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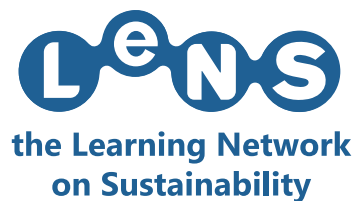
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Double-Blind Peer Review.

Scientific Commetee:

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Graphic project by:

Roman Maranov, Politecnico di Milano, Italy
Xinrui Wang, Politecnico di Milano, Italy
Yuting Zhang, Politecnico di Milano, Italy
Giacomo Bevacqua, Politecnico di Milano, Italy



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Tel. 02-2399.7206 Fax 02-2399.5970
e-mail: segreteria@polidesign.net
website: www.polidesign.net

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DISTRIBUTED PRODUCTION AND SUSTAINABILITY STRATEGIES FOR FASHION

Alba Cappellieri

Politecnico di Milano, alba.cappellieri@polimi.it

Livia Tenuta

Politecnico di Milano, livia.tenuta@polimi.it

Susanna Testa

Politecnico di Milano, susanna.testa@polimi.it

ABSTRACT

From the possibility to express oneself to functionality, from the creation of new ways to communicate to greater renewability: one of the challenges which the fashion industry, together with most other sectors, is called upon to tackle concerns sustainability.

The aim of the paper is to trace the main solutions adopted by the fashion system in terms of sustainable practices.

Firstly it analyses the contribution of material and technological innovation to promote the adoption of green products, in order to challenge the waste and the pollution.

Secondly the paper focuses in particular on the impact of digital technologies over processes and actors involved, fostering practices based on distributed production.

Key Words: Fashion, Innovation, Sustainability, Distributed Production

1. INTRODUCTION: THE HYBRIDISATION OF FASHION AND THE CHALLENGES OF THE PRESENT TIMES

Fashion as a discipline has always been characterised by the intertwining of complex trajectories based on thematic references, borrowed methodologies and the appropriation of various unrelated fields of expertise, with the clear aim of generating innovation (Conti & Dell'Acqua Bellavitis, 2006).

An example of cross-fertilisation which has traditionally been widely implemented is the formal reference, whether literal or freely reinterpreted. Throughout history there are plenty of examples which bring to the fore fashion's highly referential nature. There are numerous instances of this kind of cross-fertilisation; one of these is notably the influence which different geographical cultures have exerted on the creative production of many a famous fashion designer, an influence which to this day cyclically inspires modern collections.

Another form of traditional cross-fertilisation resorted to materials usually employed in other sectors, as was famously the case with denim. While 15th-century Ligurians originally destined it to the production of sail bags and to be used as merchandise wrapping, in the mid-19th century Levi Strauss adopted it for the manufacturing of work clothes due to its excellent resistance. Another example is Elastam, the study of which began in the 1930s as Bayer began to invest on the exploration of viable alternatives to rubber. Elastam was later marketed by Du Pont under the name Lycra and was initially aimed at the medical sector, until Emilio Pucci managed to exploit its potential to the full by presenting his fitted Lycra bathing suit in the 1960s. In a historical perspective, innovation has been achieved by importing procedures and technologies from a number of sectors, regardless of their degree of affinity. Thus, in her project 'The Mantle and the Skin' which won the Compasso d'Oro design award in 1974 Nanni Strada turned to circular knitting machines normally associated with hosiery production, and designed a line of wholly seamless "on-the-skin" clothing.

The cases reported above are just a few examples that highlight how in the history of fashion the use of contamination and hybridization is a frequent practice for product innovation.

Today the fashion industry is a highly complex pluralistic and diversified organism in which material and immaterial products, cultural capital and human resources merge together. As the outcome of a complex integration process among different methodologies and areas, fashion contributes to a new reading of the cultural changes which shape our present, and by drawing on various codes it is capable of generating a narrative which bestows meaning on the relationship between references, materials, technologies, products and processes. Given the need to rise to modernity's challenges and to be innovative, the forms of cross-fertilisation in the contemporary world are becoming ever more daring, while the number of sectors involved is steadily growing, and the skills required are becoming increasingly specialised. Fashion's boundaries (Conti, 2012), which are open to the boldest forms of research and experimentation, are the result of the interplay and mutual integration of highly diversified and specialised fields, which range from medicine to aeronautics, from engineering to city planning, and from biology to cosmetics. It is these mergers which supply the lifeblood of creativity and innovation. Contemporary fashion designers are forced to operate on more levels in increasingly complex contexts, and to harmonise diverse elements which are in contrast if not in outright diametrical opposition; they therefore show a shared inclination to a high degree of flexibility which conjugates the cross-fertilisation of different kinds of knowledge and know-how, and experience a similar need to experiment materially and to reach a developed vision of the technology they apply. Such *modus operandi* strives to seek and define original scenarios, and presupposes a special ability in audaciously stretching the designers' initiatives beyond the comfort zone, thereby challenging and breaking the limitations derived from traditional paradigms such as matter, codes, and processes.

The examples contained in the following paragraphs are presented in an order that is not intended to highlight the state of diffusion, marketing, or development process of the product, but to picture and highlight a general common trend, the existence of some avant-garde sectors, generated by contamination and integration with areas other than fashion. It is in fact a transversal research towards the approach to innovation in the field of fashion.

2. THE BOUNDARIES OF SUSTAINABILITY. TOWARDS A SUSTAINABLE MATERIALITY FOR FASHION INDUSTRY

One of the most complex challenges posed by modernity concerns the need to use the available resources wisely.

The fashion industry is only second to the oil one in terms of world pollution: not only does it make large use of chemicals, but it also produces a huge quantity of waste. The concept of waste is structurally inbuilt in the consumerist model underlying the fashion industry, which is in turn largely regulated by notion of trend. The textile market has expanded very quickly, and has grown by 50% in the first decade of the 21st century alone (Material District, 2014). According to some estimates, moreover, the quantity of discarded products is extremely high: only 30% of the clothes are paid their full market price, 25% are sold at a reduced price, and 45% remain unsold. Since only 0.1% of the recuperated textiles is recycled, the waste of resources becomes enormous (State of Fashion, 2018).

In view of these data it is imperative that a joint action between designers, materials scientists, biologists, biotechnologists and chemists be undertaken in order to identify and develop new materials and innovative solutions which may solve the issue (Forbes, 2016).

Further proof of the great interest which this topic elicits is supplied by the close partnership between the H&M group and the Swedish re:newcell, which pursues the goal of enabling the former to employ exclusively recyclable materials by 2030; indeed, the technology developed by the Swedish firm is capable of transforming cotton,

viscose and other cellulose fibres into a blend which can be processed more easily, and turned into a new manufactured fibre to be subsequently reintroduced into the production cycle (Fashion United, 2017).

There are a number of enterprises which have developed new fibres and production technologies which could foster a sustainable development.

A few experimental projects have been devoted to the recycling of highly polluting materials, such as plastic waste.

The Spanish brand Ecoalf which was founded in 2010 by Javier Goyeneche, uses for instance the plastic scattered in rivers and in the sea to create body equipment such as its Shao sneaker collection. Clean Waves, for its part, has employed the plastic recuperated in the oceans in its limited-edition line of sunglasses, while Monique Collignon has developed a line of clothing called Waste2Wear whose materials are drawn from PET plastic bottles. Finally, Anna Bullus has opted for the recycling of the plastic material contained in the chewing-gums discarded in the streets to develop her fashion objects and accessories.

Christopher Raeburn's designing activity also centres on upcycling: by repurposing the technical textiles from military gear such as vintage army snow uniforms, thin-cotton RAF flying suits, and Euro Star uniforms, he has inaugurated an ethically conscious production of outerwear.

The fast fashion industry produces 53 million tons of clothing every year, 87% of which ends up as waste in landfills (Copenhagen Fashion Summit, 2018); in this sense, the creation of biodegradable clothing might provide an alternative solution to the closed cycle of production, disposal, and recycling (Seymour, 2010). Indeed, some firms have already started developing alternative and sustainable materials.

Solve's answer to the consumerist dynamics underlying the Fast Fashion industry has been the Omdanne collection: three items of clothing which are 100% biodegradable, are wholly made of an artificial cellulose fibre derived from eucalyptus called Tencel Lyocell, and may be worn in twenty different ways.

Although traditional natural fibres, such as cotton and flax, are considered to be less environmentally damaging than synthetic fibres, they still require an abundant use of resources to be cultivated. Moreover, for example, the industrial production of cotton, the most common natural fiber used to make clothing, representing about 33% of all the fibers present in fabrics, has a strong negative impact on the environment (World Resources Institute, 2017). In fact, cotton is a fibre that requires large quantities of water to be cultivated: to obtain a useful quantity for making a cotton shirt, 2,700 litres of water are required. In areas already subject to water stress, the production of this natural fiber can be particularly harmful. Cotton cultivation is also responsible for 24% of insecticides and 11% of pesticides, even though it uses only about 3% of the world's arable land (World Resources Institute, 2017). Another important problem related to cotton concerns the use of pollutants to dye tissue.

It is for this reason that some firms have started turning organic waste available in large quantities, especially of vegetal origin, into innovative materials which may be useful for the fashion industry. An example in this sense is supplied by those materials which convey the aesthetic impression of the human skin without being of animal origin: Fruit Leather makes use of waste derived from unsold fruit and vegetables, the Piñatex fabric has been developed from pineapple leaves, while Vegea resorts to grape waste from the wine industry. Salvatore Ferragamo, for his part, is pioneering the use in the fashion context of the Orange Fiber, the first fabric made from citrus fruit waste, and Happy Genie has launched a line of handbags made from apples; Suzanne Lee, on the other hand, has created a material akin to human skin thanks to a process of tea fermentation.

Other firms have preferred to exploit the intrinsic potential of mushrooms: examples abound, and include Iris Houthoff's Mylium fabric, Muskin, Stella McCartney's handbag, which was presented at the Fashioned from Nature showcase held in the Victoria and Albert Museum in 2018, the bag jointly designed by Bolt Threads and Ecovative, the line of shoes by Nat-2 and Zvnder, and Aniela Hoitink's MycoTEX, which after having been worn may be buried in the ground and left there to decompose.

The fashion industry may thus turn an environmental threat into an opportunity, as was the case with the project jointly developed by Vivobarefoot and Bloom.

Indeed, a very concrete threat to our planet is currently posed by the exponential proliferation of algae, which is largely due to the phosphorus and nitrates released into the sea by chemical waste; however, these organisms are in fact extremely versatile, and may be transformed into bioplastic material. For instance, Ultra is a footwear collection made from algae-based foam, a valid vegetal alternative to the synthetic and oil-based ones; Tjeerd Veenhoven produces a similar fabric which is also made of the same aquatic organisms, while AlgaLife has focused on biofibres and an eco-friendly dye. Moreover, these fibres release antioxidants, vitamins and other nutrients which are beneficial for the skin of the wearer.

There are also other kinds of innovative and eco-friendly materials which rely on the processing of waste of animal origin.

Spider Silk, despite its apparent fragility and flimsiness, is in fact extremely resistant, a characteristic which has been developed by researchers with quite different backgrounds.

Adidas has presented a footwear prototype made of synthetic, biodegradable spider silk, and the same material has more recently been used by Bolt Threads in their new line of ties.

Osklen has recycled the skin of the Arapaima gigas, one of the world's biggest fish, and has made fashion accessories out of what had hitherto been considered waste material.

BioCouture, on the other hand, develops items of clothing from bacterial cellulose, and endeavours to explore

and follow natural processes which rely on an extremely limited number of raw materials, such as bacteria, moulds and recovered waste.

However, the above examples still constitute isolated cases, avant-garde experiments, whose results are often available in the prototype form and far from industrial incorporation. These researches, pioneering as they are, constitute an avant-garde trend that points to a future direction, as demonstrated by the results of *The State of Fashion 2018* (BoF and McKinsey & Company, 2017). According to the report, fashion companies have begun to grasp the importance of a sustainable and transparent approach to production: 42 out of 100 fashion brands in 2017 disclosed information on their suppliers. Also, according to *The State of Fashion 2018*, millennials are interested in more sustainable solutions: 66% of global millennials are willing to spend more on sustainable brands. Therefore an important lever towards the adoption of eco-friendly strategies is the awareness that in the fashion sector, attention to sustainability can be an important element of differentiation for the consumer.

3. DISTRIBUTED PRODUCTION AND SUSTAINABILITY STRATEGIES

«Personal fabbing, prototyping, interactivity, cutting-edge technological content, all of which are put to good use to create innovation and new kinds of sustainable local economy thanks to the open-source mechanism and Creative Commons licenses.»

Andrea Branzi

From the possibility to express oneself to functionality, from the creation of new ways to communicate (Seymour, 2008) to greater sustainability (Forbes, 2016): one of the challenges which the fashion industry, together with most other sectors, is called upon to tackle concerns sustainability.

The introduction of digital technologies has entailed a radical change which has affected the very notion of fashion. Aesthetics and technical skills have now been joined by the ethical selection of materials, respect for the environment, and the protection and promotion of the joint cultural and traditional heritage associated with the surrounding territory. This approach has had obvious repercussions also on the designers' activity and location choice, who are met with a growing need to reduce the consumption of the resources required by research, product promotion, and product commercialisation.

Biology, chemistry, and materials engineering have greatly contributed to the identification of solutions favouring sustainability, thanks to the development of new materials that are either recycled or made of biocompatible and biodegradable natural fibres; digital technologies, however, can also supply some solutions which may make the fashion industry more sustainable.

Indeed, digital technologies have occasioned great changes in the whole of fashion's production process by assisting the transition from large-scale, centralised design and production systems to ones that are decentralised, or else spread among smaller, networked units.

Modern design arose from industrial chain production with great output, and brought about the aesthetic standardisation of the industrial offer, whose only lingering value resides in its very brand name; design's widespread presence and distributed production, however, (Srai et al., 2016) do not supply only products, but also services which are instrumental in the creation of customised objects, and which actively engage consumers by educating them and stimulating their creativity. The serial production of the finished product is replaced by the design of models, digital platforms and semi-finished products which may be modified, customised and finished by the consumers themselves.

The Post-Couture Collective is an interesting example of production which endeavours to be open and cooperation-based: they actively encourages final users to access their website, and to download, customise, produce and self-assemble their chosen garments.

Consumers' new role from passive users to well-informed 'self-creators' (Recession Design, 2013), together with their involvement in the design process, has made them more discriminating as regards the products available on the market: designer products and brands are now being snubbed in favour of the consumers' own creativity and ability to constantly reinvent products, and consumers no longer acritically accept to have products imposed on them. Consumers therefore contribute to the conceptual definition of goods, and rather than waiting for companies to decide for them, they create the product they require themselves.

Industrial production has become distributed, decentralised, and has even ended up in the users' homes-turned-laboratories, as is the case with self-production; this trend greatly reduces the number of resources needed, the costs of production, packaging and transport, and even diminishes the waste derived from unsold finished goods. Manufactured objects are consequently becoming territorialised, and are being produced closer and closer to their end users, thereby cutting down the pollution occasioned by the excessive consumption of resources and transport. What is more, the consumers' new active role, together with their involvement in the actual manufacturing process, helps them develop greater manual skills, and makes them more aware of waste-related issues. The emotional attachment they develop with the object they have built reduces the tendency to easily dispose of it which is, more often than not, a common side-effect of serial production. Consumers become more sensitive to discarded objects that only exacerbate waste-related problems, and strive to reuse exhausted objects as much as possible, either by creatively modifying them or by finding new uses for them. Within this system, the waste of resources and the

costs of storage and transport are much lower than in the traditional centralised production. Mixed groups of active consumers and professional designers jointly develop projects and freely exchange skills and knowledge, pool together their strengths and abilities, and foster a production system which offers an alternative to the company-based one characterised by the lack of mediation and by costs determined by large-scale retailers. Assuming that this model may altogether replace the traditional serial one is of course unrealistic, but there is no reason why it cannot compound and influence it.

4. CONCLUSION

The introduction of digital technologies has entailed a radical change which has affected the very notion of fashion. Aesthetics and technical skills have now been joined by the ethical selection of materials, respect for the environment, and the protection and promotion of the joint cultural and traditional heritage associated with the surrounding territory. This approach has had obvious repercussions also on the designers' activity and location choice, who are met with a growing need to reduce the consumption of the resources required by research, product promotion, and product commercialisation.

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