

MakeUse V2: Digital textile technology for user modifiable zero waste fashion

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Abstract

The evolving discourse on zero waste fashion design addresses justifications and approaches for designing and making these garments in ways that attempt to fit within the existing structure of fashion education and industry. However, little has been explored about the relationship between the outcomes of zero waste fashion design and the potentially elevated fashion user experience it might enable. This paper and associated creative works explore the emerging field of enriching the fashion user experience: the post-production and post-retail environment; an area that historically the fashion industry has given little attention to. MakeUse builds on Kate Fletcher's work within Local Wisdom, specifically in the context of what she terms the Craft of Use of clothing, and the application of knowledge and skill which enables us to "mitigate ... intensify, and adapt" clothing to suit our lives. MakeUse places zero waste fashion practice in the context of user practice, where the user becomes an agent in both the design and ongoing use and modification of the garment. Through actions and opportunities facilitated by the designer, an enriched designer/maker/user relationship is possible. Using methods such as digital textile print and embroidery, embedded instructional material, online support and distributed production, MakeUse provides user modifiable zero waste fashion products and an associated product use experience that acknowledges both the opportunities and limitations each user brings, while intensifying their skills, knowledge, needs and desires.

Keywords: zero waste, modification, use practices, digital textiles, online

Introduction

The evolving discourse on zero waste fashion design addresses justifications and approaches for designing and making these garments in ways that attempt to fit within the existing structure of fashion education and industry (Fletcher & Grose,

2012; Fletcher, 2008; Gwilt & Rissanen, 2011; Landgren & Pasricha, 2011; Lumsden, 2010; McQuillan, 2009a; McQuillan et al., 2013; Niinimäki, 2005, 2007, 2013; Rissanen & McQuillan, 2011; Townsend & Mills, 2013). However, little has been explored about the relationship between the outcomes of zero waste fashion design and the potentially elevated fashion user experience it might enable. This paper explores open design to enrich the fashion user experience: the post-production and post-retail environment, an area that historically the fashion industry has given little attention to, within the application of zero waste fashion practice. Using open design strategies as a guide to develop outcomes that invite consumers to more deeply interact with their wardrobe, and in doing so attempts to slow the consumption of clothing. By enriching the user and product relationship, MakeUse suggests ongoing and changing use for all garments, not only those created for this project.

Context review

Zero waste strategies.

In defining the contemporary field of zero waste fashion, Timo Rissanen (2005, 2007) discussed the history and justifications for attempting to eliminate the production of waste from the production of clothing, speculating the potential advantages of its practice. McQuillan (in Gwilt and Rissanen, 2011) explores the practice of zero waste fashion design, identifying a range of possible approaches to achieving the elimination of waste. Since then a number of articles, papers, publications and creative works have explored zero waste in the context of education (Niinimäki, 2013; Townsend & Mills, 2013), fostering material appreciation (Niinimäki, 2013), risk taking and creativity (McQuillan et al., 2013; Townsend & Mills, 2013), and broadening the range of approaches that could be used (Carrico & Kim, 2014), including the use of CAD and digital technologies (McQuillan in Adank & Mehzoud, 2011; in Chin, Kim, Ho, Chang, and Prism, 2010; Lumsden, 2010). Rissanen's exploration in his PhD thesis (2013) concludes that more research is needed in the implementation of zero waste fashion in an industrial context. Rissanen (in Gwilt & Rissanen, 2011) discusses the use of what is conventionally considered "waste" into the design of a garment for use in future mending, therefore designing endurance into the garment. McQuillan (in Gwilt & Rissanen, 2011; McQuillan, Rissanen, & Roberts, 2013) speculates that many of the garments resulting from zero waste

practice could be considered to have a “timeless” aesthetic which sits outside of fashion fads and therefore their potential fashionable life is extended. Beyond these two examples very few have explored zero waste fashion in relation to use practices or user behavior; however, Rissanen writes:

... Zero-waste fashion design is not “good” in and of itself; it needs to be examined in a much broader context. Furthermore, entirely new ways of thinking about how the industry could exist and function while allowing humanity to flourish are required. This points towards a new, expanded vision for fashion design: as well as designing and making garments, fashion design needs to design the consumption, wearing and using of garments, and design, collaboratively with other fields, the systems in which the wearing and using occurs. (Rissanen, 2013, p. 160)

How might the peculiarities and advantages of zero waste fashion design be exploited to foster an ongoing and changing relationship with our clothing?

Open Design Strategies

In looking for examples of expanded views for designing and making things, open design strategies such as those proposed by Ezio Manzini (2013, 1994), Cameron Tonkinwise (2005), Alistair Fuad-Luke (2009; in Niinimäki, 2013) and Liz Sanders (in Sanders & Stappers, 2008) offer great insights. Manzini's 1994 call to arms, *Design, Environment And Social Quality: From "existenzminimum" to "quality maximum"*, questions the role of design in a world in crisis. He calls for designers to not look for the solution to all problems, instead to act within three proposed consumption scenarios (1994, p. 40); From Consumption to Care; From Consumption of Products to Utilization of Service; and his most radical, From Consumption to Non-Consumption. Design behavior, when activated through these lenses, aims to instigate “a new way of behaving or of viewing the world”. Tonkinwise, in *Is Design Finished*, expands this idea further, suggesting that we need to reframe design entirely and stop designing mere “things”, instead we should be designing how “things thing”. He says:

Design timely things, things that can last longer by being able to change over time. Design things that are not finished, things that can keep on by keeping on being repaired and altered, things in motion. (Tonkinwise, 2005, p. 6)

The proposal to design unfinished products is further explored by Fuad-Luke in *Design Activism: Beautiful strangeness for a sustainable world* (2009). In proposing “Ways of Making” (2009, p. 95) which target the over-consumer, Half Way Products are one such approach whereby the product is half completed by the producer and finished by the consumer, mistakes becoming part of the narrative and, as Chapman (2005) posits, stories help us want to hold on to things. Fuad-Luke explored this notion with Anya Herscher in the context of fashion in the project Half Way (in Niinimäki, 2013). Workshops were delivered whereby participants could determine their level of involvement and skill level and, with support, work to modify, make or design (or any combination of) a garment. This approach transforms the usual consumer garment relationship in the context of ready to wear (passive/inactive) into one where the consumer becomes active in the design and making of the garments they wear. The garments ongoing use or modification was not explored in the workshop or proposed in their design, however Fuad-Luke also proposes a model of “Modular Evolved Products” (2009, p. 101), whereby products are designed so as to be easily repaired; a notion our grandparents may find familiar.

Liz Sanders (in Sanders & Stappers, 2008, p. 12) discussed the “Four Levels of Creativity”, which she observes in peoples lives: doing, adapting, making and creating. Ranging from the basic imperative of wanting to “get something done” to the more explorative aim of expressing creativity, the important aspect to note is that “expertise, interest/passion, effort and returns grow with each level”. Tapping into this desire for creativity in ordinary life, everyday users can become part of the design team, but in order for them to take on this role, Sanders explains, “they must be given appropriate tools for expressing themselves” (2008, p. 12). Therefore the role of the design researcher in this process of transforming the passive consumer into the active contributor, becomes one of facilitation and “scaffold” building – leading and guiding users, and providing “clean slates” for people to express their creativity.

Parallels between Herscher's *Matrix of Involvement*, Sanders' *Levels of Creativity* and the relationship these have to time costs (Figure 1) are important to note when facilitating a user/object relationship, but why is it important that people are enabled to express their creativity and participate in the design and active use of the products they own? Why should users be given the opportunity to use their time in this way? In the context of fashion, the overwhelming problem lies in the unsustainable consumption behaviours of consumers. Kate Fletcher speculated at the Craft of Use event (Fletcher & Toth-Fejel, 2014) that the average environmental impact of fashion products may have reduced, however the increasing volume of consumption has significantly eroded any gains. Approximately 120 billion new garments are made every year, so clearly consumption behaviour needs addressing, and one such avenue may be through the transformation of consumers into users: we need to imagine a fashion industry made of individuals and groups engaged with the making and ongoing use of garments.

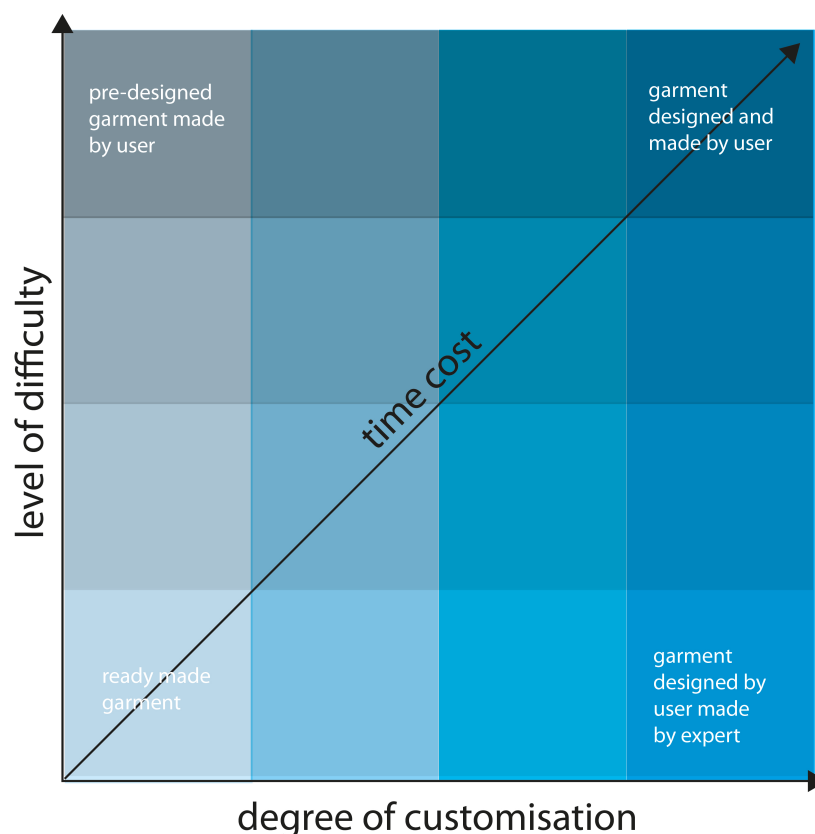


Figure 1. Proposed level of difficulty vs degree of customization and its relationship to time cost in user modifiable garments. Developed from Herscher's *Matrix of Involvement*, Sanders' *Levels of Creativity*.

Niinimäki and Koskinen (2011) identify a suite of “Attachment Attributes” for clothing and textiles – things that make us want to hold on to clothing for longer – which entice us to consume less. These include emotional values, such as memories, heirlooms or family ties; notions of effort and achievement, where items are handmade, tailor-made, self-made or self-designed; and also physical qualities relating to use, including durability, multifunctionality, reparability; and more suggestive concepts, such as the possibility of future modification possibilities and alignment with personal ideologies. The variety of attachment attributes suggests a much more complex relationship with clothing than is often assumed and offers many opportunities for designers and users to take action. Fletcher explores these complexities and opportunities in the international research project Local Wisdom (Fletcher, n.d.). By gathering the stories of people’s extraordinary and ordinary interactions with garments, she has built up a library of narratives which point to the already rich relationships many people have with the clothing they buy, acquire, find and borrow. Furthermore, in the Craft of Use (Fletcher, n.d.), Fletcher challenges designers to learn from these stories and through the application of knowledge and skill develop “Use Practices” that enable all of us to “mitigate ... intensify, and adapt” clothing to better suit our ongoing and changing lives.

Methodology

MakeUse is zero waste fashion viewed through the lens of Use Practice. Through an iterative design process undertaken in three stages, involving guided participant testing and unassisted user/maker testing, a range of fashion products was developed that exploit the peculiarities of zero waste garments while exploring Fuad-Luke’s proposed Half Way and Modular Evolved products. Just as multiple court markings on a single surface enable different games to be played over time, MakeUse embeds future modifications in the zero waste design to enable the user to make changes to their garment throughout its use. This approach exploits a key aspect of zero waste fashion design – no part of the cloth is discarded – enabling future modifications, due to changing fashion or needs, to be embedded in the garments initial production. Production is zero waste, construction is simplified, and ultimately product life is extended through engaging the consumer, enabling ongoing modifications and the application of conspicuous mending. Additionally, MakeUse

acknowledges the different skill and enthusiasm levels that all users bring to any activity and caters to a variety of makers and users by offering the product in varying stages of completion and intervention.

Local Lab workshop

The development of MakeUse began with the design of five simple zero waste blocks (basic patterns) for delivery in a workshop format to a variety of participant skill levels. The blocks were made 120cm wide (a common fabric width) but by rotating the grain line, the length or width of the garment could be easily modified on a different width cloth. The modifications possible were designed to be simple, primarily exploring sleeve length and width, and neckline placement and shape, aiming to provide easy to understand zero waste garments. The proposed garments ongoing use and modification was not a consideration at this stage. Participant's skill levels ranged from fashion design students with design and making skills, to the design and making novice.

Through discussion about the five blocks with other researchers involved in Local Wisdom WGTN (the Wellington iteration of the global research project), two of the proposed blocks were discarded before further testing due to their over-complexity in the context of the proposed workshop format. The remaining three zero waste garment blocks were tested at a two day workshop in which 12 participants were provided with full scale paper patterns, sewn samples of the garments made in calico, and pages with a scale illustration of each block, traditional garment blocks and a figure template for developing modifications. The cloth provided for making was developed as part of an accompanying workshop exploring local garment waste, resulting in a bolt of Frankenfabric. Made of unwanted garments from the local region, Frankenfabric provided workshop participants with low-value, low-risk cloth. In this researcher's experience, a common stopping point for zero waste workshop participants in taking risks is the perceived value of the cloth they bring to sew with. Frankenfabric attempted to mitigate this hesitation while visually demonstrating garment waste. Additionally the existing necklines embedded in the cloth provided starting points for the garments designed; a kind of scaffolding to assist participants.

Each block/pattern and resulting garment was explained, and simple modifications were demonstrated for the participants to choose from and attempt, including the effect of moving the neckline position and how to apply colour blocking to zero waste garment design. Feedback for this process was gained through interviews and visual diaries recorded throughout the day. The most commonly made modifications were regarding sleeve/body width/length, colour blocking experimentation and neckline shape, presumably because these were the modifications demonstrated. Commonly the discussion around what modifications to attempt focused on personal suitability and style, suggesting that design features such as neckline, length and colour may be most effective at aligning the garment design with the maker.

Many participants reported wanting more guidance, that the open-ended nature of the design process was daunting and they felt intimidated. This finding confirms the proposal in Sanders and Stapper's *Co-creation and the new landscapes of design*, which states that "different approaches to inviting and involving future users into the design development process will be needed for the different levels of creativity" (2008, p. 14). Others expressed difficulty in translating two dimensional pattern and cloth to three dimensional garments, and numerous questions about how to finish the garments arose. The results of the workshop were generally unconventional garments, but despite their experimental and unfinished nature, a number of the garments were still being worn 12 months later (Anon., 2014). As an initial exploratory stage of the design process, Local Lab was successful, resulting in a number of possible directions available to the researcher.

MakeUse V1

After undertaking the guided testing of the proposed zero waste patterns in Local Lab, a period of critical reflection and design iteration ensued. The key action points taken forward were as follows; a more direct relationship between two dimensional pattern and cloth, and the three dimensional garment needs to be articulated in order for makers/users to better understand the possible forms and modifications available to them. To achieve this, methods previously investigated by McQuillan (2011, 2009b) and Julia Lumsden (2010) were applied, where a combination of digital textile print and zero waste fashion design were used to explore the relationship between

two dimensional cloth/pattern and three dimensional garment. In Lumsden's Shirt 10 (Figure 2) and 11, pattern notches and sewing guides were applied as digital print to the men's shirts, theoretically allowing for easier manufacture of a non-traditional pattern; however this was not explored beyond the initial exploration through the two prototypes. Employing strategies such as these would allow for a number of the issues arising out of the initial workshop to be mitigated and acted upon. However, they would be at risk of closing the design into limited possibilities and care would need to be taken in order to not impose too heavily on the outcomes.

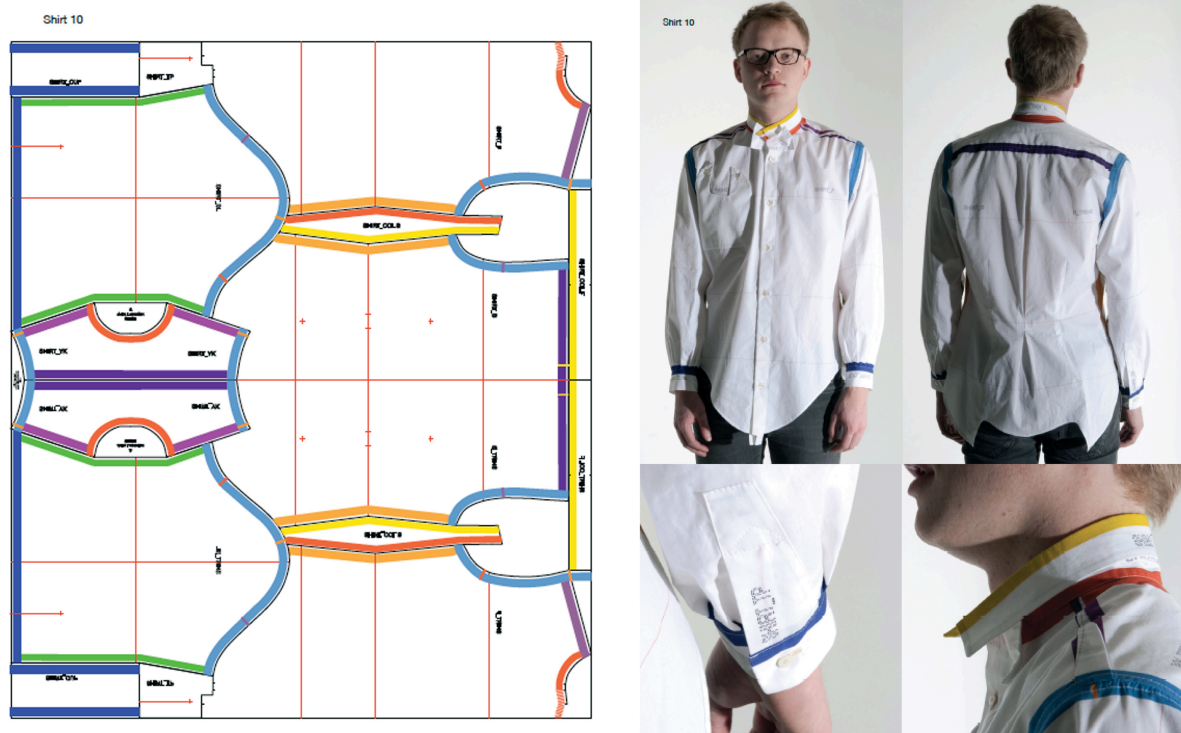


Figure 2. Julia Lumsden's digitally printed men's Shirt 10 pattern and garment, visualizing the direct relationship between two dimensional pattern and three dimensional garment.

Design + Construction

From the five initial patterns proposed and the three patterns tested in Local Lab, four patterns were taken through into the second phase of development. A kimono, cropped t-shirt, dress and trousers were developed through an iterative process to produce digitally printed textile patterns with the goal of fulfilling the following criteria; garments which are simple to sew with a simple and forgiving silhouette, with the

ability to be modified over the use of the garment. Each pattern was developed to have multiple modifications embedded in the pattern and in the print of the garment; for example, the dress can have two armhole shapes and sizes, two neckline depths, two sleeve types, and two body types. It can be widened and narrowed for different body sizes, the hem length can be modified and it can be either a dress or a shorter top. The digital print allows for these modifications to be easily accessed and executed by the user while contributing positively to the visual aesthetic of the garment. Two of the four garments require only two straight seams to be sewn and one – the dress – needs as few as one straight seam to be sewn to make a wearable garment. The trousers were the most complex to sew, but to mitigate this, a more recognizable and traditional pattern was used in their design. Garment finishing techniques were proposed to be bias binding of cut edges, French seaming on sheer fabrics, rolled hems and overlocking where able. Bias binding was used at cut edges to pre-finish a range of neckline and armhole shapes so they could be “reset” to flat cloth and closed with an insertion stitch for ease of future modification.

Embedded Instructions

A basic visual mapping system was designed to both aid the maker and user in making the garment and subsequent modifications, and to build a unique visual aesthetic (Figure 3). The shape and colour of these could be modified depending on the look desired. However the essential function is to guide and instruct the maker and user as to how each garment goes together. Simple steps such as where to cut, fold and join are printed directly on to the garment. By applying these instructions on the garment itself, it was hoped that straightforward transformation from two dimensional fabric to three dimensional garment, and from abstract instruction to concrete action, would be facilitated.

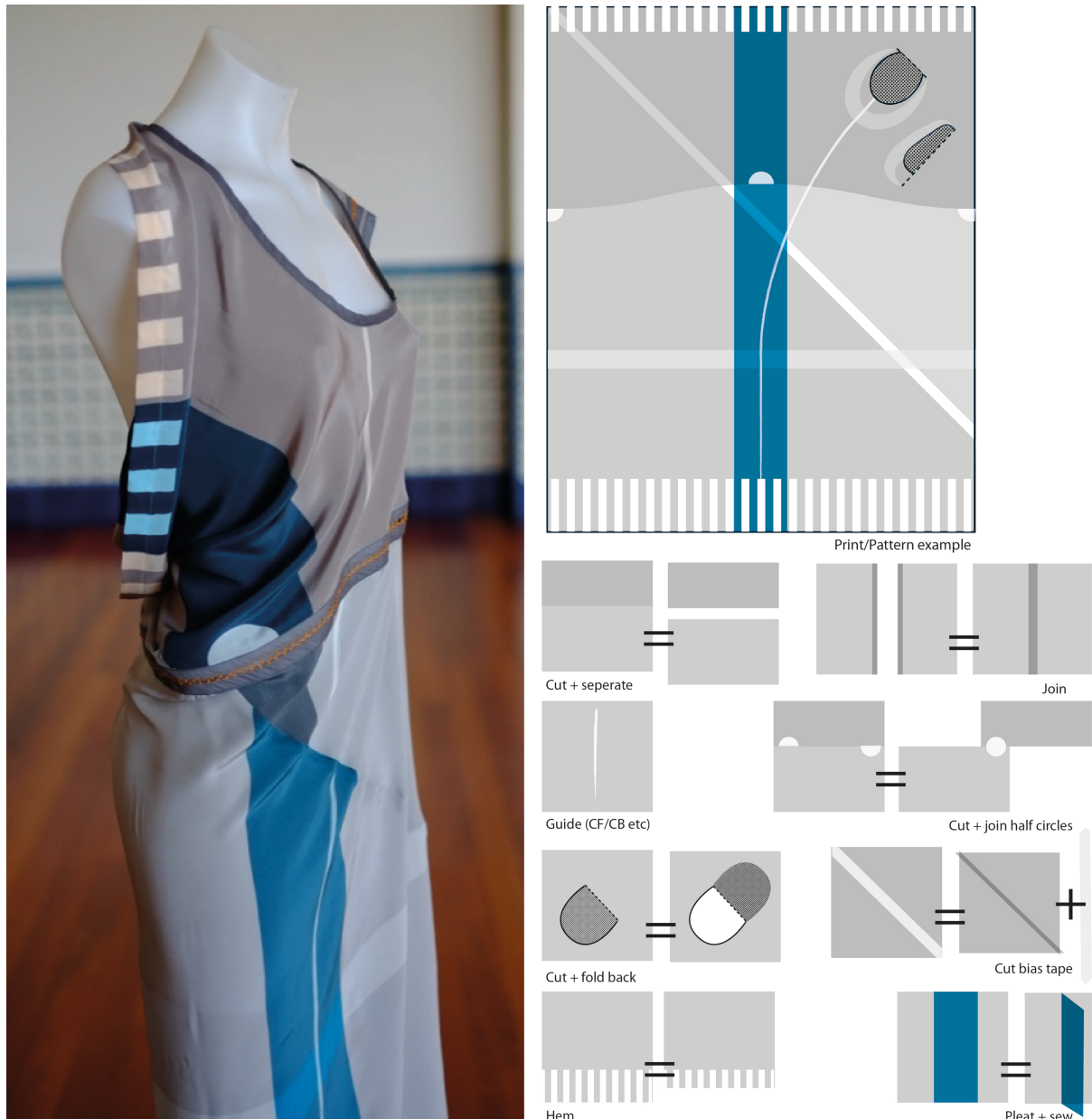


Figure 3. Digital print and prototype demonstrating embedded make and modification instructions.

To assess the ease of construction, a fashion graduate was asked to sew the garments with limited instruction or support. This tested the success of the embedded instructions and suggested the degree of online support that may be necessary for future makers and users. Findings include the observation that the garments non-traditional shapes were initially difficult to understand for the experienced sewer, who may be used to seeing particular forms. Despite this the graduate was able to sew the garments successfully. The bias tape section was

incorrectly inserted into the patterns resulting in uneven seam lengths, causing some difficulty for the sewer. Additionally, due to the curves and tight corners needing finishing, sewing the bias tape on to the garment proved to be complex and tedious even for an experienced sewer. An alternative finishing technique is required in order to achieve the goal of “simple to sew”. The insertion stitch was found to be simple to implement and effective to look at, drawing the eye to this detail, while performing a key function of closing the currently reset neckline (Figure 4). It forms a kind of conspicuous mending, borrowing from the Japanese concepts of *kintsugi* and *kintsukuroi*: the art of the beautiful repair (Bartlett, Holland, & Iten, 2008). This approach does not attempt to disguise alterations or repairs, but instead designs for future modifications and repairs to be undertaken using a visible and beautiful technique, further extending its life and improving the look of the garment.



Figure 4. Detail of initial prototypes showing use of insertion stitch allowing for ongoing modification.

Online Distribution and Support

The four patterns generated through this process were made available for download on the www.makeuse.info website. More detailed instructional support material was supplied here through the use of illustrations and step-by-step guides. The website borrows from approaches similar to Burda Fashion (Fashion, Sewing Patterns, Inspiration, Community, and Learning), | (BurdaStyle.com, n.d.), and Ponoko (Laser cutting and engraving – design, make & build your own products) (Ponoko, n.d.), to

deliver digital and physical products, with support services to facilitate the make and use of the garments. At the initial stages the website facilitates further testing of the patterns and instructions, allowing ordinary users to attempt to make the garments and feed back information to the researcher. In the future it is important to build a community of like minded makers and users of fashion to enable a feedback loop for the ongoing development of the project.

MakeUse V2

MakeUse V2 develops MakeUse further through the introduction of digital embroidery technology (Figure 5), in order to simplify the making stage of the garment while maintaining or expanding the variety of modifications available to the maker or user. In MakeUse V2, the embroidery acts as instruction, finishing (in lieu of bias binding) and aesthetic in one action, enabling a maker to simply cut and then sew as few as one straight seam on a machine (or by hand) to produce a fully finished garment. Experimentation exploring digital embroidery stitch types and placement has revealed areas of tension that need addressing including the digital embroiderer bed size and ease of placement relative to the digital print, and the impact of the application of detailed embroidery designs on the weight and handle of the cloth. These offer opportunities as well as difficulties; for example, embroidery can be utilized to reinforce structurally weak areas of the zero waste garment design, and the contrast between light weight cloth and stiffer areas of embroidery can add to the design. Explorations into mono-fibre production and end-of-life recycling/reclaiming are of particular interest to the project as these have potential to allow the product operate in a cradle-to-cradle model.

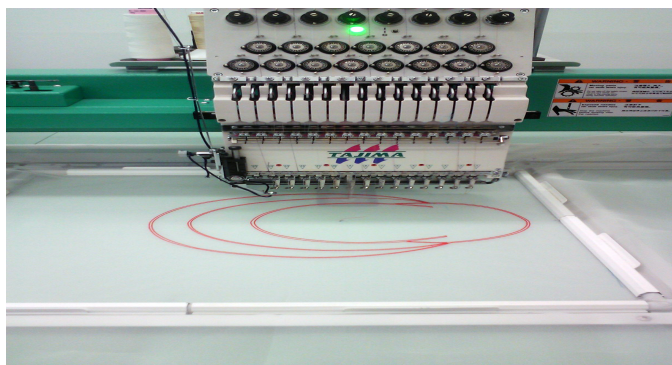


Figure 5. Digital embroiderer stitching neckline.

Proposed System

MakeUse garments are proposed to be part of a larger system designed to encourage the ongoing and iterative use of the products. Existing within a cradle-to-cradle system, MakeUse disrupts the dominant fashion consumption flow from producer to consumer to waste. In the Make phase, product possibilities are proposed by the designer, but are open for modification from the consumer before fabrication. The more input the user/maker has, the more affordable access to the garment is (Figure 6). There are multiple avenues of access from free to the most expensive; available as a basic pattern without print information (free), digital print/embroidery file for the user to modify as desired and have printed themselves, digitally printed cloth, digitally printed and embroidered cloth, a fully finished garment with all necklines/armholes uncut, and a fully finished and cut garment.

This model of engagement also encourages the re-localization of manufacturing and fosters engagement with local businesses and communities. The garments can be digitally printed and embroidered at local facilities – following a distributed manufacturing model – similar to Ponoko and FabLab for hard materials. Finishing can occur locally, either by the consumer or by a seamstress; this process re-localizes the production of fashion products. The garment then enters the Use phase, which is marked by iterative use and modification, a process facilitated by the original zero waste design of the garment. Iterative use is supported by an online community of makers and users, digital instructional information and by the garments themselves. These can be undertaken by the user (ad-lib, guided online or guided in the workshop), by an experienced seamstress or sent back to the manufacturer. Once the physical or aesthetic demands of the user cannot be met by the garment, the single fibre garment can be reclaimed, composted or recycled, depending on the fibre type and condition of the material.

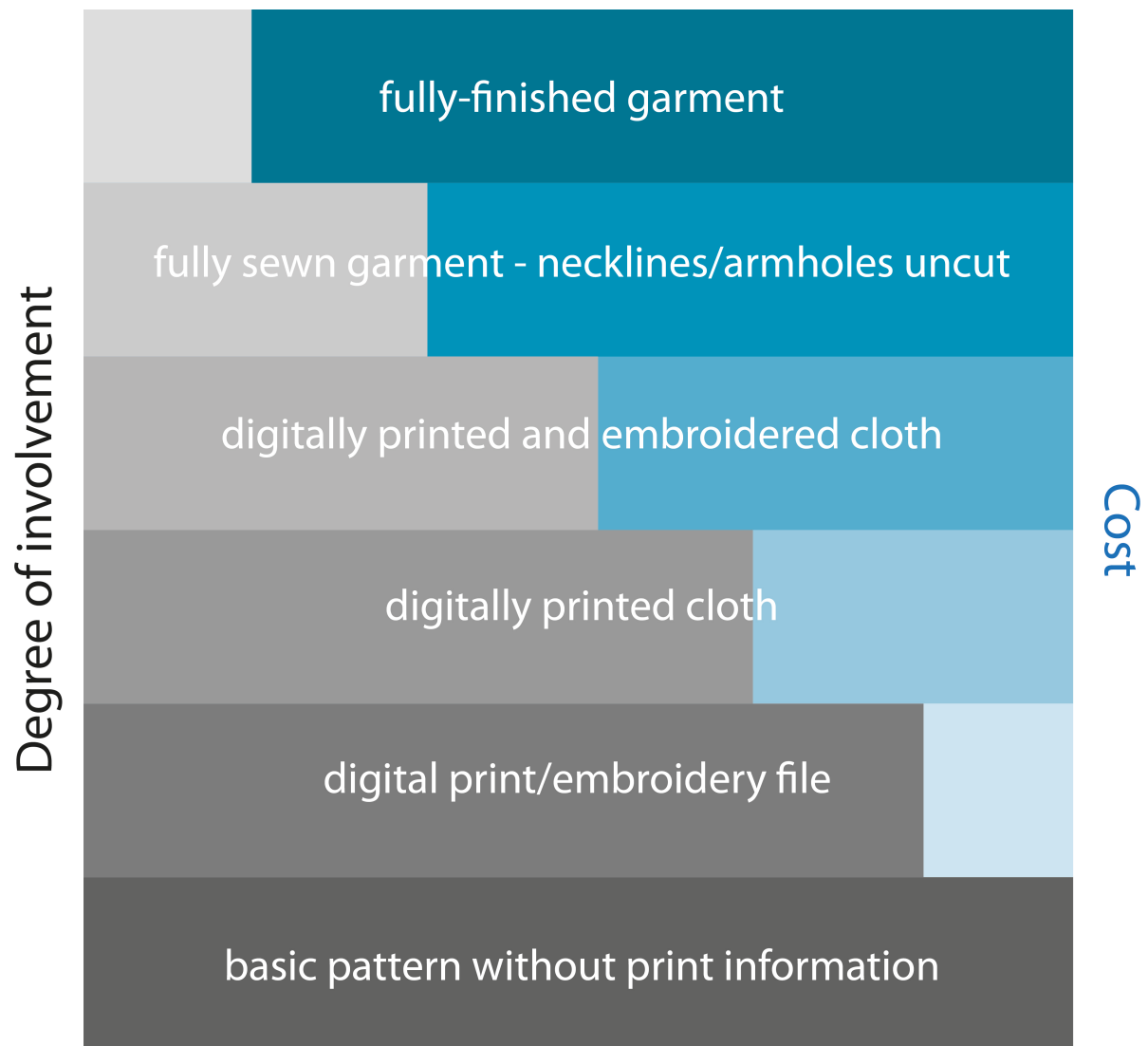


Figure 6. Relationship between user involvement and cost.

Conclusion

While many products employing mass customization have been developed, none have integrated this with the benefits of zero waste fashion design, or through this sought to transform the fashion consumer into a fashion user - an active agent in the ongoing use of clothing. In MakeUse, embellishments such as digital print and digital embroidery function in multiple ways, as decoration, instructions and finishing, ensuring the user experience is as simple and accessible as possible. While Alistair Fuad-Luke and Anja Hirscher (in Niinimäki, 2013) present halfway objects which are intentionally unfinished, MakeUse integrates this approach of active involvement with Fletcher's use practices, while taking advantage of the inherent benefits of zero waste fashion design. Together this supports the ongoing, changing and iterative

nature of use, allowing the user to not only engage with the genesis of the object, but also to direct its ongoing life and use to suit their changing needs. Through enabling users to make their own simple but experimental garments the research aims to challenge the understanding we have of making, wearing, modifying and designing clothing. With future development in the areas of mono-fibre production, digital embroidery, models of distributed production with online support, and the ongoing development of modifications by users, the garments can challenge the dominant monological discourse on fashion as consumption (Fletcher, 2008), by offering another model for fashion engagement and production. MakeUse provides user modifiable zero waste fashion products and an associated product use experience that acknowledges both the opportunities and limitations each user brings, while intensifying their skills, knowledge, needs and desires. Through actions and opportunities facilitated by the designer, an enriched designer/maker/user relationship is possible, bringing into question the role of design in the fashion context and transforming the traditionally passive consumer into an active agent of change.

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