# A New Life for Textile Waste – Upcycling in a Fashion Collection

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**Abstract.** The fashion industry is one of the most important industries in the world from an economic and social point of view, but it is also one of the most polluting, being a larger consumer of natural resources and a considerable producer of waste throughout its value chain. It is imperative to change the way the fashion industry operates, the fast fashion model has to be rethought and the circular economy emerges as an alternative. These changes should start from the awareness of young fashion designers for the impact fashion has on the environment. Design schools, in general, have the function of opening the horizons of future designers to this problem and to the role they play with the choices they make.

The present case study intends, in this way, to present an academic exercise, from the bachelor's degree in Fashion Design and Marketing, from the University of Minho (2018/19 academic year) that consisted in the idealization and implementation of a fashion collection whose basis was a sustainable and circular perspective. "Signs of Life" collection took this stance by incorporating the reuse of pre-consumer textile waste, giving it an added value – upcycling.

**Keywords:** Fashion Design · Circular Economy · Upcycling · Education

## 1 Background

The impact of the fashion industry is tremendous, not only in an economic and social level but specially on an environmental scale, mainly because we are dealing with "the world's third biggest manufacturing industry after automotive and technology industries" [1]. Therefor the effect that this industry has on the environment has repercussions in several spheres:

- Water pollution and microplastics – "Washing, solvents, and dyes used in manufacturing are responsible for one-fifth of industrial water pollution" [2]; "Each year, around half a million tonnes of plastic microfibers resulting from the washing of textiles are estimated to be released into the ocean" [3] and "By 2025, there will be 1 ton of plastic for every 3 tons of fish in the oceans, and by 2050 the weight of plastic will overtake that of fish" [4];
- Natural resources – "Textiles production (including cotton farming) uses around 93 billion cubic metres of water annually, representing 4% of global freshwater withdrawal" [5];


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- Biodiversity – "The apparel industry is a significant contributor to biodiversity loss. Apparel supply chains are directly linked to soil degradation, conversion of natural ecosystems, and waterway pollution" [6];
- Emission of greenhouse gas – "under a business-as-usual growth scenario, sector emissions will grow to 1,588 Gt by 2030 - well off pace to deliver 45% absolute reduction" [7] and even more far from the net zero by 2050;
- Pesticides and insecticides – "cotton cultivation currently uses lots of chemicals – 4% of all world pesticides and 10% of insecticides are used in cotton-growing" [8];
- Waste - "three out of five of the 100 billion garments made in 2018 end up in landfill within a year" [9] and "one garbage truck of textiles is landfilled or incinerated every second" [5].

Currently, the fashion industry is based on a business model that encourages the over-consumption which generates all the environment issues described above, and unfortunately even many more. Based on a linear economy, "take-make-dispose" [10], the commonly known fast fashion model "involves increased numbers of new fashion collections every year, quick turnarounds and often lower prices. Reacting rapidly to offer new products to meet consumer demand is crucial to this business model" [1]. Braungart and McDonough [11] describe it as an industrial linear model "from cradle to grave", characterized by the extraction, manufacture, use and consequent disposal.

For all this, it is essential to bring sustainability to the fashion industry, and the circular economy (CE) presents itself as an indisputable guideline because is more than gradually reducing the harm of our current model. According to Ellen MacArthur Foundation (EMF) [12] "it tackles the root causes of global challenges such as climate change, biodiversity loss, and pollution, while creating opportunities for better growth". Unlike the fast fashion model, "is intended to be restorative and regenerative by having better product design and processes to promote maximum reuse of resources and prevention of waste" [10].

The Cradle-to-Cradle model (also known as C2C), idealized by the authors William McDonough e Michael Braungart in 2002 [11], already presents a very innovative vision of this theme, because instead of proposing the prevention of the waste, this model creates value, goes beyond the notion of having recycling as the final step (and consequent beginning) in the product's life cycle and, as an alternative, it is based on the idea that waste doesn´t need to exist, like in Nature. They argue that life and products can be designed around the notion of nutrition, a model in which everything is a resource for something else, a circular path.

Based on this model, the CE promoted by the EMF [12] goes a little deeper, by presenting three principles that must be undeniable for all fashion products - used more (through durability, reuse and repair), made to be made again (the products enable composting, design for disassembly, recycling and remaking), and made from safe and recycled or renewable inputs (be aware of hazardous substances, microfibers, recycled material, regenerative production practices, renewable material and waste). Like the C2C model, it also considers a biological and a technical cycle (butterfly diagram) and in each cycle all the products, components and materials are keep in the highest utility and value. For this matter, the concept of pre-consumer waste no longer has a definition in a circular economy, waste in general "is 'designed-out' by intention" [12]. This way, the

technical materials must be designed to go back to technical cycle, allowing them to be ""upcycled" rather than recycled – to retain their high quality in a closed-loop industrial cycle" [11]. The process of upcycling is "converting materials into new materials of higher quality and increased functionality" [13], the opposite of downcycling where the created products have less value than the initial one (which normally happens with recycling).

Therefore, it is extremely important to look at waste as a resource, whatever its category [14], as there is still a large amount of pre- and post-consumer textile waste and, with the current model, most of this textile material is lost in the supply chain during fabric and clothing production. For this very reason, it is imperative to rethink (re)manufacturing before recycling, and Runnel and other authors [15] approach the problem through three different design strategies: "invisible remanufacturing", where production leftovers invisibly, in areas of the parts that are not visible; "visible remanufacturing", where textile structures are reused in small details on the outer part of the garment; "design-led remanufacturing" is all about designing the entire piece with a view to fully utilizing waste.

Taking this background into account, while we are in a transition phase towards a circular production process, education, especially of young fashion designers, is seen as a driver of a peaceful transition, students will be taught to think and act in a circular way. "Bringing circular economy principles into education (…) will equip learners with the systems-thinking skills and mindsets needed to become active shapers of a circular economy in general, and a new textiles economy in particular" [5]. The labor market will surely be changed by the CE, and it is "vital for product designers to take circular ideas from practice to reality. In order to apply these principles in practice, education incorporate and teach these principles as well, across specializations" [16].

## 2 Goals

The following study case intends, in a more general way, to highlight the possibility of the design process to be focused on sustainability, not just taking in account the concern with textile waste but having in consideration the entire cycle of the product created. It proposes to answer the research question "Is it possible for a fashion collection and/or brand (that takes into account fashion trends and follows the steps of design process) to incorporate the principles of circular economy?". Taking this research question into account, the most convenient option of research has the action-research, with the researcher being part of the design process and its analysis.

Despite being just an academic exercise, this collection shows that it is possible for the entire process of creating a brand and idealizing collections to be thought of to have a lesser impact on the environment, without neglecting the design, the brand's identity, and the target audience.

## 3 Design Process

The academic exercise proposed, in the discipline of "Interdisciplinary Project in Fashion Design V", began with a briefing to present the main theme – "Living in the virtual world" - on which the collection would have to be conceptualized. The design process

then proceeded according to the fashion design methods proposed by McKelvey and Munslow [17], starting with the identification of the problem and ending with the fashion products, which together forms the "Signs of Life" collection. As soon as the problem was identified, the need for the brand and the collection created to have a sustainable core, through the upcycling of mostly pre-consumer waste, was imperative. Fashion design that reuses these materials can be an interesting approach to environmental sustainability [18], and the pyramid model presented by Hawley [19] has the "conversion to new products" of waste (textiles and apparel) as an important textile recycling tool.

Prior to the design process itself, it was necessary to conceptualize the brand, its identity, marketing plan and image book. These steps were fundamental as they also allowed the definition of the target audience, the future consumer of the brand, without which the entire design process is also devoid of economic purpose, which was also one of the objectives of the project (financial sustainability). Thus, the clothing and accessories brand called "Redefined" was conceived (Fig. 1), whose motto "Waiting in the line to be new again" reflects the ecological component that the brand incorporates. The reuse of textile structures appears as the core of the brand (upcycling), seeking in this way that the brand has a positive impact on its consumers and reduces its (and its consumers') ecological footprint.


**Fig. 1.** Redefined brand logo.

Based on this assumption, which significantly alters the design process and even the production process, close contact with partners in the textile industry was essential to understand what kind of textile waste normally results from the entire production process. It was quickly found that there are many fabrics and knits that are surplus from previous collections (a few meters), as well as that the amount of textile waste resulting from cutting is also significant. The main source of raw material thus focused on these two alternatives, for larger areas of the pieces and smaller details, respectively.

Having the briefing as a starting point, the design process itself began with the analysis and defragmentation of the theme, through the brainstorming tool, building ramifications based on more concrete concepts, starting from the general to the particularization (brainstorming web). "Brainstorming has traditionally been used to spur group creativity with the intention of generating concepts and ideas regarding a specific challenge" [20]. From the three broadest terms – Technology, Energy and Virtual Communication – the duality between the "real self" and the "virtual self" emerged, which ended up becoming the concept for the "Signs of Life" collection, which is assumed as a satire on lonely society that looks for signs of life not only in the real world but also in the virtual one. The concept of the collection was described in a moodboard where the "I"

seeks in virtual communication new experiences and relationships, the illusion of a new life, moments of fun, freedom to express and be accepted or even this communication is just a refuge for the real world. The creation of alter-egos in this virtual world is assumed as a "new" way of living, as if there is an imaginary world that is opposed to the real world.

After devising the concept of the collection and contacting future partners, and because the primary raw material for this collection were old and cutting remnants from more recent collections, it was necessary to select and catalog everything that was collected. Only with this information was it possible to define the colors and later shapes, which resulted in the first sketches of the collection (Fig. 2). The choice of colors, materials and in the definition of the design of the pieces, had in consideration not only the target audience, but also the trends dictated by the WGSN style office. Inspired by street culture, in a young, urban, and bold environment, the "Glocal Connection" trend emerges, for the autumn/winter 18/19 season. Focusing on the globalization of urban culture, with references to various places, where multiculturalism is reflected, not only through the palette of cores, but also in contrasting patterns.

**Fig. 2.** Sketches of "Signs of Life" collection.

As mentioned before, one of the pillars on which the "Signs of Life" collection is based largely influences the color palette - textile structures and patterns available. Upcycling thus presents itself as a key element in the way the entire collection was designed, because although there was a focus on colors and materials that reflect the spirit of the trend, this choice was conditioned by the textile waste that was available.

Still regarding the upcycling process, it should also be mentioned that all accessories (ribbons, springs, fasteners, …) were also reused and came from various sources. From the partnership with a haberdashery, it was possible to "rescue" fasteners and lines that had been in stock for several years and that, most likely, ended up in the common rubbish bin (and consequently in landfills). With a junkyard it was possible to collect carabiners and plastic parts from the seat belts of very old cars that were going to be destroyed and whose new purpose was to be transform into belt buckles and fasteners for accessories.

With a passementerie company snap button and plaques were created, the material used resulted from the surplus of previous productions and proceeding in the same company to laser engraving these accessories. Finally, using the resources that the University itself has, filling paste and jacquard ribbons with the brand's logo were developed (with a mixture of photoluminescent yarn and recycled polyester yarn).Traditional printing was only used for the labels, not only because it is a technique that uses a lot of natural resources (mainly water), but also because the "patterns" created resulted mostly from the assembly of various fabric and knitted remnants (patchwork).

While the production process of all accessories was taking place, the necessary patterns for the production of all pieces (clothing and accessories) were developed. The cutting of the fabrics and knits was a manual process and the cutting plans developed tried to produce as little waste as possible. These surpluses resulting from the cutting process were used as labels for garments and accessories.

The prototype footwear resulted from a combination of fabric and leather waste (surpluses from the cut of previous footwear production), and the same company that supplied these waste also dealt with the pattern making and production of the boots. It should also be noted that the sole used in the prototypes also resulted from the recycling of rubber, provided by another company specializing in soles.

With the entire collection completed - accessories, footwear, and clothing (Fig. 3) - the brand would develop a series of initiatives to promote the collection. The photo shoot with catalogue development and the presentation of the entire collection in a runway show were carried out. The continuation of the marketing process did not take place as this was not required in the academic exercise. Although there was no continuity, the entire process of marketing and positioning of the brand in the market was studied, namely a very important aspect for the brand concept was defined - the pieces of the

**Fig. 3.** "Signs of Life" collection – some examples

collection sold, used and whose end had arrived would be collected and, if possible, the raw materials and accessories would be reused. If this option were not viable, recycling of the various materials would be attempted, that is, the brand's objective was to close the production cycle (circular economy).

## 4 Results

The "Signs of Life" collection was presented in a joint fashion runway with the other students of the bachelor's degree in Fashion Design and Marketing, in an iconic place in the city of Guimarães - IDEGUI - Instituto de Design de Guimarães. This show was based on the "Wasteland" theme, a post-apocalyptic world where the fragility of planet Earth reflects extreme consumption, from which not only textiles but also technological waste result. This presentation to the main public was the culmination of the entire design process and it presents itself as the first time the pieces created were seen. This runway show had not only coverage by the local media and the University of Minho's own communication vehicles, but the main result obtained was the projection that the collection had among the various partners – it was very fruitful in raising awareness of the issue of reuse of textile waste.

It can be said that the result of this case study was all the pieces created, with the transformation of waste into value-added fashion products, however it was more than that - it was an awareness of the problem of textile waste, not only of the students who created the collection and their peers, but also of the partners who contributed and allowed its development, and even, we dare to say, the public that came across it.

The exhibition of the collection did not end with the runway, as there was also a presentation of a more academic nature, with the teachers of the bachelor's degree present, as well as students from the University. In addition to this presentation, in 2019, some pieces of the collection were exhibited at the 8th Encuentro Bid_Enseñanza y Diseño, in Madrid. This last exhibition became another opportunity to make known not only the collection with its aesthetic sense, but also through it the problem of the impact of the fashion industry on the environment, more specifically with the surplus of textile waste, presenting itself this (or other) collection(s) as a solution. Another opportunity was envisioned to, in some way, bring this issue to the public eye, in this case more specifically to international university students and professors.

Finally, this article can also be seen as a result of the academic work developed, which once again generates reflection on the impact of textile waste on the environment.

## 5 Conclusion

The fashion design process, despite being relatively structured, with fundamental steps that are usually unavoidable, is based mostly on the designer's creativity and freedom, from conceptual development to the making of clothes. This design process, in the present case study, was triggered by the desire of the designers to embrace the sustainable component, using upcycling.

This approach brought several challenges, the first being the limitation of available raw materials, not only in terms of textile structures (the textile structure is not always

suitable for the intended purpose), colors and even the size of the textile waste. The creativity and freedom characteristic of the process ended up being somewhat conditioned, and the process became a little more analytical and structured. Thus, in the conceptualization phase of the garments, the size of the textile materials influenced the design, cutting and sewing area and consequently in the pattern making.

Even the pattern making process itself was very fluctuating, because when cutting, and to create the least amount of waste possible, small design changes were made that allowed the incorporation of smaller pieces of fabric, resulting from the cutting process itself.

Despite all the challenges and being a more arduous task than purchasing raw materials and accessories without any limitation, it proved to be a possible process that really brings added value to the garments. This is not only visible in the transformation of textile waste into wearable pieces, but also on the impact, the awareness that projects of this magnitude have on the general population, and also on the industry itself, with all partners getting involved spontaneously and even emotional in the process. As previously mentioned, initiatives such as these, in the case of an academic nature, can be replicated by the fashion industry, if there is awareness of the impacts, including financial ones, that these and other measures that focus on the circular economy can have on the industry itself and the world we all live in.

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