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Everything That Went Wrong: challenges and opportunities in designing and prototyping long-life garments in a circular economy

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Abstract: This paper considers the case of the Service Shirt, a proof of concept prototype made as part of a design researchers in residence programme at a fashion brand, within a scientific research consortium. During the development of the concept to prototype stage, many problems arose. In this paper the two authors - co-creators of the prototype - explore the challenges encountered when confronting the theoretical framework of new circular economy business models with the material reality of design collaboration and prototyping. The authors argue for the potential of design-led investigation to expand the lifecycle of garments and offer new insights to understand the challenges of developing circular prototypes within a linear fashion production model. By analysing the different stages of the design and prototyping phase through a combination of adapted annotated portfolio and after-action review methods, four main elements of the project were identified as potential focal points: collaboration, the design challenge, manufacturing, and materials. Throughout these categories, it was found that communication and effective transfer of knowledge were keys to success. For each of these aspects, the authors suggest how the design process may be improved in future iterations.

Introduction

In the light of current environmental issues, it is widely acknowledged that new practices and business models for the production and consumption of goods must be put forward. The circular economy provides a model for the perpetual reuse of resources in industrial and biological cycles (Webster, 2017:19), and new technology developments enable recovery and recycling of an increasingly wider range of materials are making this increasingly attainable (Östlund *et al.,* 2015:15). Moreover, new business models are emerging to challenge linear and wasteful practices (Ellen MacArthur Foundation, 2015:4). In the case of fashion in particular, whole systems need to be redesigned to provide alternatives to the current fast fashion paradigm (Fletcher, 2008).

Yet for these circular models to be applicable to products and materials, they must be designed with their end-of-life in mind from the outset (RSA and Innovate UK, 2016:3). Indeed, design is considered accountable for a large proportion of the environmental impact of goods, pointing at opportunities to implement meaningful change, not only extending lifecycles, but also making sure that end-of-life can be the starting point for new products (Bakker *et al*., 2014). Thus, textile designers are in a valuable position to tackle issues at the very beginning of the design process (Earley and Politowicz, 2013). Yet there is a distinct lack of research from this perspective; this work aims to explore the gap.

Context

In terms of a collaboration with industry, the Service Shirt takes a far-forward, or deliberate extreme perspective on long-life garments, pushing the concept as far as possible to explore the most ambitious components of new fashion systems. The Service Shirt suggests a model in which a polyester shirt goes through a 50-year lifecycle, first being overprinted several times, then combined to an outer layer to become a jacket, and then cut into strips and upcycled into high-end jewellery before being fed into a chemical recycling process at the end of this extended lifecycle. The use and business model surrounding this garment encourages sharing between users and brand responsibility over the resources.

Methods

This research puts creative textile design practice and reflection at the centre of this exploration into new fashion models. The discipline of textile design is characterised by

the importance of hands-on making (Igoe, 2013:59; Marr and Hoyes, 2016:3), and this has been used as a tool towards a better understanding of the potential for long life garments in a circular economy and has led to a first-hand experience of the challenges this incurs.

Three designers were involved in the different stages of the garment's transformation, a print designer and lead researcher (author1), a design for disassembly textile designer and PhD researcher (author2), and an artisan jewellery maker. In designing for end-of-life, each had to consider the next stage of the product from the outset of their own design process, and reversely, consider the state the garment would be in when reaching them and inform the designer of the previous stage of their requirements for their 'raw materials'. This meant that the design concepts for each stage of the shirt's lifecycle evolved concurrently, feeding into each other in terms of technical parameters but also of aesthetic inspiration. This sequential and iterative process can be compared to traditional prototyping (Brown and Katz, 2009:94) but the authors reflect through this paper on the ways in which the questions, conversations and decisions differ when making a circular prototype.

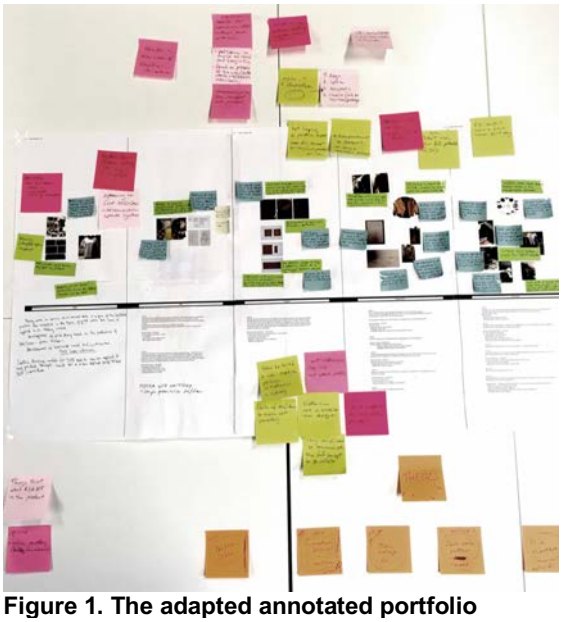

Figure 1. The adapted annotated portfolio process. © Author2.

To aid the reflection process, the prototyping stages were mapped out as a chronological sequence using an adapted annotated portfolio method (Sauerwein *et al.,* 2018:1157) (Figure 1). The insights from this process were then drawn and made into a table in an adaptation of an “After Action Review” (Morrison and Meliza, 1999) or de-briefing phase. Key moments for decision-making and where problems were experienced were identified, leading to a better understanding of the challenges and how they can be overcome and seen as design opportunities (Petroski, 2006:49).

Analysing Shortcomings

The prototype was successful in demonstrating the potential for long-life garments in a circular economy and this collaborative experimental work resulted in a series of aesthetically pleasing and conceptually strong garments. This paper focuses on the elements of the prototypes, either in the process or the result, which the authors consider as having potential for improvement.

Confronting the concepts of a circular economy for textile products to the reality of prototyping and production has led to a number of insights regarding the challenges that this may entail. Indeed, textile designers are versed in "the application of big ideas onto small rectangular pieces of cloth" (Igoe, 2013:19), and the application of these textiles to a garment often comes as an add-on. Here the function and use patterns involved in the garment were included in the design from the first stages, drawing the textile designers out of their comfort zone (Lawson and Dorst, 2009:170), but in the process, leading to ambitious concepts for the systems this garment represents. Thus, bringing together zero waste fashion concepts (Rissanen and McQuillan, 2018) with the use of recycled materials, design for disassembly strategies (Forst, 2018) and upcycling methods (Brown, 2013), and coordinating them as one product, led to a series of obstacles.

These weak spots revealed in the prototyping process born most often from miscommunication, assumptions, inflexibility and technical limitations led the authors to question how the concept would transfer to industry and start proposing how these could be amended in future iterations.

Upon analysis of the process and results of the prototyping, the researchers classified the different “things that went wrong” into four themes relating to elements of the prototyping: collaboration, the design challenge,

manufacturing, and materials. Each of these themes led the authors to reflect on how future iterations may be improved.

Collaboration

The circular garment prototyping brought together three designers with different approaches to - and understandings of - products and systems. While this allowed for a rich diversity of perspectives on the work and helped in driving concepts forward through ongoing dialogue, the communication difficulties between the different members of the team led to some challenges which resulted in shortcomings in the final prototypes.

The main barrier was to circulate knowledge across the team. Indeed, while the two researchers had an extensive understanding of circular design parameters, these had to be communicated to the artisan jewellery maker. This led to an understanding that some of the aspects that were essential to the circular garment concept were not an inherent part of this practice and required additional inputs. This for instance, led to the use of superglue in the production of the jewellery which was part of the initial practice but was ill-fitted to a circular garment concept.

Different tools were used by each designer, ranging from hand-sketches and experimental modelling to the use of software programs (Figures 2 and 3). This added difficulty in harmonising the different prototypes into a standardised garment system. Coordinating these different approaches proved challenging and created some extra work and compromises.

To overcome the difficulty in communicating and aligning the expectations for the prototype, closer collaboration between the members of the team could have been beneficial. Indeed, in this project, the collaborative work had to be balanced with other commitments, which made it difficult for all three designers to meet simultaneously and work for any extended period of time. Den Otter (2007) also suggests that in collaborative projects, the means for communication should be agreed on at the start, enabling more effective progress thereafter. In an improved iteration, it could be imagined that the project could be carried out in a “hackathon” format. This would allow to bring the skills of the designers together and limit the need for cross-communication.

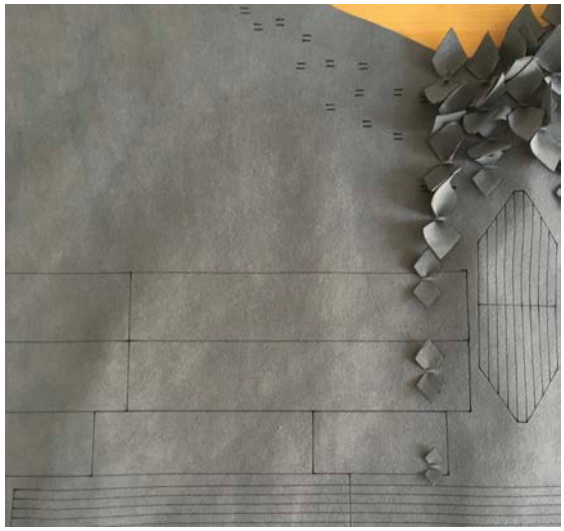

Figure 2. The laser cut garment designed for disassembly based on an Adobe Illustrator file made by Author 2. © Author2.

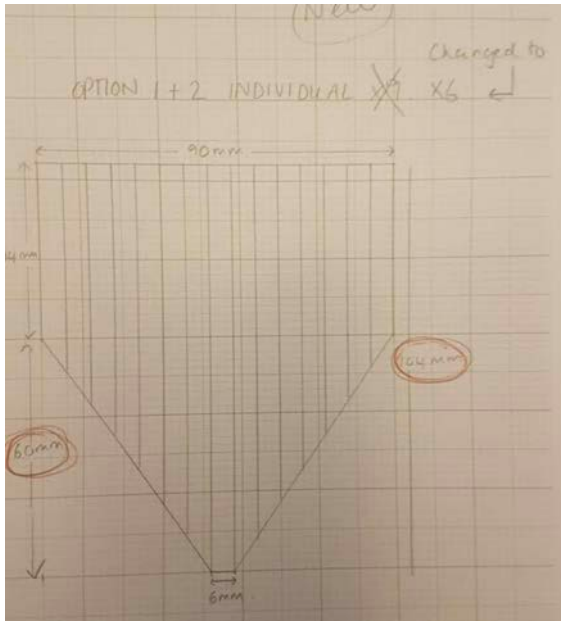

Figure 3. The hand-drawn template for the creation of jewellery which was then adapted into a computer file. © Author2.

The Design Challenge

In order to reduce the environmental impact of the garment, a zero-waste pattern cutting approach was taken. None of the designers involved in the project had expertise in this area and it was felt that bringing in an extra team member would add too much complexity as much time an effort was already invested in the collaboration between the three designers. It was therefore decided to develop a simple zero-waste shape that was within the limits of

the skills of the existing team (Figure 4). It was not anticipated how much the simplified shape would influence and limit the aesthetics of the finished garments.

The main aim of the prototype was to demonstrate the potential for a circular garment lasting 50 years in use through a series of remanufacturing stages. Adding a zero-waste component to the brief complicates the message and dilutes the findings. A more selective approach to the design challenge should be taken, picking the right 'battles' depending on the skills available in the team.

In the case where a zero-waste pattern concept should be maintained, then an expert in this field should be brought in. Circular design strategies very often work in clusters (Earley and Politowicz, 2013) and zero-waste would reduce the environmental impact of a long-life circular garment (Peters *et al*., 2018:22). In order to reduce the need to compromise on the aesthetic aspects of the garment, then a pattern cutting expert should provide key insights at the beginning of the process so that all the parameters of the zero-waste circular garment can be progressed simultaneously.

Figure 4. Making a zero-waste garment prototype. © Author1

Manufacturing

Given the limited skills of the design team concerning garment construction, help from the fashion brand's mechanist was sought. The fabric was sent to Sweden to be cut and assembled following instructions (Figure 5), however, the zero-waste concept failed to be appropriately communicated and the garments were made following traditional approaches. Furthermore, the finishing of the collar was inappropriate for an exhibition piece in which the inside of the neck would be left visible when presented on a hanger or on a flat table top. These prototypes therefore had to be amended by a seamstress when returned to London.

This failure to communicate circular fashion concepts to the production level is characteristic of the challenges encountered within brands to transfer sustainability targets to the shop floor (Vuletich, 2015:96).

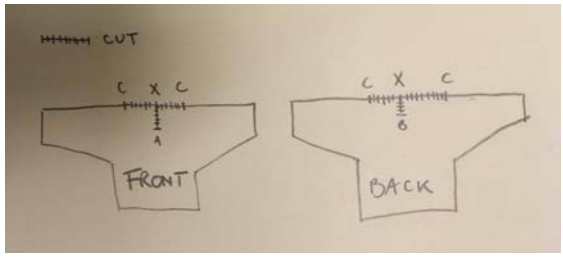

Figure 5. The sketches used to communicate to the mechanist how to cut the garment following zero-waste principles. © Author2.

Within the context of this project, this challenge coincides with the absence of a garment construction expert on the team and with the communication issues due to distance. To facilitate this phase of the prototyping it would be useful to collaborate more closely with an in-house mechanist with whom an ongoing dialogue regarding the expectations for the prototype could be developed.

Figure 6. The cut and sewn shirt. © Author2

Materials

The materials chosen for the prototype were a recycled polyester for the shirt and lining, and a polyester felt for the outer layer of the jacket. The polyester shirt had beautiful drape and shine qualities, however the felt proved to be too stiff for the pattern of the jacket and gave the garment a boxy look. While this can be a stylistic decision, it felt unplanned to the authors and would benefit from being an aspect of the garment which is more controlled. In addition to this inappropriate quality for the garment type, the felt was difficult to use in the jewellery making techniques, which were subsequently simplified and adapted, to the detriment of the luxurious effect aimed for with these products (Figure 7). Moreover, it was found in later stages of the project that the felt in fact contained a polyurethane binder which causes barriers to the recyclability of the garment, therefore undermining the circularity of the concept.

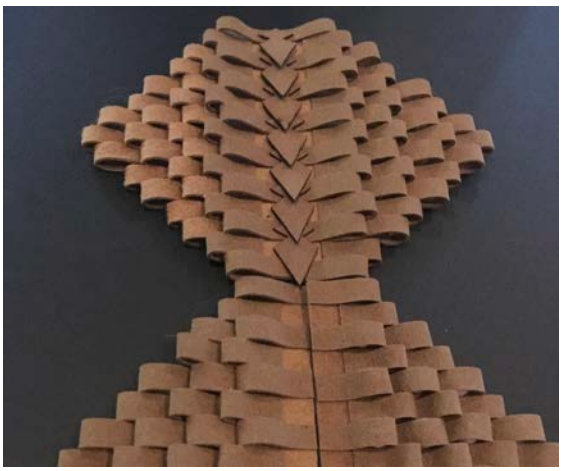

Figure 7. The new techniques for jewellery making based on the polyester felt material. © Source.

These issues highlight the complexities of material sourcing which many designers encounter when attempting to transition to more sustainable practices. Indeed, access to comprehensive information is often restricted. The difficulty in finding appropriate sources often leads to a design process in which the first phases of prototyping are carried out with placeholder materials. While this is common practice in product and interior design (Brown and Katz, 2009:90), when considering garment design, the drape and feel of the material is a major component of the product. It would therefore be useful to start the testing and intermediate prototypes phases with the correct materials and work in closer collaboration with the suppliers so as to better access key information.

Everything That Went Right

It is important to highlight some of the things that went right with the collaborative prototyping process too. Whilst all new collaborations have drawbacks – this one had clear benefits. The finished prototypes were shown in exhibitions in London and Stockholm in 2018 and 2019 (Figure 8), along with innovative work that explored 'ultra-fast' circular fashion. Showing and discussing the work in public has stimulated debate with both industry and academic audiences.

Figure 8. The final shirts, jacket and jewellery. © Jelly Luise for Centre for Circular Design, UAL.

Figure 9. The overprinted shirt patterns. © Author1

The collaboration between the project designers has enriched the respective practices – with the researchers understanding more about craft and industry practices, and the craftsperson understanding more about how research works. The designers at the fashion brand gained new insights from seeing how clothing can be co-designed with accessory

designers. The marketing team at the brand could see more clearly that being part of future circular projects would be beneficial. The over-printing shirt approach (Figure 9) gives clear guidance on how printed textile designers can design backwards from an end-of-life plan, using gradually darker tonal aesthetics. This print concept was directly informed by the work the jewellery-maker did.

Conclusion

Overall this paper suggests that to implement circular economy considerations within the design process, this process itself needs to be redesigned. Indeed, a truly circular fashion system cannot emerge from a linear design process. To achieve better outcomes for sustainable fashion, all the stakeholders must be involved in close collaboration at every stage of the design and things going wrong at least in this transition period must be expected and embraced.

The conclusions drawn from the four angles through which the challenges of designing long-life garments in a circular economy were analysed relate mostly to communication and the transfer of knowledge between the members of the design and production team. It is suggested that this type of prototyping could benefit from being carried out by the team in closer collaboration, sharing a studio and experimenting with materials and garment shapes simultaneously.

In a new iteration of the circular garment concept which was carried out following the analysis of the challenges, the insights from this process were taken on board and elements of the design were amended. In a similar way, it is intended for this analysis to allow for future circular design projects to progress with these challenges and opportunities in mind.

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