P/REFERENCES OF DESIGN

TOWARDS CIRCULAR UPHOLSTERY: PRACTICE-BASED RESEARCH FOR THE CIRCULAR TRANSITION OF THE MADE IN ITALY UPHOLSTERED FURNITURE SECTOR.

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ABSTRACT | In Made in Italy industries, craft and industry production coexist, with a continuous relationship between manual technical knowledge and the use of advanced machines. The use of material is fundamental, Italian design has a recognized aesthetic and material imagery because it experiments with materials from the noblest to the most artificial. In this context, the theme of circularity and sustainability is not always central: traditional upholstered products are a conglomerate of components made of different materials whose disposal hardly ever involves disassembly and reuse or repair processes. Through experimentation of circular re-design of an upholstered seat carried out by the author, the article proposes reflections on how to integrate design practices that can allow a circular and sustainable transition of the upholstered product. In the research, Circular Design, an approach capable of shifting perspective between user needs and the systemic implications of the process, is a central discipline of application and study. The anticipatory attributes of Advanced Design and Transition Design are also key disciplines involved. The practice-based methodology used makes it possible to integrate desk and field research and to verify it through an experimentation that aims to be an object of future design vision. The intention is to open the discussion on what strategies the designer can implement to support a circular and sustainable transition of systems products in sectors where experimentation is part of traditional production.

1. Introduction

In the upholstered furniture industry production can be artisanal and industrial. In industrial production, the quality of the products must be predetermined, the materials are designed for machine processing to obtain the greatest number of pieces at the lowest possible cost (Colaço & Matos, 2020). In craft production, on the other hand, quality is closely linked to the skills of the craftsman (Sennet, 2008), to the characteristics of the material he or she knows how to handle, and which determine the production techniques, not vice versa (Cavalli & Comerci, 2017). In Made in Italy industries, craft and industry production coexist, through which there is "a continuous relationship between manual technical knowledge, testing and verification through the use of manual machines and design for industry with technologically advanced machines" (Conti & Motta, 2020, p. 175). Moreover, it is "a production with a strongly artisanal DNA to the point of contemplating the borderline case 'of self-production by the designer'" with a "dedicated and tailor-made business approach, of handmade objects, also tailored to individual needs." (Trincherini, 2020). The use of material in connection with the process is therefore fundamental, Italian design has a recognised aesthetic, morphological and material imagery because it experiments with materials from the noblest to the most artificial and serial (Di Lucchio, 2005).
In this context of traditional knowledge and technological innovation, the theme of circularity and sustainability is not always central: often the creative, when guiding the design process, puts style and aesthetics of the product before. Upholstered products are a conglomerate of components made of different materials whose disposal at the end of their life hardly ever involves disassembly, reuse, maintenance, or repair processes during their service life (Bruno et al., 2022).

Through a design experimentation of circular re-design of an upholstered seat carried out by the author, the article proposes reflections on how to integrate in these contexts sustainable practices that can allow a circular and sustainable transition of the product, give more performing design tools both at an aesthetic and functional level, and provide them in a way that is useful to both the furniture company and the final user. The intention is, therefore, to open the discussion on what design strategies the designer can implement to support a circular and sustainable transition of systems-products critical for the use, application, and selection of materials, in sectors, such as that of Made in Italy, where experimentation is part and parcel of traditional production.

2. A Suitable Context for a Circular and Sustainable Transition

Made in Italy is defined as a set of high-quality products and services made by small and medium-sized enterprises in sectors recognized by the collective imagination and characterized by cultural contents linked to the values and heritage of the territory they belong to (Bertola & Colombi, 2014). The connection with the designer's practices is strong and characterized by complex multi-level logics; product diversity, formal and material identity of products, attention to quality and connection to local communities and knowledge are all characteristics that drive foreign companies to produce parts of their products in Italy (Turrini & Sbordone, 2020). These peculiarities, with the artisanal and industrial process described in the introduction, have over time created a territory capable of integrating sustainable and circular practices, strongly marked by experimentation and innovation.

The circular economy is a regenerative industrial strategy (Ellen MacArthur Foundation, 2013) based on eco-efficiency to keep products, materials, and resources in use as much as possible by reintegrating waste into production processes (European Commission, 2022). Historically, Italy is a country that has found circular strategies to create an economy from a lack of raw materials, characterized by its vocation to offer quality products (Massarutto, 2019). The textile district of Prato, for example, is characterized by production processes that can potentially be considered anticipatory of the circular process for its ability to process regenerated fibers (Trivellin, 2020). In fact, the territory possesses a production culture rooted in recovery and regenerated products, personified in the figure of the “cenciaiolo”, a person who selects rags by composition and color, and enables the recovery of the “cenci” (rags) derived from the textile production.

In Europe, Italy is the first country in terms of recycling (Lotti et al., 2021, p. 17): in 2022 it ranked first in Europe for urban waste recycling with a percentage of 80% compared to 39% of the EU average and, at the same time, waste going to landfills or incinerators without energy recovery decreased from 54% to 40% (ANSA, 2022). Today in Italy, 117 million tons of waste sent for recycling are used as a secondary raw material in the building/infrastructure industry and the Italian industry achieves a circularity rate of around 50% (Symbola, 2021).

However, if we look at the upholstered furniture industry, attention to circularity and sustainability issues are often less rooted for different reasons. Cerulo et al. (2022) identifies several of them:

- The environmental impact resulting from the disposal of textiles and polyurethanes;
- The complex disposal of products as they are made of materials assembled in a mixed and non-reversible way making the product not disassemblable at the end of its life;
- An impactful logistics due to the weight of the finished products that influences packaging and transport modes;
- A supply chain on a global scale with suppliers from different regions.

Each of these characteristics is strongly influenced by material selection, but the cited difficulty of this sector makes it one of the most impactful sectors (Barbaritano et a., 2019), despite the territorial predisposition to adhere to circular practices. The upholstered furniture industry is a relevant production area in the scenario of Made in Italy, and there are several regional districts that are identified internationally for their skills and competences. To avoid fast-furniture products (Griffith, 2017) that lead to the production of furniture with inexpensive materials and not designed to last (Maier, 2021), there is a strong need to understand how to transition the sector's enterprises to circular practices (Cerulo et al., 2022).

In this article, we want to reflect on this circular and sustainable transition process, seeing the designer as a key player, who starts with the material but acts systemically around it.

3. Critical Materials in the Upholstery Industry

Woods, plastics, textiles, and metals are part of the material identity that represents the high-quality level of Italian furniture production. Pellizzari and Genovesi (2021) define circular materials as 'neo-materials' because they come from renewable cultivated resources or because they are made of material that has 're-entered' the production cycle, whether from a homogeneous or different supply chain.

Not all materials mentioned are circular and, in different ways, participate in increasing the environmental impacts of the finished product: while some of them are often recyclable, it happens that in the production phase they consume a high level of energy, emit CO2 and, if the product is not used to last as long as possible, their impact is excessively significant in the production economy (Bruno et al., 2022).

Among the most critical materials are polyurethanes, which are foams of non-renewable fossil origin, assembled with other foamed plastics that, while guaranteeing the desired softness performance by combining different layers of materials, are often not separable at the end of their life. The production of these materials actively participates in CO2 emissions and when they degrade, they release environmentally toxic microparticles into the environment (Bruno et al., 2022). The use of these materials is now being strongly debated and solutions are being sought to introduce the use of expanded polyurethanes of recycled origin into the industry.

Another critical material is textiles and thus cover of upholstered products. Cover poses critical issues both from the point of view of the origin of the materials used - as non-recyclable polyesters, interwoven with other materials in a non-reversible manner - and of the assembly - as they are often sewn to the upholstery making

them not washable, repairable, and replaceable at the end of their life. Furthermore, the assembly of covers on sofas and seats often takes place using fasteners, elements found in various product sectors, which allow the assembly of the various parts of a product. In the fashion and textile sector, they form the connection point between fabrics and act as fastening, adjusting and/or opening elements. Furthermore, in the fashion industry, they can be an identity element for brands (Mitchell & McLoughlin, 2014). From the point of view of product composition, fasteners can be elements that interrupt material continuity as they often consist of different types of plastics also connected to metal components. Their composition is designed to ensure wear resistance but makes recycling complex, in fact, for example in the fashion industry, fabrics need to be separated from fasteners before the material is introduced into a new production cycle (Fantin et al., 2020) as they affect the purity of the material as well as can cause damage to machines (McKinsey & Company, 2022). Today, fasteners are used in the upholstery industry mainly for production reasons: zips are used to facilitate the assembly of pillowcases that cover the foam of the upholstery, buttons are used to make the cover adhere to the foam. Fasteners, in addition to making disassembly for maintenance, washing and disposal difficult, limit the customization possibilities of the product during use as their opening system is often blocked and they do not allow the user to change the cover. Never being able to change the appearance of a product may be one of the reasons why people discard it, the designer must anticipate the human need for modification over time (Goldsworthy & Earley, 2018).

The reasoning on the latter type of product and material is what guided the following experimentation in order to activate a theoretical reasoning based on practice to visualize the designer's scope of action to move the sector towards a circular and sustainable vision.

4. Practice-Based Research for Circular and Sustainable Transition, Guided by Material Selection

Working in anticipation is a key concept in the circular process: being able to foresee the future life cycles of the material and the product that contains it means anticipating the impermanence of needs (Rau & Oberhuber, 2019) and the possible evolutions of current technologies. Advanced Design's ability to work with anticipation and, moreover, to mediate between knowledge (Celaschi, 2008) is a key competence in these contexts in which it is necessary to be able to manage hybrid skills and professions between materials science, economics, and the sustainable use of technologies. In a different but related way, Transition Design seeks to define strategies to design transition paths for complex problems (Irwin 2015), strongly linked to concepts of sustainability, through techniques derived from the intersection between design and the study of futures. The experimentation arose from the application of a design method identified in the author's doctoral research that seeks to integrate these two disciplines with the themes of circularity and sustainability. This methodology sees the designer as a possible support for companies in the sustainable and circular transition of their products made of critical materials; the designer, called “Transition Matter Designer” (Rosato, 2023), designs the gradual metamorphosis of a critical product-system over time in such a way as to allow companies to absorb the change (Irwin, 2015). To activate this process, the Transition Matter Designer applies changes to the product-system by anticipating its metamorphosis over time, applying a gradual transformation from the micro to the macro scale. This means starting from more circumscribed actions, such as changing the material of a single component, and moving to the scale of the supply chain, and to the active involvement of the user in the process to make them aware of the importance of circular processes. The Transition Matter Designer thus proposes an approach to lower Transition Design practices (Irwin, 2018; Kossoff et al., 2015) into system-product design, feeding on the anticipatory attributes of Advanced Design (Celaschi, 2015; Celi, 2010) and aiming at the goals of Circular Design (De los Rios & Charnley, 2017; Moreno et al., 2016), working from materials, the central point of the circular economy (Fig 1). The article applies this methodology to the redesign of the cover of an upholstered seat, as it highlights one of the product components whose materials influence production, service life and disposal, while showing its future systemic development. In defining the transition, the creation of prototypes is a fundamental tool as it materializes futures and outlines possible trajectories of innovation (Celaschi et al., 2014; Iñiguez Flores et al. 2014). The practice-based methodology

(Mossé & Bassereau, 2019) used makes it possible to integrate desk and field research and to verify it through an experimentation that aims to be an object of future design vision. The intention is to open the discussion on what strategies the designer can implement to support a circular and sustainable transition of systems-products in sectors, such as that of Made in Italy upholstered furniture, where experimentation is part of traditional production. The experimentation, which interweaves craft and industrial knowledge typical of the sector, focuses on new solutions for connecting fabrics that allow mono-materiality (Rosato et al., 2023) applied to upholstered seating, and reasoning on how, starting from the selection of materials, technologies, processes and the anticipation of material life cycles, the transition levels of a critical system-product can be designed over time.

In Made in Italy context, designer role is central to work on the historical, psychological, cultural identities, skills and ongoing mutations of the sector (Turrini & Sbordone, 2020).

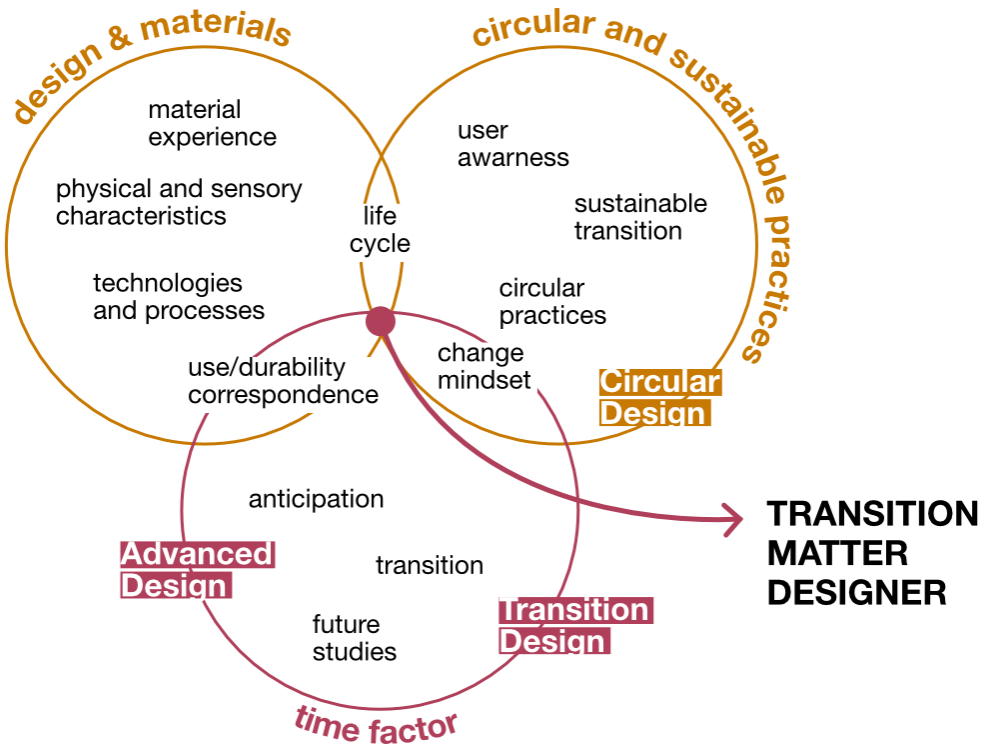

Figure 1. Disciplines relevant to the work of the Transition Matter Designer. Credits: L. Rosato, 2023.

5. Circular Re-Design of the Cover of an Upholstered Chair

The experimentation was therefore developed from the design methodologies of the Transition Matter Designer (Rosato, 2023). He or she uses a transition model that allows him or her to identify which actions to apply to the product in order to design its sustainable and circular transition. These actions are design suggestions of how to modify the product system by acting on four levels: user education, material characterisation, selection of circular production processes and anticipation of material life cycles. These 35 suggestions work on these four design perimeters, working from a micro to a macro scale, and the Transition Matter Designer can select them based on: 1) which ones are not dealt with in existing projects (of which he conducts a thorough research), 2) his personal design sensibility (Celaschi, Formia & Lupo, 2013) and 3) the component of the project on which he wants to act (education, production process, material...).

For the prototype in question, the author applied the methodology of the Transition Matter Designer and identified 10 practices pertaining to the project levels identified to work (Fig. 2).

The redesign of the cover of the upholstered seat started from the integration of the “Knitted Fasteners” (Fig. 3), a metamorphosis of zips, buttons and rivets and conceived to be designed from the textile product assembly, integrated into a knitwear process (Rosato et al., 2023). These elements, realized by the author from the previously described methodology, consist of buttonholes and rings which, when assembled in different combinations, allow the functions of closing, fastening and adjusting systems. Knitted Fasteners create a system that allows the creation of a collection of sustainable and circular fasteners as they allow the creation of mono-material coatings that thus facilitate product recyclability. Furthermore, the use of knitting allows a reduction in pre-consumer waste as it is a technique based on material addition, not subtraction. It is a reversible technique if the tightness of the yarn allows it (Motta, 2019) and, combined with 3D knitting or seamless techniques, can eliminate any element other than the material used in the garment, including seams. The design process of a knitwear garment starts from the selection of the yarn and therefore has more control over the final product, being able to decide on shape, color, texture, material, weight, stitch, processing (Conti & Motta, 2020).

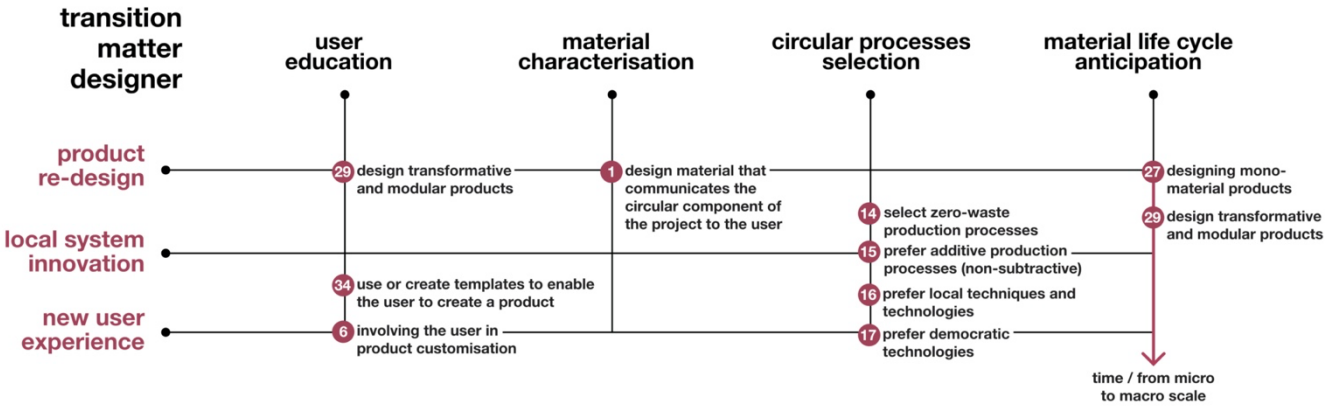

Figure 2. Practices identified for the experimentation. Credits: L. Rosato, 2023.

Knitwear allows more than other technologies to integrate the Knitted Fasteners in the direct production of the garment because it is a technique that already includes in its process both the creation of the fabric and the realization of the textile product, closely linking aesthetics and technique (Eckert, 1999). In the course of the research, other weaving techniques were also identified such as three-dimensional or integral non-rectangular weaving production (Thomas, 2009) or integral weaving approaches (McQuillan 2020; Drews, 2019; Vicerial 2019) but because of the elements described, and the author's close territorial connection of the knitwear districts, it was decided to investigate this technique further, in the knowledge that further developments could include studies on other textile strategies.

By taking advantage of these elements, it was possible to change the configuration of the backrest of the upholstered chair by dividing it into a front and a back and leaving the Knitted Fasteners along the side so as not to bother the user when sitting. For the prototype, a basic model from IKEA was used. This provocative choice was made with respect to the subject of the research both to highlight how small design actions can transform these fast-furniture sectors into places dedicated to circular processes and to focus on the individual object of the research and not the entire product. Due to the shape of the seat chosen and the elasticity of the mesh, the cover of the front and back of the backrest are exactly the same but mirrored. This choice was made to allow the user to create different combinations with only three covers available. This makes it possible to customize the two sides of the back in material, texture, and color, facilitating repair and maintenance but also following the user's need to change tastes over time (Goldsworthy et al., 2018; Karana et. al., 2017). The seat cover is designed in such a way that it can be closed using a system reminiscent of an elastic band in order to allow for quick disassembly and maintenance.

The selected yarns must be pure, recyclable/biodegradable and with renewable origin and therefore circular materials. In the experimentation illustrated, integrating these materials in a design-friendly manner is possible thanks to the techniques used and the conformation of Knitted Fasteners. For the prototypes, 100% recycled and recyclable organic cotton was chosen for reasons of availability, but future tests are planned with other circular materials.

The redesigned seat and back cover (Fig. 4) therefore allow for different levels of complexity in the industry:

- Enables the decrease in the use of complex textile materials that have impacts on component disposal in the industry. Different materials and colors can be used for the front and back of the seat, but the designed fastener system allows this to be reversible and disassembled;
- Promotes product disassembly systems in the short to medium term to customize the product and in the long term to repair or dispose of it in a circular manner through recycling;
- At the production level, disconnecting the upholstery process from the assembly process would allow to increase formal and aesthetic possibilities in the design of the seat. Whereas previously the form was constrained to the need to create a customized cover to be inserted before assembly, with this system the cover could be assembled directly onto the upholstered seat;
- It provides the user with a strong awareness of the process as it makes him an active participant in the circularity of the product. In fact, it participates in the extension of the product's life thanks to the medium to long term choice of customization of the covers and, moreover, the possibility of acting in the same circular aesthetics by finding new combinations of rings and loops. Knitting is a potentially democratic and affordable technology whereby the user can independently produce covers with the same assembly and fastening strategy.

Future developments of the prototype will concern improving the accessibility of opening and closing systems: in order to guarantee the correct tightness of the upholstery and avoid wrinkles, there are many rings and loops in the backrest, and opening and closing the upholstery can become a cumbersome job that is not intuitive or accessible to everyone. Further development of the prototype should focus on speeding up the closing process through the creation of an ad-hoc tool. Furthermore, the limitation of this application of Knitted Fasteners is the contemporary aesthetic tendency to conceal any seams in upholstered seats; a more aesthetically straightforward and suitable system could be thought of.

Figure 3. Knitted Fasteners. Credits: L. Rosato, 2023.

Figure 4. Circular re-design of the cover of an upholstered chair. Credits: L. Rosato, 2023.

6. A Circular Project Strategy Based on Anticipation and Transition

The practices of anticipation and transition intersected with circularity and sustainability allowed a vision of how to redesign, starting from a reflection on materials, a critical component of a product system. This, starting from a single component, however, has allowed a systemic work that also intervenes at the level of the supply chain, production and use intervention. In fact, using a transitional logic typical of Transition Design, intersected with the anticipation practices of Advanced Design, applied to the desires of Circular Design, has made it possible to foresee interventions, beginning with these illustrated on a small scale, but already sensing those to come on a large scale. The single-material seat upholstery was the excuse to reason about the future customization of the product, its longevity and how this can be implemented in the future with further modifications. In this sense, the user's awareness increases, and the product is itself the bearer of a message of circularity that educates the user not critically but positively by giving him new opportunities for use. These manifestations of future latent metamorphoses in a gradual logic make changes more easily absorbable and acceptable by companies and the market. In the same way, the reasoning carried out on the selection of circular materials may have tomorrow a deepening on the concept of short and local supply chain that would allow the reduction of transport and logistic impacts as well as an interesting implication on the connection to the knowledge and cultural traditions of the territory, avoiding delocalization and possible unethically controllable processes. Reasoning on a transitional intervention scale allows with small present actions to foresee future ones and to scale the intervention to macro and gradual actions (Rosato, 2023).

At the same time, the selection of circular and sustainable technologies is a fundamental step which, from a systemic perspective, also influences the variables described above. Made in Italy is a context that lends itself well to these transformations and knitwear is a technique that enhances the specificities and skills of the Italian territory. It is one of the historically largest production sectors in Italy, of which there are several districts with extensive technical knowledge that borrows from traditional know-how and relates to a

strong industrial fabric (Conti, 2013). Among the Made in Italy sectors that have evolved from an ancient craftsmanship know-how that Italy has possessed for centuries and that is often due to expertise in the processing of raw materials' (Motta 2019, p. 34), is knitwear, a practice where the link with raw materials is very strong and has led to products that generate an essential link with the world of production (Bertola & Colombi, 2014). This complexity of the knitwear product is one of the reasons that has determined the permanence of knitwear companies in Italy, which, thanks to the small size of the companies involved, have managed to keep production in the territory, avoiding delocalisation to other parts of the world (Motta 2019). These actions highlight how, in acting on the redesign of products where the material is critical, it is essential to bring back innovation for the user who uses it that can improve the quality of life and behavior with and for the product-system.

The practice-based research presented highlights how the potential areas of intervention are diverse and each of them can have different levels of depth, sometimes preparatory to each other, and integrating them all together would lead to a too sudden transformation of the supply chain that would create significant integration difficulties. As Transition Design emphasizes, for interventions to be absorbable there must be the right mindset and predisposition (Irwin, 2015) and, according to the author, this can be done with a gradual transformation time.

7. Conclusion

The article presented a practice-based research to identify possible strategies that, starting from the individual components, lead to the systemic redesign of a product, particularly in the upholstery sector. This was carried out through the use of a methodology being experimented by the author, which envisages the integration of anticipation and transition practices with those typical of circular design in order to identify what the design strategies might be to gradually make companies and the production territory absorb circular innovation in a transition perspective. The research was carried out by choosing the territory of the Made in Italy companies as a context which, due to its characteristics, skills and ability to absorb innovation, constitutes a terrain open to these practices and considering it suitable for metabolizing “projects with hybrid practices between conceptual art and complex projects that circumvent the norms of industrial production by challenging their premises and objectives" and where to contaminate knowledge using "the signs and codes of one discipline as leverage to infiltrate the terrain of another discipline” (Quinz, 2020, pp. 301–302). This project highlights what the designer can do first in designing these products and which are the ones to strive for in order to design the sustainable and circular transition in the sector: the selection of circular materials that improve the monomateriality of the components and thus facilitate disassemblability, the choice of technologies that implement circularity and decrease the production of waste already in the pre-consumption phase, a design process that anticipates the product's life cycles and foresees the different lifetimes of use by extending their temporariness as much as possible, and, finally, in all these processes understand how to make the user responsible and aware as well so as to sensitize him/her to his/her active role in the circularity of the product.

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