Jacquard weave for interior design: valuing arts and crafts through encoding emotion and information

A thesis submitted in partial fulfillment of the requirements of the Royal College of Art for the degree of Doctor of Philosophy By Jimin Seo

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Copyright Statement

Abstract

This dissertation exists in relation to the exhibition of design practice at the RCA, November 7th 2014 (documented in photographs accompanying the text); it is structured according to my construction of the exhibition. It therefore integrates the question of describing my practice-based research methods along with the descriptions of my research context, and case studies of other contemporary designers; the history of the Arts and Crafts ethos, as a precursor of modernity, is also reconsidered as of potential use for a crafts approach to textile sustainability. The methods used are a compound of the workshop method of experiments at the desk, drawing board, computer screen, loom and print room, along with a search for existing cases of similar textile-weave practice in current production, some historical research and some *autoethnography*[1]*,* which documents the subjective experience of researching sustainability in one aspect of textile design.

The thesis explores aspects of emotional durability through textile design. The meaning of emotionally durable textiles, particularly those using a Jacquard weave design, was encoded in the form of QR code (Quick Response code) patterns, which, when scanned by a smartphone, lead users through the digital portal to digital platforms which inform and network users. Considering the origins of the computer in the digital binary logic of weave and its mechanisation in the Jacquard loom, the use of the weave process as a medium for encoding the meaning of the material is especially interesting for the designer as a means of activating the agency of the maker and the user. The use of textiles in all aspects of everyday life ensures the proximity of textile as an interface between the familiarity and comfort of the material and the designer's addition of the function of rationality in relation to others and to the world of knowledge, networking and activism. The research concludes with a range of prototype Jacquard designs, which activate the relationship between designer and user through the medium of encoded messages. Using the Jacquard code as a part of new digital media of twenty-first-century technology is a way for design practice to celebrate the industrial innovation of mechanised weave and to apply this to the challenges of sustainability.

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[1] Carolyn Ellis, *The Ethnographic I: A Methodological Novel about Autoethnography.* Walnut Creek: AltaMira Press, 2004, p.37

The aim of the research is to explore some of the ways in which Jacquard weaving can resume its original pioneering role in industrial innovation. My design aims to explore how the concept of emotional durability can encourage people to care more about the environment through their encounters with textiles. This may offer the designer greater agency in encouraging responsibility for sustainability. I conclude that this is a journey, and I design a series of textiles for mass transit upholstery.

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Acknowledgements

Author's Declaration

During the period of registered study in which this thesis was prepared the author has not been registered for any other academic award or qualification.

The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than that for which it is now submitted.

Signature: _____   _____

Date: 13ᵗʰ April 2016

Introduction

Before I came to the RCA and to London, I worked as a textile designer specialising in the design of men's ties in Seoul, South Korea. My business was relatively small and I enjoyed making bespoke textiles for my customers. Over time, I got to know my customers well, and tried to base my designs on this personal knowledge. I wanted the ties to be more than just mere physical objects; instead I wanted to imbue them with an emotional attachment that reflected the relationship between me and my customers and my knowledge of their lives and personalities. I began talking to my customers and noticed that – unconsciously – my designs were becoming more dialogical[2], a graphical representation of the conversations and stories we shared. This emotional engagement became an important part of my practice. My customers told me that they were wearing my ties more than the ties that they had bought anonymously in shops; for my customers, the relationship with the tie maker and the emotional connection with the design of the tie was very important to them, and it made them want to keep wearing the ties over time.

I began to wonder whether this idea of an emotional engagement with textiles could be used to make a more sustainable product, one that would be worn, cherished, and loved over many years rather than worn for a season and then replaced by another mass-produced, anonymous tie. I also tried to work out what exactly it was that was making my clients feel more attachment to my ties and decided that the shared narratives and experiences between maker and wearer were key.

I wanted to explore these ideas further, in both a practice-based but also theoretical way. That is how I came to apply to the RCA.

This research started from the question of the need for greater considerations of sustainability to be implemented within the woven textiles industry. I was working as a designer of Jacquard-woven luxury silk ties for men, and although silk is known to be a renewable source of fibre, the industry is very costly in water consumption and other forms of abuse of scarce resources. In *Silk*, Mary Schoeser discusses the

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[2] Richard Sennett, in *Together: The Rituals, Pleasures and Politics of Cooperation* (New Haven: Yale University Press, 2012) proposes this term for the quality of interaction between designer and user encoded within design

historical and social perspectives on the material[3]. The new research raises the question of ethical silk, made without the destruction of the moth within the cocoon, and the ethics of employment practices within the silk manufacturing industry today.

The majority of mass production generates pollution, which causes climate change. In an era of fast-fashion, mass-produced textile waste has continued to grow[4]. According to the report *Valuing our Clothes* , extending the average life of clothes by only three months of active use would lead to a five to ten per cent reduction in each of the carbon, water and waste footprints; around 350,000 tonnes of used clothing ends up in landfill in the UK every year[5].

Waste is not just a UK problem. Dongdaemoon market is the biggest fashion and textiles market in South Korea. Many young designers work there but follow fashion trends rather than creating their own unique designs. About 20 tonnes of fabric waste is generated per day. Seoul city authorities estimate that it collects about 5,000 tonnes of waste resources, such as fabric and banners, per year from the Dongdaemoon market.[6]

The challenge of designing environmentally friendly textiles within existing economic systems without exacerbating climate change became my research goal. (I had observed the problem when I designed men's ties within the mass-manufacturing system and the experience led me to realise the significance of sustainability. It has been noted in the 2014 book *Textiles and Fashion: Materials, Design and Technology* that the textile industries are responsible for a significant proportion of the pollution generated by mass production[7].

[3] Mary Schoeser, *Silk* (New Haven; London: Yale University Press, 2007)
[4] Theguardian.com, http://www.theguardian.com/sustainable-business/haiti-fashion-clothing-recycling-upcycling
[5] *Valuing our Clothes*, (WRAP; Waste and Resources Action Programme, 2012),available at: http://www.wrap.org.uk/content/valuing-our-clothes, accessed 27 September 2015
[6] DongA.com, '[수도권]새 '디자인 서울'… 버려진 자원에 色을 입힌다', available at: http://news.donga.com/3/all/20120606/46790918/1 , accessed 6 June 2012 강경석 기자 coolup@donga.com
[7] Rose Sinclair, ed., *Textiles and Fashion: Materials, Design and Technology*, (Manchester: The Textile Institute, 2014), p. 540

Initially, as a textile designer, my interest lay in surveying a range of materials and assessing their environmental credentials. I wanted to find the most sustainable, environmentally friendly fabric and set out to compare and contrast a wide range of textiles, from traditional cotton to less conventional material such as those made from banana and piña fibres. This approach, however, proved unsatisfactory for a number of reasons. The most important reason was the lack of emotional durability offered by the fabrics – the fabrics themselves were sustainable (to a greater or lesser degree) but they had no connection whatsoever to the central tenet of my thesis: to create *emotionally* durable textiles[8]. As a design choice throughout my practice, however, I always choose to work with environmentally friendly textiles, such as organic cottons, soya, and *hanji*.

In addition to choosing environmentally friendly textiles, there are many approaches manufacturers can take in their research on sustainability. These include 'Cradle to Cradle' (C2C) thinking in the textile industries, such as Interface Flor and Desso. For instance, Interface Flor and Desso explore alternative economic models with C2C thinking at their heart in their approach to sustainability. Desso is committed to a C2C manufacturing process. The company has reduced CO_2 emissions to a minimum, sources sustainable raw materials, uses non-toxic materials and develops long-life and low-maintenance products. I was interested in combining these new technical business-led ideas of sustainability with my intuitive idea that the principles of emotionally durable design also created a more sustainable product.

As a designer, rather than campaigner or policy maker, I was keen to prove that the role of the designer could also be understood as having both power and responsibility. How could my designs, in industrial Jacquard weave, become a medium for enabling a new approach to sustainability? Could textile surfaces and patterns become encoded with messages for future users?

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[8] The work I did on exploring different fibres for their environmental credentials can now be found in the appendix
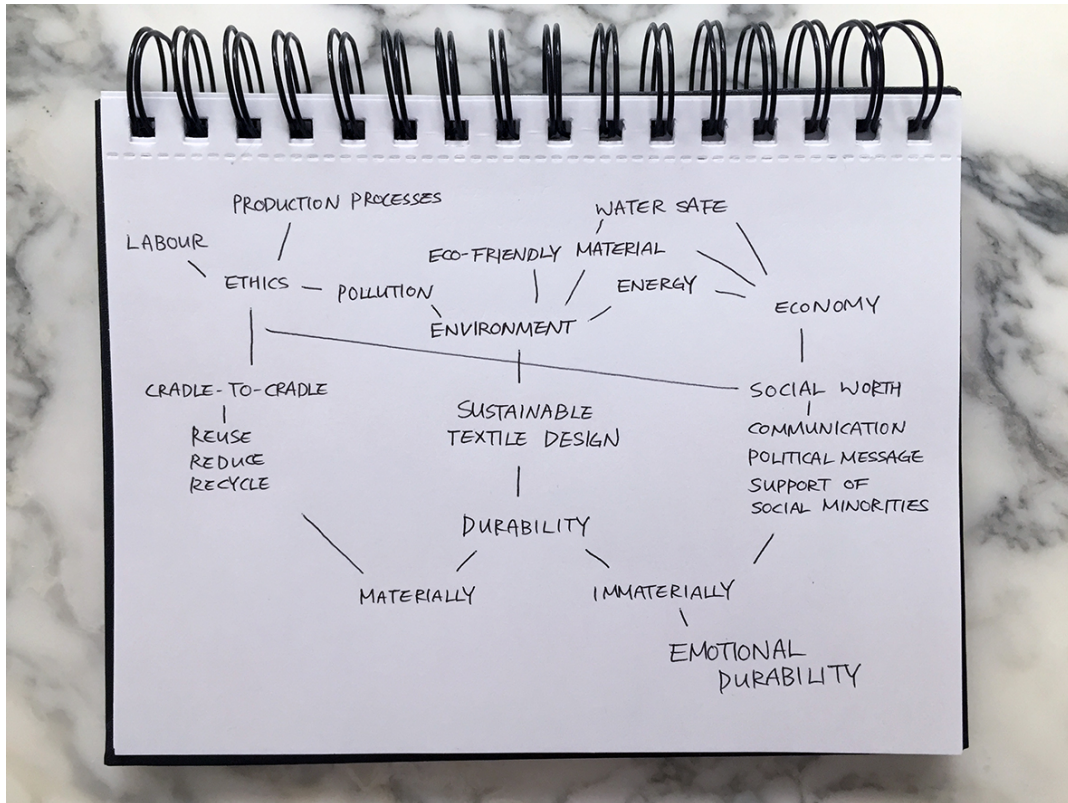
Figure 1 Idea note-emotional durability for sustainable textile design

When I set out, in November 2014, to show the four years of design practice, organised as an exhibition of my creative practice experiments and my reflection on these, I grouped my work, intuitively, into five sections. These sections not only reflected the chronological development of my practice, but also seemed to explain the conceptual and theoretical development of my research.

I numbered the five exhibition sections and then named them as I reflected, retrospectively, on what I had made. I will discuss the significance of naming as I discuss my research process in each section

1) 'Happy Together'
2) Craft and Technology
3) Collaborative Design Experiments

4) CODE

5) Making, Connecting, Together

In place of the dissertation that first accompanied the exhibition, and which was discussed during the *viva voce* examination that took place within the exhibition space, I now have restructured my dissertation along the lines of the exhibition itself, aiming to show the strong reciprocal relationship between material making and knowledge making. This reflects a different understanding of the research process. In my initial understanding, research was a task of historical and contextual fact-finding, which was to precede and thereby inform the practice of design. In this version I understand research to be an account of the iterative process of design thinking which spirals between making, testing and reflecting on prototypes. The historical context and theoretical frameworks are present, and were completed along with the design of textile weave patterns and samples, but take no priority over the process of making itself.

These two different approaches of research correspond, in some ways, to the cultural differences between design research in Korea, where I completed my first, technical PhD in Jacquard weave, and the UK culture of design research, based on the art school and Bauhaus 'workshop traditions' of learning from making.

The current dissertation is therefore more of a narrative than a series of chapters on different kinds of data, which the structure of the first dissertation which accompanied the exhibition offered.

Chapter 1, 'Happy Together', is my first practice of this practice-led research. I explore emotional attachment with textiles by knitting and thinking about emotional durability for textiles.

Chapter 2, 'Craft and Technology', explores how I can approach emotionally durable textiles by making using traditional material and historical research through the Arts and Crafts movement.

Chapter 3, 'Collaborative Design Experiments', explores how experiences and storytelling support emotionally durable design through interviews and co-design practice.

Chapter 4, 'CODE', explores more genuine co-design by using digital code to weave interactive textile designs.

Chapter 5 is my conclusion of this research. By showing videos I suggest that coded interactive textiles can be a new way of moving emotionally durable textiles towards sustainability.

The plan of the exhibition is shown in (Fig 2); the plan of this thesis is shown in (Fig.3)

Making, Connecting, Together

Happy together

Craft and Technology

Lower Gulbenkian Gallery

Collaborative Design Experiments

CODE
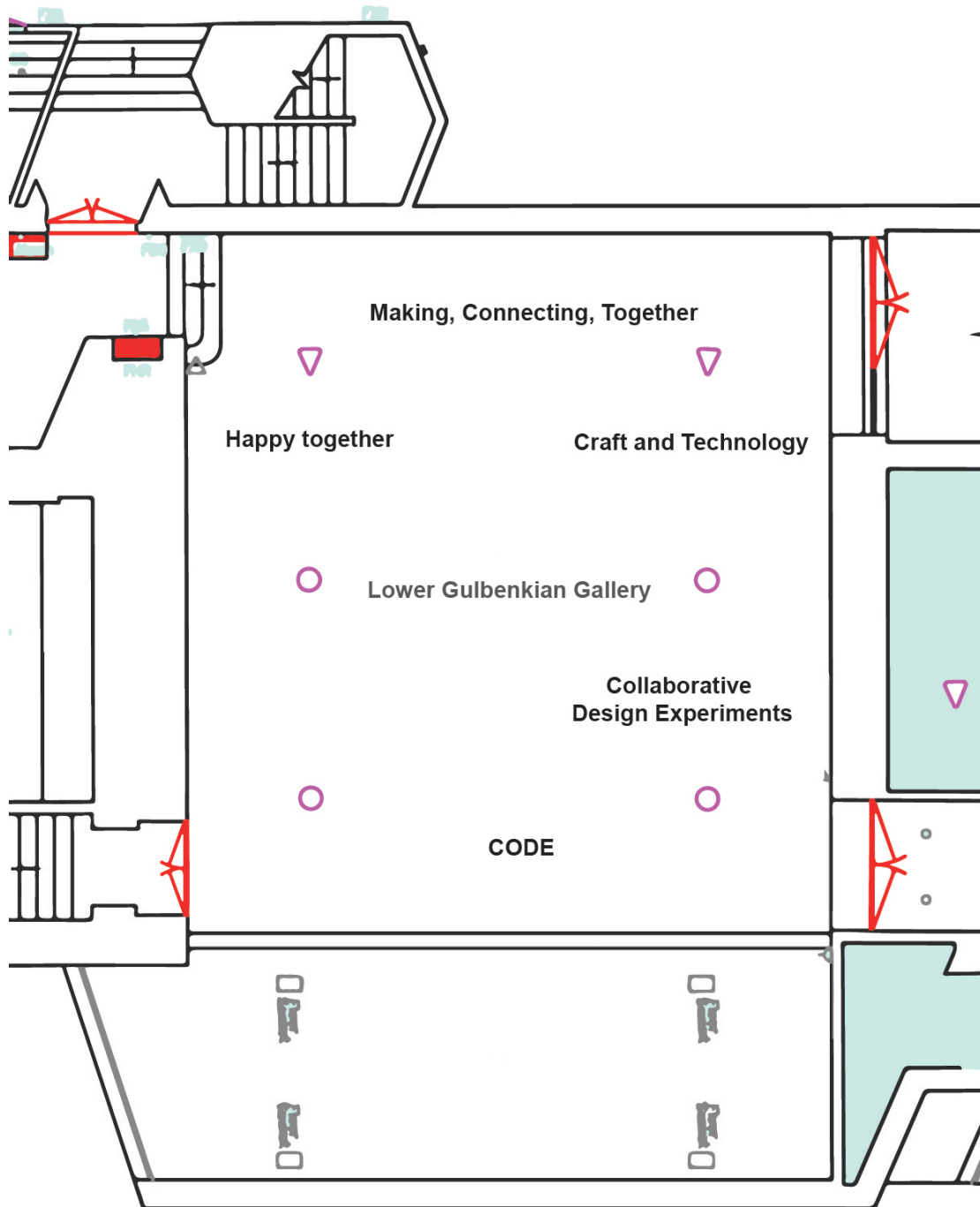
Figure 2 Floor Plan

Figure 3 Thesis plan

In making the exhibition of my work for the viva exam I realised that exhibition and display is an important component of the research process. The making of the exhibition showed me a new structure for the thesis. I decided to use a different font/typeface for the different types of research within my process. I use THIS to show the thinking that has developed from reading, historical and theoretical research. I use THIS font to show the autoethnography, which is the more experiential and subjective dimension of my research.

Current industrial context for sustainable textiles

Many textile designers and manufacturers have focused on environmentally friendly materials, processes and techniques of upcycling and recycling in order to produce sustainable production. For instance, Julie Behseta used recycled PET bottles to produce tiles for interiors[9]. A consideration of all the variables for sustainable production is offered in Kate Fletcher's 2008 book **Sustainable Fashion & Textiles**[10] and include water consumption, the toxicity of chemicals used in the production processes, atmospheric pollution, ethical employment, responsible sourcing, carbon footprint, energy and economic costs of transportation for manufacture, retail and consumption and the costs of waste management.

Camira is one of the best-known sustainable furnishing textile companies in the UK, providing products for offices, companies, schools and trains, with noted clients such as Transport for London (TfL) and Eurostar. Their customers include clients not only in Europe but also in North America and Asia, including South Korea. The company received the Queen's Award for Enterprise (Sustainable Development) in 2010, validating their environmentally friendly products and manufacturing stewardship.

Camira has been producing environmentally friendly fabrics, such as recycled woollen upholstery fabric made from old army uniforms from the British Ministry of Defence, and recycled polyester and natural fibres from annually harvested bast fibre, such as nettles and hemp, since the 1990s. The company considers every element of sustainable textiles: materials, embodied energy, energy use, longevity, durability, fitness for purpose, water use and 'end of life' issues. Its ideas of sustainable design and manufacture start from materials. It uses a large selection of environmentally friendly materials, such as nettle, hemp, jute, linen and occasionally blended wool, cotton, and recycled polyester. The wool-blended fabric can both decrease frangibility and make the fabric more flexible. 'Second Nature' is their trademarked label for their environmentally friendly fabric. They aim for different approaches to ensure environmentally friendly product management, using recycled raw materials, renewable and compostable fibres or highly environmentally friendly wool fabrics that are climate-neutral through CO_2 offsetting. In addition, they also have a fabric recycling system. They have a 'take-back' scheme for customers' waste fabrics and end-of-life products.

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[9] Julie Behseta, 'Synthetic and Natural Polymers Recycled to Make Matter with new Functionality and Aesthetics', Unpublished PhD Thesis, (London: Royal College of Art, 2013)
[10] Kate Fletcher, *Sustainable Fashion and Textiles: Design Journeys* (London: Earthscan, 2008)

Camira clearly thinks that the satisfaction of consumers is a key element in sustainable design. Camira has many selections of fabrics from which customers can choose in their standard fabric binder; however, customers can order customised fabrics for individual requirements or corporate identity. This exemplifies emotional and user-centred design, with the aim of emotional durability and sustainable textile design.

Camira's production process is documented below (Fig.4).
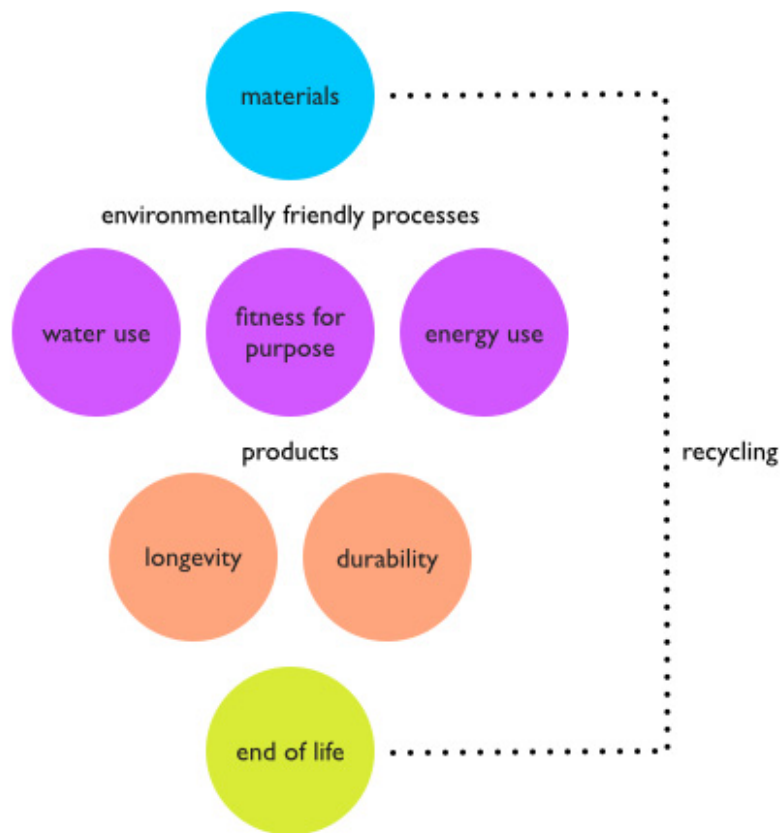
Figure 4 Camira's production process

Like Camira, many design companies offer customised products for the satisfaction of their customers. However, most companies offer limited options for customisation, such as materials and colours. Could we say that such limited options are genuine customised design? For genuine customised design, designers need to understand not only an individual's requirements, but also their lifestyle or environment, for the best result.

The research into the sourcing of fibres, yarns, dyes and materials is one very important aspect of a designer's agency in supporting sustainability. The industries of agriculture, harvesting and processing fibre are not always easy to trace. Many forms of fibre agriculture do involve the use of chemicals in insecticide, fungicide, organo-phosphate soil 'enrichers', and the employment practices of underpaid, non-regulated labour. These processes also change and are mutable. The designer needs to find out as much as possible about the source of her fibre. The designer might also find ways of communicating the importance of these decisions to the users of her textiles.

Chapter 1. HAPPY TOGETHER

This concept, in retrospect, characterises my initial idea that it could be possible for a designer to make a material and surface design that would be so attractive that a user would never be willing to be parted from it, thereby ensuring minimum wastage and maximum 'durability'[11]. The idealist, even utopian, dream of a material that would be 'forever' is what led me, in retrospect, to name this series of design prototypes as 'Happy Together'. The song of this name, the hit single by the US group The Turtles which knocked the Beatles from the top of the charts in 1967 and then had an afterlife in parodic TV shows such as *The Simpsons*, conjures the fantasy of an uncomplicated and 'natural' relationship between lovers, and its popularity seemed, to me, to share some of the simplistic idealism that can, sometimes, accompany the politics of environmentally friendly design such as 'emotionally durable design'. An attachment without ambivalence or change, without obsolescence or renovation, seemed, in retrospect, a hopeful but naïve project.

My initial experiments for the Happy Together period of research were in finding environmentally friendly yarns that had the 'right' 'feel' and aesthetic, and produced the 'right' surface. The aesthetic of knitting seemed to me to be associated with much-loved objects, like favourite sweaters and handmade, customised presents. I would, later, explore in greater depth the meaning of 'making', 'thinking' and tactile qualities within textiles. This would also lead me to explore the history of the debates between artisanal and mechanical production techniques in pre- and post-industrial Britain.

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[11] Jonathan Chapman, *Emotionally Durable Design* (London: Earthscan, 2005), pp. 163-164

1.1. Experiment with knitting and vintage chair

Figure 5 Knitting Chair, Jimin Seo

Clothing has a symbiotic relationship with its wearer. The clothes by themselves are very different to the clothes when they have the presence of a person, the warmth of skin and the bulk of flesh, inside them. In a café one day, I was struck by the different feeling I had between the empty chairs and the chairs that had human occupants. Chairs, just like clothing, have a symbiotic relationship with humans; they are shaped to accommodate our form and they nourish and protect us. They need us just as we need them. The thing that most struck me, though, is that we have a far longer-term relationship with our chairs than we do our clothing. It is far more common to buy new clothes than to but new chairs. This has nothing to do with cost: chairs, thanks to today's mass-production and a globalised market, cost very little. We are used to having chairs around in our life for a long time – the patina of life (the minor scratches and marks) adds memories to the chair. I spoke to an English friend about this and he told me of an English phrase: 'to become part of the furniture.' This expression, he

explained, is a way to convey when something becomes a comfortable part of our life, nice to have around, part of the family. This made me think of the Korean expression 'happy together' in relation to chairs, and I wanted to explore this in my research.

A chair has meaning for me as something that can be shared with others. I feel the presence of others from a chair even though they have left the seat. When we describe a chair, we use anthropomorphic terms such as arms and legs, making a chair seem like a metaphor for who we are. Ian Sansom, a novelist and academic, discusses, in a BBC Radio 3 essay,[12] the symbolism of chairs and proposes that a chair is most powerful when empty, because empty chairs always imply people. A chair can be a private space but it is also one of the most public objects; unlike a bed, for instance, a chair has a public face, it speaks openly and publicly both to and upon the body. It can be at once both a symbol of authority and power and a melancholic reminder of lost memories. Tim Edensor discovers personal links, even in the debris of industrial ruins, through the chairs left behind:

> 'In canteens, seats and tables remain, bent out of shape through use. Body shapes remain embedded in more comfortable chairs, footprints are marked on floors, stair-rails are shiny from serial handling and steps worn from innumerable footsteps. These objects and their material surrounds cajole us into performing the past as we put our bodies into its flow.'[13]

I felt the trace of people from the riven wood chair. The chair might have had a long journey in its life and waited with a price tag of £10 in the corner of a vintage shop. I imagine the chair has experienced the warmth of many people. It has also experienced many different weather conditions such as rainy, windy days outside and felt the warm glow of the sunset. The chair is an object that I associate with having a life of its own, and something that can be imparted to users. Is this a Buddhist idea that humans exaggerate their own importance? Do I wish chairs and furnishings to be as human as us?

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[12] Ian Sansom, 'Who's been sitting on my chair? Our shadow selves', *Furniture: a Personal History of Moveable Objects*, BBC Radio 3, broadcast 21 April 2015
[13] Tim Edensor, 'Waste matter- the debris of industrial ruins and the disordering of the material world', *Journal of Material Culture*, 10(3) (2005), p.329

If I was the chair,

I am waiting for someone here.
I still remember her scent.

Every late afternoon I see the sunset from this corner of the shop
And I remember many people who stayed with me.

One day, I met a lady and she took me somewhere.
I was with her in the afternoon by the window with jazz music.

She left me after her knitting but she left a warm cloth for me.

The chair reflected its years of experience and it seemed to have been through many storms of life, so I wanted to cover its chips and imperfections. I wanted to give the chair my temperature and draw it close to me with an invisible thread, like 인연(因緣, *Inyeon*) a Korean concept that ties people, animals and objects together (to be 'happy together'). I wanted to let the chair know that it was still 'living', that it had a real life within the imagination. I wanted to honour the chair for its service to us across millennia. I wanted to imagine the world from the perspective of the upholstery that we 'take for granted', and to work as a designer to reconstruct the relationship which makes consumers into thoughtless users of objects and materials to satisfy their needs with minimum reciprocity.

While I knitted for this chair I was reminded of my childhood and felt my mother. The knitting activity not only gave another life to the chair but also made me look back on my own life. Would my knitting and my nostalgic thoughts make the chair a more emotionally durable object? Why do people just consider materials and processes when assessing sustainability? I thought this idea of emotional durability could be another approach to sustainability. Jonathan Chapman argues that an emotional attachment might give objects a longer life than just physical quality. He states in his book that 'emotional durability' is a sustainable field where natural resources need not be destroyed to satisfy every fleeting human feeling and the very notion of waste is obsolete. In this ideal future, users and products flourish within long-lasting

empathic partnerships, blissfully oblivious to the relentless taunts of capitalist machine[14]. For this ideal, future sustainable world, emotional attachment between human and a product can be a solution away from the whims of people for products.

Knitting chair design illustrations from my sketchbook:

Figure 6 'Knitting chair', Jimin Seo

Figure 7 'Knitting chair', Jimin Seo

Figure 8 'Knitting chair', Jimin Seo
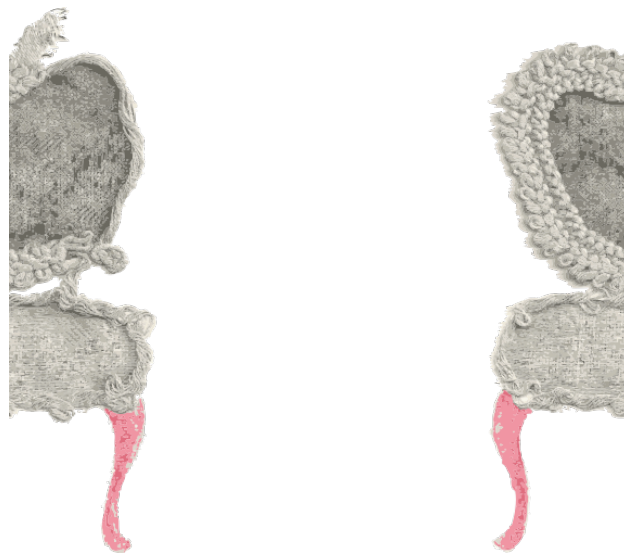
Figure 9 'Knitting chair', Jimin Seo

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[14] Chapman, 2005, p.18

Figure 10 'Knitting chair' idea boards, RCA WIP show 2011

1.2. Jacquard woven fabric with knit pattern

Figure 11 'Knitted' Chair and Jacquard woven fabric with knitting pattern. The wall showing the drawings. Sketches and pattern prototypes for final design. The floor showing soya yarn,

Jimin Seo

In *Matter and Memory* (1896), Henri Bergson states that pure memory registers the past in the form of 'image-remembrance'. Other senses also trigger emotional recall: in his book *À la recherche du temps perdu* (In Search of Lost Time), Marcel Proust famously smelt his madeleines, for example. However, images are the most powerful way of recalling the past for me. I'm 'happy together' with these images; images are for me a central to memory and memory is central to building an emotional attachment. People recall the memory and afterimage when they see similar images or objects. Experience, it seems to me, makes a stronger memory. People remember their experience, what they saw, heard and touched, as an image. I remember the scene of my mother and grandmother knitting for my family when I was young. The image is strong and I feel the warmth of my family and my mother's scent as a series of images. Whenever I hold an item knitted by my mother or grandmother, I am transported visually to my childhood. Knitting, for me, triggers memories of a shared activity, something that builds a strong emotional bond, often between women. This

is still the case today and knitting is seen as a communal, shared and sharing activity, something that brings people together to make a series of overlapping emotional experiences. The London knitters group Stitch and Bitch is a good example of how the traditional shared practices of knitting are still important today; the group offers a safe but creative space for people, mainly women, to come together and share their knitting practice at the same time as building emotional bonds and friendships. Knitting is, and has been for many generations of women from all cultures, a female-centred, emotionally charged experience. Therefore I, a Korean woman coming from a long line of female knitters, applied knitting images to Jacquard weaving to remind me of what I experience when I think of knitting.

Figure 12 Jacquard woven fabric with knitting pattern. Drawings from life of plants and natural forms as experiments in finding a design motif that might prove attractive to 'all'. Jimin Seo

I wanted to bring together different aspects of my life: the old (my memories, my South Korean culture) and the new (my life in London, my research, my exposure to new technology). Could I express the texture of knitted fabric within a Jacquard weave pattern? Pattern is one of the most important aspects of textile design. The texture and colour of textiles create atmosphere. Maybe the knitted pattern woven fabric can give the warmth of real knitted fabric? Maybe it can evoke the emotional response often associated with knitting?

The knit pattern came to the surface while, with the noise and rhythm of the Jacquard loom, each thread came down to become a fabric. The pattern looked like the twisted yarn used in hand-knitting. Each thread came together to make a surface, something to cover me, by twisting the threads on the needle and moving the thread-ring to the other needle.

Jacquard weave, the first mechanised form of loom weave, is not, strictly speaking, handcraft; however, I could see the pattern emerge within the loom and felt a human connection with the textile as it was gradually built up, line by line, following my pattern. The pattern, drawn by hand, becomes encoded into dot matrix code, and the mechanised loom then 'draws' the pattern anew within the fabric. This pattern of criss-crossing metal shafts reminded me of what I have seen when yarn is crossed through needles, such as when needles cross one another in hand-knitting. The rhythm of the machine is fascinating, so I filmed it. I did not know why I filmed it but felt it was meaningful. The digital film was stored in my computer's hard drive until I decided to screen it by projecting it onto white fabric as the final section of the examination exhibition. The film produced a hypnotic effect, and many people commented that the rhythm of the loom in conjunction with the visual was very soothing, producing an emotional connection between the viewer and the loom.

The images that I drew for the Jacquard weaving moved to a computer screen. Then using the Jacquard CAD program I decided on the structures I would use in the weaving. My image was revealed in tangible form by the Jacquard loom. And sometimes my images looked different depending on the weaving structures. Turning yarn into a fabric surface might be one of the greatest pleasures that I have had in all my years of designing textiles. Designing on my sketchbook and computer screen always gives me infinite colours and pens, and I can draw whatever I want. On the screen I make my world, the world I always dream of; there are no limitations and no restrictions. I am free. To be able to integrate that pleasure with the feelings I had for making designs that could be part of a practice of 'sustainable' textiles would integrate my two greatest feelings. However, sometimes I struggle with my weaving, such as when I have a limited choice of yarn and when I cannot find the colour that I draw on the screen. Also, I only have a limited time to use the Jacquard loom. These problems of the making process are difficult. I find them frustrating and they inhibit my creative freedom and my practice. To solve the problems I had to think about

different options, such as different yarns, colours, materials etc. Sometimes serendipity intervened and I met an accidental effect that I had not imagined. I think this is one of the great pleasures of making, and it showed the unconscious 'happy together' connection between my idea, emotion, studio, and resources; my making environment became an agent in my practice.

As well as the design, the material is, of course, also very important in weaving. Materials are a necessary starting point for redefining the craftsperson's agency. A craftsperson always, to some extent, chooses the material to use in their practice. However, it should also be remembered that a craftsperson's agency is redefined by and through the material they work with. I studied environmentally friendly materials, such as jute, hemp, piña and so on, and chose soya for this practice. Soya is thought of as healthy, and has a natural image. The soya yarn has a very soft texture like wool. However, it was too flimsy to be durable for upholstery. So, this fabric may not have the physical durability required for upholstery, but might be a meaningful textile for other uses. Was the meaning of the soya fibre weave generated by the emotional experience that I had in the making process? This might not be a reliable source of meaning. Others seemed not to experience the textile as either attractive or desirable.

I had chosen soya yarn as a material to express soft textures like 'cosiness' and knitted fabric. Perhaps the name of an edible protein also influenced my choice of fibre, as if the resulting textile might be a source of nourishment to users. Soya is one of the most environmentally friendly materials. Many manufacturers and designers, as seen above, use environmentally friendly materials and manufacturing processes to develop sustainable products. However, just because a product is made in a sustainable way does not mean that the product will have a long lifespan, one of the main aims of one branch of 'sustainable' products. I keep and use something which is emotionally important to me longer than products which are sustainably made but to which I have no emotional relationship. Although the politics of 'sustainable design' necessarily include considerations of ethical sourcing and manufacture, this, alone, is not sufficient for a successful design practice of sustainability.

In this initial section of design practice, I researched and tested material for 'emotional durability' according to criteria that were entirely based on my own

aesthetic. There was some satisfaction in the process, but when discussing my work with others, during the annual Work in Progress exhibition, or at supervisory tutorials, I wondered how this aesthetic and the criteria could be tested more objectively. This made me think about research methodology and the difference between research carried out in a professional/industrial context and academic research. In a professional/industrial context, I would have generated a range of different colour palettes or 'colourways' for manufacturers to reach the widest range of consumers, but the context of academic research led me to question the choices and responsibility of the designer herself. I began to think more about the role of the designer as a form of social agency.

1.2.1. Material study: Soya

Soya fibres are part of a class of regenerated materials made from protein, either from a vegetable or animal source. They were initially developed in the 1950s and recently have undergone a renaissance as ecological pressure to develop fully biodegradable fibres from renewable sources has intensified. In the 1950s the fibres were viewed as substitutes for more traditional ones in a period of shortages after World War II but were shelved due to technical difficulties and intense competition from other fibres, both natural and synthetic. Recent research and development, conducted mainly in the USA and China, has overcome some of these difficulties and has produced a fibre with a soft touch and an attractive lustre, similar to that of silk. Soya fibre is seen as a potential replacement for petrochemical-based synthetics generally, and also for cashmere. China, a world leader in cashmere production, hopes that soya fibres, sometimes called 'vegetable cashmere', can help reduce the negative impact caused by cashmere goats grazing on fragile grassland.

The agents used in the processing of soya fibre are said to be non-toxic, and waste can be used as animal feed once the protein has been extracted. Soya fibres are promoted as health-giving, with natural anti-bacterial properties.[15]

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[15] Kate Fletcher, *Sustainable Fashion and Textiles: Design Journeys* (London: Earthscan, 2008)

1.3. My Initial Conclusions

My first series of textile prototypes, the 'knitted' woven fabric, sharply illustrated the limits to any designer's own taste and aesthetic. To depend on the criteria of one person, however they are trained, in producing an aesthetic that might have ambitions to be more universally desired was evidently not a good idea. I decided to go back to the 'design thinking' spiral and reconsider the variables in the designer's agency. Could I find, in history, examples by which to be instructed? Did William Morris, for example have the right idea in designing patterns that are still in production today? If the model of designer as individual was not the right way to proceed, might I find ways of understanding alternatives to this?

I called my first mistake 'Happy Together' as it reminds me of the naïveté of the Turtles' song. However I am still interested in the power of the idea of 'togetherness' as discussed by Richard Sennett in his book *Together: the Rituals, Pleasures and Politics of Co-operation*, and by Jonathan Chapman's conclusion, in *Emotionally Durable Design*, that sustainability requires some form of collaborative design practice which will integrate users more reliably with makers. How might this be made? The emotional sharing from a deeper relationship between designers and users might enable the support of the strong ownership of a longer lifespan of textiles. The word 'together' makes a stronger emotional bond in a relationship. I still remember when I made something with my friends, where I have been with my family. This is one of the reasons why I explore emotionally durable textiles through empathy between users, designers and textiles.

Chapter 2. Craft and Technology

In retrospect I was, from the outset, much influenced, albeit initially subconsciously, by the ethos and work of William Morris and the Arts and Crafts movement of late-nineteenth-century England. This was, perhaps, because of the proximity of the RCA to the Victoria and Albert Museum, with its heritage collections of Arts and Crafts designs. The William Morris ethos was, instead of using mechanised and industrial processes, to produce goods by hand in the form of repeat patterned hand block-printed textiles and wallpapers. I wondered if the crafts aesthetic of renewable fibres could also be made to 'imitate' or converse with current industrial manufacture. Might the role of the designer be developed from the role of the artisan? Could anything be learned from the past? I read histories of the birth of the designer within industrialisation in England's first industrial revolution, and wrote a chapter on the comparison between this and the current 'digital revolution'.
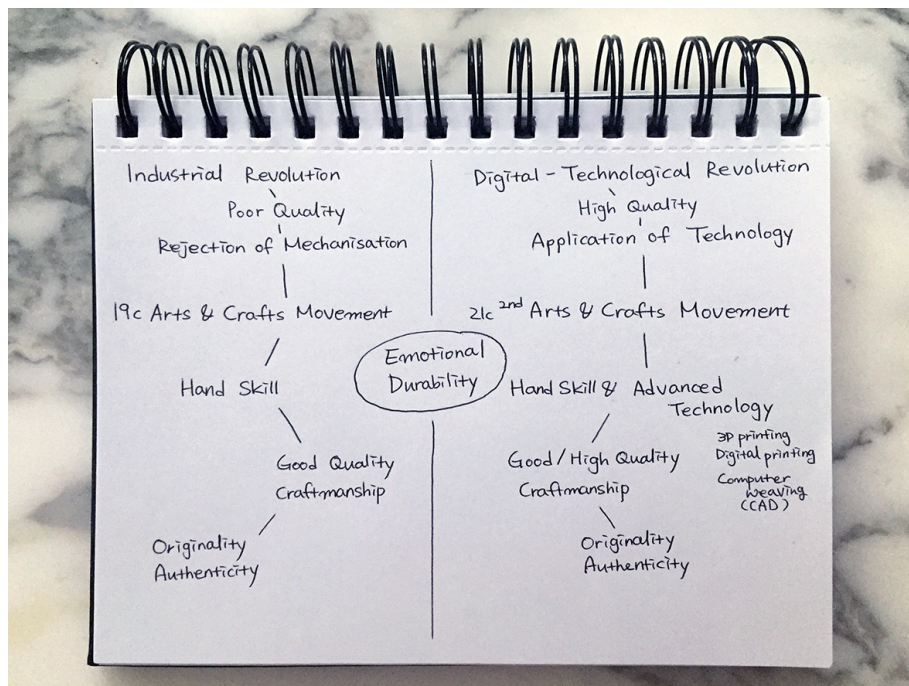
Figure 13 My note: Crafts and Technology in the nineteenth and twenty-first century

2.1. A handmade mulberry chair and Philippe Starck's 'Ghost chair'

Figure 14 Handmade mulberry chair, Jimin Seo

To make this mulberry chair, I used a traditional Korean material, mulberry bark, and also used Philippe Starck's mass-manufactured 'Louis Ghost' chair as a mould. The Louis Ghost chair uses a modern material (polycarbonate); however, I wanted to explain how I use these two paradoxical materials to make a craft object.

Still very much inspired by a search for the 'right' sources, I was searching for a new method of experimentation. Should I simply weave swatches of Jacquard loom textiles and compare these for 'feel', 'look' and 'user preference', as a market researcher might do? This would provide a quantifiable and measurable source of data for choice of fibre and pattern.

Figure 15 Idea sketch for the mulberry chair

At this point a group of RCA textile researchers went to visit a series of exhibitions, including the textile work of jewellery designer Caroline Broadhead at the Marsden Woo Gallery in London. A craftsperson known for her experimental methods, Broadhead transformed the crafts 'showroom' of the Marsden Woo shop front into an 'art' gallery showing photographs made by her daughter Maisie, and the collaborative 'chairs' made by the entire family. A range of pieces of conceptual furniture transformed the space from that of desirable commodities for sale into a philosophical enquiry into the meaning of textiles and their 'use'. The role of crafts as pioneering new frontiers between design and art was quite suddenly made very real to me. I was impressed by several pieces, and more powerfully by the possibilities offered by the imaginative experimentation of playfulness and 'uselessness' in art, compared to the more functionalist and utilitarian decisions of designers. It is the imaginative experience of the making process that seems key here. Stephanie Bailey, in *Aesthetica* magazine, argues that there is little difference between making and thinking (or thinking and making) and suggests that the two processes are symbiotic; she goes on to point out that it is this creative space (of thinking and making) that craft inhabits in a mechanised, industrial world and this space could offer a way to re-unify craft and industry, blurring even more the already fuzzy

dichotomy between craftsmen and industrial designers[16]. Glenn Adamson suggests that this space creates 'sloppy craft', a non-derogatory term which he uses to define the hand-made crafts that lack industrialised polish and perfection. Sloppy craft foregrounds the handmade quality of the object (its 'humane character'[17]), offering a direct challenge to the perfectly-made and universally available objects brought about by mass consumption and globalisation. The 'personality'-led nature of sloppy craft appeals to me and I was interested in returning to a playful and 'useless' form of research practice. I was, however, interested in using sustainable materials alone. Would it be possible to combine the rational use of materials with the imaginative forms of the avant-garde in modernist art? Would the new crafts activism be a way forward? I decided to experiment with form, and to trace the history of the frontier between design and craftsmanship in textile practice.

2.1.1. Process

I soaked the rough bark of the Korean mulberry tree in water and made it soft. When I put the material in the water, I thought of the pond 'Gwanghallu' in Namwon, South Korea. The pond is the main location of a famous traditional Korean story and folk tale, Chunhyangjeon. The pond where Chunhyang played on a swing is very beautiful and peaceful. The bark of the tree in the bucket reminded me of the pond and my favourite Korean story, because the material is hard and strong like Chuhang's integrity. As I soaked the bark in the water, the act evoked the scene of Chunhyang's swinging and also made me feel connected with my Korean roots. When the soaked material became soft, it was like Chunhang's heart for her fiancé; this process, 'a hard material becoming soft', also made me relaxed. The integrity was often regarded as a virtue with '외강내유(外剛內柔): a soft heart under a stem exterior' of traditional women in Korea. This mulberry material is like '외강내유(外剛內柔)'; the texture before soaking is hard like an old tree; however, after soaking it became soft like its concealed inside. Then I covered the Ghost chair with the soaked material, creating a fusion of Korean and European design – this made me feel as though I was here in modern London but enrobed in my traditional Korean costume, a hanbok. I felt calmer and more relaxed: I was making the city – and the

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[16] Stephanie Bailey, 'making is thinking', Aesthetica, http://www.aestheticamagazine.com/a-reaction-to-globalised-production/, accessed 10, June, 2015
[17] Glenn Adamson, 'When crafts get sloppy', Crafts, 211, (2008), pp. 36-41

object – part of me. I then left the wet material to dry on the chair overnight. The dried material on the chair in the morning was hard and brittle, reminding me of a freshly-starched *hanbok*. Finally, I sprayed starch on the material and dried it again to hold the shape of the chair. The dry, hard chair was very satisfying to touch and it had a rough sensuous quality. This process passed through my hands, as when Koreans make *hanji* by the traditional method. The *hanji* paper-making process starts by soaking the bark of the tree in cold water and then boiling it. It is then steamed and washed in order to make the surface denser. The paper is relatively smooth and uniform in texture. However, when I covered the ghost chair in the bark material, I purposefully left cracks and holes in the material to show both the texture of tree and the original characteristic of the material. If I had made a denser bark fabric, it would have been able to obtain a harder, more solid shape, but it would have lost the characteristics of the material.

The relationship between the crafts aesthetic of the mulberry fibre and the Philippe Starck moulded polycarbonate chair was like a duet between two ghosts. The ghost of traditional Korean materials and handcrafting killed by the mass production of cheap and popular 'designer' objects. The ghost of Philippe Starck reflects the idea of the signature designer falling from grace with a new ethos of sustainable and collaborative design. The designer, it seems to me, is no longer an individual agent, solely in control of the creative process, but is part of a team of people who must interact and work together to make a difference.

Figure 16 Soaking the bark of Korean Mulberry

Figure 17 Moulding the bark on the Starck chair

2.1.2. 'Arts and Crafts'

What was becoming clear to me through my work with the mulberry chair was that the idea of authenticity was very important in helping to create an emotional engagement with an object. Using the mulberry bark in my contemporary practice made me reflect on my Korean cultural heritage and allowed me to think about the history of Korean crafts, where the privileging of the 'authentic' was shared between generations of craftsmen and consumers. I wondered whether any such feelings towards craft existed in British history. In the exhibition 'The Cult of Beauty: the Aesthetic Movement 1860-1900', at the V&A museum, London, I saw that nineteenth-century people were seeking a new beauty against the 'modern' and thought this

notion might be relevant again now. It seems that in the contemporary world people are looking for a 'real' aesthetic and 'unique' design in this materially rich but emotionally desolate era. So I went to the V&A again to try and discover more about the history of British craft and see some historic examples. I was drawn to the Arts and Crafts movement of the mid- to late 19th century – these objects in the museum appealed to me as works that valued the authentic; they were beautiful products that had a warmth and exhibited the 'humane character' that Adamson cites as being essential to craft. I thought that the British Arts and Crafts movement might provide a useful historical model for my own thinking and practice and set out to learn more about it.

Figure 18 'Acanthus', wallpaper by William Morris, 1875. Museum no. E.495-1919
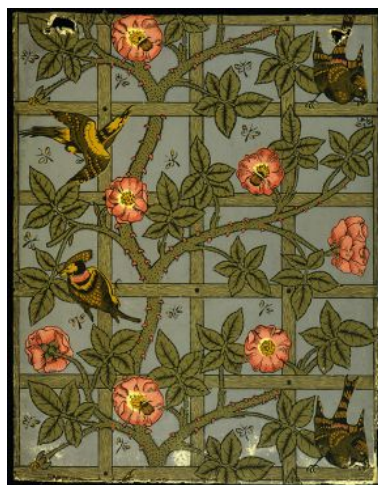
© Victoria & Albert Museum, London

Figure 19 'Trellis' woodblock printed wallpaper, by William Morris, England, 1864. Museum no.

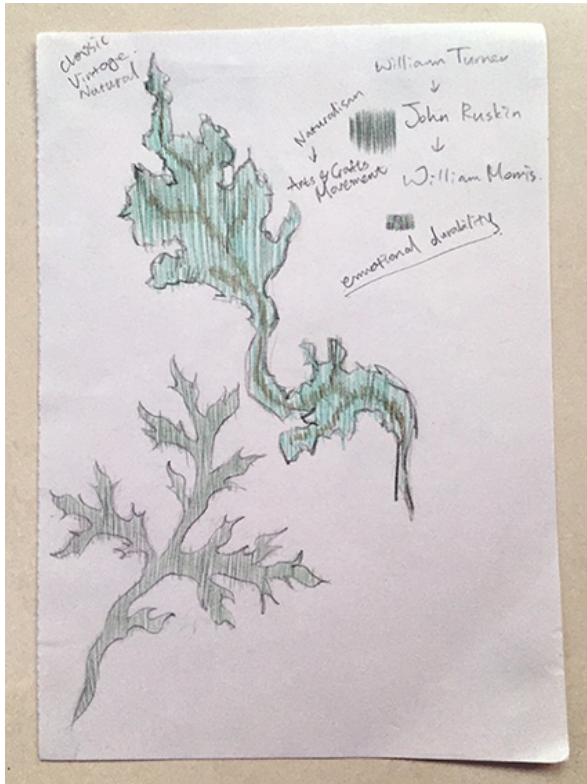**E.452-1919, © Victoria & Albert Museum, London**

Figure 20 idea sketch and from my sketchbook

Figure 21 idea sketch and from my sketchbook

Figure 22 idea sketch and from my sketchbook

Figure 23 idea sketch and from my sketchbook

I found that the Arts and Crafts movement did, indeed, value the idea of the authentic. The movement was a reaction to the mass-produced 'inauthentic' products being produced by a newly industrialised society (after the Industrial Revolution). One reaction of artists and artisans to this rapid mechanisation of manufacture was the Arts and Crafts movement. The Arts and Crafts movement was far from a sudden and spirited reaction to the aesthetic and moral ugliness of industrial society. It had evolved out of the strict design morality of the Gothic Revival in early Victorian Britain, nurtured, supported and helped along the way towards a moral but free aesthetic by a number of strong-willed theorists and practitioners.[18] Unlike many other art movements, it had a strong social and moral dimension: the Arts and Crafts movement emphasised the aim of improving the quality of people's lives through beauty, craftsmanship and authenticity.[19] John Ruskin, William Morris and Owen Jones, leaders of the movement, wanted not only to improve the working conditions of craftspeople and to establish an educational framework for their training, but also believed that good design and craftsmanship could improve society as a whole.

William Morris was inspired by thinkers from various fields, and formed his perspective in reaction to industrial capitalism. The most influential figure for William Morris was John Ruskin. Ruskin argued that the move towards ever more pervasive mechanisation had replaced ideas associated with beauty and nature. Ruskin's ideas prompted Morris to criticise empty commercialisation and the industrialised separation of labour from the finished product. In the nineteenth century, people (and society at large) obtained many benefits from the mechanised world of the Industrial Revolution[20] but some writers and thinkers, such as John Ruskin and William Morris, argued that such large-scale mechanisation led to an emotionally drained society, one in which human values were becoming subsumed into large-scale commerce and mass-produced industry. The human touch was, they argued, disappearing.

Morris tried to enhance nineteenth-century art and design and the prevailing way of life by reviving handwork that emulated medieval artistic processes; he sought to create a nineteenth-century English tradition which associated medieval architecture and decorative arts with

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[18] Elizabeth Cumming and Wendy Kaplan, *The Arts and Crafts Movement* (London: Thames & Hudson, 2002), p.10-11

[19] Mary Greensted, *The Arts and Crafts Movement in Britain* (Oxford: Shire Publications, 2010), p.7

[20] The benefits of the Industrial Revolution: 1. Industry-based economy: Better, stronger and faster growing economy 2. Better utilization of resources: development of agricultural methods that led to improved produce from the same cultivable land 3. Enhanced standard of living: better healthcare, education and laws for the middle-income group 4. Increased environmental awareness: the formulation of several laws to protect the environment 5. Better labour laws: better working conditions, healthier lifestyles and longer lifespan

natural functionalism. This was, he argued, the outcome of social harmony among people living in close contact with nature.[21] In parallel, he thought of the wonder and pleasure obtained from human handwork as not only beautiful but also a moral activity.

In addition, William Morris and other craftspeople were seeking to regenerate aesthetics; they thought that mass production caused people to lose the sense of real aesthetics and the pleasure that comes from something made by hand. The key point in relation to my practice is that they believed that objects made with craftsmanship had a greater longevity than mass-industrial products. This was, they argued, because objects in which consumers could feel the human touch of the craftsmen would be more valued, both financially and emotionally, than objects produced on a large, impersonal scale by machines.

How did William Morris and the Arts and Crafts movement import emotional durability to craft? In order to address this question, we need to define the meaning of craft in the nineteenth century. Through a study of the ideas of John Ruskin and William Morris it has become clear that nineteenth-century craft was essentially decorative handiwork using material with skill. The craftspeople drew, cut, wove, affixed, and painted by hand. They could sense the accomplishment of this labour, and believed that their labour had a high value.

Craftsmanship in the nineteenth century was focused on the technique of the craftsperson, who needed good hand skills, which were technically sophisticated, and the ability to choose good materials. Traditionally, craft refers to a skilled hand-making activity for producing useful objects. The terms 'hand-made', or 'hand-finished', to express the authenticity of the materials, were more important than their creative aspects to demonstrate craftsmanship in this period.

My mulberry chair showed the authenticity of Korean materials and traditions. I argue that this is a craft piece even though I used a well-known piece of 'signature' design, a contemporary, mass manufactured chair, as a mould-form in the making process. Starck's chair, for me, is a good example of an inauthentic product. It values novelty over craft and its mass-produced nature contradicts the artisanal humane quality of the original baroque chair on which it is based. In his introduction to *The Craft Reader*, Glenn Adamson suggests that modern craft is best seen as a means of

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[21] Lauren S. Weingarden, 'Aesthetics Politicized: William Morris to the Bauhaus', *Journal of Architectural Education*, 38 (3), (1985), p.8

articulation, a modern way of thinking *otherwise*[22]. My mulberry chair is an attempt to see Starck's chair 'otherwise', to reimagine and 're-craft' a modern, technologically produced object as an emotive piece of handmade, authentic craft.

The use of Philippe Starck's parody of a Baroque dining-room chair as a mould for the handmade *hanji* bark piece became a way of thinking. The chair is not for sitting in, but is for thinking through and looking at. Rather than 'design', my quest to find the authentic in craft had led me to ponder the ideas behind making and think about how material could be used to provide a 'warm' emotional engagement with an otherwise 'cold', anonymously produced object.

2.1.3. Material study: *Hanji*

The accelerated globalisation of manufacture and retail in recent decades has further compromised the independence of local cultural identities, already eroded by nineteenth-century imperialist and colonialist economies. One of the reasons for this is because of the invisible nature of production processes and supply chains: in a world of globalised economic production and distribution, design and production, both take place far away from one another and from the points of retail and consumption. The consumer is denied knowledge about the provenance of the materials and the processes of sourcing and manufacture of a product. Furthermore, the advertising and publicity industries of the twentieth century produced an ideology that was complicit in fantasies that commodities 'arrived' as if by magic from exotic locations into the daily lives of innocent consumers. The material basis of industrial manufacture was systematically concealed by marketing cultures at the point of dissemination and acquisition. However, there are signs that, despite this confusion and exploitation of cultural identity within production, new cultural strands are being activated and traditional cultural heritage is being revived.

The textile industry in Korea developed with the growth of synthetic textiles in the 1970s. However, over the last 20 years the textile industry in China has grown considerably, and it is now almost impossible for Korean, European or American textile manufacturers to produce synthetic textiles at competitive prices. The market in Korea and the west, however, now values high-quality textiles over cheaper synthetic fabrics. Therefore the Korean textile

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[22] Glenn Adamson, *The Craft Reader*, (Oxford, New York: Berg, 2010). p.5

industry now focuses on high value textiles, such as those that are sustainable and culturally specific. '*hanji*' fibre, Korean traditional paper fibre made from the mulberry tree bark, is a locally produced material with good environmental and social credentials. Traditionally Korean people made this paper by hand in groups. Today, groups of local people are finding their roots by rediscovering the traditional Korean method of making paper. Traditional methods are sometimes used to make small runs of paper. The traditional paper has numerous microscopic pores, which help to control the flow of air and humidity. Because of these qualities Koreans traditionally used this paper not only for making books but also for windows and doors, making a room cool in the summer and warm in the winter. *Hanji* fibre has recently started to be used in the interior design and fashion industries.

The *hanji* industry, however, has also been recently modernised so that the paper can be mass-manufactured, meaning that it is cheaper to buy, therefore growing the market for this traditional product. The modern manufacturing system also uses contemporary designs, matching modern design items with traditional material.

Jeonju in South Korea is the main production area for both traditional and modern *hanji* fibre. The research centre for *hanji* in Jeonju promotes the Hanji Project, that employs local people to manufacture textiles using the paper fibre. An example of the premium quality and high status of this material can be seen in the luxury fashion brand Chanel's use of *hanji* yarn. In the pre-fall 2014 show on 10 December 2013,[23] luxury fashion brand Chanel showcased a line of jeans that used Korean *hanji* textiles by Troa, a Korean textile company.

Figure 24 Chanel's pre-fall 2014 fashion show, Dallas, Texas, 10 Dec. 2013

© Evans Caglage, Firstview.com

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[23] Hoo-ran, Kim, 'Korean Fabric Gets Spotlight on Chanel Runway', *The Korea Herald*, 30 Dec. 2013, available at: http://www.asianewsnet.net/Korean-fabric-gets-spotlight-on-Chanel-runway-55560.html, accessed 6 May 2014

2.2. Moon jar (달항아리) with Hanji

Figure 25 Hanji woven fabric with moon jar pattern, Jimin Seo

Cultural identity is one of the significant elements in the field of design. It is also useful in explaining the authenticity of my practice and background. In this context, my work has been inspired by the traditional Korean 'moon jar' (달항아리). This type of jar was made during the latter period of the Joseon dynasty in the eighteenth century. The name 'moon jar' derives from its spherical shape and the white glaze of the jar, which resembles the moon. White was a supremely important colour, thought to signify integrity and purity by the Neo-Confucianist (Joseon dynasty) ideals of austerity, simplicity, plainness, frugality, humility, and abstinence from extravagance and vanity. An important Neo-Confucian scholar, Yi Kyu-gyoung (1788-1856) wrote: ' the greatest merit of white porcelain lies in its absolute purity'.[24] This aesthetic sensibility became part of the Korean artistic values, and simplicity and purity are still a key part of Korean design today.

Like the craftsmen in the Joseon period, I would like to keep my mind focused on

[24] British Museum (2000),
http://www.britishmuseum.org/explore/highlights/highlight_objects/asia/w/white_porcelain_moon_jar.asp
x, accessed 22 Sep. 2015

45

purity and integrity as a designer and craftsperson. Aesthetically the height of a moon jar is almost equal to its diameter, giving it an apparently perfect spherical shape. However, the moon jar is actually made by joining two separate bowl shapes, so they are not always perfect. The diameter of the base is also smaller to that of the mouth, so the moon jar appears slightly unstable. However, these slight imperfections are considered to be a reflection of nature's full moon and man's uncontrived relationship with nature; these slight imperfections, in harmony with the creamy white body, highlight the sheer size and the voluptuous curves, lending to a greater dignity in the piece[25].

This concept of 'joining two separate bowls to make a jar' was meaningful for my practice because I am studying in London, using modern machinery but using Korean traditional material. These two ideas are in balance and become a 'whole' in my mind toward sustainability.

In contrast to Europeans, Koreans met modern machinery much later and more slowly. It was not until the mid-nineteenth century that the Joseon people 'invented' machinery, and it was more for agricultural than industrial uses. A real, meaningful development in industry and economy in South Korea did not occur until after the Korean war, when people saw and used enormous numbers of machine-made products. Today Korean companies such as Samsung, LG and Hyundai lead modern technology. Possibly because of this new-found technological supremacy and the ubiquity of technological products that accompanies it, many of the current generation of Koreans are reconsidering the value of the crafts. Hand in hand with this is a re-evaluation of traditional Korean practices and designs; the current generation of Korean craftspeople is looking 'back to the future' as a way to fuse our past with our present. This is the reason why I used the moon jar concept for my pattern design.

As well as utilising traditional motifs and objects in my design, I also wanted to use traditional materials. I chose the material (*hanji*) to weave emotionally durable textile because *hanji* is emotionally important for me: I can feel my home town 'breathing' whenever I touch it, evoking a warm, cosy, and nostalgic sensation for me. The

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[25] Korean Culture Centre, The Korea Blog (2005), http://blog.korea.net/?p=16552, accessed 22 Sep. 2015

material is also important to me as a designer, as it positions me within an enduring design tradition in Korean crafts. I thought the material would help build sympathy and curiosity with users, leading to a stronger emotional relationship and helping them to experience Korea through textiles.
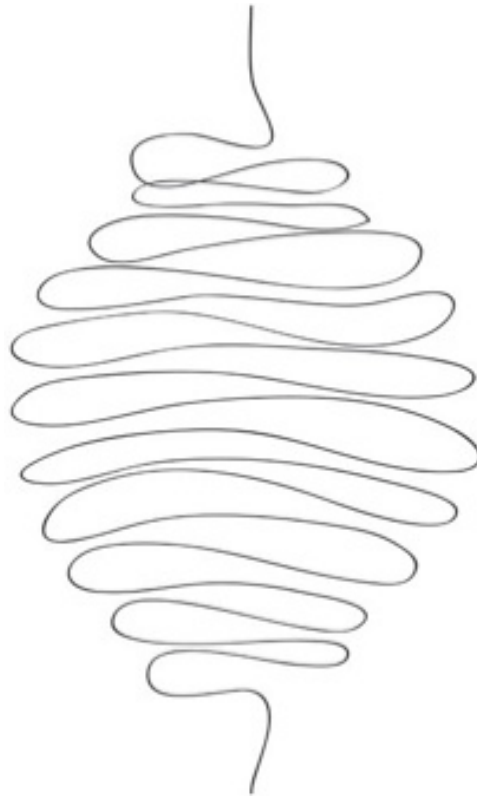
Figure 26 Moon jar pattern design, Jimin Seo

However, it was difficult to make emotionally engaging textiles for other people. This pattern design communicates my emotional experience, such as memories of my childhood and *hanii* communicates a Korean cultural identity strongly. Both concepts linked me to my life in Korea. However, to gain interest in this design from other users, I needed to integrate not only my view into the design but also those of others. As a foreigner in London, it is difficult to build an emotional relationship with other people because of the cultural differences between us. Introducing my culture to other cultures is very important to me, and I thought it would help to make my designs more emotionally engaging. However, people cannot learn about other cultures and establish an emotional bond with that culture merely from an object. It is

easier to learn about another culture through physical experiences, such as visiting and sampling food.

Therefore, I had to ask myself how I could make designs that would be emotionally durable for people other than myself. My answer was to make the object more than just a product to buy. Emotional durability could be built in not only by turning the consumption of an object into an experience but also by making the design of the object into an interactive experience for the consumer. This would enhance the emotional durability between the textiles and the designer/users.

Understanding the range of differences in subjective experience is important in order to create emotionally durable design. Although it might be impossible to maintain the Arts and Crafts ideal of a shared authentic aesthetic, where the designer could rely on their own taste to be universal, it would still be important to find ways of communicating with user groups. I therefore decided to embark on experiences with users to design the textiles.

2.3. Knit pattern with Hanji

Figure 27 Knitting pattern and *hanji* woven fabric, Jimin Seo
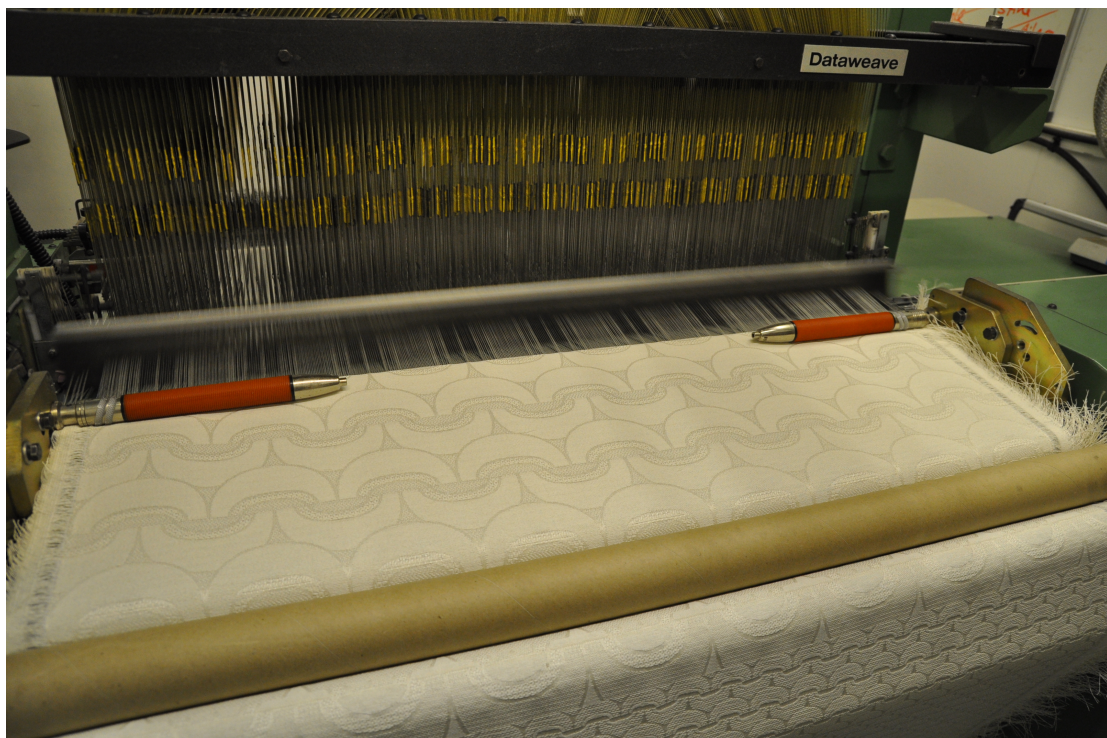

Figure 28 Knitting pattern *hanji* fabric weaving on Jacquard loom

Thinking about material in my practice meant two main things: the physical qualities of the material (the fabric itself) and the design which would be used on the fabric. To make a truly emotionally durable design both of these would have to work towards building a connection of some sort with consumers.

I chose to use *hanji* yarn, as this has great cultural significance to Koreans. As mentioned above, *hanji* is a traditional type of paper that has recently been developed as a yarn; this process is heavily dependent on new technology, yet the fabric maintains a craft sensibility because of *hanji*'s deeply significant cultural heritage. While I was making the mulberry chair I thought about the characteristics of *hanji*. *Hanji* is a traditional Korean material, albeit one that some designers and manufacturers have used in a contemporary way: thus I could integrate this contemporary product with my own cultural heritage and emotional background.

Not only weaving with *hanji*, but also the actual woven pattern, was important to me in giving the textile an emotional life. The pattern recalled twisting Korean straw ropes. Both twisting and weaving have the meaning of 'tying together'. When I weave this knitting pattern I join together two disparate objects, my textiles and me. As well as 'tying together', 'making together' is also important in Korean culture. *Hanji* has the concept of making together because traditionally people make the paper together. In addition, twisting a straw rope carries a meaning associated with life in Korea. When parents have babies, they twist a straw rope and hang it on the door: this is supposed to protect the babies from devils. Also, they integrate love for the baby while they twist it. Thus I chose to weave a twisted, knitted pattern with the meaning 'tying together' from Korean culture, wishing for the emotional durability of my textile.

Moreover, studying abroad made me lonely, and sometimes I found it hard to mix with other people in London – this means that I was an emotional stranger in London. Thus one of the things that was important while studying for this research project. was to be integrated more into British culture. Tying together the design of my weaving symbolised for me this longing to break out from the cultural isolation that I found myself in when living in a foreign country. I wanted to reach out and join in. As I wove, these were my thoughts and wishes. I wanted the woven fabric to show not

only an authenticity of material and design, but also the emotional authenticity of my troubled and confused cultural identity.
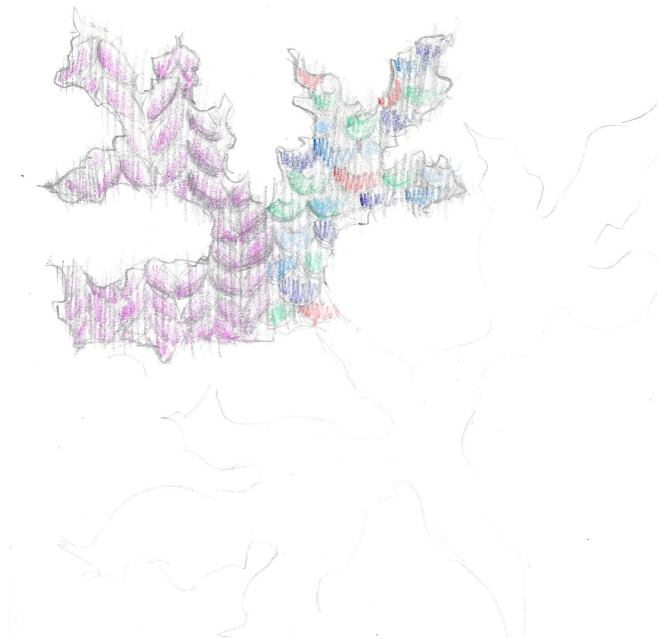

Figure 29 idea sketch and from my sketchbook
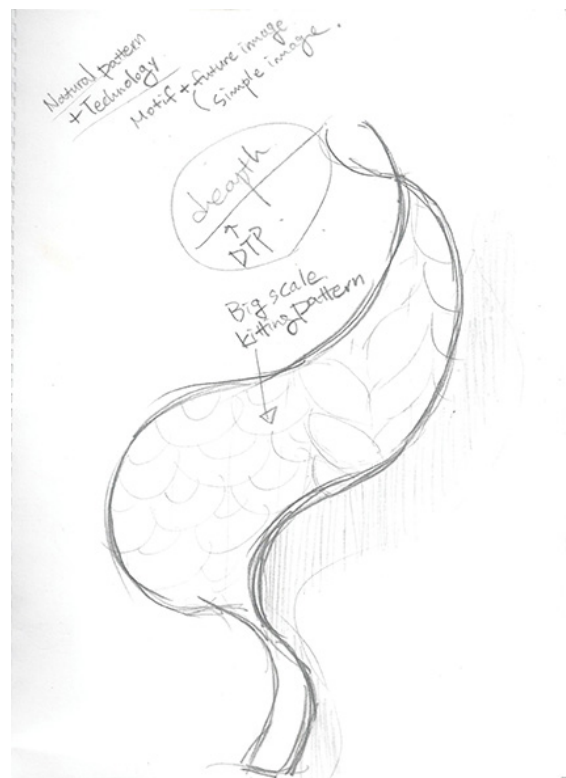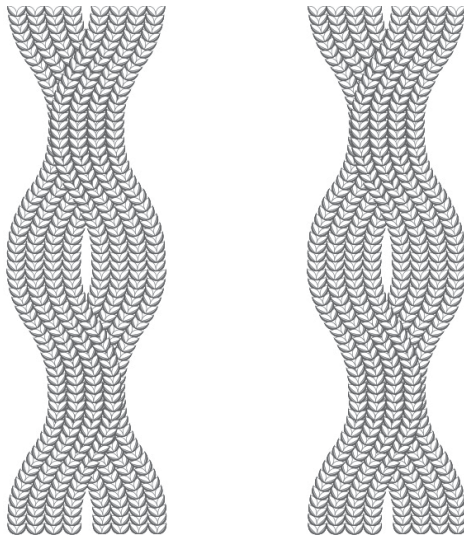

Figure 30 idea sketch and from my sketchbook

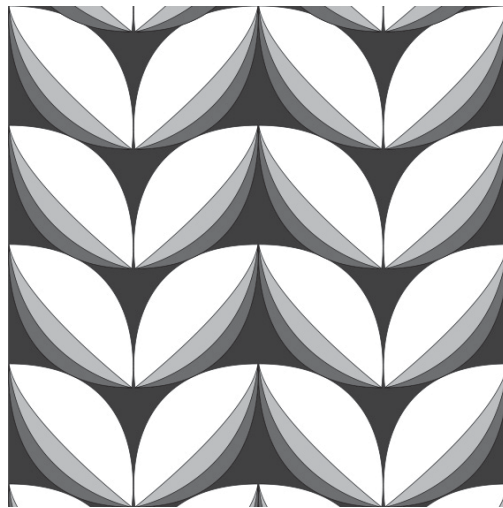**Figure 31 knit pattern design, illustrator, Jimin Seo**

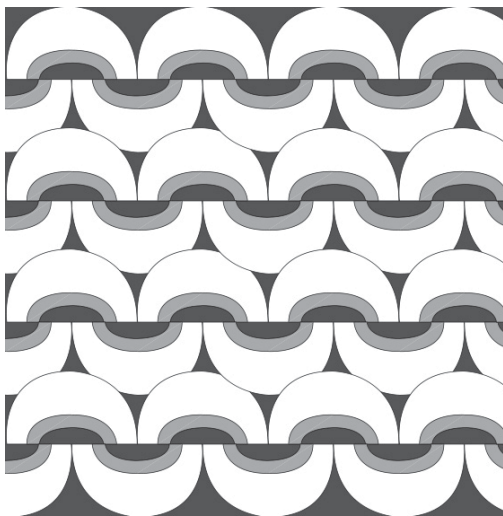**Figure 32 knit pattern design, Illustrator, Jimin Seo**

Figure 33 Knit pattern design, (Illustrator), Jimin Seo

2.3.1. Digital technology for contemporary crafts

Knitting is traditionally a feminine craft; however, I wanted to try weaving knitting patterns using modern machinery such as the Jacquard loom. I wondered if I could express and feel emotional attachment and find the authenticity of my fabric in the working process even though I was using modern machinery to weave a knitting pattern. I used digital tools, the Illustrator computer programme and Jacquard CAD, and modern machinery, the Jacquard loom.

To understand the meaning of contemporary crafts and its authenticity in the twenty-first century it is useful to explore the meaning of art in this period[26]. Making traditional art requires hands and skill. However, the meaning of art changed significantly in the modern period. Marcel Duchamp, for example, famously separated artistic work from conventional signs of artistic authorship in works such as his *Fountain* (1917) or *Bottle Rack*(1914). In copying without copying and disinvesting artistic labour of 'purposefulness' he eradicated the normative distinction between skill and deskilling in pre-modern art. The result is that Duchamp's work opened itself up to general social technique without seeking to aestheticise this process[27]. After Duchamp, contemporary artists used materials and objects which, rather than being hand-made,were actually ready-made products, such as Damien Hirst's *Pharmacy* (1992). In addition, traditional art required only hand tools, such as brushes, and the artist's skill; however, this is not the case with contemporary art. For example, David Hockney used new technology in his iPad works in 2011. Hockney did not use pencils or pens to create the 32 works in the series *The Arrival of Spring*. Instead, he created a new kind of drawing using everyday technology not only as a material but also as a tool, replacing the pen and brush. There are endless other examples of contemporary art that are imbued with technology; much contemporary art could not exist without technology of some sort.

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[26] There is, of course, an important difference between art and craft. Art is purely aesthetic, whereas craft objects have a purpose, a 'use' and an 'applied function'. Craft is often explained in the context of art and design. Despite Adamson and Bailey arguing, as we have seen above (when discussing the Mulberry Philippe Starck chair), that the two binary opposites of handmade/machine-made and aesthetic function/practical function may be somewhat redundant in today's craft context, these binaries are, for this thesis, useful to help us think about the differences between craft and design. Crafts and design have the same ideas of useful functionality but they often (but not always) fall into the handmade/ machine-made and aesthetic function/practical function binaries. A large majority of contemporary practitioners transgress the boundaries, which is precisely what makes contemporary art/craft/design exciting.

[27] John Roberts. *The Intangibilities of Form: Skill and Deskilling in Art After the Readymade.* (London: Verso, 2007) p. 81

The use of technology in the art world, however, does not diminish the works of art. There is no doubt at all about Hockney and Hirst's status as artists. Their works can be found in the major galleries and museums of the world, even though they have both utilised technology and machines to make their work. The binary opposites seen by Morris in the nineteenth century (hand-made vs machine-made / craft vs industry/ human vs machine) are simply irrelevant in contemporary art.

The challenge to mechanisation and the application of technology is the key difference between nineteenth-century and twenty-first-century textile design: their use of new technology. The Arts and Crafts movement was 'anti-technology' and embraced the idea of the individual craftsperson by using hand tools. In the nineteenth century, the term of crafts was only applied to hand-made products; however, the meaning of crafts has changed. Many contemporary craftspeople use new tools, such as machinery and digital technology, and develop new materials, using new tools and methodologies to create synergy in craft: for example, the use of digital print, media, environmentally friendly chemicals and laser-cutting in textiles. One of the most important characteristics of contemporary textile crafts is the application of technology. I was interested in exploring whether the emotional durability achieved by Morris in his work could be replicated today using twenty-first-century technological craft practice. One key aspect in creating this emotional connection for Morris was the authenticity of materials, design, thinking, and practice, and I wanted my own practice to replicate this.

Today, there is a general consensus amongst craft practitioners, educationalists and theorists that the engagement of contemporary craft with digital technology is something to be embraced rather than feared. In November 2014, a debate was held at Nottingham Trent University entitled 'Is technology killing hand-made craft?'. Christopher Breward, Principal of Edinburgh College of Art, argued that craft is a process; even though craftspeople use technology they need skill and technique to use the technology effectively. Both handcraft and technology-led craft are iterative – they are skills that craft practitioners need to learn, practise, perfect, and internalise. Andrew Adamson, Corporate Services Manager of Johnson Tiles, Stoke on Trent, built on this idea and argued that even with all the help of computer software and CAD the key element in the design process is the thinking of the designer – as yet, computers cannot 'think' through the design of a product – it is this creative thinking process that leads to a successful product design. In order to facilitate this creative thinking, people need to have more handcraft education at school. Thus skills, both traditional and modern, should be thought of and utilised throughout the process of making. Contemporary

craftspeople still have skills, autonomous ideas and studios. Through the integration of new technology, contemporary craftspeople are developing new types of skills and updating old skills, thereby inventing a new tradition.

To understand the authenticity of contemporary craft using digital technology, it is useful to think about the difference between craftsmanship and workmanship.

According to Risatti (2007), workmanship concerns that which is actually done to a material by hand. The meaning of workmanship includes dextrous hand skill and technical skill in the handling of materials; however, the quality of workmanship results from the output of manual skill;[28] therefore, creativity and ideas are not necessarily part of workmanship.

In his essay 'The Nature and Art of Workmanship', David Pye (1968) discusses 'workmanship using any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on the judgement, dexterity and care which the maker exercises as he works.'[29] His thinking on workmanship is similar to craftsmanship; however, craftsmanship is different from workmanship. Workmanship comes from a rote process, learnt by continuous making activity. It should not be confused with craftsmanship,[30] which comes from a process of conceiving, thinking, reflecting and creative practical activity.[31] Nineteenth-century craftspeople refused to use machines because they thought that machines would diminish their 'craftsmanship', and mean that their skills were reduced to 'workmanship'.

Today, however, craftspeople have embraced modern technology and at the same time argue strongly that they are using craftsmanship, not workmanship. This is because craftspeople or designers who use modern technology have become reskilled in both digital and craft activity. During this reskilling, they are still concerned about their creative practice. In addition, craftspeople or designers sometimes make mistakes when using technology or machinery and thus improve their skills through repeated practice with the technology. An example of this is the use of a computer programme such as Photoshop, Illustrator or a CAD programme to make something: modern technology cannot make something by itself, people who have skills

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[28] Howard Risatti, *A Theory of Craft: Function and Aesthetic Expression* (Chapel Hill: University of North Carolina Press, 2007) p. 163.
[29] David Pye, *The Nature and Art of Workmanship* (Cambridge: Cambridge University Press, 1968) p. 20
[30] Risatti, p. 163.
[31] Ibid., p. 167.

in using the programmes control and use this technology to channel their skills, creativity and passion for their work.

Another reason why I maintain that digital activity can be integrated into craftsmanship is because craftspeople, not digital technology, decide on key factors such as colour, structure and form.

Finally, modern craft objects are not made by technology, they are made by people who use and control the technology. Technology cannot create and control for people, but people create and control technology; unlike Morris's fears, technology does not control people in craft activity. Craftspeople and new technology mutually influence each other. Humans *evolve* with new technology. With each new technology adopted into their practice, modern craftspeople change their usual *modus operandi*. The physical and psychological impact new technology has on the maker is also important. In my view, we can never be in perfect control of the tools we use, but can use the tools effectively. It might be more effective to emphasise that we should remain conscious of our own action. We should be *reflective practitioners*.

In this thesis, I define contemporary crafts as a creative activity using human skill to make useful and decorative objects with materials, fully utilising the potential of all of these. New technology has also enabled craftspeople to be even more reflective in their practice. In the past, craftspeople were reflective but they were constrained by the physical properties of the material they were working with – it would be difficult to re-think a textile once it had been made on the loom. New technologies, however, have given craftspeople the opportunity to model their practice in a digital world, facilitating a more reflective practice.

My research demonstrates the authenticity of my work by revealing the making process, through photos, videos, sketches and so on. My intention to reveal all of these in my final exhibition, my website, and in my thesis will hopefully generate an emotional link with the users. In her 2012 article 'Showing Making: On Visual Documentation and Creative Practice'*,* Lehmann discusses the effect that various methods of revealing the process has on the viewers / users. A combined study of the imaging of craft and the crafting of images opens up new perspectives for media and craft studies, not only because it can tell us about the cultural, social and

material conditions of making, but because it reminds us that images are an integral part of making in their own right[32]. Therefore, when I choose to use material and digital tools in my practice, the user is able to access my design thinking process and understand the motivation behind my choice, building an emotional engagement with my textiles.

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[32] Lehmann, Ann-Sophie., 'Showing Making: On Visual Documentation and Creative Practice', *The Journal of Modern Craft* 5(1), (2012), p.20

2.4. My Initial Conclusions

The use of site-specific installation from a fine art context as a method for 'thinking' differently about design was an unexpectedly rewarding process. The *hanji* bark and textiles moulded across the Philippe Starck design 'classic' could not be sat upon, but could speak of the differences between living solutions and ghostly remains. If the mass production of polycarbonate injection-moulded furniture provides commodities for the market, how can the designer of sustainable goods from ethically sourced materials be anything other than a dream? Should the new, sustainable, designs be moulded onto existing prototypes? As in the Biblical story, can the 'new wine' of sustainable upholstery be put into the 'old skins' of popular forms? The chair that hangs here is like a drawing of a chair, as if it is the ghost of my original hope to make something universally attractive and endlessly desirable. The piece is now a statement about 'going back to the drawing board' and thinking more about ideas.

Part of going back to the drawing board was the sense that I needed to learn from the experiments of previous generations. Although William Morris was not especially conscious of what we now call the sustainability agenda, his thinking and the resulting movement was nevertheless a response to the negative effects of capitalist greed for profit on the ethics of social inclusion. My research into design history brought new questions about the capacity for comparison between the nineteenth and twenty-first century, specifically comparing the Industrial Revolution and the digital revolution. These have both had an impact on the role of the textile designer. The first suggested that designers might be more like artists and artisans and the latter suggests that digital media are so thoroughly a part of daily life that we must use them, even if the alienation of digital media seems to drive an appetite for aesthetics of the 'hand made' and authentic. As well as researching into design history I started to research crafts that integrate traditional and new techniques. I was especially drawn back to Korean materials and designs.

Working on the material in this chapter showed me that modern technology can, and even should, be an integral part of contemporary craft. The modern technology that underpins much contemporary practice should be nourished and celebrated, rather than ignored and feared. I also found, however, that technology itself cannot build emotional durability. I found that the things that lead to an emotional connection with

a design for me are not necessarily the same as those for other people. Because of this, I decided that I would need to engage with consumers to find out their motives, desires, thoughts and memories – I would need, once again, to use the Korean concept of 'happy together' by speaking to people and finding out what emotional durability might mean for them.

Chapter 3. Collaborative Design Experiments

Figure 34 'Origami' woven textiles, co-design between Jeongin Lee, Jimin Seo

In this section, to create emotionally durable design I set out to communicate with my customers by turning their experiences into stories which would feed into the design. I called this process storytelling. I had been reading an essay by cultural theorist Walter Benjamin. Benjamin suggests that the traditional role of the storyteller is an integral part of a pre-literate society, where not all everyone can read and write, but where an oral tradition of dialogue sets the logic of culture. The storytelling is quite different from the authority of 'instruction' or 'information'. These are monologic forms, where information moves from down from above, whilst in storytelling there is a sense that the roles of speaker and listener can be reciprocal. Benjamin calls the structure of knowledge in storytelling a 'dialogical' one. I wondered if a designer could make something like a 'storytelling' structure.

A new sort of manifesto of design principles seemed to be emerging in my practice. Design should be a dialogue between designers and users, objects and users. Designers cannot design just for themselves. However, our designs need to be not only useful for people physically but must also generate some kind of emotional response. Today, many designers argue that emotional design is significant. For

example, the current design trend for customisation is a reflection of the concept of emotional design. However, could we say this design concept of customisation in industry is really customised design? Many design companies provide colour, material and pattern design options of samples to customers for customised design. However, I think that just choosing from given options is not customising. If customers can only choose something from a restricted set of given options chosen by unknown designer, they cannot make enough of an emotional connection, such as the emotional experience in the making process, with the final objects. I think 'real' customised design should record the 'real story' of customers.

Therefore my practice as a designer changed from being 'at the desk' or 'in the library' to being out 'in the world' and talking with users. I had several meetings with a variety of people, thinking that these people might be 'users', and that I could find ways of engaging with them that did not transform them into 'customers', I wanted to find their own stories. These people were a textile artist, a Korean tea ceremony expert and a product designer. After listening to their stories I would design and make for them customised textile design based on their own emotional subjectivity, but using the materials that are known to be sustainable.

To approach emotionally durable design, I also considered crafts and craftsmanship in my previous practices, exploring the meaning of craft through these. Craft is not only making by hand. Craft is storytelling itself, by choosing the material and making. Craftspeople work in the studio and learn skills from others. Earlier, I tried to design my own story into my textiles, but it was like a monologue. Thus it was difficult to convince and understand other people. Often empathy is aroused not by *what* we tell, but by *how* we tell. From this point of view, I would like to design interactive textiles which include the story of both the designer and the customer. For 'real' customised textile design, when I interviewed my clients, one of my aims was to understand what were meaningful textiles for them so that I could then base my designs on their earlier emotional responses to textiles.

3.1. Interviews

My first interviewee was a Korean tea ceremony specialist, Kang. I visited his tearoom, Sookoohoi (숙우회) several times with my mother. I was fascinated by the Korean tea ceremony because of the beautiful Korean tea setting, with its natural dyed fabric. Kang's collections, and the atmosphere of Sookoohoi tearoom, were enough to fascinate me. There were many people in his tearoom to experience Korean tea ceremony and I imagined that they also loved both the place and Korean tea culture. Thus I wanted to know what creates this strong emotional experience for people.

The Sookoohoi uses 4 floors of a building: the second floor is the *Ikijeong* (이기정:二旗亭)'. the *Ikijeong* symbolizes the *Ilchangig* (일창이기(一槍二旗) of tea leaves; it means two pointed leaves in a branch; however, it also represents the 'yin and yang' of the oriental spirit. In this space, *Ikijeong* (이기정:二旗亭)', people learn the Korean tea ceremony and to stand on their own through the discipline of the tea ceremony. In the Korean ceremony people always have tea together but at the same time they cultivate their own independent mind. While carrying out the tea ceremony they build their relationships and empathy through continuous dialogue.

If the *Ikijeong* is a sharing place, the first floor, *Deungtapam*: (등탑암(燈塔庵) is Kang's personal place. *Deungtapam*: (등탑암(燈塔庵)' means a small bright temple, like a lighthouse. Through big, wide windows people can see the beautiful sea and small fishing boats. To understand his idea and his life with tea, I visited Kang's '*Deungtapam*:등탑암(燈塔庵)'. The interior of his home was different from my expectations. I expected that his home would have a traditional Korean interior; however, he decorated his space with various craft objects and used textiles that he had collected from other countries he travelled to, such as Tibet and Nepal. I asked him why he collected and kept the souvenirs. He said each textile reminded him of the places he had visited, for example the people and the scent of the places. The emotional durability is from his experience. He wants to keep his good memories and the emotional connection to his travels by collecting cultural items from the places where he has been. I wondered if he could have an emotional attachment to textiles designed by me, even if the design provokes the places where he has been? I thought it would be difficult to design his experience with my imagination because I

didn't have the experience alongside him, so I could not perfectly understand his mind and emotion.

Figure 35 Korean tea ceremony at '*Ikijeong* (이기정:二旗亭)'

Figure 36 Korean tea ceremony at '*Ikijeong* (이기정:二旗亭)'

Figure 37 Kang's home interior with cultural items at '*Deungtapam*:등탑암(燈塔庵)'

Figure 38 Textiles from Asia, Kang's collection at '*Deungtapam*:등탑암(燈塔庵)'

My second interviewee was a textile artist, Jung Hwa Kim. She had been a civil servant for more than 10 years before becoming a textile artist. She started natural dyeing for textiles two years after her divorce and whilst she was a single parent. She said she overcame her ordeal by focusing on the natural dyeing; she had to focus on the work because the work was very complicated and the colour became deeper by the process of repetition. She was building an emotional attachment to her textiles through her life experiences. While she dyed she always thought about her life and tried to enhance her life through her satisfaction of creating the dyed works. I thought she felt happier when she made deeper colours, because she could feel satisfaction, unlike her past unhappy life. I could feel the depth of natural colour like an aura of her life and textiles.

My third interviewee was a collector of Kim's textiles. She helped Kim to communicate with other people and reach out into the world. Before Kim met this collector, Kim worked in her studio without communication with other people. However, for more than 10 years, this collector and Kim have become more involved with each other and understand each other's life. The collector has a strong emotional attachment to Kim's textile art because she understands the artist's life. Because of their strong, longstanding relationship, the collector's life stories sometimes offer inspiration to Kim's textiles. After meeting these two people (artist and collector) I thought it would be difficult to understand a person by just meeting and talking with them. They have a long relationship and have been making a life story together for more than 10 years, so they can make their 'colours' together – but I cannot create their colours just by having meetings and interviews.

Figure 39 Jung Hwa Kim and her customers   Figure 40 Natural dyed textiles, Jung Hwa Kim

Through these interviews I thought about the designer's role in emotional design. The interviews made me realise how important the relationship between a designer and a client could be. The interviews helped me see how people think about culture and textiles. However, it is difficult to understand others and sympathise with them in a brief timespan. Time is needed to understand each other's experiences and also to understand why they empathise with objects. This is because people's emotional attachment often stems from their experiences. I think that to make emotionally durable textiles I should have experience with my clients to understand what they think and what they want to make, and to make our story.

3.2. Experience and emotion

As discussed in the 2010 publication *Dimension of Leisure for Life: Individuals and Society* the interchange of feelings or ideas and 'real' communication have been reduced by increasing technological sophistication and the rapid change in society.[33] The authors argue that to compensate for the lack of physical experiences, metaphysical experience should be expanded in human life.[34]

Every time we use objects, or even just look at them, we have an experience. The experience, no matter whether it is intense or subtle and ephemeral, leaves an impression and remains in people's memory. In addition, the subtle and ephemeral experience becomes deeper the more people use the object.

However, emotion by experience is difficult to measure. Even though some neuroscientists have discovered that the nerves of the brain react differently according to emotion, it is impracticable to evaluate them objectively. However, even the measurement is non-objective; it is an undeniable fact that people recognise, remember and experience emotion when using objects.

The value of experience, even if it is transient, always reveals itself slowly and deeply. These experiences, even though subconscious and uninfluential, become a durable connection between users and objects, materials and the other experiences. In '*À la recherche du temps perdu* (In Search of Lost Time)', Marcel Proust (1871-1922) wrote about involuntary memory with an example of the episode of the madeleine cakes. Proust remembered his childhood through the madeleines in the book. However, madeleines provoke a memory of my favorite Japanese film, *Love letter* (1995). In the latter part of this film the male character Itsuki Fujii asks the female character Iisuki Fujii to return the book *À la recherche du temps perdu* to the library for him. I remember the scene as one of the most beautiful in the film. This beautiful scene led me to read the book for myself and to love the madeleines with which Proust suddenly remembered his childhood from their smell.

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[33] *Dimensions of Leisure for Life: Individuals and Society*, (Champaign,IL: Human Kinetics, 2010), p.170
[34] Chapman, p. 96

Another unforgettable memory is the sunset in Greenwich. I was in Greenwich with a friend around three years ago. The sunset was the most beautiful I have seen. At that time, I was having a tough time with my research and I printed the photo of Greenwich on my Jacquard weave. I wove the fabric when I was struggling with my research and search for materials. The result of the print was not good and the design was challenged in my transfer exam. Thus the design and the image of Greenwich continue to prompt memories of my life as a researcher.

Figure 41 Greenwich, London: photo from IPhone

Figure 42 A pattern design using the IPhone photo of Greenwich
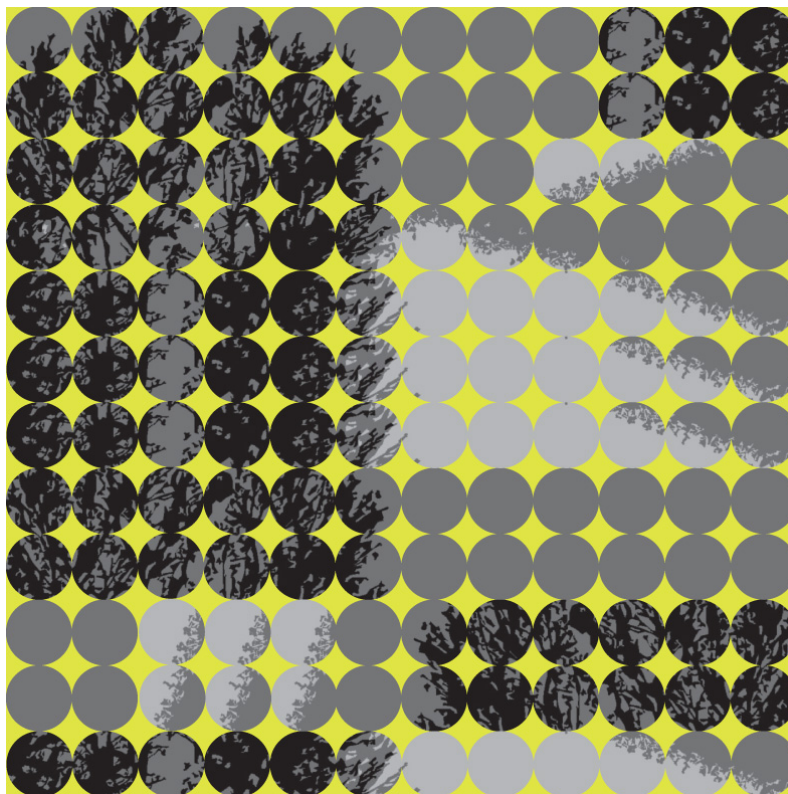

Figure 43 A pattern design using IPhone photo of Greenwich

Thus, the value of experience emerges from the process of experience. It becomes meaningful as a result of this process of producing experience. For example, much experiential value comes from the knotty and complicated production process of crafts, rather than from mass production. In addition to the production process that creates experiential value, owning and using the object also, of course, creates emotional value. The user experience happens, even if the value is subtle, when people use the objects every day. Also, each experience becomes much more meaningful and long-lasting when these are conflated.

Our lives are formed by many unconscious experiences. For instance, the toys people have in childhood remain in our subconscious as nostalgic touchpoints. In the same manner, experience gives enormous value to people's lives.

The value of physical and metaphysical experiences and emotion are regarded as a key strategy of attracting loyal customers in a commercial context. Through the experiences of users, companies can create a better relationship with customers and attract more loyal consumers. The key principle of co-creation is shared ownership of the production process between all stakeholders, i.e., the customer, designer, manufacturer etc. The market is seen as a platform on which to share ideas, constantly renewing the practice and creative resources of all parties. Co-creation thus creates value for all concerned through its interactions and learning mechanisms.

LEGO designed a notable co-creation system for emotional engagement with users. LEGO believes that in order to co-create meaningful value users need to employ creativity. It receives feedback from users and makes new designs/products in co-operation with these users. Also, many children globally and historically have experience of playing with Lego and developing their creativity, and because of this adults are nostalgic about LEGO. LEGO manufactures not only for children but also for adults; it keeps in touch with its customers and knows its customers' needs, and therefore has many loyal and emotionally engaged customers.

Establishing a dialogue with consumers is now a key part of the marketing strategies of most companies. Many consumers now experience not only the practical facilities of products but also emotional ties with products while they use them. Customers can

empathise while they use the objects, and then communicate this to the manufacturer. This empathy enhances the trust and loyalty consumers feel towards designers and manufacturers. This, in turn, facilitates an ever-closer communion between users and manufacturers. In the case of the relationship between Jung Hwa Kim and her collector, the collector strongly empathises with Jun Hwa Kim's textiles because she knows how the textile artist works, what the artist thinks during the dyeing process and she feels the artist's passion for textiles while she uses her textiles.

As well as being useful to manufacturers, customer feedback is also useful for designers. Designers take inspiration from customers' feedback. Products that have been through this process should offer more emotional attachment and produce a sense of 'design ownership' for consumers.

The value of emotion through experience, therefore, prolongs the lifespan of objects by making the product more meaningful to consumers, and thus strengthening emotional attachment.

3.3. Co-design for a chair

Figure 44 'Origami' project process image

Figure 45 A paper model of origami chair, co-design with Jeongin Lee, Jimin Seo

I decided to make a 'design story' with my client instead of just interviews, by suggesting sample colours or design patterns to make strong emotionally durable textiles. My client was a product designer, Jungin Lee. I collaborated with her to design the upholstery for her chair design.

As I noted in the first chapter, chairs, more than other objects, give me a special feeling because I can feel others' warmth. A chair can be a private space; however, it is also one of the most share-able objects. Thus I explored Jungin's taste and lifestyle, and analysed her chair design and design concepts. Finally I designed furnishing textiles to make an emotionally 'sharing' chair with her. During the research, I found her photos of origami works (Fig.46) and I thought they could match her chair design. I took inspiration from the origami for this design project.

Figure 46 Origami works, Loosing Blue, Jingin Lee

Origami is a craft that is deeply reminiscent of childhood. This chair design was inspired by origami and I attempted to match her chair design with a corresponding textile. The process is documented below (fig.47), (fig.48),(fig.49), (fig50).
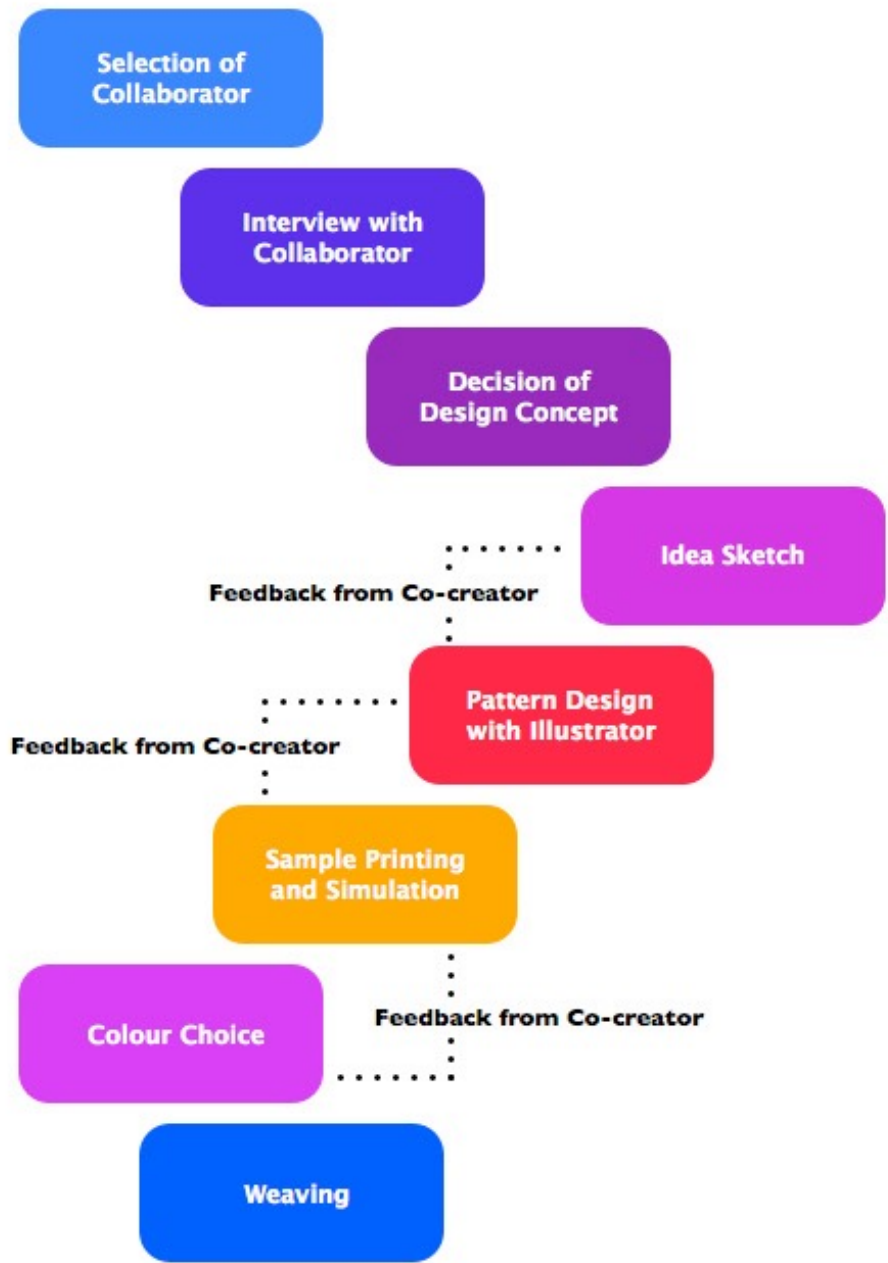
Figure 47 Co-creation process

Figure 48 Paper Folding Simulation
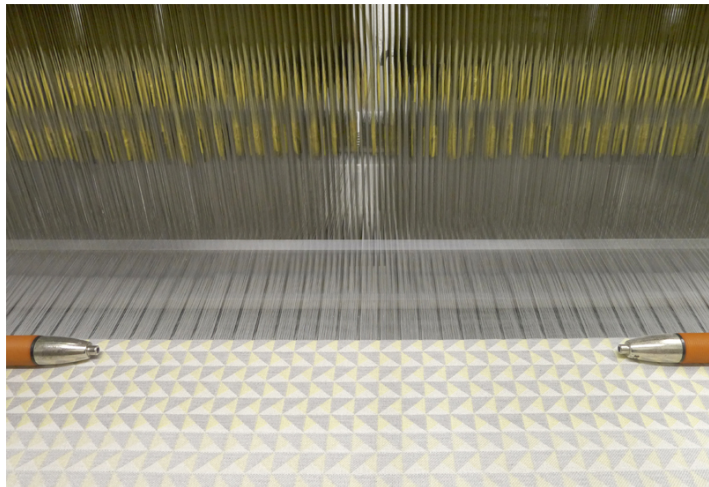
Figure 49 Weaving for origami pattern

Figure 50 Frozen Chair, Collaboration with Jungin Lee, Photo copyright Jungin Lee

3.3.1. Interview with co-creator (I (S) and Jungin Lee (L))

S: What is the Concept of the chair design?

L: The project 'Frozen' explores a new process of making furniture. Each stool, part of a series, is only 5mm thick and is very light. Because of the short curing time of the material used, Jesmonite, it is manufactured in a very short time using a folding technique that expands into an unpredictable form. It uses an unconventional process of moulding to create a one-off object using an industrial process.

S: What is the process of making the chair?

L: Two sheets of fabric are sandwiched together, with brushed Jesmonite in between them. This is then folded into a seat in 15 minutes. Then the curing process starts, and it soon becomes solid. The whole process of preparing and designing the fabric is very lengthy, but once all the materials are ready it takes only 30 minutes to make one piece.

S: Why did you work with the origami concept?

L: It started from one of the briefs at the RCA, 'Losing blue', which was based on a short journal written by Haruki Murakami about losing the colour blue at the millennium. For this project, I folded papers into objects, such as a plane, a boat and a lily, which is the kind of origami that I used to do as a child.

S: Do you have unforgettable memories relating to origami?

L: When I was young, it was very common to make origami and put all of them in a glass bottle. Also I still remember that the coloured paper that we used was designed perfectly for the object that we wanted to fold. For instance, when there was a centred gradation of yellow and red, it was beautiful to fold it into a flower.

S: Have you gained anything from your collaboration with a textile designer?

L: It was a very interesting time, working with a textile designer, because of the process of weaving. Working with her, I learned how the outcome can be different depending on the colour or types of yarn, and on the types of structure. She tried to understand very well what my project is about and it ended up as a very satisfactory result.

S: The textile designer empathised with the chair designer's memories for this design work. Were you reminded of your childhood or memories in this textile?

L: I didn't notice that I was using origami to make my stools and I didn't try to bring my childhood memories to my project. But I realised while I was folding one of pieces that it was a bigger version of the paper origami (Fig.51) that I used to make when I was little.

Figure 51 Origami, Jungin Lee

My position as a textile designer was somewhere between a designer and a technician in this project. Textile designers usually focus on the detail of the textile and are not seen as equal creative partners by other designers; however, in this project, the textile designer and the chair designer both had strong views about pattern design.

This project concept was 'Customised textiles': the chair designer wanted to control the element of pattern design, such as colour, scale and so on. If I had followed all

the opinions of the collaborator, the collaborator might have been satisfied with the fabric, but I would have lost my agency.

The biggest problem of this project was communication. How can I deal with other people in order to ensure a successful collaboration? My answer is that the designer should approach collaboration from a new approach. Traditional communication methods and working together can cause problems, such as one of the collaborators claiming more agency and assuming leadership. To make a more meaningful collaboration I tried to find an answer to the question of what is genuine co-design. To do this, my aim was to record my client's story instead of choosing materials or colour. However, my client focused on surface design such as colour or materials.

Thus I needed to find a more effective communication method to record people's 'story' for emotionally durable textiles.

Moreover, the question of the materials used was not fully resolved, Whilst certain forms of polymer and resin can be recycled and reused, the effect of fusing a woven textile onto the surface of the 'Frozen' chair rendered both textile and substrate impossible to separate and recycle. It was a totally unsustainable object.
In my mind the scale was wrong, the textile unsatisfactory, the pattern (although loosely based on origami) was not appealing, the materials used in the Jacquard loom not entirely under my control. The whole experiment was, mostly, a negative learning experience. I needed to find another way to integrate the structure of 'co operation' within my practice.

3.4. Sustainability and narrative/storytelling

Storytelling has a strong relevance for the sustainable world. Jonathan Chapman argues that narrative is an important aspect of sustainability in human behaviour in his book *Emotionally Durable Design*.[35]

Daily life gradually grows ever more electronically mediated. Therefore it has become both timely and important to examine the nature of engagement that we currently encounter with the superabundance of the domestic electronic products that surround us. According to the book *Longer Lasting Products*, empathy is encountered not so much between each other but through fleeting embraces with manufactured artefacts.[36] This situation moves us away from a sustainable culture of human-to-human engagement, toward a rapidly changing culture of engagement between humans and products; in fact, many people in contemporary society have negative material experiences, associated with dissatisfaction or waste, in relation to industrial objects. This movement, towards a more immaterial and anonymous experience, is seemingly only the result of a wider culture that is rapidly imparting a greater understanding to the way we perceive, condition, and create the world in which people live.[37]

Walter Benjamin wrote about Nikolai Lescov, the nineteenth-century Russian storyteller, in his 1936 essay 'The Storyteller'.[38] In this essay, Benjamin related experience to storytelling. He suggests that storytelling thrives for a long time in the milieux of work, such as the rural, the maritime, and the urban.

Storytellers deliver their experience to audiences by word of mouth. And the audience can be both reader and another storyteller. In this essay, Benjamin compared storytelling with the novel. He stated that the novel was distinguished from the story by the invention of printing. In addition, he explains that a storyteller takes what he tells from experience; however, a novelist works in isolation.

In the essay, Benjamin examines how storytelling was regarded as a craft by Nikolai Leskov. Leskov felt far from industrial technology but felt close to craftsmanship in storytelling. This is very similar to the nineteenth-century and contemporary generations of craftspeople. In the

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[35] Chapman, 2005
[36] Tim Cooper, ed., *Longer Lasting Products: Alternatives To The Throwaway Society,* (Farnham: Gower; Ashgate, 2010), p.65
[37] Chapman, 2009, p.31
[38] Walter Benjamin, 'The Storyteller: Reflections on the Works of Nikolai Leskov', in: *Illuminations* (1968) (London: Pimlico,1999)

nineteenth century, craftspeople felt that industrial machinery was unfamiliar and their position was diminished by the Industrial Revolution.

Benjamin's essay goes further in illuminating a historical, practical affinity between craft skills and storytelling. The ability to tell stories, Benjamin tells us, is rooted in two factors; travel to faraway places and knowledge of past local lore. Benjamin writes:

> The resident master craftsman and the travelling journeymen worked together in the same room; and every master had been a travelling journeyman before he settled down in his hometown or somewhere else. If peasants and seaman were past masters of storytelling, the artisan class was its university. In it was combined the lore of faraway places, such as a much-travelled man brings home, with the lore of the past, as it best reveals itself to natives of place. [39]

The storyteller takes what he tells from experience and makes it the experience of those hearing the tale. True experience is conceived as close and practised knowledge of what is at hand. The hand touches and has practical experience of life.

Benjamin describes storytelling as the transmission of real experience and wisdom. He writes that the trace of the storyteller clings to the story the way the handprints of the potter cling to the clay vessel. The story or the object does not stay the same as the printed text; they change as they get integrated in another person's life or experience. A maker cannot control how the object is interpreted, used and personalised so the focus should perhaps be on how we tell the story, not what story we tell.

Time goes by and people move to different places; however, they can feel emotions from a different period and place through storytelling. Storytelling, through experience, creates strong emotional attachments in design and supports emotionally durable design.

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[39] Ibid., p.85

3.5. The designer's role in sustainable design

Design is fundamental to all human activity. At the nexus of values, attitudes, needs, and actions, designers have the potential to act as transdisciplinary integrators and facilitators.[40] This insight into the all-pervasive function of design thinking has made some impact on the education of designers and on the professional practice of design.

Peter Dormer, in his 1997 book *The Culture of Craft*, argued that a designer is a maker who makes objects which humans desire and one who creates new objects. He also suggests that the definition of 'designer' works on several different levels. The activities and skills of making are at the centre of design. 'Craft' may have evolved culturally as a term that has become intellectually divorced from the pursuit of aesthetics (art) and purpose (design), but as a definition for the skills and knowledge that put things together, and the ability to make things work by using hand and brain in tandem, craft cannot be divorced from design.[41]

David Chaney, in his book *Lifestyles*, observes that the designer makes meaning possible. Crafting a design solution is merely the first part of a design process that is continued by users or consumers as part of their lives – or 'everyday consumption work'.[42]

Designers make their own definition of what it is to be a designer. Creativity, ingenuity and imagination are increasing in value in the new economy that is emerging, and these are qualities that design education encourages above all. At the same time, the old certainties regarding patterns of work and lifelong careers are dissolving.[43]

However, the designer can be implicated in a series of social, economic and ideological forces that influence their agency and actions. The capacity of designers to take an active part in addressing the global issue of sustainability is dependent on a number of variables. Not least is the ability of designers to understand the way that their practice can have an effect on sustainability. Design thinking needs to include a range of new strategies to invite designers to address this issue.

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[40] Daniel Christian Wahl, Seaton Baxter, 'The Designer's Role in Facilitating Sustainable Solutions', *Design Issues* 24 (2) (2008), p. 72
[41] Peter Dormer, *The Culture of Craft* (Manchester: Manchester University Press., 1997).
[42] David Chaney, *Lifestyles* (London: Routledge, 1996), p.156.
[43] Mike Press, Rachel Cooper, *The Design Experience: The Role of Design and Designers in the Twenty-First Century*, (Farnham: Ashgate, 2003), pp.6-7.

Society and culture have changed, so the situation of the consumer is different now, and the designer must address the consumer differently. The role of designers has changed. Modern designers can act as a hub between manufacturing and consumption. They can initiate a form of 'storytelling' within their design practice, organising the story and designing sustainable textiles.

Communicable design processes can also be a new kind of sustainable textile design process. Transdisciplinary conversation and collaboration can encourage researchers and practitioners to contextualise and situate their specialist knowledge within a larger holistic / integral meta-perspective that acknowledges the validity and contributions of a multiple point of view.[44] Design through research and collaboration would encourage emotional durability towards sustainability. In other words, the new design method would support the products not only with a physical lifespan but also with an emotional lifespan.

The criteria of successful design should not only focus on consumer sales but also other factors, such as sustainability, namely the lifespan of a product; the question of the ethical sourcing of materials; renewable sources and ethical manufacture and retail. Furthermore, designers should think about 'empathic design' and 'emotional design' in order to understand users' needs and include them in the design process.

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[44] Daniel Christian Wahl, Seaton Baxter, p. 74

3.6. My Initial Conclusions

Although I started this phase of my research by 'going back to the drawing board' and rethinking the very idea of the designer's role, it was not a simple success. The collaborative design experiments that I started, in order to work with users' subjectivity as a lead for my design decisions, proved inconclusive. It was not possible for me to set up a convincingly rigorous method of collecting data, or of testing outcomes. My interest in storytelling, and hearing the stories of others, did not translate itself into a specific set of aesthetic criteria. It was ever more complicated. The decisions that I made about yarns and colour palette, for example, did not necessarily generate emotional attachment in users. I did not investigate empirical ways to measure emotional attachment, although there is a research project at Queen Mary College, University of London which seeks to measure and quantify this. The informal interviews with users were neither broad enough to count as 'market research'. I wanted to keep something of the poetic and imaginative quality of what Walter Benjamin calls 'storytelling'. I wanted to be able, magically, to make every textile surface a space that could be a storytelling space. Perhaps there is a way of telling the story of sustainability, as a poem or love story or tragedy rather than as a set of data. Maybe there is way of integrating the song of sustainability as part of the textile's origins and history. I knew that other designers had been able to use labels with barcodes to identify the origins of materials within woollen garments. (Joan Farrer's 2000 PhD thesis documents this[45].)

Could a textile design and surface become as compelling as a conversation? How can textiles become as interactive as a relationship with a friend? How can the designer make relationships with users that are endlessly renewable?

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[45] Joan Farrer, 'From Straw to Gold', Unpublished PhD Thesis (London: Royal College of Art, 2000),

Chapter 4. CODE

Figure 52 QR woven textiles, Jimin Seo

Figure 53 QR woven textiles, Jimin Seo

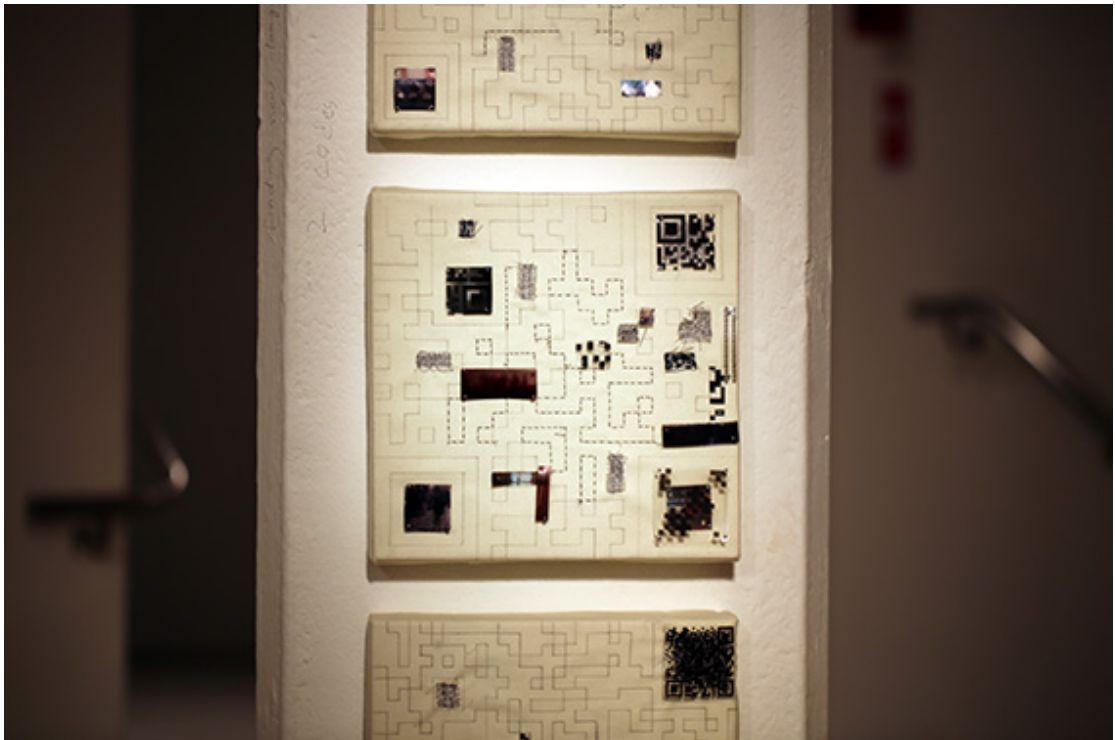**Figure 54 QR woven textiles, Jimin Seo**

Figure 55 QR code weaving idea boards, a series of 'Story in a board', Jimin Seo

In this section, I explore how I came to realise that I can use my textiles as an archive for people's stories, for the storytelling of the sustainability question and as a form of contemporary aesthetic. The pattern of Jacquard weave is a code, just as language, narrative and even beauty is a code.

I think the greatest technological revolution of this generation is the digital revolution. In my research into the Arts and Crafts movement of the nineteenth century I compared the mechanical revolutions of the eighteenth and nineteenth century in Great Britain, and the new technologies of the late twentieth and early twenty-first century. I understood that the digital medium and its message had generated an almost nostalgic affection for the tactile, the authenticity of materials and the physical experience of textiles. Digital, virtual space such as the space of the Internet enables people to communicate without being bound by physical limitation. The almost miraculous use of text-to-voice software has restored his voice to Stephen Hawking; sensory implants in prosthetic arms have restored voluntary physical movement to paraplegic subjects. The digital can transmit messages across space and time. Of course the utopian aspect of the new technologies can be overemphasised: there are abuses of social media in cyber-bullying, online grooming of victims of abuse by predatory stalkers, new legislation has been passed in the UK ensuring that 'revenge' broadcasting is a punishable offence, and members of parliament have been rebuked for careless indiscretions on Twitter. Other problems, such as isolation from 'live' face-to-face human life can become deeply pathological. In Korea young gamers can be so addicted to their on-screen play that they become ill, and deaths have even been reported. However, there is no doubt that digital technology has brought unlimited possibilities to human life. The Internet enables people to access virtual space fast and easily; people can travel virtually and access an almost infinite amount of information. With a mobile phone and a micro loan from Muhammed Yunus,[46] a woman in Bangladesh has been able to start up a textile enterprise which provides income for herself and her children, and then employment for others. A young woman in North Africa has created an app that allows farmers to ascertain the best price for their crops before they go to market. In Mumbai an urban designer has installed a touch-screen computer in the wall of a city space used by poor and uneducated people, and found that, within weeks, children have learned how to use it

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[46] http://www.muhammadyunus.org, accessed 10 Aug. 2015

and to generate creative possibilities for themselves, all without reading an instruction manual. The power of digital coding is that this replicates the human brain's ability to 'think' in algorithms. I know that weave patterns are one form of algorithm, thinking in digital code.

Before coming to London for my research, I was able to 'walk' around London on Google Street View, taking a virtual perspective of my new frontiers. Therefore, when I arrived I felt more at home in London and found a place to live easily. If I had not had the Internet, I might have felt homesick, and would not have been able to adapt myself to London life. In the last four or five years I have been able to meet my family and friends from Korea and make new friends in virtual space. The screens of mobile devices such as the laptop and smartphone, despite being glassy, cold and hard, are, nevertheless an immersive world of warmth and safety, just like the 'cosiness' I wanted to impart in my 'Happy Together' designs.

In the same way, digital technology has provided unlimited virtual space-time to people. This digital-UX (user-experience) design is usually found in the product design field. Now, people in developing countries use computers and smartphones, sometimes sharing a sim card, or owning a sim card rather than the handset, and they can communicate with other people and have access to global information.
I considered using this digital code for textiles to communicate and make stories with people to weave emotionally durable textiles. Traditionally textiles have been used for clothes and upholstery; however, I suggest that textiles can also be used as archives and interactive spaces. Interactive textiles trigger not only 'traditional' emotion, which people can respond with to textures or colours, but also personal emotions communicated through experiences and their story.

Over the last three decades, a number of fashion and textile designers such as Vivienne Westwood and John Galliano have used digital concepts in their work. However, these early designers of digital textiles used digital technology as a material or method of communication. However, through these designers' attempts, digital code has become a medium of communication and aesthetics, rather than just a tool or material for manufacture.

I, too, started to use digital code, in all aspects of the design process, from pattern design to output. I was experimenting with the legibility of coding in weave patterns to find more options within the weave structure.

Instead of using barcodes to add data to garment labels, as in commercial merchandise, I was drawn to the beauty of the QR code pattern. It was already in evidence on packaging, in advertising and on some forms of publicity and ticketing when I first started to experiment with weaving the QR code into Jacquard textiles. Over the next two years, from 2012 to 2014, the QR code became ubiquitous: on airline tickets, on quality control, on materials to be scanned by an iPhone camera and decoded by an app that transformed this into a computer portal.
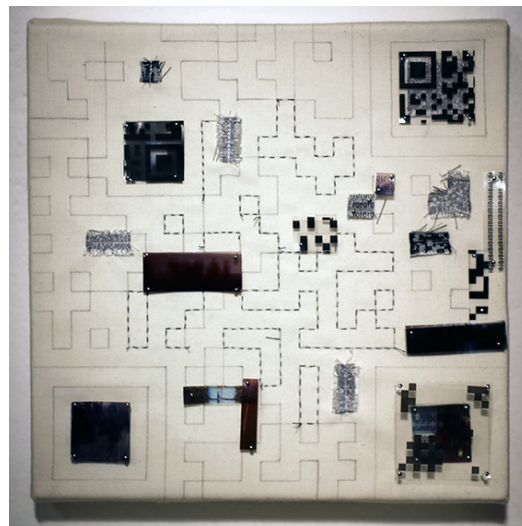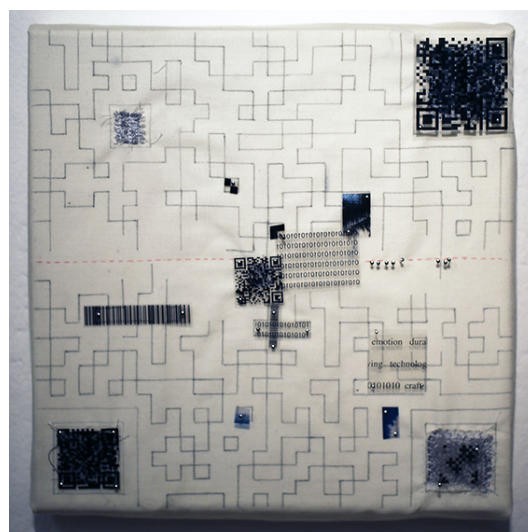

Figure 56 Story in a code 1, Jimin Seo

Figure 57 Story in a code 2, Jimin Seo

4.1. Code weaving

The idea that woven textiles are acknowledged to be this first human artefactual manifestation of digital logic in culture was becoming more widely discussed in textiles. Janis Jefferies, of Goldsmiths College, had written about the idea of text and textiles being both coded and digital processes[47]. Fellow textiles research students were discussing 'e-textiles' and the way that textile surfaces can become 'smart' by being connected to computers with wiring.

However, my textile designs would not include wiring or light-up LED displays, as I wanted to maintain the 'feel' of familiar and traditional upholstery rather than creating a 'science fiction' story. There must be other ways to encode messages within the weave. A supervision session with Clare Brass and Claire Pajaczkowska led to thoughts about Charles Babbage finding the origins of computing, 'the difference engine', within the machine of Jacquard looms. The Jacquard weave design is a code, and codes can be read by scanners. The barcode is already ubiquitous on price tags and on classification devices such as on medical samples and archive and library labels. Would it be possible to celebrate the innovative history of Jacquard as the original 'computer', through testing new weave designs? The QR code, if legible to scanners and decoded by apps, could lead users to screens with stories, data, information, social media relationships, activist campaign information, and virtual space that would be continually renewed at source. The sites could be customized for individual clients and users. People could have upholstery textiles that are made of sustainable yarns and communicate in a relationship of innovation. It was an exciting idea but nobody knew if these would be legible to the scanning devices such as iPhones.

I decided to weave some sample swatches to explore this experiment. The first swatch was tested by summer 2013 and proved legible, in monochrome. I used the QR code pattern for SustainRCA first (fig.58) (fig.59), and then brought a code for my research project and my own 'Storytelling' design ideas. I then decided to test the scan legibility using different colours, contrasts, complexity and scale of pattern and proximity of repeats.

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[47] Janis Jefferies, 'Letter from the Editors', *Textile*, 1 (2). 2003, pp. 115-117

Figure 58 Black and white QR code woven fabric, the first test weaving

Figure 59 Sample woven fabric / RCA WIP show

Figure 60 research keywords for QR codes

Firstly, I generated QR codes using online code generator. QR codes were designed to be black and white like other barcodes; however, they have developed further and now can be designed with other colours using advanced technology. At the beginning of this practice, QR code reader apps were only able to read black-and-white woven code. Therefore, I used black and white for QR code weaving and other colours such as grey, dark blue and metallic gold in the other areas, except code areas, for surface design.

The RCA's industrial Jacquard loom works by using digital code structures that I designed for weaving. The QR code pattern was exposed by crossing the warp and weft. At this stage, I had several attempts to read the codes because of the structures of the weaving. I needed to find the right structures to read the codes; it should create a tight textile structure, and the codes needed to be more than 5cm to be readable.

Figure 61 code for Jimin Seo, RCA

Figure 62 QR code for research keywords

Figure 63 QR code for SustainRCA

Figure 64 QR code for storyintextile.com
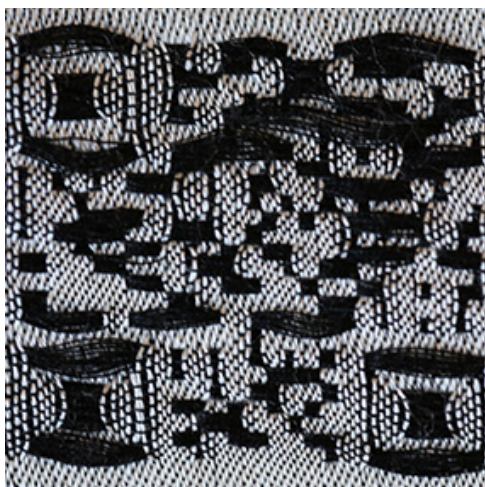
Figure 65 illegible structure

Figure 66 Legible structure

The contrast of colours is as important as pattern structures and scale. Early QR codes were designed in black and white, and cameras scanned and decoded the code by pixel contrast. However, recently a new QR code reader technique has been developed to read several colours in a code. In this project, I considered the colour in a code rather than my colour preference, because I was limited to choosing colours to weave QR codes at college due to the limited range of environmentally friendly yarns for Jacquard weaving at the RCA's yarn store. However, the aim of this project is to weave interactive storytelling textiles, and thus choosing colours was less important than weaving codes with the right structures.

Figure 67 Black and white QR code woven fabric
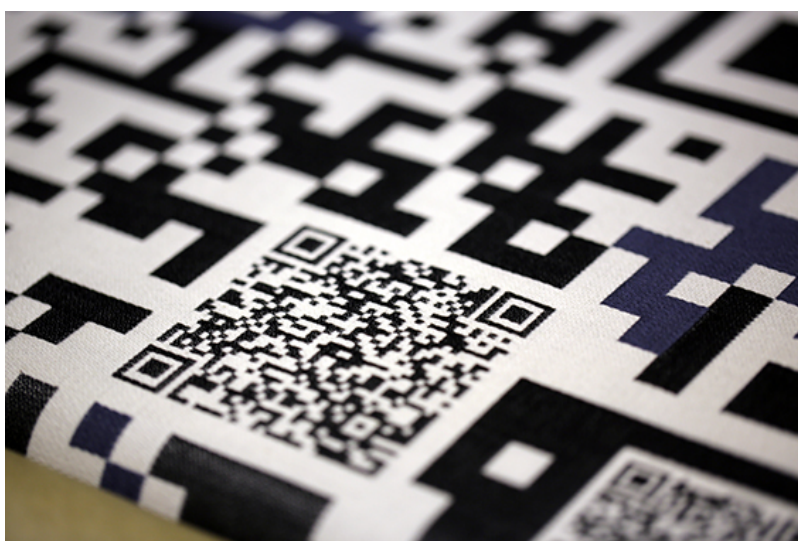
Figure 68 Black and white QR code woven fabric

Figure 69 Weaving QR code with black and white

After weaving black and white code, I tried blue and white code with organic cotton for my weaving (Fig.70). I used same weight of yarns to weave; it makes a clear structure and easy scanning of the QR code. The pure white, which I used for this woven fabric, makes it easy to scan too. I learned that should use same or similar weight yarn to make a clear structure, and I could use other colours for the QR code if I can make a strong contrast, even if it is not black.
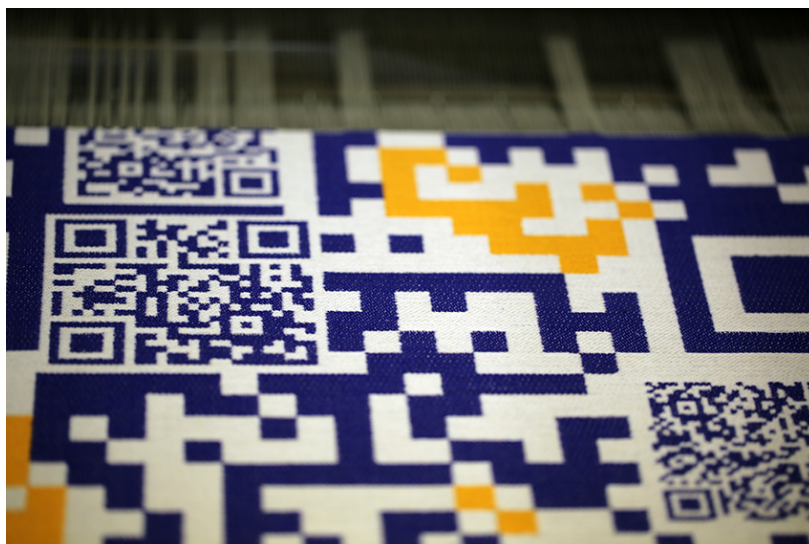
Figure 70 Code for Sustain RCA and designer/fabric information with blue and white

While I tested the weaving structure and scale for the QR codes, I set up a code for my website on Storyintextile.com (www.storyintextile.com) for another design. For QR code pattern design, I used the Adobe Illustrator computer programme. The Adobe Illustrator programme enables the design not only of textiles but also of other graphic design projects.
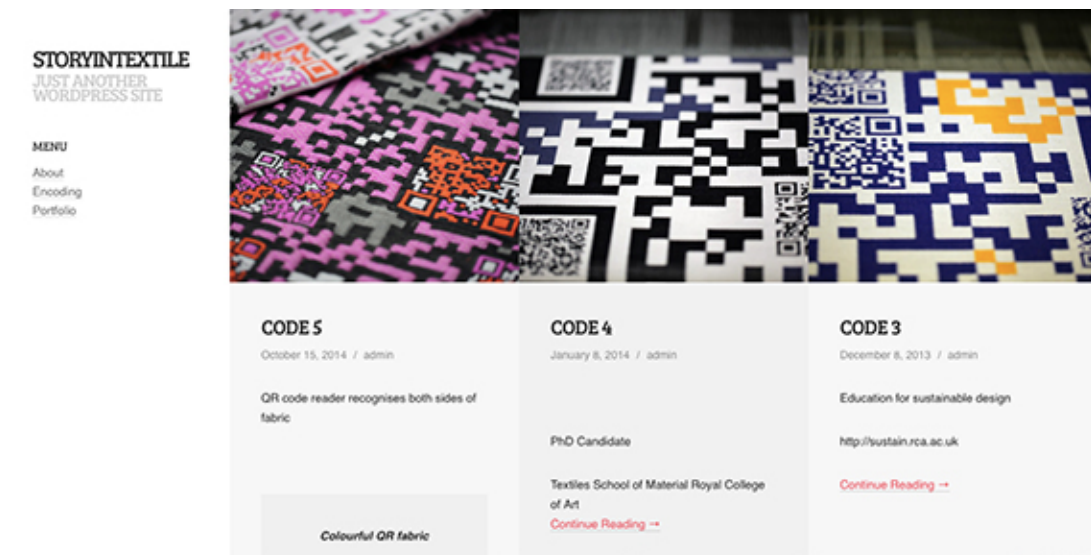
Figure 71 www.storyintextile.com
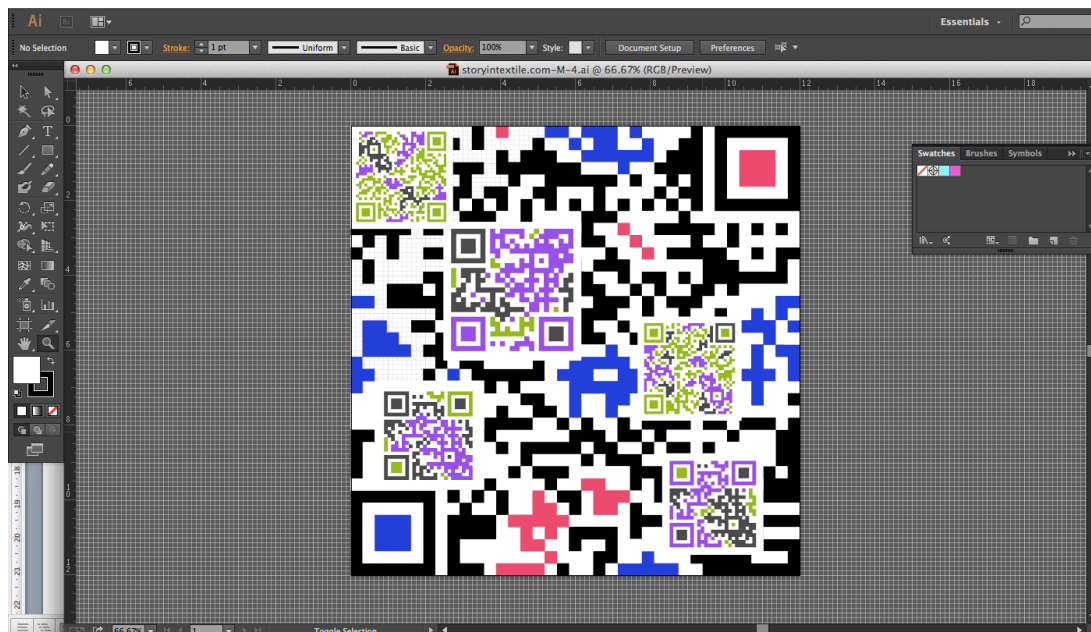
Figure 72 QR code pattern design using the Adobe Illustrator programme

Figure 73 QR code pattern design   **Figure 74 QR code pattern design**

At this stage, there were only encoding and decoding processes on screen, and I was not sure that these would produce legible patterns that could be 'read' by a smartphone scanner. I needed to try all the variables of contrast, colour, scale, fibre, and pattern repetition. After this process, I modified the codes using a Jacquard weaving structure for the best result for machine weaving.
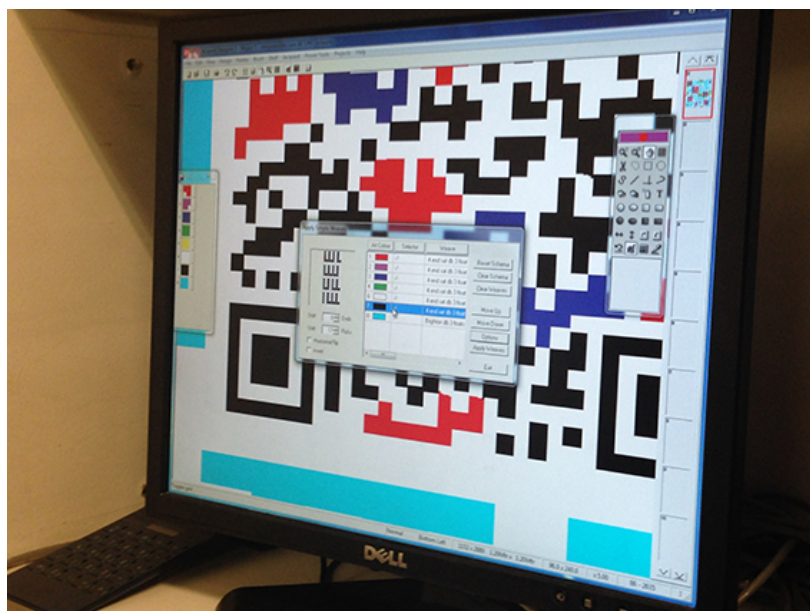
Figure 75 Jacquard CAD process for structure

The QR code textiles led users to a virtual space, such as Sustain RCA, Transport for London (TfL) and this project's own website, where they can communicate with others and find a wide range of useful information. This project suggests the possibility of interactive textiles that can be used for education, public design and personal space.

The woven fabric for my website (www.storyintextile.com), (fig.77), (fig.78) was inspired by geometric pattern. It was interesting when I displayed it in the exhibition, because everyone had different reactions to these geometric patterns depending on their background. Some Korean audiences said the textiles reminded them of Korean traditional patchwork, 'jogakbo', while some British viewers associated them with Mondrian's works. This design was inspired by a puzzle from the pieces of my memories of this research. Each step of the research was hard, but they are all connected and developed gradually. My research was like putting pieces of a puzzle together: sometimes I struggled with different ideas but after putting it all together I could feel fulfilled. Thus these geometric patterns in my website express the puzzle of my practice-based research. I used wool as an environmentally friendly material for these designs, and the colour used as background was natural, not the pure white. Nevertheless, I used the colours of these series of designs, such as pink, orange, green and black, to test the colour contrast when using several colours in a code. The contrast of pink, black and natural colours was strong enough to be legible. However, the contrast of light green, orange, black and white was illegible. The combination of green, orange and natural colours was too bright so the similar brightness of natural and orange colours rendered the code unreadable.
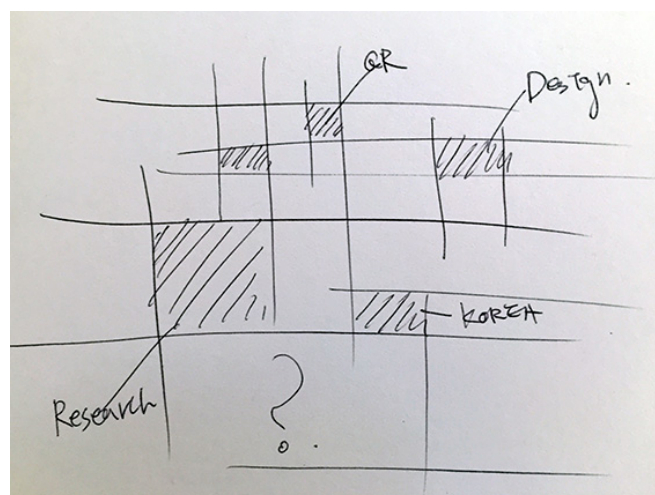
Figure 76 Idea sketch for code weaving
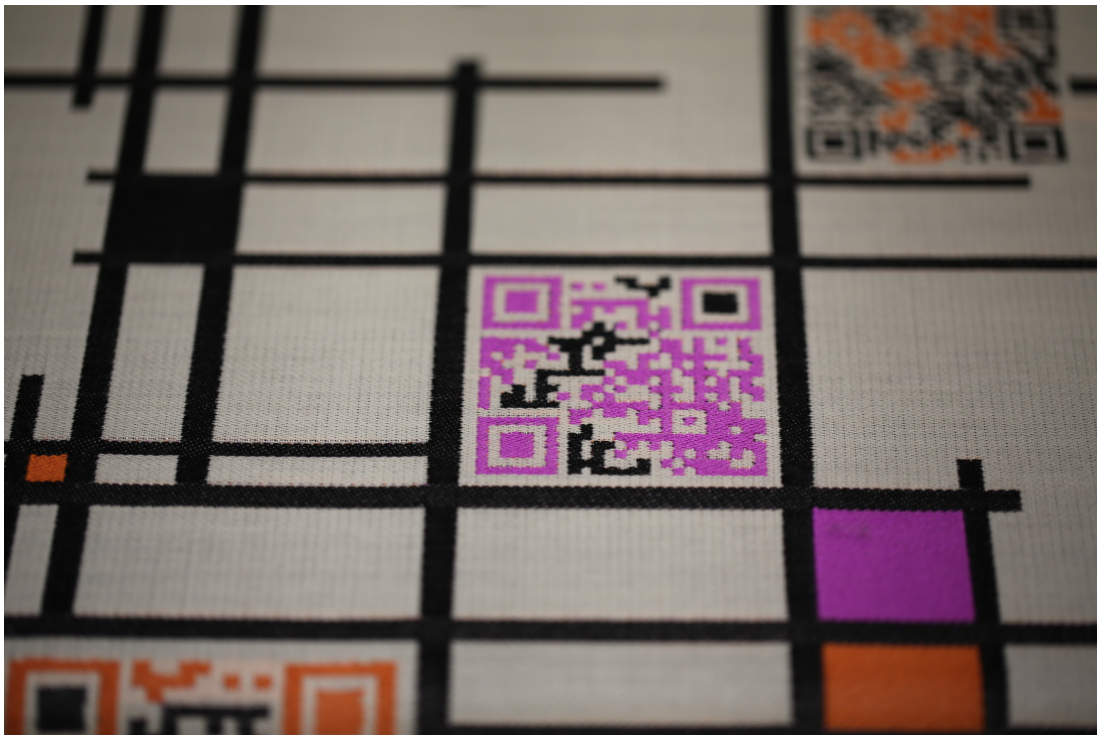
Figure 77 multi colours in the woven code, Storyintextile.com

Figure 78 Multicoloured combination in the woven code, Storyintextile.com

Figure 79 Pink, black, natural colours in a code/ legible

Figure 80 Light green, orange, black and natural colours in a code / illegible

Figure 81 Pattern design for storyintextile.com
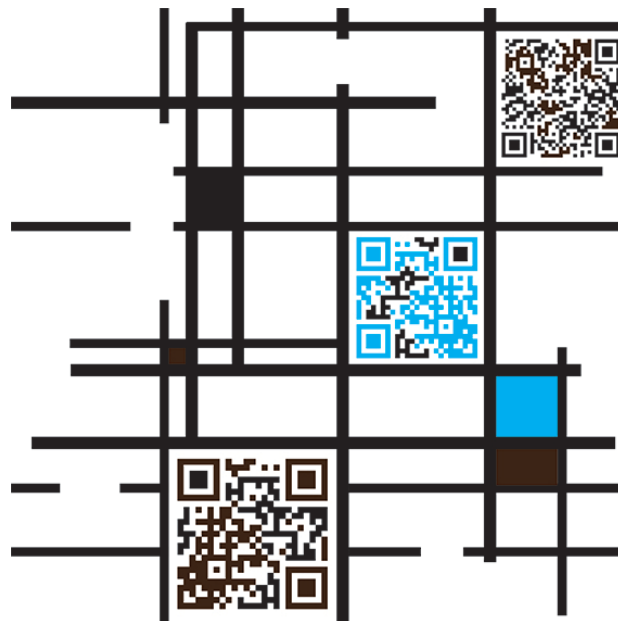
Figure 82 Pattern design for storyintextile.com

I wove another design for my website (storyintextile.com) with four colours in a code to continually test whether a code which includes several colours is readable. Previous test fabrics (fig.77), (fig.78) did not provide enough colour contrast, thus I used pure white for the background and strong orange, purple and black for the code (fig.83). The contrast of these colours was strong enough to be easily scanned. Yarns were also finer than those which were used in previous tests so the fabric structure was tighter. While making the website, I had several technical problems such as uploading images and inserting titles. Sometimes I had to stay up all night for several days to fix technical problems and I could feel a sense of achievement when I was able to solve them. Thus I tried to express the complicated web environment using gradation weaving as a background to the woven design while I wove clearly legible QR code.

Figure 83 Multicoloured pattern in the woven code

In the trial that followed I used both sides of the fabric (Fig.84). I used four colours such as white, pink, orange and black. The white background side was clear for the codes (storyintextile.com and designer information) (Fig.85).   On the pink background side, the code for storyintextile.com was legible (Fig.86); however, the

other code was not legible (Fig.87). The orange colour in the code provided a strong contrast with the pink background; however, it was not legible when pink was the main colour in the code. This is because pink and orange colours have similar chroma so weren't contrasting enough to be legible. Colours on both sides of the fabric recall the image of a computer game, 'Tetris'. I would like to design the textiles so that people can play and be joyful as when they are playing the computer game. Interestingly, I didn't expect the darker colour code (the back of fabric), (Fig.86) to be legible by the QR reader app but it was. It was unbelievable, and created another challenge, to weave darker colour combinations of the QR code.

Figure 84 Multicoloured patterns in the woven code

Figure 85 Legible colour balances in a code

Figure 86 Legible colour balances in a code

Figure 87 Illegible colour balances

In the woven fabric for TfL (Fig.88), I tried to use different colours in a code because the fabric design can be linked by the colour associated with each underground line, such as the Piccadilly line and Jubilee line. The white background colour part (Fig.89) is legible because of the strong contrast between the background and the code; however, it gets dirty easily. Usually train upholstery is designed in a dark colour to avoid dirt. Thus I tried to weave legible code on both sides of the fabric, but the dark part of the fabric was not legible (Fig.90). In addition, I wove information about the designer into the fabric; however, the code was too complicated and the yarn was too heavy for the scale of code so it was not legible. The code needed to be on a bigger scale or the use of lighter yarn to be legible (Fig.91).

Figure 88 Different colours in the woven code, TfL

Figure 89 White background, different colours code (TfL)/ legible / cotton

Figure 90 Different colours code (TfL)/illegible/ cotton

Figure 91 Encoded information on the designer /illegible / cotton

I tried to weave another design for TfL with four colours (brown, magenta, purple and white) in a code. The contrast of the colours was strong and the code looked clear. I used same weight yarn and similar colour chroma in the code, making it easy to read (Fig. 92). Codes are connected to each other by the lines of the underground map, by which I mean invisible connections or links between people and between people and objects on my fabric design.

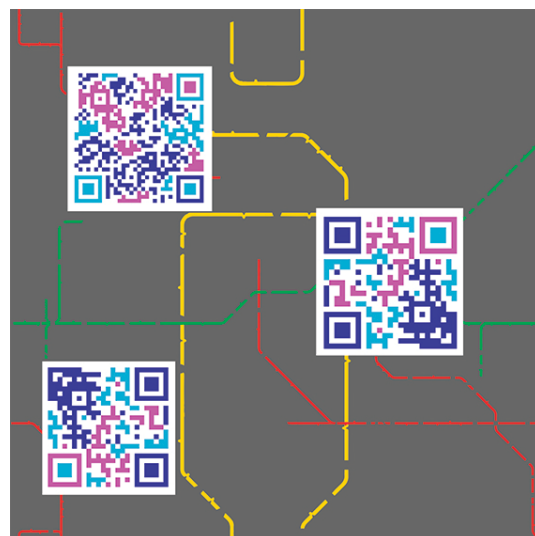**Figure 92 woven fabric for TfL**

Figure 93 Pattern design for TfL

I tried to use environmentally friendly materials such as organic cotton, silk, linen and wool. However, there were also other limitations such as cost and the constraint of having to use whichever warp was in the Jacquard loom at the RCA studio. Organic cotton is much more expensive than normal cotton. In addition, I wasn't able to change the warp of the Jacquard loom at the RCA because the warp, unlike the weft, is not changeable in the loom. However, I believe that if this project is developed by industry, designers can choose environmentally friendly materials which are suitable for the aims of the project. It may be within the power of manufacturers to comply with the recommendations and regulations now suggested by campaigners for sustainability.

Sustainable design is still a new field of creative activity to learn and develop. Chapman suggests that sustainable design must remain open to new possibilities[48]. It is quite possible that the methods through which people currently address sustainability are not as sustainable as they expect: for example, there are many products made from recycled or environmentally friendly materials using the right process; however, some are thrown away even though they still physically work. This causes other costs and energy uses. It is difficult to say they are sustainable products. A truly sustainable design approach should take the wider creative industries several steps closer to an environmentally friendly world. However, to approach a 'genuinely' sustainable world, people should think about how they could coexist not only physically but also emotionally with others.

I seem to be reaching the conclusion that my research suggests a new possibility for interactive and emotionally durable textile design. This use of code as pattern is not only functional, like a label, but is also beautiful like a Mondrian painting, a Constructivist print by Popova, an abstract modern typographical experiment by El Lissitsky, a digital craft artefact and a luxurious tapestry of rich and attractive colours. At the Work-in-Progress exhibition in January 2014 I had one sample of woven upholstery which I used to cover a chair seat, and wrote on the wall above it 'Scan Me' 'Use Me'. This experiment proved that people were alerted to the function and meaning of the design by its appearance as well as by the 'instructions', which were as cryptic as Alice in Wonderland's 'Drink Me' bottle. I want the aesthetics of

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[48] Chapman, p.170

sustainability to be as wonderful as storytelling, not as literal as a Ministry of Information factsheet.

I wanted to create something beautiful and desirable. People were drawn to the new pattern and commented on how much they liked the computer-generated patterns. The QR code had, successfully been transformed from a square denoting 'data' to a tapestry connoting mystery, a journey, sumptuous experience and desire.

4.2. Code and colours on textiles

Even though the contrast of colours is more important than my colour preference, I considered the correlation between some of the colours I used and emotion for my weaving. Also, some of the colours evoked personal memories while I worked. The colours on the fabric attract users and support to express designers' emotions or ideas. In this section, I illustrate the meaning of key colours through my ideas and emotions.

4.2.1. Black and white

At the beginning of this practice, I had to use black and white to weave QR codes, because these were only available in black and white. Black and white codes on the fabric induced a hypnotic trance while I wove them. The codes looked like 'raster graphics' from old analogue television screens when they had no signal. The black spots look like numerous black dots or microscopic characters on the paper. I was almost hypnotised by the machine's rhythm, or was deep in thought while I vacantly looked at the machine.
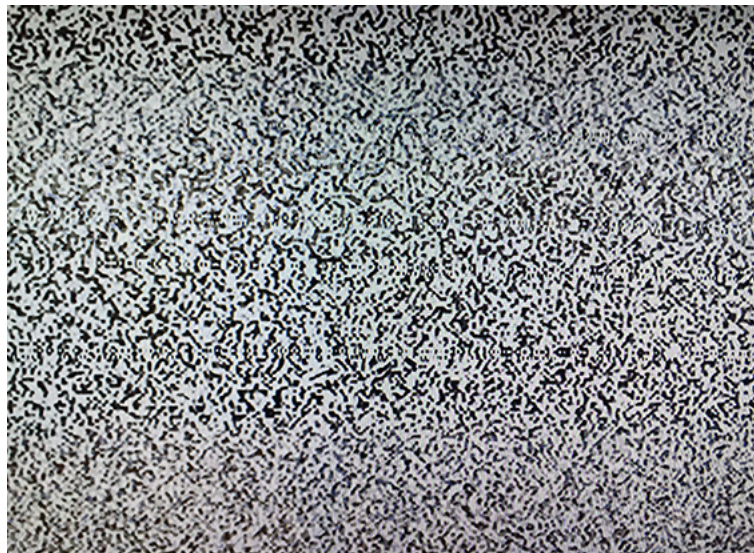
Figure 94 Raster graphics on a TV screen, Jimin Seo

4.2.2. Grey

Grey is the intermediate colour between black and white. Grey in my QR woven fabric means the medium between the user and me on the textile surface and in the

digital world. Digital technology sometimes evokes 'soulless' city life. Also, grey often symbolises the colour of the modern city. When I put QR codes on the screen it seemed as if I was placing cubic buildings in a virtual city online. In the city, the absence of communication is a problem. Thus grey is a 'medium' between users and me in the virtual city on my textile surface.

4.2.3. Blue

Kandinsky describes blue as 'The inclination of blue to depth' in his book *Concerning the Spiritual in Art* (1912)[49]. For me dark blue evokes the deep, calm sea, and sometimes when I read a book in the library it seems as if 'I am in the deep sea'. Also when I struggled in my research, I felt my life was very dark, like the deep sea. I could not see and think about anything around me then. However, after overcoming this hard time, I could take pleasure from my study, and then I learned there was enormous potential knowledge. So dark blue in my QR woven fabric represents not only the calm, deep colour of the sea but also deep and wide knowledge in the world. I would like to enable people to take information and knowledge from my encoded textiles.

I learn something every day. Learning something is what people do every day till the end of their life and they teach this knowledge to others, too. Could the acquisition and sharing of knowledge be among the most valuable work of human life? Also, would the learning and sharing of knowledge be among the most sustainable work since the beginning of humanity? This project makes me feel that I am studying infinitely to fulfil my research, and it seems like 'the great blue hole', the sinkhole off the coast of Belize popular with scuba divers. The QR woven fabric is a material that enables the learning and sharing of knowledge through encoding and decoding processes. It suggests not only material sustainability but also immaterial sustainability.

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[49] Wassily Kandinsky, *Concerning the Spiritual in Art* (1912), tr. M.T. Sadler; ed. Adrian Glew, (New York : MFA Publications; London: Tate Publishing, 2001)
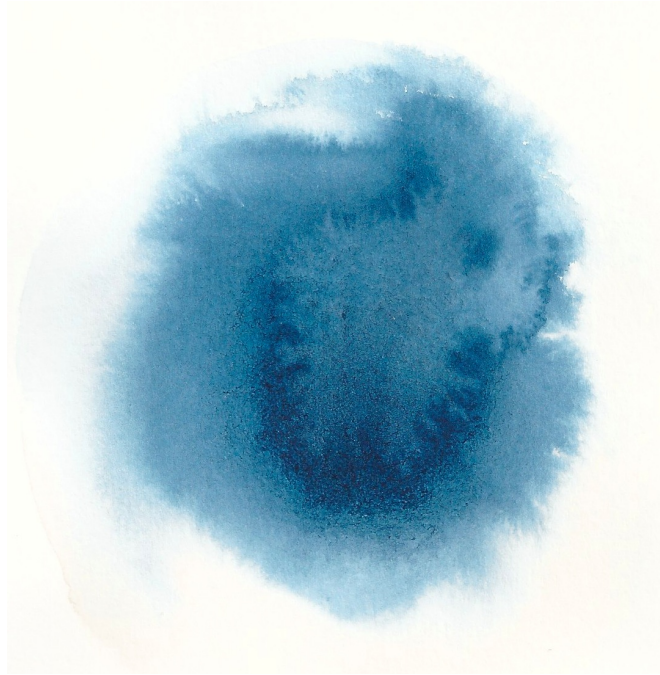
Figure 95 'The great blue hole' from my sketchbook, Watercolour, Jimin Seo

4.2.4. Gold

I tried to use metal yarn such as gold colour for my weaving even though the metal yarn is not an environmentally friendly material. Gold represents 'healing' and 'wealth'; however, it evokes Art Deco which makes entertains with diverse artf orms such as Jazz. Metal colours such as gold, silver and chrome were often used in the Art Deco period (1910-1939). Art Deco was the prevailing style of the 1920s and 1930s, creating the defining look of the inter-war years.[50]. It was an eclectic style and drew on many sources. Designers tried to infuse jaded traditions with new life and to create a modern style based on a revitalised decorative language, drawing on distant and ancient cultures[51]. The background of the musical *Chicago* is the jazz age of the 1920s. The costume and stage designs are glamorous and flashy. They made me fantasize and dance to the music. Is it possible that my encoded textiles also communicate eclectic, diverse tastes, culture and information, like Art Deco design does? Also, people can enjoy my textiles like an extempore jazz rhythm? Would my textiles be joyful?

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[50] Charlotte Benton, Tim Benton, Ghislaine Wood and Oriana Baddeley, *Art Deco:1910-1939*, (London: V&A, 2003)

[51] http://www.vam.ac.uk/content/articles/a/art-deco-global-inspiration/, accessed 20 Sep. 2015

4.2.5. Pink

Pink is usually recognised as a feminine colour. Feminine taste is marginalised in modern design culture. Penny Sparke has argued that the language of modernism, rooted in the British design reform movement, excluded feminine taste from its definition and depended on a historical, binary system of terms and concepts that made its values abundantly clear[52]. However, the value of feminine taste is become equal in value to masculine preferences in a multicultural, postmodern world[53]. My encoded woven textiles also show this multicultural context and I hope that weaving is no longer seen as 'feminine work'.

My fabric is not a traditional fabric: people, both male and female, can build their community and input their knowledge through encoding on textiles. Thus my pink does not imply a feminine approach anymore, my 'pink' represents the integration of feminine taste into modern design and gender equality in a multicultural society.

4.2.6. Green

Green provokes the image of a green field.

I stand on the middle of the field and hear the sound of the wind. The grass is swaying in the breeze and I feel the soft touch of the grass.
I feel comfortable and fresh in the balance of a natural white colour with green, such I see on the emerald sea in my home town.
I hear the roar of the waves. Small fishing boats are on the sea. A conch shell has been washed ashore and touches my foot.

I would like to encode other people's stories such as mine on my textiles. This is the reason why I used green to encode my research website textiles with.

4.2.7. Purple and violet

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[52] Penny Sparke, As Long as It's Pink (Nova Scotia: NSCAD, The press of the Nova Scotia College of Art and Design, 1995, 2010), p. 162.
[53] Ibid., p.165

I used purple and violet to weave for the TfL QR code textiles. Most of the upholstery of the London underground is blue and red. Blue and red represents London's transport; however, I would like to use the colour in between blue and red. My purple and violet refers to the integration and harmony of race, nationality, and culture in this society. Many people use the tube to go to work, meet friends and travel. However, sometimes the space demonstrates how busy and cold our life is. People avoid other's eyes and concentrate on reading books or playing mobile phone games. People can be physically close to others but emotionally distant on public transport. My purple and violet represents the integration of people and culture that I suggest through my QR code project.

4.3. Reflections on Coding

The workshop experiments on weave patterns took place from 2013 onwards; I wrote up my experiments and also researched further into the history and culture of coding in design and craft, to ensure that my own experiments were not already in the public domain. I understood that in order to be a doctoral design research project, my work needed to be both new and original. I researched current developments in craft and design as I continued with Jacquard loom samples using metallic yarns and experimenting with scale and repetition.

I carried out research into the history of coding and into the effects that the new digital technologies are having on the culture of crafts and design.
The following are some findings that may be useful for other researchers who want to follow a similar path.

4.3.1. The meaning of code/technology in crafts

The textile industry has long utilised technological advances to create woven fabric.[54] The tradition of textiles as domestic design and craft activity has continued in this century in spite of the competition offered by the manufacturers and retailers of high-quality clothing. Domestic textile craft has been improved by advanced technology; thus the current generation of electronic knitting or sewing machines for domestic textiles are sophisticated and programmable, and enable the amateur to create more things than she/he would otherwise have the time or the ability to produce.[55]

Since the invention of the Jacquard loom in the eighteenth century, technological coding has played a key role in the textile industry and modern textile crafts. Moreover, the concept of code is now ubiquitous in everyday life, as we experience reality through digital media. Coding, as a form of computer language invented by Charles Babbage following the principles of binary logic in Jacquard weave mechanisation, is present in all forms of contemporary culture.

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[54] Dormer, p.168
[55] Ibid., p.173

The technology of using codes has enabled the industry to experiment with skills such as the way in which computing reinvents images, material, structural processes and advanced 2D/3D design output. Sarah E. Braddock-Clarke and Jane Harris argue that coding is used in three ways in fashion and textiles production: 'the look of code', 'material code' and 'digital imaginings'.[56] Modern crafts have become hybrid crafts because of their use of modern technology, such as coding. The codes play a role similar to that of a tool, a material, and a method of expression, but they are also used as a language to communicate between makers and tools, makers and makers, makers and users.

4.3.1.1. Code as a medium Itself

If code is now experienced as a cultural environment in modern life, is it possible to use the code medium as a creative one? Can code become a tool for the designer of materials? Coding is taught today in the school curriculum, but remains a specialist form of knowledge for those who wish to work on software. Whereas CAD and CAM have been present in design practice for several decades it is now possible to use the concept of code as a medium of communication and aesthetic, rather than as a tool for manufacture.

Whereas Jacquard used code in order to simulate naturalistic images and appearances, and whilst Bauhaus designers used design to celebrate the machine aesthetic, I explore the code algorithm in textile weave, as a medium itself.

a. Digital textile printing

One of the most advanced and widely used textile techniques is printing.
Contemporary textile designers and manufacturers still use traditional screen-printing; however, because of the development of Digital Textile Printing (DTP) both professional designers and amateurs can print fabrics with their own designs.

Traditional printing methods are not able to incorporate many colours, but DTP can use an unlimited range of colours: thus it should be possible to design more attractively and decoratively. In addition, traditional printing usually has a limited repeat size, whereas DTP can create unrepeated textile design.

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[56] Sarah E. Braddock Clarke and Jane Harris, *Digital Visions for Fashion and Textiles: Made in Code* (London: Thames & Hudson, 2012), pp.14-81.

Digitally printed textiles can be used in diverse areas, such as interior textiles – wallpaper, bedding, interior accessories, furnishing – and fashion textiles: clothing and fashion accessories.

Furthermore, this new technology is an eco-friendly method, unlike traditional printing. It reduces water waste because, unlike traditional printing, digital printing only requires water in the after-treatment.

Digital textile printing shows that using new technology in the twenty-first century can not only create diverse and effective design expression but can also lead to products being created in a more environmentally considerate way.

b. Media

Perhaps the most significant change in the past century has been the transformation in technologies of manufacture, distribution, and media. This has changed the process by which commodities are produced and the process by which designers work.

This expansion in the potential of types of media has expanded the meaning of textiles. Traditionally, textiles are produced by weaving or printing, the pattern design made visible by woven yarn or printed or dyed colours. However, the new digital media enables moving patterns on fabric, forming virtual space on the 2D fabric (Fig.96).

Figure 96 Hamish Morrow, 'Beauty of Technology' Spring/Summer 2004

c. Modern Jacquard loom

The Jacquard loom is known for creating elaborate fabrics such as damask and brocade. Jacquard fabric is three-dimensional and complex. However, when using traditional tapestry it is difficult to create smooth, three-dimensional expression such as is possible with Jacquard weaving.

Some people argue that even traditional Jacquard weaving cannot be considered as a craft because it uses machinery. The skills involved with creating of complex 3D textiles, however, should, I argue, be classed as craftwork - 'programming' a Jacquard loom is a complicated, highly nuanced skill. The real complexity of Jacquard weaving is in the design of fabric. Jacquard weavers have to decide which hooks ought to be up and which down. In Jacquard weaving, weavers create the design by changing the physical structure of the fabric. From the start, weavers are constrained by the size of the threads. The excellence of a Jacquard design is a result of a Jacquard weaver's extraordinary skills, which clearly consist of a great deal of craft.

Today Jacquard textiles can be made digitally, using CAD technology. This is a good example of technology 'democratising' a skilled, inherently complex craft-based process. One of the positive aspects of new technology is that it provides us impetus to rethink the values of existing technology. (e.g. painting & photography, tapestry & Jacquard, punch-card Jacquard & digital Jacquard, etc.)

However, to produce a sophisticated, well-made Jacquard textile using CAD, it is vital to understand the structure of Jacquard fabric and the complicated production process. Simply being able to use CAD Jacquard software does not enable a designer to produce beautiful, emotionally durable Jacquard textiles. Therefore making Jacquard textiles using CAD should also be considered as a craft.

In industrial textile design, the primary need is to manufacture quickly. Industrial textiles are produced by automation. The problem is that in this situation people can lose control when they need to get the design right. However, weavers who use Jacquard looms are not attracted to this approach. They work out their design, apply the design to the Jacquard CAD programme, decide the structure of Jacquard fabrics and correct them for the right design.

Independent Jacquard weavers control the entire design process and are responsible for all stages of the manufacturing processes. A wide knowledge of textile craft is necessary, and every step of this type of artisan Jacquard production can be understood as craftwork.

Industrial jacquard textile production, however, should not be entirely understood as craftwork. When textile designers work out the design and trial it with different colours, textures and fabrics this can be seen as craftwork because craftsmanship is an important part of this process. When the design has been finalised and sent the factory, however, the remaining part of the production process should not be seen as craft. Instead it is a highly mechanised, industrial process used to weave quickly for commercial profit. Here the finished woven fabrics are not craft objects. A machine, the Jacquard loom, can weave fabrics; however, the structural quality and aesthetic value of fabrics are decided by the skills of weavers.

Just as the Jacquard loom was the first form of complex mechanisation in textile production, it was also the first form of mechanical computing. Thus as a Jacquard weaver I intend to return to this technology in order to see how it can be used to address the predicament of contemporary design. The problem of manufacturing industrial textiles that can communicate with users in ways that inform, entertain and educate about sustainability will be explored in the next sections.

4.3.1.2. Code as a material

Braddock-Clarke and Harris observe that:

> In order to communicate something important about the rapidly changing age we live in, designers have to frequently adopt new vocabularies, visual languages and codes. Digital media provides a myriad of different expressions from imagined screen based scenarios, incorporating abstract, hyper-real, macro, time-based, self-generating and fast-evolving imagery. Making material digitally tangible requires a connection with the real world. As contemporary design embraces both handmade and digital techniques, a touch of individuality is brought to industrial mass-production, and a new aesthetic is born: techno craft.[57]

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[57] Sarah E. Braddock Clarke and Jane Harris, Digital Visions for Fashion and Textiles: Made in Code (London: Thames & Hudson, 2012), p.33

Even before this research began, I was creating printed textiles using digital techniques and programmes including Illustrator and SPD Look (a textiles CAD programme) for digital textile printing. Textile design using coding creates unique designs; they have a more layered appearance than traditionally printed textiles and 3D-patterned textiles.

4.3.1.3. Code as a method of expression

Many contemporary designers, artists and craftsmen describe their work, methods, technique, processes or ideas through digital technology.

In the 1980s, fashion and textile designers started to use 'codes' for their design. For instance, Jean Paul Gaultier launched his 'High Tech' collection (A/W 1980-81), which combined punk culture with digital references, such as hardware circuitry safety-pinned onto leather garments. Vivienne Westwood also presented her 'Time Machine' collection (1988-89 A/W), named after the H.G.Wells novel and inspired by the idea of time travelling, and linked the Fair Isle sweater to computer game-patterns.[58] The Fair Isle knitting pattern captured the spirit of the pixelated image of computer games in the 1980s.

Faig Ahmed, a textile artist whose work often features the traditional hand-woven rugs of Azerbaijan, has recently sought to reinvigorate the Azerbaijani textile tradition through a series of playful juxtapositions that dramatise the encounter between past and present, the handmade and the digital.[59] He reintroduces traditional crafts by using digital technology; this helps the younger generation of native Azerbaijanis and others to understand and feel closer to the traditions and culture of the country. A good example of how he does this is his work that incorporates both traditional Azerbaijani hand-woven rug designs and contemporary pixelated designs. Both designs are structurally similar; hand-woven or digitally pixelated, both are subject to the orthogonal logic of the grid. An observer who is not cognizant of the significant amount of skill needed to make the traditional design may begin to understand through the ubiquitous contemporary trope of the pixel.

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[58] Sarah E. Braddock Clarke and Jane Harris, p.20
[59] Murtaza Vali, 'In the Spirit of Islam', *V&A Magazine*, 32 (2013), p. 59

Figure 97 Faig Ahmed, 'Pixelate Tradition', 2010, Courtesy YAY! Gallery, Photo by Fakhiyya Mammedova

Hussein Chalayan's work utilizes both technology and innovative materials. In his 'Airborne' collection (A/W 2007), garments used digital technology such as LED lights.[60] Chalayan's designs offer physical manifestations of digital coding.

Figure 98 Hussein Chalayan, 'Airborne' collection, A/W 2007, Photographer Chris Moor

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[60] Hussein Chalayan, Design Museum http://designmuseum.org/exhibitions/2009/hussein-chalayan, accessed 20 Aug. 2014

Today, encoding is one of the methods that designers and artists use to express their ideas. Since the late twentieth century, people have had new approaches prompted by the digital revolution. They express these by using not only traditional techniques, such as drawing and weaving patterns with dyes and yarns, but also drawing ideas from digital technology.

4.3.1.4. Code as communication

In the twenty-first century, ideas and techniques are often exchanged by online communication. In the past, communication between craftspeople was in a studio; however, modern technology has expanded the studio and it is now an online space, as well as a real space. Thus technology has greatly facilitated the exchange of ideas between makers. For example, the Etsy website[61] connects maker/designer and customer. The virtual shop is accessed directly by people around the world. Here customers can find the origin of the items and information about the designer. In addition, customers can write and read reviews of items, and they communicate with other customers and makers. In the traditional crafts market, local craftspeople and customers meet in the local market. Thus the customer can see and touch the items, and meet the makers in person. However, there are limitations; people have to travel and need to be the area of manufacturing. Also it is difficult to get feedback from users, unlike in the online market.

In addition, customers/users are able to understand the originality and processes of production through this expanded studio. Consumers can see the creative process online, through videos and even real-time interaction. Consumers can also use technology to exchange their ideas with manufacturers and take part in the design process.

For instance, Nike designs customised trainers; customers are able to choose colours and materials for their personal items online. Customers can be designers in the Nike's virtual design studio. In other words, customers insert codes for colours and materials and manufacturers produce the trainers by using the customised codes. This customised design by Nike enables customers to take an active role in the design process; such customers become creative stakeholders in the products they have helped design. However, Nike's customised design is not genuine 'customising'; this is mass customisation. Manufacturers provide several materials and colour options to customers. The customers feel 'creative' and 'unique'

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[61] Etsy, available at: https://www.etsy.com

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in the online design studio; however, customers do not have a properly creative role in the design process. They can only choose what Nike's designers suggest.

Furthermore, social media and the new digital technology have expanded the amateur involvement of people in craft. Amateurism has long been a characteristic feature of craft but now, thanks to new technology, many more people can learn craft techniques and make objects in online studios. The online community has led to a DIY craft culture being embedded in wider society.

Some people argue that the flood of technology in contemporary society causes us to lose genuine relationships in our life. However, people can use modern technology, such as social media, to support the emotional relationship between manufacturers and users, people and objects, in the same way as the Arts and Crafts movement tried to do in the nineteenth century. Modern technology enables designers to support emotional durability in the virtual studio.

Thus, the exchange of information by modern technology, such as social media, helps the sharing of ideas. Furthermore, it creates an emotional attachment between users and objects because the user better understands the connection the maker has with an object when they make it. They learn by online tutorials and see the making processes and give feedback to makers.

4.3.2. Modern craft is hybrid craft by code

Computers have had a significant role in textile works since the1990s. Many textile artists and designers use digital computer code to create woven textiles. The brushes and layers of computer programs such as Adobe Photoshop, Adobe Illustrator and other textile CAD programmes are used in woven and printed textiles to express design. Computer software has given weavers the opportunity to design more complex weave structures and textile printing designers or artists can use a greater number of colours and more complicated designs with the unlimited size of the printing screen.

Elements such as originality, materials and skills, and the narrative and attitude of the amateur – the love of craft and being open to new experiences that Adamson discussed in his book can still be found in contemporary crafts; these days technology is often used. Also,

communication between craftspeople and consumers, co-creating in a studio, still remains in technology-led craftwork.

The interaction between craft and modern technology in textiles, especially woven textiles, has been led by several practitioners. One Japanese designer/craftsman, Junichi Arai, has connected handcraft, traditional craft, new design and new technology through his textile works. The textile techniques of Arai are used by fashion designers such as Issey Miyake and other textile craftspeople. Arai grew up in Kiryu, Japan, a centre for Japanese craft weaving, and Jacquard weaving in particular. Arai's family has worked in the textile industry for three generations. Modern technology was an integral part of life for Arai's generation, and thus he wanted to use the potential of computers in his practice. This led him to incorporate computers into the weaving process by using them to make more complicated Jacquard punched cards than the traditional ones. These complex cards are a type of code. They enable the craftsperson to introduce complicated woven fabrics which would be impossible without the use of computers. The manufacturing processes of Arai's designs are from craft-based producers and specialists in synthetic materials. Also, his textiles are based on the physical structure of weaving, which involves combining not only elements of craft, art, design and manufacturing but also technological creativity (Fig.99).[62] [63]

The Japanese textile artist Hideo Yamakuchi grew up surrounded by Japanese traditional textiles: his family were weavers of textiles for traditional kimonos. Yamakuchi uses the computerised Jacquard loom to create unique large-scale patterns. His particular aesthetic achieves a photographic realism, scanning imagery and manipulating it by computer and Jacquard loom. He takes photographs to record his experiences, which are transformed into digital textiles using code, by warp and weft in woven structures using the Jacquard loom. He describes this as 'digital fabric' and sees the woven textiles as possessing great potential for the next generation. (Fig.100)[64] The ability to code visual images is central to his work.

The textile designer Phillippa Brock weaves 3D textiles using the Jacquard loom. Her 'Self fold #1 & #2' are inspired by Brock's experimentation with paper-folding techniques. The textiles are highly textured and robust, and the structure of the weave is elastic. These fabrics

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[62] Dormer, p.169

[63] V&A Museum, Arai Junichi, available at: http://collections.vam.ac.uk/item/O141410/puffed-blocks-loom-width-arai-junichi/ , accessed 4 Dec. 2013

[64] Sarah E. Braddock and Marie O'Mahony, *Techno Textiles: Revolutionary Fabrics for Fashion And Design* (London: Thames and Hudson, 1998), p. 169.

are not possible without the use of digital code and textile CAD/CAM: the process relies on initial prototyping by hand loom (Fig.101)[65].

All three designers use code as a tool in their work. The combination of traditional methods and computer technology has created a whole new arena for contemporary textile artists, designers and craftsmen. The evidence of physical making should not be lost when using new techniques, but should remain part of the process.[66] Also, the ethos of craft and craftsmanship should be maintained while using new technology as a tool. In this way, textiles which incorporate modern technology can be meaningful as crafts, and should be included as valid craft techniques.
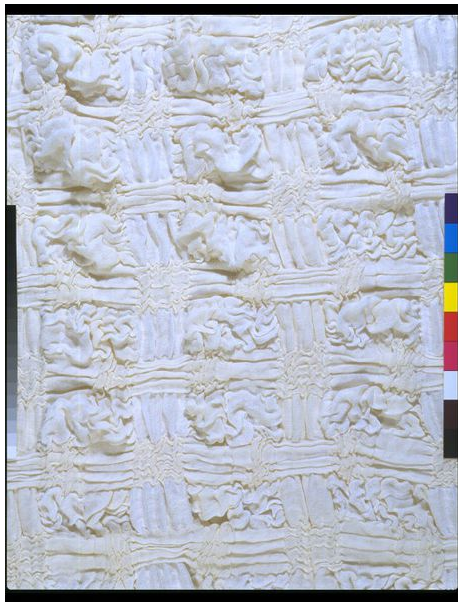

Figure 99 **Junichi Arai/V&A**

Figure 100 'Shisen (Eyes Meet)', 1997, Hideo Yamakuchi,

The Metropolitan Museum of Art

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[65] Crafts Council, 'Labcraft: Digital adventures in Contemporary Craft': Makers: Philippa Brock, available at: http://www.labcraft.org.uk/makers/about/philippa-brock, accessed 5 Dec.2013
[66] Braddock and O'Mahony, p. 168.

Figure 101 'Self Fold #1 & #2', 2009, Phillippa Brock, www.labcraft.org.uk

Tools and technologies have both assisted and opposed the hand throughout history. Technique is a practical method and skill, and may use technology[67]. Modern craftspeople demonstrate their skill, technique and creativity in their hybrid making process. When designers and craftspeople partly use modern technology instead of entirely hand processes, they can express a greater range of things. Modern technology is different from nineteenth-century machinery. It is advanced technology that is beyond people's imagination. Sometimes the technology supports the craftsperson in improving their ability. By using technology, the expressive possibilities of crafts practitioners and designers have been expanded, and this continues to happen. Thus this thesis maintains that contemporary craft is hybrid craft. It comes from the technological revolution in the twenty-first century.

4.3.3. Can crafts made using code be a tool for sustainable design?

Much craft utilises the idea of nostalgia. It also communicates the sweat and labour of craftspeople. Craft can appear to the senses by its use of materials and skills. All of these can be connected to human emotion.

In the nineteenth century, the Arts and Crafts movement pioneers rejected mass production because of not only the absence of the hand but also the disappearance of identity. At that time, machines were limited, so the machine products were not well finished. The purpose of making products was commercial success and emphasis of convenience; thus people could not find real aesthetics from the mass-produced objects. In addition, nineteenth-century

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[67] Malcolm McCullough, 'Abstracting Craft: the Practised Digital Hand', in: *The Craft Reader*, ed. Glenn Adamson (London: Berg, 2010), p.311

manufacturers aimed to produce as many products as possible in a short time, so the quality and beauty of appearance were very poor.

However, nineteenth-century crafts, which were championed by William Morris, were beautiful and well finished because they were made by skilled hands. Many craftsmen thought about their aim when making, and tried to make the best quality objects they could. The ideas and passions of craftspeople were reflected in their designs. Thus the nineteenth-century crafts had non-utilitarian value. William Morris and other pioneers of the Arts and Crafts movement sought to find genuine aesthetics in this invisible value.

However, the products from the Morris workshops were very expensive, and well beyond the financial reach of ordinary people. William Morris was aware of the paradox that his artisanal excellence was only affordable to the middle class. He grew critical of this class and its hypocrisy in wanting 'beauty' within their surroundings but tolerating cruelty and exploitation in the society which produced their wealth.

At that time, they did not use the words 'sustainable design'; however, through the reinterpreting of the nineteenth-century ideas of crafts, we can understand that the Arts and Crafts movement pioneers sought to rescue the disappearance of identity and the unsustainability of products by genuine aesthetics though craft activity. This thinking is in parallel with the idea of sustainable design today.

However, the meaning of craft is changing. In the nineteenth century, John Ruskin praised the Gothic and sought to find the authenticity of materials, William Morris emphasised that expression through craft had the real aesthetics of materials and the elaboration of hand finishing. Many contemporary craftspeople also seek to be honest to materials. This is seen not only in raw materials but also in new materials or technology. For example, Thomas Heatherwick's Zip Bag for Longchamp (Fig.102) uses craft techniques to make a bag which foregrounds its own technological materiality. Sometimes, modern technology supports better finishing and provides a new methodology of production. In this way many modern crafts are going through a period of digital revolution.

Figure 102 Thomas Heatherwick's Zip Bag for Longchamp

Moreover, modern craft overcomes the limitations of human faculties by using technology as a new tool, examples of this being digital printing, laser cutting and 3D printing. Craftspeople such as Andrew Livingstone and Michael Eden are happy to use technology for crafts. Michael Eden brings together traditional ceramic craft skill and digital technology in his work. One of his pieces, 'Babel Vessel' (2010), shows a combination of actual and virtual experience.

Figure 103 'Babel Vessel', Michael Eden, 2010, © Michael Eden

Nowadays many textile craftspeople use modern technology, such as digital textile printing, knitting machines and Jacquard looms. There are many arguments about whether using such machine-centred practice is craft or not. In terms of authenticity, I maintain that someone who

uses modern technology for textiles with their craftsmanship is definitely a textile craftsperson. They produce craft objects.

Many craft objects using technology can approach sustainable design because they are still authentic. A designer with a craft approach has the possibility of exercising full control over the entire supply chain – the sourcing of materials, toxicity, energy use, processes etc. The entire product is thus curated by the craftsperson and s/he can ensure that sustainable values are maintained.

Moreover, traditional craft objects are made individually for a person. This is very different to mass-production. Many modern crafts using technology also have individualism. Craft manufacturing can be highly customised by using technology (e.g. digital textile printing). This facility of offering bespoke craft will support more emotional durability for sustainability.

4.3.4. The Jacquard code and the QR code

The textile industry is a key producer of contemporary material culture. Indeed, textiles and textile technology have long played an important role in many aspects of society. The Jacquard loom led to the industrial revolution. The machine has had a role in the spreading of high quality textiles to the public since the nineteenth century.

Punched cards were first used in the eighteenth century by Basile Bouchon and Jean-Baptiste Falcon as a more robust form of the perforated paper rolls then in use for controlling textile looms in France. Subsequently, Joseph Marie Jacquard improved this technique in his Jacquard loom in 1801. The original Jacquard loom was mechanical, and the design was stored in a series of punched cards which joined together to form a continuous chain. The punched cards indicate the structure of the Jacquard fabric. They could be seen as codes, much like contemporary digital codes.

The Bonas Machine Company invented the first electronic Jacquard loom in 1983. Even though the machines have become smaller, modern technology has allowed the Jacquard loom capacity to increase significantly and single end warp control can extend to more than 10,000 warp ends.

The weaving code system has been further improved by digital technology since the end of the twentieth century. Woven textiles are created by a set of two interlaced yarns, warp and weft, on a weaving loom. The expression 'weaving coding' was first used by V. Milasius in 1998 to develop computer-aided textile design software.[68]

Today, Jacquard looms do not need punched cards; instead, manufacturers use digital code with CAD programmes. Designers input their design and a computer transfers the images to pixels and then textile designers create structures, namely the 'weave code', with a textile CAD programme. The weave code of CAD programmes is much faster to transfer from design to output and it is easier to incorporate complex structures in a woven fabric design.

Today's textiles designers and manufacturers continue to input their creativity, ardour and craftsmanship in textile production using the Jacquard loom and CAD programmes. Some people argue that only hand weavers have craftsmanship; however, this thesis maintains that designers who use modern technology have the same level of craftsmanship as hand weavers. The Jacquard code (punching code) has traditionally been the medium that connects a designer, the Jacquard loom and textiles. However, in the twenty-first century, digital code, such as barcodes and QR codes, is the medium that connects a designer, the loom, textiles and a user.

The experience of living in a coded world, more generally, is characteristic of modernity, where all forms of language and image are subject to mass reproduction and dissemination by machine, and where identity is mediated by mass culture and communication. The concept of culture as a system of codes was first proposed by Soviet Formalist linguists, and then developed by French Structuralists such as Roland Barthes.

The textiles industry, producing elaborate and ornate textiles before the Industrial Revolution, was labour-intensive; however, the Jacquard loom meant that craftsmen could focus more on design and new materials than labour. In the nineteenth and twentieth centuries, however, Jacquard looms could only be used for mass production; individual personalisation was only possible on hand-made textiles, and this was still very labour intensive. New digital technologies have enabled me to use Jacquard looms to produce individually personalised fabrics quickly without the work being labour intensive.

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[68] Binjie Xin, Jinlian Hu, Gerge Bacieu, Xiaobo Yu, 'Development of Weave Code Technology for Textile Products', *Fibres & Textiles in Eastern Europe*, 19: 2 (85) (2011), 33.

Therefore, this thesis maintains that twenty-first-century textiles, because of the result of the digital revolution, create opportunities not only in terms of design and materials but also in terms of identity, ideas and communication with users.

The aim of this research is to demonstrate that it is possible to use the nineteenth-century technology of the Jacquard loom to mobilize the twenty-first-century medium of code, especially QR code, in order to make new designs that will enable textiles to be both beautiful and communicative, integrating the surface pattern of textile weave with the technologies of smartphone sensors to connect users to the narratives of sourcing, production and history of their environment.

Sadie Plant, in her book *Zeros + Ones: Digital Women and the New Technoculture*, writes:

> The weaving of complex design demands far more than one pair of hands, and textiles production tends to be communal, sociable work allowing plenty of occasions for gossip and chat. Weaving was already multimedia: singing, chanting, telling stories, dancing, and playing games as they work, spinsters, weavers, and needle-workers were literally networkers as well.[69]

Weaving as a multimedia event, as Plant suggests, is not limited to just the manufacturing methods of textiles production. In this digital era, which enables instant digital communication, the role of weaving as a part of the media has expanded because of digital languages. Communication only used to occur during the production process, i.e. the punched card communicated the designer's commands to the machine. Today, digital multimedia enables communication to occur in weaving between designers and users. In this research, users are given access to a significant amount of information relating to the product and its production process; this demonstrates that textiles can today offer an invisible interchange between designers, manufacturers, consumers and the next generation who will use the textiles.

Woven textiles using QR code can store enormous amounts of information, such as the identity of the designer, methods of manufacturing, origin, and stories from customers if the textiles are customised. This meaningful information can be woven into a pattern; this pattern

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[69] Sadie Plant, *Zeros + Ones Digital Women and the New Technoculture* (London: Fourth Estate, 1997), p.65

can communicate emotion to the first generation of users and also to the next generation. Benjamin wrote:

> The most profound enchantment for the collector is the locking of individual items within a magic circle in which they are fixed as the final thrill, the thrill of acquisition, passes over them. Everything remembered and thought, everything conscious, becomes the pedestal, the frame, the base, the lock of his property. The period, the region, the craftsmanship, the former ownership – for a true collector the whole background of an item adds up to a magic encyclopedia whose quintessence is the fate of his object. In this circumscribed area, then, it may be surmised how the great physiognomists – and collectors are the physiognomists of the world of objects – turn into interpreters of fate. One has only to watch a collector handle the objects in his glass case. As he holds them in his hands, he seems to be seeing through them into their distant past as though inspired.[70]

Therefore, weaving using QR code enables us to sustain the emotion of designers and users in both the short and long term.

Thus emotional durability of sustainable textiles is created by weaving with emotion, story and materials.

If we reconsider the meaning of emotion as it is currently being researched,[71] it is significant that emotional experience is now mapped by neuroscientists as a system of neural firing within a circuit of connections. The nineteenth-century context of understanding emotion as 'natural' is no longer feasible. The general population understands emotion as a form of attention, as a state of mind which is connected to brain and body, as well as to culture. This understanding of emotion as a code is something that is especially significant to my research as a textile designer in Jacquard weave code. Is it possible to weave designs which tell the story of code itself? In addition, can curiosity and interest also be used to generate emotional durability in textiles? New types of clothing have always generated initial interest and curiosity but this is hard to sustain – this thesis will explore whether using technology to

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[70] Walter Benjamin, 'Unpacking My Library', in *Illuminations* (1968), New York: Schocken Books (2007) pp.60-61
[71] Simon Baron-Cohen, *The Essential Difference: Men, Women and the Extreme Male Brain* (London: Penguin, 2008)

connect users to their material environment and its ecology can be used to help sustain emotional attention.

The Jacquard code was the bridge between a manufacturer and an output; the digital code for textiles can be a new bridge to communicate emotional engagement between designers, manufacturers, the loom and users. Thus, digital code for textiles will be the main conduit for emotional durability through communication and information delivery.

4.3.4.1. QR code as a language in textile design

The barcode was developed by Norman Joseph Woodland and Bernard Silver in 1952. Barcodes were in general use by the 1960s because of rapid economic growth. Supermarkets began widening the range of various products they sold, whose prices needed to be keyed in manually and this made the task onerous and potentially unhealthy for the checkout cashiers. The invention of barcodes alleviated this situation. When the barcode of an item of merchandise was scanned, information about the item was sent to a computer and the price was automatically displayed on the cash register.[72]

A QR code, a two-dimensional matrix code that belongs to a larger set of machine-legible code, is a type of barcode. QR codes were developed by Denso Wave Incorporated (part of the Denso Corporation) in 1994 for the Japanese automotive industry.[73] Barcodes were widely used in industry; however they only stored a limited amount of information. QR codes were developed to store more information than barcodes, such as images.

Today the QR code system is used in diverse industries for product tracking, item identification, time tracking, document management, general marketing, healthcare, life science, transportation and so on. Now with the growth of the smartphone industry, the QR code is also being used in mobile marketing and advertising campaigns as a fast and effective method of communicating with customers and providing information such as website links, mobile coupons, train or airline boarding passes and museum visitor information.

QR codes contain not only simple information such as numbers and limited words but also the address of a website. By scanning the QR code, the user can access the website without the extra work of manually entering the address (URL). Therefore the information provided at the

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[72] 'History of the QR Code', QRcode.com http://www.qrcode.com/en/history/, accessed18, Dec 2013.
[73] http://www.qrcode.com/en/history/, accessed 18 Dec 2013.

other end can be tailored to individual consumers as well as displaying other related issues on the website.

QR codes hold much more data than other barcodes. Furthermore, QR codes can be read more reliably and speedily by an advanced error-correction method. Unlike human language, barcodes are designed for reading and decoding by computers and machine-vision systems of optical laser scanners or cameras and barcode-interpreting software.[74]

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[74] http://www.qrcode.com/en/history/, accessed 18 Dec 2013.

4.4. My Initial Conclusions

I concluded my practical and historical research by integrating current crafts practice and encoding patterns within Jacquard weave. Many designers and craftspeople use digital code (technology) as a material and tool; however, I wove narrative textile by encoding on the fabric for emotionally durable textiles. The encoded textiles can be an archive that records useful information or storytelling for people, and the textiles can be interactive rather than just 2D surfaces. Actual hands may not be present on the surface of textiles; however, the user can still be touched by emotionally tactile textiles. The 'tactile quality' of textiles means not only touching and feeling with the hands, but can also be touching in an emotional sense in my practice.

In 2013, the QR code, as a valuable source of data, with a special relationship to the history of Jacquard loom technology, became the basis of this research project. Although the QR code is traditionally only seen in monochrome, and in printed form on paper, it is possible to weave it into the fabric of textile materials in innovative and interesting ways. By testing a series of colour, contrast and textural combinations it is possible to generate a range of woven textiles that might be used to support the intellectual, ethical and political interests of sustainability with the power of aesthetic and emotional impact. With the QR code, which is legible through woven textile pattern design, it is possible to generate a global visual culture which extends beyond local and national cultures. The familiarity of upholstery textiles provides a feel of safety and locality, whilst access to the virtual space of digital cultures gives access to the constantly updated information of the internet.

Chapter 5. Conclusion: Making, Connecting, Together
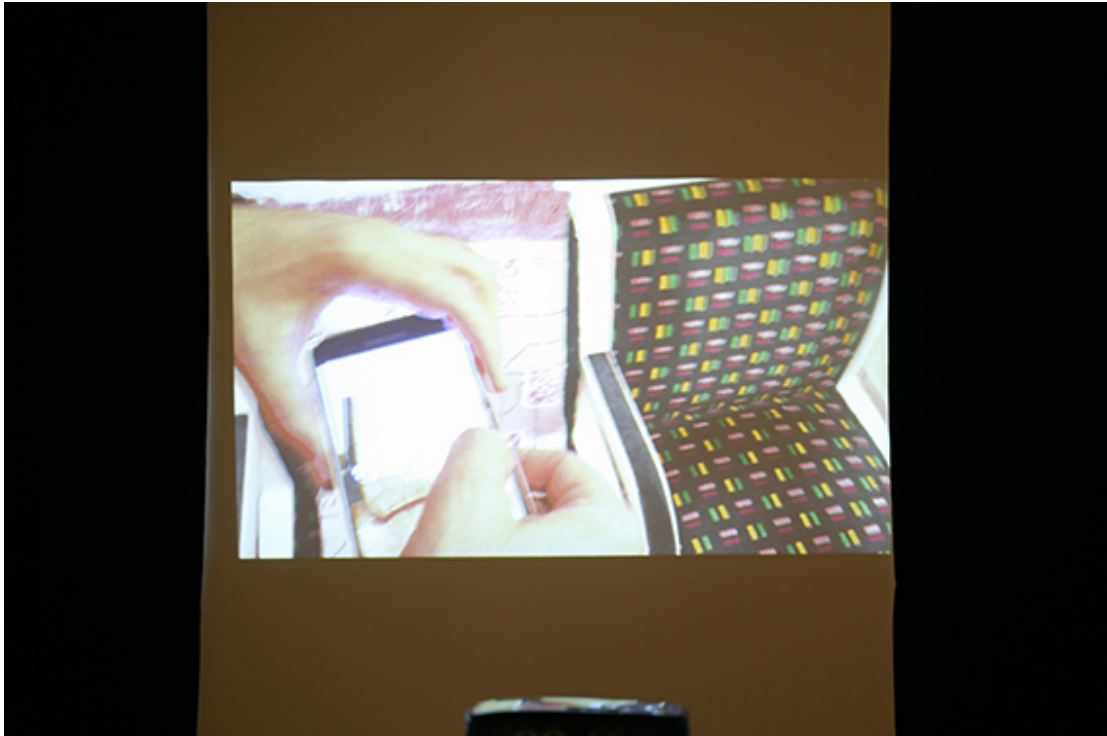
Figure 104 The moving image for simulation of TfL code at the viva exhibition

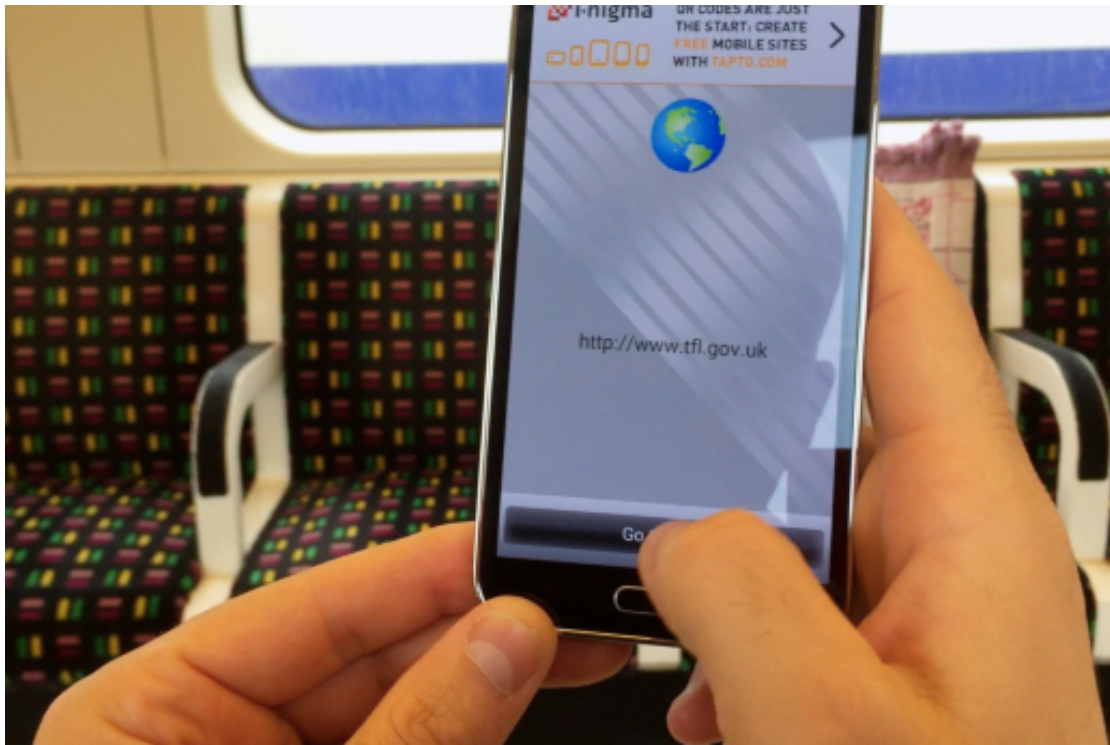**Figure 105 A capture of the moving image for simulation of TfL**

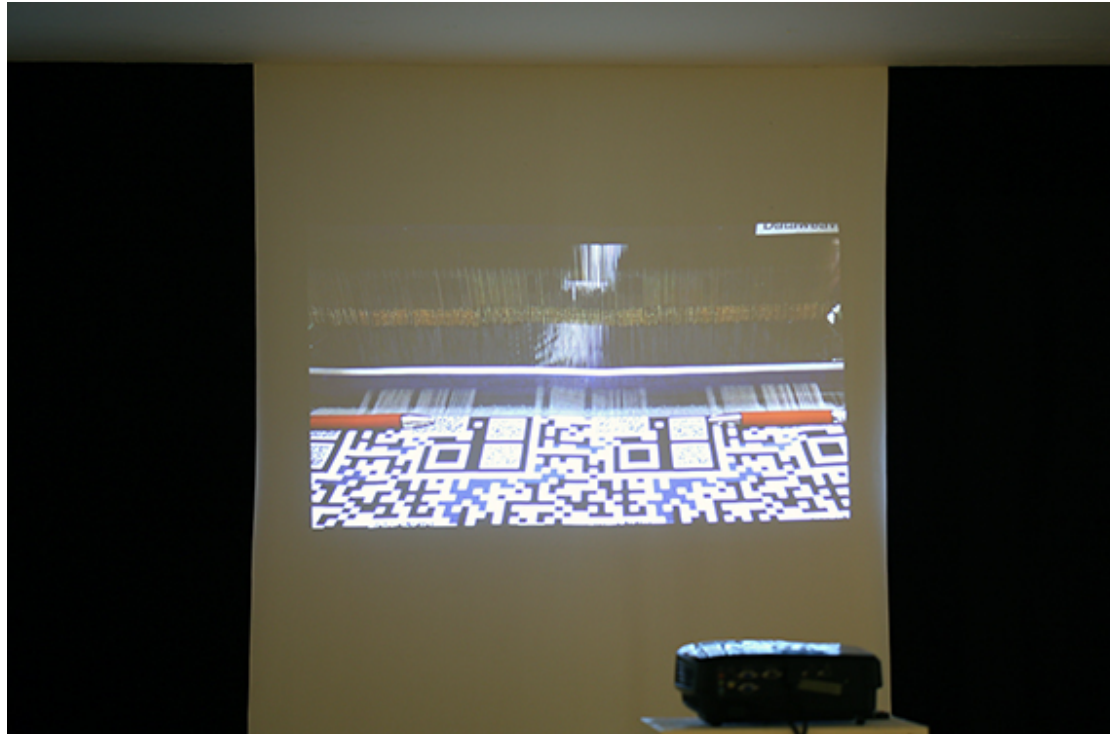**Figure 106 A capture of the moving image for simulation of TfL**

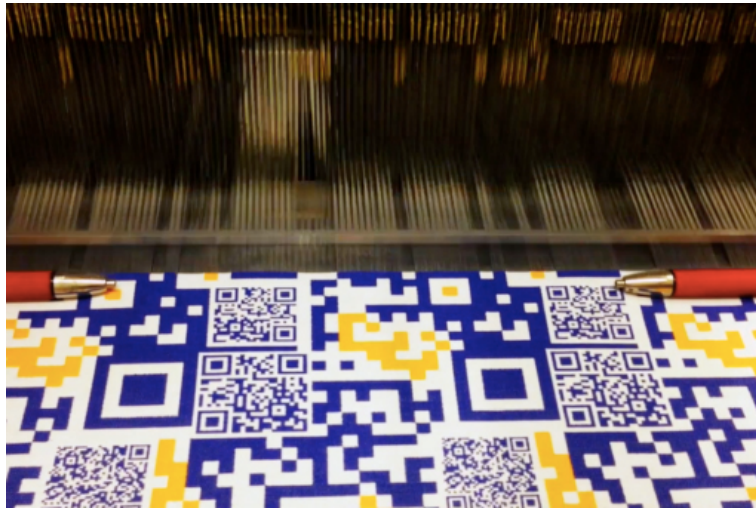**Figure 107 The moving image for the Jacquard loom at the viva exhibition**

Figure 108 A capture of the moving image for the Jacquard loom

Figure 109 A capture of the moving image for the Jacquard loom
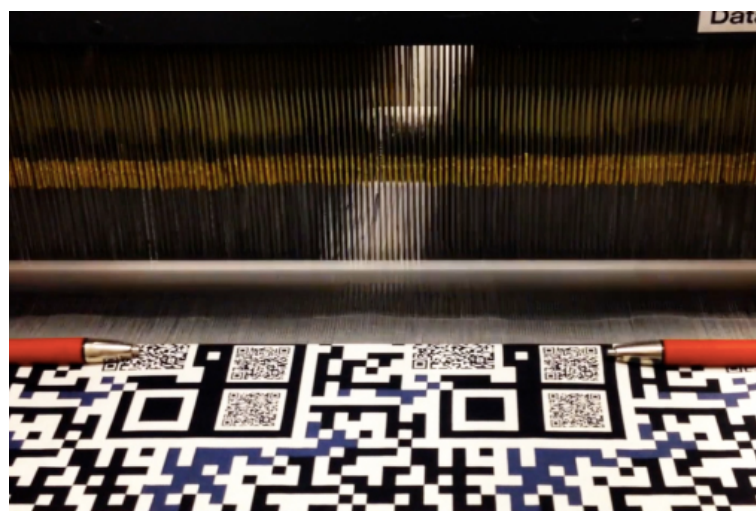

Figure 110 A capture of the moving image for the Jacquard loom

In this section of the exhibition I use the moving image, time-based medium of digital film/video to show the destination or 'conclusion' of the work. Using time-based media is a way of showing the research process as one of duration, repetition and change, one of progress and movement. It is usual in design research to describe the process of design thinking as an iterative process, following the initiative of John Cross and the IDEO group. The iterative process is, crucially, one of repetition through time, in which a prototype is made through an encounter with materials and a problematic. The prototype is then tested, perhaps to destruction, by placing it within contexts in which it aims to be used or deployed; and the learning resulting from these tests is then integrated into the new design problematic which transforms the prototype and its new iteration. The cycle of the iterative process must take place in time as well as space, and, in the case of my project, a social space. Film makes it possible to make viewers aware of the process of research, which is, often, invisible to the spectator or user of the final prototype, but which is vital for defining the new knowledge created through research. As my project shared some of the concerns of design thinking, as thinking for sustainable design, the concluding thoughts refer to issues and solutions already articulated by others[75]; however, as my project is specifically about textile thinking it is important to show that this field of research has its own, specific, concerns.[76] The use of textile as a screen into which I project the two short films is a reference to the way that textiles are used, in everyday life, as a substrate for more visible objects. Just as a cinema screen becomes invisible to the cinema spectator who is immersed in the illusion and narrative of the cinematic spectacle so it is usual for people in daily life to 'take for granted' the textiles that constitute the substrate of life. Upholstery textiles are especially liable to be overlooked, as we use them for the actions of functional living. Carpet is walked on, chairs, sofas and seating is used to rest on or flop onto, domestic textiles are used for household and maintenance tasks, medical textiles for supporting health and wellbeing, and modern living values the supremacy of human agency over the awareness of the issues of materiality. My research aims to allow people to become aware of the issues of sustainability through an encounter with their material, and

[75] Chapman; Farrer; Behseta; Carmen Hijosa, 'Piñatex, the Design Development of a New Sustainable Material', Unpublished PhD Thesis, (London: Royal College of Art, 2015)

[76] Elaine Igoe, 'In Textasis: Matrixial Narratives of Textile Design', Unpublished PhD Thesis, (London: Royal College of Art, 2013)

specifically textile, environments. Using textile as screen for two films is a way of inviting spectators to think about the relationship between textile substrates and the projection of stories of human agency. I made two films, and show these as 'loops' or continuous duration, repeating two minutes of sequential observation, First is the documentation of the industrial, electric and electronic Jacquard loom at the RCA Textile workshop as it manufactures the woven textile I designed to show the potential of the QR code as a visual design motif. I especially wanted the sound of the loom, its mechanical 'voice' of the reality of industrial and mass manufacture. It was textile manufacture that led the world's industrial revolution in eighteenth-century England, and it is the industrial scale manufacture of Jacquard weave textiles that is the focus of my research. As the film shows the machine producing the weave, weaving patterns generated by computer, into a structure transmitted and encoded by computer, the spectator is invited to wonder 'what is the role of the designer?' The design, if considered as pattern, is not a means of making the mechanical process invisible. This question is one of the main discoveries of my research into the role of the designer in making textiles for a manufacture of sustainable textiles. When I started the project, aiming to create textile designs for sustainable Jacquard weave, the definition of 'designer' was limited to the activity of drawing patterns that would create new surfaces to generate emotional attachment between user and textile. The designer was, at the outset, considered to be the control of surface pattern through yarn selection and weave and print techniques. Through a series of iterations this definition of a 'textile designer' was tested to destruction and it led to new boundaries of the designer's responsibilities and agencies. Firstly I began to consider the historical precursors of contemporary sustainable design, which led me to research the British Arts and Crafts movement to consider the responses of the first designers to the Industrial Revolution. Secondly I explored contemporary sources of fibres and materials that can be used by design for emotionally durable textiles towards sustainability within industrial manufacture. Thirdly, the role of bespoke and customised design became significant to me as a designer, thereby redefining my role, as a designer, as one of collaboration with others, be they users or co-designers, or as sources of material. The fourth iteration of the redefinition of the designer as collaborator led me to consider using the Jacquard computer-aided design process as the image or structure of the weave pattern itself. This led to a series of tests in which I tried different fibres, yarns, colours, contrasts, scale and pattern to test the legibility of the QR code patterns in weave, as these are scanned

by an iPhone or scanner. The use of the code as motif satisfied my responsibility as a modernist designer who celebrates industrial manufacture rather than, as did William Morris and the Arts and Crafts artisans, using imagery to refer to a pre-industrial naturalism or the idealisation of nature as the antithesis of mechanisation. Using the QR code as a visual motif allows users to become aware of upholstered surfaces as meaningful and communicative surfaces, rather than inert or decorative surfaces that are 'merely' pleasant or trying to please by becoming unobtrusive and decorative. The QR code conveys an image that is hyper-modern, and is familiar, as it is recognizable from retail design, consumer information labelling and contemporary media dissemination. The QR code can also invite users to scan and to decode it, unlocking meaning and opening the portal to another, virtual dimension.

The film of the Jacquard loom, with its rhythmic soundtrack, recalls this whole journey and celebrates the mechanics of production, celebrating the 'machine aesthetic' of the Bauhaus which was an inspiration for RCA designers. Art and design within industrial modernity is the institutional context for this research. Although my research is necessarily constrained by the limitations of this academic institution (such as the need to work within the resources of shared equipment and materials rather than using only specifically sustainable materials from selected sources) the ethics of the modernist design process is the context for this research. The institutional context for the research enabled imaginative experimentation that other settings may have denied.

The second film shows a section of a journey on the London Underground where a static camera gives the point of view of a potential customer or service user, travelling on the District line. The seat opposite has been resurfaced using the designer's QR code weave upholstery textile, and the film shows this 'in situ', suggesting the possibility that all mass transit upholstery textiles could be redesigned to use fibre from sustainable sources and motifs that inspire, educate and inform, as well as are sat upon. This use of Transport For London (TfL) as the imaginary context for my final prototype design has several references. It refers to the wonderful designs by Enid Marx, the textile designer at RCA who worked with London Transport to create the iconic moquette in red, green and blue which characterized the buses and trains of the UK public transport systems. This tradition is also a reference to the modernist principle of the Bauhaus design principles and the choice

of the geometrics of loom-based designs for loom-based materials. This is celebrated in the code-based matrix for code-based pattern and structure of the Jacquard loom. The reference to TfL is also a celebration of the popular culture of design practice which, in my research findings, differentiates it from the more elitist studio-based workshop and artisanal craftsmanship chosen by the Arts and Crafts designers for the luxury fabrics for the domestic interiors of an exclusively upper- and middle-class consumer. The problem and challenge of sustainability is a global issue that is the concern of all who live in the modern world, and we need modern, mass, democratic and communicative solutions that will affect and be relevant to all of us, not only retailed to an elite few who can afford to buy an ethical product. The film loop has the soundtrack of the underground train on its rails, which seem to echo the mechanical sounds of the industrial loom in the adjacent film. The films are projected alongside one another to show the parallels between industrial manufacture and the modern world. The train journey has been understood by historians of modernity as the invention that revolutionized the lives and reality of the world as profoundly as did the invention of industrial manufacture of goods, starting with textiles in the UK Industrial Revolution. The building of railways appears as a trope for the arrival of a new world reality, as a signifier of modernity, in the novels on nineteenth-century authors such as Emile Zola and Elizabeth Gaskell, bringing new conventions, modes and social structures to rural and conservative communities. The railways led to common timekeeping, as trains carried the accurate pocket watches and chronometers from city to city, replacing the timekeeping of church tower bells or daylight coordinates. The train, then, functions as a signifier of progress and of a journey, using new technologies to accelerate perception, observation and to multiply social and cultural connections. This makes public transport a satisfying paradigm for the design prototype for the conclusion of my research.

The contradiction, of course, is that the conclusion is an ongoing journey. There is no stopping point for this research, or the design practice issuing from the research, as the journey towards manufacture for a sustainable environment is a perpetual and ongoing challenge that will become a permanent dimension of all designers' problematic and solutions. Sustainability becomes a way of thinking and making, rather than a problem to be 'solved', and the conclusion of the research is the start of a journey towards a new form of textile design.

Aside from the QR code as image the designs also function as scannable code which enables users to find digital platforms that will instruct them in information about a range of data. One code takes users to the TfL website which informs passengers of the current state of the transport system, its routes and maps. Other code weaves take users to the SustainRCA website, allowing them to discover more about the definitions of sustainability in art and design today. Another code takes the user to the website of this research project, with all the images, data and eventually the dissertation accompanying the textile weave prototype design and samples.

As the code functions as a conduit for the user's curiosity it recalls the 'transportation' of the self through knowledge and imagination. The metaphor of the train and public transport operates, here again, as an apposite equivalent for the integration of traditional and new, digital, technologies. The new function of the textile designer is not to make textiles that are more desirable or simply 'ethical' than others but to generate a new culture of modernity where user and designer work together to collaborate on sustainability. If Chapman is right in suggesting that emotional durability is as important as material sustainability then this experiment in design practice allows us to question the range of experiences that can be qualified as 'emotional'. It is not only attachment which can generate emotional 'durability' but the constant renewal and innovation which is possible when the textile design allows users to access a constantly updated and renewed website or digital platform which allows users to 'travel' to new knowledge and new cultural dimensions.

Future developments of QR code in weave form might include:

1. Public transport: Encoded textiles can provide useful travel information. People can find local information such as landmarks, restaurants and directions.

2. Fashion and interiors: A woven QR code can provide origin and textile care information. Manufacturers don't need to make labels. Many people cut the labels off after purchasing and make washing mistakes. Also, a woven QR code can save material and reduce the cost of making labels.

3. Personal: People can have their own encoded and personalised textiles. The encoded textiles can be a diary or family archive or album.

4. Solution of design limitation: Other digital codes are developing. High Capacity Colour Barcode (HCCB) is a technology developed by Microsoft for encoding in a 2D digital code. Tag codes are the newest edition of 2D digital codes. They offer more flexibility than older formats, such as barcodes or QR codes, in the code design (patterns and colours). In addition, people can update the content any time without having to change the Tag code. Tag codes can be black-and-white or full colour, and can include customised images[77].

Like this, digital technology is developing. QR codes still have limitations for pattern design because they are only readable in square patterns and limited colour contrast.

If digital code technology is developed, people can have a more active experience and diverse designed and encoded textiles.

This research project has two findings.

1) First is the designs that I set out to create, as a textile designer using Jacquard weave for upholstery manufacture. I set out to find a contribution to making designs that will support the eco sphere and environmental sustainability. I discovered that, along with Chapman, I thought that sustainability needs to be emotionally meaningful as much as it may be intellectually, rationally or politically significant, in order for people to get involved. I found that my role as designer needed to be completely changed and transformed. This led to my second finding.

2) The research journey in practice-led design research cannot be predicted at the outset. The learning by experiment within the workshops, and through testing prototypes with user groups, is a form of design thinking that values process over product. This value of process and the excitement of learning through making is something that can be shared between designers and their 'clients' or user groups. The designer is part of a relationship which requires the designer to be open to reciprocal agency in the process. Sustainable design requires not only attention to sourcing and materials, but also to the quality of the designer's relationship with

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[77] http://tag.microsoft.com/, accessed 15 Sep. 2014

users. Users should not become passive consumers but can be activated to become fellow travellers on an infinite journey towards a more sustainable planet.

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Appendix

1. Sustainable design

(1) The meaning of sustainability in design

Sustainability is a concept that requires a balance between economic, ethical and environmental (material) resources.

In order to achieve sustainability, three defining contexts need to be considered, all of which are essential to achieve sustainability. The organization Trie, which develops sustainability, has defined sustainability development by ethics, environment and economics as follows:

Ethics

The challenges we face require more thought than a binary system of wrong and right. Rather, ethics provides a framework for critical analysis of the values, attitudes and reasons underlying the decisions we make everyday that help or harm.

Environment (Material)

It is where we live, our surroundings and our ultimate source of life – through the air we breathe, the water we drink, the food we eat, and the raw materials we consume

Economics

It is about more than just profits. It is the way society assigns, creates and exchanges value[78]

In addition, contemporary manufacturing systems have been developed through technological progress, the development of rationalism and the rise of utilitarianism, over two centuries of industrial capitalism, mass production and consumerism since the Industrial Revolution. Sustainable development is a reaction to these societal and environmental changes, in sequence; the significance of sustainability has emerged in design fields[79] (for example, the annual SustainRCA Show at the Royal College of Art). Perhaps social and environmental issues are becoming an increasingly important phenomenon in the design field. A number of

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[78] Trie, 'Sustainability in action', http://trie.co/home-old/sustainability/, accessed 15 Sep. 2014.
[79] Stuart Walker, *Sustainable by Design*, (London: Earthscan, 2006), p.32

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designers are looking for ways of reducing the environmental and social impact of their work, through the use of more environmentally friendly materials, understanding supply chains and exploring methods for sustainable processes. However, in the commercial world the designer still has very little or no influence over the kinds of decisions that are usually made by marketing or production teams. However, the craftsperson/designer can take control of his/her design decisions.

One function of sustainability in design is that products created by one generation can continue to be used by the next generation, thus reducing the need for the creation of new products. The elements of sustainability in design involve philosophy, ethics, durability, the environment, aesthetics and the 'Cradle-to-Cradle' (C2C) approach.[80] Environmentally friendly thinking and the notion of C2C can lead to significant improvements to the environmental impact of products and reduce waste. However, in an industrial context these are extremely complicated to bring about and require whole system shifts. Sustainable design must look beyond sourcing, resource management, recycling and second-life usage, C2C and design ethics and also consider socially, ethically and emotionally sustainable design. Crucial to all these is the deployment of effective strategies to develop awareness of the sustainability agenda and to disseminate knowledge and research about social and environmental issues. Emotional durability, in which the user develops a deep connection to an object, is central to my practice-based research. Not only can people become less wasteful in their consumption but also every point of contact with familiar materials and design interfaces can become sources of meaningful knowledge and acquisition and exchange. New social networking systems can help activate the agency of the power of consumer choice and increase the pressure on conventional systems of manufacture and retail. In fact, many social networking services, such as Facebook and Twitter, have become powerful tools for the rapid dissemination of this kind of information.

(2) Strategies of sustainable design

1) The aesthetics of the 'timeless'.

Is it possible to arrive at a universally applicable standard of value in design aesthetics? In order to engender a relationship of attachment between users and their objects the designer must consider the qualities which users find valuable in their possessions. It may or may not

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[80] William McDonough and Michael Braungart, *Cradle to Cradle: Remaking the Way we Make Things* (2002), (London: Cape, 2008)

be possible to extrapolate from individual cases to general principles. The concept and aesthetic of 'good design' were present, as argued above, in the patterns of the Arts and Crafts movement. These styles, however, proved meaningful only to a specific class, namely the bourgeois, and were not popular more generally. The idea that a middle-class aesthetic may be imposed more widely on society through the means of the dissemination of correct 'attitudes' and 'education' can, Christine Atha argues, be traced in British design culture of the 1950s.[81] When post-war Britain turned towards design as a central component of reconstruction the designers and planners were predominantly middle-class professionals, designing for a proletarian user group. The result was an aesthetic culture of 'Modern Classics', which needed to be widely authorised and validated through events such as the 1951 Festival of Britain, and through mass-media publications such as women's magazines and DIY journals. This process reinforced the idea that there may be 'universals' of good taste that can be applied across social variables. This was seen as evidence that a general code of taste existed. The market research industry is testament to the significance of this quest for universal good taste.

'If you want to make a golden rule that will fit everybody, this is it: Have nothing in your houses that you do not know to be useful, or believe to be beautiful.'[82]

However, aesthetic preference is a highly personal matter, with huge variations that seem determined by social convention. Aesthetic perceptions change with every generation. Thus, sustainable aesthetics are characterized by the aesthetics of the past lasting until today and contemporary aesthetics still being current in the future. This means that even though the perception of the aesthetics changes, if the philosophy of aesthetics or design can be delivered to the next generation, it will lead to a sustainable aesthetics. For instance, this generation has a different aesthetic perception from that of the eighteenth century but the aesthetic of the eighteenth century is still loved. In addition, even design language that is strongly associated with specific generations, for example the Gothic, or Minimalism, can still be appreciated by subsequent generations.

Many design companies pursue the idea of 'timeless design' in their design philosophy. Iittala, a leading Finnish design brand, believes in an emotionally universal and timeless

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[81] Christine Atha, *Coals in the Bath: Design Reform and the British Working Class,* 1937-1947 (Unpublished PhD Thesis, Royal College of Art 2013)

[82] William Morris (1880), 'The Beauty of Life', Birmingham Society of Arts and School of Design, in: Donald E. Norman, *Emotional Design: Why We Love (or Hate) Everyday Things* (New York: Basic Books, 2004), p.3

design concept. Iittala believes in lasting design: therefore their designers and craftsmen create simple and timeless objects that will never be thrown away. The design seeks to be forever useful, adapting to new circumstances; the products are outside of fashion and are designed to be timeless. Samuji, one of the Iittala design studios, produces sustainable design in historic district of Vallila, Helsinki. One of Samuji's designers, Hennamari Asunta, was involved in Iittala's Sarjaton project (Fig.111), the aim of which was to produce timeless design that should lead to less consumption and as a result help consumers be more environmentally friendly. However, there is a tricky paradox for design; in this paradigm, Iittala can only survive by selling more and more products: but people keep them for a long time. The Sarjaton collection is popular not only in Europe but also in the USA and Asia. The brand markets its products as 'timeless design' and 'sustainable design'; however, no industry can claim to have achieved sustainability simply by using a 'timeless' design concept.

Figure 111 Sarjaton bowl, Iittala

This aim, to conceive a timeless, 'classic', universally treasured design proved to be the first, and most misguided, part of my research experiments.

A textile design in itself is not 'timeless'. Classic patterns such as dots and lines do not, on their own, foster an emotional attachment. A larger, more fully encompassing design language and identity is needed in order for a product to become emotionally durable. This can best be exemplified in luxury brands. Why do people love luxury brands? People love trendy design, but they also love design that has not changed, seen in the logos of Chanel, Louis Vuitton and the check patterns of Burberry. These luxury brands have their identity rooted in their design and keep their original designs for a long time, building brand recognition. However, sometimes they make small alterations in design and still attract customers. Consumers accept the small changes in the design of luxury brands as long as they fit with the brands' heritage and design ethos. Luxury brands often make their iconic designs timeless. This is important because it encourages consumers to build an emotional engagement with the designs.

In this luxury brand context designs are cherished and are not thrown away at the end of a

season. However, there is a paradox. Luxury brands still create many new products and stimulate much consumption. Luxury brand consumers simply buy more products. In his 2001 article 'Income and happiness: towards a unified theory' Richard Easterlin states that 'Even though rising income means people can have more goods, the favourable effect of this on welfare is erased by the fact that people want more as they progress through the life cycle.'[83] He refers to this effect as 'the hedonic treadmill' as people's desire for more constantly outstrips that which people already have.[84]

2) Economy: the circular economy

The circular economy is a generic term for an economy that is regenerative by design.[85] It refers to an industrial economy that is restorative by intention; aims to rely on renewable energy; minimizes, tracks and eliminates the use of toxic chemicals, and eradicates waste though careful design.[86]

A circular economy aims to rebuild capital, whether this is manufactured, financial, human, social or natural. This ensures an enhanced flow of products and services. The system diagram indicates the continuous flow of technical and biological materials through the 'value circle'. (Fig.112)

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[83] Richard Easterlin, 'Income and Happiness: Towards a Unified Theory', *The Economic Journal*, 111, (473), (2001), 481
[84] Jonathan Porritt, *Capitalism: as if the World Matters* (London: Earthscan, 2007), P.89
[85] Ellen MacArthur Foundation, 'circular economy', available at:
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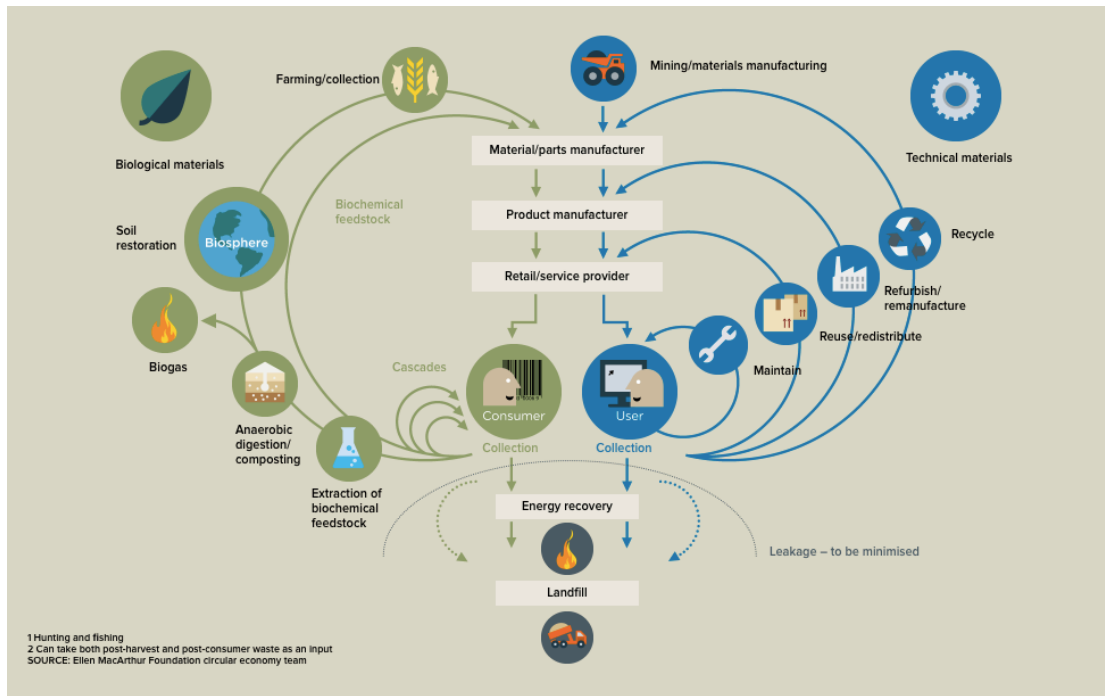
Figure 112 Circular economy system diagram, ©http://www.ellenmacarthurfoundation.org

3) Affectivity-emotion-engagement, feeling-attachment

Emotion makes consumers buy objects, while feeling makes them keep them. People may not love a product any more, even though the product physically works well and is made of high-quality materials. Thus designers need to consider how to make their products attractive to consumers for as long as possible. In his 2004 book *Emotional Design; Why We Love (Or Hate) Everyday Things* Donald A. Norman suggests that attractive things work better. In creating attractive products, designers need to consider four key points.

1. The practical: choice of materials, manufacturing methods, marketing and the ease of use[87]
2. The emotional/the visceral: appearance
3. The behavioural: the pleasure and effectiveness of use
4. The reflective: self-image, personal satisfaction and memories[88]

People usually keep something with a positive emotional attachment, such as good memories, and throw products away that have negative emotional experiences. For these reasons, emotional design is a key concept in sustainable design.

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[87] Donald A. Norman, *Emotional Design: Why We Love (or Hate) Everyday Things* (New York: Basic Books, 2004), pp.4-5
[88] Ibid., p.39

There are many types of emotional design.

For example, emotionally engaged design is 'retro'. In terms of rapidly changing trends, many people enjoy a variety of new designs and cultural experiences; however, sometimes they miss the past. For this reason, retro design has become a trend. Retro design inspires human emotion. People can nostalgically experience the past and also the ambience of the previous generation.

Some people throw products away when they look used or old. However, the marks of age and wear on a product (its patina) leave vestiges of people's lives that can affect many people's feelings. The patina of age holds treasured memories and creates an emotional attachment. When there is an emotional attachment, the product will not be thrown away. Thus, being able to 'inscribe' feeling onto a product helps prolong its lifespan.

4) Authenticity

The history and social context of a fabric is increasingly important in differentiating it in the marketplace. One way that textile manufacturers give a fabric this significance is by drawing on elements of cultural heritage.

Some of these new cultural strands are intentional and radical (strategically driven to reclaim the social agency of disempowered cultures) and are direct manifestations of the desire to reclaim a longer-lasting cultural identity and thus social integrity. There has been a return to a type of 'cultural fundamentalism': a reconsideration of the roots of national design in Europe, led by Dutch design and Scandinavian design. For example, work by contemporary Swedish designer Johan Lindstén looks reflects his Scandinavian cultural heritage with its strong elements of sustainability and use of materials. It uses these key principles to develop contemporary objects centred on the recognition of cultural heritage, eco-design and human interface design (Fig.113).

Figure 113 Embroidery chair by Johan Lindstén, © Johan Lindstén, http://www.lindstenform.com

There is an interesting dialectic between nostalgia and emotional attachment to heritage. Aspects of nostalgia can be understood as having powerful agency for use in the new ethics of sustainable textile design practices. The emotional allure of nostalgia is in collective storytelling and shared heritage.

Something we have kept for a long time has a 'story', and it has become part of the user's life. It might be an individual story, such as family history or the narrative of a sequence of individual lives. Walter Benjamin proposed that storytelling is the cultural heritage of certain artisanal societies, where knowledge is disseminated through word of mouth rather than through print media, and where individual identity and subjectivity is integrated into the narratives that bind subjects to the social fabric.[89] In addition, craftspeople put their mind, their passion and their life story into objects during making. Storytelling in design might make objects much more valuable, because they are meaningful, to someone. In this sense, craftsmanship as a dimension of design objects could make an important contribution to sustainable design. It is possible that this aspect of the subjective experience, becoming integrated or encoded into the design process, may be specifically meaningful in textile design. I suggest that Jacquard weave, with its history of technological and industrial innovation through encoded data, has a special affinity to contemporary strategies for the integration of subjective agency within the fabric of a design object.

It is difficult to ascertain why people form strong attachment to their own cultures. Nostalgia

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[89] Walter Benjamin, *Illuminations* (1962) (London: Pimlico, 1999), pp.83-107

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for an imaginary lost utopia is common, and many religions manifest this as a form of fear of change or empowerment. Cultural heritage, however, holds the power of the story and storytelling in ways that are not rational. If nostalgia can be seen as a defensive, conservative and reactionary culture, is it possible for other aspects of heritage to be activated as sources of empowerment, change and concern for sustainability? Storytelling, through the encoding of relational aesthetics within Jacquard weave, can, I suggest, provide an accurate, up-to-date cultural resource which invites consumers to reconsider their agency in the production process, to take an active and reciprocal role in the politics of sustainability. Storytelling which invites subjective identification within the narratives of production and dissemination can, I suggest, be a powerful element in the toolbox of future sustainable design.

5) Social worth

To make a more valuable product in terms of sustainability, there is a need to consider not only its utilitarian function but also the social role of the product. Communication between users, political messages, the preservation of tradition and the support of social minorities through design can all create social worth.

An example of socially valuable products is the 'Lifesaver' water filter bottle The Lifesaver bottle was developed for use after natural disasters such as tsunamis and earthquakes. The bottle incorporates portable technology that removes all bacteria, viruses, cysts, parasites, fungi and all other microbiological waterborne pathogens without the aid of any foul-tasting chemicals or the need for any power or UV light. In addition, the filter cartridge is replaceable. (Fig.114)

Figure 114 'Lifesaver' water filter bottle, ©http://www.lifesaversystems.com

Another example is the collaboration between the two major companies Nike and Apple. The Nike+iPod Sensor gives the user feedback while it records diverse information about their running activity. People can then view all their own completed runs and share motivation with runners across the world. These designs impart social responsibility to products and support human-to-human relationships. Nineteenth-century social and economic theorist Karl Marx suggested that capitalist production resulted in commodity fetishism, producing an ideology in which people are a by-product of the relationship between commodities, and he proposed that radical culture should dispel this myth by exposing the fact that people produce commodities through their labour. The design of products not only plays a practical role but also helps, rather than effaces, communication between users. If an ideal consumer in traditional systems of consumption is imagined as an individual 'proprietor' of commodities, then new design might enable consumers to understand themselves as part of a community of users with the potential to exercise power and agency through choice and demand.

6) Ethical production

According to Kate Fletcher, producing textiles involves one of the longest and most complicated industrial chains in the manufacturing industry The conversion of raw textile fibre to finished fabric and final product consumes labour, energy, water and other resources and cumulatively constitutes a high-impact sector.[90]

Improved sustainability in processes and sustainable design strategies and opportunities are key stages in the progress of sustainable textile manufacture. This describes efficiency measures, toxic chemical substitution and best practice in terms of baseline labour and chemical standards. 'Best practice' techniques provide valuable benefits in the short term and improve the company's manufacturing processes.[91] This is due to the fact that innovative manufacturing processes involve fewer toxic chemicals, environmentally friendly production processes and a better working environment for manufacturing. This creates a long-term benefit.

7) Durability

Durability is a complex quality that needs definition in relation to any exploration of product lifespan in design thinking. The aim to extend the 'lifespan' of commodities, objects,

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[90] Fletcher, 2008, p.41
[91] ibid.,, p.42

possessions and tools for users is also a popular strategy and represents long-established 'good' design qualities. The concept of a design 'classic' is acknowledged as involving qualities such as efficiency and timelessness. These aspects are not far removed from the aesthetics and ethics of the first Arts and Crafts movement, with its concept of the combination of utility and beauty. According to Fletcher, 'durability is often seen as a truly sustainable approach, an antidote to fashion change. Moreover, extending the life of products does bring benefits.'[92]

8) Waste hierarchy and the 'cradle-to-cradle' approach

The most common approach to tackling waste hierarchy (Fig.115) is widely known as 'the 3Rs': Reduce, Reuse, and Recycle, in addition to this it includes Recovery and Disposal. The aim of these activities is to extract the maximum benefits from products by extending their life, as whole products, fabrics or fibres, before throwing them away. Waste hierarchy intervenes at the end of the industrial chain and contains or helps to remediate the negative environmental effects of waste generation.

Reduce	lowering the amount of waste produced
Reuse	using materials repeatedly
Recycle	using materials to make new products
Recovery	recovering energy from waste
Disposal	safe disposal of waste to landfill

Figure 115 The waste hierarchy

With a focus on materials, 'Cradle to Cradle' (C2C) thinking, a concept initially coined by Walter R. Stahel, was brought to the attention of the design community by the architect William McDonough and the chemist Michael Braungart. C2C design is a biomimetic

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[92] ibid.

approach to design that models human industry on nature's processes in which materials are viewed as either technical or biological nutrients circulating in a healthy, safe metabolism. The materials can be used in continuous cycles as the same product without losing their integrity or quality. In this way, these materials can be used over and over again instead of being 'downcycled' into lesser products and ultimately becoming waste. Jerome Caruso developed the Celle chair (Fig.116) for Herman Miller in 2005 using a C2C approach. The chair was developed for recyclability, safe content, easy disassembly, minimal packaging and minimal waste. It is 98% recyclable.[93]

The notion of the circular economy is attracting businesses of all sizes to explore alternative economic models with C2C thinking at their heart. Examples of businesses modelled on C2C principles include Interface Flor, Desso, and Orangebox.[94] Desso is committed to a C2C manufacturing process. The company has reduced CO2 emissions to a minimum, sources sustainable raw materials, uses non-toxic materials and develops long-life and low-maintenance products.

Figure 116 Celle chair, Jerome Caruso for Herman Miller (2005)

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[93] Herman Miller, Celle chair, available at:
http://www.hermanmiller.com/content/hermanmiller/northamerica/en_us/home/products/categories/seating/performance-work-chairs/celle-chairs.html, Accessed 30. June. 2014
[94] Ellen Macarthur Foundation CE100

2. Sustainable textiles

In this section I explore the challenges that confront the textile designer who chooses to engage with the sustainability agenda. When working within industrial, large-scale manufacturing, the designer is not always free to choose specific materials and sources, but may be constrained by the demands of the employing organisation and its economic strictures that demand a high profit margin for shareholders and owners. However, the designer can always be aware of the choices that he or she is making, even if these are not freely made. It is important for the designer to be informed of the choices and their effects. It is possible that designers can have an effective agency within the production process, and can use design and pattern as a way of communicating directly with consumers and users.

(1) Sustainable textiles: exploration of adequate eco-friendly materials for sustainable textile design

Today's global textile industry, like many others, is inherently unsustainable, and has a high impact on the environment. The cotton industry alone is a major user of synthetic fertilisers and pesticides. Other 'natural' fibres, such as wool, also impact on the environment. Synthetic fibres are manufactured from petrochemicals, contributing to the depletion of rapidly dwindling fossil fuels, and the toxic chemicals used for dyeing and finishing all textiles also have high environmental impacts. As a whole, the textile industry consumes large amounts of water and other environmental resources.

All kinds of organic textile products and raw materials are labelled and marketed as 'eco friendly' and 'green'. Organic certification is a useful mechanism, because it provides a guarantee that the fabric has been produced in a chemical-free way, without fertilisers, pesticides and processing chemicals.

Ruth Singer, in her seminal book *Sew Eco*,[95] proposed a checklist of issues which need to be addressed in order for a textile to be considered sustainable:

1. Chemical use in fabric production
2. Fair and ethical working practices for producers

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[95] Ruth Singer, *Sew Eco* (London: A & C Black, 2010)

3. The amount of waste textiles in landfill

4. The use of precious non-renewable resources

5. Pollution caused by the production of textiles

6. The amount of energy used to produce, process and transport fabrics

7. The amount of water used in textile production and processing

(2) Sustainable textile materials

Green products usually mean environmentally friendly products. Products are considered green when they are made from environmentally friendly materials or made by environmentally friendly methods of processing or recycling. For instance, the European commission authorises the EU Ecolabel to identify products and services that have reduced environmental impact throughout the lifecycle of products, from the extraction of raw material through to production, use and disposal. The EU Ecolabel scheme is a commitment to environmental sustainability.

The EU Ecolabel logo (Fig.117) on textile products informs consumers of the green and sustainable credentials of the product. These include:

Limited use of substances harmful to the environment

Limited use of substances harmful to health

Reduced water and air pollution

Textile shrink-resistance during washing and drying

Colour-resistance to perspiration, washing, wet and dry rubbing and light exposure[96]

The label also informs consumers of substances excluded in the EU Ecolabel products:

No mineral fibres, glass fibres, metal fibres, carbon fibres and other inorganic fibres

Limitations of certain pesticides

No lead-based pigments

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[96] European Commission Environment: Ecolabel, available at:
http://ec.europa.eu/environment/ecolabel/eu-ecolabelled-products-and-services.html, accessed 27.08.2014

Limited use of zinc and copper

No heavy metals and formaldehyde

No azo dyes

No dyes classified as carcinogenic, mutagenic, toxic for reproduction

No plasticizers or solvents[97]

Figure 117 EU Ecolabel

Thus, the production process associated with the making of materials is one of the key elements of sustainably designed products. A 'green' production process involves many elements, such as the reuse of recycled materials, the maximisation the efficient use of raw materials, the minimisation of environmental pollution and the eradication of the use of harmful substances (eg. chemicals). It is only when the production of a material involves all of these elements that a product can be truly considered as being 'green'.

As well as involving recycling, another method of producing a green product is by choosing green raw materials. Many Asian countries, for example, have explored the use the waste of raw materials such as piña and banana fibres.

In addition, the exploration of new environmentally friendly materials is continuing. For instance, textile designer Carmen Hijosa is developing textiles using pineapple fibre. (Fig.118) Moreover, several companies are exploring protein fibre extracted from soybeans or milk.

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[97] European Commission Environment: Ecolabel, available at:
 http://ec.europa.eu/environment/ecolabel/eu-ecolabelled-products-and-services.html, accessed 27.08.2014

Figure 118 Piñatex, Ananas anam, Carmen Hijosa

The exploration and use of new eco-friendly materials is important in the green industry context. As documented above, sustainable textile company Camira's textiles use sustainable raw materials, or renewable and compostable fibre.

In terms of recycling, there are two main types of product. One is where the original form of the product remains intact and the other is where the original form is broken down to create an entirely 'new' material. Fabrics made from recycled materials are extremely rare and difficult to purchase. The most commonly used recycled fibre is polyester, which is indefinitely recyclable, and can be made from polyester fabric as well as from plastic bottles.[98]

Finally, there are other product traits that help to define environmentally friendly products, for instance a commitment to fair trade, that play an important role in the production of materials. Fair trade commitment contributes to sustainable development by offering better trading conditions and securing the rights of farmers. Fair trade organisations, backed by consumers, are engaged actively in supporting producers. In addition, the 'Fairtrade' award allows consumers to choose fabrics and other products that have been assessed as being produced with fair prices, local sustainability and good working conditions.

The Ethical Fashion Forum (FEE) defined fair trade as follows:

> Fairtrade is about better price, decent working conditions, local sustainability, and
> fair terms of trade for farmers and workers in the developing world. Fairtrade
> addresses the injustices of conventional trade, which traditionally discriminates

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[98] Singer, p.21

against the poorest, weakest producers. It enables them to improve their lot and have more control over their lives.[99]

The UK-based Bishopston Trading Company is a fair trade company which uses fair trade certified organic cotton and is a member of the World Fair Trade Organisation. They import organic cotton and hand-made fabric directly from rural India.

Increasingly, organic materials also comprise an important part of green production. Organic materials, as discussed above, have had no chemicals or fertilisers used in their cultivation. Organic cotton is a prominent example of organic textile production. According to Clive Hallett and Amanda Johnston, authors of *Fabric for Fashion*, organic cotton does not use genetically modified organisms but seeks to build a biologically diverse agricultural system, replenishing and maintaining the soil's fertility. However, organic cotton is usually more expensive than other cottons.[100]

Many consumers clearly consider eco-friendly materials as part of green consumption. It is clear that developing eco-friendly materials and recycling materials are both important in the green market.

3. Materials sustainability research

The exploration and use of environmentally friendly materials is significant in the context of new cultures and legislation concerning sustainability and climate change. Many industries, including the textile industry, must now produce evidence of the measures taken by manufacturers to limit the deleterious effects of the industry on climate change. Many sustainable textile companies, such as Camira and Inter Flo try to search and use sustainable raw materials, or renewable and compostable fibre. In addition, many consumers clearly consider eco-friendly materials as part of green consumption. It is clear that developing eco-friendly materials and recycling materials are both important in the 'green market'.

These sustainable textile materials can be classified into two types, natural and manufactured fibre: Biopolymers/ protein fibre and Recycled fibre.

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[99]The Ethical Fashion Forum, http://www.ethicalfashionforum.com/the-issues/fairtrade, accessed 8.Sep.2014
[100] Clive Hallett and Amanda Johnston, *Fabric for Fashion* (London: Laurence King, 2010), p. 153

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                    │   ECO-FRIENDLY      │
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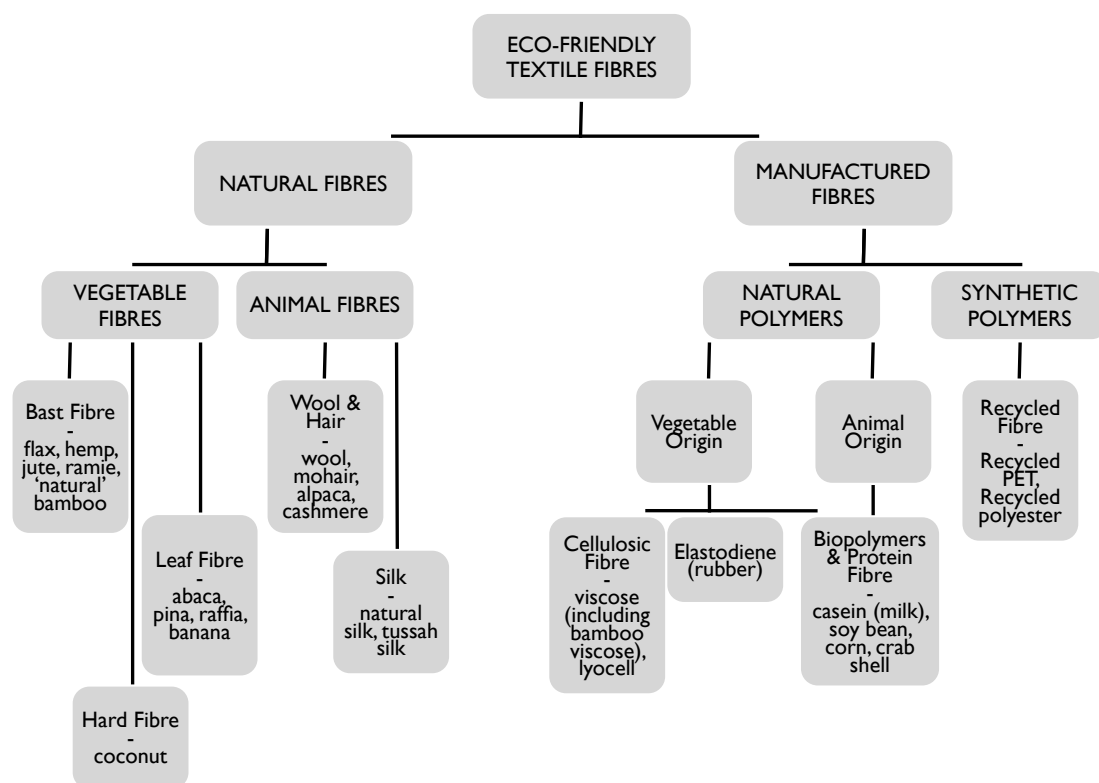
Figure 119 The types of environmentally friendly textile fibres

3.1. Natural Fibre

3.1.1. Bast fibre

Jute (Hessian)

Jute, or hessian, is one of the best known, cheapest natural fibres and the second most important plant fibre after cotton in terms of usage, global consumption, production and availability. Jute is a long, soft, shiny fibre which can be spun into coarse, strong threads.[101]

Jute is native to monsoon-prone areas and most widely cultivated in India. The most important region for jute has always been Bengal in the Ganges delta, where it has been an integral part of local culture.

Jute has very strong environmental credentials, because it does not require excessive watering, fertilisers or pesticides. It is a fast-growing plant with a good yield ratio of fibre to weight and acreage. It can be recycled several times within its lifecycle, and also has important

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[101] R S Blackburn, *Biodegradable and Sustainable Fibres* (*Woodhead Publishing in Textiles*) (Cambridge; Boca Raton: Woodhead; CRC Press, 2005), p.61

biodegradable properties.

Thus, jute is popular not only in India for the creation of local products but also in the USA, Australia and Europe to make sustainable textile products such as 'eco' bags, wall hangings and floor coverings.[102]

Ramie

Ramie is a plant fibre which has been used since ancient times: it was used in mummy cloths in Egypt as long ago as 5,000-3,300 BC. This fibre was introduced into Europe in 1733 and was first cultivated in Holland and Italy in the late eighteenth century.

Ramie is strong, and has significant fibre length (125-126mm) with a tensile strength between three and five times tougher than cotton and at least twice that of linen. It holds its shape well but does tend to wrinkle easily; therefore it is often blended with cotton or wool. In addition, ramie is a natural linocellulosic fibre, which can be used as a substitute for flax and silk.[103]

Ramie is a good example of a sustainable plant because it has a long fibre-producing lifespan of around 20 years and can be harvested around six times per year.[104]

Hemp

Industrial hemp has various uses. The fibre of this plant is most valuable because it is used for production in the fabric industry and for biodegradable plastics and biofuels.[105]

Hemp is a sustainable plant, and is often regarded as the most useful plant in the world. This is because hemp production requires much less water than the production of other plant fibres, and it does not require the use of toxic, polluting fertilisers during its lifecycle. In addition, this fibre is renewable.[106]

Hemp grows fast and its land use is highly efficient compared to the other plant fibres. However, it is closely related to cannabis, so cultivation is restricted in many countries. Transforming the plant to fibre creates pollution, but controlled production can limit the impact.[107]

The fibres are strong and durable, resist mould, have good absorbency and offer protection against ultraviolet light.

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[102] ibid., p.62
[103] Blackburn, pp.70-71
[104] Clive Hallett and Amanda Johnston, *Fabric for Fashion* (London: Laurence King, 2010), p. 171
[105] ibid., p. 173
[106] ibid., p. 174
[107] Ruth Singer, *Sew Eco* (London: A & C Black, 2010), p.12

Kenaf

Kenaf is cultivated for its fibre in the USA, China and India. Kenaf is a species of hibiscus with visual similarities to jute. The Kenaf fibre can be found in the bark and core of the plant; they are long and slender. This fibre is used for a variety of purposes, such as rope, twine, coarse cloth, paper, engineered wood, clothing-grade cloth, animal bedding, packing material and so on.

Nettle

The common nettle or stinging nettle has potential for fibre crop production; it is much stronger than cotton and finer than other bast fibres. It is regarded as an ecologically sustainable plant because it requires less water, and no chemical pesticides or fertilization. Nettle can be used as an alternative environmentally friendly fibre; however, today its use is limited to the specialist clothing market.[108]

Bamboo

Bamboo, one of the stem fibres, has been used for thousands of years. This fibre is strong and durable, with good stability and tensile strength.

Bamboo is a naturally produced, sustainable resource which requires no pesticides or chemicals, partly because it contains an anti-microbial and anti-fungal substance known as bamboo-kun. Thus bamboo fibre is popular in the sustainable and environmentally friendly textile industry. However, to be genuinely environmentally friendly bamboo, it must be processed in an environmentally appropriate way, such as high-tech processing methods that include refining the stem fibre through engineered enzyme processes without chemical additives.[109]

3.1.2. Leaf fibre

Abaca

Abaca or Manila hemp is a herbaceous plant which has been produced in the Philippines since the 1800s; commercial plantations were also started by Britain and the Netherlands in the early 1920s in Borneo, Malaya and Sumatra, Indonesia.[110] It is also cultivated in Central America. The origin of abaca plant is in the southern Philippines, where there are rainforests

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[108] Hallett, Johnston p. 174
[109] ibid., p. 177
[110] ibid., p. 178

and highly humid areas. Abaca can be used several times because the fibres of abaca are particularly resistant to salt water, and it is often used for fishing nets. The fibres are used mainly for teabags and meat casings.[111] It is not commercially used as a clothing fibre; however, people are developing its viability as a sustainable alternative.[112]

Piña

Piña fibre is obtained from the leaves of pineapple plant. Usually the leaves are a waste part of the plant because the fruit is more popular. It is used as material for traditional garments and other formal wear in the Philippines. It is also used for table linens, mats, bags and other clothing items.

The fibre is soft and lightweight and easy to care for. It is usually white or ivory in colour and has an elegant appearance similar to linen. Nowadays, some designers who are developing sustainable textiles use this material.

Raffia

Raffia fibre is long, thin, soft and pliable but also strong; it also has good dyeing properties. This fibre can be used for many different uses, such as weaving baskets, decorative textiles such as mats and making traditional clothes.

Banana

Banana plants can be used for various purposes. The plant is a source of high quality fibre for textile manufacture even though it is more popular for its fruit. The banana fibre is produced from shoots and is a good source for the production of high-quality textiles. In addition, it has variety of softness, which can be used for making different products.

Banana fibre paper is popular commercially in about 25 countries, including Japan and Europe. The papers are chemical-free and possess a durability of 700 years. The fibre is used for making traditional dresses, such as kimonos, in Japan. It is suitable for summer dresses because of its soft, lightweight and texture. Moreover, the fibre can be made into not only fashion items such as clothes and bags but also interior products, such as tablemats, runners and floor mats.[113]

3.1.3 Hard Fibre: Coconut

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[111] Blackburn, pp.81-82
[112] Hallett, Johnston, 2010, p. 178
[113] 'Industry articles', www.fibre2fashion.com, accessed 9 July 2014.

Coconut fibre comes from the husks of coconuts and is considered a waste product; for instance, approximately 75% of coconut fibre is considered as waste in Sri Lanka. This fibre is one of the strongest natural fibres, used for making shoes, mats, and mattresses. Some manufacturers use this material for sustainable products because of its durability and renewability.

3.2 Manufactured fibre

3.2.1 Biopolymers and protein fibre

Corn

Today, the cheapest and most abundant source of sugar is glucose from corn. Corn fibre requires a low-cost manufacturing process that requires little fossil fuel. Corn fibre has high strength, stability, inflammability and hygroscopic properties. Moreover, the fibre more resists UV light than synthetic fibres. The textiles from corn can be degraded into natural compost.

3.2.2 Recycled fibre

Recycled PET

Polyester stable fibre is made from recycled plastic PET bottles which have been melted and extruded. The fibre is then crimped, cut, drawn and stretched to achieve the appropriate strength and length. Finally the fibre is brought together, and can then be made into various fabrics such as felts or non-woven fabrics.[114] The fabrics are breathable, durable, easy to cut and soft. These felts and fabrics are available in various versions, colours, thicknesses and compositions. The applications of recycled PET fabrics are in apparel, such as clothing, footwear and fashion accessories; interiors, such as furnishings, interior decorations and wall coverings, and toys and craft felts.[115] This recycled PET fibre is an innovative material made by using technology. This material offers new potential for environmental friendliness, while at the same time using technology.

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[114] Foss Manufacturing Company, Materials Matter VI, *Material Connexion*, 2012, p.83
[115] Lanificio Bigagli S.P.A, Materials Matter VI, *Material Connexion*, 2012, p.101

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