explore the features, and therefore improve his attitude towards products.

Finally, about the explicitness of quality we know from literature that visual contents are better assimilated by the user and more effective to arise emotions. However, depending on the user's idea of quality, additional explicit information should be provided. The implementation of a label that contains a message to be understood cognitively also contributes to making the experience more respectable and sincere. However, this more technical message should have to remain in the background compared to the aesthetics of the product, which we have seen to be essential for the perception of quality and the purchase choice.

## Conclusions

The VR shopping user experience should be as engaging as possible to face the attractiveness of upcoming contents for metaverse. The experience should be hedonic, catching user's senses and emotion, avoiding boring explanations. Building the communication around quality manufacturing by highlighting intrinsic quality cues, requires the interface to be product-centric, differently from ones by fast-fashion giants, that base their value on branding. The interface is more effective wether it's custom to the outerwear, including only key cues involved in the quality assessment. The system should be highly interactive, giving sense of control and supporting the assessment, leading to a positive attitude. The high level of detail, as well as animation, are key to the perception of materials and the hedonic experience, therefore designers should push these aspects and future development of a more performative technology is needed.

## Future research agenda

Additional contributions in this field will drive design of interface to product-centric scenarios that prioritize quality manufacturing over the fast-fashion industry, to make the market more sustainable. This work proposed a method applying it to outerwear, however, for greater validation, there is a need for further application to other categories of products. This work specifically covers the area of Intrinsic cues, and future work could extend the analysis also on extrinsic cues. Moreover, identified guidelines should be tested through user experience designs at commercial level, developed with the participation of industry.

## Acknowledgments

*Project co-funded by: European Union – NextGenerationEU, National Recovery and Resilience Plan (PNRR), Italian Ministry of University and Research, MICS (Made in Italy - Circular and Sustainable), Mission 4 Component 1/2 , Spoke 2, Project "Experience Made in Italy: Immersive Storytelling Design for Contemporary Values and Sustainability" (EMOTIONAL), Project n. PE_00000004, CUP D93C22000920001*
*FESR 2014 – 2020 Obiettivo Convergenza, Emme Evolution S.r.l., CUP B95H22000810007.*
*PhD in "Smart e Sustainable Industry" XXXIX cycle – Politecnico di Bari , DM n. 117/2023, PNRR, Mission 4, component 2/2 "Dalla Ricerca all'Impresa" – Investment 3.3 "Introduzione di dottorati innovativi che rispondono ai fabbisogni di innovazione delle imprese e promuovono l'assunzione dei ricercatori dalle imprese" – Genesys Srl.*

# References

1. *Aakko, M. & Niinimaki, K. (2022). "Quality matters: reviewing the connections between perceived quality and clothing use time". Journal of Fashion Marketing and Management, 26(1), 107-125. [Online] Available at: https://doi.org/10.1108/JFMM-09-2020-0192 [Accessed 29/02/2024]*
2. *Cooper, T., Claxton, S., Hill, H., Holbrook, K., Hughes, M., Knox, A. and Oxborrow, L. (2014). "Clothing Longevity Protocol". Nottingham Trent University, Banbury. [Online] Available at: https://irep.ntu.ac.uk/id/eprint/29901 [Accessed 29/02/2024]*
3. *De Klerk, H.M. & Lubbe, S. (2008). "Female consumers' evaluation of apparel quality: exploring the importance of aesthetics". Journal of Fashion Marketing and Management, 12(1), 36-50. [Online] Available at: https://doi.org/10.1108/13612020810857934 [Accessed 29/02/2024]*
4. *Fletcher, K. (2012). "Durability, Fashion, Sustainability: The Processes and Practices of Use". Fashion Practice, 4(2), 221-238. [Online] Available at: https://doi.org/10.2752/175693812X13403765252389 [Accessed 29/02/2024]*
5. *Hines, J.D. & O'Neal, G.S. (1995). "Underlying determinants of clothing quality: the consumers' perspective". Clothing and Textiles Research Journal, 13, 227–223. [Online] Available at: https://doi.org/10.1177/0887302X9501300403 [Accessed 29/02/2024]*
6. *Laitala, K. & Klepp, I.G. (2013). "Environmental and Ethical Perceptions Related to Clothing Labels Among Norwegian Consumers". Research Journal of Textile and Apparel, 17(1), 50-58. [Online] Available at: https://doi.org/10.1108/RJTA-17-01-2013-B005 [Accessed 29/02/2024]*
7. *Laitala, K. & Klepp, I. G. (2015). "Making Clothing Last: A Design Approach for Reducing the Environmental Impacts". International Journal of Design, 9(2), 93-107. [Online] Available at: https://hdl.handle.net/10642/4920 [Accessed 29/02/2024]*
8. *McNeill, L.S., Hamlin, R.P., McQueen, R.H., Degenstein, L., Wakes, S., Garrett, T.C. and Dunn, L. (2020). "Waste not want not: behavioral intentions toward garment life extension practices, the role of damage, brand and cost on textile disposal". Journal of Cleaner Production, 260. [Online] Available at: https://doi.org/10.1016/j.jclepro.2020.121026 [Accessed 29/02/2024]*
9. *Mittelstaedt, R. A., & Stassen, R. E. (1990). "Shopping behavior and retail merchandising strategies". Journal of Business Research, 21(3), 243–258. [Online] Available at: https://doi.org/10.1016/0148-2963(90)90031-8 [Accessed 29/02/2024]*
10. *Spence, C. (2020). "Shitsukan—The multisensory perception of quality". Multisensory research, 33(7), 737-775. [Online] Available at: https://doi.org/10.1163/22134808-bja10003 [Accessed 29/02/2024]*
11. *Steenkamp, J.-B.E.M. (1990). "Conceptual model of the quality perception process". Journal of Business Research, 21, 309-333. [Online] Available at: https://doi.org/10.1016/0148-2963(90)90019-A [Accessed 29/02/2024]*
12. *Swinker, M. E. & Hines, J. D. (2006). "Understanding consumers' perception of clothing quality: a multidimensional approach". International journal of consumer studies, 30(2), 218-223. [Online] Available at: https://doi.org/10.1111/j.1470-6431.2005.00478.x [Accessed 29/02/2024]*
13. *Xi, N., Hamari, J. (2021). "Shopping in virtual reality: A literature review and future agenda". Journal of business research, 134, 37-58. [Online] Available at: https://doi.org/10.1016/j.jbusres.2021.04.075 [Accessed 29/02/2024]*
14. *Yang, K., & Kim, H. (2012). "Mobile shopping motivation: An application of multiple discriminant analysis". International Journal of Retail & Distribution Management, 40(10), 778–789. [Online] Available at: https://doi.org/10.1108/09590551211263182 [Accessed 29/02/2024]*
15. *Zeithaml, V. A. (1988). "Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence". Journal of Marketing, Vol. 52, pp. 2-22. [Online] Available at: https://doi.org/10.1177/002224298805200302 [Accessed 29/02/2024]*
16. *Dictionary.com (2023), "[Definition of] quality". Available at: QUALITY Definition & Usage Examples | Dictionary.com [accessed 15 August 2023]*
17. *Dictionary.com (2023), "[Definition of] quality". Available at: OUTERWEAR Definition & Usage Examples | Dictionary.com [accessed 15 August 2023]*

# Research through Design in Multisensory Narrative Dimensions

*Clice de Toledo Sanjar Mazzilli*
*clice@usp.br*

*University of São Paulo, Brazil*

***Keywords:***
*Design research*
*Design processes*
*Multisensorial*
*Narrative*

## Abstract

This paper introduces the Multisensory Narrative Dimensions research line, in light of the *Research Through Design* (RtD) approach, aiming to bring research theory and design practice closer together, and believing it to be a path to innovation and sustainability in investigations related to editorial, environmental and interaction design. RtD has proven effective in addressing complex and interdisciplinary problems inherent to this kind of research, although it still requires reflection. Therefore, the conceptualization of RtD is presented, as well as five case studies, using the quality indicators of Prochner & Godin (2022) to evaluate them. The findings highlight the recurring aspects of contextualization, credibility, and applicability in such research efforts. This study may encourage researcher, educators, and students to experiment with design processes in unexpected ways, leading to innovation while maintaining research rigor.

## Introduction

*Multisensory Narrative Dimensions* names a research line from the Image Laboratory, which is linked to the Project Department at FAU-USP. The laboratory brings together professors of design, architecture, engineering, and arts, in addition to undergraduate and postgraduate students. The team explores new paradigms for visual and environmental design research across various dimensions (environmental, editorial, audio-visual, digital interfaces, illustration, communication, data visualization). It is believed that combining applied and experimental research with new technologies and artisanal processes can fosters innovation and sustainability in design. In general, projects are developed with the aim of enhancing the well-being, as well as promoting health, education, culture, leisure, and fostering harmonious coexistence in public spaces, in alignment with the sustainability goals outlined in the SDGs for 2030 (3, 4, 9, and 11). The theoretical foundation, along with design processes, can be integrated with various fields such as Cognitive and Behavioral Sciences (including Neuroscience, Psychology, Environmental Psychology, and Artificial Intelligence), Health Sciences, Ecology, Computer Science, Engineering, and Education.

It is considered that RtD is an appropriate approach to address the complexity of the phenomena involved. This entails investigating through experimentation and seeking answers through practical implementation,

while also incorporating research procedures to systematize information and generate knowledge. However, this method demands the researcher's direct involvement, necessitating careful attention throughout the research process. Therefore, it is essential to critically evaluate the process based on research quality indicators to ensure the validation of its results in academia.

This is not an easy task, as the disruptive nature of RtD makes it challenging to align its projects with a rigid set of indicators. The practice of design proposes a singular form of knowledge generation distinct from other scientific fields. For instance, this knowledge can be developed through intuitive and practical approaches, exhibiting a more dynamic, ephemeral, and heterogeneous nature than other sciences (Schon, 1983, as cited in Prochner & Godin, 2014). Such characteristics facilitate real-time discussions of specific problems, creatively challenging the status quo. Additionally, the replicability of results is sometimes questioned, which is not always desirable in design. This implies that the same process may not necessarily lead to the same design "solution" due to contextual variations in every design problem. However, the underlying strategy could be replicated, contributing to the accumulation of knowledge in the field.

Therefore, this paper exposes the conceptualization of RtD, based mainly on Godin & Zahedi (2014) and Zimmerman (2010), as well as presenting RtD quality indicators proposed by Prochner & Godin (2022), to then present and analyze five investigations developed within the Multisensory Narrative Dimensions research line, organized into two dimensions: editorial design and environmental design.

The criteria for case selection are primarily based on their experimental quality and the integration of design practice into the research process, along with their potential for innovation in the technologies (analog and digital) involved in the creation process.

The editorial design group presents two cases, specifically focusing on books that predominantly convey narratives through images. It explores how design elements are integral to the storytelling process, encompassing format, layout, materials, textures, smells, sounds, etc., whether through digital or artisanal processes. The significance of these studies lies in their contribution to graphic design education and their exploration of the creation of meaning and visual/sensory narratives. They delve into the complexity of the process and the languages involved, as well as the paths leading to initial inquiries and potential solutions. On the other hand, design practice involves contextualization related to various societal, environmental, educational, and health issues. In this context, the products resulting from the design process, namely, the books, can help advance solutions to these contextual challenges.

The second group highlights three investigations centered on environmental interventions that employ research through design, addressing themes such as teaching and education, culture, and the enhancement of urban spaces. The significance of these cases lies in the increasing interest in immersive environments across various contexts, utilizing augmented, virtual, and mixed reality technologies. These technologies are combined with the creation of narratives that engage multiple senses and body movement within space. Moreover, these technologies can aid in the design process itself or in the evaluation of experiments. Another recurring approach is the focus on the user, which guides decision-making regarding project paths and the assessment of interventions, as well as the cultivation of affective and emotional values within the environment. In contrast, one of the studies

begins with physical and ephemeral experiments to propose play spaces in schools. These three projects are of considerable complexity, involving collaborative processes and the engagement of stakeholders.

It was considered that such cases would be suitable to be evaluated, in a comparative way, using the criteria proposed by Prochner & Godin (2022) as they present, to a certain extent, complete stages of research and project development.

## Research through Design (RtD)

The processes of applied and experimental research in design presuppose multidisciplinary knowledge and practices, using varied methods. Therefore, it is not about finding a step-by-step guide for their development, but rather clarifying the principle of such approaches and identifying qualifying aspects, to then discuss and evaluate the cases of this study.

A recurring designation for this type of investigation is Research through Design (RtD), with connections to other approaches such as Constructive design research, Practice-led research, or Project-grounded research. The use of this term is not recent; it has been in circulation for at least 30 years. According to Godin & Zahedi (2014), the concept originated from Christopher John Frayling (1993), a renowned British professor and author in the field of art and design education. Later, Alain Findeli (2004) redefined the term for the design field:

> *"Research through design is the closest to the actual design practice, recasting the design aspect of creation as research. Designer/researchers who use RtD actually create new products, experimenting with new materials, processes, etc." (Findeli, 2004, cited by Godin & Zahedi, 2014, p.2)*

Several authors have discussed this approach over the past 20 years (Findeli, 2004; Jonas, 2006; Findeli et al., 2008; Zimmerman et al., 2010; Godin & Zahedi, 2014; Herriot, 2019; Prochner & Godin, 2022; Zahedi & Tessier, 2023), seeking RtD definitions, their outlines, forms of validation, and evaluation.

Godin & Zahedi (2014) offer an overview of the origin and evolution of RtD, along with its characteristics, based on a literature review concerning RtD. The study examines ontological aspects (the nature of reality), epistemological aspects (validity of observations), expected contributions (anticipated outcomes), methodological aspects (the research process), and limitations (common queries and constraints) associated with RtD. Their analysis underscores the consistency demonstrated by this approach over time.

Especially around Human-Computer Interaction (HCI), scientists and engineers have recognized that design-oriented research approaches can offer innovative, valid, and pertinent insights. Zimmermann et al. (2010) conduct a critical examination of RtD within the HCI domain. Alongside a systematic literature review, they conducted interviews with 12 leading researchers in the field, focusing on three key topics: "design research," "design theory," and RtD specifically. Subsequently, they discussed the three most cited cases by the interviewees. Different types of research and theories were investigated, identifying RtD as a canonical research approach within the HCI domain, often centred on creating artifacts to drive social change and enhance society.

Another related practice is Action Research, commonly employed in the humanities, with a focus on fostering social transformation. The iterative sequence of procedures – iteratively planning, acting, observing, and then reflecting – brings these two types of investigation closer. These approach-

es often entail interdisciplinary teamwork or the integration of knowledge from multiple disciplines.

On the other hand, certain problems may arise from this approach. Many RtD examples lack comprehensive documentation, with some design researchers considering artifact development sufficient without textual support (Zimmerman et al., 2010). It's argued that RtD should stem from a coherent theoretical framework to distinguish it from mere design practice. Having multiple case studies to support the research is desirable, as it can either bolster or challenge commonly accepted assumptions. Additionally, there's a risk of oversimplifying design procedures and methods, which may be perceived as a natural outcome of RtD. This could lead designers and researchers to apply resulting theoretical models without a profound grasp of the underlying methodology.

Prochner & Godin (2022) faced the challenge of discussing quality in RtD projects. To achieve this, they conducted a systematic literature review, exploring quality indicators in research and examining their applicability within RtD. The theoretical survey on research quality was based on various research paradigms, including positivism, post-positivism, constructivism, and pragmatism, each with its own set of detailed quality indicators (refer to Table 1).

*Table 1. Framework of research quality indicators and their categories. Based on Prochner & Godin (2022, p.8).*

| Categories | Indicators and paradigm of origin | Applications in RtD |
|---|---|---|
| **Traceability** | Replicability (positivism/post positivism)<br>Recoverability (pragmatism) | Explanation of the RTD project and how it led to the research conclusions. |
| **Interconnecivity** | Internal validity (positivism/post positivism)<br>Credibility (constructivism)<br>Contextualisation (pragmatism) | Collaboration with stakeholders in the RTD project and/or description of the context in which the project is based and its implications on the project. |
| **Applicability** | Internal validity (positivism/post positivism)<br>Credibility (constructivism)<br>Contextualisation (pragmatism) | Inspiration for research and practice approaches or to enhance the 'habitability' of the world. |
| **Impartiality** | Objectivity (positivism/post positivism)<br>Confirmability (constructivism)<br>Contextualisation in theory and research (pragmatism) | Contextualisation of the RTD project in design practice, other research and/or in relation to the researchers' subjectivity |
| **Reasonableness** | Reliability (positivism/post positivism)<br>Dependability (constructivism)<br>Soundness of research methods and research norms (pragmatism) | Establishment of a repeatable process for design practice or explanation of the use of design practice norms, general design research norms or RTD norms. |

Finally, they put forward three sets of recommendations for RtD researchers: "(1) position work in paradigms or around quality indicators, (2) rebalance the quality indicator categories, and (3) consider the reasonableness of the project and what reasonableness could mean in RtD." (Prochner & Godin, 2022, p.20).

## Multisensory narratives: case studies

This section aims to elucidate the nature and approach of the projects within the research line under examination. It focuses on five researchers, comprising two master's and three doctoral theses, which delve into multisensory narratives. These projects encompass experiments in both editorial and environmental design dimensions, incorporating aspects of interaction and immersive experiences. Subsequently, the analysis is presented according to the quality indices proposed by Prochner & Godin (2022) in a comparative.

## 1. Children's book-object [editorial design dimension]

Elizabeth Romani researched the design of children's book-object for her master's and doctoral studies. Her master's thesis (2011) explored manual interactive elements in children's books, as integral to narrative engagement, blending theoretical and practical research. Drawing from Linden (2007) and Perrot (1987), she analyzed playful strategies, such as synesthetic, humorous, guessing, image-based, and cut-out games; and Munari (1998) guided the design process. Additionally, Romani examined books by Bruno Munari (1956) and Kveta Pakovska (1996), focusing on production technologies and graphic language as playful narrative elements. The practical phase involved experiments using cut-out and collage techniques, grouped by playful function. These experiments (Fig. 1 to 5) demonstrated how design tools can stimulate book manipulation through techniques like accordion folding, special cutting, diverse supports, and three-dimensional structures. Additionally, support dimension optimization was considered.

*Figure 1. Book-city experiment. Visual narrative using accordion binding and various materials. Fantasy game. Photo by Romani (2011, p. 121)*


*Figure 2. Guessing game with the compound word "guarda" [e.g., guarda-chuva ("umbrella")]. Explores surprise when turning the page. Photo by Romani (2011, p.122-123)*


*Figure 3. Three-dimensional experiment - word game – articulates object and poetry. Photo by Romani (2011, p. 131)*

*Figure 4. Experiments with different textures, full and empty – fantasy game. Synesthetic, associations between visual and tactile animal textures. Photo by Romani (2011, p.127,133).*

In her doctoral research, Design of Illustrated Tactile Books (2016), Romani tackled a more complex question. She questioned whether the language of tactile drawings would be suitable for blind readers, as well as whether the relationships between braille text and graphic language would enhance the understanding of the narrative. The research delved into studies on haptic perception, and several visits to institutions were made. Six books for the blind were analyzed. In parallel, various experiments were conducted with visually impaired users, addressing the issue of image reading for blind individuals. The sandwich stage at Politecnico di Milano enriched her research, where she initiated the experimental part of the project and deepened some theoretical points about accessible design. It is argued that the book produced exploring different textures and languages could be a way to innovate inclusive editorial production for blind children: "The illustrated tactile book is a multisensory artifact that expands reading possibilities and allows children with and without disabilities to share the same narrative support." (Romani, 2023, p.119)


*Figure 5. Illustrated tactile book prototype, made with the participation of blind users. Translation: NEIGHBORS / I have a lot of neighbors / not all of them are the same / there are those who are kind / those who are rude / those who are noisy / those who are closer / those who are always moving / despite the differences, they are all friends.*

## 2. Artist–designer–editor book [editorial design dimension]

In the master's dissertation Graphic Experimentation in Handmade Book Projects (2019), Julia Contreiras investigated the process of creating handmade books, seeking to understand "how the articulation of artisanal techniques occurs in the making of the book in an experimental way, where the designer emerges as a central figure in the project, acting both as an au-

thor and as a designer." (Contreiras, Part I, p. 20). The dissertation volume itself embodies the research concept, presented as a handmade book-object. The volume, starting from either the first or fourth cover in reverse directions, elucidates two facets of the same inquiry, speculating on theory and practice, scientific methodology, and authorial craftsmanship.

The theoretical-methodological framework draws upon the intersection of art and design. Key concepts such as the book, handmade craftsmanship, and graphic experimentation (inspired by Certeau and Sennett) are explored. The study of reference works establishes links between historical and contemporary Brazilian graphic design productions, spotlighting independent artists and designers who employ artisanal processes in book creation. The research uncovers significant insights, including the work of artist and designer Cecília Jucá, whose contributions were previously underappreciated. Through interviews and analysis of works by Flavio Vignoli, Gustavo Piqueira, Gilberto Tomé, Danilo de Paulo, and Cecília Jucá, the dissertation incorporates comprehensive insights, with interviews presented in full as annexes.

In Part II, a rich experimental process intertwined with the studied concepts, artisanal techniques, and poetics was developed. Small print run publications and unique works were produced using artisanal techniques considered manual and/or traditional, such as lead movable type, engraving, silk-screen printing, and their variations (Fig. 6).


*Figure 6. Experimental processes for the books Presença (letterpress printing process), and Antropomorfose (engraving the matrices on linoleum). Photo By Contreiras (2019, p.64-65, 70-71)*

At the end of the practical stage, two editions of small print run books were produced, in addition to two unique books that are records of the visual studies of the process (Contreiras, 2019, vol II, p.5). In the first series, the texts of the interviews were explored for the narrative content of the works. In the second series, a trilogy was produced, whose poetics explored the concepts of Richard Sennett in "The Craftsman" (2009), unfolding in the works: Metamorphosis, Presence (Fig. 7), and Anthropomorphosis. The volume is rich in images, tables, and diagrams that facilitate the understanding of the method and results achieved.

## 3. Playful narratives for urban spaces [environmental dimension]

Graziela Escolar, in her master's dissertation Playful situations for playing in urban spaces (2018) investigated the process of designing spaces and installations aimed at children's free play, observing children's participation and behavior during the conception and implementation of such projects, elevating them to the status of co-authors or collaborators. Painting on the ground was chosen as the theme of the interventions because it is done with a simple technique, low cost, easy maintenance, and accessible to all.

The theoretical foundation for the design of children's play spaces was based on the full development of children, according to the fields of developmental psychology and anthropology. The survey included the production of two notable Brazilian architects, Mayumi Watanabe de Souza Lima and Elvira de Almeida, interviews with architecture and design firms, educators, and psychologists.


*Figure 7. Presence: Sequence of book pages, leafed through with hands Multisensory visual storytelling. Handprint, linoleum and lead types. Photo By Contreiras (2019, p. 80-81)*

Participant observation was used for the analysis of play in urban leisure areas. All of this provided the basis for the proposal of experiments with children through playful workshops at a municipal school in São Paulo. The results and discussions led to reflections on the urgency of rethinking the design process, the social, environmental, and economic responsibility of the architect and designer, the relationship between who designs and who it is designed for, and the need to incorporate new forms of interaction with the parties involved, time, and space for experiments. Escobar stood out for her creativity in building research instruments and procedures, working with drawing and modeling workshops (Fig. 8), carrying out spatial interventions with simple and ephemeral materials, with the collaboration of children. Documenting the process in photography and video was essential. Helmets with cameras positioned on the children's heads were used to collect the point of view of their actions.

*Figure 8. Workshop "where do I play?" Image extracted from video in dynamics with hula hoops. Photo by Escobar (2017, p.195, p.210).*

## 4. Chromatic narratives for urban space in virtual and augmented reality [environmental dimension]

Anamaria Amaral Rezende, in her postdoctoral research, investigated the use of color as a strategy for urban renewal through the development and evaluation of an intervention project in a staircase located in Jardim Ruyce, municipality of Diadema, São Paulo, Brazil. She utilized representation technologies in virtual and augmented realities (VR and AR) throughout the design process and its evaluation within the community (Fig. 9, 10, 11). A literature review and theoretical framework were conducted, drawing upon concepts of 'creative and tactical placemaking' (Boeri, 2017). The experimental project was structured into five stages – Collection, Understanding, Concept, Creation and Communication, and Evaluation – providing insights for the development of a comprehensive guide for chromatic project development using VR and AR. The researcher's additional didactic and extension activities at FAU-USP not only improved the project's development and outreach but also enriched the education of undergraduate and graduate students in architecture, and design.

*Figure 9. Analisys of place's dominant colors. Photo by Anamaria Rezende (2023, p.34, p.37).*

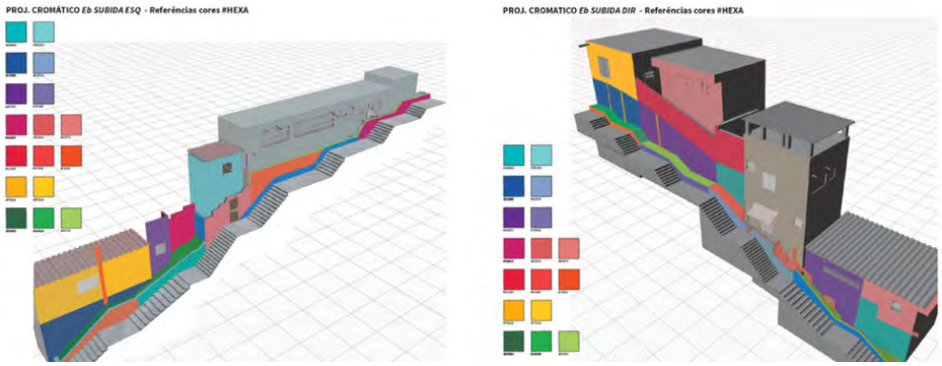



*Figure 10. Chromatic design in virtual representation, by Anamaria Rezende (2023, p.76-77).*

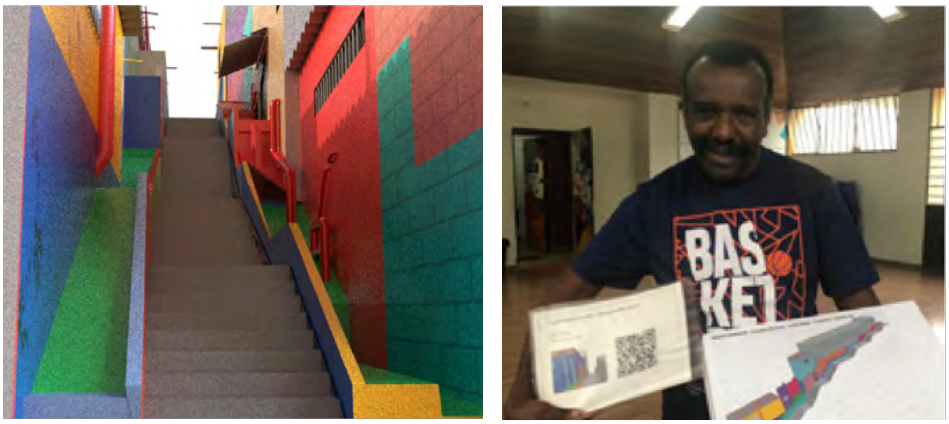



*Figure 11. Prototype verification: 3D model developed with Blender software. Presentation to the community. Photo by Anna Rezende (2023, p. 80-81, 102)*

## 5. Everyday narratives for urban space in extended reality [environmental dimension]

Diego Ricca's doctoral thesis, The Loom of Experience: Attention-Based Design for Everyday Education in Extended Reality (2023), aimed to identify design strategies that facilitate the transition between different levels of attention in Extended Reality (XR) interfaces for everyday education, with the goal of creating design guidelines for these scenarios. In today's context, technology greatly expands the interaction possibilities between objects and humans, fostering ubiquitous opportunities for informal learning in users' daily lives. However, it raises concerns about attention overload, stemming from notifications, reminders, and information dispersed across various devices and environments. The central hypothesis posits that facilitating a gradual transition between different levels of attention, beginning with peripheral awareness, and progressing to more focused and reflective states, proves effective in fostering learning within Extended Reality (XR) interfaces (Ricca 2023).

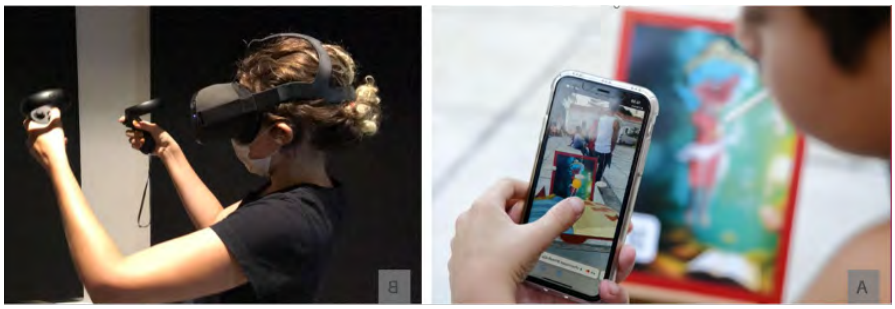


*Figure 12. (A) Child interacting with AR application prototypes (B) Co.Necto project intern, making a prototype using VR. MIS Ceará (BR). Photo by Deivyson Teixeira (Ricca 2023, p.15)*

*Figure 13. People's interaction with the installations Sands of time (above) and Memories in Pixels (below). Photos by Diego Ricca and Deivyson Teixeira, on Ricca (2023, p. 173).*

The investigation follows three phases: (1) theoretically discussing the relationship between attention levels, Design, XR, and learning via a narrative review; (2) analyzing practical design strategies, inspired by RtD, for transitioning between attentional levels in eight XR projects, augmented

by in-the-wild user research analyzed with Activity Theory; (3) constructing design guidelines grounded in practical experiments and examining tangential cases. The main outcome is the Loom of Experience Model, defining three attentional levels in XR interfaces: linear, circular, and spiral. These guidelines can aid XR interface design in daily life, mitigating user attention overload.

## Discussing cases based on RtD quality criteria

The analysis of cases, considering the Research Through Design (RtD) quality criteria outlined by Prochner & Godin (2022), provides a critical view of how the projects were executed and assessed in the realm of design research.

The **traceability** criteria aid in comprehending the research methodology and offer insights into researcher's reasoning, indicating the potential replicability of the experiment. While exact replication might not be feasible due to contextual variables and individual perspectives, understanding the approach taken – be it positivist, constructivist, or a blend of methodologies – can provide epistemological consistency. In the presented cases, detailed transparency characterizes how the research was conducted, ensuring the recoverability of their processes. Romani strictly adheres to Bruno Munari's design methodology in her experiments with the book-object. While her master's research was more authorial, her doctoral research adopts a co-design process, prioritizing user-focused studies. Contreiras explicitly outlines her mixed approach, blending art and design, with a focus on craft processes influenced by Richard Sennet's ideas. Nivoloni engages in participatory processes to create play spaces with children, drawing from constructivist educational perspectives and situationist urban concepts. Rezende rigorously follows design methodology in developing chromatic projects for staircases, integrating "placemaking" actions and showing keen interest in technology, yet also prioritizing resident involvement in proposal evaluation. Ricca employs a mixed framework for experiment development, collaborating with students and multidisciplinary teams.

The second set of variables pertains to **interconnectedness**, focusing on relationships within the research context and credibility, aspects well addressed in the RtD approach. Each proposal elucidates the creative process context, detailing where experiments were conducted, their dynamics, and involved parties. Occasionally, external influences may steer results in specific directions, necessitating transparency in reporting. Rezende encountered challenges in securing a suitable location for her experiment, involving negotiations and community access, where differing opinions and conditions could affect the creation process. Similarly, Ricca and Escobar faced similar issues. Romani confronted obstacles accessing institutions for the blind and adhering to protocols, leading to modifications in the research process. Employing data triangulation, such as combining theoretical insights with interviews and user feedback, can enhance procedure validation and bolster credibility. This method instils confidence in researchers and stakeholders, reinforcing their trust in subsequent results.

**Applicability** is inherent to all projects, given the nature of RtD, which generally starts from concrete needs, of a pragmatic nature.

**Impartiality** assesses the objectivity of the researcher, their involvement in the research process, and the potential impact on decision-making. This category can be contentious as it implies a separation of subject and

object. While this division is pertinent in certain contexts, it may not be applicable to RtD approaches, where researchers are actively engaged in project decisions and subjective procedures. In such cases, transparency and honesty in reporting are paramount, with researchers confidently assuming their positions. Most cases examined grappled with subjective issues, with researchers positioning themselves as the subject/designer of the research.

Lastly, **reasonableness** encompasses reliability, dependability, and solid methods and standards. It reflects the research's rigor, whether the results are grounded empirically, analytically, and theoretically, and whether the methods adhere to scientific research standards, be they qualitative or quantitative. The aim is to minimize ambiguities and gaps in peer evaluation. In the five cases analysed, the theoretical and methodological foundations are well-established. Paradigms are clearly articulated, and research scopes and methods are grounded. However, sometimes a method may be unique and tailored to a specific situation, making replication challenging. Ricca conducted multiple experiments under varied conditions. In projects involving user participation, such as Romani's, ethical protocols were meticulously observed. Impartiality, on the other hand, gauges the extent of the subject's involvement in the research process and its potential influence on their decisions.

## Final considerations

This paper presented the research line of research Multisensory Narrative Dimensions, focusing on investigations using the RtD approach. This particular interest stems from a commitment to applied research, fostering the development of innovative design solutions capable of addressing contemporary challenges. The novelty lies in the uniqueness of the cases presented and their results, obtained through the integration of research theory and design practice. Despite the potential inherent to this approach, it was considered important to have a critical look, analysing them according to the RtD's quality indicators outlined by Prochner & Godin (2022).

The projects typically begin with a review of the study object's state-of-the-art, identifying foundational concepts, relevance, objectives, methodological approaches, and limitations, following customary scientific research procedures. These projects are inherently connected to the exploration of multisensorial experiences and narratives, aiming to recognize existing practices while posing new challenges. This involves conducting surveys, systematizing, analyzing, and synthesizing data. Additionally, researchers are often driven by personal interest and curiosity, exploring new techniques, technologies, and materials, influenced by social interactions.

The discussion reveals that the analyzed projects have addressed most criteria, though some, like impartiality, may be deviated from.

Limitations of this study include differences between master's and doctoral research, such as varying requirements and development timelines. Doctoral research typically allows for more comprehensive exploration of practical research questions. The presentation of projects was partial, necessitating consultation of the originals for a deeper understanding.

This research is ongoing, and this is a first hypothesis approach to analysing research based on design practice. A larger study is being conducted in partnership with the Politecnico di Milano. The need to deepen the epistemological bases and quality indicators is recognized. Moving forward, the aim is to apply these studies in postgraduate teaching and in guiding research projects using RtD approach, working collaboratively with other researchers and stakeholders.

## Aknowlegments

This work was supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES-PRINT - 88887.915312/2023-00).

## References

1. *Boeri, C. (2017). Color loci. Placemaking: The urban color between needs of continuity and renewal. Color Research and Application, 42:641–649. http://doi.org/10.1002/col.22128 .*
2. *Contreiras, J. (2017). Experimentação gráfica em projetos de livros artesanais [Master's dissertation, University of São Paulo]. Digital Library USP. https://doi.org/10.11606/D.16.2019.tde-05112019-115903*
3. *Escobar, G. G. N. A. (2018). Situações lúdicas para brincar no espaço urbano: experimentações para processos projetuais sensíveis às perspectivas das crianças. [Master's dissertation, University of São Paulo]. Digital Library USP. https://doi.org/10.11606/D.16.2018.tde-19092018-141455.*
4. *Findeli, A. (2004). Project research: a method for design research. Design Research Symposium. HGK Basel under the auspices of the Swiss Design Network.*
5. *Frayling, C. (1993). Research in art and design. Royal College of Art Research Papers series, 1(1).*
6. *Herriot, R. (2019). What kind of research is research through design? International Association of Societies of Design Research Conference - IASDR. Manchester: Manchester Metropolitan University. https://iasdr2019.org/uploads/files/Proceedings/op-f-1078-Her-R.pdf*
7. *Godin, D. & Zahedi, M. (2014). Aspects of Research through Design: A Literature review. Design Research Society International Conference 2014, 16-19 June, Umeå, Sweden, 1667-1680*
8. *Jonas, W. (2006). Research through DESIGN through research - a problem statement and a conceptual sketch. Design Research Society International Conference, Lisbon, Portugal.*
9. *Linden, S. V. D. (2007) Lire l'album. França: L'atelier Du Poisson soluble.*
10. *Mazzilli, C. T. S. (2023). Design e dimensões narrativas multissensoriais: livro como objeto de pesquisa e prática criativa. FAUUSP. USP Open Books Portal. https://doi.org/10.11606/9786589514480*
11. *Munari, B. (1998) [1981]. Das coisas nascem coisas. Martins Fontes.*
12. *Munari, B. (2007) [1956]. Na noite escura. Cosac&Naify.*
13. *Pakovská, K. (1996). Alphabet. Ravensburger Buchverlag.*
14. *Perrot, J. (1987). Du jeu, des enfants et des livres. Éd. du Cercle de la librairie, Collection Bibliotheques.*
15. *Prochner, l. & Godin, D. (2022). Quality in research through design projects: Recommendations for evaluation and enhancement. Design Studies, 78-C. Published by Elsevier Ltd. https://doi.org/10.1016/j.destud.2021.101061.*
16. *Ricca, D. E. (2023) Tear da Experiência: design baseado na atenção para a educação cotidiana em Realidade Estendida. [Doctoral Thesis, University of São Paulo].*
17. *Rezende, A. A. (2023) Bases para o desenvolvimento de um projeto cromático para áreas urbanas degeneradas utilizando tecnologias de realidade virtual e realidade aumentada. [Post-doctoral research, University of São Paulo]. https://issuu.com/anarezendeg/docs/guia_anna_rezende_2023*
18. *Romani, E (2023). Construção experimental de um livro tátil ilustrado com a participação de cegos: discutindo o processo de design. In C.T.S. Mazzilli, Design e dimensões narrativas multissensoriais: livro como objeto de pesquisa e prática criativa, p.118-144, FAUUSP.*
19. *Romani, E. (2011). Design do livro-objeto infantil. [Master's dissertation, University of São Paulo]. Digital Library USP. https://doi.org/10.11606/D.16.2011.tde-11012012-115004*
20. *Romani, E. (2016). Design do livro tátil ilustrado: processo de criação centrado no leitor com deficiência visual e nas técnicas de produção gráfica da imagem e do texto [Doctoral Thesis, University of São Paulo]. Digital Library USP. https://doi.org/10.11606/T.16.2016.tde-01092016-164009*
21. *Schon, D. A. (1983). The reflective practitioner: How professionals think in action. Basic Books.*
22. *Zahedi, M. & Tessier, V. (2023). Designerly activity theory supporting research-through-design, in De Sainz Molestina, D., Galluzzo, L., Rizzo, F., Spallazzo, D. (eds.), IASDR 2023: Life-Changing Design, 9-13 October, Milan, Italy. https://doi.org/10.21606/iasdr.2023.337*
23. *Zimmerman, J., Stolterman, E., & Forlizzi, J. (2010). An analysis and critique of Research through Design: Towards a formalization of a research approach. 8th ACM Conference on Designing Interactive Systems (DIS 10), 310. Aarhus, Dinamarca. https://doi.org/10.1145/1858171.1858228*

# Anthropogenic Narratives. Imagination and Anti-Disciplinarity for the Communication of Non-Human Perspectives

*Francesco E. Guida[1], Martina Esposito[2], Enrico Isidori[2]*
*francesco.guida@polimi.it, martiiiesposito@gmail.com, enrico.isidori@gmail.com*

*[1]Politecnico di Milano, Department of Design, Italy*
*[2]Politecnico di Milano, School of Design, Italy*

***Keywords:***
*Speculative Design*
*Communication Design*
*Climate Change*
*Prototyping*
*Anti-Disciplinary*

## Abstract

The paper, presenting some of the projects developed in a Communication Design Studio at Politecnico di Milano under the title of Anthropogenic Narratives, aims to discuss how teaching visual identity and experience design in communication design undergraduate education may be developed within an anti-disciplinary approach, adopting a speculative design framework. Anthropogenic Narratives, starting from the assumption of proposing non-human perspectives (e.g., rocks, moon, ice), aims to provoke and activate reflections on the relationship between humans and nature, unfolding futuristic scenarios while involving the human/user in interactive experiences essential to understanding the narratives. The results come from an experimental educational path based on the risk of trying new solutions and techniques and verifying them on a real scale. Design speculations that are not meant to give answers and certainties, aiming to imagine new questions and reflect on contemporary and future times.

## 1. Context

The climate change we are currently experiencing is the most complex challenge humanity has ever experienced. If our Earth has passed through extreme events, such as the Ice Ages, the crisis the world has been facing in recent years, although equally severe and urgent, is very different, advancing at a pace without precedent. Climate change is getting worse year after year, and though there is awareness and discussion on the topic, nothing seems enough to provoke action.

Data related to possible risks is clear: the changes in people's daily lives and the small actions everyone can do are still insufficient. According to Funk & Kennedy (2016), although most Americans declare themselves as environmentally conscious, only a much smaller percentage confess to trying to live in a way that promotes sustainability. Three-quarters declare themselves as particularly concerned with helping the environment in their daily lives. However, only 20% describe themselves as people who strive to live "sustainably always". It is possible to call this kind of behaviour cognitive dissonance: a psychological phenomenon that occurs when a person holds contradictory values or attitudes or their actions conflict with their beliefs (Funk & Kennedy, 2016). It often leads to rationalizing one's behaviour by minimizing the importance of actions or blaming others for the problem

(Jonas et al., 2014).

Mitrovi (2018) underscores the pivotal role of design in shaping the Anthropocene era, characterized by the profound impact of human activities on the Earth's ecological systems, generating unprecedented possibilities for catastrophic scenarios. Historically intended as a driver of innovation, design has predominantly focused on developing novel tools and products, often overlooking the environmental consequences of mass production. Mitrovi (2018) further discusses

> *The idea that design thinking as a method could be used for resolving problems in business or everyday life has conquered the neo-liberal world. Through concepts and business models offering methods and tools for 'designing one's own life' [...], this business philosophy tends to transform into a worldview.*

Indeed, our world is the result of a design process in continuous action. However, this faith in the capacity of technology and organizations to take over these systems has led to inefficiency. Mitrovi calls this feeling "Western melancholy," the ultimate consequence of our community's acceptance of the incapacity to stop the devastation of the environment and climate change.

Mitrovi 's insights highlight the complex interplay between design, technology, and environmental sustainability, underscoring the need for a more holistic and conscientious approach to design practices in the face of contemporary challenges. Central to many of these problems is anthropocentrism, the conviction that a particular species, Homo Sapiens, has some kind of privileged relationship with the world's objects (Caffo, 2017). It is a metaphysical system that considers all other beings as tools to serve one's interests (Rao, 2021).

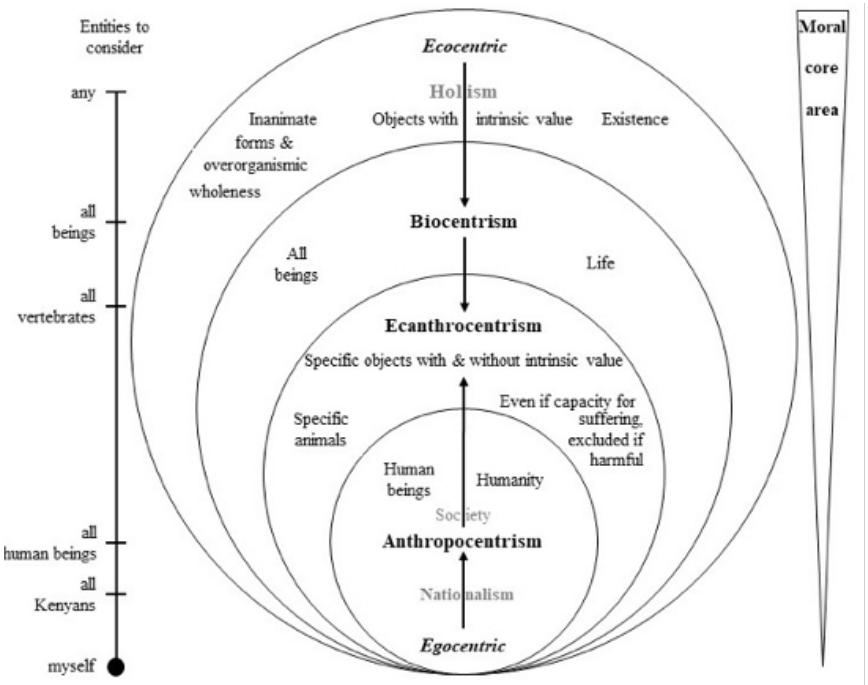



*Figure 1. Ideologies synthesis on anthropocentrism, biocentrism, and ecocentrism (Rülke et al., 2020).*

These premises served as the foundation for the 2022/2023 edition of the Final Synthesis Communication Design Studio (Section C1), third year, Bachelor in Communication Design at Politecnico di Milano. The students were challenged to adopt a new perspective and reassess their role as hu-

mans. The belief is that sustainability-related changes and our connection with the planet require profound critical reflections and a significant shift in perspective, moving away from a purely human-centred view. By departing from an anthropocentric viewpoint, students were encouraged to adopt the perspectives of beings that, despite their participation in our ecosystems, are often perceived as silent observers. The perspective taken within the project, then named Anthropogenic Narratives, is ecocentric, a view that places a moral obligation on all beings, not just humans (Rülke et al., 2020) (Figure 1). In particular, the projects considered the point of view of different natural elements, both living and nonliving, biotic and abiotic.

Speculative design revealed itself as the perfect framework to give a voice to these quiet participants of the planet's ecosystem. It offers the opportunity for an anti-disciplinary approach, using traditional and established design tools and methods to face "wicked problems" (Dunne & Raby, 2013, p. 2). Through imagination and a radical approach, speculative practice inspires thinking, raises awareness, examines, provokes actions, opens discussions, and provides alternatives in today's world (Mitrovi , 2019).

Through critical thinking, speculative design endeavours to anticipate the future by designing objects that tell a story or, more precisely, to make designers more aware of the narratives embodied within each artefact and their impact on society. Appadurai (2013, pp. 355–364) states that objects are not mere things placed in space; they are creators of contexts.

Even if only viewed as a fictional exercise, the Studio allowed students to gain greater awareness of the impact of their role in shaping society and the relationships between people and the world they inhabit. The projects gave the possibility for a real dialogue toward unheard dimensions. If natural elements could speak, they probably would not use human language, but they would still be capable of conveying a message. By embodying their perspective, each group demonstrated how different natural elements transmit signals and messages worth understanding. These messages enrich our vision and awareness and can guide us toward restorative action.

Leitão (2023) states that our planet is home to many 'worlds'. Her article refers to pluriversality, a concept coined by Arturo Escobar (2018), that indicates the human capacity to build different worlds based on different assumptions and beliefs. Although this term refers to human societies only, extending its meaning to all beings, living and nonliving, is possible. By deconstructing the anthropocentric narrative, it is possible to reconsider other possibilities of world-building that are already real and available.

Another goal of the Studio was to make the students question their ethical role as designers of the future. It aimed to connect the urgent needs of a world in crisis, requiring action, awareness, and responsibility. Schools and universities are the perfect contexts to overturn the scope of traditional design tools to address, evaluate, and discuss contemporary issues.

## 2. Education and Speculative Design

As practice fields, the design disciplines have "the potential to detect, mediate, and generate new relations and to encourage radical imagination" (Mitrovi , 2023, p. 35). In that sense, the practices related to Speculative Design reveal this potential and how successful it is as "an experimental environment to test different hypotheses about our lives in the future" (Mitrovi , 2023, p. 35). In education, adopting such approaches broadens students' perspectives and fosters critical thinking (Helgason, 2020). It challenges the

traditional problem-solving approach and encourages reflective practice (Schön, 1983) on the practice itself. These approaches prioritize subjective interpretation and practical experience over abstract theory (Mazè & Redström, 2007). Butoliya (2020) affirms that "As design educators we cannot afford to exclude Speculative Design from […] education of our students, especially after the current crisis that the whole world is experiencing."

We are convinced that design, particularly communication design, is more than problem-solving; it is a tool for exploration and questioning in uncertain times. This perspective laid the groundwork for the learning program mentioned above, which aimed to imagine and design possible futures critically. The students developed communication design ecosystems within a speculative design framework, creating visual identities, experiences, and prototyped devices (named Communicative Machines) that resulted in an open event-exhibition.

The brief encouraged students to explore non-human perspectives, provoking reflections on the relationship between humans and nature (Rao, 2021). Each subject was treated as a fictional organization, communicating through a fictional brand and related touchpoints, unfolding futuristic scenarios, and involving users in interactive experiences essential for understanding the narratives. Through dystopic narratives and alternative realities, the project aimed to influence the present (Inayatullah, 2020).

## 3. An Anti-Disciplinary Design Studio

Communication design is used to validate speculation in this educational path: the speculative process is correct when design artefacts can effectively convey it, and vice versa. Design should not be considered a mere self-reflective practice but a powerful communication tool to promote speculation and critical, if not political, positions (Mehl & Höfler, pp. 13–14). Students were organized into small teams and taught to traverse disciplinary boundaries and embrace a critical stance towards an apparently fixed discipline.

Experimentation is central to the iterative learning process. It is a pathway to finding solutions, even in domains where students may lack complete mastery. During the prototyping phase (from initial development to final stages), students adopt a 'learning by doing' approach, embodying something akin to the concept of "thinkering" (Antonelli, 2011), whereby a conclusive outcome is achieved through successive collective refinements. Experimentation and prototyping entail iterations of "trial and error", a pivotal aspect across various stages of response development, from design conception to ultimate implementation (Berglund & Grimheden, 2011, p. 737).

The prototyping phase is crucial, and students are introduced to using Arduino and some coding environments to promote technological fluency (Lukens & DiSalvo, 2012). In this educational setting, the goal is not to specialize but to become literate, as Reas (Cangiano, 2016) affirmed. This means understanding which tools best bring concepts to life. Students are encouraged to explore different technologies to find the best fit for their project, whether print, three-dimensional space, or code.

The educational design process is grounded in an anti-disciplinary and evolutionary concept, rejecting a rigidly fixed design methodology. Characterizing the teaching approach as anti-disciplinary implies transcending mere multidisciplinarity and entails drawing from diverse sources (Childress, 2016; Brin, 2016), avoiding narrow specialization. This pedagogical strategy, underscored by a critical perspective, prioritizes unconventional problem-solving paradigms, encompassing problem-seeking initiatives and

problem-posing inquiries (Blauvelt & Davis, 1997, p. 80).

In the third year, the Final Synthesis Communication Design Studio serves as the apex of undergraduate students' academic journey, providing a platform for synthesizing the knowledge and skills gained in preceding semesters. Coding and prototyping augment the competencies associated with communication design and visual systems. Rather than being confined to a specific domain, the final project encourages students to engage with a hybrid, transversal dimension of communication design.

As Bernstein (2011) observed, fluency with technology often necessitates traversing traditional disciplinary boundaries. Students become confident with different media and tools that transcend conventional design methodologies by adopting a speculative design approach. This enables them to explore diverse approaches, techniques, and instruments while drawing insights from many practices and disciplines, as articulated by Mitrovi (2019). Lukens and DiSalvo (2012) emphasize that speculative design and technological fluency embody cross-disciplinary and integrative principles.

In summary, Speculative Design offers a versatile approach that transcends disciplinary confines, nurturing creativity, critical thinking, and technological fluency, all of which are indispensable for effectively addressing future challenges.

## 4. The Pedagogical Model: Designing Narratives, Prototypes and Experiences

The learning iterative process can be summarised in five main parts, two overlapping phases crossing three design areas, as it is in the Speculative Overlapping Double Diamond model (Fig. 2):

- Exploration: the phase of research on the assigned subject.
- Speculation: scenario building, what if, concept definition, narrative.
- Communication: from concept to visual identity, defining a communication strategy into and out of the narrative.
- Interaction: definition of the prototype's main functions and the experience's user journey, considering all the touchpoints consistently to the communication strategy.
- Making: the phase of building and verifying the prototype through progressive refinements.

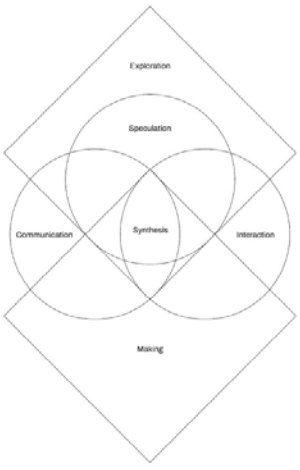



*Figure 2. Speculative Overlapping Double Diamond Model (Isidori, 2023).*

The overlap of the various phases and areas, defined as Synthesis, is indeed the moment of transformation into key intermediate project outputs. In the central area, where the exploration gradually stops (converging) and the making begins (diverging), the project's genesis occurs. The field represents the transition from definition to development. The central phases merge into the Define-Develop phase (Fig. 3). As represented in the Overlapping Double Cones Model (Fig. 4), the design process shows a series of nodes representing the various decision points in the project's progression. The model, which has the temporal dimension on the vertical axis and the various domains on the horizontal plane, retains all the characteristics of reticular or complex models.

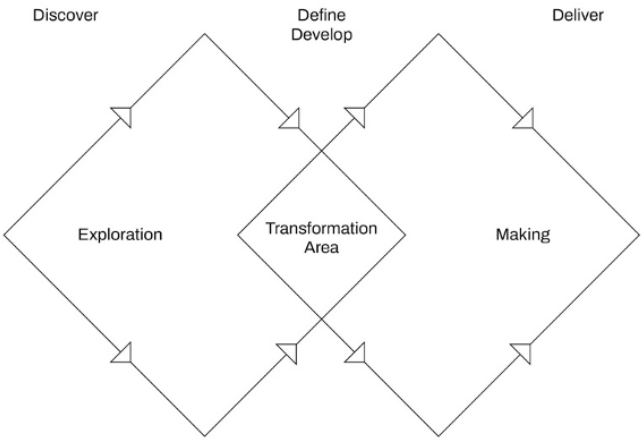



*Figure 3. Overlapping Double Diamond Model (Isidori, 2023).*

The vertical position of the nodes is defined by time, while the reference area of the nodes determines the position on the horizontal planes. The reticular representation has convergent and divergent dynamics, as already synthesized in the Overlapping Double Diamond Model (Fig. 3). The model aims to show all paths: the design space explored over the time of the process, as well as the unexplored space, the generative nodes as well as the blind nodes.

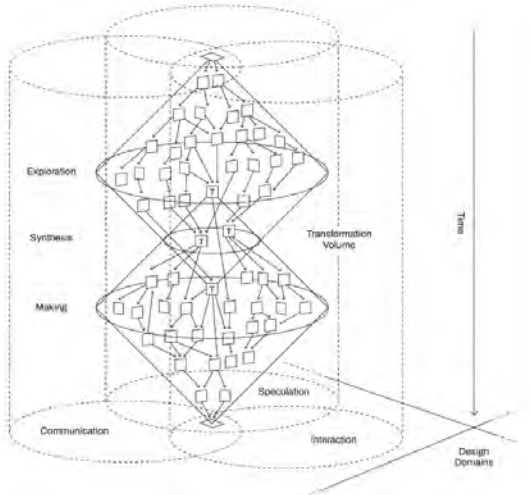



*Figure 4. Overlapping Double Cones Model (Isidori, 2023).*

Throughout each phase of their progress towards the final project, students engage in various stages of the design process. However, this process is not merely "reduced to a mechanistic set of steps" as "method without imagination contributes very little to the design profession and the solution of complex design projects" (Frascara & Winkler, 2008, p. 7).

Students collaborated in groups of 4 up to 6. Each team member assumes a specific role within the group based on interests and skills. Received the general theme (e.g., climate change), each group delineates a specific perspective on the assigned subject (e.g., rocks, moon, or ice) and a corresponding scenario to address. Thus, they identify and dissect a problem through analysis and research. Leveraging human superstructures and organizations as valuable subjects, they employ fictional branding to "represent" their narrative, using competencies and skills acquired during the initial two years of the Course. Subsequently, they define a concept and communication strategy and its multidimensional and multichannel execution (touchpoints and selected media).

Additionally, the students delineate the main functions, meanings, and contents of the Communicative Machine. Aligned with their concept and strategy, they develop a visual identity to ensure consistent communication across two- and three-dimensional outputs. They gain confidence in designing complex systems.

The main outputs, called Communicative Machines, are objects, installations, or interactive devices realized as prototypes for testing and verification. These objects are at the centre of narratives and intended to be like deus ex-machina, allowing the users outside the narrative to interpret the provocation and jump into the narrative. Serving as primary entry points, the Communicative Machines allow the audience to enter the fictional world of the narrative. These are hybrid elements that belong to the real world and the imaginative reality crafted through the project. Mitrovi (2016, p. 11) argues that these diegetic objects materialize the narrative, facilitating the suspension of belief. By personally experiencing the fictional scenario, the devices enable users to fully engage with the proposed narrative, enhancing its credibility. The prototypes can also be intended as "provotypes" (from "provocation" and "prototype") (Casnati et al., 2024). Provotypes are tangible or intangible design artefacts "whose main goal is to foster, encourage, and provoke discussions and reflections among different users and stakeholders" (Casnati et al., 2024; Boer & Donovan, 2012).

In addition to the Communicative Machines, other artefacts support the narrative: a system of touchpoints designed to offer users a comprehensive understanding of the proposed (fictional) world. These communication ecosystems form the narrative systems, comprising touchpoints, artefacts, and interactive devices.

However, it is essential to note that these works of fiction are not purely products of imagination. They draw inspiration from real data and the actual risks humanity faces or will face due to climate change. The fictional frame creates a more engaging context through which to learn about these data, exaggerating real-life situations to provoke a response regarding their gravity. Through a reflection for absurdity, the user is invited to reflect on problems that, if left unaddressed, could truly degenerate.

## 5. Students' projects

The following paragraphs provide brief descriptions of three case studies from the eleven projects that resulted from the 2022/2023 Communication Design Studio. Each description examines natural elements (moon, ice, rocks) and their perspectives on climate change, which could be either victim, cause, or completely left out of the phenomenon. Links to full descriptions, images, and videos are included in each case study for comprehensive understanding.

## 5.1 Moondo

The moon is an outsider participant in the crisis of climate change. However, it contributes to the damages provoked by its effects. Its perspective is detached, neither worried nor angry; instead, it cynically capitalizes on the situation to increase its influence and power. The narration is set in 2030. The rise of sea levels, triggered by global warming and moon activity, caused the flooding of several coasts and the abandonment of many cities. Moondo is a travel agency that takes advantage of the new environmental conditions and turns submerged cities into perfect tourist destinations (Figure 5). The company offers numerous activities in each city, such as kayaking, paddle surfing, snorkelling on the surface, and scuba diving in the deep. Moondo transforms what would have been abandoned cities into the most fascinating tourist destinations. At the Moondo stands, it is possible to have a complete forecast of the floods that will occur within the next 120 years. Users input specific parameters, such as desired coastlines, moon phases, and years of interest, using an interactive device shaped like a computer. Once the user confirms these inputs, the parameters are used to identify the perfect holiday destinations and experiences tailored by the company to those specific places and conditions.

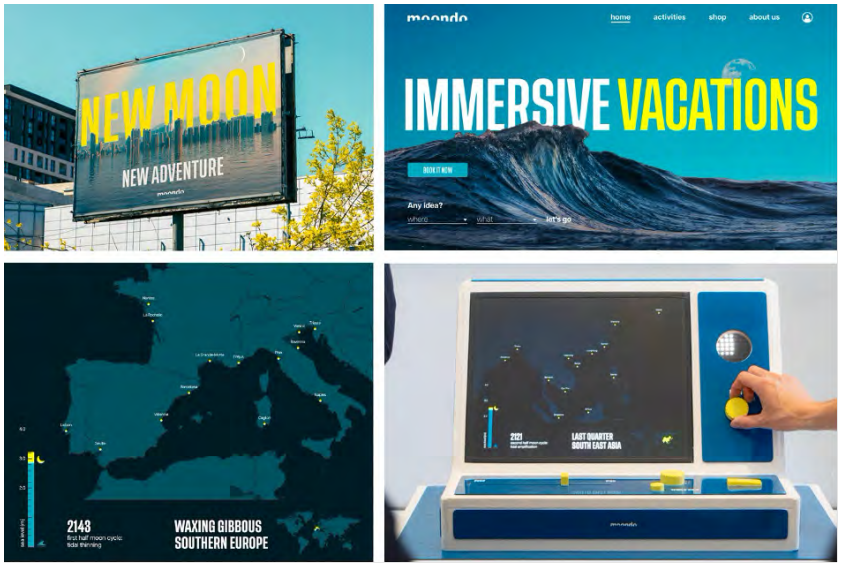



*Figure 5. Moondo: advertising billboard; website landing page; a screenshot of the destination's selection process; the Communicative Machine. Authors: Guglielmo Basile, Matteo Dell'Agostino, Arianna Marenghi, Marta Piatti, Chiara Provana, Ilaria Urgesi, Davide Vitrano, 2023 (https://anthropogenicnarratives.labsintesi-c1.info/projects/10_MOONDO.html).*

## 5.2 I.C.E.

From the same issue arises a vastly different perspective: that of ice. This element is indeed greatly affected by climate change. Humanity, blinded by its hunger for power, has made it weaker and weaker, dangerously close to extinction. Despite the melting of ice is one of the oldest and most widely recognized consequences of global warming, the actions responsible for this problem have persisted for years, fueling a growing rage and resentment. I.C.E. (Insurge, Commit, Extinguish) is a terrorist organization whose goal is to put to an end the harmful being that humiliates and destroys nature: humans. I.C.E. bombs are everywhere (Figure 6). Their timer lasts a few minutes and accelerates if anyone tries to get close. The only way to stop them is to stay still: place a hand on the icy surface of the device and stop doing anything that would make the crisis worse. However, once contact is broken, the countdown resumes, culminating in an explosion that unleashes environmental devastation at a designated location on Earth, spreading terror and chaos. The project is situated in a non-specific moment, taking

reference from different periods and contexts to create a surreal world that could be either in 20 years or tomorrow.


*Figure 6. I.C.E.: the Communicative Machine composed of the bomb and the television set; scenario building: urban graffiti and a newspaper headline announcing the possibility to stop the countdown. Authors: Ginevra Bernasconi, Giulia Bonalumi, Jacopo Domenichini, Agostino Sanna, Andrea Vitali, 2023 (https://anthropogenicnarratives.labsintesi-c1.info/projects/01_ICE.html).*

## 5.3 SPECTA

The project presenting rock's perspective was also developed in the same undefined time context. Rocks are not affected by climate change. They have witnessed countless climatic changes, and this crisis is nothing more than one of the many that Earth has and will always experience. Human beings, however, have developed a feeling of anxiety towards this problem. To cure this disease a company for self-care named Specta has created Litia, a device that allows the user to see climate change as the geological phenomenon of rock stratification.

Climate change is not a problem, seeing it is. Thanks to Specta (Figure 7), eco-anxiogenic events are visualized as relaxing layers that expand the user's perception into a space of dialogue with the rocks. By lifting and slowly rotating the device, the user can alter the vision of catastrophic events into rock stratifications. Humanity does not have to fight climate change, as it is an inevitable evolution of Earth's life; it just has to change the way it looks at it.


*Figure 7. Litia: Specta in use; the product's section of Litia's website; the user journey of Specta in use. Authors: Francesco Bonetti, Federico Gajo, Emiliano Garibaldi, Enrico Isidori, Cecilia Pizzagalli, Camilla Tosi, 2023 (http://anthropogenicnarratives.labsintesi-c1.info/projects/08_LITIA.html).*

## 6. Conclusions

By embodying non-human perspectives, each Final Synthesis Communication Design Studio group demonstrated how different natural elements could communicate and what. In that way, they can enrich our vision and guide us to restorative action. While it might appear detached from the chaos of reality, this exercise represents a tangible gesture that tackles a delicate problem such as climate change, to which we often feel harmless.

Storytelling emerges as a potent tool for comprehending the future and motivating action and serves as the means through which we shape the reality that surrounds us. As Harari (2015) suggests, humans utilize language to describe and create new, fictional realities. Fiction proves to be a powerful tool for crafting believable narratives and redefining the relationships between elements in our world. It reveals that the world as we perceive it is partly the product of human imagination.

As affirmed by Anagnostou, Karvinen, and Vasko (2020), the concrete actions useful to create different futures do not need to be "grandiose intervention, they can also be gentle gestures". Despite its ironic and disruptive methods, Speculative Design operates subtly and quietly. It discreetly touches the hearts of the people who participated in the project and found themselves indelibly changed by the experience.

Spurling and Kuijer (2016) emphasize that participation plays a crucial role in scenario development, creating a shared language, and understanding future issues. Since the construction of a narrative for the future is a shared practice, the future is the result of a shared vision. When involving multiple stakeholders, it is important to acknowledge that each person may be concerned about different issues that could influence their choice of a preferred future. Therefore, the visioning scenario results from the contrasting perspectives of the people participating in the experience. The intention is not that a particular visioning scenario is chosen as 'the way forward' (Meadows & Kouw, 2016). Rather, the set of different perspectives acts as a vehicle to promote an informed debate.

*Figure 8: participation of non-academic audience during the exhibition "Anthropogenic Narrative: Communicating and Experiencing Non-Human Perspectives", Triennale Milano, Salone d'Onore, March 22, 2023.*

Over the years, feedback from students and audiences during various presentation events or dissemination actions, such as exhibitions, websites, and social media platforms, has consistently validated the efficacy of the presented learning process and educational experimentation. Students highly value the anti-disciplinary approach, which enables them to acquire new knowledge and skills while directly experiencing the hybrid nature of communication design. Moreover, they cultivate a proactive attitude towards learning, embracing the dynamic challenges of an ever-evolving field. Comments from past editions of the Communication Design Studio characterize the approach as "highly innovative" and "useful to learn by doing, work more independently, and deal with technologies never used before." Additionally, tackling assigned issues through the speculative approach is seen as "stimulating" and "a challenge," allowing them to "find unconventional design solutions."

The fiction generated during the Communication Design Studio has concretely impacted the lives of different audiences, including students, professors, and visitors to the exhibition. To conclude the learning journey undertaken during the Studio, the eleven projects were showcased at a one-day exhibition at Triennale Milano. The exhibition, emphatically titled "Anthropogenic Narratives: Communicating and Experiencing Non-Human Perspectives," succinctly summarized both the learning process and the outputs.

The involvement in the exhibition of people outside the university (Figure 8) allowed the students to confront themselves with the world they were and will continue to design for. The varied backgrounds of the participants enriched and fortified the narratives crafted in the projects, validating Ziegler's (1991) assertion that shared stories and visions gain strength through collective engagement.

However, as Neeley (2020) stated,

> *The provocation about the future is only half the work. [...] Speculative Design is one of many disciplines that can allow us to touch what is ahead, and this illumination of possibility is in and of itself a meaningful and powerful act of creativity, but it is only when we connect this back to new behaviors in the present that we have actually changed the probabilities of one future outcome or another and hopefully shifted towards a preferable one. [...] If we are looking for further impact after the speculation is where the real work begins.*

Even if only viewed as a fictional exercise, the Studio allowed students to gain greater awareness of the impact of their role in shaping society and the relationships between people and the world they inhabit.

The future is not a place we are just getting to, sitting there quietly, waiting for it to happen. The future is what we do any minute, just thinking about what we are eating for dinner or doing over the weekend. We produce the future by our choices and actions in the present.

## Acknowledgments

All authors equally contributed, read and approved the final manuscript.

The authors would like to thank the teachers and colleagues who worked during the last years at the Final Synthesis Communication Design Studio C1, Bachelor's in Communication Design, School of Design, Politecnico di Milano: professors Andrea Braccaloni, Pietro Buffa, Alessandro Masserdotti and Giacomo Scandolara; assistants Marcello J. Biffi, Alberto Candido, Pietro Forino, Antonio Garosi, Michele Invernizzi, Adele Mazzali, Andrea Pronzati, Claudia Tranti, Ernesto Voltaggio. Launching, managing, and sharing an anti-disciplinary design practice in an educational context has been possible with them. Consequently, a grateful thought is for all students who, over the years, accepted the challenge.

## References

1. *Anagnostou, D., Karvinen, K., & Vasko, T. (2020, October 14). Trojan Horse: Concrete Anagnostou, D., Karvinen, K., & Vasko, T. (2020, October 14). Trojan Horse: Concrete Actions are not Necessarily a Grandiose Intervention [Interview]. SpeculativeEdu. https://speculativeedu.eu/interview-trojan-horse/*
2. *Antonelli, P. (2011, July 4). States of Design 03: Thinkering. Domus Web. https://www.domusweb.it/en/design/2011/07/04/states-of-design-03-thinkering.html*
3. *Appadurai, A. (2013). The Future as Cultural Fact: Essays on the Global Condition. Verso Books.*
4. *Berglund, A., & Grimheden, M. (2011). The Importance of Prototyping for Education in Product Innovation Engineering. In A. Chakrabarti (Ed.), Research into Design — Supporting Sustainable Product Development (pp. 737-745). Research Publishing.*
5. *Bernstein, D. (2011). Developing Technological Fluency Through Creative Robotics [doctoral dissertation, University of Pittsburgh]. D-Scholarship @ Pitt. http://d-scholarship.pitt.edu/8780*
6. *Blauvelt, A., & Davis, M. (1997). Building Bridges: A Research Agenda for Education and Practice. In M. Beirut, W. Drenttel, S. Heller, & DK. Holland (Eds.), Looking Closer 2 (pp. 77-81). Allworth Press.*
7. *Boer, L., & Donovan, J. (2012). Provotypes for participatory innovation. In Proceedings of the Designing Interactive Systems Conference, (pp. 388–397). Association for Computing Machinery. https://doi.org/10.1145/2317956.2318014*
8. *Brin, S. (2016, November 2). Making/Meaning in the Realm of Anti-Disciplinarity. opentranscript.org. http://opentranscripts.org/transcript/making-meaning-antidisciplinarity/*
9. *Butoliya, D. (2020, July 2). There is no Prescriptive Way to do Speculative and Critical Design [Interview]. SpeculativeEdu. https://speculativeedu.eu/interview-deepa-butoliya/*
10. *Caffo, L. (2017). I due dogmi dell'Antropocentrismo. Scienze e Ricerche, (46), 25–31.*
11. *Cangiano, S. (2016). Coding as a Way of Thinking – Interview with Casey Reas. Progetto Grafico, 13(30), 10–19.*
12. *Casnati, F., Ianniello, A., & Romani, A. (2024). Provocation Through Narratives: New Speculative Design Tools for Human-Non-Human Collaborations. In F. Zanella et al., Multidisciplinary Aspects of Design. Design! OPEN 2022 (pp. 747–755). Springer. https://doi.org/10.1007/978-3-031-49811-4_71*
13. *Childress, J. (2016, May 26). Head, Hands, Heart & Voice. justinchildress.co. https://justinchildress.co/head-hands-heart-voice*
14. *Dunne, A., & Raby, F. (2013). Speculative Everything. Design, Fiction, and Social Dreaming. MIT Press.*
15. *Escobar, A. (2018). Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds. Duke University Press.*
16. *Frascara, J., & Winkler, D. (2008). Jorge Frascara and Dietmar Winkler. On Design Research. Design Research Quarterly, 3(3), 4–14. https://dl.designresearchsociety.org/design-research-quarterly/8/*
17. *Funk, C., & Kennedy, B. (2016, October 4). The Politics of Climate. Pew Research Center. https://www.pewresearch.org/science/2016/10/04/the-politics-of-climate/*
18. *Harari, Y. N. (2015, July 24). Why Humans Run the World [Video]. YouTube. https://www.youtube.com/watch?v=nzj7Wg4DAbs*
19. *Helgason, I. (2020, November 26). Speculative Design is Being Integrated into Education in Diverse Ways [Interview]. SpeculativeEdu. https://speculativeedu.eu/interview-ingi-helgason/*

20. *Inayatullah, S. (2020, December 2). We See the Future as a Learning Journey, Not as a Site of Prediction [Interview]. SpeculativeEdu. https://speculativeedu.eu/interview-sohail-inayatullah/*
21. *Isidori, E. (2023). Progettazione. In F. Bonetti, F. Gajo, E. Garibaldi, E. Isidori, C. Pizzagalli, & C. Tosi, Specta (pp. 10–63) [Unpublished thesis dissertation]. Politecnico di Milano.*
22. *Jonas, E., McGregor, I. A., Klackl, J., Agroskin, D., Fritsche, I., Holbrook, C., Nash, K., Proulx, T., & Quirin, M. (2014). Chapter Four - Threat and Defense: From Anxiety to Approach. In J. M. Olson, & M. P. Zanna (Eds.), Advances in Experimental Social Psychology. Volume 49 (pp. 219–286). Academic Press. https://doi.org/10.1016/b978-0-12-800052-6.00004-4*
23. *Leitão, R. M. (2023). Pluriversal Worlding: Design, Narratives, and Metaphors for Societal Transformation. AM Journal of Art and Media Studies, (30), 17–35. https://doi.org/10.25038/am.v0i29.551*
24. *Lukens, J., & DiSalvo, C. (2012). Speculative Design and Technological Fluency. International Journal of Learning and Media, 3(4), 23–40. http://dx.doi.org/10.1162/IJLM_a_00080*
25. *Mazé, R., & Redström, J. (2007). Difficult forms: critical practices of design and research. In S. Poggenpohl (Ed.), IASDR07. International Association of Societies of Design Research Conference Proceedings (pp. 1–18). Hong Kong Polytechnic University. https://www.sd.polyu.edu.hk/iasdr/proceeding/papers/Difficult%20forms_%20Critical%20practices%20in%20design%20and%20research.pdf*
26. *Meadows, M., & Kouw, M. (2016) Future-Making as Collective Composition: Towards an Inclusive Design of Smart Cities. In N. Spurling, & L. Kuijer (Eds.), Everyday Futures (pp. 65–73). Lancaster University. https://wp.lancs.ac.uk/everydayfutures/files/2016/08/meadows_kouw.pdf*
27. *Mehl, J., & Höfler, C. (2023). Foreword: Attending [to] Futures. In J. Mehl, & C. Höfler (Eds.), Attending [to] Futures Matters of Politics in Design Education, Research, Practice. Adocs. https://doi.org/10.53198/9783943253726*
28. *Mitrović, I. (2016). Introduction to Speculative Design Practice. In I. Mitrović, & O. Šuran, Speculative – Post-Design Practice or New Utopia? (pp. 5–12). Ministry of Culture of the Republic of Croatia & Croatian Designers Association*
29. *Mitrović, I. (2018, August 27). "Western Melancholy". How to Imagine Different Futures in the "Real World"? Interakcije. https://interakcije.net/en/2018/08/27/western-melancholy-how-to-imagine-different-futures-in-the-real-world/*
30. *Mitrovič, I. (2019, July 22). New Reflections on Speculativity. SpeculativeEdu. https://speculativeedu.eu/new-reflections-on-speculativity*
31. *Mitrović, I. (2023). Futures, Speculations and Education. In M. Roth, T. Cerina, & I. Mitrović (Eds.), Designing in Coexistence. Reflections on Systemic Change (p. 35). Croatian Architects' Association.*
32. *Neeley, J. P. (2020, May 27). After the Speculation is Where the Real Work Begins [Interview]. SpeculativeEdu. https://speculativeedu.eu/j-paul-neeley-after-the-speculation-is-where-the-real-work-begins/*
33. *Rao, A. (2021, December 10). Speculative Design for Eco-centric Innovation. Medium. https://blog.prototypr.io/speculative-design-for-eco-centric-innovation-75e9d48738c7*
34. *Rülke, J., Rieckmann, M., Nzau, J. M., & Teucher, M. (2020). How Ecocentrism and Anthropocentrism Influence Human–Environment Relationships in a Kenyan Biodiversity Hotspot. Sustainability, 12(19), 8213. https://doi.org/10.3390/su12198213*
35. *Schön, D. (1983). The Reflective Practitioner: How Professionals Think in Action. Temple Smith.*
36. *Spurling, N., & Kuijer, L. (2016). Everyday Futures. Institute for Social Futures. Lancaster University. http://wp.lancs.ac.uk/everydayfutures/essay-collection/*
37. *Ziegler, W. (1991). Envisioning the future. Futures, 23(5), 516–527. https://doi.org/10.1016/0016-3287(91)90099-N*

# MADE IN

# Design storytelling e microstorie del Made in Italy: Nuovi modelli di sostenibilità e innovazione nel distretto produttivo murgiano

*Vincenzo Paolo Bagnato, Antonio Labalestra*
*vincenzopaolo.bagnato@poliba.it, antonio.labalestra@poliba.it*

*Politecnico di Bari, Italy*

***Keywords:***
*Made in Italy*
*Country of origin effect*
*Distretto Murgiano*
*Furniture design*

## Abstract

A valle dell'iniziativa New European Bauhaus, che sottolinea l'importanza dell'inclusione, della sostenibilità e dell'estetica, il marchio Made in Italy, come accade in ogni contesto nazionale, vive oggi un processo in cui la sua nuova identità è in fase di ricostruzione (Dellapiana, 2022): i radicali cambiamenti sociali ed economici degli ultimi decenni, così come le nuove sfide globali, richiedono una profonda revisione della dimensione culturale di prodotti e processi che si traduca, in altre parole, in una chiamata alla responsabilità progettisti, aziende e utenti finali.

Nel campo della ricerca accademica ciò significa la necessità di tracciare i nuovi contorni del Made in Italy, della cultural value chain e dei nuovi paradigmi di coinvolgimento degli utenti, contribuendo a dare un contributo alla definizione di un nuovo sistema etico di valori in cui la ri-qualificazione delle tradizioni locali potrebbe produrre un nuovo country of origin effect.

Il presente saggio, che è parte integrante della ricerca MICS (Made in Italy Circolare e Sostenibile), intende indagare le metodologie narrative delle aziende italiane con un focus sul Distretto della Murgia nel Sud Italia per individuare e analizzare le strategie per la sostenibilità, l'innovazione e l'inclusione nonché le forme di dialogo che le aziende mettono in atto per superare il contrasto tra dimensione culturale e marketing. Con particolare riferimento alla possibilità di proporre queste microstorie –connesse alla pratica storiografica comparsa nel nostro Paese con i lavori di Edoardo Grendi (1972) e di Giovanni Levi (1973) all'inizio degli anni Settanta, poi sviluppata da Carlo Ginzburg (1979) – a sistema con le discipline del design.

## Microstorie del Made in Italy: Il Distretto murgiano del salotto

Il distretto murgiano del salotto, ovvero il distretto del mobile imbottito della Murgia (o triangolo del salotto), è uno dei più importanti contesti produttivi manifatturieri del Sud Italia che, a partire dagli anni Ottanta, ha strutturato un sistema di creazione, produzione e messa sul mercato italiano ed estero di prodotti di alta qualità manifatturiera, portandolo a costituire uno dei principali motori nazionali del settore, almeno fino ai primi decenni degli anni Duemila (Becattini, 1998; Greco, 2015).

Il distretto, definito identitariamente dalla grande sedimentazione e diffusione di conoscenze tecniche e di know-how nonché dalla presenza di manodopera altamente specializzata, assieme a una fitta rete dinamica di sub-fornitori e produttori di componenti, comprende imprese che risiedono per la Provincia di Bari nei comuni di Altamura, Cassano delle Murge, Gioia del Colle, Gravina in Puglia, Modugno, Poggiorsini e Santeramo in Colle; per la Provincia di Taranto nei comuni di Ginosa e Laterza; per la Provincia di Matera nei comuni di Ferrandina, Matera, Montescaglioso e Pisticci.

Il distretto ha raggiunto nei primi anni Duemila il 55% della produzione nazionale e l'11% di quella mondiale, superando il miliardo di euro di fatturato. La concorrenza sul mercato internazionale, unita alla crisi industriale del 2008, hanno determinato poi condizioni di grave difficoltà per l'intero settore, a cui hanno cercato di porre rimedio l'Accordo di programma dell'8/2/2013 e l'Addendum del 9/7/2019, promossi dal Ministero dello Sviluppo Economico, Regione Puglia e Regione Basilicata, attraverso la salvaguardia e il consolidamento delle imprese operanti nel settore, l'attrazione di nuove iniziative imprenditoriali, il reimpiego della manodopera qualificata espulsa dalla filiera produttiva.

Negli anni più recenti, ed in particolare subito dopo il periodo pandemico, il distretto ha mostrato significativi segni di ripresa, frenati solo dall'impennata dei prezzi delle materie prime (legname, metalli, poliuretano, pelli, tessuti e plastiche). Tale congiuntura ha portato gli attori economici di questo contesto a rivedere i sistemi di produzione: aumentando il livello qualitativo dei materiali impiegati e virando sul target di mercato medio-alto, con l'obiettivo di difendere e inquadrare in maniera più chiara possibile il valore d'identità, autenticità e inimitabilità dei prodotti, al contempo rivendicando un ruolo di protagonismo all'interno del processo di revisione della supply chain del New Made in Italy a livello nazionale e internazionale (Bettiol, 2015; Bettiol & Micelli, 2005).

Tra le ormai numerose realtà produttive, aventi in comune le fasi della filiera (realizzazione della struttura lignea, modellazione dell'imbottito in poliuretano, realizzazione del rivestimento in pelle e assemblaggio) nonché le caratteristiche dei prodotti (telaio ligneo, rivestimento in pelle, materiali riciclabili, forme ergonomiche, prezzo medio-alta), spicca come azienda leader la Natuzzi s.p.a. di Santeramo in Colle, fondata nel 1959, e primo produttore mondiale di divani in pelle e maggior produttore italiano nel settore del mobile, 'fondatrice' del distretto grazie alle innovazioni introdotte nei suoi processi produttivi.

La Natuzzi comincia ad affermarsi tra la fine degli anni Sessanta e l'inizio degli anni Settanta, innovando la sua produzione tappezziera e di falegnameria artigianale attraverso l'industrializzazione dei processi, lo snellimento della filiera produttiva (lean production) e la sempre maggiore offerta di varianti di prodotto oltre che l'apertura verso i mercati internazionali. Alla Natuzzi, peraltro fondatrice di Divani&Divani, primo franchising italiano dedicato al mobile imbottito, si sono poi aggiunte aziende come Calia (fondata a Matera nel 1965), Nicoline (nata nel 1994 ad Altamura) e, tra le altre, Dienne Salotti, Marinelli, Max Divani, Piquattro, configurando il distretto come polo d'eccellenza specializzato nel settore dell'imbottito e costruendo un vero e proprio network internazionale.

## La storia e la narrazione delle aziende del distretto murgiano

L'attuale sviluppo delle aziende del distretto murgiano, a valle del potenziamento della filiera produttiva, è oggi soggetto a tensione dinamica verso l'espansione indotta da numerosi fattori economici esogeni. Da un lato in riferimento alla pressione esercitata dalla concorrenza internazionale, dall'altro per la crisi e conseguente aumento dei costi delle materie prime. Ciò ha portato le aziende del comparto ad orientarsi verso l'individuazione di nuove metodologie, strategie narrative e di dialogo con l'utente. A partire dalla risposta a quella domanda relativa alla trasmissione dei propri valori tipici ai buyers internazionali; soprattutto in relazione ai contesti delle produzioni e alla loro relazione con la sostenibilità e l'innovazione coerente con la tradizione culturale della regione.

Il primo tassello di questa ricostruzione identitaria è rappresentato dal recupero del valore del territorio come luogo di nascita dell'eccellenza delle produzioni locali (Dalla Mura, 2015); da ciò deriva la ri-attribuzione di senso e significato al fattore geografico, in forza della sua appartenenza al mondo del Mediterraneo, con tutte le fascinazioni che esso intrinsecamente esprime (De Fusco, 2007; De Fusco & Rusciano, 2015).

In secondo luogo si è ricercato un concetto d'innovazione frutto dell'incontro tra ricerca tecnologica, design e marketing (open innovation), che potesse sancire: da un lato, l'avvicinamento alle nuove possibilità offerte dalla tecnologia digitale e informatica; dall'altro, l'accettazione del ruolo del design come attore fondamentale per il controllo della qualità sia estetica che dei processi. Infine, l'adesione a un marketing non più imposto 'dall'alto' ad utenti-consumatori bensì forma di dialogo orizzontale con utilizzatori intesi come soggetti attivi di modelli di business aperti e partecipativi (Pellegrini, 2016; Raimondi, 2005).

In terzo luogo, il riconoscimento della componente sociale dei luoghi, non più sfruttata o bypassata per accedere più rapidamente ai mercati internazionali, ma intesa ora come imprescindibile volano per le sfide culturali e ambientali della contemporaneità (Rinaldi, 2015). Con uno sguardo attento verso la tradizione artigianale locale in ragione della volontà di costruire un rapporto con la cultura materiale dei territori consolidata. Rispetto questa esigenza la pratica della microanalisi storica, nella sua scala ridotta di osservazione, fornisce la giusta misura spaziale per tentare di ricostruire le relazioni interpersonali tra attori locali, come soggetto storico, e sistemi globali come contesti di vendita. Ma offre anche la possibilità di sperimentare procedure analitiche che consentano di mettere alla prova dei fatti nuove categorie interpretative utili a rappresentare le scelte possibili di individui e gruppi sociali del distretto murgiano e, al contempo, i meccanismi e le dinamiche del mutamento sociale.

Questi temi, già associati da una forte aspirazione alla formalizzazione dai primi saggi degli anni Settanta di Levi, come L'eredità immateriale (1985), rivelano come la pratica della microstorica ha un'indubbia spendibilità nella direzione della modellazione di esperienze sociali uniche che possano fornire delle specificità rispetto i contesti geografici delle produzioni manufatturiere.

In questo senso anche i temi e i problemi affrontati rispetto il contesto di questa indagine, seppur di carattere generale rispetto le procedure analitiche

e le domande alle fonti può rivelarsi utile, oggi, nell'individuare strategie e pratiche per cui il design entra in relazione con i territori del Made in Italy (Labalestra, 2018)

In linea generale, le strategie narrative delle aziende del distretto murgiano nascono dalla necessità, ormai cogente, di coinvolgere sempre più gli utenti nelle varie fasi di concept, progettazione, produzione e vendita, condividendo con essi i propri principi e i propri valori, attraverso strategie di interazione aperte e coinvolgenti. Un sistema di user interaction (UI) e customer experience (CX) quindi, che potenzi e personalizzi le esperienze di acquisto e di dialogo azienda-cliente nei contesti dell'exhibition e del retail, nonché nelle piattaforme dei cataloghi fisici e digitali (Lotti & Trivellin, 2017).

Nel quadro di una serie di valori comuni che vanno dall'estetica all'artigianalità, dalla sostenibilità ambientale all'innovazione dei processi produttivi, la shopping experience promossa dalle aziende del distretto murgiano sembra passare da una modalità processuale lineare ad una condizione esperienziale basata su nuovi sensi e nuovi significati: per ciò che riguarda i prodotti, sebbene in sé secondari rispetto ai valori che sottendono, si passa dall'omologazione alla differenziazione, dai caratteri estetici e funzionali a quelli semantici ed etici, nel quadro di un approccio al consumo etico, autentico e trasparente basato su valori culturali condivisi e non più contrapposti (Micelli, 2011).

## Casi studio: Calia, Natuzzi, Nicoline

L'analisi più generale sulle strategie narrative delle aziende del distretto murgiano, nel quadro del nuovo paradigma 'Made in Italy', confluisce nell'individuazione di alcuni casi studio su cui la ricerca di cui al presente contributo intende concentrarsi per analizzare le forme di customer experience nei quattro distinti ambiti del retail, exhibition, digital e catalogue: Calia Italia, Natuzzi Italia, Nicoline.

La Calia Italia ha recentemente aperto un flagship store a Milano, attraverso cui l'azienda offre una shopping experience basata su valori quali l'artigianalità, l'efficienza produttiva e il confort ergonomico dei prodotti, comunicando uno spostamento di baricentro verso la soddisfazione degli utenti, rispetto alla quale la professionalità del personale che produce i mobili viene messa completamente a disposizione del pubblico. Il retail esalta inoltre, sebbene in maniera ancora piuttosto blanda, il legame con il territorio murgiano, tradendo in qualche misura l'intenzione di appartenere ad un Made in Italy non proprio geo-referenziato rispetto all'origine lucana dell'azienda. Anche il livello di coinvolgimento dell'utenza è limitatamente partecipativo: ad ogni collezione è associato un QR code attraverso cui si può accedere alle schede tecniche degli imbottiti, mentre i materiali usati per la realizzazione dei rivestimenti sono ben illustrati ma di essi non è specificato il livello di sostenibilità e innovazione. Il flagship store di Calia Italia sembra quindi mantenere ancora un approccio sostanzialmente prodotto-centrico, che mostra le qualità formali dei divani, trascurando un po' la narrazione delle sue caratteristiche di trasparenza, sostenibilità e innovazione dei processi produttivi.

Per ciò che riguarda l'exhibition, nel contesto dell'ultimo Salone del Mobile (2023), l'azienda mostra una maggiore tendenza a manifestare i propri valori etici rispetto a quanto avviene nel contesto del retail: qui infatti il tema del confort viene associato a quello della sostenibilità mettendo in

evidenza come i due caratteri siano strettamente legati da un rapporto di causa-effetto. Anche il legame con il territorio appare narrato in maniera più esplicita, utilizzando soluzioni espositive e cromatiche legate alla terra e al concetto di 'origine'.

La storia e la filosofia aziendale sono presentate in modo particolarmente significativo nel catalogo digitale (sito web), con info-grafiche, linee del tempo e schede sui processi produttivi piuttosto chiari. Appaiono invece meno incisivi i temi della sostenibilità e dell'innovazione, così come non elevato è il livello d'interazione con l'utenza che la piattaforma mette a disposizione, ad eccezione dello show-room virtuale che permette di visualizzare il prodotto scelto all'interno del proprio ambiente domestico. Al sito web l'azienda associa i canali social, tra cui Facebook, YouTube e Pinterest, che si configurano ancora prevalentemente come siti-vetrina.

Nel catalogo aziendale, di alto livello grafico, appare più forte il legame con il territorio, così come particolare risalto è dato all'identità e alla storia dell'azienda. Il design assume qui un ruolo significativo, perché vi è qui probabilmente la necessità di individuare una sorta di fil rouge che unisca le varie collezioni presentate (nel catalogo racchiuse peraltro in un unico moodboard), sebbene i prodotti vengano presentati non tanto in maniera narrativa o informativa quanto illustrativa e contemplativa. Anche qui la dimensione della sostenibilità e dell'innovazione restano in secondo piano, occupando peraltro uno spazio che esce da quello culturale della produzione ed entra in quello tecnico delle certificazioni.

La Natuzzi Italia ha uno showroom a Milano interamente dedicato agli imbottiti, che mette in esposizione cercando di affiancare alla celebrazione delle qualità estetiche dei prodotti i valori dell'artigianalità, dell'innovazione e del legame con il territorio: quest'ultimo aspetto viene però comunicato all'utente utilizzando immagini di una Puglia salentina più affini a ciò che è la Puglia nell'immaginario collettivo rispetto alle reali zone d'origine dell'azienda (la Murgia). Se gli aspetti relativi alla sostenibilità, alla tradizione e all'etica produttiva sono lasciati un po' in secondo piano, notevole risalto viene invece dato al ruolo del progetto di design: l'azienda infatti espone i prodotti sempre in associazione all'esperienza progettuale che li ha generati, con un QR code attraverso cui l'utente può accedere non solo alle informazioni tecniche ma anche a quelle relative alla collaborazione con i designer. L'allestimento (organizzazione dei prodotti nello spazio) è orientato a dare un'immagine di ambiente domestico che allude alle atmosfere della Puglia rurale, ma nonostante ciò esso appare a volte impersonale e distaccato essendo privo di occasioni di reale interazione con l'utente.

Per ciò che riguarda l'exhibition, la Natuzzi nel 2023 ha bypassato la Design Week di Milano allestendo due esposizioni Fuori Salone presso lo show-room di Via Durini. Qui sono stati presentati i nuovi caratteri dei divani tra cui il confort, il valore del tempo, l'utilità rispetto alle ritualità della vita quotidiana, ed è stato sottolineato il legame con il territorio attraverso delle esperienze di food con prodotti tipici pigliesi e una certa immersione in un paesaggio naturale appositamente riprodotto. In questa occasione l'azienda è riuscita inoltre a impostare il dialogo con gli utenti in maniera più esperienziale, creando condizioni di confronto, dibattito e scambio culturale.

Particolarmente significativo è il contesto del digital: il sito web di Natuzzi mostra infatti più esplicitamente rispetto a quanto avvenga nei contesti del

retail e dell'exhibition i valori di legame col territorio e con la tradizione, l'approccio 'culturale' alle forme d'uso dei divani, sebbene questi si ritrovino più associati ad ogni singolo prodotto che in una sezione più generale atta a raccontare chiaramente la filosofia aziendale. Risulta scarna la narrazione dei processi produttivi e dei criteri di innovazione e sostenibilità, a fronte di una molto efficace messa in mostra dei prodotti sapientemente realizzata con immagini che vengono utilizzate anche per l'integrazione con altre piattaforme social come Facebook, Linkedin e Instagram.

I valori aziendali sono invece presenti nei cataloghi cartacei, nei quali è dato anche risalto al rapporto con il design e un particolare focus ai materiali utilizzati e quindi ai temi della sostenibilità. Al contrario del digital, qui i valori aziendali sono concentrati in una sezione che rispetto ai contenuti del catalogo si configura come una sorta di 'introduzione', mentre il rapporto con il territorio è espresso attraverso le fotografie che contestualizzano i prodotti in luoghi della Puglia rispetto ai quali propongono anche soluzioni di allestimento. La presenza di bozzetti progettuali e simulazioni virtuali accanto alle foto dei prodotti mette in risalto un'attribuzione di valore al progetto di design, configurando in definitiva le strategie narrative della Natuzzi piuttosto efficaci nel dimostrare l'aderenza ai principi di rispetto per l'ambiente, recupero della tradizione ed etica dei processi di produzione, anche se non adeguato risulta ancora il livello di partecipazione e interazione che viene riconosciuto agli utenti.

La Nicoline, azienda più recente delle altre prese in esame (fondazione nel 1994), ha uno showroom presso lo stabilimento di Altamura che è l'unico punto vendita aziendale (per il resto del retail l'azienda si affida a rivenditori multi-brand). Questa apparente limitazione consente all'azienda di costruire un dialogo prodotto finito-sistema produttivo da mostrare all'utenza con maggiore facilità e incisività; ciononostante, questo aspetto, così come il rapporto con il territorio, non appaiono adeguatamente valorizzati, a fronte di un'esposizione che mette al centro i prodotti mostrando quasi esclusivamente la loro dimensione estetico-formale.

Anche l'exhibition, sperimentata nell'ultimo Salone del Mobile, appare piuttosto tradizionale nelle sue modalità narrative, in quanto all'esaltazione delle qualità del prodotto finito non corrisponde un'adeguata informazione sull'origine delle materie prime impiegate e sulla sostenibilità dei processi produttivi. Di contro, appaiono efficaci i rapporti con il territorio murgiano, così come interessante è l'assenza di gerarchie tra i prodotti esposti (secondo un principio di democraticità) e l'esaltazione dei valori di flessibilità e di unicità. Assente è infine la dimensione esperienziale, con un sistema che coinvolge poco i visitatori.

Nel contesto del digital, costituito da sito-web, canale YouTube e piattaforme social, l'azienda mette in evidenza la collaborazione con i designer e comunica un importante principio di 'centralità' dell'utente: si evidenzia quindi un atteggiamento più aperto, a cui si aggiunge un atteggiamento etico rispetto alle intenzionalità aziendali in termini di raggiungimento di obiettivi di sostenibilità, innovazione e protezione del know-how attraverso la formazione continua delle maestranze. L'azienda inoltre manifesta la sua volontà di costruire un dialogo sempre più fruttuoso tra tradizione artigianale e tecnologia e dichiara l'aderenza al valore della difesa della qualità produttiva (nessun compromesso sui tempi di lavorazione, cura nell'esecuzione delle cuciture, accurata selezione delle imbottiture) e della dimensione artistica della concezione dei prodotti stessi.

I cataloghi cartacei sono strutturati in maniera molto chiara e razionale: l'attenzione al dettaglio e al particolare costruttivo denota una strategia narrativa poco purovisibilista e più tendenzialmente informativa, accanto all'uso sapiente della fotografia che mostra come i prodotti si allontanino da una condizione rurale-vernacolare e ambiscano a connotare spazi di grande eleganza. Nonostante ciò si ritiene non del tutto positiva la carenza nel sistema dei riferimenti al territorio di origine dei prodotti, che resta sempre su un piano implicito, così come non adeguatamente potenziata è la dimensione dell'interazione con l'utente.

## Conclusioni

Dall'analisi dei casi studio sopra menzionati emerge come, sebbene sia oggettivamente riscontrabile un cambio di rotta nelle modalità narrative delle aziende del Distretto Murgiano verso il potenziamento degli aspetti etici della produzione, nel complesso il definitivo passaggio al nuovo paradigma aperto, collaborativo e partecipativo non sembra essere ancora del tutto avvenuto (Cianfanelli et al., 2020). La sfida, ancora aperta, è quella di aumentare la competitività nazionale e internazionale aumentando il grado di l'integrazione tra design, sostenibilità dei prodotti-servizi e circolarità dei processi attraverso l'individuazione di nuovi modelli di business più centrati sull'utente, sulla valorizzazione delle culture locali sedimentate storicamente, sulla gestione di reti di approvvigionamento e di produzione aperte e collaborative, sulla messa in campo di strategie di marketing e branding mirate al potenziamento della user experience in chiave etica e responsabile, nel quadro di un nuovo effetto country of origin basato sulla circolarità e sulla sostenibilità (Celaschi & Deserti, 2007).

L'analisi di questo futuro scenario è l'oggetto della fase successiva della ricerca di cui al presente saggio, che sarà prevalentemente indirizzata a delineare progettualmente nuovi framework narrativi, nuovi archetipi strutturali per la filiera produttiva e della distribuzione, nuove modalità di interazione con l'utente, sia fisiche che virtuali, a partire dalle fonti storiche per ricostruire gli elementi singolari della cultura materiale del distretto, per configurare il nuovo user engagement dei luoghi della vendita e dell'esposizione (fisica e su piattaforme on line) con l'obiettivo di contribuire a ri-costruire la dimensione culturale del Made in Italy contemporaneo. Questo nell'ottica della costruzione di un sistema di elementi utili a riverberare le potenzialità competitive delle realtà produttive locali nel mercato globale seguendo le rinnovate indicazioni comunitarie e le nuove sensibilità sociali sulla sostenibilità ambientale e l'innovazione di processo (Sbordone & Turrini, 2020).

A livello operativo, la ricerca tenterà inoltre di definire strategie progettuali innovative per prodotti, dispositivi, supporti, banconi, strutture e sistemi (effimeri, temporanei e/o permanenti) in spazi in cui è richiesto di rafforzare l'interazione tra azienda venditrice, prodotti e cliente/utente finale attraverso un nuovo approccio in cui il sistema vendita/acquisto si trasformi in un dialogo basato su un common ground condiviso tra azienda e buyers (Trapani & Del Puglia, 2022). Nella sua dimensione progettuale quindi, la ricerca avrà come oggetto l'individuazione di nuovi paradigmi di esposizione/presentazione di mobili e prodotti in diverse tipologie di luoghi (negozi, mostre, padiglioni temporanei, fiere di design, ecc.), lavorando secondo l'identità delle aziende e, allo stesso tempo, alle aspettative dei clienti, rispondendo in prima istanza alle seguenti questioni principali:

- Ricostruzione storica dei fattori qualificanti dei contesti sociali ed economici locali riferiti alle produzioni manufatturiere;

- Definizione dei caratteri identitari delle produzioni del mobile rispetto i caratteri dei contesti originari di produzione;
- Attribuzione e riconoscimento del valore semiotico, semantico e culturale;
- Definizione di un rapporto tra dimensione culturale e marketing;
- Modalità di personalizzazione dei prodotti;
- Strategie espositive;
- Narrazione dei caratteri di sostenibilità e innovazione su materiali, processi, prodotti e sistemi;
- Scenari relativi ai modi d'uso dei prodotti;
- Dimensione narrativa del branding e del packaging.

## Ringraziamenti

Il presente saggio è parte integrante del progetto finanziato nell'ambito del Piano Nazionale di Ripresa e Resilienza (PNRR), Missione 4, Componente 2, Investimento 1.3, Bando di gara n. 341 del 15/03/2022 del Ministero dell'Università e della Ricerca della Repubblica Italiana, finanziato dall'Unione Europea – NextGenerationEU. Codice: PE00000004, Decreto di Concessione n. 1551 dell'11/10/2022 adottato dal Ministero dell'Università e della Ricerca della Repubblica Italiana, CUP D93C22000920001, MICS (Made in Italy Circolare e Sostenibile).

Nello specifico, la ricerca di cui al presente saggio fa capo alla sezione A3 'Shopping experience in physical stores. New paradigms for the user engagement' (Ref. Prof. Vincenzo P. Bagnato e Prof. Antonio Labalestra) del progetto 'Cultural value chain. From local traditional production districts to a new country of origin effect' (Referente: Prof. Annalisa Di Roma), inserito nel macroprogetto 'Spoke 7. New and cunsomer-driven business models for resilient and circular supply chain' (Coordinatrice Prof. Ilaria Giannoccaro), di cui è Leading partner il Politecnico di Bari.

# References

1. *Becattini, G. (1998). Distretti industriali e made in Italy: le basi socio-culturali del nostro sviluppo economico. Torino: Bollati Boringhieri.*
2. *Bettiol, M. (2015). Raccontare il Made in Italy. Un nuovo legame tra cultura e manifattura. Venzia: Marsilio Editori.*
3. *Bettiol, M. & Micelli, S. (2005). Design e creatività del made in Italy. Proposte per i distretti industriali. Milano: Mondadori.*
4. *Celaschi, F. & Deserti, A. (2007). Design e innovazione. Strumenti e pratiche per la ricerca applicata. Roma: Carocci Editore.*
5. *Centro Studi Federlegno Arredo Eventi SpA (2013). Mappatura del settore legno-arredo in Puglia. Analisi di settore e traiettorie di sviluppo. Milano: FLA Eventi.*
6. *Cianfanelli, E., Giorgi, D., Tufarelli, M., Makki, F., De gennaro, M. & Grazia Soreca, M. (2020). Le italie del saper fare. Verso una nuova geografia relazionale del Made in Italy. MD Journal, 9, 126-135.*
7. *Dalla Mura, M. (2015). Il design italiano oltre la crisi. Autarchia, austerità, autoproduzione: VII edizione del triennale design museum. AIS/Design Journal/ Storia e Ricerche, 6, 233-241.*
8. *De Fusco, R. (2007). Made in Italy. Storia del Design italiano. Bari: Editori Laterza.*
9. *De Fusco, R. & Rusciano, R. (2015). Design e Mezzogiorno tra storia e metafora. Bari: Progedit.*
10. *Dellapiana, E. (2022). Il design e l'invenzione del Made in Italy. Torino: Einaudi.*
11. *Ginzburg C. (1979) Spie: radici di un paradigma indiziario, in Crisi della ragione, a cura di A. Gargani, Torino: Einaudi, 59-106*
12. *Greco, L. (2015). Il distretto del mobile imbottito della Murgia: resilienza e risorse sociali per l'azione. Meridiana, 84, 91-117.*
13. *Greco, L. (2015). Sud dinamico. Meridiana, 84, 91-117.*
14. *Grendi E. (1972) L'antropologia economica, Torino: Einaudi.*
15. *Labalestra A. (2018). Il ruolo della storia nella conoscenza dei territori Design, aziende, cultura e valori. In D. Russo, P. Tamborrini (a cura di), Design & Territori. Università e aziende tra sperimentazione e innovazione, pp. 67-82. Palermo: Palermo University Press.*

16. *Levi G. (1973). Famiglie contadine nella Liguria del Settecento, «Miscellanea storica ligure»: 207-290.*
17. *Levi G. (1985). L'eredità immateriale. Carriera di un esorcista nel Piemonte del Seicento, Torino: Einaudi.*
18. *Lotti, G. & Trivellin, E. (2017). Una possibile strategia per il prodotto italiano. MD Journal, 4, 60-73.*
19. *Micelli, S. (2011). Futuro artigiano. L'innovazione nelle mani degli italiani. Venezia: Marsilio Editori.*
20. *Pellegrini, S. (2016). Il marketing del Made in Italy. Roma: Armando Editore.*
21. *Raimondi, M. (2005). Marketing del prodotto-servizio: integrare tangibile e intangibile per offrire valore al cliente. Milano: Ulrico Hoepli Editore.*
22. *Rinaldi, A. (2015). La user experience dei prodotti made in Italy. In G. Lotti, F. Tosi, S. Follesa & A. Rinaldi, Artigianato Design Innovazione. Le nuove prospettive del saper fare, pp. 203-215. Firenze: DidaPRESS.*
23. *Sbordone, M.A. & Turrini, D. (2020). Designed & Made in Italy. Invarianti, transizioni, nuove mappe valoriali. MD Journal, 9, 6-19.*
24. *Trapani, V. & Del Puglia, S. (2022). Design e narrazioni. Spazi fisici e concettuali per il Progetto della conoscenza. Siracusa: LetteraVentidue.*

# Values, Identity, Stereotypes

*Daniela Anna Calabi*[1], *Francesco Ricciardi*[2]
*daniela.calabi@polimi.it, francesco2.ricciardi@mail.polimi.it*

[1]*Department of Design, Politecnico di Milano, Italy*
[2]*School of Design, Politecnico di Milano, Italy*

***Keywords:***
*Design*
*Literature Education*
*Transdisciplinarity*
*University Management*

## Abstract

This research investigates the relationship between the value system of the "Made in Italy" brand, and the way communicative practices reinforce it by setting products in typical Italian landscape atmospheres. The landscape is a geo-referenced communication protagonist, and its presence, more recurrent in productions intended for the general public, is reduced in the communicative strategy of products intended for sector supply chains, where expressive and value forms disconnected from the representation of the Italian place are reiterated. The analysis focuses on the communicative experience with a semiotic perspective, providing the initial methodology of analysis and provoking reflections. The question arises whether enhancing Italian productions through real places (the "made in domestic country" of corporate brands and the globalized production ones) can restore greater awareness in the buyer and deeper relationships among stakeholders, without impoverishing the value system of Made in Italy.

## Introduction

The research on the perceived values of the "Made in Italy" brand and the importance of the representation of the territory arises in the context of an internal Project of PE11 Made in Italy Circular and Sustainable - Spoke 2 PNRR, titled: "Emotional. Experience Made in Italy: immersive storytelling design for contemporary values and sustenability" . The following considerations aim to draw attention in detail to the value system of the "Made in Italy" brand in relation to its territories, which do not always coincide with those where production takes place. The analysis initially focused on marketing choices that, for certain production and commodity sectors, use images of landscapes that do not coincide with actual production territories. Communication, in these cases, refers to places unrelated to the production location, depicting typical Italian environments with references ranging from history, arts and nature. Thus, starting with the historical framing of the Made in Italy phenomenon and the value traits that have enabled brand identity development, the analysis considered the Country-of-Origin Effect (COE) on the consumer during shopping experiences and the consequences on markets.

A series of case studies have been selected among those that, dealing with the communication of Made in Italy products, can be most clearly identified as leading product sectors (food, fashion, design, automotive,

tourism, mechatronics, chemical, aerospace). For each case study, the iconic representation of the territory and landscapes in the communication strategy was evaluated.

The methodology by which the analysis was conducted has a predominantly semiotic approach and was applied to images in order to identify expressive planes and content.

## A multifaceted identity

The use of the expression Made in Italy began to spread around 1980, referring to the range of manufacturing sectors that, going beyond the fashion system, include typical Mediterranean food products, home products and designer furniture, as well as mechanical manufacturing sectors. These areas affirmed the evolution of the Italian production system, with specializations that stood out internationally.

*According to Fortis (2016, p. 10), the strength of "Made in Italy" derives from the extensive diversification of its specializations (…), driven mainly by the "4F" macro-sectors (Fashion and cosmetics; Food and wine; Furniture and ceramic tiles; Fabricated metal products, machinery and transport equipment), but also by other important sectors such as metallurgy, paper, and chemicals-pharmaceuticals. Creativity, innovation, quality, design, and a strong tradition of "industrial cratismanship", (the ability to build customized products for clients), even in the high-tech sectors such as mechanical engineering or transportation vehicles, are the winning factors of "Made in Italy" and Italian SMEs. (Schilirò, 2017, p. 7).*

The recognizable attributes of Italian productions are expressed in a diversified production context; they stem from a strong industrial tradition that inherited a series of sensitivities, skills and design principles that matured over time, in a cultural and social fabric traditionally linked to the transmission of knowledge in family craftsmanship. According to Terenzi and Furin (2020) the uniqueness of the Made in Italy product comes from a particular mix of tangible and intangible elements, specific know-how and creative skills.

To this day, some of the peculiar aspects of Made in Italy include: high specialization of production techniques, territorial context of development, creative conception and product quality. The district character and the strong roots of some territorial specializations, which seem to have been influenced by Italian historical events, also stand out.

*But Italy by its nature is characterized by a layered and recognizable multifaceted identity. For this reason, "Made in…" design variations are being accredited as local expressions of a certain environment or milieu, intended as an integrated place of skills, knowledge, culture, environmental goods, material and immaterial excellence. These local versions claim their reason for existing on the national and international scene, going to outline for the traditional production sectors, new expressive possibilities that look to the future. […]. (Terenzi, Furin, 2020, p.74).*

In the modern production context, defining the origin of an artifact by acknowledging the characteristics of Italian production does not actually guarantee that it was made within the country's borders. Rather, it assumes recognition of the particular and specific relationships between that specific object and the cultural, affective and geographical values that connote the area in which it was generated.

It may be argued that a brand's story is determined by the relationship

it establishes with its target audience person. These relationships manifest as the outcome of a brand enhancement process that involves the design of a brand image and the subsequent formation of its personality (Keller, 2003). In other words, the design process and strategic choices generate brand awareness and a perceived image. Through the filter of attitudes and judgments, perceived meanings can lead to the construction of lasting relationships between the brand's value system and its recipients.

When it comes to a brand value system whose identity is deeply related to the territory of origin, the perceived image and characters associated with the product are definitely influenced by that which territory and country evoke. In other words, what the percipient defines as typical and characteristic of that particular country, and even the atmospheres that characterize it, are transferred to the product as typical qualities.

## Atmosphere and Image of the Country

Gernot Böhme (2010) defines atmospheres as environmental qualities that influence perception and relate to the surrounding world. They imply a global perception and determine complex reactions, involving affective and cognitive elements.

According to Bhöme, atmospheres are only almost objective, thus not fully determined in their essence when no one is involved in them. There is always a subjective aspect to the essence of atmospheres, which generally exist only in the current experience.

The atmospheric element is determined by an emotional and intangible component associated with a real and tangible context, giving it an expressive form. According to Bhöme, also, those who perform aesthetic work, creating objects, devices, spaces and compositions capable of generating emotional involvement in the observer, are designers of atmospheres (ibid.).

One of these aesthetic professions consists in the design, organization and staging of atmospheres and elements that contribute to creating a brand image. Made in Italy products evoke Italian environments and atmospheres through communication choices and influence perception with emotional associations through the place they represent (Griffith, 2011).

*"Academic research on country-of-origin (COO) effects has long established the existence of a "home country bias" phenomenon, that is, a bias against foreign products and in favor of domestic ones (Balabanis and Diamantopoulos, 2004 ). Many studies have reported a consumers' preference for products of domestic vs foreign origin in various product categories and countries (…). This bias, which also often induces the preference for a local brand vs a global one, is usually explained by consumer traits such as consumer values (…), economic and socio-psychological motives (Verlegh, 2007 ) and/or patriotism (He and Wang, 2015 ; Vianelli et al., 2015 ; Zeugner-Roth et al., 2015 )." (Bernard et al., 2020, p. 2965).*

In addition to influencing perception, country-of-origin (COO) effects can generate bias. As stated by John and Nebenzhal (1986) the favorable/unfavorable image of a brand depends on the perception of the value of the country: a true indicator of quality regardless of the true quality of the product. In other words, the consumer is somehow inclined to think that products, brands or services from a specific country share a particular trait associated to that country, thus assigning to the country-of-origin the role of pre-packaged quality indicator." (Andhén et al., 2016, p. 1).

In recent studies on "brand equity," and on the value (both ethical and economic) of the examined brands, the "country-of-origin effect" phenomenon diminishes (Bernard et al., 2020), partly as a result of globalization. However, it is interesting to note how the words Made in Italy have been joined over time by the label "made in domestic country", to inform the consumer that the product was made in the country of origin.

The "country-of-origin effect" remains strongly conditioned by its "country image"; which is ultimately represented by its landscapes and coincides with iconic and stereotypical atmospheres.

*Notable developments of how the construct of country image has been used in the literature to date include among other contributions the development of a scale to measure it (Martin and Eroglu, 1992 ). Its division into country image and product country image (Zeugner-Roth and Diamantopolous, 2009 ), to distinguish between notions of a country writ-large and those that are more directly relevant to product evaluation. The further division of the concept into basic origin image, product origin image and category origin image (Josiassen et al. 2013 ) to account for the potent moderating effect evoked by product categories. (Andhén et al., 2016, p. 2).*

## Image and Stereotypes

"Made in Italy" encompasses an articulated set of meanings that lend themselves to many definitions and interpretations; even the definition of perceived Made in Italy production sectors is the subject of academic treatises. The fashion, food, furniture, and design sectors, most readily associated with Italy's image with an important effect of information on their origin, are those on which the largest number of scientific investigations and analyses can be found.

However, the Made in Italy brand is relevant to many other important manufacturing sectors, such as the jewelry and musical instruments sectors, as proven by positive international perception. Nevertheless, the brand is not always used. Sectors with productive skills such as culture and tourism (cf. Temperini et al., 2016) leverage the image of the Italian landscape, but not always Made in Italy brand.

Because of the competitive advantage that the country image can determine in the success of a given product, it was necessary to define the conditions under which a product is eligible to be classified as Made in Italy. As Gregori, Palanga and Temprini (ibid.) state, Made in Italy must be protected and safeguarded from phenomena such as counterfeiting, Italian sounding and foreign takeovers of brands belonging to the brand in order to avoid devaluing the promise of high quality that distinguishes Italian origin. In general, EU regulations stipulate that a product can be labeled with the country of origin only if at least 45 percent of the added value of the product comes from that country, encouraging the increasing presence of a market of "hybrid" products, designed in Italy and manufactured abroad. In fact, numerous studies show that the country of manufacturing (COM) is becoming less important than the country of brand (COB); however, it is questionable whether these brands will continue to be perceived as Italian and connected to Italian style.

The intangible values that constitute Made in Italy originated from the characteristics of the Italian manufacturing system, which certainly did not identify with the communicative stereotype common to places of art and tourism.

If the country of production is becoming progressively less important than the country of origin of the brand, it is because the territories involved in production are increasingly international. Even Made in Italy aims to maintain the "Italian spirit" despite delocalized productions, at the cost of using stereotypical visual rhetoric to still appear "Italian".

To summarize: corporate brands build their reputations and identities by generating a unique image and personality through a process of enhancement undertaken in relation to market expectations; "Country of Origin" brands define their reputations and identities through a sort of transitive property of values generated by the country's productive sectors, often represented by atmospheric landscape backdrops.

The summaries of two significant researches regarding the perception of the Made in Italy brand and, in general, the Country Image, prompt further reflections.

The first study concerns the Italian consumer and summarizes the concept of Country Image through a series of "dimensions" that qualify the nation in productive terms.

*"According to Roth and Romeo , the image of a country is determined by a number of dimensions that positively qualify a nation in terms of production; these dimensions are related to the areas of "innovation" (superiority, technology advantage), "design" (style, elegance), "prestige" (exclusivity, status of national brands), and "workmanship" (reliability, durability, quality of domestic products). The Country Image's effect on perceptions and on the behavior of individuals, can be an important competitive tool both at the enterprise level and at the country level" (Cappelli et al., 2017, p.3)*

The study notes that there is no point of convergence in the academic community for the definition of Country Image. Some researchers define the national image as a "perception", "impression", "stereotype" or "pattern". Other authors define value dimensions as a multidimensional construct of beliefs (ivi, p. 4)

The research was implemented from a questionnaire conducted on 660 citizens from the cities of Rome and Cassino, which differ in size and catchment area, to highlight the behaviors of a metropolitan and a non-metropolitan demographic group. The questionnaire developed by researchers is structured in 4 different sections; six representative Made in Italy sectors emerge (food, furniture, drinks, jewelery, mechanics, fashion, technology) and nine characteristics most frequently associated with the brand (beauty, certification, quality, price, elegance, originality, tradition, sustainability, utility).

The second study focuses on reflections concerning the current and future prospects of Made in Italy, considering mid- to high-end consumer goods characterized by a particular design, quality of materials, and workmanship.

The research thus contributes to the debate on Italy's position in the global landscape, focusing on the fundamental role of the Italian country's image as a source of competitive advantage in emerging markets. It presents preliminary results of a survey conducted by the Center for Research on Made in Italy at the University of Rome International Studies (MADEINT) and the University of Sannio, considering seven emerging economies (Brazil, China, India, Indonesia, Russia, South Africa and Turkey) and a sample of 3,150 consumers (De Nisco, Mainolfi, 2016).

The results show that the perception of Italy and its products is mainly related to affective attributes (among the most cited: exciting country, high quality of life, sociable and friendly population, ideal country to live). The importance of the image of the cultural heritage of Italy is also emphasized.

Key cultural attributes include: aesthetics, beauty, visual arts, architecture, culinary tradition, as well as leather products, clothing, design, and furniture.

## Made in Italy territories in brand communication

This section collects case studies, with the aim of detecting the characteristics of the communication of commercial brands, semantically and for communication design. The semiotic analysis of images involves observing the elements present in visual compositions: explicit and deep meanings of communication, such as the relationship between territories, landscapes, values and products.

The sheets summarize advertising content through an image while texts support a visual description, the evoked spatial value, the sign function, the formal components and their meanings, and the values and attributes conveyed. The work is part of the analysis carried out by Francesco Ricciardi for his Master's degree thesis. The main criteria for case study selection were:

1) the symbolic presence of the physical territory and its cultural characteristics

2) the choice of a narrative atmosphere consistent with the reference environment (colour, light, weather).

Semiotic analysis focused on: visual representation, determined by sign function and communicative tone (Hjelmslev, 1968); plastic symbolism and eidetic, chromatic and topological components; identity and communication (Floch, 2016); visual correspondences. The communication strategies of products belonging to the food, automotive, fashion, design and tourism sectors were analysed.

The results highlighted, on the one hand, the presence of an iconic Italian landscape, with references to rural situations – especially in the food sector (see Barilla commercial A sign of love) – or to cities of art – especially in design, and in the automotive and tourism sectors (see Bulgari's commercial Unexpected Wonders).

On the other hand, we see the choice of daytime and sunny or serene twilight atmospheres, characterized mainly by natural light, saturated colors.

The use of a plastic symbolism most evident in chromatic categories highlights how the sign function of the product is expressed in iconic and symbolic form with characters of similarity with the territory (see the Ita Air commercial A sky full of Italy), or with subjects immersed in the territory (see Fiat commercial: new 500). Utopian/playful variations promote non-utilitarian but existential values, belonging not so much to the promoted object, as to the subject that joins it, combining a sense of belonging with a deep identity.

Direct return of affective attributes related to the area is present in the selected case studies.

The same criteria were used to analysed advertising communications from the chemical, mechatronic and aerospace sectors.

The result for these sectors defines on average:

- an almost total absence of the physical territory in the background (except in a few cases concerning the aerospace sector where the environment takes on a clear cultural vocation);
- an absence of affective atmospheres replaced by work/industrial pragmatism;
- absence of explicit plastic symbolism;

- absence of explicit sign function;
- enhancement of functional and convenience aspects belonging to the sponsored object, necessary for the subject to perform certain actions;
- return of qualitative attributes specific to the brand and the sponsored object.


*Figure 1. Analysis sheet: Barilla "A sign of love". https://www.foodweb.it/2023/10/i-classici-barilla-tornano-in-una-campagna-integrata/*


*Figure 2. Analysis sheet: Fiat " Nuova 500". https://spotfiat.altervista.org/nuova-500-100-elettrica-naturale-che-sia-nata-qui-accogliente/*

**Chimica - Mapei | Le sfide di Mario | Sigillare e incollare più oggetti possibili | Mapeflex MS 45 (spot)**

(https://www.youtube.com/watch?v=3ElwYJnk0DM )

**Descrizione audiovisiva**

**Ambiente**: Interno fabbrica/magazzino

**Colori**: Colori piatti luminosi.

**Luce**: luce diffusa delle lampade a neon.

**Soggetti**: Il soggetto deve riuscire a completare la sfida di sigillare una serie di materiali con il prodotto sponsorizzato.

**Audio**: Una profonda voce maschile ci racconta con un tono da competizione le modalità in cui si svolgerà la sfida.

**Stratificazione territoriale**

Il territorio **non è presente fisicamente**.

**Valorizzazione (oggetto)**

L'oggetto promosso (Sigillante) subisce una **valorizzazione pratica**: viene raccontato per i suoi **valori utilitari**, permette al soggetto di realizzare il suo piano narrativo.

**Attributi restituiti**

**Qualitativi/Brand**
- Qualità
- Eccellenza
- Affidabilità


*Figure 3. Analysis card: Mapei "Le sfide di Mario". https://www.mapei.com/it/it/sfide-di-mario*

**Settore design: Bulgari**
tramonto - lusso - giardini - architettura - Roma


*Figures 4 and 5. Analysis cards: Bulgari "Unexpected wonders". https://www.lastampa.it/spettacoli/2022/05/24/news/unexpected_wonders_lo_spot_bulgari_di_paolo_sorrentino_con_anne_hathaway_e_zendaya-4581745/*

**Design - Bulgari | Unexpected wonders (spot)**

(https://www.youtube.com/watch?v=tLFQnjl_ojw)

**Descrizione audiovisiva**

**Ambiente**: Palazzo lussuoso con ampi giardini e vista su Roma.

**Colori**: i colori sono caldi e sfumati.

**Luce**: luce naturale calda che crea ombre e contrasti nelle varie ambientazioni. momento del giorno: sera - tramonto.

**Soggetti**: i due soggetti sono ripresi nella loro eleganza in un clima di tranquillità, distaccato dalla realtà metropolitana.

**Audio**: lo spot è accompagnato dalle voci extradiegetiche delle due attrici e una leggera musica al violino.

**Stratificazione territoriale**

il territorio è **presente fisicamente**, viene declinato nella sua stratificazione
- **Rappresentativa:** Fornisce le informazioni di provenienza del prodotto.
- **Percettiva:** Fa immergere lo spettatore nel momento in cui i personaggi svolgono le loro azioni.

**Funzione segnica (prodotto)**

I gioielli assumono **funzione simbolica** ***per convenzione guidata da fattori di somiglianza***: creano un'analogia, un rapporto di similarità con gli elementi costitutivi di lusso ed eleganza che permeano le scene della narrazione.

**Simbolismo - categorie plastiche**

Il territorio assume un ruolo principale nella composizione:
- **categorie cromatiche**: Le tonalità dorate disegnate dalle componenti atmosferiche rimandano all'idea di lusso e di pregio, i bianchi delle architetture e degli abiti delle attrici simboleggiano l'idea di purezza e di un nuovo inizio mentre gli elementi cromatici più scuri come le ombre marcate e i vestiti delle attrici rimandano al concetto di mistero ed eleganza.

Le categorie **cromatiche** creano un aura di lusso, raffinatezza ed eleganza, atmosfera che trova la sua espressione nell'elemento territoriale che fa da contesto alla narrazione e nel quale le due attrici si rispecchiano.

**Valorizzazione**

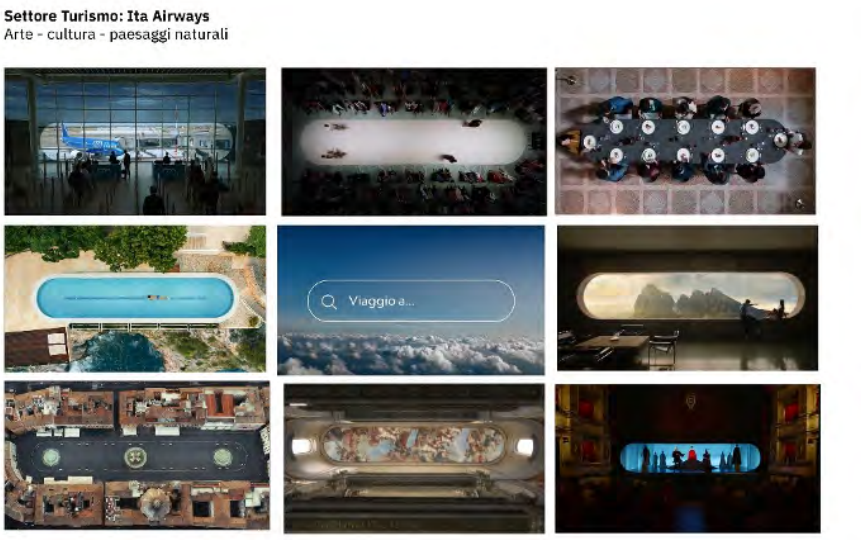
I gioielli (oggetti) subiscono una **valorizzazione ludica**: le qualità estetiche degli stessi vengono esaltate nelle inquadrature.
Le due attrici (soggetti) subiscono una **valorizzazione utopica**: si ricongiungono agli oggetti realizzando i propri valori di base.

**Attributi restituiti**

**Qualitativi/Brand**
- Eleganza
- Raffinatezza
- Unicità
- Lusso
- Design

**Affettivi/Territoriali**
- Paese ideale
- Qualità della vita
- Paese emozionante

*Figures 6 and 7. Analysis sheets: ITA Airways "A sky full of Italy". https://www.youtube.com/watch?v=W3Le_uhBID0*




**Ita Airways | A sky full of Italy (spot)**

(https://www.youtube.com/watch?v=W3Le_uhBID0)

Esiste un'altra versione dedicata al pubblico estero che varia per un paio di scene. non troviamo più il territorio delle dolomiti che sono state sostituite dalle valli del Chianti. La motivazione del cambio di scena ce la da il CMO di ITA Airways Giovanni Perosino. *"[...] Tutta la campagna è strutturata su studi granulari molto specifici di quello che gli stranieri desiderano dall'Italia nei vari Paesi target basandosi sulle ricerche Google. Ci sono Stati Uniti, India, Giappone, Israele e varie zone dell'Europa. Le colline del Chianti, in quest'ottica, rispondono maggiormente a quello che è un immaginario comune dell'Italia e del desiderio che hanno i suoi viaggiatori."*

**Descrizione Audiovisiva**

(le scene che vengono descritte sono quelle della versione italiana dell spot che coinvolgono direttamente il territorio fisico)

**Ambiente:** 1- Piazza Navona (Roma) | 2 - Tre cime di Lavaredo .

**Colori**: 1- i colori sono piatti e forti | 2 - Colori naturali, scuri tranne per il cielo al tramonto.

**Luce:** 1 - luce naturale piatta che non crea ombre (clima nuvoloso). momento del giorno: pomeriggio. | 2 - Fasci di luce naturale che creano ampie ombre e contrasti marcati e donano alle nuvole colore roseo. momento del giorno: tramonto.

**Audio**: L'audio che accompagna l'intero spot è composto da una musica ritmata e profonda sostenuta da una voce femminile che descrive l'attitudine italiana nell'affrontare la vita e la quotidianità.

**Stratificazione territoriale**

il territorio è **presente sia fisicamente che non fisicamente**, viene declinato nella sua stratificazione

- **Rappresentativa**: è orientativo e informativo rispetto al luogo in cui ci troviamo
- **Culturale**: Il territorio descrive lo stereotipo italiano per una promozione turistica dello stesso.
- **Mnestica:** descrive di una traccia storica che rimanda ad un immaginario stereotipizzato del contesto.

**Funzione segnica**

La barra di ricerca della compagnia aerea che troviamo all'inizio del video con scritto "Viaggio a..." assume una **funzione simbolica:** mano a mano che le scene si alternano la forma iniziale rettangolare si ripete nei vari scenari culturali/paesaggistici legandosi quindi a quegli scenari per convenzione guidata da caratteri di **somiglianza**. Alla fine la forma comune alle varie scene si stringe in se stesse fino a diventare la forma del finestrino dell'aereo, come se tutto quello che fino a quel momento aveva rappresentato si racchiudesse nelle forme e quindi nei valori della compagnia.

**Simbolismo - componenti plastiche**

Il territorio assume un ruolo principale nella composizione:

- **categorie eidetiche**: Nelle varie scene la forma iniziale si ripete in varie declinazioni
- **categorie topologiche**: la figura simbolica che fa da legante in tutto lo spot è sempre posizionata al centro della scena.

**Valorizzazione (prodotto)**

L'oggetto (compagnia aerea rappresentata dalla barra di ricerca) subisce una **valorizzazione utopica,** contraria ai valori utilitari, corrisponde alla promozione di valori esistenziali, identitari: *"L'essenza di questa compagnia si racchiude nei valori fondanti del territorio e della cultura italiana"*

**Attributi restituiti**

**Qualitativi/Brand**
- Eccellenza
- Eleganza

**Affettivi/Territoriali**
- Paese ideale
- Paese eccitante

The results are significant for the different uses that productive sectors make of the Italian landscape. In the food, textile/fashion, automotive, design and tourism sectors, it is possible to recognize stereotypical area communication. In contrast, the mechatronics, chemical, and aerospace sectors are disconnected from the image of places. The first group combines traditional affective values with the landscape, with the use of highly evocative atmospheres and situations. In the second group, which tends to be less present in mass communication, the values of Made in Italy are communicated with a different rhetoric, directed to a different and specialized audience. The fundamental difference between the two groups is determined by the type of production and the audience to which they are referred: "everyday people" (Business to Consumer or B2C), or stakeholders (Business to Business or B2B). B2C takes on an emotional character by focusing

on an atmospheric narrative; B2B opts for a communication of a technical nature, oriented toward innovation and Made in Italy quality, thereby developing its narrative around pragmatic aspects for which, evidently, there is no need to represent the landscape. The territorial presence thus seems necessary to evoke the affective and familial atmospheric component of the best traditions, synonymous with quality and care, echoing a cultural environment that transforms from a background into a protagonist of the value narrative (cf. De Nisco, Mainolfi, 2016). Territorial identity is a vehicle of brand identity.

*Table 1. The two macro-areas of Made in Italy communication.*

| The Communication of Made in Italy | | |
|---|---|---|
| | B2C | B2B |
| **Target** | Everyday People | Stakeholders |
| **Character** | Emotional | Technical-Scientific |
| **Narration** | Atmospheric | Pragmatics |
| **Presence on territory** | Protagonist | Absent |
| **Sign function** | Iconic / symbolic | Absent |
| **Enhancement** | Ludic / utopian | Practice / criticism |
| **Returned attributes** | Brand affective attributes | Brand qualitative attributes |

## Conclusion

In conclusion, it can be observed that many Made in Italy products are made in market niches that are more competitive and innovative than large manufacturing companies, thus successfully maintaining a level of quality and flexibility that allows them to operate in the international market, albeit with small investments.

This character can historically be described as "typical" of Italian small and medium enterprises or SMEs, whose development and establishment is a unique aspect of Made in Italy.

*A unique aspect of "Made in Italy" is that most Italian firms do not operate in major sectors or in sectors where scale economies or science supremacy are critical success factors. In fact, many of the firms have significant strengths in (for example) a technology or brand, with an extraordinary influence on exports. This is particularly true in the most successful sectors of Italian internationalization (the 3Fs: food, fashion and furniture), showing a strong conceptual link with handicraft and the consequent development of specialized areas (e.g. industrial districts). (Festa et al., 2019, p. 428)*

The representation of the Italian territory in the communication of brand names, whether they are representative of large realities or SMEs, is a strategic choice that creates a link with places, even if it does not always allow the territorial production realities to be identified.

The idea of place (places) in its configuration as a local or national entity, precisely geolocated, de facto interacts with the concept of flows of knowledge, culture, goods, and services, but also of capital flowing through

it. Relationships between local businesses and social realities, with national and international actors, redevelop technologies and skills historically rooted not only within businesses but also in territories (Salone, 2012).

Historically, artisanal producers were the ones who felt the connection with their territories of origin; today, territorial structures and productions have changed, but for SMEs, rootedness in the territory continues to define the place of labour relations, brand identity and, therefore, brand image.

In accordance with Festa et al. (2019) there is a belief that the local combination of society, culture, people, communities and businesses can generate forms of development capable of playing a direct role in expanding environmental boundaries to transnational spaces, thus globalizing Made in Italy territorial knowledge.

"… new industrialization and internationalization models have facilitated the introduction of processes that promote knowledge sharing among all local actors in a given "place," activating further processes of social modernization and technological innovation (Bencardino, 1997), in conjunction with the valorization of local productive resources and endogenous entrepreneurial qualities." (Festa et al., 2019, p. 430)

The concept of territory understood as "intellectual capital" allows it to be interpreted (and thus communicated) as a catalyst tool for productions that share contexts, cultures, and symbolic references of Made in Italy.

*In fact, the patrimony of tangibles (morphology, natural resources, infrastructures, etc.) and intangibles (shared values, quality of life, reputation, etc.) of a territory expresses specific determinants that can greatly contribute to business success in international competition (for example, proximity efficiency, local services and contextual skills). (Festa et al., 2019, p.431)*

An important finding from the value analysis concerns the presence of iconic landscape settings in "B2C" advertisements. Instead of representations best suited for touristic promotion, communication design could replace those layered cultural values, the resource system, and the unique relationships and knowledge embodied in the place where production has taken place. The international reputation of Made in Italy, in fact, derives not only from human factors but also (and perhaps above all) from environmental factors. For SMEs, the competitive advantage depends equally on company resources and on territorial, tangible and intangible resources.

The investment in territorial identities is as important as that of its enhancement in relation to internationalization processes: a system of local value relationships that can enable processes of business co-creation (ibid.).

This cultural investment in territorial relations proves necessary to enhance experience and reflect on the future, including that of Made in Italy.

# References


1. *Andéhn, M., Gloukhovtsev, A., & Schouten, J. (2016, July). The country-of-origin effect – Key issues and future direction. Paper presented at the Global Marketing Conference, Hong Kong. Retrieved from https://www.researchgate.net/publication/305473373_The_Country_Of_Origin_Effect_-_Key_Issues_And_Future_Direction*
2. *Bernard, Y., Collange, V., Ingarao, A., Zarrouk-Karoui, S. (2020). Products labeled as "made in domestic country": the brand matters. European Journal of Marketing, 439. https://www.emerald.com/insight/0309-0566.htm*
3. *Böhme, G. (2010). Atmosfere, estasi, messe in scena: L'estetica come teoria generale della percezione, T. Griffero, Milano: Christian Marinotti Edizioni.*
4. *Cappelli, L., D'Ascenzo, F., Natale, L., Rossetti, F., Ruggieri, R., Vistocco, D. (2017). Are consumers willing to pay more for a "made in" product? An empirical investigation on "made in italy". Sustainability, 9(4), 556. https://doi.org/10.3390/su9040556*
5. *Festa, G., Rossi, M., Kolte, A., & Situm, M. (2020). Territory-based knowledge management in international marketing processes – the case of "Made in Italy" SMEs. European Business Review, 32(3), 425–442.*
6. *https://doi.org/10.1108/EBR-06-2019-0129*
7. *Floch, J-M. (2016). Identità visive. Costruire l'identità a partire dai segni, Milano: Franco Angeli.*
8. *Hjelmslev, L. (1968). I fondamenti della teoria del linguaggio, Torino: Einaudi.*
9. *Jain S. C., E., Griffith, D., A. (2011). Handbook of Research in International Marketing, Cheltenham, UK, Northampton, MA, USA: Edward Elgar Publishing.*
10. *Johansson, J. K., & Nebenzahl, I. D. (1986). Multinational production: Effect on brand value. Journal of International Business Studies, 17(3), 101–126. https://doi.org/10.1057/palgrave.jibs.8490861*
11. *Keller, K. L. (2003). Strategic brand management: Building, measuring, and managing brand equity. Upper Saddle River, NJ: Prentice Hall.*
12. *Schilirò, D. (2017). Italian industrial districts: Theories, profiles and competitiveness. Management and Organizational Studies, 4(4), 1. https://doi.org/10.5430/mos.v4n4p1*
13. *De Nisco, A., Mainolfi, G. (2016). Competitiveness and Foreign Perception Of Italy And Made In Italy On The Emerging Markets, Rivista Italiana di Economia Demografia e Statistica, Volume LXX n.3 Luglio-Settembre 2016.*
14. *http://www.sieds.it/listing/RePEc/journl/2016LXX_N3_15_28_DeNisco_Mainolfi.pdf*
15. *Salone, C. (2012). Politiche territoriali. L'azione collettiva nella dimensione territoriale, Collana Geografia ambiente territorio, Torino: Utet Università.*
16. *Temperini,V., Gregori, G., L., Palanga, P. (2016). The Brand Made in Italy: A Critical Analysis. Management Studies, May-June 2016, Vol. 4, No. 3, 93-103. https://doi.org/10.17265/2328-2185/2016.03.001*
17. *Terenzi, B., Furin, E. (2020, luglio). Dal design Made in Italy al design Made in… Umbria. L'identità territoriale per l'innovazione del settore ceramico. MD Journal, 9, 74-85.*

# From territories to communities. A new perspective for Made in Italy.

*Iole Sarno*
*iole.sarno@unina.it*

*Università degli Studi di Napoli Federico II, Italy*

***Keywords:***
*Territory*
*Generative Community*
*Digital Culture*
*Process Design*

## Abstract

The article presents the preliminary results and development paths outlined within the ongoing PhD research in the field of Made in Italy. The work is focusing on the evolution of the relationship between "design and territories", in connection with the emerging concept of community and the settling of digital culture. During the first stage of study of the existing literature, the research deepened the concept of Made in Italy in its historical meaning that combines the cultural, productive, and economic identities of the Italian national context, then proceeding with an evolving study on the relationship between "design and territory". This binomial was the core of the socio-economic definition of industrial districts of the early 1950s that attributed production to circumscribed geographical contexts, while later assumed a more systemic dimension, as highlighted by the first design academic research carried out in the late 1990s. In this phase of recognition of the state of art, the bibliographic survey revealed the shaping of a new reading of the relationship between design and territories: considering the settling of digital culture and the need to address global challenges, the conception of territorial boundaries is erased while the building up of distributed and collaborative networks between communities is enhanced. The new perspective then emerging sees the community at the center of the design process in the development of territory, at local and global scale. As a first result of the literature research, a categorized bibliographic collection has been developed, to define the different design's fields of action in this context (Fig.1).

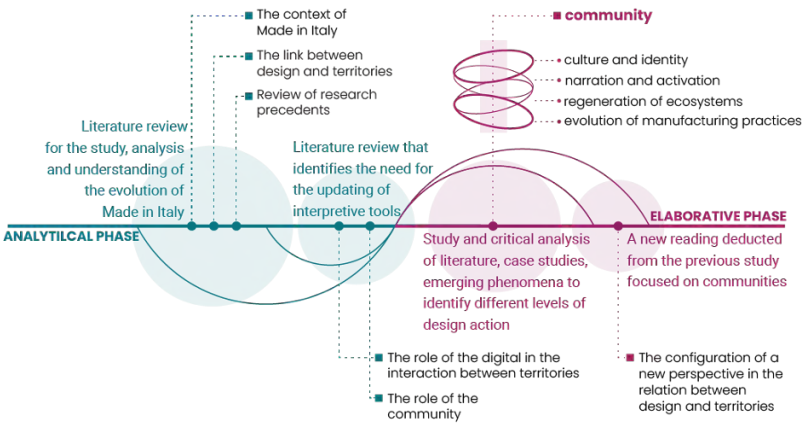



*Fig.1 Research methodology*

# Introduction

## Made in Italy through the connection between Design and Territory

The concept of Made in Italy originated from a context of small, often family-owned businesses specializing in specific products, materials and production techniques that conformed to Italian quality standards. This phenomenon, which asserted itself with greater incidence during the years of the "Italian economic miracle" (1958-1963), saw the development of small manufacturing activities maintaining a balanced combination of artisanal know-how and competitive industrial production. To understand Made in Italy, it is necessary to read its evolution beyond the concept of "product" to include broader economic and identity dimensions (Dellapiana, 2022) .

Aiming to give a contextualization to the phenomenon, emblem of the design-production-territory relationship, in the postwar period the Italian economy has experienced a process of widespread industrialization, that intensified in the late seventies, mainly concerning the northern regions of the "industrial triangle". The productive dimension of the Italian country was characterized by the relationship between industries and territories, defined as industrial districts . The economist Becattini, in the late '60, started a reflection on the socio-economic meaning of this concept, investigating the phenomenon of Italian industrial development (Becattini, 1979) and coming with the definition of the industrial district as a «socio-territorial entity characterized by the active coexistence, in a circumscribed territorial area, of a community of people and a population of industrial companies». In such a vision, the industrial dis trict becomes the theoretical-practical place and the interpretive tool that allows to explain italian local development (Schilirò, 2008).Thereafter, during the 1990s, due to the industrialization model that was getting more complex, diverse, and the demand more customized and representa tive of the evolution of socio-cultural changes, new solutions, new interpretative tools, new approaches by all disciplines dealing with the development of territories were needed (Parente, 2016).

The Italian design manifested its pervasiveness in even unexpected sectors such as food, culture, communication. It was becoming, as Branzi (2015) defines it, a mass, anonymous profession made up of groups of people, and considered as a strategic leveler able to activate local development processes connecting competences, know-how, resources and reinforcing local networks between people, institutions, enterprises. The territory becomes the place where the scaling action of the project is exercised, being the context of design and the object of design, then leading and converging into the "design for territories" discipline (Parente, Sedini, 2017).

In the late 1990s, the binomial "design and territory" has been consolidated through a series of academic design research (Fig.2) such as the SDI (Sistema Design Italia), conducted by Ezio Manzini, who implemented a methodology based on case studies to test innovative applications of design in local contexts. Later projects , such as Me.Design (2002-2004), focused on the centrality of the local community as an active player in the decision making and the strategic action of design in enhancing participatory bottom up processes, particularly in Mediterranean regions, while d.CULT (2004-2006) represented the start of a reflection on the relationship between design and cultural heritage.

In 2008, the DRM research (Design Research Maps) consolidated the results of these previous national design research, identifing emerging trends, and facilitating the formulation of future research strategies through

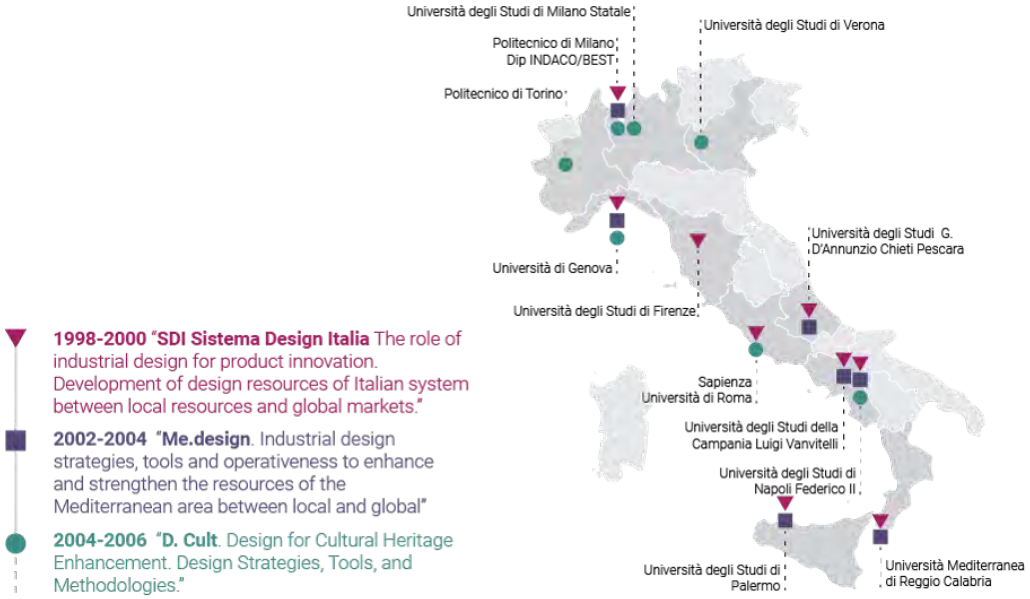



*Fig.2 Mapping of the earliest national research about design and spatial aggregation's system.*

the visualization of data. These initiatives revealed the power of design in enriching cultural landscapes, promoting community resilience, and driving socioeconomic progress.

## The role of the digital in the interaction between territories

The integration of digital culture has radically changed the relationship between production sectors and industrial landscapes in Italy, encouraging a decentralized network of craft activities across geographic boundaries. In this new scenario, cities become 'laboratories', representing the ideal place to test the ability of territories to adapt to social, economic, and environmental changes (Celaschi, Gianfrate, Boeri, Longo, Vai 2018). Places for sharing, co-design, production, and debate called Fab Lab are generated in the urban system (Ratti 2014). The emblematic figure of this scenario is that of the maker. The makers culture, which in Italy showed its largest potential during the Covid 19 pandemic, is based on concepts of open knowledge, open source, distributed production.

The rapid evolution of new information technologies, communication platforms and the diffusion of new tools for digital production (3D printers, laser cut) contributed to a democratization of processes and enabled a new generation of digital artisans who are able to relaunch a manufacturing tradition otherwise set to disappear (Micelli, 2016) thanks to the interaction with other professional figures (designers, makers, product engineers).

In this scenario, the conceptualization of territory and its role in the design process is changing: the spatial line that delimits a territory that fits into a specific cluster – as it happened for the industrial districts - through digitalization becomes thinner and thinner, while the formation of a distributed community network is enhanced.

## The configuration of a new perspective.

The matching between the territorial system and the demand for needs is changing continuously, sometimes related to global challenges such as the climate change, in which territories, as communities, are called to respond in terms of transportation systems, energy supply, emission load reduction, that only through local mechanisms can be successful. Communities emerge as primary agents of change: social innovation, thus community-based innovation, becomes pivotal in addressing local development challenges, fostering collective solutions to societal needs. Manzini (2015) clarifies the role of the designer in initiating and driving significant social change highlighting that «in a changing world, everyone designs». Individuals and collective entities, including non-expert designers, actively participate in the process through their decisions and actions. Furthermore, Villari (2021) in "Community-centered design: a design perspective on innovation in and for places" promotes a community-centered approach by outlining four scenarios focused on the community: design by the community, with the community, for the community, and of the community.

Community-centric design approaches, facilitated by academic initiatives and by digital platforms, have emerged as key drivers of inclusive and sustainable development. By prioritizing community engagement and social innovation, design becomes not only a catalyst for economic growth but also a tool for fostering collective empowerment and resilience within local contexts.

From the stu

dy and critical analysis of literature, case studies, emerging phenomena and by a first definition of design's fields of action, it is evidenced that the concept of territory and its evolution are influenced by the engagement and activism of the community that inhabits it. With the rise of digitization, communities remain local yet open and interconnected. Beyond the physical territory with its resources, identity and culture, it exists a secondary layer defined by the relationships between different types of community (Fig.3).

These digital and atypical aggregations require new interpretations and perspectives, driving an exploration of the fundamental shift in the relationship between design and spatial systems, from geographic contiguity to affinity-based community connections. Going forward, further research and interdisciplinary collaborations are essential to advance the understanding of Made in Italy and its implications on contemporary society.

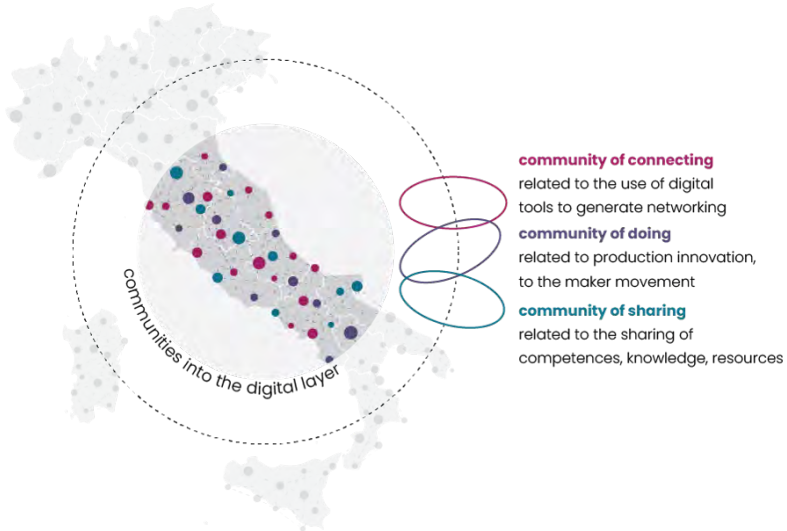



*Fig.3 Visualization of the community network layer generated by digitalization upon the territorial one, based on a first definition of three types of communities.*

## References


1. *Becattini, G. (1979). Dal settore industriale al distretto industriale. Alcune considerazioni sull'unità di indagine dell'economia industriale. Il mulino.*
2. *Bertola, P., & Maffei, S. (2008). Design Research Maps. Prospettive della ricerca universitaria in design in Italia. Maggioli Editore.*
3. *Branzi, A. (2015). Introduzione al design italiano. Baldini & Castoldi.*
4. *Celaschi, F., Gianfrate, V., Boeri, A., Longo, D., & Vai, E. (2018). Design e tecnologia applicate al contesto urbano. Le città come laboratorio di conoscenza e innovazione. MD JOURNAL, 5, 188-197.*
5. *Cristallo, V., Guida, E., Morone, A., & Parente, M. (2002). Design e sistema territoriale. Cinque casi studio di successo in Campania. LIBRia.*
6. *Dellapiana, E. (2022). Il design e l'invenzione del Made in Italy. Einaudi.*
7. *Fortis, M. (1998). Il Made in Italy. Il mulino.*
8. *Manzini, E. (2015). Design, when everybody designs: An introduction to design for social innovation. MIT press.*
9. *Micelli, S. (2016). Fare è innovare. Bologna, Il Mulino.*
10. *Micelli, S. (2011). Futuro artigiano: l'innovazione nelle mani degli italiani. Marsilio Editori Spa.*
11. *Parente, M., & Sedini, C. (2017). Design for Territories as practice and theoretical field of study. The Design Journal, 20(sup1), S3047-S3058. Available at https://www.researchgate.net/publication/319561587_Design_for_Territories_as_Practice_and_Theoretical_Field_of_Study [accessed 21st March 2023]*
12. *Parente, M. (2016). Design for Territories as reflective practice. PAD, 13, 10-27.*
13. *Politecnico di Milano. (1999). Sistema Design Milano.Abitare Segesta Cataloghi.*
14. *Ratti, C. (2014). Architettura open source, Torino. Giulio Einaudi Editore.*
15. *Schilirò, D. (2008). I distretti industriali in Italia quale Modello di Sviluppo Locale: Aspetti evolutivi, potenzialità e criticità (pp. 1-33). Vita e pensiero. Available at: https://www.researchgate.net/profile/Daniele-Schiliro/publication/46459414_I_distretti_industriali_in_Italia_quale_Modello_di_Sviluppo_Locale_Aspetti_evolutivi_potenzialitA_e_criticitA/links/0912f5064a972c6632000000/I-distretti-industriali-in-Italia-quale-Modello-di-Sviluppo-Locale-Aspetti-evolutivi-potenzialitA-e-criticitA.pdf [accessed 08th April 2023]*
16. *Villari, B. (2021). Community-centered design: a design perspective on innovation in and for places. The International Journal of Design in Society, 16(1), 47.*

# MADE IN AItaly. The Identities of Fashion Design in the Era of Artificial Intelligence.

*Andrea Quartu*
*andrea.quartu@unicampania.it*

*Università della Campania Luigi Vanvitelli, Italy*

***Keywords:***
*Design*
*Literature Education*
*Transdisciplinarity*
*University Management*

## Abstract

The fashion sector has been grappling with the exponential technological and digital transformation for several years, revolutionizing the way of conceiving, designing, producing, communicating, and marketing (Bertola and Teunissen 2018). Within this scenario, new forms of considering Italian fashion products and the Made in Italy label emerge, capable of identifying themselves within a network where creative exchange can be a driving force for development and research. The use of artificial intelligence in the Fashion Design sector gives rise to new perspectives and acts of cultural and social construction, wherein human creativity and technology blend into new co-creative and collaborative approaches. In the ongoing debate on the concept of Made in Italy in Fashion Design ( Dellapiana, 2022; Segre Reinach, 2015; Emanuela Mora & Paolo Volonté, 2014), this contribution aims to develop a critical analysis of existing literature with the goal of highlighting how, in an increasingly interconnected global fashion landscape, it is becoming more complex to pinpoint a concept of Made in Italy.

## Introduction

MADE IN AItaly. The Identities of Fashion Design in the Era of Artificial Intelligence.

The exponential technological innovation and the consequent integration of artificial intelligence (AI) into the world are transforming the entire fashion system. The use of generative AI softwares supported by specific datasets and the compilation of prompts manifest new scenarios in which questions arise about the identity of fashion, its products, and the professionals involved. At the same time, there is the complex challenge of how to effectively convey and define, through both text and images, the representation of the concept of Made in Italy to artificial intelligence algorithms, upon which the fashion system has anchored its identity. The contribution aims to investigate and question how the concept of Made in Italy related to fashion is evolving in this new scenario, presenting a review and critical analysis of existing literature with the aim of highlighting how, in an increasingly interconnected global fashion landscape, the use of the term Made in Italy loses meaning, assuming a somewhat anachronistic connotation.

The contribution represents the initial outcome of a PhD research within the scope of the National Interest Ph.D. in Design for Made in Italy, which

aims to redefine the concept of Made in Italy to explore the limits and opportunities of employing Artificial Intelligence in fashion design. In this initial phase, a review of the academic literature on the subject of Made in Italy in fashion design and the use of Artificial Intelligence in this hybrid landscape is presented. Subsequently, a keyword search was conducted using Google Scholar, which highlighted how this theme is still anchored to its initial definitions and is only partially influenced by developments resulting from technological advancements and new production processes. The doctoral research will continue in the following months with field research activities. This will allow reflection on how AI, integrated transversally into fashion design in the increasingly phygital hybrid landscape, inevitably leads to a reconsideration of previously investigated definitions in order to understand how they evolve.

This reflection can only begin by looking back and trying to outline the origin of this idea of Italianness. The root of this concept first appeared in the USA through the event shows of Giovanni Battista Giorgini (Figure 1) and his promotional activities in the international market for Italian fashion products (Pagliai, 2011). In fact, among the various productive sectors that make up the broad panorama of Made in Italy, the fashion industry stands out as the first to achieve a prominent position internationally (Belfanti, 2013).

According to the narrative explored by numerous academics (Savi, 2023; Dellapiana, 2022; Segre, 2015; Mora & Volonté, 2014; Barile, 2006; Colombi, 2015), over the years, fashion has positioned itself as the direct descendant and legitimate heir of the concept of Made in Italy, establishing a link with it that is perhaps universally recognized today. By engaging in the ongoing debate and investigating the notion under discussion, it was possible to map out the various definitions of Made in Italy, allowing us to understand and highlight how, even today, in increasingly contaminated scenarios, this theme is increasingly difficult to interpret. In 1998, Marco Fortis argued that "for many, Made in Italy is simply synonymous with fashion." According to Benini (2019), Made in Italy is defined by "the coexistence of peculiar national logics such as the diversity and articulation of the merchandise offer, the marked formal and material identity of products, attention to executive quality, rootedness in local communities and widespread knowledge, the ability to transform consumption into imagery." Again, for Barile (2006) and Giumelli (2019), it takes on a strongly communicative connotation with the idea of a metabrand where personal and collective stories converge, and abilities are combined in combinations and dosages significantly different from the past. Thus, the analysis of these definitions reveals the multiple, hybrid, and sometimes dichotomous reality of the nature of Made in Italy, which in fashion becomes increasingly blurred, mixing and multiplying with the activities of designers from different "Made in" backgrounds, globally decentralized production systems, and the advent of new technologies, particularly AI, which manifest new scenarios and acts of social and cultural construction. In this context, I believe it is necessary to implement a sort of "remanufacturing of thought (Barucco et al., 2020)" in order to try to provide new trajectories and redirection practices that allow for further reinterpretation of the Italian fashion system and consequently Made in Italy.

Fashion and technology have always been deeply intertwined, in a succession of technical, formal, and material innovations that allow us to read the history of fashion as a history of technology (Quinn 2002, 3). The future is shaping the ongoing debate on contemporary fashion (Smith et al., 2017),

increasingly aware of being in a moment of transition (Irwin, 2015). AI is entering, more or less consciously, into many activities of daily life, initiating a silent revolution that involves everyone. In fashion, significant changes are characterizing the ways in which we think, design (Figure 2), produce, sell, and communicate (Figure 03). I believe it is crucial, in the emerging cyber-physical fashion system, to inquire into how Made in Italy evolves, how the integration of artificial intelligence redefines it by enhancing or detracting from it until it denatures it.

The design flow, thanks to AI systems, is inevitably redefined, impacting both theory and practice.

The contribution intends to argue that reflecting on Made in Italy today also implies investigating how the collected and exploited data - for the use of generative AI systems - drastically influence the final concept of Italian fashion products; on the relationships between fashion designers and technology, and on speculations that question how much the finished product is the work of the machine and how much of the human. Leveraging artificial intelligence, trained with a significantly broad range of data of various natures and origins, on the generation of new concepts of Italian fashion products, leads to reflection on the definition of Made in Italy itself; on the Italianity inscribed in the selected, reformulated, and thought-out random data by AI for fashion designers in new stereotyped outputs that further rhetorically homogenize the concept of Made in Italy. This completely replaces the value landscape of Italian fashion, which is based on complex and fragile grounds, strongly hybridized and not homogenizable.

New meanings inevitably emerge for the Italian fashion system, which arrives in new territories and scenarios where material and immaterial values must be redefined, not by demanding the formulation of new answers to the questions of past decades, but by the need to pose new questions that fuel uncertainty or generate awareness.

*Figure 1. Giovanni Battista Giorgini fashion show event, Florence. Photo by Hulton Deutsch*

*Figure 2. Collaboration between Acne Studios and Robbie Barrat, Fall/Winter 2020 men's collection. Photo by Joelle Diderich (Instagram @jdiderich).*


*Figure 3. Experiments with generative AI text-to-image, the artist Benjamin Benichou recreates an advertising campaign for Balenciaga. Photo generated with AI by Benjamin Benichou.*

## References


1. *E Barile, N. (2006). Made in Italy: da «Country of Origin» a Metabrand, in Fatto in Italia. La cultura del Made in Italy (1960-2000), a cura di P. Colaiacono. Roma: Meltemi.*
2. *Barucco, A., M., Bulegato, F., Vaccari, A. (2020). Remanufacturing Italy. L'Italia nell'epoca della postproduzione. Sesto San Giovanni: Mimesis.*
3. *Belfanti, C. M. (2013). Rinascimento e Made in Italy. L'invenzione di un'identità culturale per l'industria della moda. Allegoria, 68, 32-46.*
4. *Benini, R. (2019). Lo stile italiano. Storia, economia e cultura del Made in Italy. Roma: Donzelli.*
5. *Colombi, C. (2015). Made in Italy: Rethinking a Century of Italian Design. Journal of Modern Italian Studies, 20(1), 140-142.*
6. *Dellapiana, E. (2022). Il Design e L'invenzione del Made in Italy. Torino: Giulio Einaudi Editore.*
7. *Fortis, M. (1998). Il Made in Italy. Bologna: Il Mulino.*
8. *Giumelli, R. (2019). Post-Made in Italy. Nuovi significati, nuove sfide nella società globale. Broni: Altravista.*
9. *Mora, E., & Volonté, P. (2014). Local Culture and Global Market: A Conversation with Protagonists of the Italian Fashion System. Fashion Practice, 6(2), 263-272.*
10. *Irwin, T. (2015). Transition Design: A Proposal for a New Area of Design Prac- tice, Study, and Research. Design and Culture, 7(2), 229-246.*
11. *Pagliai, L. (2011). La Firenze di Giovanni Battista Giorgini. Artigianato e moda fra Italia e Stati Uniti. Firenze: Edifir.*
12. *Quinn, B. (2002). Introduction. Techno Fashion. London: Bloomsbury.*
13. *Reinach, S., S. (2015). The meaning of Made in Italy in fashion. Craft + Design Enquiry, 7, 135-150.*
14. *Savi, L. (2023). A New History of "Made in Italy" Fashion and Textiles in Post-War Italy. London: Bloomsbury Visual Art.*
15. *Smith, P., Baille, J., & McHattie, L.-S. (2017). Sustainable Design Futures: An open design vision for the circular economy in fashion and textiles. The Design Journal, 20(1), 938-947.*

# Food, Design, and Territory: The Valorization of Manna in the Madonie area.

*Benedetto Inzerillo, Samuele Morvillo*
*benedetto.inzerillo@unipa.it, samuele.morvillo@unipa.it*

*Università degli studi di Palermo, Italy*

***Keywords:***
*Inner areas*
*Design*
*Madonie*
*Food design*

## Abstract

The contribution explores the connection between food, design, and territory, focusing on manna, a typical product of the Madonie region. It highlights the importance of manna, not only as an economic pillar but also as a cultural one for the local community, through the analysis of traditional agronomic practices and artisanal harvesting techniques. The work emphasizes the intrinsic value of manna, both in its raw form and as a component in innovative products, with examples like Fiasconaro Panettone from Castelbuono and "Birra artigianale delle Madonie," which uses manna as a key ingredient. It also discusses the territorial history, referencing the manna museum in Pollina and suggesting its redesign to enhance the story. Manna is showcased as a paradigm for demonstrating how a "unique" raw material can boost the development of a territory.

## Introduction

The paper examines the interaction between food, design, and territorial context, with a particular focus on products that, through the use of raw materials and the transmission of unique traditions present only in certain contexts, define the identity of places and activate positive processes for territories. Through the valorization of such resources, territorial identities are generated that activate cultural dynamics, such as the creation of museums and pathways for their protection. This process stimulates economic development, thanks to the valorization and artisanal or industrial transformation of the products, contributing to the creation of processed or semi-processed items that enrich the local context (Tantillo, 2023). These products catalyze a wide range of design processes, ranging from product design to communication, from packaging to food design, up to the planning of services (Spence, 2020). These processes, far from being isolated, intertwine in a complex interdisciplinary mosaic that blends design, tradition, and culture. In this way, design becomes a bridge between food, territory, and cultural identity, creating a dynamic interconnection that enriches and valorizes the local context through a holistic and innovative approach (P. Tamborrini, 2022). The article examines the theme through the analysis of specific case studies like the Immaterial Micromuseum of Wheat and Bread, located in Borgo Santa Rita, represents an emblematic case study on the ability of design to renew the cultural heritage of rural areas, skillfully integrating traditional and innovative elements. The initiative represents an

example of territorial development initiated by the community, where this space, dedicated to identity and territory, innovatively combines material and immaterial heritage, offering an experience that embraces history, individual and collective memory, science, and technology (Monterosso, 2023).

Another ongoing case study is the "Innova-Pollina" research project developed with the agreement between the Department of Architecture of Palermo and the Municipality of Pollina, has emerged as a result of the research, the importance of one of these unique products, the Manna. This same raw material, identity and distinctive of the Madonita landscape, is one of the selected case studies, also thanks to its detailed agronomic practice and artisanal collection techniques. This study aims to highlight the crucial role of Manna not only as an economic foundation but also as a cultural bulwark for the local community, which has given life to various local initiatives such as startups for the territory. The work underlines how Manna, extracted following methodologies handed down in history, retains intrinsic value not only in its raw form but also in its transformation into innovative products.

## Food, design and territory

The concept of territory transcends the mere geographical definition to assThe concept of territory transcends the mere geographical definition to assume the role of a dynamic scenario, in which cultural practices, traditions, and innovation manifest. This perspective transforms the territory into the foundation of community identity, emphasizing how the relationship between individuals and their environment is crucial in the construction of social and cultural dynamics (Manzini, 2015). Within this context, the role of food is elevated from a simple sustenance element to a symbol of connection between the past and the present, as well as between the local and global realm. Food thus becomes an expressive vehicle of identity and traditions, significantly contributing to the preservation of cultural heritage and responsible innovation. Some products of excellence, such as manna whose traditions represent a collective knowledge heritage, offer critical insights for reflection on sustainable development modes and the transmission of knowledge (Galati, 2006). The valorization of food-related traditions emerges as a vital strategy to consolidate territorial identity and encourage cultural tourism. The revival of ancestral harvesting and processing techniques, together with the celebration of indigenous products, allows communities to infuse new life into local economies and promote a more equitable and sustainable development. Consequently, the interaction between territory, identity, food, and traditions configures as a prism through which to deepen and exalt cultural diversity. Through active engagement in the protection and promotion of the intangible heritage, it is possible not only to safeguard the foundations of a community but also to prepare the ground for a sustainable and meaningful future (Daverio, 2013).

In this context, design manages to pour its processes into different aspects and sectors, enhancing and enriching the possibilities of use and systematization of these values. From the realization of services thanks to the material and intangible heritage, which allows the correct enjoyment and use of what today we can call the "experience" of these unique features, to the communication of the territory through orientation systems and valorization of cultural places like museums, or still pertaining to visual communication, that of the creation of territorial branding or typical products and traditions or of packaging that not only tell as they usually tell a product, but tell its story, its culture, and its territory.

The Immaterial Micromuseum of Wheat and Bread In the geographical context of southern Sicily, precisely in the province of Caltanissetta at "borgo Santa Rita," a marginal territory, known for the cultivation of wheat, which is still processed using traditional methods and for the production of organic bread and pasta, considered among the best in Italy, so much so as to attract the interest of tourists, academics, journalists, food enthusiasts, and renowned chefs from all over the world. Thanks to the natural vocation of this territory, in addition to the passion of stakeholders who have developed participation processes, through entities such as GALs and third sector associations. The wheat product that is transformed into bread becomes a cultural event, thanks to the birth of a micro-museum that uses technological tools for narration, becoming a place where memory, knowledge, and interaction merge into storytelling. This innovative space integrates historical-anthropological aspects with scientific and educational approaches related to the world of wheat and bread, offering an emotional and sensory narration of the universe of Borgo Santa Rita. The fundamental objective of the micro-museum is to valorize this place not only by transferring simple information to visitors and tourists with the exaltation of the unique characteristics of the artisanal processing of wheat, but also wants to preserve and transmit to future generations the traditions and collective memory of the place, so as to conserve in that territory, the memory of an intangible heritage (Monterosso, 2023).

## The manna, identity by Madonie

Most Sicilian municipalities are distinguished by their rich historical, landscape, gastronomic, and cultural heritage. However, among these marvels, Pollina stands out for its abundant legacy, despite its limited visibility in the tourist landscape due to its relative obscurity. Sicily is renowned for being the principal producer of manna since the late 19th century. This substance is masterfully extracted from the Fraxinus Ornus, which appears as a normal ash tree. However, in July and August, its exceptional capacity to produce manna through a simple incision in the bark is manifested (Lentini, 1983). This natural sweetener, with its notes of sugar, earth, wood, and a subtle honey trace, is delicately fragrant, evoking the smell of moss or wet wood. Manna is usually transformed into "cannoli," representing the most widespread form in which it is marketed (Figure 1). This substance, also known as "Dew honey," "Secretion of the stars," or "Nectar of the gods," played a key role in the local economy until the mid-20th century, generating employment for local inhabitants called frassiniculturists, or "Ntaccaluòru" in Sicilian dialect. This practice has maintained its continuity thanks to the determination of a small group of elders who, resisting the process of industrialization, have perpetuated the traditional techniques season after season. Manna and the traditions associated with it face significant challenges, particularly the emigration of the young, potentially future farmers and producers, threatening the definitive disappearance of this product. Despite these difficulties, enthusiasts of the tradition and those who dedicate themselves daily to its preservation are firmly intent on not letting it disappear.

## The manna product

Manna and its processing articulate a strong vocation towards the enogastronomic production of the territory, allowing creative space for local artisans to produce new products or to develop their Re-Designs of traditional products, using the local raw material, which is manna, to

*Figure 1. Manna natural process. By https://www.consorziomanna.it/it/content/6-cos-e-la-manna-, 28/02/2024.*

develop unique identity products.

The Fiasconaro "Oro di Manna" Panettone from Castelbuono represents a reinterpretation of the Milanese panettone, characterized by the use of manna as a peculiar ingredient. This product, born in an artisanal laboratory (now an industrial laboratory), has gained international fame, demonstrating the positive effect of the valorization of unique territorial resources on the economy and regional culture (Scrofani, 2019). In addition to the panettone, various products stem from the local genius of Master pastry chef Nicola Fiasconaro, who precisely from manna in his premises produces creams and other sweet leavened goods. Fiasconaro today, a well-established brand, becomes a driving force for the territory, also thanks to its culinary innovation activity and its innovative recipes, has given a significant push for the nomination of Castelbuono as "Creative City Unesco." Especially for communication, design is a fundamental discipline for the Fiasconaro brand, from the creation of its brand, which today is recognized worldwide, with precise and recognizable branding and well-positioned, from the timely and well-designed packaging with attention to details from materials to the communication system (Rundh, 2009). The proof of the brand's importance internationally is with the partnership with a globally recognized brand like "Dolce & Gabbana", where thanks to the union of these two realities, Sicilianity is communicated, through packaging with Baroque style or colors, which recall the uniqueness of Sicilian carts. These Packagings become touchpoints that communicate territorial uniqueness in various international locations like Airports or Dolce & Gabbana stores (Figure 2).


*Figure 2. Fisconaro Product. By https://www.fiasconaro.com/prodotto/oro-di-manna/, 28/02/2024.*

Beyond already internationally established realities, manna today becomes a design opportunity for the creation of new products, thus can give life to new startups as it was for the "Madonie Craft Beer" project produced in Pollina. The idea is to produce a local beer, incorporating manna, highlighting innovation in the food sector through experimentation and the use of local resources. This intuition gave life to the birth of the beer "Manna Crystals and Ash Flowers" born in the heart of the Madonie Park, fruit of the collaboration between Peppe Genchi, marketing consultant and craft beer enthusiast, and Beppe Cassataro, entrepreneur and manna expert. This beer, defined by its creators as "Mystical", aims to stand out, thanks to its recipe that integrates manna and makes it unique in the Sicilian panorama of craft beers. The originality and territoriality of the project are also evident at the communicative level, in its branding and its label, which wants to unite "beer and art", this by collaborating with local craftsmen and professionals, like the artist Stefania Cordone, who creates the illustrations then used in the labels and in the visual artifacts, which represent a homage to nature, and to the product "manna" creating a real "Cameo". The artistic illustrations are then curated and systematized by the designer Mariano Norata, who realizes the visual system of the product.

The research group of the "innova-pollina" project, taking inspiration from these researches, has developed other analyses on the Madonita territory, focusing in particular on that of Pollina. The research has highlighted, for example, how the production of sweets based on Manna in the territory of Pollina is substantially absent; this once again shows the need to plan and implement projects useful to enhance the potential of a territory. A research group has therefore developed a project hypothesis aimed at creating Manna biscuits, aiming to expand local production developing possible job opportunities and attracting visitors drawn by these specialties that could become recognized excellences on a larger scale, as in the case of Fiasconaro products. In this hypothesis, Food Design, incorporating other disciplines, considers food a design product, emphasizing sustainability and innovation, from the creation of the product recipe, to the shape, which determines the actions of fruition and therefore its "User Experience" (Heapy, 2019). Moreover, the usability and the shape of the product, is combined with the design of its packaging, which unites the functionality and communication of the product. The idea is to propose an exclusive artisanal product of the Pollina territory (Mangano, 2014). The product's name is "Frassini", grissini biscuits, inspired by the slender and elongated shape of manna, aiming to evoke the natural and irregular aspect of the sap, with dimensions of about 12 cm in length and 1 cm in diameter. The integration of orange in the recipe not only facilitates the production process, thanks to its preexistence, but also creates a taste.

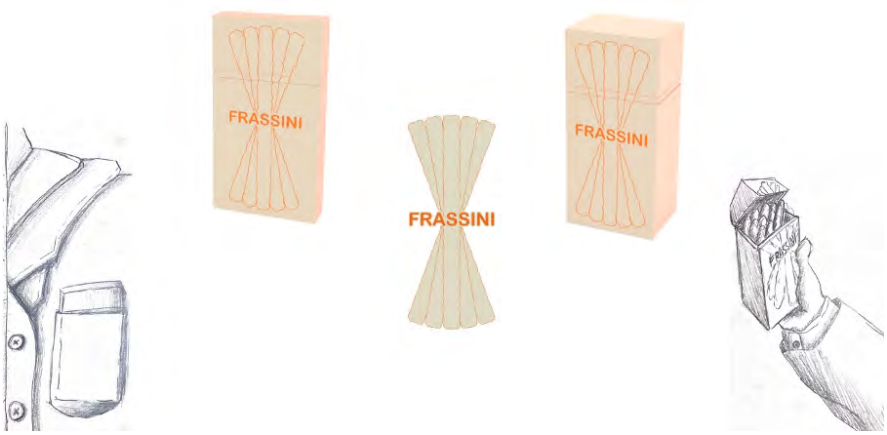



*Figure 3. Product in project "Innova-Pollina" designer team: Marina Alfonso, Gioia Campo, Mattia Caronia.*

**The Manna Museum: Status and Possible Future Visions**

Since 2011, the town of Pollina has been home to the Manna Museum. Located in Piazza Duomo on the first floor of the building that formerly housed the town hall, the museum hosts an exhibition of historical objects and tools used for manna production, in addition to several informative panels funded by the Madonie Park Authority. As part of the Madonie Park Museum Network, the museum offers a guide that narrates the history of manna and includes product tastings.

Despite being part of an established network, the museum requires a comprehensive project overhaul to more effectively tell its story and enhance the presentation of its exhibits. The current layout is inadequate and disorganized, and the lack of a strong presentation of the exhibited items significantly hinders the museum's ability to convey the intrinsic narrative of the exhibition space (Figure 4).

In the context of the research conducted for the second case study, the work team implemented a comprehensive methodological approach aimed at exploring the specific characteristics of the museum context under examination. The analysis began with a series of site investigations conducted by experts in the field of museums, exhibitions, and cultural heritage. These professionals provided valuable insights into the problems inherent to the location, offering a solid foundation for further investigation.

The research process was significantly enriched through interactions with local stakeholders. Among these, key figures included the museum manager, the mayor of the locality, and notably, one of the last masters skilled in the collection and processing of manna, residing in Pollina. The latter, in particular, offered invaluable contributions for understanding the existing gaps in the museum narrative, thus better guiding valorization strategies.

Concurrently, fieldwork was conducted that included direct interviews with museum visitors, randomly selected during site visits. This allowed for the collection of authentic feedback on the perception of the museum experience by a diverse sample of the public. The information gathered through these interviews constituted an additional tool for calibrating museum renewal initiatives in a manner more aligned with visitor expectations and needs.

In summary, the research method adopted embraced a plurality of sources and perspectives, configuring a holistic approach to the understanding and enhancement of the museum experience.

The absence of a cohesive visual identity and a clear wayfinding system prevents visitors from fully enjoying the museum experience. Today's design tools allow for a more engaging and immersive experience. In this direction, detailed analyses of visitor preferences have led to the design of a new internal layout, the development of a visual identity with a new brand, a new signage system, and the optimization of wayfinding to facilitate navigation within the museum, redefining the experience of the existing museum system (Villani, 2018).

The Manna Museum has the potential to become a focal point of cultural, social, and historical significance for the Madonie area. By narrating the history of manna, its production processes, identifying the "mystical" sites where ash trees grow, and mapping the stakeholders involved in its production, the museum can significantly enrich the territorial context. The introduction of a space dedicated to product tasting, realized in collaboration with producing companies, offers the opportunity to develop immersive experiences directly aligned with the museum's objectives.


*Figure 4. Pollina "manna" Museum*

*Figure 5. Product in project "Innova-Pollina" designer team: Federica Sciortino, Nadia Geraci, Maria Chiara La Monica, Cecilia Serraino.*


## Conclusion

This study delves into the significance of manna in the Madonie region, highlighting how the synergy of food, design, and landscape can catalyze economic and cultural revival in the area. Through the incorporation of innovative products such as Fiasconaro Panettone and craft beer, manna emerges as a development catalyst, showcasing the effectiveness of blending traditional practices with innovative approaches.

The analysis focuses on the designer's role in interpreting the identity and potential of the region, identifying and enhancing its unique features. Termed as "design opportunities," these potentials necessitate the development of targeted strategies, supported by appropriate tools for their promotion. Thus, the designer acts as a facilitator, coordinating and implementing these strategies.

It is underscored that these processes can undoubtedly bring benefits to the economy, culture, and social fabric of inland areas, reinforcing the identity of communities that preserve the culture and traditions of an Italian territory, which would otherwise risk losing its cultural heritage.

# References


1. *Calabretta, G., Gemser, G., & Karpen, I. (2016). Strategic design: Eight essential practices every strategic designer must master. BIS Publishers.*
2. *Cacciato, A. (2021). La Sindrome del Gattopardo: La cultura dell'innovazione nell'era post lockdown. Rubbettino Editore.*
3. *Daverio, P., & Trapani, V. (2013). Il design dei beni culturali: Crisi territorio identità–Cultural heritage design: Crisis territory identity. Milano: Rizzoli.*
4. *De Rossi, A. (2019). Riabitare l'Italia: Le aree interne tra abbandoni e riconquiste. Donzelli Editore.*
5. *Gaiardo, A., Remondino, C. L., Stabellini, B., & Tamborrini, P. (2022). Il design è innovazione sistemica: Metodi e strumenti per gestire in modo sostenibile la complessità contemporanea: Il caso Torino (pp. 1-179). LetteraVentidue Edizioni.*
6. *Galati, A. et al. (2006). La rivalutazione della frassinicoltura per la produzione di manna come prodotto officinale. In Workshop "Colture artificiali di piante medicinali" (p. 287-297). Pisa.*
7. *Heapy, J., King, O., & Samperi, J. (2019). Customer Experience Design: Imparare a mettere i clienti al centro con il design thinking. Apogeo Editore.*
8. *Lentini, F., & Mazzola, P., Not, R. (1983). I frassini da manna. Natura e Montagna, 30(4), 21-33.*
9. *Mangano, D. (2014). Che cos' è il food design (Vol. 496). Carocci.*
10. *Manzini, E. (2021). Abitare la prossimità: Idee per la città dei 15 minuti. Egea.*
11. *Rundh, B. (2009). Packaging design: Creating competitive advantage with product packaging. British Food Journal, 111(9), 988-1002.*
12. *Scrofani, L., Petino, G., & Novembre, C. (2019). Le attività culturali e creative per il rilancio turistico delle aree interne in Sicilia. Il caso studio dell'Ypsigrock Festival. Bollettino dell'Associazione Italiana di Cartografia.*
13. *Spence, C., Medici, L., & Sedehi, S. (2020). Gastrofisica: La nuova scienza del mangiare. Readrink.*
14. *Tantillo, F. (2023). L'Italia vuota: Viaggio nelle aree interne. Gius.Laterza & Figli Spa.*
15. *Villani, T. (2018). Materiali e soluzioni tecniche per il wayfinding nei musei. TECHNE: Journal of Technology for Architecture & Environment, (16).*

# Made in Italy. Values, Identity, and Relationships

*Mario Bisson, Daniela Anna Calabi, Stefania Palmieri*
*mario.bisson@polimi.it, daniela.calabi@polimi.it, stefania.palmieri@polimi.it*

*Associate Professor of Politecnico di Milano, Department of Design, Milan, Italy*

***Keywords:***
*Perception*
*Country-of-origin effect*
*Design*
*Communication*
*Atmosphere*

## Abstract

The interpretation of "Made in Italy" values and their relationship with consumer perception are deeply intertwined with cultural and social aspects. With its strong connection to places of origin, the Made in Italy brand carries a profound symbolic value that resonates with our shared cultural heritage.

Over the years, Made in Italy has evolved into a powerful collective brand, uniting numerous companies and embodying qualities, style, and historical culture. It stands as a beacon of design leadership, conjuring images of diverse productions, boundless creativity, and innovative prowess that we all contribute to.

Yet, the perception of the current Made in Italy is a nuanced interplay of current production transformations and more profound shifts in the global, sociological, and cultural context. Understanding this dynamic can give us a richer perspective on the brand's evolution.

## Introduction

The following reflections are crucial to the PE11 Made in Italy circular and sustainable Spoke 2 PNRR Project. This project, titled: "Emotional. Experience Made in Italy: immersive storytelling design for contemporary values and sustenability" .

The research is based on the shared understanding that the values of 'Made in Italy' are intricately tied to national cultural and social aspects. This includes the unique link between companies and their original production areas, even in international productions. One of the key factors that sets 'Made in Italy' apart is its strong connection with specific places, which gives it a unique brand value. Over time, 'Made in Italy' has evolved from a brand of origin to a collective brand, uniting numerous companies and symbolizing quality, style, and historical culture. It is synonymous with leadership in design, fashion, quality of food, raw materials, technologies, and artistic and creative sectors, reflecting Italian productions' diverse and innovative nature (Terenzi and Furin, 2020).

However, not all Italian companies are able to share these values, even though they have compatible characteristics. This is because their history goes beyond the brand paradigm but is also deeply rooted in the territory's evolution.

The notion of "country of origin" has shifted from the generic "Made in Country" to a more extensive set of meanings: Country of Manufacture, the

Country in which the production phases take place; Country of Assembly, the Country in which the parts of the product are assembled; Country of Design, the Country in which the product is designed. "Country" represents one of the territories that welcomes production passages and transformations; being only a "stage" of the production landscape, to strengthen its identity, it tries to regenerate the relationship with the consumer by referring to values traditionally linked to Italian culture.

The current communication of 'Made in Italy' has not kept pace with the profound global transformations. It remains stereotypical and disconnected from contemporary variables, multiculturalism, changing territorial paradigms, and globalized productions. This detachment from today's production realities has led to the misuse of' Made in Italy' on counterfeit products, which are only superficially Italian (Temperini, Gregori, Palanga, 2016).

Among the most significant reasons lies the fragmentation of identity values associated with territories. The territory of Italian productions is dynamic, fluid, and constantly evolving; it is rooted in its history, indeed, but it evolves and changes. The perception of the current Made in Italy is not always attributable to production transformations and only partially relates to the more profound transformations in the sociological and cultural context. Made in Italy, it could recognize itself in an atmosphere more consistent with the complex landscape of the future. According to Böhme (2010), the atmosphere is "the primary perceptual reality": it does not end in a passive observation of the surrounding physical reality but implies an affective/emotional involvement. Within a territory, identities, cultures, and productions intertwine intricately. By aligning the communication of the Made in Italy brand with the contemporary values of Italy, there is an expectation for increased participation from companies and, to some extent, consumers in the production process.

## Perceived values.<br>The culture of the production process

By Stefania Palmieri

"The Made in Italy expression embodies a culture and emblematically characterizes the industrial production of our Country.

Made in Italy is not just a production system but also a cultural system: family, art, creation, ingenuity, and innovation."

Adolfo Urso - Minister of Enterprise and Made in Italy (2024)

**Is Made in Italy a family affair?**

Every object with the Made in Italy label is a testament to a globally renowned brand. This label is not just a mark of origin but a symbol of superior quality, meticulous craftsmanship, unparalleled luxury, and a rich family heritage. It encompasses various products, from fashion and footwear to regional delicacies and fine wines. But it doesn't stop there. The Made in Italy brand extends to services, such as tourism and territorial marketing, showcasing our cultural heritage and local traditions.

A brand that represents its way of life, its history, and its cultural roots. The Italian manufacturing vocation is so highly esteemed worldwide that Made in Italy is considered one of the most important brands globally.

A critical lens through which to understand and delve deeper into this concept is undoubtedly the production culture that generates Made in Italy. Are there recognizable types of companies that, more than others, keep this

brand so "local" alive and well in such a global age? The answer is yes!

At the core of Italy's entrepreneurial landscape are family-run businesses. These enterprises, deeply rooted in their local communities and traditions, are also forward-thinking, embracing innovation and looking to the future. Many Made in Italy success stories share a common thread- the family. These businesses stand out globally, not just for their products but for the values they uphold. They are a testament to the enduring power of history and tradition, driving steady growth across generations.

It is within these family-run businesses that the true essence of Made in Italy thrives. Italy boasts one of the highest concentrations of family businesses in Europe and the world, accounting for approximately 65% of Italian companies. These are often long-established enterprises, outperforming other business types regarding growth and profitability. They are also highly focused on international expansion, a testament to their adaptability and resilience in complex and competitive markets. Many of these businesses operate in the Made in Italy sectors, where the values of authenticity, uniqueness, quality, craftsmanship, trust, and ethics are deeply ingrained. This is particularly evident in industries such as food, fashion, and furniture, where the creation of brand value and its positive perception are crucial, both domestically and internationally.

Among the secrets of the success of family businesses, which characterize them as ambassadors of Made in Italy in the world and make them more or less attractive to potential investors, are the so-called social capital and patient capital.

Social capital refers to the attachment to social values related to respect for tradition and employees. They operate in a reality perceived as their own property and always focus on quality. Furthermore, confrontation is marked by blood ties and is therefore felt as more genuine. Finally, guaranteeing customers, suppliers, and investors the same name, if not the same face, over the years is synonymous with stability.

On the other hand, patient capital refers to the foresight typical of these companies. Rather than immediate profit, family businesses aim for consolidation and security for their heirs. And indeed, the success of Italian family businesses lies precisely in generational transition (Amore et al., 2021). Experts agree that the great success of a family business comes when the new generations grasp the entrepreneurial DNA of the company and transform it into something new.

But is there a way to measure the perception of Made in Italy worldwide?

The Best Countries Report, compiled by the US News & World Report, the BAV Group, and the Wharton School of the University of Pennsylvania using qualitative and quantitative parameters, seeks to assign a value to this intangible asset. A set of 73 national attributes, or terms that can be used to describe a country and are also relevant to the success of a modern nation, has been identified.

These attributes have been grouped into ten thematic subcategories that entered the ranking of the best countries: Adventure, Agility, Cultural Influence, Entrepreneurship, Heritage, Movers, Open for Business, Power, Quality of Life, and Social Purpose. This report measures Made in Italy by calculating the market value of the 30 most important Italian brands, trying to extrapolate their strengths.

In the Best Countries Report 2023, for the year 2022, Italy is ranked 14th out of 85 countries. Globally, the main Italian brands are perceived as a guarantee of quality, authenticity, and style. These brands refer to a group of large, agile companies interconnected with a dense network of other small to medium-sized enterprises. In particular, references are made to companies driven by a strong entrepreneurial spirit and characterized


*Figure 1. U.S. News Best Countries -2023 Rankings (https://www.usnews.com/news/best-countries/rankings)*

by innovation, internationalization, and a focus on customer experience. This entrepreneurial drive and innovative mindset are critical factors in the success and perception of Made in Italy.'

The analysis reveals that some Italian companies are very skilled at leveraging their image, while others are less strong. Except for specific sectors such as luxury, fashion, design, and food, Made in Italy seems to have a weaker image compared to Made in Germany, the USA, and France.

At a global level, the USA, China, Japan, Germany, and the United Kingdom are the national brands with the highest added value. China continues to narrow the gap with the USA; the Chinese brand would be worth 18.8 trillion dollars compared to the 23.7 trillion dollars of the American brand. Despite the proliferation of Italian names worldwide, the true' Made in Italy' remains a beacon of strength and global recognition. This is due to the concept of brand rarity. Italian raw materials, often rare and found only in certain geographical areas (think of wines or olive oil), contribute to this unique perception. The same concept of rarity is found in the skills of human resources: workers in Italian companies are technically prepared, with unique and hardly imitable skills. This is perhaps why many Italian fashion brands have their own school where they train tailors and pattern makers.

'Made in Italy' is not just a label; it's a central element of Italian cultural identity. It represents a depth of professionalism, know-how, knowledge, work, innovation, research, quality, and extraordinary value. Italy must be much more aware of its economic, social, and cultural strength as a country of aesthetics, taste, design, image, identity, and history that have always accompanied it. This cultural significance of 'Made in Italy' sets it apart and demands respect and appreciation.

## Symbolic Identities. The Culture of the Territory

By Daniela Anna Calabi

The country-of-origin effect (COO) represents an intriguing starting point for reflections on the culture of territories and its perception. Presented as a cognitive bias (from a detail, one forms a complete, and not necessarily correct, idea of content), the COO effect has the great potential to distort the consumer's perception who based on the "made in" label could deduce that the quality of a product is good simply because it is made in a given country (De Luca & Pegan, 2012).

The theme of the COO effect has been widely discussed in the international economic literature over the past forty years, which has highlighted its ability to influence consumer decision-making (Baker & Ballington, 2002; Usunier, 2010; De Nisco, 2007; Balabanis & Diamantopoulos, 2011; Vianelli & Marzano, 2012; De Luca & Marzano, 2012; Bursi et al., 2012). The process underlying the relationship between COO and consumer behavior is attributed by some authors (Obermiller & Spangenberg, 1989; Verlegh, Steenkamp, 1999) to three main components that interact with each other: the cognitive sphere, the affective sphere, and the normative sphere.

In the cognitive component, the image of the country of origin indicates the product's quality and its individual attributes (e.g., reliability, durability, design, etc.). In the absence of more detailed information on the quality level of the product, the consumer subjectively evaluates it by "substituting" such information with what they know about the country of production as a whole or in the specific sector to which the product belongs.

The affective component manifests when the product's country of origin can evoke an emotional value (e.g., after a vacation spent in that country) or a symbolic value (e.g. when the country's image is associated with a specific national identity or social status). Finally, in the normative component, the purchase is linked to the willingness to support or not the economy of a particular country based on the level of agreement with its policies and conduct (such as boycotting products from some countries as a form of protest).

From an economic, political, and cultural perspective, the image of a country can influence the purchasing intentions of foreign consumers regardless of the judgment on the quality of the products themselves (Wang, Lamb, 1983). Some studies have found a kind of "hierarchy among countries" in the minds of consumers on which evaluations and judgments are expressed. At the base of this scale is essentially the level of economic development of the country (Manrai et al., 1998). However, these rankings inevitably vary over time (Bilkey, Nes, 1982). Furthermore, the COO effect is not significant to the same extent for all types of products, so a country may be appreciated for some types of goods and not others. The effect is also more pronounced when referring to products associated with a country holding a particular production tradition, such as Italian fashion, French perfumes, or Swiss chocolate (Roth, Romeo, 1992).

Moreover, scholars are shifting towards expanding the COO effect model, no longer limited to the country alone but more generally applicable to any geographical region, from cities to districts, provided they can convey distinctive characteristics in the minds of consumers (Andehn, Berg, 2011). According to another perspective, studies on the COO effect are repositioning toward concepts such as product-country image (PCI) (Papadopoulos et al., 1993; Liefeld, 2004) or, more recently, toward country image (Zeugner-Roth, Diamantopoulos). Several contributions highlight how the image of the country of origin (understood as representation, reputation, and stereotype) associated with its productions is the fundamental antecedent of the effect that the country of origin can have on consumer decision-making (Usunier, 2006; Bursi et al., 2012). In particular, this construct qualifies the productions of a specific country concerning the areas of innovativeness (superiority, technological advancement), design (elegance, balanced style), prestige (exclusivity and status of national brands), and workmanship (reliability, quality of national products, durability) (Roth, Romeo, 1992; Aiello, Donvito, 2011).

Recently, studies on the theme of the country of origin have focused more on deepening the interactions between the country of origin and the brand, namely the country of brand origin (COB) effect. From this perspective, the study focuses on the origin perceived by the consumer through the brand; the belief is that in different situations, the consumer does not possess nor seek information about the product's origin but relies on the "signals" that the brand can provide.

From this framework, the strategic relevance assumed by Made in Italy emerges, which, from a simple mark of origin indicating the international specializations of the Italian production system, has become a collective brand over time. Synonymous with leadership in design, quality, and globally recognized reliability, Made in Italy evokes the unique and distinctive image of productive quality, creativity, innovation capacity, and lifestyle (Fortis, 2005). Made in Italy, its evocative and connotative power is connected to typical and unique meanings and values (Vescovi & Gazzola, 2007), and it can be compared to a "megabrand" (Fan, 2006). A country brand becomes a megabrand when it enjoys an accumulation of trust and reputational resources that facilitate a rapid accreditation process among multiple international audiences in terms of notoriety, appeal, and credibility (Roth, 1995; Holt et al., 2004).

Made in Italy is thus a process of identity elaboration aimed at finding new balances between technical-economic components and cultural components. Adopting this perspective, the search for a competitive identity for Made in Italy can overcome two extreme modalities. The first, restrictive, according to which Made in Italy indicates only what is entirely Italian, with the risk of excessively emphasizing the value of the territory and underestimating the value of cultural exchange instead. The second, instrumental, where Made in Italy is everything perceived as such by the market (excluding counterfeiting or imitations), and which, compared to the first modality, nullifies the distinctive value of the territory, exacerbating the role of international marketing strategies (Corbellini & Saviolo, 2004).

The analysis of the different interpretations of the Made in Italy phenomenon highlights that the distinctiveness factor is the strong connection between the product and the territory (Marino & Mainolfi, 2011). Paradoxically, an effect of globalization is precisely that it has conferred a competitive advantage on the local identity of Made in Italy products, which has always stood out abroad for its high quality and originality, the result of traditions and historical skills rooted in specific territories (Golinelli, 2012). Some surveys aimed at investigating the distinctive features qualifying successful Italian productions abroad recognize Made in Italy products not only a high intrinsic value (use value) as instrumental "ingredients" for achieving a better quality of life but also a high symbolic value, thanks to their ability to evoke the so-called "Italian dolce vita".

From a conceptual point of view, it must be emphasized that the notion of "country of origin" is not unambiguous and elementary. If initially the concept of the COO effect was linked to that of the generic "Made in Country", gradually the spectrum of meanings has expanded; as is known, it is possible to distinguish between "country of manufacture" (COM), i.e., the country where the production phases take place, "country of assembly" (COA), where the assembly of the product parts takes place, and "country of design" (COD), the country where the product is conceived, designed, and drawn (Samiee, 1994; Nebenzahl et al., 2001).

# Territories as networks of relations. Trans-territorial cultures

By Mario Bisson

Every time the land becomes a place of exchange and cooperation, it becomes a territory, a means and object of work, production, cooperation, and communication (Magnaghi 1998). More precisely, it takes shape as a "landscape" of nature and culture and as a space of sharing where relationships and exchanges intertwine.

The concept of 'territory' encapsulates geographical, cultural, and spatial values , rendering it a dynamic and adaptive system (Bretagnolle et al.). Its properties are in a constant state of regeneration, presenting a 'surprise' for the observer (Batty & Torrens 2001: 3), thereby highlighting the dynamic nature of a 'territory' as a complex and adaptive system.

From an epistemological perspective, it is essential to differentiate between 'landscape' and 'territory.' The latter refers to a geographic area and its physical structure, delineated by boundaries and imbued with its historical and cultural dimensions. On the other hand, 'landscape' represents the aesthetic perception of the relationships between the environment and human beings, reflecting the human interaction with the territory, places, and spaces.

Over time, the territory evolves into cultural heritage, a product of continuous human actions that shape it into a common good in the present (Magnaghi, 2015, p. 140). This territory serves as a crucial reference point for formulating plans, policies, and strategies for economic development, encompassing relationship building, knowledge advancement, and organizational transformation (Rullani, 2010). It stands at a pivotal juncture, once again underscoring the importance of the term 'territory' in economic development.

*In short, the territorial paradigm is changing again due to some fundamental data. Referring to territorial conceptions that date back to Fordism or the district capitalism of the last century risks overshadowing the transformations that are taking place in the present and, above all, the opportunities and threats of evolution that we will face shortly. The essential point is that today's generative and replicable knowledge tend to separate and distance themselves, connecting remotely within global networks and supply chains. Their synthesis is no longer in the individual territory but in the trans-territorial relationship that traverses each place, connecting local productive systems with increasingly relevant knowledge, goods, and capital flows. (Rullani, 2013, p. 148)*

Nevertheless, geographic proximity remains highly important: it is a context of shared experience that shapes and evolves with those who inhabit it; it represents the result of the sedimentation of shared experiences.

Today, the territory is an "unfinished system" (ibid: 151) that continuously seeks to regenerate its identity through external events that deconstruct it to find a new balance. It is a transitional system that, thanks to the generative intelligence of the subjects who inhabit it and with whom it interacts, takes on new forms capable of responding to the opportunities and challenges of each season.

Strategic action on a territory involves promoting actions that enhance the resources of an area through virtuous mechanisms that generate further resources. Design, with its visual cultures that re-signify places and connect the idea of a particular place to the collective imagination, is a crucial tool for enhancing historical, cultural, and environmental resources. Each landscape contains a well-structured and complex system, both tangible and intangible,

of values, narratives, and opportunities, which should be the foundation of the design process.

Tomàs Maldonado defines design as the "strongest link that connects man to reality and history" (1970, p. 31); in the case of the design of place identities, that link operates within the French concept of milieu (Governa, 1997), referring to an endogenous, rooted, and appropriated design. Design, therefore, acts on the cognitive and material interaction of the local network with the environment and the ecosystem, a relationship that involves translating the potential of the context into communicable and exchangeable values through processes of symbolic and material transformation of the environment. If productive innovation processes evolve from the presence of a characteristic and recognizable cultural, social, and productive environment suitable for exchange, the process develops from the interaction among the actors. In this case, both the processes of constructing the design culture and the network of generative relationships and collective co-production processes of values can be made explicit (and potentially translated by communication design), as they are based on tacit processes of relationship and collaboration.

The cultural environment is, therefore, the fundamental "layer" of the territory necessary for the construction of recognizable identities.

The communication of Made in Italy products to date is 'fragmented.' Correct communication of the country's system, instead of the chaotic proliferation of promotional messages, initiatives, and events that end up diluting each other, could make a significant contribution. One of the vulnerabilities of Made in Italy is the confused management of communications, which leads to a significant weakness: the inability to evolve with the changing socio-cultural and economic context.

A statute for Made in Italy seems lacking, often used parasitically for "cloned" products; there is talk of Italian sounding, a chronic counterfeiting problem affecting various merchandise categories. In evaluating a product, consumers can easily be influenced by false considerations that leverage cultural, affective, and emotional characteristics.

The argument focuses on the importance of understanding the complex dynamics of urban networks and the possibility of classifying them based on their local integration and external functional openness. This approach allows for the analysis and comparison of different models of urban development, highlighting variations in the structure and organization of urban networks at both global and local levels. The operational definition of the critical components of urban networks provides a conceptual framework for studying the relationships among cities, organizations, and urban systems within a broader context of interconnected global networks. The communication problem affects the identity of territories starting from advertising atmospheres, where "Made in Italy" seems to be conveyed mainly through a stereotypical representation of tourist territory; it raises crucial issues concerning the perception and communication of authenticity and cultural diversity associated with the Made in Italy brand. The identity of a territory is often influenced by advertising representations that promote Italian products, with an excessive emphasis on tourist and stereotypical aspects. This approach reduces Made in Italy to a simple label of origin, different from global production, rather than enhancing the complexity and authenticity of Italian traditions, craftsmanship, and culture.

Even just considering advertising atmospheres, it is noted that they mainly focus on the tourist representation and stereotypical image of Italian values, neglecting the highly advanced technologies and scientific research that characterize contemporary productions, conveying a superficial and reductionist image of the cultural heritage. This phenomenon could lead to standardization of Italian products in the global market, losing sight of the

historical, artistic, and artisanal roots that characterize true' Made in Italy'. However, the problem requires a critical reflection on the communication and branding strategies used to promote' Made in Italy', and a strong call for more authentic, diversified, and respectful approaches to the Italian cultural richness.

Still far from being able to offer solutions, it is recognized that the cultural perspective determines the methodological indication and the choice of the design standpoint. The designer's perspective becomes the tool of investigation and communication that is thought to provide a synthesis of the complexity of the territorial relationships of the urban milieu. Remember that the urban milieu refers to the physical and social environment in which daily life occurs in a city, namely tangible elements such as architecture, urban structure, and productive places; intangible elements such as culture, habits, and social relations. The milieu plays a fundamental role in constructing the sense of place, the latter understood as the emotional and psychological bond that an individual develops with a specific place, an emotional or affective source of gratifications and memories.

## Conclusions

The narrative that Made in Italy embodies is necessarily partial, but when it becomes a cliché, it fails to reflect the continuous and profound transformations of the country. It is argued, therefore, that a modern one could be introduced through a nuanced and truthful narrative in response to the perception of a Made in Italy that strongly evokes the past. This shift is a suggestion and a necessity to keep up with the evolving global market.

The country of origin brand results from a compromise between two representations of the country: real and "crystallized," acquired, and strongly stereotypical. It is a representation in which idiosyncratic beliefs weigh significantly. It is therefore necessary to identify the foundational values of the country brand, establish a positioning, and a desirable and adaptable vision across different productive sectors.

The identity communicated by Made in Italy does not reflect the current reality, which is characterized by diverse identities and sectoral productions organized in international networks. The Italy of De Sica, Fellini, Rossellini films evokes a memorable vision that portrays past social, cultural, historical, and political realities; it tells of a time sedimented in memory, realistically foundational, but not suitable for identifying realities born from the layering of other narratives, choices, and visions. Certainly recognizable and much loved, historical identity alone is unfortunately inadequate to transparently communicate the value of global productions. To construct a narrative today capable of considering the many Italian productive and cultural identities, a strategy of realism is necessary, with the aim of creating a unified communication that rests on fundamental values, such as cultural heritage, strong material, and immaterial memories, but capable of intercepting and communicating the value of international networks of relationships and contemporary social, trans-territorial trends. This unified strategy is crucial to ensure a clear and consistent message about Made in Italy (Rullani, 2013, p. 142).

# References


1. *Aiello, G., Donvito, R. (January 2011). L'immagine paese e l'immagine di marca: gli esiti di una ricerca empirica sul Made in Italy. Proceedings 10th International Congress Marketing Trends Conference Paris.*
2. *Amore, M. D., Bennedsen, M., Le Breton□Miller, I., & Miller, D. (2021). Back to the Future: The Effect of Returning Family Successions on Firm Performance, Strategic Management Journal, 42(7), 1432–1458.*
3. *Andéhn, M., Berg, O. (2011). Place of origin effects–From nations to cities: A conceptual framework based on a literature review. Conference: 2nd International Place Branding Conference.*
4. *Balabanis, G., Diamantopoulos, A. (2011). Gains and Losses from the Misperception of Brand Origin: The Role of Brand Strength and Country-of-Origin Image. Journal of International Marketing, 19(2), 95-116.*
5. *Baker, M.J., Ballington, L. (2002). Country of Origin as a Source of Competitive Advantage. Journal of Strategic Marketing, 10, 157-168.*
6. *Batty M., Torrens P. (2001). "Modelling complexity. The limits to prediction". Cybergeo, European Journal of Geography, 12th European Colloquium on Quantitative and Theoretical Geography, St-Valery-en-Caux, France, September 7-11.*
7. *Bretagnolle, A.; Daudéand, É.; Pumain, D. (2003). "From theory to modelling: urbansystems as complex systems. La complexité dans les sys-tèmes urbains: de la théorie au modèle", 13th European Colloquium on Quantitative and Theoretical Geography, Lucca, Italy.*
8. *Bilkey, W., J., Nes, E. (1982). Country-of-Origin Effects on Product Evaluations. Journal of International Business Studies, 13, 89-100.*
9. *Böhme, G. (2010). Atmosfere, estasi, messe in scena: L'estetica come teoria generale della percezione. Milano: Christian Marinotti Edizioni.*
10. *Bursi, T., Grappi, S., Martinelli, E. (2012). Effetto "Country of Origin". Un'analisi comparata a livello internazionale sul comportamento d'acquisto della clientela. Bologna, Il Mulino.*
11. *Carcano L. (2013) Strategic Management and Sustainability in luxury companies, The Journal of Corporate Citizenship, 52.*
12. *Corbellini, E., Saviolo, S. (2004). La scommessa del Made in Italy e il futuro della moda italiana. Milano, Etas.*
13. *Dematteis, G. (1994). Global networks, local cities. FLUX Cahiers scientifiques internationaux Réseaux et Territoires, 10(15), 17-23.*
14. *De Nisco, A. (2007). Country of origin e buyer behavior: una meta-analisi dalla letteratura internazionale. Mercati e Competitività, 2006/4, 81-101.*
15. *Fortis, M. (2005). Le due sfide del Made in Italy: globalizzazione e innovazione. Profili di analisi della Seconda Conferenza Nazionale sul Commercio con l'Estero. Bologna, Il Mulino.*
16. *Gebrekidan A., Hyder A., (September 2021) Transformation of Strategic Alliances in Emerging Markets, Volume II, Emerald Publishing Limited.*
17. *Golinelli G.M., (2012). Patrimonio culturale e creazione di valore. Verso nuovi percorsi. Padova: Cedam.*
18. *Heslop, L., A., Papadopoulos, N., Bourk, M. (April 2009). An Interregional and Intercultural Perspective on Subcultural Differences in Product Evaluations. Canadian Journal of Administrative Sciences.*
19. *Temperini,V., Gregori, G., L., Palanga, P. (2016). The Brand Made in Italy: A Critical Analysis. Management Studies, 4(3), 93-103. https://doi.org/10.17265/2328-2185/2016.03.001.*
20. *Terenzi, B., Furin, E. (July 2020). Dal design Made in Italy al design Made in… Umbria. L'identità territoriale per l'innovazione del settore ceramico. MD journal, 9, 74-85.*
21. *De Luca, P., Pegan, G. (January 2012). La percezione del Made in Italy sui mercati internazi-*

*onali: primi risultati di una ricerca "net-nografica" sulle comunità online di consumatori di caffè. 9th Conference SIM.*

22. *De Luca, P., Marzano, F., C. (January 2012). L'effetto 'country of origin' sull'intenzione d'acquisto del consumatore: un'analisi metodologica. Trieste, Eut edizioni.*
23. *Fan, Y. (2006). Branding the nation: What is being branded? Journal of Vacation Marketing, 12(1).*
24. *Governa, F. (1997). Il milieu urbano come fattore di differenziazione e sviluppo. In Dematteis, G., Bonavero, P. (Eds.): Il sistema urbano italiano nello spazio unificato europeo. Bologna, Il Mulino.*
25. *Holt, D., B. (2004). How Brands Become Icons: The Principles of Cultural Branding. Harvard Business Press.*
26. *Liefeld, J. (December 2004). Consumer knowledge and use of country-of-origin information at the point of purchase. Journal of Consumer Behaviour, 4(2), 85–96.*
27. *Magnaghi, A. (1998). Il patrimonio territoriale: un codice genetico per lo sviluppo locale autosostenibile. In Magnaghi, A. (Ed.): Il territorio degli abitati. Società locali e auto sostenibilità. Dunod, Milano.*
28. *Maldonado, T. (1971). La speranza progettuale: ambiente e società. Nuovo Politecnico 35, Einaudi, Torino.*
29. *Manrai, L., A., Lascu, D-N., Manrai, A., K. (November 1998). Interactive effects of Country of origin and product category on product evaluations. International Business Review, 7(6), 591-615.*
30. *Marino, V., Mainolfi, G. (2011). Il processo di country branding per la valorizzazione del capitale reputazionale. Un caso studio sul paese Cina. Esperienze d'Impresa, 2/2011, 5.*
31. *Nebenzahl, I.D., Jaffe, E.D., Lampert, S.I. (1997). Towards a theory of country image effect on product evaluation. Management International Review, 37, 27-49.*
32. *Nebenzahl, I. D., Jaffe, E. D., Kavak, B. (2001). Consumers' punishment and rewarding process via purchasing behavior. Teaching Business Ethics, 5, 283-305.*
33. *Obermiller, C.; Spangenberg, E. (1989). Exploring the Effects of Country of Origin Labels: An Information Processing Framework. Advances in Consumer Research, 16(1).*
34. *Quarato F., Salvato C. (Eds.) (January 2024). XV Osservatorio AUB - Il ricambio al vertice nelle imprese familiari italiane: Minaccia o opportunità?, AIDAF, UniCredit, Bocconi.*
35. *Roth, M., R., Romeo, J., B. (January 1992). Matching Product Category and Country Image Perceptions: A Framework for Managing Country-of-Origin Effects. Journal of International Business Studies, 23, 477-497.*
36. *Wang, Chih-Kang, Lamb, C., W. (December 1983). The impact of selected environmental forces upon consumers' willingness to buy foreign products. Journal of the Academy of Marketing Science, 11, 71-84.*
37. *Roth, A. E. (1995). Bargaining Experiments. In Kagel, J. H., Roth, A. E. (Eds.), The Handbook of Experimental Economics (pp. 253-348). Princeton: Princeton University Press.*
38. *Rullani, E. (April-June 2010). "La conoscenza e l'organizzazione. Promesse e minacce dei sistemi incompiuti", Rassegna Italiana di Sociologia, 51(2), 303-324.*
39. *Rullani, E. (May-Aug 2013). Territori in transizione: nuove reti e nuove identità per le economie e le società locali. Sinergie Italian Journal of Management, 31, 141-163.*
40. *Samiee, S. (1994). Customer Evaluation of Products in a Global Market. J Int Bus Stud, 25, 579-604.*
41. *Usunier, J-C. (December 2010). Relevance in business research: the case of country-of-origin research in marketing. European Management Review.*
42. *U.S. News Best Countries, 2023 Rankings, https://www.usnews.com/news/best-countries/rankings*
43. *Verlegh, P., W.J., Steenkamp, J-B. E.M. (October 1999). A review and meta-analysis of country-of-origin research. Journal of Economic Psychology, 20(5), 521-546.*
44. *Vescovi, T., Gazzola, P. (December 2007). Immagine territoriale e identità globale. L'utilizzo del legame con il territorio nello sviluppo della marca. Micro & Macro Marketing, 3/2007.*
45. *Vianelli, D., Marzano, F., C. (2012). L'effetto country of origin sull'intenzione d'acquisto del consumatore: una literature review. Trieste, Eut edizioni.*
46. *Zeugner-Roth, K., P., R., Diamantopoulos, A. (2010). Advancing the country image construct: Reply to Samiee's (2009) commentary. Journal of Business Research, 63, 446-449.*