THE CONSTANT CHANGE

An innovative zero waste fashion design process

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requirements for the degree of

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ABSTRACT

Waste appears in all the areas of fashion and apparel industry, through manufacturing, overproduction, fast fashion and also over-consumption. Scholars such as Kate Fletcher and Alison Gwilt have cited statistics about the pollution created by the clothing industry and the increasing impact of the fast fashion trend on landfills. This practice led research project exemplifies a zero-waste pattern design process primarily aimed at reducing waste at the pre-consumer stage. In it, I employ an integration of fashion design technologies such as various zero waste techniques in the development of a new pattern design method and textile print. The alternative pattern design method uses Constant and Variable pattern shapes created by cutting straight-sided polygons[1] from set fabric lengths. This method of zero waste cutting becomes more visible with a dissected block print textile design. The cut shapes are draped on the form to derive a range of three innovative garment designs. My design process draws on "three levels of processing – Visceral, Behavioral and Reflective" (Norman, 2004, 2013) . This methodology has aided my own development as a designer by blending my own history, culture and experiences into this design process for a more meaningful conscious cognition[2]. This aspect and technical design process creates possibilities for other designers in the industry and future applications.

1. Polygon – a plane figure with at least three straight sides and angles, and typically five or more.

2. Meaningful conscious cognition – refers to the reflection or looking back over history, culture and experiences, evaluating the circumstances, actions and outcomes. As a result, this helps make decisions of outweighing the strengths of one aspect over the deficiencies of another.

KEYWORDS

Figure 1. Child carrying garbage at Okhla landfill, New Delhi | Huffington post India |

Landfills
Fabric waste
Environment – and social imbalance
Sustainable Fashion
Zero waste
Indian Craft

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INTRODUCTION

Figure 2. Runway to NZ, 'future generation' collection | Yoshino and Megha |

My Story

According to the facts and figures of the Ministry of Textiles, India and Department of Environment, New Delhi, there has been a rapid increase in manufacturers and export houses in India over the last decade that produce approximately 600 tonnes of textile rubbish daily in New Delhi alone (Department of Environment, n.d.). The Okhla landfill, one of the tallest stacks of waste, produces an extensive amount of toxic gases that are harmful to the environment, workers, and also the residents of the area. While driving through the site, I could see men, women, and kids working, and segregating different kinds of solid waste in the dump that takes years to degrade back into the soil, if at all. I felt humiliated by the awful sight and started to think about the environment and social imbalance created in the triple bottom line[3] due to this mass of solid waste.

This negative experience inspired me to investigate sustainability as a design solution to the fast-paced fashion industry and the waste it produces. Being a fashion design student, I consistently questioned the waste created in the process of constructing garments from sketched design. Prior to this project, I travelled to extreme rural villages, where I was exposed to the simple lifestyle of skilled artisans and their creative ability of storytelling. The undervaluation of their skills and the unawareness of crafts today in India instigated a sense of responsibility in me. My previous practice examined alternative methods of fashion design, also influenced by the crafts of India. I applied various waste management strategies such as re-use, re-design, and multi-functional design in my honours research project. This led me to an opportunity of collaborating with a Massey fashion design honours student to develop a sustainable collection-themed 'future generation' using Indian natural fabrics (Fig. 2). The amalgamation of cultural collaboration, new industrial techniques and ancient natural methods of garment making offered a particular perspective to my understanding of sustainability.

This master's project has facilitated new directions of my practice within sustainable fashion design. Through this practice-led project I highlight a zero-waste pattern design process during its pre-consumer stage reinforced by a personal pursuit to promote the craft techniques of India. Often, the craft of pattern making and intricate hand skills of artisans are overlooked in the industry. As a designer, I weave patternmaking and craft techniques together to achieve a design. In my experience, pattern making and garment construction are the most important stages of durable design development. Thus, the focus of this thesis is developing an innovative zero waste pattern technique and process

applicable to the fashion industry, and also considering the present production structure. This methodology has aided my own development as a designer by integrating my own history, culture and experiences into this design process for a more meaningful conscious cognition[2]. According to Don Norman's framework, our brain experiences three levels of processing – visceral, behavioural and reflective to build or form a strong perception or opinion (Norman, 2013) refer to pg. 29-30. Through this master's project, I have been able to support this method of designing as a conscientious research-based process for product development of apparel design with aims of longevity and durability. The combination of these techniques and strategies helped me achieve constancy in the process of fashion design from a holistic and constructive viewpoint

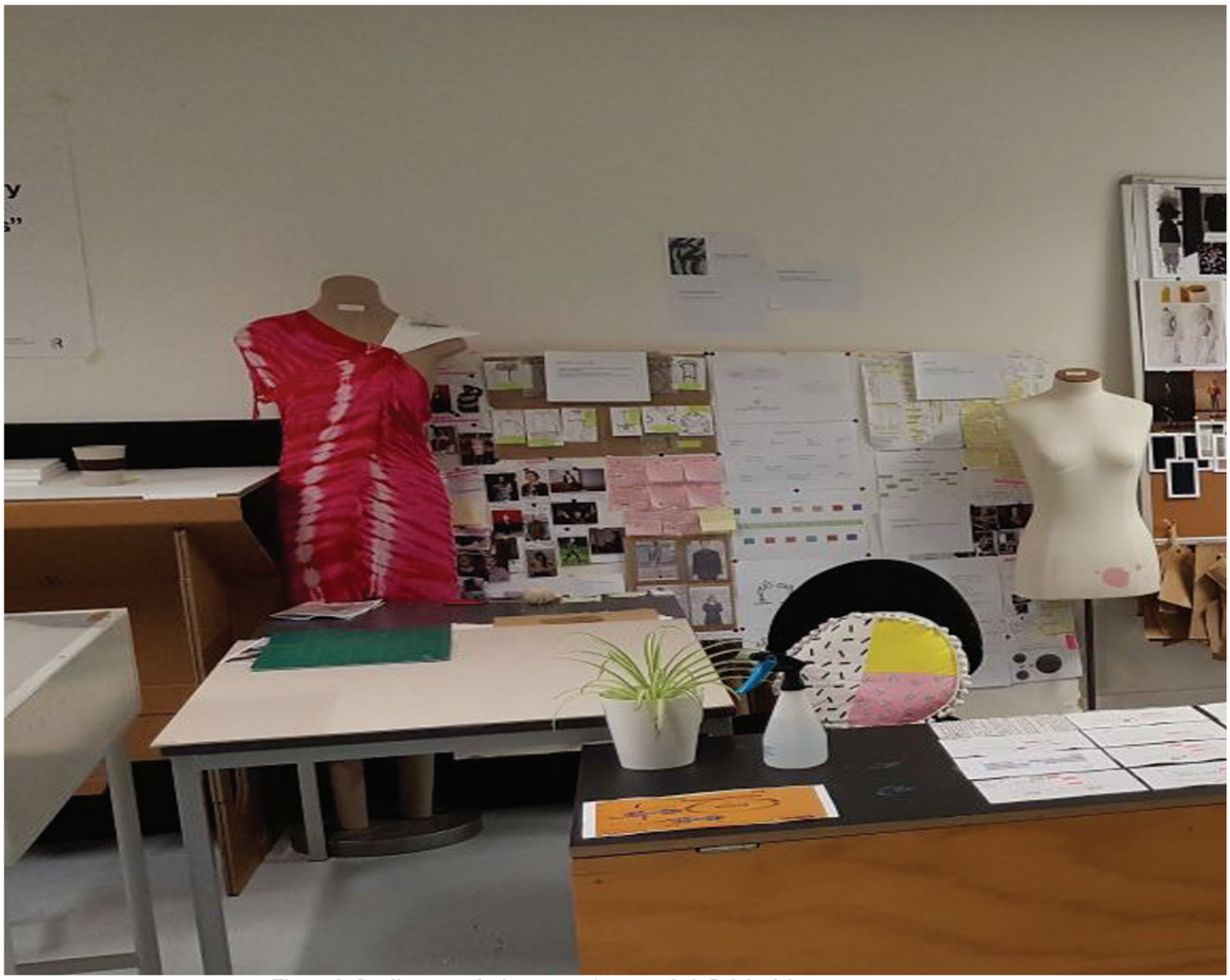

Figure 3. Studio space during master's research | Original |

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LITERATURE REVIEW

Can fashion help save environment and traditions?

Exploitation of the creative process due to the importance given to the commercial and economic factors has now become an eternal factor in the fashion design process. Fashion plays an important role in our society; however, it is a global industry dominated by "fast fashion" – contributing to the sustainability challenge (Cataldi, Dickson, & Grover, 2010). As Fletcher highlights, the negative implications of the growing economy of the fashion industry are experienced as increased pollution, resource depletion, and climate change along with clothing workers' poverty wages, inappropriate working conditions, and large-scale disposal concerns. Therefore, the clothing industry is the second largest polluter in the world (Fletcher, 2016). These destructive effects of the industry on social and environmental activities involved in the life cycle of a fashion product from design to consumption create the imbalance in the triple bottom line[3] (Kozlowski, Searcy, & Bardecki, 2016). The rapid increase in production and over-consumption of fast fashion across the globe has led to dilapidation of the society and environment in developing countries where fibres are cultivated, fabrics woven, dyed, finished and sewn into garments (Niinimäki, 2013). As a result, approximately 22% percent of textile waste is discarded in the landfills, out of which 15% is the pre-consumer waste and 7% waste is post-consumer (Rissanen & McQuillan, 2016).

Creative design strategies can have a positive impact to alter these environmental issues. Fashion design has the potential to enrich our social, environmental and cultural lives beyond economic gain (Gwilt, 2014). Over the past few years, application of the slow fashion movement within the fashion industry has helped achieve better sustainable results. The slow fashion movement is a cultural shift away from product-based society towards a new system where community and ecological assets are valued more highly and "islands of slowness" are developed (Jégou & Manzini, 2008). It also builds a connection between the user and the environment and garment maker. The word "slow" in context of fashion is a synonym of values like local, artisanal, historical clothing, on material pleasure and collaborative experience, cultural diversity, ecosystem health, on awareness, responsibility, and information (Fletcher, 2015). Design processes, from ideation to completion, can benefit the resource flow, workers, communities, and ecosystems as well as allow users to acknowledge and appreciate the design process (Fletcher, 2014). The slow fashion movement model aims to assemble eco-ethical and sustainable fashion into one movement in order to meet fundamental human needs while allowing for the earth's natural regeneration to take place and help maintain the social and environment interests in the fashion industry.

3. Triple bottom line – (TBL) is a concept that seeks to broaden the focus on the financial bottom line by businesses to include social and environmental responsibilities. A triple bottom line measures a company's degree of social responsibility, its economic value, and its environmental impact. The term was first coined by John Elkington in his book "Cannibals with Forks" in 1994.

The slow approach against fast fashion encourages responsible production and consumption, in other words reducing, re-using or recycling waste during its pre-consumer and post-consumer stage. The most applied strategies of the three are re-use and recycle, as they focus on one small part of the product development process rather than the whole. These are effective, but they do not prevent waste creation in the first place. As Lewis and Gertsakis (2003) discuss, it is better to not create waste than to manage it (Fig 4).

The waste management hierarchy has strongly influenced the approach of this project. The application of reducing and removing fabric waste at the early stages of the fashion product cycle is the significant element of this project.

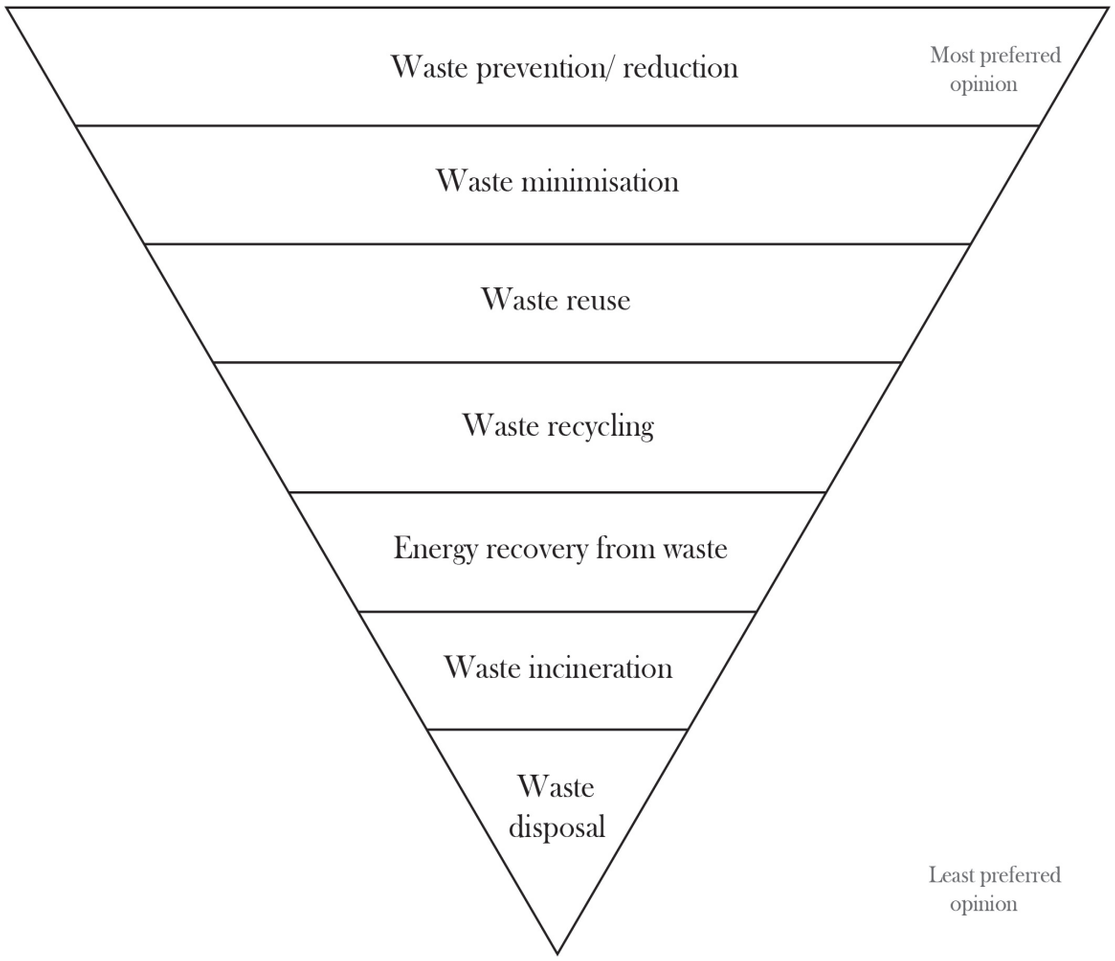

Figure 4. Waste management hierarchy | adapted from (Rissanen, 2011) |

Fashion with no waste

1.1 Fabric waste in a conventional design process

According to Rissanen, the conventional design approach generates approximately 15 percent waste of the fabric used to make a cut and sew garment. Fabric waste should become an important environmental and ethical consideration for the fashion industry rather than just being considered as an economic concern in the manufacturing stages (Rissanen, 2013). In this project, fabric waste is referred to as the cut-offs of fabric material in the process of cut and sew garments. The standard process of making garments in the fashion industry is arguably wasteful and inefficient in respect to social and environmental well-being. In most fashion industry practices, designers and pattern cutters are usually not aware of the amount of fabric waste that is produced because it mostly appears during the manufacturing stage – often in a separate physical location (Rissanen & McQuillan, 2016). It is the marker maker or sample cutter who carries out the practice of altering the layout of a garment pattern by shifting, adding or eliminating a seam in order to achieve cost-effective usage of fabric.

The shape of the pattern pieces (pieces from which the garment is made) generated for a sketched design is usually conformist and often do not interlock perfectly or make a complete jigsaw puzzle. When a fashion designer sketches the design, it is purely the 2D representation of a 3D form and the shapes of the pattern pieces are not explored in relation with the each other and fabric width (Fasanella, 1998). In this process, there is a high percentage of waste generated, as the patterns are commonly aligned with the grainlines of the fabric (Fig. 5). The emphasis of this project investigates the development of an alternative pattern making method in opposition to the conventional system predominantly operating in the industry.

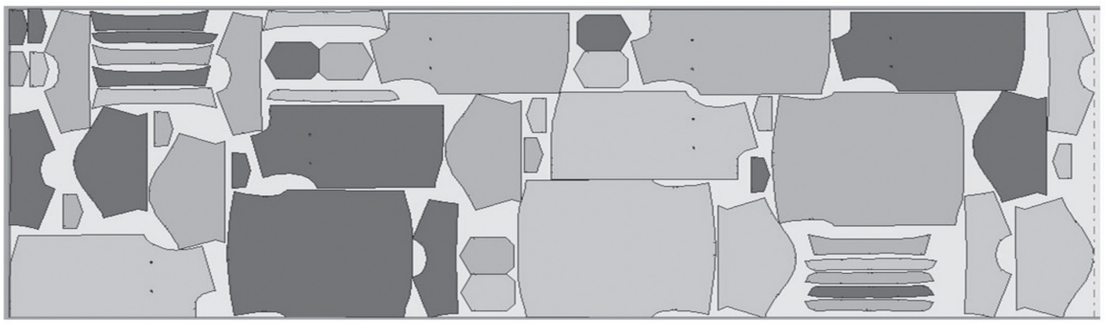

Figure 5. Pattern layout in a conventional design process | adapted from (Armstrong, 2009) |

Figure 6. Greek peplos | Museum of modern art |

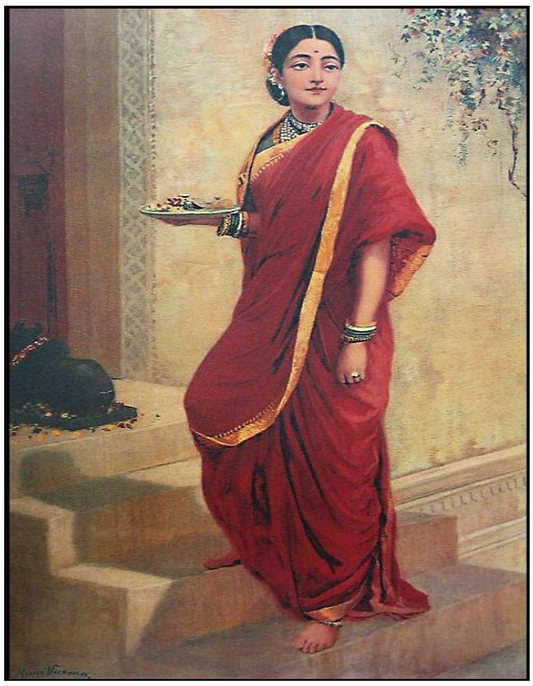

Figure 7. Indian Sari | Raja Ravi Varma painting |

1.2 Alternative pattern approach: minimum/zero waste techniques

As stated by McQuillan (2011), throughout history all clothes were designed to create no waste or minimise waste. Rectangular pieces of fabric were wrapped around the body such as the himation, chiton, and peplos of ancient Greece (Fig. 6) and Indian sari (Fig. 7) (Rissanen, 2005). All of these rectangular pieces can change their form each time since there are no cuts in the fabric to dictate a defined silhouette (Lindqvist, 2013). These shapes were formed by the size of the looms and body requirements, as exemplified in the Roman toga, a half-oval shaped hand woven piece draped around the body without making any cuts (Fig. 8) (Tarrant, 1994; Rissanen, 2005). Another traditional method uses a length of fabric with cut shapes that fit in and around each other like a jigsaw puzzle, also a zero waste technique (Rissanen & McQuillan, 2016). A good example is the Japanese kimono, where the pieces are engineered to the fabric width, therefore no waste is created in the cutting process (Rissanen, 2005). The excess fabric on the neck is pleated inside to make a collar rather than cut. Also, easing the seam allowance on the inside of the sleeve helps achieve a curve at the bottom of the sleeve (Fig. 9). The kimono has continued to inspire many designers for its simplicity and technical sophistication.

Figure 8. Roman toga| Museum of modern art |

Figure 9. Japanese kimono | Museum of modern art |

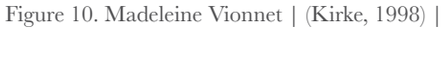

Figure 10. Madeleine Vionnet | (Kirke, 1998) |

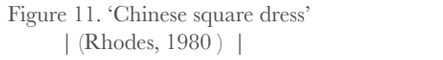

Figure 11. 'Chinese square dress' | (Rhodes, 1980) |

Figure 12. A-Poc | (Miyake, 1999) |

Madeleine Vionnet, a 1920's fashion designer, practised draping fabric inspired by geometry "based on the dynamics of movement" (Kirke, 1998). Vionnet, as a couturier, acknowledged the role of geometric shape and the correlation of geometry with the materials for construction of garments for the human body. She designed through simple shapes draped on the dress form to create innovative designs, with the fundamental ideology of appreciating the relationship between the fabric and the wearer (Miyake, 1998). One of her greatest innovative discoveries was the bias cut[4], "most difficult and desirable cut in clothing" (Kirke, 1998). Vionnet's designs also exhibited a harmonious relationship with the fabric width. The popular handkerchief dress is an example of rectangle-based patterns, cleverly cut to use geometric shapes that take advantage of the bias grainline when worn (Fig. 10). This often created patterns that were minimal in shape, yet the designs contoured the body.

Over the past few decades, practitioners have challenged the conventional method of pattern making and garment construction. Fashion designers and textile designers have designed garments while considering pattern making as an integral part of their design practice. Zandra Rhodes, a trained textile designer, uses her skills to determine the pattern shapes with zero waste cutting shapes. The "Chinese squares" dress is an example of where textiles can lead the garment design fully when utilising a minimal waste pattern (McQuillan, 2011). The result of the print design is a tessellation[5] arrangement from a series of squares. It wraps around the body, eliminating the need for side-seams. Cut-offs from the neckline and waste are used to construct the mechanism of wrap-around at the waist (Fig. 11).

Issey Miyake is well known for his experimental textile pieces, which use the concept of "a piece of cloth". A-POC is a manufacturing method that creates clothing from a single piece of thread in a single process, using computer-aided technology. The philosophy behind this concept is to not only explore the relationship between the body and clothing, but also the space that is born between them. A collaborative project 'A-POC Queen Textile' between Miyake and Fujiwara was designed to let users become the designers themselves and allowed customisations of the garments of certain parts such as sleeve length, bias, and neckline (Miyake & Dai, 1997) (Fig. 12).

4. Bias cut – cut obliquely or diagonally across the grain. The "bias-cut" is a technique used by designers for cutting clothing to utilise the greater stretch in the bias or diagonal direction of the fabric, thereby causing it to accentuate body lines and curves and drape softly.

5. Tessellation - an arrangement of shapes closely fitted together, especially of polygons in a repeated pattern without gaps or overlapping.

Figure 13. 'Subtraction cutting' | (Roberts, 2012)|

Figure 14. Zero waste pajama set | Collection: MLS | (Rissanen, 2011) |

Figure 15. Holly Mcquillan | Project Make/Use|

Julian Roberts introduced "subtraction cutting" as an innovative minimum fabric waste method. As the name suggests, the final form is "created by the removal of fabric, rather than the addition of fabric" (Roberts, 2012). While explaining the role of fabric in pattern making, he highlights the movements of the fabric as it can fold, roll, zigzag, twist, and tie itself in knots. Roberts continues to explore pattern cutting by using 'tube technique', 'plug technique', and 'displacement technique', and also making his design multi-purpose (Rissanen & McQuillan, 2016) (Fig. 13).There is evidence of increased attention being given to zero waste fashion design practice. At this stage there has not been significant take-up in the industry but more companies are looking at sustainable solutions.

Timo Rissanen and Holly McQuillan, leading contemporary zero waste fashion practitioners, have combined research and conscious pattern making practice in their seminal text "Zero Waste Fashion Design" for a sustainable fashion design approach (Rissanen & McQuillan, 2016). The aim of the book is to highlight and share zero waste fashion practices from all perspectives, historical to present, and they advocate future application. Multiple methods of pattern making are described and aesthetics realised throughout the book. Timo Rissanen (2011) has investigated various possibilities of achieving zero waste through recycle-upcycle, and incorporation of fabric for purposeful details of the design such as wider seam allowance, larger hems and reinforcement pieces (Fig. 14). Most of his projects are also a response to longevity and durability of the garments, as the designs can get altered, re-sized and repaired. Rissanen also discusses the building of an emotional connect with his designs, using the customary family tradition of crafts (Rissanen, 2011). This has particular relevance to slow fashion processes.

Holly McQuillan's (2011) project "embedded zero waste" is an interesting method of achieving zero waste by embedding multiple garments in one pattern for a collection (McQuillan, 2005). This broadens the scope and manufacture of multiple zero waste garments. Project make/Use is an open source library for zero-waste patterns, which are inspired by the Danish Bronze Age pattern (McQuillan, 2013) . The single rectangular piece of cloth can be transformed into a crop t-shirt, with the help of curved guidelines and an instruction set. McQuillan has spent a number of years exploring many different approaches to working with varied fabric widths and manipulation of standard blocks into alternative shapes to fit into limited fabric lengths. At an earlier stage, McQuillan investigated tessellated shapes. These varied in scale and intensity and, when cut, were applied to the dress form to create textual interest that contoured the body (Fig. 15).

Figure 16. The gauze coat |zero + one | Deb Cumming|

Figure 17. Zero waste minimal seam | Project Yield| David Telfer|

Figure 18. Four way jacket | Project Yield| Tara St James|

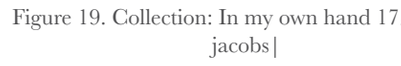

Figure 19. Collection: In my own hand 17/18| Lela jacobs|

Collaborative projects, with other fashion practitioners and disciplines, have extended the design and functional possibilities. McQuillan's work with Deb Cumming – Project zero + one is a collective approach to alternative pattern making technique of zero waste and one-piece pattern (Cumming & Mcquillan, 2017). Cumming's approach to minimal/zero waste pattern making is through exploring experimental one-piece patterns for complex forms. Her technique demonstrates "minimalism in aesthetics and production with reduced cutting and construction". The consideration of the project is to optimise volumetric fashion shapes with increased comfort and movement for the wearer (Fig. 16). The gauze jacket is a result of anthropometric[6] studies interpreted through pattern making in order to increase comfort, which also induces new aesthetics drawn within the process.

David Telfer's methodology to garment construction is "zero waste" and "minimal seam". Instead of cutting the body, sleeves, and hood separately, a slash and spread method has been used to wrap the sleeves over the shoulders from front to back, and back wraps at the sides to the front (Fig. 17). In collaboration with Dr. Kate Goldsworthy, he explored one-piece pattern-cutting to examine different ways of cutting and stitching the garment (Telfer & Goldsworthy, 2013) .The design is adaptable to different fabric widths, determining the length of the garment . The flexibility of design outcome in shape and detail adds longevity to the garment. Tara St James, the founder of Study NY (2009), reinforces zero waste as a technique to slow down the fashion cycle. She repeats the square cut zero waste dress several times in her collections since it can be worn in multiple ways (Rissanen & McQuillan, 2016). By doing so, she lets her users engage with the garment as they can play with the intricate placement of buttons and buttonholes to create a new form (Fig. 18). She also collaborates with artists and textile designers. According to Tara, building a deeper connection between the user and garment results in a longer lifespan, reducing the waste and creating a valued experience.

New Zealand designer, Lela Jacobs (2016), designs experimental silhouettes through challenging technical pattern making to achieve minimum waste solutions. Her collections are minimal and understated with an emphasis on strong design and innovation inspired by local and international artists using high-quality fabrics (Fig. 19). Her philosophy to achieve zero waste is to work backward during the design process and to allow cloth/fabric design the form by itself. A designer should be taking risks and be open minded within inherited cloth limitations such as cloth width, drape, weft and warp[7], and bias (Rissanen, McQuillan, & Jacobs, 2016).

6. Anthropometric - the study of human body measurements especially on a comparative basis

7. Weft and warp - Warp and weft are terms for the two basic components used in weaving to turn thread or yarn into fabric. The lengthwise or longitudinal warp yarns are held stationary in tension on a frame or loom while the transverse weft (sometimes woof) is drawn through and inserted over-and-under the warp.

Another New Zealand based fashion brand, 'FraserCrowe', is a collaborative set-up of fashion designer Kim Fraser and artist Deborah Crowe. FraserCrowe push their collection against trend-focused fashion, think about the future of the planet, and design clothing that feels gorgeous to wear (Fraser & Crowe, 2018). They produce high-quality sustainable garments that are directional, questioning traditional approaches. Their designs are flexible and offer fluidity in fit and size, unlike traditional size conventions. The inventive nature of the garments reflects a confident sophistication and timelessness (Fig. 20).

Figure 20. Waste-less black dress; artworks |FraserCrowe | Kim Fraser and Deborah Crowe |

Figure 21. Artisans practising hand block printitng using 'jaal and buti' motif | Anokhi Museum of Hand Printing |

2. Crafting emotions and connection

Artisanal craft is rich and diverse, as it is a result of skills and resources, and also cognitive features such as histories, attitudes of people, their traditions, and social structures (Fletcher & Grose, 2012). With the help of designers, it can act as a catalyst for economic and social change as it responds to the marginal communities and connects cultural styles with the target market. Clothing as a fundamental need was elevated into an art form by skilled craft artisans of India and contributed to the ancient economy of the Indian subcontinent (Guy, 2014). Traditionally, Indian art forms were crafted to narrate stories, and be expression of people belonging to different cultural and social groups. Textile crafts, even today, embrace weavers, dyers, printers and embroiderers who have been producing meaningful fabrics for the global market for at least two millennia. As Kolay (2015) probes, due to industrialisation and change in social behaviour, Indian crafts are becoming secluded from a larger number of the Indian and global population. The transition of consumer behaviour towards 'fast fashion' and 'digitised merchandises' is because of the extreme shift of perspective from a need for a durable and essential product to a non-durable product with modern brand value (Fletcher, 2014).However, according to Jonathan Chapman, consumers are always fascinated by the constant search for meaning, which is an accumulation of deep sensations of attachment and empathy developed exclusively to the user. Fashion products are far beyond the elementary purpose of clothing, and they are one of the visual means through which individuals can make expressive statements about their identities and opinions (as cited in Bennett, 2005). In my view, crafts can help create positive and reflective emotions.

To be able to create these emotions, there is a need to appreciate sensitivity of the process, which is deeper than just the shape and surface of the product to change the experience one has with the product (Walker, 2016). As Fletcher suggests, the textile craft can be a guide to adaption, using key symbols, patterns and colours, and create a sustainable activity to encourage the user. An inspiring case study is Anokhi, based in Jaipur India, known for its traditional 'hand block printing'[8] from Bagru and Sanganer. John and Faith Singh (founders), wanted to preserve ancient block-printing techniques and provide sustainable employment to craftspeople (Edwards, 2016). Their motif patterns are developed out of 'butis and jaal'[9], which are traditional Indian motif designs (Fig. 21). To cope up with the serious challenges faced due to modern manufacturing – fast fashion – they set up the Anokhi Museum of Hand Printing to educate people. Dedicated to the art of block printing, AMHP strives to inform both textile specialists and general public alike; but more

8. Hand block print – the process of impressing patterns on textile fabrics, especially calicos, by means of wooden blocks having the pattern cut in relief on their surface and charged with colour. A similar method is frequently used in printing paper-hangings.

9. Buti and jaal - A small motif on its own is called a Buti (Fig. 21, right). The buti can be floral, paisley or geometrical but is called a buti which means the smallest one. Jaals are interconnected vines, sometimes directional but mostly non- directional, all over in the pattern of laced floral butis, leaves and tendrils (Fig. 21,left)

importantly, the artisans themselves are encouraged to visit and view their craft in a unique and inspirational way.

It is also important for the fashion designer to understand this in their own process of designing in order to connect with themselves and the product they create. As Don Norman (2004, 2013) writes, the brain responds to three levels of processing: visceral, behavioural and reflective, and seven stages of action: goal, plan, specify, perform, perceive, interpret, and compare to build cognitive and emotional connect with the product (Fig. 22). Although this strategy does not originate from the fashion design discipline, it can strongly relate to a design methodology. The visceral system is the most basic level of processing responsible for sub-conscious responses, and the human brain performs and perceives immediately to the situation unaffected by the context of the situation. While the behavioural system considers and interprets values, history and experiences, it does not concentrate on the details (Norman, 2013). However, for designers, the reflective level ensures conscious cognition. This is because it is the most conscious and aware system, and emotions produced during reflective activity are the most protracted as they contemplate self-image, personal satisfaction and memories (Norman, 2004). This can aid the designer by integrating history, culture and experiences into their own design process for more meaningful conscious cognition (Fig. 23).

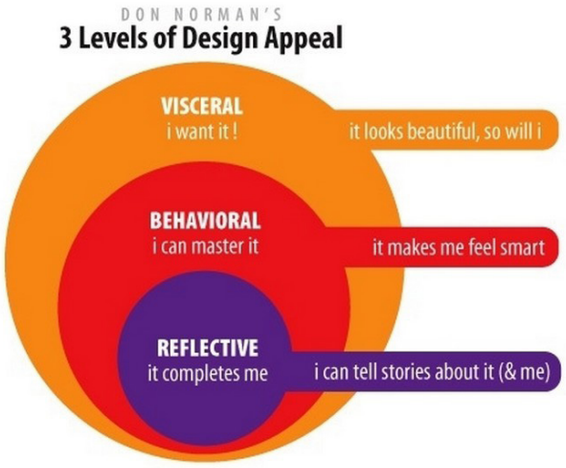

Figure 22. Three levels of processing| adapted from (Norman 2004, 2013) |

Figure 23. The power of emotion| Story telling | Information experience design at Pratt |

3

PROCESS

Figure 24. Exploratio

The primary aim of the project was to develop my own pattern design method focusing on innovative zero waste pattern making. This integrates a sustainable design practice and Indian craft of hand block printing to illustrate the patterns and enhance personal and cultural meaning and aesthetics of the collection. Throughout the project, I have used a reiterative design technical process, beginning with pattern case study analysis, explorative pattern making through geometric shapes and 3-dimensional translations in half scale and full scale (Fig. 24). To apply these shapes to the dress form, I have applied contouring and form extension method. This process is shown through the development of three garments, which can be transformed and altered for varied body sizes with fabric length and width changes. My design process integrated reflective aspects of Norman's theory of three levels of processing and seven stages of action for conscious cognition (Norman, 2004, 2013). There have been instances where I have been influenced by my history, values and experiences, and I have consciously integrated my personal memories and emotions into the design process.

Pattern exploration beginnings

The starting point of my ideation was to carry out intensive technical pattern design research. An important new personal approach for this process was to not decide a final outcome from the start. I have allowed myself to traverse the findings of the methods and techniques and take risks to avoid any predetermined aesthetics, as in a conventional fashion design process. At the same time, I worked with half scale measurements to develop and sample pattern designs in the explorations to contribute to less waste within my process. During the development process, I have been creating, documenting and reflecting on iterations at each stage. The documentation of each stage is useful in analysing and identifying the parameters of the project and refinement of design and technical details.

ın process | Original |

Case Study 1. Madeleine Vionnet's handkerchief dress

As I have been inspired by Madeleine Vionnet's work in using geometric shapes that were highly sympathetic to the body contours, I replicated her famous handkerchief dress to understand the workings of the straight-patterned shapes and altered positioning on the body (Kirke, 1998).

Figure 25. Replica of handkerchief dress (Madeleine Vionnet) | Original |

To make the pattern for the handkerchief dress, I closely examined the construction of the dress and the 2D pattern drawing to determine the placement of unconventional straight seams on the body. I reconstructed the handkerchief dress using approximate body measurements for pattern making and stitched the patterns, practising different methods of overlapping and controlled gathers at specific areas (Fig. 25). The most challenging part of the development process was to assess the measurements, as the pattern block is made up of straight lines while the human body is a curvy linear form. My intention was to construct Vionnet's creation through flat pattern making rather than draping. In other words, I wanted to understand how 2D straight geometric shapes could successfully take the form of a curved body.

Within this process, I found the use of bias[4] crucial when applying squares and rectangles on the body as this can help attain the curve to emulate the body shaping or allow movement in the garment. It was thought provoking to convert a draped geometric pattern design into 2D without compromising the minute fitting details. The iterations of the flat pattern and the stitched garment became an important factor. To conclude, I did an analysis of the case study based on aesthetic, form and balance to set parameters for further explorations.

- Aesthetic- Visually, the designs showed a relaxed sophistication. They appeared simple in form yet the patterns were cleverly functional. The fabric material plays an important role when using bias cut. The looser weave drapes and takes the form effortlessly in comparison to strongly woven fabric. The flat overlapping of the patterns creates visual volume while avoiding fabric bulk on the inside of the garment. There is a repetition of line and shape within the pattern and the garment outcome, which enhances the design.
- Form- The handkerchief dress is constructed out of geometric shapes, yet the visual form of the design is organic and subtle, enhancing the curves and softness of a feminine body.
- Balance- The shaping of the handkerchief dress stitched on bias cut still gives stability and structure to the garment. The equal distribution of the fall of the fabric from the shoulders in the front and back creates balance, and the belt at the empire waist anchors the dress and shapes the waistline.

Case Study 2. Holly McQuillan's project make/use crop t-shirt

Reflecting back to my culture in India, I am very aware of the saree as a piece of no-waste clothing, comprising a rectangular piece of fabric that is defined by a set length. Considering this as a zero waste concept I wanted to understand the application of this for other contemporary clothing. I am drawn to Holly McQuillan's work, which has investigated many variants and has a modern contemporary aesthetic with sustainable motivations. After researching a number of her methods (McQuillan, 2005) I selected McQuillan's Make/Use crop t-shirt for this case study.

Figure 26. Exploration inspired by 'Project Make/Use' crop t-shirt| Original |

Project make/use is an open source for zero waste fashion design patterns. For my research, I used the cropped t-shirt grid template to develop my own pattern using the half scale measurements. I used this particular pattern because I wanted to understand the drafting of the pattern. I followed the steps outlined on the website for construction, but at the same time investigating the movement of straight and curved lines around the body. As a result, there are a few changes in the construction and aesthetics of the final outcome.

The intersection of the fabric centre line and shoulder line, as well as 1/4th fabric width and sleeve depth were the key anchor points for drafting the pattern of the crop t-shirt (Fig. 26). The method provided a number of variations by altering the draft preparation. This allowed the design variations and also modification, depending on the width of the fabric. The process accommodated for this with the first step being to mark half way between the edges of the fabric. The fabric width plays an important role, as it determines the circumference of the garment and the span from sleeve hem to sleeve hem. To construct the pattern, I used 'to cut and wrap' method to create a hollow structure with sleeves and a round neckline. Since the pattern is a one-piece pattern, I found it interesting as to how the conventional side seam shifted and merged at the centre back. This was a simple yet effective shift from the conventions of constructing a familiar garment. Similar to the previous case study, I did an analysis of the project Make/Use crop t-shirt on the basis of aesthetic, form and balance.

- Aesthetic- The patterns created a loose relaxed look with considerable space between that garment and body. The integration of the screen printing and stitchwort into the design pattern gave a new aesthetic in colour, texture, and patterning as well as a guide for visibility and construction of the pattern lines and seams. Seaming needed to be internal to the patterns, incorporated within the fabric parameters.
- Form- The combination of a geometric shape and curved lines can be used to develop a contemporary look. The curved pattern lines move along the posture of the body for easy movement of the body. Again, fabric use was important in creating the varied silhouettes and form. The forms can be adjusted in lengths and shapes changed in positioning on the body, depending on the maker's choice. Pattern templates are available for cutting out various details such as round necklines and collar necklines.
- Balance- The division of the fabric into halves and quarters related to the fabric width and generic measures of the body. The balance varied, depending on how the garment was worn and what aesthetic was wanted.

Setting up pattern design parameters

Both case studies informed my understanding of the role of geometric shapes in achieving minimum or no waste pattern making. This allowed me to interrogate my own design motivations and explore zero waste patternmaking designs based on the parameters that I set out as a result of my case study analysis.

I began my explorations by constructing a toile of the traditional basic double dart jacket in half scale measurements. The purpose of this was to calculate the amount of fabric usage in a traditional pattern making as I considered it important to not use excess fabric with a new process. This also allowed me to think critically about the conventional practices of block shapes and flat patternmaking in relation to the body. I chose to make a jacket pattern as it is developed out of the torso foundation, being a combination of bodice and skirt without a waistline seam. This can be the basis for a jacket and a dress pattern work. It was important for me to consider the critical areas of a human body – the bust and the hip – as these are the widest parts and most relevant for my zero waste explorations. In making up the darted jacket, I adhered to the conventions of using a front, back and sleeve block with shoulder seams, side seams, and waist darts vertically positioned. The lengthwise grainline was placed vertically to the body on all pieces. These technical characteristics replicated a tubular garment shell, body and separate sleeves with ease built in, and a degree of contour shaping for fit (Fig. 27). This is a familiar and standard pattern design, which acts as a block for further design explorations.

Figure 27. Half scale traditional double darted jacket| 1/4th set size | Original |

Parameters

Straight sided pattern
Use of bias cut
One rectangular piece
Form expression
Integration of hand block printing with crafts

To disrupt the conventions in pattern design, my own explorations were led by geometrical pattern shapes, as these would direct the design process with minimum or no fabric waste (Fig. 28). These shapes facilitate methods like jigsaw and embedding pattern shapes within the fabric dimensions in one block. Based on my own design preferences, I made the decision to explore a degree of soft structuring and fit as integral to developing the designs using geometric pattern shapes.

Figure 28. Minimum/zero waste explorations | Original |

Creating pattern shapes: the polygons

As an outcome of my previous explorations and inspiration, I decided to confine my explorations to a specified and limited use of fabric. To resolve a set length and width of the rectangular block I calculated 1/4th of the entire fabric dimension used to construct the basic double darted jacket on a half scale measurement: 64cmx51cm (refer fig. 27). I noted the fabric usage of the conventional jacket and challenged myself to produce a geometric-based design with the same or less fabric meterage.

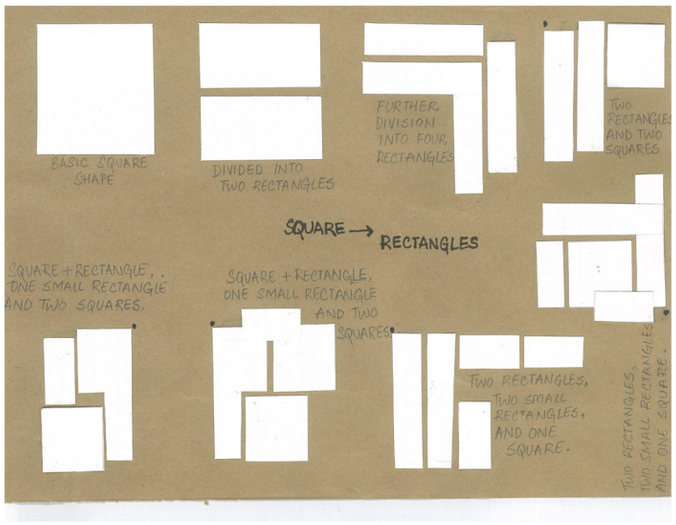

Figure 29. Dissection of square into rectangles and squares | Original |

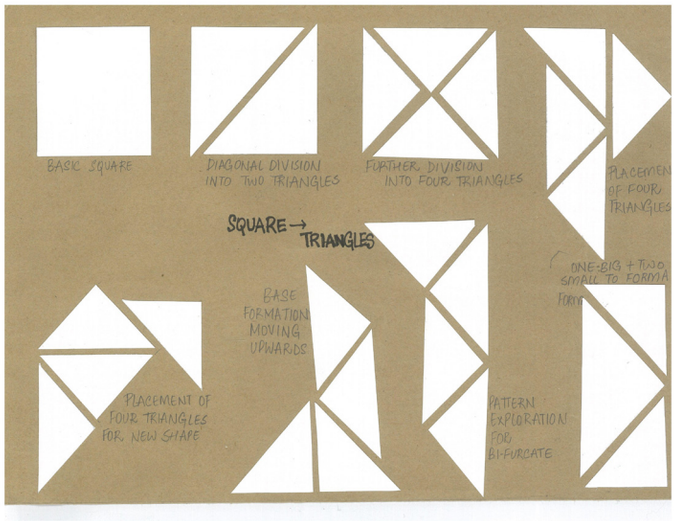

Figure 30. Dissection of square into triangles | Original |

I started with dissecting a square into two rectangles and further into smaller squares and rectangles. This shape gave multiple combinations through dissection and altered placement. Simultaneously, I tried different combinations of the two shapes and placed them in a way that looked closest to the traditional top/shirt with a neckline, centre front, side seam, armholes and sleeves. (Fig. 29). In other words, the dissection was random as well as being guided by a system of placing the shapes with visual familiarity so that they look like a bodice garment. All these patterns shapes are dissected out of the rectangular block. Similarly, I dissected a square into triangular shapes and placed them in the silhouette of pants (Fig. 30). However, with these triangles experiments, I allowed myself to let the shapes create new forms with the projection and protrusion of uncontrolled angles. This exercise gave me a new perspective and freedom to develop multiple innovative silhouettes out of the basic shapes.

Initial conversion of these flat 2D shaped patterns into a 3-dimensional form was carried out on small on a 20cm wooden expression manikin, using wrapping and folding as key methods (Fig. 31). Although this was restricted to paper, I was able to ascertain quickly some of the advantages and limitations of these three basic shapes: the square, rectangle and triangle. An obvious advantage of rectangular use is that it is an industry friendly shape in that fabric is originally produced in rectangular dimensions. The biggest advantage of the square and rectangle shapes is that it can be manipulated by cutting and folding into smaller shapes of a rectangle, triangle and square, allowing versatility and multiplicity. The angular cut sides of a triangle fall on the bias, which allows softer contouring of the fabric along the curved body. These shapes can be inserted as gussets[10]/godets[11] for attaching two parts and adding fullness for movement or aesthetic form.

Figure 31. 3-dimensional development on 8" wodden mannekin | Original |

10. Gusset – in sewing, a gusset is a triangular or rhomboidal piece of fabric inserted into a seam to add breadth or reduce stress from tight-fitting clothing.

11. Godet – a godet is an extra piece of fabric in the shape of a circular sector, which is set into a garment, usually a dress or skirt. The addition of a godet causes the article of clothing in question to flare, thus adding width and volume.

Based on these initial exercises and visual analysis of the shapes on the miniature form, I developed a more systematic process, combining rectangles and triangles to create a Constant shape, which was dissected into a complex geometry that could be used across multiple designs (Fig. 32). Other variable zero waste shapes can be injected into this to create even more design variations.

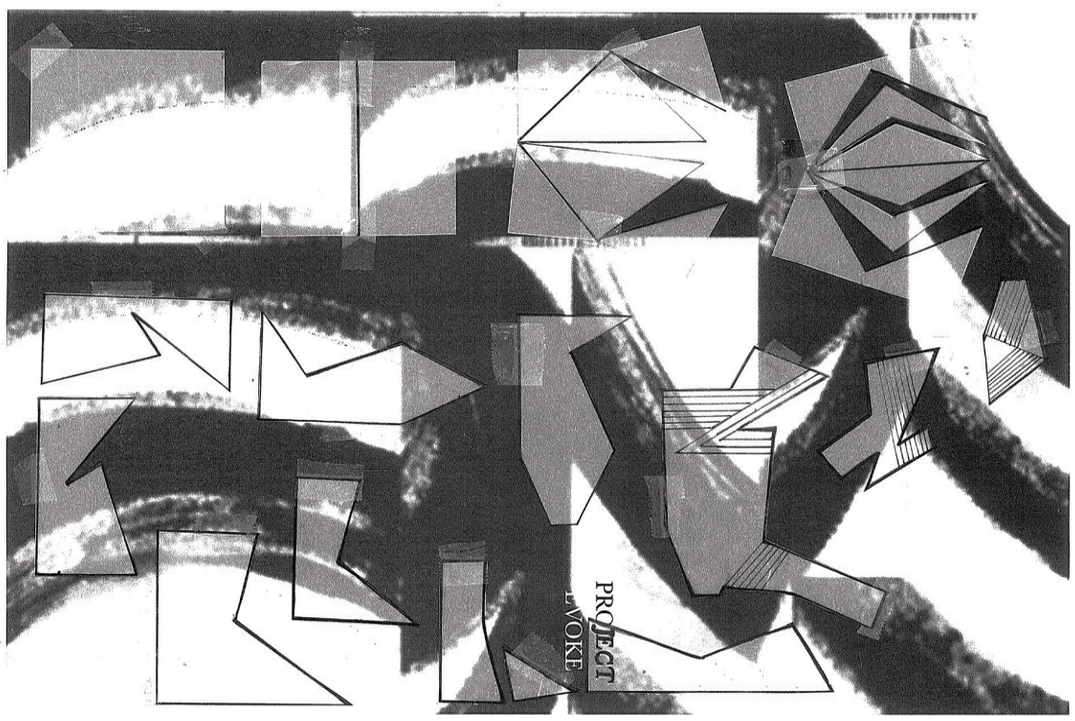

Figure 32. Combination of rectangle and triangles ; geometric shapes derived out of void | Original |

New pattern blocks: Constant and Variables

About the Constant: From my understanding of the case study of project Make/Use, where I drafted the pattern by dividing the fabric length into half and quarter, I carried out the same steps to prepare the draft. Analysis from Vionnet's handkerchief dress and the advantages of a triangle informed the diagonal lines. In order to let the fabric move in the direction of the body curves I found it extremely necessary to create a bias cut within the pattern shape. Therefore, I joined the anchor points of the pattern into an arrangement of eight triangles divided in the centre to create balance on both sides of the form (Fig. 33). As a result, I developed a pattern block with the potential of variations to designs. The centre anchor point, which is an uncut point, creates a pattern with two identical sides, which makes it simpler to drape on the body. It acts as a pivotal point that holds the other cut triangles/polygons together and is the vital starting point for draping, for example the intersection of centre back or centre front to neckline or hem.

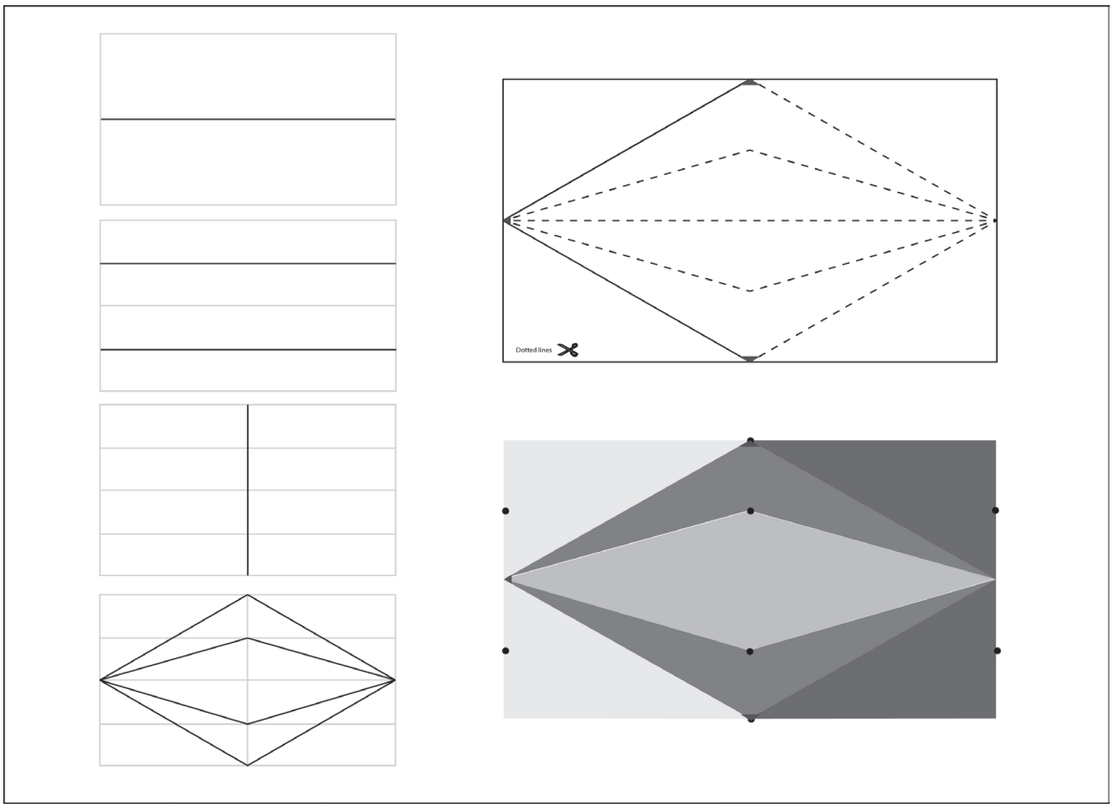

Figure 33. Steps to draft the Constant pattern | Original |

Figure 34. Constant draping exploration | Original |

Figure 35. Tracing set sized fabric legth to derive Variables | Original |

About the Variables: The Variables are geometric zero waste pattern shapes that are used to fill in or add dimension to the Constant pattern block. While draping the Constant around the body for deriving a jacket design, I observe the gaps/voids in the between the pattern lines (Fig. 34). I placed the set sized 'Variable' rectangle into this void and traced the shape on the rectangle block. As a result, a polygon shape was derived that was specific to fill in the void. I repeated this method for all the negative spaces produced after draping the Constant pattern in various ways (Fig. 35). Hence, the variables, which are different shaped polygons, were developed to support the Constant pattern and add to the form. It is also important in this process that variables are directed by the drape or placement of the Constant on the body and cannot be done vice-versa. They are essential for design variations and for creative input as they can be changed and manipulated against the Constant pattern. The possibilities are limitless for the zero waste designer/maker, who will have their own aesthetic parameters.

As the name suggests, this pattern making technique is a combination of two patterns: a Constant pattern shape and a Variable pattern shape, which are a complex combination of different polygon shapes that are both derived from the set sized rectangle. On reflection, the Constant pattern is an alternative equivalent to the basic block in traditional pattern making, which is an unchanged pattern shape for all the three designs. The Variables change for each design with insertion and addition. The combination consists of polygon shapes embedded together in the set sized rectangle. (Fig. 36).

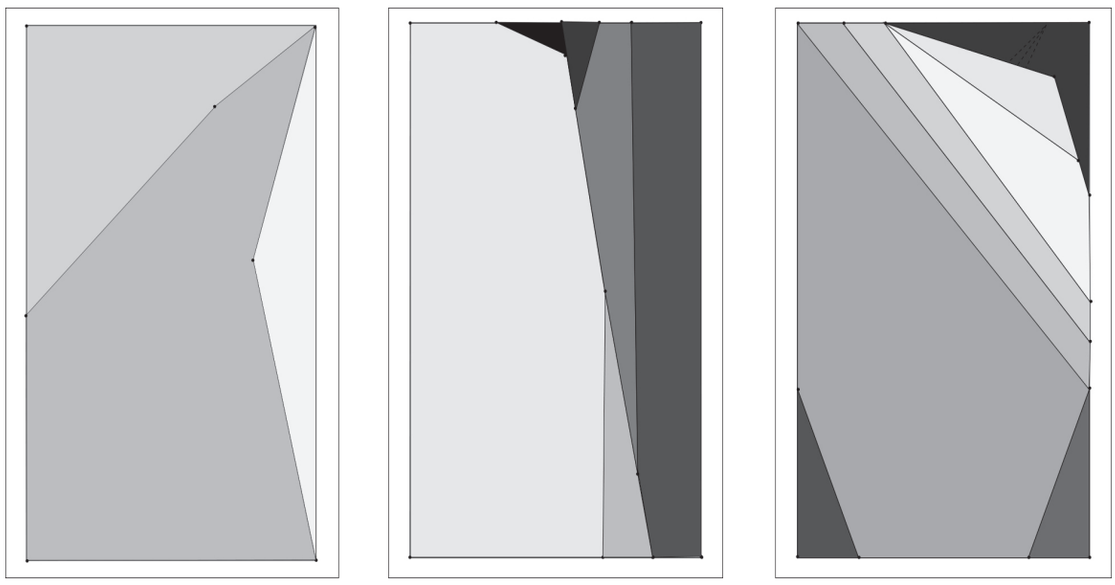

Figure 36. Variables : Jacket, Dress and Trousers (from left to right) | Original |

Figure 37. Toile: jacket, dress and trousers | Original |

Figure 38. Form extensions and detailed features of toile | Original |

3D sampling: contouring and form extensions

For this project, I designed three garments – jacket, trouser and a dress – using the Constant and Variable patterns and further drape development in order to refine the designs using contouring and form extensions. Through this method there is scope for varying the forms and degree of contouring. Initially the pattern shapes were draped on a half scale dress form to realise the silhouette and possible variations. All the three developed designs were then translated into full scale and refined at each stage. While experimenting with multiple design possibilities, the three garments designs were visually connected through contouring and form extensions. I have used contouring to convert the excess fabric or the seam attachment into style lines. In addition, I have enhanced the silhouette and forms with subtle geometric protrusions formed by the use of seamed angled pattern shapes, as visible on the draped form (Fig. 37).

These photographs show the first samples in full scale. The printed section of the garment highlights the Constant pattern, while the whites are the Variable patterns. For the exploration, I used the rectangle block of 56cmx64cm, cut along the grainline on the fabric 112cms wide. The width of the fabric defines the circumference of the garment, and the length of the fabric determines the length of the garment. The jacket shows angled fullness at the back and sleeve for adequate arm lift yet also a contoured fit at the back and front waist. The resulting shapes and grainline use gave interest to the dimensional form and a degree of waist shaping, but a more exaggerated design outcome was developed for the final prototypes by changing the fabric dimensions to 61cmx69cm cut out of 137cms wide fabric. This can be applied to different fabric widths to still achieve zero waste principles. The dropped crotch pants were refined with adjustments to the crotch area and contoured leg-lines with the variable pattern shapes. The dress is designed with a simple geometric form, yet is refined with contoured elements of fit through the triangular shaping and grainline placement. Back and sleeve angular shaping emulates the jacket but with more subtle protrusions (Fig. 38). The prototypes designed use 3/4th of the fabric consumption in comparison to the traditional double darted jacket.

Figure 39. Block development on laser; block printing process | (Verma, 2018) |

Fabrication and Block Print tooling

The 'Constant Change' collection is an exemplar of how crafts can be integrated as an important component within the design process. My motivations are to highlight the zero waste pattern method developed by printing the fabric used for the Constant pattern and using block colour for the Variable patterns. This not only allows a clearer visual communication of the integration and relationship of the pattern shapes involved but also gives textile design interest and meaning in the final garment designs. The geometric shapes used in the block print design were key to the pattern process and my previous experiences of hand block printing and the traditional craft. While composing textile mood boards, these motivations informed visual cues with contemporary graphic colour tends.
Hand block print technique is a traditional craft of India, in which artisans carve out the motif design on a teakwood square or rectangle block. The block is soaked in oil for 10–15 days to soften the timber. The dye colour is usually made out of natural resources mixed with glue and pigment binder (alum mordant). To begin the print, the colour is kept in a tray covered with a layer of muslin for even spreading of colour on the block. Finally, the ready block is dipped in the colour and pressed down hard on the fabric, to make a clear impression. For this project, I utilised the digital resources available to me, used a laser machine to cut out my motif, and made a block as similar as possible to the traditional block with similar depth and a handle (Fig. 39). My designs were converted to Illustrator in black and white and re-sized to cut the exact motif shape. To make the final block, I fixed the motif shapes to a thicker piece of wood block in the same pattern of the print.

White block print on navy blue is a popular combination in India, which is achieved either through discharge printing or direct printing. It is a longer process to prepare a white colour for direct printing. Traditionally the artisans used limestone soaked in water until the right consistency was attained. I have used a white paint as a substitute due to local availability and time factor for completion of this project. However, the traditional techniques of hand block printing are used. This was a slow process that represented the artisanal craft and values of block printing.

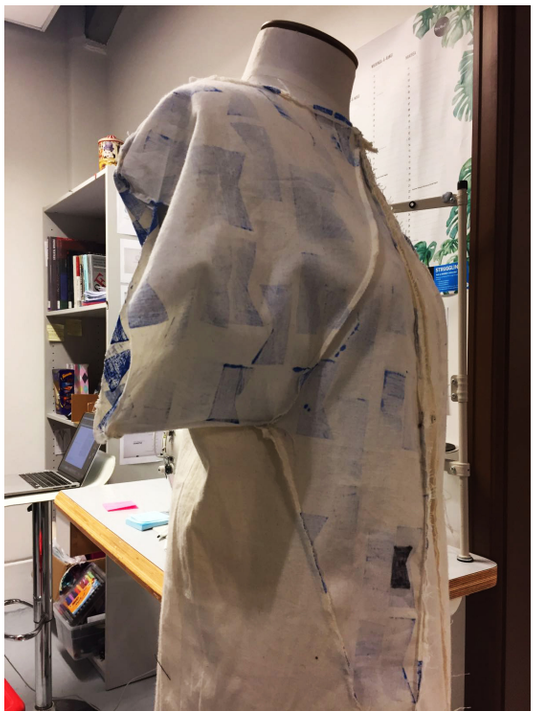

Figure 40. Seam detail; fabrics | Original, (Verma, 2018) |

Constructing the shapes

As with all the garment designs, the fabric choice plays an important role since the pattern shapes are cut on the bias and placed at multiple angles. The fall of the fabric can be considerably different within the garments. For my final prototypes, I have used 100% linen, for it is a tightly woven fabric that provides a degree of stability, yet it has a softness that can adapt to the form. The cutting of the Constant and Variable pattern pieces is straightforward within the fabric widths and lengths.

Construction of the innovative shapes required a good understanding of how patterns related and joined to each other. However, conventional methods of notching for identification can be marked, or colour coding of seams can be used to ensure the accurate construction of the pattern shapes. The zero waste pattern shapes incorporated their seam allowances within their dimensions. The Jacket and Dress are sewn with open seams. There was testing of alternative seam types, as French or flat felled seams show bulk at the anchor points and intersections of fabric joints. Both the Jacket and Dress are finished with a lining, which provides a neat finish for multiple open seams. The lining, constructed of lightweight 100% linen of a contrasting colour, adds the design value of allowing the garments to be worn reversible. The lining also gives strength and durability to the garment so it can last longer. The trouser is constructed with overlocked plain seaming. These are not lined, so as to avoid bulk and restriction of movement around the crotch area. The pockets in the trousers are secured with the shell fabric, using welt seaming.

The fastenings of the garments are derived out of the Variable pattern length. For the dress and jacket, I have used selvedge of the shell and lining fabric held together with double sided fusing (Fig. 40). The jacket has a tie opening at the centre front and the dress has a similar fastening at the centre back. The trouser has an elasticated waistband, which gives the user an option of wearing it at preferred waist level. In summary, the designer/maker can alter these production considerations.

Figure 41. Personal reflection | Original |

Reflection of Norman's theory

As Norman's theory of three levels of processing suggests, the conscious application of reflective memory can help attain longevity and durability as it helps to build emotional attachment with the product (Norman, 2004, 2013). In this project, I have interrogated my own cultural values while investigating my design process. Mood boards have provided clarity in this process and help to visualise these conscious thoughts. This analytical research method has facilitated development of key ideas and understanding in my design motivations and correlation with the new pattern making process, fabric qualities and surface textures.

Growing up in India, amongst the Indian women who still wear a saree (a 6-yard-long piece of cloth) that reflects their regional cultures, built my appreciation for the multi-aesthetic feature. The concept of no-waste clothing is not only restricted to women's wear. Indian men traditionally wear the dhoti, a long pure cotton fabric draped in multiple ways as a bottom reflecting their regional identities. The multi-functionality of squares and rectangles have allowed Indian households to re-use the old fabric for other various purposes such as cloth nappies, tunics, jackets and stoles. Elements of design, such as material, print, colour and texture, determine the clothing for specific occasions. The print designs, embroidery motifs and weaving styles differ from region to region, and are inspired from local art forms or nature. I was exposed to these communities at a very early stage, as my mother always preferred buying her saris and fabrics from local artisans. I was always fascinated by the skills and techniques of the artisans and their way of living. My personal reflection of Indian clothing and experience has been directing the pattern development process and selection of pattern shapes and motifs in this project (Fig. 41). The integration of this conscious cultural reflection and my current living and learning environment have pushed my creative exploration with both respect for the traditions and new technologies in a world context that demands sustainable thinking.

4

FINAL DESIGN PROTOTYPES

COLLECTION: THE CONSTANT CHANGE

Figure 42. Collection: The Constant Change | (Van Ginkel, 2018) |

Figure 43. The jacket | (Van Ginkel, 2018) |

Figure 44. The jacket | (Van Ginkel, 2018) |

Figure 45. The jacket det

ails | (Van Ginkel, 2018) |

Figure 46. The dress | (Van Ginkel, 2018) |

Figure 47. The dress | (Van Ginkel, 2018) |

Figure 48. The dress det

ails | (Van Ginkel, 2018) |

Figure 49. The trouser | (Van Ginkel, 2018) |

Figure 50. The trouser | (Van Ginkel, 2018) |

Figure 51. The trouser de

tails | (Van Ginkel, 2018) |

Figure 52. Collection: The Constant Change | (Van Ginkel, 2018) |

Figure 53. Collection: The Constant Change | (Van Ginkel, 2018) |

5

CONCLUSION

Through my willingness to experiment and to push my own boundaries, I have developed an innovative zero waste fashion design process. The non-conventional pattern making method of zero waste fashion – Constant and Variable – has its own advantages and scope of improvement for the designer and future researchers. The Constant and Variable method can be used to explore limitless possibilities for designing clothing. The exploration process consists of risk-taking and a slow practice, although it can be adapted for the fashion industry. This method is zero waste and utilises less fabric (75%) in comparison to traditional pattern making methods for comparable garment types.

"The Constant Change" collection adds a new aesthetic direction to the existing zero waste methods. The distinct features of angular protrusions and multiple angular seaming create structure away from the body, while the style lines of the pattern shapes give a contoured look to the garments. As the pattern shapes employ the bias cut, the fall of the fabric facilitates comfort and ease. The use of the block printed motif within the design and on the body highlights a valued craft and adds a humble sophistication to the garment designs. The integration of craft technique with the experimental Constant and Variable pattern designs blends craft and contemporary apparel trends. The designs share a distinctive look yet can be versatile in wear and market placement. Interpretation of Norman's theory has aided the project at each step and is used as a methodology for meaningful conscious cognition. Reminiscence of my history, culture, values and experiences throughout has informed the approach and explorations of the project. This method can be used by designers by consciously reflecting their memories within the design process for decision making to achieve durable design. The three levels of processing can also be applied to establish distinct and long-lasting connections between users and their products (Norman, 2004, 2013). Creating personal narratives through customisation, personalisation and memory reflection ensures the longevity of the product along with high quality, good design, and reliable upgradable and maintainable products (Fletcher, 2014; Fuad-Luke, 2009). Designers, educators and researchers can use this methodology to design participatory workshops.

This year has been the most self-realising and experimental experience. It is an experience I will always be grateful for. "The Constant Change" project is a result of an unspoken language of the relationship between the social and the environment factors of the triple bottom line. The philosophies and ideologies that I have studied have further increased my belief in making conscious fashion. In my immediate future, I am travelling back to India and planning to collaborate with a craft community specialising in weaving in order to explore Constant and Variable through engineered weaving techniques.

REFERENCES

Cataldi, C., Dickson, M., & Grover, C. (2010). Slow Fashion: Tailoring a Strategic Approach towards Sustainability.

Chapman, J. (2015). Emotionally Durable Design Objects, Experiences and Empathy (2nd edition). Routledge, London. Retrieved from https://www-taylorfrancis-com.ezproxy.massey.ac.nz/books/9781317574828

Cordin, G. (2016). Narrative Design. Peter Lang. Retrieved from https://www.peterlang.com/view/product/22933

Cumming, D. (n.d.). zero + one. Retrieved December 14, 2017, from https://www.debcumming.com/zero-one/

Department of Environment - Environment (Air,Water,Noise,Waste). (n.d.). Retrieved December 13, 2017, from http://www.delhi.gov.in/wps/wcm/connect/environment/Environment/Home/Environment+Data+%28Air%2CWater%2CNoise%2CWaste%29/

Edwards, E. (2016). Block printed textiles of India Imprints of culture.

Fasanella, K. (1998). The Entrepreneur's Guide to Sewn Product Manufacturing (third edition). Capitan, NM: Apparel Technical Svcs.

Fletcher, K. (2014). Sustainable fashion and textiles. [electronic resource] : design journeys. London : Routledge, Taylor & Francis Group, 2014. Retrieved from http://ezproxy.massey.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cat03987a&AN=massey.b3673279&site=eds-live&scope=site

Fletcher, K. (2015). Slow Fashion: An Invitation for Systems Change. Http://Www.Tandfonline.Com/Action/JournalInformation?JournalCode=rffp20, 2(2).

Fletcher, K. (2016). Craft Of Use. Routledge.

Fletcher, K., & Grose, L. (2012). Fashion & Sustainability: Design for change. London: Laurence King Publishing Ltd.

Fraser, K., & Crowe, D. (n.d.). THE BRAND – Fraser Crowe. Retrieved March 3, 2018, from https://frasercrowe.com/pages/about

Fuad-Luke, A. (2009). Design activism beautiful strangeness for a sustainable world. Earthscan, Taylor and Francis.

Guy, J. (2014). A short history of early Indian textiles. In Indian Textiles : The Karur Thakar Collection. Pretsel Publishing.

Gwilt, A. (2014). Fashion Design for Living. London, UNKNOWN: Taylor and Francis. Retrieved from http://ebookcentral.proquest.com/lib/massey/detail.action?docID=1843549

Jégou, F., & Manzini, E. (2008). Collaborative Services: Social Innovation and Design for Sustainability. POLI.design.

Kirke, B. (1998). Madeleine Vionnet. San Francisco : Chronicle Books, 1998.

Kolay, S. (2015). Cultural Heritage Preservation of Traditional Indian Art through Virtual New - media. ScienceDirect.

Kozlowski, A., Searcy, C., & Bardecki, M. (2016). Innovation for a Sustainable Fashion Industry: A Design Focused Approach Toward the Development of New Business Models. Springer, Singapore.

Lewis, H., & Gertsakis, J. (2003, March). Sustainability and the Waste Management Hierarchy. A discussion paper prepared for EcoRecycle Victoria.

Lindqvist, R. (2013). ON THE LOGIC OF PATTERN CUTTING foundational cuts and approximations of the body.

McQuillan, H. (2005). Holly McQuillan. Retrieved December 14, 2017, from https://hollymcquillan.com/

McQuillan, H. (2013, August 22). MAKE|USE for Local Wisdom. Retrieved November 28, 2017, from https://hollymcquillan.com/2013/08/22/makeuse-for-local-wisdom/
Miyake, I. (1998). Madeleine Vionnet: Foreword. In Madeleine Vionnet. San Francisco :

McQuillan, H. (2011, March 28). YIELD:Zandra Rhodes – Chinese Squares. Retrieved December 12, 2017, from https://hollymcquillan.com/2011/03/28/yieldzandra-rhodes-chinese-squares/

McQuillan, H. (2013, August 22). MAKE|USE for Local Wisdom. Retrieved November 28, 2017, from https://hollymcquillan.com/2013/08/22/makeuse-for-local-wisdom/

Miyake, I. (1998). Madeleine Vionnet: Foreword. In Madeleine Vionnet. San Francisco : Chronicle Books, 1998.

Miyake, I., & Dai, F. (1997). Issey Miyake, Fujiwara Dai. A-POC Queen Textile. 1997 | MoMA. Retrieved February 6, 2018, from https://www.moma.org/collection/works/100361

Niinimäki, K. (2013). SUSTAINABLE FASHION: NEW APPROACHES. Helsinki, Finland: Aalto University publication series.

Norman, D. (2004). Emotional Design. Basic Books.

Norman, D. (2013). The design of everyday things (Revised and expanded edition). Basic Books.

Rissanen, T. (2005). From 15% to 0: Investigating the creation of fashion without the creation of fabric waste.

Rissanen, T. (2011). MLS, 2011 [For image]. Retrieved December 12, 2017, from https://timorissanen.com/portfolio/mls/

Rissanen, T. (2013). ZERO-WASTE FASHION DESIGN: a study at the intersection of cloth, fashion design and pattern cutting. University of Technology, Sydney.

Rissanen, T., & McQuillan, H. (2016). zero waste fashion design. Bloomsbury Publishing.

Rissanen, T., McQuillan, H., & Jacobs, L. (2016). Interview with Lela Jacobs. In zero waste fashion design.

Roberts, J. (2012). FREE CUTTING by Julian Roberts. Retrieved December 14, 2017, from https://subtractioncutting.tumblr.com/?og=1

Tarrant, N. (1994). The Development of Costume (The Heritage : Care-Preservation-Management) (1st ed.). Routledge, London.

Telfer, D., & Dr. Goldsworthy, K. (2013). Textile Toolbox - Seamsdress. Retrieved December 12, 2017, from http://www.textiletoolbox.com/exhibits/detail/seamdsdress/

Walker, S. (2016). Sustainable by Design: Explorations in Theory and Practice. Earthscan, Taylor and Francis.

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