WASTE, SO WHAT?

A REFLECTION ON WASTE AND THE ROLE OF DESIGNERS IN A CIRCULAR ECONOMY.

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ABSTRACT

This paper discusses research currently being undertaken which addresses the interrelated volume, value and cost of waste and the responsibility designers have in its creation. The paper begins by outlining the contemporary waste problem (in the fashion industry). Then utilising observations made during recent field tests – where waste reduction and elimination strategies were applied to existing designs ¬ the impact that explicit and implicit design hierarchies and complexity have on waste minimisation attempts are discussed. Questions such as: is waste a problem in the context of proposed Circular Economy models? After all, if we have a Circular Economy, then any waste we make can be put back into the cycle. So, will the CE let designers (and industry) off the hook? Lastly, I speculate as to what a fashion industry without waste might look like, discussing my design response to the issues raised.

INTRODUCTION

This paper discusses research currently being undertaken as part of a PhD in Artistic Design and addresses the interrelated volume, value and cost of waste, and the responsibility designers have in its creation. The discussion utilises textile waste as an example however many of the problems that exist in the fashion and textile industry exist in other design fields, and it is possible that some of the ways of thinking discussed to address these problems will be transferrable. The paper begins by outlining the contemporary waste problem (in the fashion industry). Then utilising observations made during recent field tests – where I was invited by major brands to apply waste reduction and elimination strategies to existing designs ¬ I sketch out the impact that explicit and implicit design hierarchies and complexity have on waste minimisation attempts. Then I question if waste is actually a problem in the context of proposed Circular Economy (CE) models – after all if we have a CE then perhaps we can continue the status quo in terms of design (overproducing and generating excessive waste in production) because any waste can be put back into the cycle? Maybe the CE will let designers (and industry) off the hook? Lastly, I speculate as to what a fashion industry without waste might look like, discussing my ongoing design response to the issues raised.

Things overrun our world. Many products are over-manufactured, never owned and so are waste through poor management, others are produced, bought, owned but sooner or later discarded. Many products are designed as waste, such as packaging, or waste as an inevitable outcome of manufacturing. As an example, the fashion and textile industry generates between an estimated 55 and 92 million tons (Kerr & Landry, 2017) of waste every year based on 2015 consumption figures. Within one year close to two-thirds of the material used to produce clothing becomes waste. Only 10% of this is currently recycled, with the remainder ending its life in the incinerator or landfill.

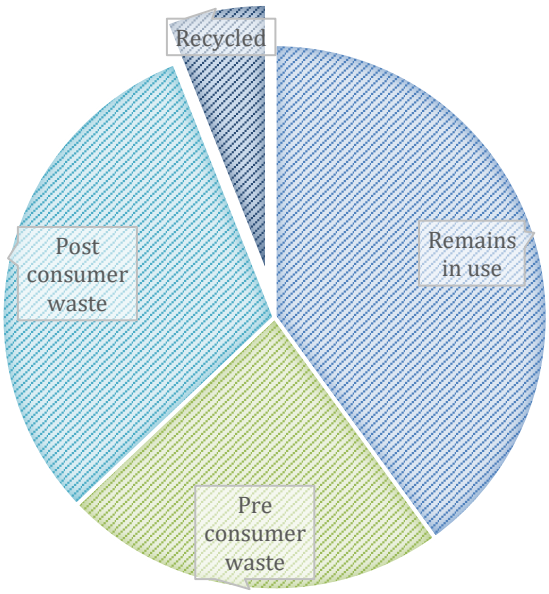

Figure 1: Raw material status within the fashion system after one year. Based on 2015 data (Kerr and Landry, 2017)

METHODOLOGY

This research program (Redström 2017) asks a seemingly simple question: What if we eliminate waste from the production of products? What could that look like in the context of the fashion industry? Employing an experimental and phenomenological approach, I have undertaken a series of iterative field tests and experiments in response to these questions, grounded by ongoing reflection (Schön, 1983) and analysis of available consumption and waste data. Through a lens which advocates for us to consider design as an act of future-making (Simon 1969, Yelavich & Adams, 2014) I have begun to craft an argument supporting the call for an alternative fashion industry.

REFLECTIONS ON DESIGN HIERARCHIES AND WASTE

The waste hierarchy asks that we first eliminate the production of waste and that all other approaches, including recycling, are secondary to this. It is common to consider waste an inevitable 'by-product' of industry and disregard the role designers play in its creation. However, it is important to remember that before it was waste, it was potential. Consider the garment: Fibre into yarn, yarn into cloth, cloth into a garment, at every stage materials are imagined and manufactured into existence – what we do with them, how we make them, how we utilise them – each step we transform them from ideas and materials with potential, to products. And waste – we design that too. If we consider design as an act of future-making (Simon, 1969; Yelavich & Adams, 2014), we have designed our reality and continue to generate the future. Nine years ago McDonough and Braungart in their seminal work Cradle to Cradle (2010) advocated for a redesign of the very notion of waste, however, our models of design, our society and industries continue to make a future consumed by both products and waste.

In this context, I was invited by two major fashion and clothing brands to work with their teams. In this section, I will discuss my reflections relating to the second, longer field test to demonstrate that when attempting to reduce waste within an existing business and production model there occurs a powerful – and lopsided – negotiation between resource waste and design outcomes.

Field Test 2: In 2016 I led a zero-waste design workshop with a large American sustainable clothing brand. In preparation for the workshop, I was asked to redesign an iconic mid-layer fleece jacket using zero waste design principles to demonstrate to the team what may be possible. I presented this design while hosting the zero waste design workshop with the product team who suggested changes to seam placement, such as moving seams slightly for reasons of function, taste or aesthetics. When making these changes, both large and small, efficiency and yield returned close to the original.

Later, the team decided to embark on another related project with me – redesigning a men's and women's technical fleece mid-layer. The project began "off calendar" meaning it would have a long development period, acknowledging the peculiar challenges this type of project faced. However, it was moved to be "on calendar" midway through the process, significantly reducing the time available to develop effective solutions. An iterative process continued back and forward for many months, with shifting explicit and implicit constraints playing an ever-increasing role in the decisions made. Despite the challenges presented through constraints, the designs progressed satisfactorily enough that the company arranged for the design and technical design team, and me to travel to one of their factories for a week of intensive collaborative work. This kind of at-factory design had never taken place in the company before, and in a short space of time, a significant amount of work and related breakthroughs were achieved. The outcome of this week was a working sample of both the men's and women's technical garments, with a significantly lower yield than the original. However once assessed by the wider team, and suggested changes to the aesthetic and fit of the design were actioned, the yield and waste were only marginally improved on what it was initially. The company is proceeding with this version of the garment. (McQuillan, 2019)

The key finding of this field test was the lived observation of the limitations that existing hierarchies of design impose when trying to reduce or eliminate waste

from the fashion design process. There exists a fundamental schism between design as an act of product creation and design as a simultaneous act of waste creation. Waste is considered a management problem that requires collection and disposal. For cut and sew garments waste is the parts cut off when making the desired/designed form and detail. It is emphatically NOT part of the design. Perceptions of fit, function, form, aesthetic and cost are considered exponentially more important. And yet, if design is not only what we design into existence, but also what we design 'away' (Tonkinwise, 2014), then the waste is also what we have designed. The problem is currently, where we only recycle 10% of textile waste, there is no 'away'.

We are content to design out adverse outcomes that do not have an impact of aesthetic, form, function, fit and cost. We use organic cotton, but only if it does not impact on cost or aesthetic. We specify for the removal of toxic dyes so long as the replacement is equally vivid and colour fast. We do not yet have a solution for non-toxic waterproofing, so we continue to use it despite its impact. Please, make it zero waste, but do not change any aspect of the form, fit, function, cost or aesthetic. We have designed the fashion system to prioritise almost all things above the environment we all rely on. The result is the world we live in now.

Through this research, I often ask myself: should 100% resource use in production be the ultimate goal? If the answer is an ideal yes, then we need to address expectations of aesthetics/fit of garments or develop new methods of design and production which eliminate waste while maintaining current expectations.

REFLECTIONS ON COMPLEXITY

In a 2017 report by the Global Fashion Agenda (GFA) (Kerr and Landry, 2017) industry workers identified the following barriers to sustainability; short-term thinking, siloed roles, resistance to collaboration, lack of company resources, among others. Contemporary industries tend to have complex supply chains, with materials sourced globally, and key actions and decisions made independently of others, often in different buildings, cities or countries, using different languages. How can we negotiate the various forces at play in the development of a design when a holistic approach is needed. A key observation from the first field test described was that the most rapid and successful period in the design and product development process was when many of the stakeholders were working together in the same space and time –when the hierarchies and silos were partially broken down.

The tightly controlled hierarchies governing who controls the design and the sequence these levers of control are used became very apparent in Field Test 1.

Field Test 1: was of short duration, lasting three days and taking place in Istanbul. I was asked by a large fast fashion company to work with a group of their freelance marker makers. The company are known for their efforts to reduce the negative impacts of their garments; however, they are a brand where high-volume, low-cost garments dominate. I worked with teams of marker makers on a specified existing dress design, exploring a range of approaches and small changes to the design in order to dramatically improve garment yield and reduce waste, without change of silhouette or critical details. In this context, we developed three different possible outcomes, one of which reduced yield for the planned style by 26%, by adding a single seam. These modified garments and markers were costed by the company, however, as the savings they would make on material yield, were outweighed by the extra cost of sewing the additional seam – because their cloth was so inexpensive – they were not implemented. (McQuillan, 2019)

The marker makers in this field test were experts at making pattern pieces fit efficiently into a lay plan, often performing much better than computer software. However, they had no contact with the designers or pattern cutters in this context. So any insights they had as to waste and yield reduction via changes to the pattern or design had no avenue for communication. This field test also speaks to a particular way of thinking that dominates our capitalist society and industry. Even if a design can be made more efficient in terms of material use, it needs to save money overall to be considered viable. So, how much fabric do we need to save for it to be 'worth' the human effort and financial cost?

When using a conventional production process, particularly within a high volume, low-cost context, reducing yield and improving waste does not seem a valuable investment in time and resources – especially if the material cost is not a significant part of the cost of a garment. The changes required to the profoundly ingrained system are too significant for them to be worthwhile unless there is motivation outside of a financial imperative. This observation is supported by an examination of Runnel et al. 2017 report on textile waste. Despite advocating for a somewhat radical rethink of the role and value of textile waste in the industry, the report still only attempts to address waste once it is made, not the prevention of its production through design. This is perhaps because doing this impacts on design systems, hierarchies in both design and production and potentially garment aesthetics.

I wonder: To what extent are industry and consumers willing to change?

REFLECTIONS ON THE CIRCULAR ECONOMY AND WASTE

If we have a circular fashion system then does that mean we can continue to overproduce and produce excessive

waste in production because the waste can all be put back into the cycle?

Humans are impacting on the geological record to such an extent that the International Geological Congress in 2016 designated that we are now in the Anthropocene, despite the fact humans only account for about 1/10000th of the world's biomass (Bar-On, Phillips. & Milo, 2018). Yet the dominant business-led discourse around 'radical' developments such as the circular economy and circular textiles on the surface seems to suggest that there is little need to modify wider behaviour of consumers and business models because the 100% recycled circular economy will save us from climate oblivion. However, Fellner et al. (2017) and Brooks et al., (2017) argue that such simplistic notions of recycling solving our problems – even if we achieved a theoretical 100% recapture of materials – is flawed. The 2017 study by Fellner et al. examined what level of greenhouse gas (GHG) emissions reduction we might expect if we recycled 100% of the materials used across a wide range of industries: plastic, aggregates, iron, steel, aluminium and paper/board. They found that even with a theoretical (and impossible) 100% recapture and recycling rates we would only generate a 1.6% reduction in GHG emissions. This is because the industries examined already recycle at relatively high rates, the materials are often in permanent (or near permanent) use, so material throughput is low, and growth is still very high, so replacing new with recycled material will not come close to meeting the increase in demand. The report concludes that growth in material use needs to flatten and stabilise.

A NOTE ON DATA

Getting reliable data on the volume of waste generated by the fashion industry is notoriously difficult – a reality exemplified by the fact that the Kerr and Landry's report seems to suggest we discard significantly more garments (92mt p/a) than we consume (62mt p/a). Perhaps the authors have conflated the fashion and textile industries when reporting on waste and not when calculating consumption. Additionally, the Global Fashion Agenda who commissioned the report is in part funded by garment giants Kering, ASOS, Nike and H&M, which could be argued as being a conflict of interest. Most garment companies do not keep reliable records of textile waste (Runnel et all 2017), and there is no clear categorisation of types of waste or what is done with it. In many cases, companies have little information about what happens to production waste as they do not technically 'own' it, and only have a moral responsibility for it. With these limitations in mind, I have calculated the theoretical recycling shortfall c based on the 62mt p/a consumption figure and adds 35% to account for pre-consumer waste, as is indicated in the GFA report (Kerr & Landry, 2017).

TEXTILE WASTE AND THE CIRCULAR ECONOMY

Fellner et al. (2017) do not discuss the fashion and textile industries (though they could be included in some of the figures used for plastic and even potentially paper). However utilising the figures provided in the GFA report (Kerr & Landry, 2017), we can extrapolate figures to illustrate the textile and fashion story. Assuming a theoretical 100% recapture and recycle rate at both pre and post-consumer stages, the fashion industry would be almost 33.5million tons p/a short of recycled material to maintain even current levels of consumption, assuming both zero growth and no improvements in efficiency in production. This shortfall is mainly because people hold on to 54% of their garments year to year (Kerr & Landry, 2017).

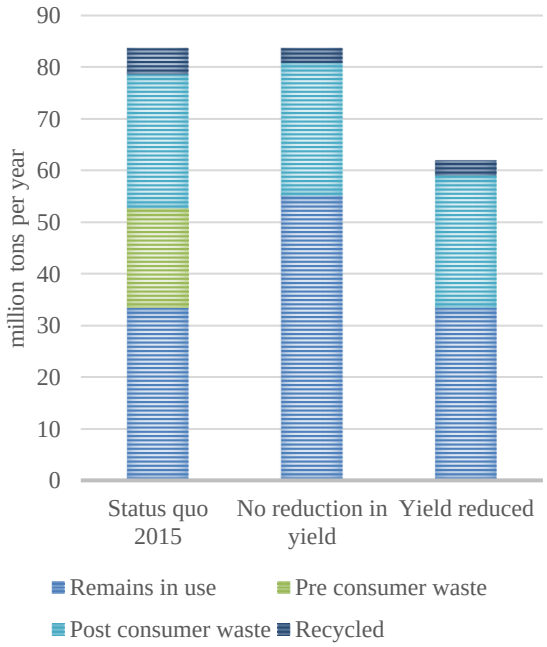

Figure 2: Comparison of material status after one year, assuming zero growth and no rebound effect.

Between 35% (Kerr & Landry, 2017) and 25% (Runnel et al. 2017) of the raw materials used to produce garments becomes waste at the factory. An average of 15% (Rissanen, 2013) is generated at the design stage via the pattern cutting-to-marker making process, and the remainder is end-of-roll, selvedge waste, and other yarn waste. Zero waste through design can lead to a reduction in waste while maintaining yield, or both a reduction in yield and a reduction in waste (before meeting a theoretical minimum yield). If we achieve a theoretical 100% utilisation of raw materials two entirely different outcomes are possible depending on how we do this. For example, if we currently need 200cm of cloth to make a dress but only utilise 160cm (20% waste), but we redesign the pattern or production

method to make the same style utilising the full 200cm, without generating waste but without a reduction in yield – then this will maintain overall total demand. It also drives an increase in the need for virgin materials (a theoretical increase of 21,7 million tons per year) because of the resulting increase in a recycled material shortfall. If instead, we make the same dress utilising only the 160cm needed to make the style (the theoretical minimum yield) then we will reduce demand of recycled material while maintaining demand for virgin materials, assuming we maintain current levels of consumption (Figure 2). Should we, therefore, disregard the reduction of waste without the reduction of yield as a strategy for zero waste? Under theoretical 100% recycling rates yes, however, we do not have that, and it is not likely to ever be the case. This strategy will remove significant volumes (up to approx. 8.3 million tons per annum at the 2015 rate of consumption, see Figure 3) of waste from landfill and incineration, however under a theoretical 100% recovery and recycle scenario the goal shifts to reducing yield while reducing waste.

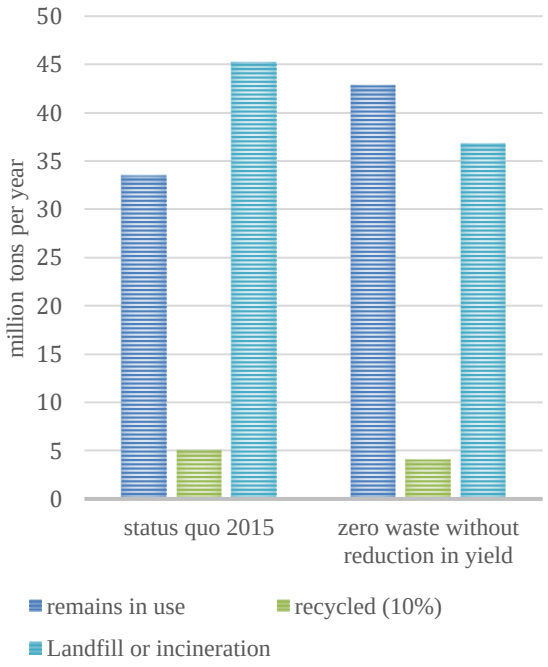

Figure 3: Impact of zero waste (without reduction in yield) on textile waste volume at current recycling rates.

If consumption increases, which it is expected to do so (from 62 million tons per annum in 2015 to 102 million tons per annum in 2030) then the benefits to be gained from achieving theoretical minimum yield in production increase further (Figure 4). However, growth in virgin material demand is still clearly a problem.

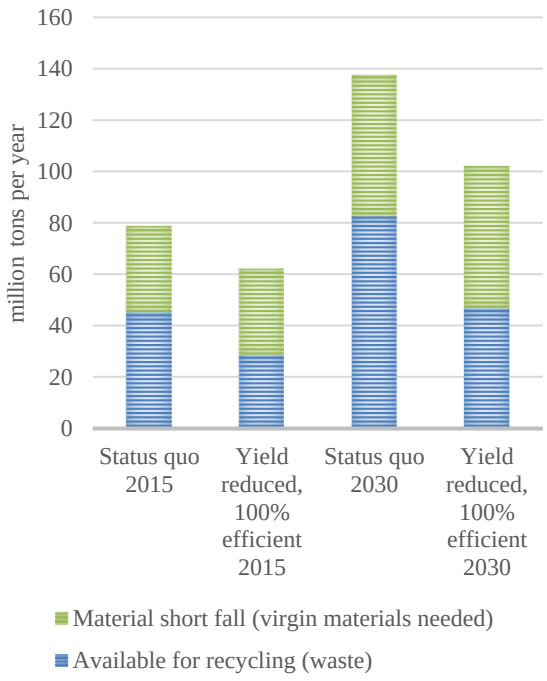

Figure 4: Material demand and shortfall over time, assuming 100% recovery and recycling.

At a theoretical 100% recovery and recycling rate, the key driver for the demand of virgin material use becomes how long people use their garments and its relationship to growth in consumption. If people hold on to their garments (without using them) while also increasing consumption (hoarding), then the demand for virgin materials increases as the material available for recycling cannot keep up with demand driven by growth. However, if people reduce consumption because they hold on to their garments and use them (slow garments, Figure 5), then demand for virgin material is moderated. Alternatively, if people speed up the flow of products through their lives and we can capture and recycle 100% of these products, and there is no growth in demand as one garment is made for every garment recovered. In this scenario, more recycled materials will be available and less virgin materials required.

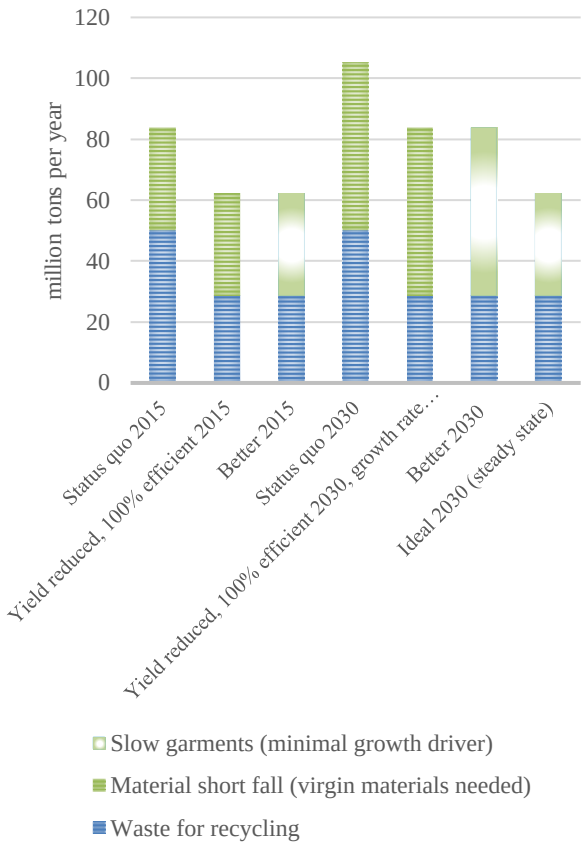

Figure 5: From status quo to better to ideal.

So, we need a multi-pronged approach. First, we need to reduce the amount of material needed (aiming for theoretical minimum yield) to make the garments. Secondly, we need to be able to achieve as close to 100% recapture and recycling rates as we can. Thirdly, we need to eliminate the hoarding of garments, and instead have two distinct kinds of garments (Peters, G. et al. 2018): those that are designed to last, that do not drive consumption increases because they are repaired, cherished, reused, lent, on-sold – these are the only garments (if any) we should consider making from virgin materials. Also, fast '1:1 garments'; which move through the fashion cycle rapidly, providing their own raw material to be reborn, therefore meeting their own demand for recycled material. Lastly, ideally, we need to flatten growth in material use to achieve a steady state economy.

A NOTE ON THE 'REBOUND EFFECT'

It has been observed that increases in efficiency often increase production and consumption, as the raw materials saved through efficiency become drivers for growth – a phenomenon called the 'rebound effect'. "Invariably… efficiency in production processes have been used by the businesses… to save on costs so as to be able to produce and sell more. In fact, what we call economic growth is the long history of the diversion of efficiency gains into production increases." (Grosse, 2011). There seems to exist hope for a perpetually expanding market fed by ever decreasing raw material consumption.

During the field tests I often reflected at the companies motivation for increases in efficiency, it is impossible perhaps for a company operating in a neo-capitalism to view efficiency gains as anything but 'guilt-free' raw material for more production and therefore growth. The potential problem, however, is that without a limit on growth our notion of a circular economy will always be, in fact, an ever-increasing spiral requiring ever more virgin inputs.

FUTURE-MAKING

"The best way to predict your future is to create it." Abraham Lincoln

It makes sense that business is reluctant to disrupt the status quo after all industry has been benefitting at the expense of the environment and many humans for hundreds of years. A progression of efficiency savings in labour (first through the division of labour and more recently automation), and extraction has fostered a business model for the garment industry which is so complex, global and entrenched that change on almost any level seems infeasible. However, change we must. CE "is not a "more of the same" approach…[it] has the potential to understand and implement radically new patterns and help society reach increased sustainability and wellbeing at low or no material, energy and environmental costs." (Ghisellini, Cialani, & Ulgiati, 2016). The future we need (as a self-realised choice and not catastrophic collapse) can seem thoroughly fantastical. The point is that we need radical change – either it happens to us or we design it ourselves.

This research seeks to illustrate what a future alternative model of design and production for woven textiles might be in response to the question: What if we eliminate waste from the production of products, and what could that that look like in the context of the fashion industry? The remainder of this paper seeks to explore some of the approach taken so far.

ZERO WASTE COMPOSITE GARMENT WEAVING

Building on my tacit (Polanyi, 1966) knowledge gained from past experience and in response to the field tests outlined earlier I began to explore the edges of zero waste design practice. Based on my experience attempting to design within the tight framework provided in the field tests it became clear there was a need for a holistic approach, and that the fundamental design of the textile was underexplored as a method of reducing waste for woven textiles.

A key critique of zero waste fashion design is the perceived difficulty in controlling the exact outcome. A holistic approach is required where a careful negotiation

is made between the various competing goals of a product. A fundamental limitation is the rectangular form of the cloth at odds with the curved form of the human body. This perhaps explains why many zero waste garments are voluminous or boxy in form – controlling details and silhouette in the context of rectangular cloth can be difficult.

In response, I experimented with designing both the textile and the form in a simultaneous design process (Townsend, 2003). This enabled me to find the 3D potential in what most designers consider a 2D material. Treating the loom as a kind of 3D printer for woven textiles, "composite garment weaving" (CGW) is defined by Piper and Townsend (2015) as the simultaneous design, and production, of woven textile and garment. This way of working has existed for knitted garments for many years first through fully fashioned knitting and later whole garment knitting, but woven garments are made utilising a method called Cut and Sew.

Cut and Sew is the primary method of garment creation for both woven and knitted garments within the industry. It has been adopted by industry because it enables the various actions of garment creation to be divided into separate steps (the division of labour). However, it is a complex, time consuming and resource intensive practice. This method of production contributes an average of 43% of the waste generated at production due to inefficient and entrenched design and pattern cutting processes. This research critiques cut and sew as an appropriate production method in the context of the circular economy.

In contrast, CGW (like its cousin whole garment knitting) hybridises and automates many of the various actions needed to make a garment – form and detail are materialised with textile. Existing explorations of composite garment weaving include Issey Miyake and Dai Fujiwara in A-POC (1999 - present), and recent explorations of composite garment weaving by Anna Piper (Piper and Townsend 2015), Jacqueline Lefferts (2016) and Linda Dekhla (2018). Other models which disrupt cut and sew for knitwear have begun to be explored by London based Unmade, and Knit for You (Adidas, 2017) with onsite, on-demand whole garment knitting of garments that have been partially designed by the user. Seamdress' by Kate Goldsworthy and David Telfer (2013) explored circular economies, mono-materials and laser-etched garments reducing the steps and materials required for garment production. 3D printed garments are an area of increasing interest, and more work is needed for the outcome to have a cloth-like feel.

By situating the majority of garment production processes in a single automated action and location – ideally, in an on-demand, distributed model close to end-users – production and transportation emissions are reduced and over-production limited. Additionally, it makes possible the re-shoring of production – reversing the decades-long process of 'offshoring' the waste and labour abuses which occur in conventional production.

None of the current examples of CGW fully explore the potential for CGW to generate recognisable forms while reducing or eliminating waste for woven garments. As discussed previously there is a clear need to reduce the yield required to manufacture garments, eliminate (or at least drastically reduce) waste of all kinds (including weaving waste and overproduction) in the context of the CE. It is in this territory that my work has been focussed so far.

Figure 6: The design process occurs primarily in the digital software CLO3D. https://vimeo.com/user42375475/review/311307753/8f2247db1e

CONCLUSIONS AND ONGOING RESEARCH

Design in the context of a circular economy should ideally adhere to the following: Reduce yield to the theoretical minimum while reducing or eliminating waste in overall production. Products need to be able to be recycled easily, so we can achieve as close to 100% recapture and recycling as we can. We need to design two distinct kinds of products: those that are designed to last, that do not drive consumption increases because they are repaired, cherished, reused, lent, on-sold: And '1:1 products; which move through the use cycle rapidly, meeting their own demand for recycled material.

My design responses to these demands are beginning to take form. The use of the t-shirt archetype enables me to explore the possibilities for recognisable form creation utilising a radically different design and production method. The zero waste CGW t-shirt shown in this example was designed almost entirely utilising digital software (CLO3D), which would theoretically enable an on-demand design model for consumers where the garment is digitally tailored to fit. It is then woven on a digital jacquard loom and cut so that the embedded layers, details and 3D form of the t-shirt expand out from the 2D woven cloth.

Figure 7: Video showing the weaving and cutting for the tshirt.
https://vimeo.com/user42375475/review/311307665/fb5719ed3b

All of the examples made so far are woven from 100% cotton to avoid hybrid materials which are more difficult (or sometimes impossible) to recycle, and with further development will require no stitching (which is usually a polyester-cotton blend). Further research will include developing more variation in the creation of form, surface, edges, and details. Variable yarn weight will be explored to potentially eliminate the need for adhesives in production and to control the density (for durability and drape) of the cloth across the loom width.

WASTE, WHO CARES?

So what is the effect of eliminating waste from the design of the products we make? It is clear that we are facing a waste problem that requires we transform our industries and that the scale of the problem is vast and designers cannot continue to behave as though it is only a management and recycling problem. We need to understand that aiming for 100% resource use in production needs to be part of our goals. To achieve this, we need to either address expectations of aesthetics/fit of garments or develop new methods of design and production which eliminate waste while satisfying needs and expectations – or perhaps both. However, 100% efficient resource use cannot be our only task. McDonough and Braungart (2010) critique the waste hierarchy – reduce, reuse, recycle – as the logic of death and argued that we must find a way to design for abundance. Their argument is that growth isn't in and of itself wrong, only the way we do it and that the things society and industry tends to want to grow like product sales and dividends – unless also tethered to the finite environmental (and social) limits of our planet – are the very things that can make abundance for all impossible to achieve.

The complexity of the fashion industry mirrors the complexity of many design-led industries. Our ingrained ways of working, particularly the silos and hierarchies are barriers to meaningful change. Designers need to act as translators and facilitators, enabling better communication to improve the status quo and providing a clear creative vision for what the future might look like. We have work to do so that the products we design are the right kind of products, able to be recycled, and repaired, at the right time. We need to design to prevent the creation of waste in the first instance while reducing the total material needed to make them and meeting our needs. The circular economy will not save us from climate disaster unless we employ its mechanisms well and creatively. We need to utilise all the tools at our disposal to transform the ways products are made and the system they exist within so that once technology catches up with our design dreams, we are ready and waiting.

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