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In-Use sustainable apparel design
D4re – Clothing Design for Reassembly
• In-Use Denim D4re Design
• D4re Design Process
• Modular pattern drafting
• Gusset drafting
• Knee articulation
• Seams
• Implications for the chainstitch machine
• Re-use thread in notches
• Construction sequence
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ABSTRACT

In-Use Clothing concept

The benefits of repairing products have been eclipsed by fast consumption, faster production and a lack of attachment to the products we own. It is no secret that the apparel industry plays its part in the ecological crisis we are heading towards today. Waste appears in all areas of the apparel industry; manufacturing, over production low quality garments, ‘dispensable’ clothing to name a few. Conventional methods of dealing with these issues have been criticised as being symptom based. The key point conventional strategies have not commonly addressed is, the way in which we consume (Chapman 2009).

This research focuses on the design durability and longevity of products, both physically and emotionally. It explores the idea that consumption patterns can be slowed if we are able to create a bond to the clothing we own. In order to change the way we consume we need to change the way we feel about our clothing and what that clothing can offer us. An emotional attachment to the product will change the value we associate with them (Niinimaki & Hassi, 2009).

The project looks at sustainable clothing being more than just a niche market. The INUSE CLOTHING concept is a method of design and business that can be applied to the design philosophy of multiple business sizes and collectives collaborating in economies of scale, and does not rely on an environmentally conscious consumer.

In-Use clothing design extends the lifetime of the garments in an attempt to reduce consumption and does not result in the loss of revenue for the manufacturer. Consumer involvement with the design and lifestyle affiliation and the tracking and recording of one’s own history, with the garment, develops a sense of attachment and user investment. The consumer-garment relationship works on an ongoing repair-and-modify basis and supplies a visual record of garment maturation and individualisation, all contributing to the consumers sense of self. The same relationship also works to create a consumer – manufacturer bond generating brand and service loyalty, repeat purchase and longer product lifetimes, in local and global hubs. This project undertook a mixed method approach to research and design research. Exploratory qualitative research is carried out in the form of in-depth interviews that explore garment attachment, and long-term ownership of first-owner garments. The design development of the In-Use denim jeans went through a process of sampling experimentation, deconstruction and reconstruction. Garments were wear tested and the denim went through repairs. All components of the In-Use model were brought together by a process of connecting many parts of research including existing literature on sustainable design in niche markets and research into how users are creating their own continued experience and emotional connections to garments, and design development practice.
INTRODUCTION

Waste appears in all areas of the apparel industry; through manufacturing, over production, in low quality garments and disposable ‘clothing, to name but a few. In the UK alone Wrap (2012), the UK’s leading body on resource efficiency, states the approximately 350,000 tonnes of clothing goes to the landfill every year. Conventional methods of dealing with these issues have been criticised as being symptom based. Conventional strategies have not addressed the current consumption rates, it is now understood that to reduce the environmental impact of the apparel industry attention needs to be directed towards increasing the lifetime of garments. Value needs to be placed on use, attachment and stronger user-product and user-manufacturer relationships (Armstrong & Lehew, 2011; Chapman, 2009; Niinimaki & Hassi, 2011).

This research focuses on the emotional and physical durability and longevity of apparel products, the factors that elicit an emotional response/attachment to garments and what effect empathic design can have on slowing down replacement rates. It explores the idea that consumption patterns can be slowed if a bond is created between user and product. User product connection will increase the likelihood of product care, reducing replacement and increasing repair. User product attachments create user-manufacturer relationships which will increase post purchase. It investigates the shift in value from novelty to use and addresses the need for accountability from both manufacturer and the user. In-Use Clothing aims to develop a sustainable apparel design business model that encompasses an In-Use website. The website develops emotional attachment to the design product, manufacturer and user accountability, design re-assembly through repair and modification and uses local and global production concept processes.

The studies covered in the literature review offer design strategies and methodologies which are an outcome of qualitative and quantitative research, (Armstrong & Leheu, 2011; Cooper, 2010; Lether and Goggin, 2001; Forlizzi & Ford, 2000; Gam et al, 2011; Niinimaki & Hassi, 2011; Van NES, 2010; Niinimaki & Koskinen, 2011). Selected studies review waste reduction, reuse and design for disassembly with the focus on emotional attachment to design. This research project has taken design for disassembly one step further and created design for re-assembly, it focuses on technical design, construction methods and stitch use. Garment designs have been developed to be easily disassembled for the purpose of reassembly in the form of repair, modification and re-design. Repair and modification increases a product’s lifetime, it alters frequency of replacement and creates bonds between product and user (Van NES, 2010; Mont, 2008) and user-manufacturer relationships (Chapman, 2009). This project developed denim jeans as an example of an In-Use garment that is easily redesigned with time and desire. In-Use garments are created by making subtle alterations to classic design and shifts in traditional pattern drafting and construction. In-Use denim focuses on applying aspects of the chainstitch machine that are currently under utilised. Focusing on pattern drafting, construction methods and stitch use, and using denim as a key example, garments have been developed that are easily repaired and modified.

This project also considers that sustainability needs to start with the designer and involves more than just choice of materials and yield; manufacturers need to be accountable for what they produce. Accountability needs to be consistent throughout all stages of production including design, wholesale, retail and in use life time. The In-Use Clothing concept does not rely on the consumer’s stand point on sustainability and the environment; it extends the lifetime of In-Use clothing and does not impair profit as repair and modification form new pathways to increase returns. The consumer-garment relationship is developed through use and the investment of time. It is aided by repair and modification services and, coupled with the continued user experience through recording the maturation of garment and self on the In-Use website, users develop a sense of attachment and connection to the garments they own. The same relationship also works to create a consumer-manufacturer bond generating brand loyalty; repeat purchase and longer product lifetimes. Ideally the In-Use Design business method is a comprehensive, integrated model but various components could be used by companies wishing to become more sustainable in practice.
“It is no longer worthwhile to repair products, and the whole economic system in the industrialized world is actually based on products’ fast replacement and planned obsolescence (Mont, 2008, as cited in Niinimäki & Koskinen, 2011, p. 166). “The textile and clothing field is no exception” (Niinimäki & Koskinen, 2011). The concept of planned obsolescence is the fore planning of shortened life cycle of products to ensure a market need for future products (Cooper, 2010b, p. 4).

The transience of fashion trends survive on this strategy which ensures fast consumption and replacement rates, creating tonnes of waste from the apparel industry each year. The conventional methods of dealing with the negative impacts of the apparel industry have been develop manufacturing methods with less of an environmental impact, the use of recyclable materials and the utilisation of waste and bi-products. Although industrial development has successfully moved toward a smaller environmental impact over the last 25 years, “production as well as consumption has increased...which rodes the environmental benefits of technological advancements” (Niinimaki and Hassi, 2011, p.1877). Describing current sustainable design methodologies as “adopting a symptom-focused approach” Chapman (2005) explains that the root cause of the ecological crisis is often overlooked. Using recycling as an example, he speaks of the growing suspicion that it provides ‘an ethical get out of jail card’, for companies and users alike, and is effective only in reducing consumer guilt. “Consumers continue wastefully on but do so now with recycled material instead of virgin ones” (Chapman, 2005, pp.10-11). Opportunities still remain within the fashion industry to move towards reducing the negative impacts of the industry on the environment. Design and product development represent a key inception point for multitude of impacts” (Armstrong and Lehew, 2011, p.29). “Fields such as engineering and industrial design have, in many ways, demonstrated an innovative shift in practice that may indicate ways forward applicable to apparel design, (Armstrong and Lehew, 2011, p.31).

Sustainable product development and design concepts such as cradle to cradle for apparel design, design for disassembly, customisation, halfway products and modular structures have been developed to assist apparel designers in working towards eliminating environmental problems the clothing and textile industry may create. Borrowing from different industries, sustainable apparel design models have been researched and tested. Cradle to cradle design, (McDonough & Braungart, 2002) is a model in which “products can be designed from the onset so that they will provide “nourishment” for something new after their useful lives”. Cradle to cradle apparel design (C2CAD) materials are seen as “biological nutrients” that can re-enter the soil without depositing toxins, and as “technical nutrients” that will continue to circulate as valuable materials within a closed loop” (Gam, Cao, Farr, & Heine, 2009, p.168). The Cradle to Cradle model puts emphasis on the designer to achieve sustainability. Following the cradle to cradle guidelines, designers should “seek to practice environmental responsibility and discover solutions for current problems since designers determine the properties of the products” (Pahl, G., Wallace, K., & Blessing, L, 2007). Gam et al., (2009) developed C2CAD by blending ‘Cradle to cradle ’and pre–existing apparel design models. They employed the C2CAD model in the production and design of knitwear in 2007. When Gam (2007) tried the model “it became clear that the manufacturer could not comply with the tenets outlined in the
The most common approaches to sustainable design strategies are product-focused and results focused, dealing with the environmental efficiency of manufacturing, use and distribution of existing products (Armstrong and Lehw, 2011). Examples of common sustainable design strategies in practice can be seen in both high end and low end manufacturers. Cradle to Cradle design has been adopted by large and small companies alike. An example of a large established company undergoing a transition into more environmentally-aware production and design is Nike. Nike's considered line of products was introduced in 2005 and has expanded considerably since then (Agogino et al 2010). Technical nutrients are kept as valuable materials to be re-used at the same level of quality in the closed loop production system. Nikes 2009 Livestrong jacket is produced from 100% polyester, the zipper and cord locks are constructed from Nike Grind. Similar in theory to the C2CAD, Nike has set up initiatives to reclaim athletic shoes the end of their life and recycle them. Shoes are recycled into a product named ‘Nike Grit’ which is used as ground cover for running tracks, basket ball courts or playground or recycled into new Nike shoes, and apparel. “Nike Apparel – Products ranging from All Conditions Gear to the Livestrong Jacket use Nike Grind in finishes like zipper pulls, snaps and buttons” (Nike Reuse a Shoe, 2012). An example of a smaller scale re-use is Nudie Jeans’ who manufacture a line named Post Recycle Dry Jeans. Effectively turning old jeans into new jeans, Nudie collects unwanted used jeans and recycles them by turning the old denim into cotton like pulp which is then turned into yarn and used for new fabric. “Since the fibres of pure recycled yarn are very short, virgin organic cotton is added in order to get a durable fabric. The final denim is slubby with a soft hand feel. The slubs are mainly a consequence of the natural irregularities of the recycled yarn” (Nudie Jeans, 2012).

C2CAD focuses on waste of resources, toxic synthetic waste and recovering the same quality materials after recycling (Game et al, 2011). Another major area of waste in the apparel production process is fabric wastage during manufacturing. Most apparent in the cutting process, waste is created from the ‘negative’ areas of the pattern pieces and the spaces in between pattern pieces. The issue of gaps between pattern pieces can be reduced when using laser cutting in mass production. In small to medium sized production runs gaps are needed to reduce risk of accidental cutting when using hand held cutting machines.
Holly McQuillan’s work with zero waste pattern cutting focuses on reducing waste from ‘gaps’ but also eliminates the unused areas of negative space caused by flat patternmaking, as explained on the Yield exhibition website “Approximately fifteen percent of the fabric used to create a piece of clothing ends up in a landfill, but the zero waste fashion design movement aims to change this” (McQuillan & Rissanen, 2011). Zero waste pattern cutting “aims to eliminate the production of waste from the production of clothing, while importantly revealing exciting new detail, line and form” (McQuillan, 2011a). In response to criticism regarding the wearability and aesthetic of Zero Waste garments McQuillan explains that the “outcomes of zero waste fashion are entirely determined by the designer” (McQuillan, 2011b), Zero waste fashion doesn’t have to be limited to high fashion. An example of Holly McQuillan’s Zero Waste Pattern Cutting (McQuillan, 2011a).

Another practice to eliminate waste in production is DPOL (Direct panel on loom) technology produced in India. DPOL, designed by Siddhartha Upadhyaya, involves weaving ready to construct woven garment pieces, eliminating the cutting process and the waste produced by cutting from roll of fabric. All edges are finished with selvedge and the weaving process can include colour, embellishment and shape. DPOL claims to increase fabric efficiency by 15%-22% and reduces stress on other resources like energy and water by being 70%-80% more efficient than the traditional manufacturing processes (August, 2011). The other bonus of DPOL is its ability to offer small runs, meaning this sustainable practice is available to small and large designers alike.

The practice of reducing waste and reclaiming and recycling garments is an example of manufacturers being accountable for what they produce. Accountability exists within the sustainable apparel industry and like most sustainable design can be found in athletic and outdoor apparel design. A clear example of this is Patagonia’s latest approach to sustainability their Common Threads Recycling Programme: a promise that none of their products will end up in the landfill. Yvon Chouinard (2012) the Founder of Patagonia says “we’ll make sure of it with a liberal repair policy and by accepting old clothes for recycling” (Chouinard, 2012, cited in Wang J, 2012, para, 6). Offering product services not only encourages environmental awareness it also has the potential to increase a product’s lifetime. Niinimaki (2011) explains that in order to promote long life guarantee and product satisfaction consumers need to be aware of the intended lifespan and maintenance of the products they are purchasing. Niinimaki and Hassi (2011) suggest that manufacturers could provide consumers “information about the intended lifetime of the product…manufacturers could also provide information on how many washes the garment will take and still look good” (Niinimaki and Hassi, 2011, p. 1879). Niinimaki (2011) also explains that products life spans can also be increased by offering services such as upgrade, repair and modification. These services extend the enjoyable use time of the product as well as postpone the psychological obsolescence that consumers themselves feel about the product (Niinimäki, 2011). Product Service Systems (PSS), “is a strategic initiative that seeks to replace product ownership with Utility” (Briceno and Stavl 2006). The United Nations Environment Program (UNEP) states that the move toward PSS is the next logical step after a couple of decades of industry efforts towards cleaner production processes.

Consumers are ready to criticise or approve of a company’s sustainable practice but, sustainable products alone may not be enough to appeal to consumer needs. Fletcher and Goggin (2001) explain that “the dominant approaches to ecodesign to date tend to focus on pollution and resource use in production, rather than human choices and actions. In contrast to this, a people focus in ecodesign considers ways of satisfying fundamental human needs” (Fletcher and Goggin, 2011, p.25). Gam and Banning (2011) suggest another challenge to sustainable practices in the apparel industry, perhaps one
of the biggest barriers encountered, is the fact that fashion trends and seasons make apparel one of the most change-intense categories of consumer products. Wait (2010), suggests that the advent of ‘fast fashion’ also undermines the sustainable textiles industry. Wait (2010) explains that the relationship between ease and speed of manufacturing, consumption of fast fashion and the price of textiles leads to a less sustainable textile industry. “The short life span of textiles and especially clothing is one of the main problems in the current industrial system based on planned obsolescence” (Niinimäki & Hassi, 2011). The concept of ‘planned obsolescence’ “remains entrenched in industrialized economies despite criticism over many years” (Cooper, 2010b, p. 4). The reality is that product lifetimes have become increasingly shorter and companies want to “substitute their products at an increasing pace” (Niinimäki & Hassi, 2011, p. 1878).

In Vezzoli and Manzini’s (2007) four stage continuum, they describe the different levels of sustainable design strategies. The lowest level deals with the symptoms of the industry, such as reducing waste and resources during production, and the third level out of four describes satisfaction as being the crucial factor in product design. “This system designs new ways to achieve satisfaction that may or may not include a tangible product (Armstrong and Lehw 2011, p.41). Level four, the most difficult of all levels of sustainable intervention involves the creation of sustainable lifestyles, “here, design finds its function far beyond product design and is heavily reliant on the designer’s ability to intuit socially created ideas (Armstrong and Lehw 2011, p.42).

Described as a “voracious appetite for novelty” (Jackson 2010, as cited in Cooper, 2010a), the social logic of a throwaway society (Cooper, 2010b), the symptom of fast fashions, and many more, the current manner in which we consume is where change is needed. Sustainable development will only be possible if the throwaway culture is challenged and there is an overall increase in the lifespan of products” (Cooper, 2010, p. 1). It is now believed that to increase products lifespan user-product relationships need to be increased and emotional attachments formed. Chapman (2005) describes the early stages of subject-object relationship as a “period in which everything is new and exciting” but all too often expectations are set too high. In a very short space of time novelty becomes normalcy which often leads to disappointment. “Products are emotionally discarded so the consumer can once again experience the emotional high of newness” (Armstrong & Le-Hew, 2011, p. 44). Chapman (2010) explains that most waste, in an emotive sense, is a failure of subject-object relationship. He remarks that there is little point in designing durable products so they can last forever in a landfill. He suggests that elong partnerships between consumer-to-product and consumer-to-manufacturer can be formed by taking a more empathetic approach to design. By identifying areas of attachment, between design and consumer, relationships can be formed that make it easy and desirable to care for a product during its lifetime through repair, upgrade and service. The aim if empathic design is to “design products that are meaningful to the user over a long period of time and thus they are not easily disposable this often means a unique design process or co-creation with the user. The objectives of empathic design and emotionally durable design are to build on a deeper understanding of the individual consumer’s needs and values” (Niinimäki and Hassi, 2011, p. 1880). Niinimaki has carried out three extensive research questionnaires in Finland in 2009 and 2010, which investigate product attachments and long term use in the context of textiles and clothing. A study entitled “Empathic knowledge in sustainable design”, focusing on textiles and clothing explains that “in order to promote sustainability, designers need to aim at enhancing long-term product relationships” (Niinimaki and Koskinen, 2011, p.165). The study consists of two questionnaires; the results were content-analysed in regards to product attachment and satisfaction. In the first 2009 questionnaire, respondents were asked to write about their oldest owned garments and or home textiles and the reason for keeping them. In the second 2009 questionnaire respondent were asked to write a short description of the garments and textiles which for them stayed long-term in use and to give the reason why. Many of the respondents in Niinimaki’s 2009 survey identified a strong emotional bond to the oldest garment by way of a connection to another person, “they could be inherited, a present, or simply represent someone close, be they mother, grandmother, another relative or friend” (Niinimaki and Koskinen 2011, p. 169). Likewise in Kate Fletcher’s Local Wisdom project, User Stories, delivered on the website under the title Users’ Craft and Wisdom, is overwhelmingly dominated by attachment to garments stemming from links to other people. Grouped into umbrella categories such as My community, Transfer of ownership and Connections, many more users explain their love for the garments are due to the history embedded into them by previous owners, whether the owners are known to the user or not. An idea that goes hand in hand with sustainable fashion is “slow fashion” (Collins, 2010). Reflecting on a panel discussion on sustainable fashion held at Manhattan’s Prat gallery, Collins explains the discussions were centred around a whether there is a possibility for a slower production and consumption model in the fashion industry. “One really good point that Gilhart (Julie Gilhart - Barney’s New York senior vice president and fashion director), mentioned in light of this question is that if we invest more history and memories into our clothing, in a sense investing more emotionally, then maybe we could effectively slow the tempo of the industry” (Waite, 2010).

Attempts to introduce memory and emotional attachments into apparel products have been carried out for example the Colour-in dress by Soepboer & Schuurman (2011) or the 5 ways project by Early & Fletcher (2002-2003). I query whether such ideas will ever appeal to more than a niche market. They are far removed from classic design lines, colours and material; as Fletcher (2008) describes, slow fashion utilises classic styling and fabrics that age well. I believe the sustainability of fashion needs to be seemingly invisible in product, and appeal to a consumer’s aesthetic needs. As Armstrong and Lehew (2011), explain of Verlozzi and Manzini’s (2007) highest level of sustainable intervention, the designer needs to have the ability to perceive socially created ideas. An example of emotional attachment and memories embedded in mainstream apparel can be seen in the denim industry. Within the denim world exists a denim enthusiasts (affectionately referred to as ‘Denim heads’) who have created their own continued experience with the product by way of blogs, forums
and web sites devoted to the wear and fade of denim. A main element of these pages are fade features, with stories and photographs of before and after shots of denim jeans. The basic information added is brand, denim weight, length of time jeans have been owned and how many and what type of washing the denim has been through. The Rawr Denim blog has a feature named Fade Friday. Here it shows denim as a new ‘before shot’ and the faded ‘after shot’ when the denim has had time to mature. It explains how long the jeans have been worn and how many and what type of washes they have gone through (Rawr Denim, 2012).

Figure 4 - Rawr Denim.2012.[Fade Friday Images and text - October 12, 2012] Retrieved from http://www.rawrdenim.com/2012/10/fade-friday-naked-famous-elephant2-8-months-2-wash/

Most Fade Fridays come with user stories of how the specific areas of fade have occurred such as, the ‘whiskers’ at the crotch and the ‘honeycomb’ behind the knee. This is beneficial for the manufacturer as it displays the on-going development of a pair of denim jeans. It also creates an example for future users of how their new denim jeans will wear and become their own individual pair of jeans. The images are telling a story and the user wants to share it. Many denim aficionados follow and comment on the progress of others. Super Future, a global urban travel guide, runs a contest spanning two years that is a worldwide challenge of fades. All contestants wear the same contest-specific pair of Eternal’s classic, fit 811, for two years. The final fade results are judged by Eternal in Japan and the winners are rewarded with Eternal company credit. According to Rawr Denim one of the most popular pairs in the competition are worn by forum member ah_long. An article on Rawr Denim tells the story of these jeans: “Worn for the last two years by forum member ah_long, these jeans have seen a lot of wear between frequent fishing trips and an amazing travel-log. According to ah_long, in the last couple years the jeans have been to Toronto, Vancouver, Montreal, Halifax, St Johns, Calgary, our home town of Edmonton, Winnipeg, NYC, Chicago, Los Angeles, Boston, Santiago, Santa Maria, Hong Kong, Shanghai, Beijing, Tokyo, Dublin, Athens, London, and more” (Sean, 2012). Currently this type of recording of ‘own history’ can only be found as posts on forums. However what has been noted is that there is no archiving of this information. Own history is available until the forum is deactivated but, as forums are on-line conversations, post are essentially lost until stumbled upon by chance as part of a Google search. Holding on to your clothing archive is archiving your history. In an interview Wayne Berkowitz, Founder & Producer of SuperFuture speaks of his denim history when asked what his favourite raw denim is. “I used to be an A.P.C. whore through most of the early 2000s and went through an astronomically expensive dior homme phase around 2005. Though these
ays I look like a slob and live in my jet fuel stretch chitch ksubis” as cited in Coe, 2012). Users tend to remember what they wore because they wear them often and commit with time and personal style. The brands one wore become a symbol of who the user was and their values at a certain point in their lives. This project asserts that a market exists for an online space where users can record the lifetime and evolution of their personal product use. An example of market enthusiasm is the major denim forum SuperDenim on the SuperFuture website. Berkowitz, the founder and producer of SuperFuture, explains that “superDenim is 100% user generated organic content. SuperFuture just gave it the airspace and paid for the bandwidth” (Coe, 2012). As explained in the literature, respondents and users identified motional attachment and long time use with garments that have a pre-existing history (Niniimaki and Koskinen 2011 and Fletcher, 2010). Garments with a pre-existing history are a distinct factor in product attachment and an example of the strength of emotional attachments. However the garments with pre-existing history are for the most part lifted, found or bought second hand. Existing research wasn’t found about how bonds are created with newly purchased items, which constitute the bulk of what we consume. This research project is a complex combination of all aspects of sustainable design method and theory. I have developed a coherent comprehensive integrated model that opens the sustainable apparel market to a wider range of consumers of fashion and mainstream apparel. Using existing and accessible technology to achieve sustainable apparel design and manufacture the In-Use concept is aimed to be a comprehensive, integrated model. In addition, various components could be put into practice separately. The In-Use model can be applied to businesses of varying size, from micro ventures to global corporation. It is intended to run as a collective beneath an umbrella In-Use company. Pre-existing manufactures or brands would become part of the In-Use Collective, however the model can just as easily be taken up by free standing companies.
Development of the In-Use Business model began with a mixture of multiple iterative design exercises, analysis of sustainable design literature and design practice precedents in design research. Taking note from the literature and my own apparel transformation design research, I developed a solution to the gaps I could see in the growth of sustainable clothing in today’s market. To test these solutions I have developed construction and manufacturing processes and designed garments that physically and aesthetically stand the test of time and offer the user ways of connecting to the products they use. Research was carried out to gain a stronger understanding of product and consumer emotional attachment. First-owner garments are items the user has selected of their own accord at time of purchase or, at a minimum, has personally chosen to utilise. Due to time restraints on this project, qualitative research was carried out and will be furthered in a future study. Three respondents were chosen; as the research is exploratory, the methodology used was in-depth interviews. This project uses semi structured in-depth interviews to explore the latent and manifest factors that determine garment attachment, and long-term ownership of first-owner garments. The interviews helped develop an understanding of factors that contribute to why we form bonds with our first owner clothing. Interview notes were recorded but future data analysis will be carried out in accordance with Rubin & Rubin’s Qualitative interviewing: the art of hearing Data (2012). Other qualitative research to aid market profile included interviews with alteration specialists, to ascertain what the most requested alterations are and who the consumer is.

I used the final project from my honours degree in design as a starting point for further research in transformative design. For this project I developed garments that were given to wear-testers to record daily life and adventure travel. Using a hooded sweatshirt I designed for this project that functions both in an urban setting and in the bush, a wear tester took the garment on a trip to Nepal, the Philippines and Sydney. He was able to record his adventure in a series of images which act as anecdotes for sharing his adventure and the manner in which the marks and wear patterns developed on his garment.
This project uses denim jeans as an example of the In-Use design model, chosen because of their global popularity and obvious wear patterns. The design development of the denim jeans went through a process of sampling experimentation, deconstruction and reconstruction. Many pairs of experimental jeans were made and fit-models wear-tested the denim tested throughout this design process. Technical design modifications were carried out along the way; all are recorded in a work book and on the website. The In-Use website itself had been through multiple style changes as the concept developed. I considered it important to develop a contemporary and minimalist aesthetic which will not restrict users of differing subcultures. The In-Use model was formed by connecting many types of research: existing literature of sustainable design strategies in niche markets; how users are creating their own continued experience and emotional connections to garments and design development practice. Low risk ethics form was carried out to ensure safety for all participants (fit models seen in photographs gave permission for images in this project).
In-Use
Sustainable Apparel Design

In Use apparel is the concept developed for this masters of design. Below I present a table of the components that make the In-Use concept.

<table>
<thead>
<tr>
<th>CLOTHING</th>
<th>In-Use Website</th>
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<tbody>
<tr>
<td>D4re</td>
<td>Platform for users to develop emotional attachments to products, increase user experience post purchase. Shift in value from novelty to use</td>
</tr>
<tr>
<td>Design for reassembly</td>
<td>- Every item logged on to the website on the DOP date of purchase</td>
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<tr>
<td>- Increasing product lifetime</td>
<td>- Track and archive garment fade and maturation recording own history</td>
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<tr>
<td>- Mass produced base product</td>
<td>- Share and promote individual outcomes with other users on web site and social media</td>
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<tr>
<td>- User creates bespoke</td>
<td>- Extend product lifetime and user satisfaction offering examples of other users’ wear results as guidelines of how the end result is achieved</td>
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<tr>
<td>- Individualisation occurs after purchase</td>
<td>- Educate process regards to sustainability, promoting not ordering environmentally focused consumption</td>
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<tr>
<td>- Repair</td>
<td>- Creating strong user-manufacturer relationships</td>
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<tr>
<td>- Modify</td>
<td>- Accountability</td>
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<tr>
<td>- Redesign</td>
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<td>- Chairstitch</td>
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<td>- Gusset</td>
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<td>- Tangible notches</td>
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Manufacturer accountability
Manufacturer takes all precaution to prevent product ending up in the landfill

- Every garment produced is given an individual code and is able to be tracked.
- Creating reverse logistics of unsold stock as ‘re-calls’ to be re-designed.
- Sends prompt to user if the In-Use garment seems to be out of action.
- Change of owner ship if garment is re-sold as a pre-loved item.
- Provides repair and modification services to prevent early replacement.
- Initiates use value for consumers - consumers desire to keep In-Use items as long as possible. The longer the history, the richer the fade the higher the value.

User accountability
Consumers desire to keep In-Use items for as long as possible. The longer the history and the richer the ‘fade’ the higher the value.

- Garment logged and User given personal page on the In-Use website
- Leather tab is branded with date of purchase
- Record own history
- Visual recording of all items the user is working on. Can be photographed daily at home or as user please in store.
- User earns a ‘notch’ every four months of ownership and after every repair or modification to develop a visual record of wear.
- If bonds are not formed with the garment users have the option to on-sell, trade or lend items with other members on the website.
- Some members of In-Use may choose to only purchase used In-Use items. Reasons being they may appreciate a particular fade, not enjoy breaking in an item, or feel a connection with garments that have a pre-existing history.

In-Use Venture Concept

In-Use brand - developed for the sake of this project as an example of the In-Use concept.

- Locally made until experienced growth
- User experiences local services and participatory design in the process of their item becoming bespoke.
- Repair and modification happen in store. The user can monitor their highly valued worn in item.
- Where user can not be present the company offers means of reverse logistics and personal appointments can be scheduled to take part on-line.
- Once developed produced off shore, reducing cost of base garment.
- Off shore production is a very small percentage of product’s life. All subsequent repair and modification are local.

In-Use Collective

- Established brands participate in the In-Use Movement.
- Mass produced or produced as per manufacturer’s current production.
- Taking part in the global factory reduces cost of base garment, subsequent cost of repair and modification more ‘manageable’.
- Shared In-Use web space
- Shared local hubs for repair and modification.
- Each manufacturer has guidelines for repair and modification that are followed by the In-Use hub
- Local hubs could exist as participating retail stores; In-Use will educate and supply out-workers, or
- Local hubs could consist of retail space of collective of manufacturers. Repair and modification done in store.
have developed Design for Re-assembly (D4re) for this master project with the aim of creating easily repairable and modifiable clothing with minimal alteration to traditional construction techniques. D4re is a strategy that enables inconspicuous repair which extends the physical durability of the garment. To deal with the ever changing style of clothing D4re allows for the modification of fit and style. This eliminates early disposal due to aesthetic obsolescence, a symptom explained by Burns (2010) as consisting of two components – wear and tear and the transience of fashion trends.

D4re- Design for reassembly, is clothing designed by the manufacturer to be easily disassembled for the purpose of being re-assembled. It incorporates modular like panels that the garment fit can be re-styled through. Specific placement of such panels allow for areas of high wear to be repaired easily and inconspicuously. Extending the use of the chain stitch to cover more areas than the traditional in-leg and centre back seams, D4re utilises the ‘negative aspects of this stitch to its advantage. Designed for this project D4re is demonstrated in denim jean design.
In-Use Denim D4re design

In-Use denim jeans are made up of a base shape with interchangeable gusset and yoke pieces. The base fit consists of front and back legs and yoke, pocket shaping may differ between ranges. The base fit does not differ between styles. The fit and style is modified by the manufacturer through the gusset. The user purchases a pair of In-Use denim of the style that suits them best. They are then able to choose from different gusset shapes that will alter the style of the jeans.

- A short skinny gusset adds only a minimal amount to the base cut resulting in tight fitting jeans.
- A short gusset is slightly longer and deeper than the short skinny gusset. This allows for a roomier thigh girth and extends the crotch depth, allowing for a more relaxed fit.
- (Both the short skinny gusset and the skinny gusset are the same fit form the knee down)

- A long skinny gusset extends from crotch to hem. This widens the leg and creates a fitting straight leg style.
- A long gusset widens the leg and increases the crotch depth creating a relaxed straight leg style.
- The yoke is also interchangeable. Like the gusset the yoke can be removed and replaced. Changeable yoke depth is for style purposes and functionality, for example, urban cyclists may desire a higher sitting waist line at the back.

Other alterations and repairs are made possible by the ease of disassembly but may be permanent modifications to the original base cut. Examples of this may be darning wear holes on the base denim or adding knee articulation.
The Design Process

The D4re study began by investigating a worn pair of denim jeans. This pair of denim was deemed to be at the end of their useful life by the wearer, and was headed for the rubbish bin. The denim had been worn for two and a half years, were worn and washed regularly. When questioned why the wearer was set to dispose the answer was that although he had a connection to the jeans, he felt he had already held onto them for longer than he should have. Over the four year period changes in style meant that the user felt like the legs were too wide in comparison to the slimmer line of today and wasn’t happy wearing them in an urban setting. In regards to the holes and tears the user was happy with the way they looked but didn’t like the crotch rips. In the early stage of the crotch wearing thin the user felt about it as it was not too obvious. But as the hole grew and denim fashions changed the wearer felt it was time to let the jeans go.

After evaluating different areas of wear the jeans went through a reconstruction process. Due to the weight of the thread used in the construction of denim jeans, pulling the stitches from front and back was quite arduous and time consuming as the thread does not snap. Attempting to rip the seams the denim tore as the jeans were relatively old the fabric had become thin, this resulted in tearing the denim. In terms of manufacturer repair disassembly needs to be fast and clean, either of which these methods were. The in-leg seam and centre back seam had been sewn together using a double thread, single needle chain stitch. Due to easy unravelling of the chain stitch, a couple of long pieces of strong thread and several shorter pieces were salvaged and wound onto bobbins.

Attempts were made to reuse the thread on a plain sew industrial machine. Due to the weight of the thread and the short lengths the knots where the salvaged pieces had been joined were unable to pass through the tension plates resulting in a low quality stitch. Experimentation re-using the thread on the bar tack machine also proved to be unsuccessful.

Modular pattern drafting

From here I began drafting trouser patterns to experiment with a modular construction. The use of a modular drafting is to enable
repair and modification of smaller areas of the garment as opposed to having to replace whole panels or the whole garment. Modular design available in the market today such as this has been developed for the consumer to be able to modify into different styles, mostly through use of unzipping components. This idea is effective in its offerings but it is difficult to create invisible variations to classic styles. For example long trousers that zip off to become shorts are very difficult to design without the trousers looking like active pants.

Another issue is that the garment design has not followed classic styling or design and has followed current trends. It is unlikely that all styles will be worn for long periods of time; once the style has been created it cannot be changed. If the dress is a purple sun dress then a mini skirt then a maxi dress, all styles are of a current season’s fashion trend, so whilst they are interchangeable in form now, all forms may fall victim to what Brian Burns (2010) terms aesthetic obsolescence and become out dated within Figure 2 - In-Use denim jeans, worn in. In-Use, 2013.

Gusset drafting

Beginning with cotton drill a discreet gusset was drafted into the crotch. The aim was to investigate how fit could be altered through the crotch gusset seam, the most discreet seam on a pair of jeans, and to investigate how modular pattern cutting can create garments that can be repaired and altered discreetly, and with ease to make it viable in higher volume. The Gusset in denim jeans was seen first as an alteration to denim jeans for cowboys when straddling the horse. Cut on the bias to allow movement the next notable trousers with a crotch gusset were advertised as action pants, catapulted to stardom by Chuck Norris.

The gusset also became a mainstay for hiking and adventure pants. This is due to freedom of movement, but also to eliminate seam rub in the inner thigh region, which can create serious chaffing when walking for extended amounts of time. Off the urban wear radar for approximately 20 years, the gusset has made a comeback of late specifically in trendy cycling jeans. Companies such as Rapha and SWRVE create urban cycling jeans that feature the crotch gusset.

The first fitting of the gusset was successful, in terms of fit. Design lines were drawn on for extending the gusset higher up the centre back to accommodate wear and tear repairs in the seat of the jeans.

Slight alterations were needed to the long gusset. Both short and long gussets had been drafted to be interchangeable with in a base cut of the jeans. The short gusset was intended for a slim fit skinny jean, while the longer gusset adds to the girth of each leg and lengthens the crotch, creating a wider fitting style.
Chuck Norris jeans (Denimology, 2006)

Figure 4 - Toile experimentation - In-Use Denim, 2013

Figure 5 - Short skinny gusset - In-Use Denim, 2013
Knee articulation

The next step was to create modular pieces to the garment for choice of alterations. Starting with an articulated knee a knee ‘patch’ with shapings was mocked up. A successful fit and keenly accepted by the wearer who is also a motorbike rider. The articulation is useful and the patch has an attractive design line. The negative factor is in its permanence. A patch requires seams meaning that unless the whole pant leg panel is changed the knee will always have seams. This affects the ability of a more aesthetically complete modification and it is far from the classic design line.

Seams

In order to have repair on large scale be economically viable it needs to be easy, clean and fast to disassemble. The initial thought was to use needle and looper thread chainstitch on all seams. This would allow easy disassembly with no risk of tearing fabric. The first attempt at all seams being stitched using a chainstitch used a heavy weight thread in the needle and a standard on the looper. Many issues developed with the machine skipping stitches. Places of concern were corners, inter-crossing of seams causing bulk and sharp curves. To reduce these issues a few different factors needed evaluation one being thread weight. The different weight of thread was causing uneven timing. A chainstitch machine does not cope well with the stopping and starting that is necessary when stitching short seams and turning corners. During experimentation it was found that if the machine wheel was turned by hand, enough to almost end the stitch, the machine is more likely to pick up the thread and not skip stitches. This works on right angled corners but not well enough to expect it to work in mass production.

Implications for the chainstitch machine

Constructing the first pair of fully chain stitched denim jeans it was observed that it could be commercially viable if the industrial machines were modified specifically to manage with problem areas. The risk factor in going into production with a temperamental machine is that time will be taken up fixing. Another very real risk is that if the machine skipping goes un-noticed the whole seam is likely to unravel.

Using the so called negative factors of the chainstitch to its advantage in-use benefits from the ease of unravelling and the large amount of thread the chainstitch uses. After experimentation with the chainstitch machine and not achieving overall positive results, re-evaluation was needed in regards to the necessity of all seams needing to be chain stitched.

Ease of unravelling is the positive and the negative of the chainstitch machine. It does unravel easily but in its current use in commercially produced denim jeans it doesn’t seem to cause any issues. The
The second so called negative factor of the chainstitch is its use of thread. It does use more thread than the lock stitch however this is an advantage in In-Use denim. Where long seams fall the thread is re-used, shorter seams are too short to re-use the thread. I have eliminated use of the stitch on the fly construction and topstitching of the fly. The ends of the waistband will not be chain stitched and the back patch pockets will not be topstitched nor attached to the back pieces using a chain stitch. These areas are the least likely to need repair or modification, are high risk areas for the chain stitch machine, and are short thread lengths meaning the thread is not re-useable.

After determining which seams will be using chain or lock stitch, it became apparent that In-Use Denim was not at the same level of construction as other international denim brands. Seams needed to be flat felled and overclocking minimised. Minimising overclocking was to use less thread and to create a higher standard finish. As a local producer creating hand flat felled seams is a time consuming process which translates into a higher retail price. In a commercial factory a flat felled folding machine will eliminate time consuming procedures. The benefit of hand felling is extra stitch runs meaning extra strength.

**Re-use thread in notches**

At time of purchase the signature leather tab is branded with the date of purchase using an interchangeable electronic heat branding tool. Each time the user gets a repair or modification the garment is notched. This Notch utilises thread salvaged from In-Use alterations. To measure length of ownership, the garment is also notched every four months. The notches appear on the inside of the waist band, a nod to notching one’s belt, and an In-Use arrow is added to the back of the garment so it can be seen when worn. Users of In-Use will instantly recognise the symbol and will be able to gauge the effort and time that has gone into the garment. Tangible recognition of the length of ownership and repair is a way of extending the user experience after purchase and creating an emotional attachment to the garment.
Denim
Designers cannot craft an experience but only the condition or levers that might lead to an intended experience" (Forlizzi & Ford, 2000). The In-Use website is the platform that creates longer user-product relationships and generates user-manufacturer relationships. As Forlizzi and Ford (2000) describe, designers cannot design emotional attachment into a garment but they can offer pathways for connections to be made.

Denim enthusiasts have created their own continued user experience in the way of on-line forums and websites. These spaces are completely user created and exist purely because of the user’s love of the product. The In-Use website harnesses this enthusiasm and sees it as an opportunity to offer consumers continued and more enjoyable user experience. At the time of purchase of their first In-Use garment, the consumer will become a member of the In Use community. They will be logged in and given a page of their own which will hold information about every garment they own from the company. Alternatively the user can sign up prior to purchase to explore experience and become part of the community before purchasing their first item. Once purchased, using photographs and text, the user is able to follow their garment fade and maturation. The website allows the user to record, share and brag about their fade results and the routine, adventure and lifestyle they live that lead to those results. At the time of purchase the user is photographed wearing the brand new item, this photograph and associated garment data is added to the user’s online in-Use wardrobe and specific information about this garment can be accessed on the user’s personal ‘Your item’ page.

In-Use supplies a canvas backdrop with specific footprint positioning that is located in the dressing room of all In-Use stockists. The User can return to the In-Use space to be photographed wearing the garment as often as desired. Alternatively the user can download the ‘Poseprint’ and can photographically log the wear of their denim at home.
IN-USE CLOTHING

About In-Use
Design methods
Your history
Our clothing
Your clothing
Brag
Share
Trade

My Denim

WHAT: In-Use Denim 16912
WHEN: September 6, 2012
WHERE: Wellington, NZ
HISTORY: fresh
WASHES: fresh
FIT AT PURCHASE: base cut, high waist short, gusset
WAIST: 29"
INLEG:
DENIM: Raw indigo - 10oz
In-Use offers users a space to log and track their own garments. At the users’ discretion, they are able to share their ‘hard work’ (their routine and lifestyle that created the fade of their denim), adventures and lifestyles with other members. On the item-specific page, users are able to upload images of fade but also images and albums of experiences had whilst wearing the garment, e.g., travel. Alternatively, users are able to link to albums on their social media sites from the In-Use website. Linking to social media will increase the likelihood of users sharing stories; ease of involvement is a very important factor in sustainable fashion and the In-Use concept.
Figure 3

Figure 5 - Your item page, created on the date of the first modification (In-Use Clothing, 2012)
Sharing user stories and images of fade enables other users to decide on their own product care and maintenance in accordance to the wear results they desire. Niinimaki and Hassi (2011) suggest that manufacturers could provide consumers with information about how long the garment is intended to last, to increase use satisfaction. Each newly purchased In-Use garment will come with basic care instructions and guidance on how to achieve basic wear patterns. In some ‘Famed Fades’ will be generated by users sharing their images and an In-Use panel will decide on the top fades to display.

Users can either choose to mimic the routine that developed the particular fades or, specific instruction, from the In-use team, will be supplied to users of how they can imitate these fades using a sand paper and soak process. Participation allows the user to be involved in the bespoke design throughout the life time of the garment. Kate Letcher’s (2012) Local Wisdom Project focuses on the craft of using garments, a process she has coined The Craft of Use. She explains the importance of re-assembly to “increasing the quality of people’s fashion experience within the mists of the clothes they already have, it has the potential to promote self reliance and a more satisfying and engaged use of recourses” Local Wisdom section, para. 1).

Under the ‘our clothing menu’ is an option of choosing Current collection or Archive. Whilst In-Use does not particularly do seasonal ranges, a range of In-Use will always be in production and can be purchased on line from the Current Collection page or in store. One of the main request alteration specialists get from users is to copy a favorite but worn garment because it is no longer available from the manufacturer. On the archive page is a record of all In-Use garments manufactured, the user is able to search through the archive, order an archive item and it will be made to order. Another aspect of the In-Use sustainable apparel model is that over production does not result in waste. In-Use aims for none of their garments to end up in the landfill, all unsold stock is return to the manufacturer and the retailer gets a percentage of credit to be used toward their next wholesale purchasing order. D4re allows the unsold stock to be disassembled efficiently, restyled and resold as new garments but with a pre-existing history. All reassembled In-Use denim comes with the first notch pre-embroidered and information of re-assembly is automatically added to the user’s personal ‘your item’.

The Trade and exchange page on the In-Use website

The Trade and Exchange section within the concept offers a platform or consumers/members to exchange or on-sell their garments if they have not managed to make a connection with the item. This reduces the chance of garments being disposed of before their useful life time is over. Users are also able to sell faded Inh-Use jeans to consumers who perhaps don’t have the lifestyle or patience to create the desired fade. Certain fades will fetch various prices, the item in the ‘Famed fades’ section is likely to sell for a premium. An example of consumers purchasing worn denim can be seen in the A.P.C Denim Butler range. Users bring in their worn and faded A.P.C jeans and trade them in for 50% off a new pair of A.P.C jeans. The ‘Butler’ or original owner initials the worn jeans, A.P.C then washes and mends the jeans and sells them in store as part of their butler range (Hypebeast, 208; Yu, T, 2008).

Lending within the In-Use community, particularly in the case of outdoor clothing or evening wear, will be trackable and logged on the user’s personal page. This gives the user the chance to grow the history of their garment and create stories around clothing. Listed on line, it also gives the user the opportunity to trial garments they may be interested in owning without cost to the company. Lending will run on a user beware and borrower repair basis. Lending between consumers of the same manufacturer, offers the opportunity for users to trial products at no expense to the manufacturer. The lender benefits by way of adding to the history of their item as all stories and adventures will be logged by the borrower.

About In-Use – The In-Use website menu bar

To describe the In-Use concept to the market a very casual but informative description of the concept of can be found by exploring the web space. Below is the text found on the website explaining the concept to the user.

About In-Use

How you and In-Use begin: You’re at the store and itching to find a new pair of jeans. You’re ready for commitment, you want a second skin, you choose well, you choose In-Use. The In-Use leather tab is branded on the spot and you will become part of the on line In-Use community. The brand is your date of purchase; you’ll be wearing these for the next two years, three years, four years or more. Every crease and fade mark is a representation of your routine, your body, your experiences. When people think of you they see you wearing In-Use Denim. Your social media site is bursting with pictures of you and your denim In-Use.

Design for re-assembly lets In-Use repair your jeans without looking like they’ve been repaired. The fatal crotch blowout should not signify the end of an era. Nor should the end of an era be the end of your jeans. The In-Use crotch gusset allows discreet repair in the in-leg by replacing the whole gusset, we match the fade so it’s invisible. The gusset also allows for change in shape. Even the most classic of designs can change, and In-Use allows for that without having to bid your faves adieu. You can re-create your denim to how you want it, our base cut is altered through the gusset, if you’ve worn skinny and want to go straight we can make that happen. Collect notches every time you repair or modify your garment and every four months you’ve spent together.

By tracking your jeans on-line you keep a journal of how they are developing. Either shooting images from home or in store, as often as you like, they are logged on to your In-Use web page meaning you can watch your fade develop. You are archiving your history, keeping a log of your denim history and sharing your hard work with others. Because your fade is a representation of your adventures, your adventures should be represented. From your In-Use page you can link to albums on social media sites and display how your fade was created, and vice versa.
In-Use aims to help you hold on to your items for as long as possible, we have goals of not letting our products end up in a landfill. We never over produce we re-assemble.

**Philosophy**

Clothing grows with you, it contains your history - we want to make to make both last longer.

Our routine and escapades give your clothing life; every wear mark, repair and fade represents you. Growing with your garments means holding on for longer, logging that growth creates a library of who you have been and what you've done. Our goal is to provide clothing that becomes a part of you and represents you: a self-made bespoke.

We know quality craftsmanship and classic design is worth its weight in gold. One well crafted item you connect with replaces many low quality trends that you don't. We've developed innovative ways of using traditional construction techniques, blended with quality and style, allows us to mend to look like there was never an issue, and modify so you evolve together. All aspects of In-Use is brought together and packaged in a web space, here your items become your story. See all the In-Use clothing you own in ‘Your Drobe’, add to your history and keep a record as you and your clothing evolve.

**Sustainability**

Design should not be restricted and innovation can’t go backwards. Styles change and so do we. We’re all about sustainability we even have our own Re-‘re-assembly’, but we do it first so you can think about it second. We believe sustainable clothing starts with us, as designers it is our responsibility to provide considered apparel.

Innovation is something to be excited about, sustainable design should not be restricted by materials or yield; it’s how you continue to use those resources that count. If you’re already seeking sustainable clothing greater but, we know due to style, price and availability, the majority of consumers don’t. We know because that was us, that’s how In-Use was born.

Consumption rates and the speed of fashion are two of the main causes of the mess the apparel industry is leaving behind and we’re pretty keen to slow it down. There is a lot of clothing on offer at a cheap price that looks good the first time it’s worn, but doesn’t last much longer. In the current cycle of fast fashion, consumption and production work in tandem. As consumption rates increase production rates increase further. Masses of over produced, unsold stock traverse locations until the price has dropped so low it starts to cost the retailer money. This coupled with low price apparel being seen as ‘disposable’ is how thousands of tonnes of apparel goods end up in landfills every year.

**WHAT WE DO**

**In-Use Denim doesn’t get left behind**

In-Use Denim doesn’t get left to the retailer to deal with. It is our responsibility as practicing sustainable designers to be accountable for any waste. We recall our unsold items, disassemble then reassemble into our new style. To find out if your IN-Use Denim has been re-assembled look it up on your ‘your denim’ page where you can find the history of your jeans. To find out in store if you’re looking at a virgin In-Use pair, check out the tab. If there’s a notch your denim’s story has begun.

We don’t leave our clothes to retailers to dispose of and we don’t leave you accountable either. If you aren’t getting along with any of your In-Use items, log in to the trade and exchange page on the In-Use website and find someone who will. Find pre-worn items with embedded history waiting for you to carry on the journey. As soon as you purchase a worn in, In-Use item from another wearer, ownership changes and the item is placed in your ‘drobe, under your name with the DOP (date of purchase). When you are ready, find your local In-Use hub and get your picture taken. Otherwise print off the footprint take your own pic’ and send it to us, we’ll load it for you.

**How we do what we do – Design methods**

**D4re –Design for reassembly**

Styles change and so do we. That’s why we’ve come up with the base cut that can be modified to fit your style as it develops and evolves. Our D4re (design for reassembly), enables invisible repair and modification, not to mention less risk of waste. You choose how to modify, repair and alter. The maturation of you with your clothing builds natural patina and a fit tailored to you: you create bespoke.

**Gusset**

We didn’t create it we just made it better. Originally for cowboys and action pants, the gusset is now a popular feature in trendy cycling jeans and hiking pants. We cut it on the bias of the fabric which means it has slightly more stretch to make it easier to move. We can replace this bad boy so you can keep wearing your denim long after you’ve had a crotch blow out. We modify the gusset to alter fit and style. You change, so should your clothes. Chat to us, and then collect your next notch.
The Chain stitch
Garments like denim jeans already utilise the chain stitch, we take it further. It’s tougher than the usual plain sewn, lockstitch seams, and is used in areas that are under pressure, generally the in-leg and centre back seam. We’re fans of the stitch because it’s authentic, it’s tough and it’s easy to disassemble.

We use the so called ‘negative’ properties of this stitch, it unravels easily and it uses more thread than a plain sewer, to our advantage in In-Use Clothing. Easy unraveling equals’ clean disassembly, and long lengths of thread that we re-use in re-assembly.

When we disassemble, we do it clean
We don’t rip seams; broken stitches are messy and risk tearing your fabric. The chain stitch un-does clean, it’s tough and you have to know how to unravel it to take it apart. It uses more thread but that’s how we use less. The chain stitch unravels leaving one long piece of thread, and another even longer. We re-use these pieces in our fly fronts, back pockets, side seams and notches.

Figure 4 - In-Use short slim gusset (In-Use 2012)
In-Use ensures it is accountable for everything it produces. Design for reassembly not only allows for repair and modification, it allows for overproduced unsold items to be re-called and re-designed. Should the company be wholesaling to retailers, In-Use would offer a certain percentage of credit to the retailer and re-call unsold stock to be redistributed after redesign. By keeping a record of every item purchased, the manufacturer is able to track everything it produces, and ensure its products do not end up in a landfill.

The ‘ownership’ of each item after purchase is transferable, allowing used items to be sold, accountability to be transferred and ensuring the item is still in use. The Trade and Exchange section within the concept offers a platform for consumers/members to exchange or on-sell their garments if they have not managed to make a connection with them. This reduces the chance of garments being disposed of before their useful life time is over.

Lending within the In Use community will be track-able and logged on the user’s personal page. This gives the user the chance to grow the history of their garment and create stories around clothing. Listed online, it also gives the user the opportunity to trial garments they may be interested in owning without cost to the company. Lending will run on a user beware and borrower repair basis. In the case of a multi-company In-Use initiative lending between consumers of the same manufacturer, offers the opportunity for users to trial products at no expense to the manufacturer. The lender benefits by way of adding to the history of their item as all stories and adventures will be logged by the borrower.
Niinimaki and Hassi (2011), explain that business models are still linked to the volume of sales and profit alone. Therefore, even if manufacturers are following sustainable production models and using renewable resources, all efforts are made futile by the increasing rate of consumption. Currently, sustainable consumption is viewed as leading to reduced profitability and reduced profit. They convey that strategic innovation looks at who the customer is, what products and services should be offered and how they should be offered. Creating new consumption patterns “is not merely about rethinking the fundamentals on the supply side, but also redesigning the business on the demand side, e.g. in the form of user experience and rethinking value creation” (Niinimaki & Hassi, 2011, p. 1876).

By introducing Product Service Systems (PSS) “Businesses may compensate for lost revenue from material goods by selling unique services that support their products” (Armstrong and Lehw, 2011, p.50). The characteristics of PSS are direct and enduring contact between manufacturer and user, collaboration of companies and support networks (Van Halen, Vezzoli & Wimmer, 2005).

The In-Use concept is presented for the case of this masters project as a singular brand this is to be seen as an example of how the concept will work. The concept itself is not limited to a single company; It is intended to be a collective of manufacturers all taking part in the In-Use endeavour. A large part of the In-Use concept is making sustainable clothing available and desirable to a wide range of users. In-Use clothing is mass produced on a production line and the ‘bespoke’, or product services, begin post purchase. To keep costs low and quality high, In-Use manufacturing does not directly involve the consumer the way bespoke tailoring does. Cramer 2011 suggests that consumers of participatory design, such as bespoke products, naturally feel a “connection with items they have had a hand in designing” (Cramer, 2011, p.437). While this statement holds true many users can not afford the time, money or patience that purchasing bespoke requires. Co-creation or involvement in the growth of a product creates a bond between product and user, increasing the rate of care and repair and making disposal more difficult (Niinamaki & Hassi, 2011; Chapman, 2009; Van Nes, 2010). In-Use offers lifetime contact with the user as all garments are logged on the In-Use website and ongoing involvement by way of repair and modification of garments. Loss of revenue from finished product are made up through the cost of repair and modification by the consumer, it is also replaced by the continued relationship between user and manufacturer which is likely to result in added and repeat purchase. As well as remaining connected online users are able to connect with the In-Use community in person...
both locally and internationally. In-Use offers repair services by way of the user coming into the local store and discussing their request, if the user is not in travelling distance, reverse logistics and Skype appointments are arranged by the In-Use representative at the retail site. By having a local space and being able to physically communicate with staff about their personal items, users get a sense of consuming locally. If the company is small being local may already exist as manufacturing is likely to be taking place on site or at least in the country of origin. As the company experiences growth the advantages of offshore production will be taken advantage of. In-Use garments retain the benefits of being local as all repairs, retail and manufacturing takes place locally. In-Use retail and repair can be said to be a globally local system. In-Use hubs are located internationally wherever an In-Use item is retailed. In-Use hubs consist of outworkers who are trained, and supplied with the necessary equipment, to carry out repairs and modifications in accordance to the manufacturers requirements. If demand is high in store service sights will be developed. Retail staff will be skilled to assist with fittings and advice or Skype meetings can be set up in store directly with the manufacturer. Global hubs supply the user another pathway to log their travel and enhance their adventure. The In-use global passport is a means of connecting the user with In-Use international and creating desire to visit In-Use hubs when travelling. Stamps will be added to user’s specific repaired or modified items on the web space and a notch added to the item itself. All items purchased have the country of purchase stated on the item’s web space, adding proof to the anecdote.

The singular In-Use denim company was created as an example of how the system works. The In-Use concept itself is designed to be made up of a collective of existing manufacturers. Manufacturers will choose their brands, if they have multiple, to be a part of the In-Use company. The benefits to the manufacturer is the relationships they are able to form with the end user and their outward efforts to sustainability are visible to the public by offering repair ad PSS. All repair and PSS is organised and carried out by the In-Use company which stands a separate entity from the manufacturer. In-Use consists of a web space, and repair faculties around the globe taking charge of repairs. The user’s online In-Use wardrobe will contain garments from all participating manufacturers. Repairs, and reverse logistics will run out of this joint ‘in use’ company. Trade and exchange becomes an invaluable source of market information as users will discuss lend, share stories and trade clothing. Links to official manufacturer web pages and fade searches within the In-Use web space will serve as advertorial and as an introduction to users of brands they may have otherwise not known of. It is an affordable means for small and large companies alike to broaden their global market share. Very minimal alterations need to be made to existing manufacturing processes and garment specifications, in order to successfully create easily disassembled products for re-assembly. Manufacturers choose a range of garments to become In-Use, if they desire they can set specific guidelines for repair and modification and the In-Use company will comply.
Conclusion

The apparel industry is no stranger to waste. Low quality, overproduction, and transient trends are all factors that make up the negative effect the apparel industry has on the environment. Traditional methods of dealing with negative impacts are deemed to be symptomatic (Chapman, 2005). It is now understood that the main factors that will lead to a more sustainable apparel industry are a reduction in consumption rates and increasing the lifetime of apparel products. WRAP (2012) states that approximately 30% of clothing in an average consumer’s wardrobe has not been worn for a year and extending the average life of clothing by just three months would lead to a 5-10% decrease in each of the carbon, water and waste footprints. A shift in value from novelty to use, focusing on emotional attachments to garments, creates user-product bonds which increases product care, repair and reduces the rate of replacement (Capman, 2005; Armstrong and Lehw, 2011; Van Nes, 2010; Niinimaki & Hass, 2011).

The aims were achieved in this project in the creation of the In-Use sustainable apparel design business model. The website allows for the tracking of In-Use garments and consequently the tracking of one’s own history. Recording garment use opens pathways for emotional attachment to the products; by tracking garment, lifestyle and adventure the user creates a history of themselves and the garment. Service systems such as repair and modification become integral parts of the characteristics and lifetime of garments. Repair represents commitment (proof of which appears on the user’s personal In-Use webpage and physically on the denim jeans in the form of notches), and modification deals with changes to style and fit. The design for reassembly (D4re) sustainable apparel design created for this project successfully allows for repair and modification to be possible at any scale of production. The enhanced use of existing technology makes D4re sustainable apparel design accessible to manufacturers of all scale, from micro ventures to global proportion. The In-Use venture project as a whole encompasses clothing D4re, the In-Use website and the In-Use venture concept. All aspects were developed through findings from the literature, my own design and quantitative research into current forms of continued user experience; users are creating of their own accord. The In-Use sustainable apparel concept is a complex combination of all aspects of sustainable design method and theory. We have developed a coherent, comprehensive integrated model that opens the sustainable apparel market to a wider range of consumers of fashion and mainstream apparel. The In-Use concept can be used as an integrated model either by a stand-alone company or as part of collective of manufacturers. Alternatively, companies wishing to test the waters of sustainable business practice can use certain aspects of the model that fit in with their company ethos.

Research intended for future study is research into own history of users with garment; how bonds are formed and emotional attachments are made to first owner garments. Niinimaki & Kosinen (2011) and Fletcher (2010) explain that the garments with the highest emotional attachments are items that come with a pre-existing history; however, garments with pre-existing history are for the most part gifted, found or bought second hand. There is scope for further research to be carried out regarding first owner attachments to garments. This project carried out three semi-structured, in-depth interviews at the respondents home that discussed the items in their wardrobe. Future research will cover a wider study on the own history and user attachments to garments. The research will develop a deeper understanding of the latent and manifest factors that determine garment attachment. Such research will be a rich source of information to develop future sustainable apparel design and sustainable apparel businesses with the focus being on a longer in use lifetime.

The apparel design aims for this project were achieved and successful. Research and experimentation was thorough, and considered both the user and the manufacturer. D4re (design for reassembly) was developed for this project. D4re takes into account many different aspects of sustainable design and accountability in niche markets and references research that has covered the user’s level of use satisfaction (Fletcher, 2012, Gam et al, 2011; Hypebeast, 2008; Niinimaki & Hass, 2011; Niinimaki & Kosinen, 2011; Van Nes, 2010 & Wang, 2010). In the design requirements for D4re garments, my aims were: garments need to be able to be repaired in economies of scale as well as at small local companies, repairs need to be inconspicuous and the styling of the garments need to be classic in design, for longevity, but need to be modifiable when styles inevitably change. By using the chainstitch machine on a higher percentage of seams than usual, garments can be rapidly disassembled and the thread (depending on weight) can be re-used. Reassembly is made easy with pre-determined modular panels, in particular the crotch gusset and yoke. These panels enable ease of repair in areas of high wear; they also make modification of fit and style possible. The restrictions I faced when carrying out design research were the ability to measure the manufacturing time and cost differences in the construction of In-Use denim jeans compared to current manufacturing practices of denim jeans. I am convinced the cost of manufacturing In-Use jeans will not be higher than current production methods, but cost is difficult to measure without delving into large scale production of the jeans. Time measurements were difficult to gauge per unit. I constructed the denim using flat bed machines instead of free arm, I made whole garments as opposed to piece-work and each step was a new and innovative method that until practiced slowed down production speeds. Overall the In-Use denim jeans are a very successful outcome of the design research and experimentation that has made up this project. Alterations to the final design are minor and consist of seam direction particularly at the back gusset seam. The seam direction needs to be flipped so that friction and wear happens on the gusset seam and not the garment.

The In-Use model as a whole has achieved the aims of this project. It is intended to be an example of sustainable apparel design that is available to all users rather than the traditional sustainable apparel niche markets. It is achievable, affordable and explains an advance theory of user-product and user-manufacturer relationships. I intend to develop the research further and turn the In-Use model into a functioning In-Use Clothing business.
References


sam, hae jin, cao, huantian, farr, cheryl, & heine, lauren. (2009). c2cad: a sustainable apparel design and production model (pp. 166-179).


labat, k. l., & sokolowski, s. l. (1999). a three-stage design process applied to an industry-university textile product design project. clothing and textiles research journal, 17(1), 11-20.


mcdonough, w., & braungart, m. (2002). cradle to cradle: remarking the way we make things. new york: north point press.


niinimäki, kirsi, & koskinen, ilpo. (2011). i love this dress, it makes me feel beautiful! empathic knowledge in sustainable design. 14, 165-186. doi: 10.2752/175630611x12984592779962


nudie jeans co. (2012). tearing it apart to get it together. retrieved from


Appendix

Market - Developed for this project the table below is a description of the In-Use clothing market

**DEMOGRAPHIC**

- **Age:** 20 – 50
- **Sex:** Male and Female
- **Income:** Disposable income or not they are willing to spend/invest in clothing that suits a personal perception of quality. Such perceived quality may involve a blend of aesthetics, place of manufacture, fit, future experience and involvement in products of choice. Consuming with conscience, especially in regards to the environment, will assist this consumer to justify purchasing decisions and will only happen if it does not compromise their personal style.

**DOMINANT BENEFIT SOUGHT**

- **Convenience:** The consumer is aware of environmental issues and interacts in one way or another, whether it be recycling, buying local produce etc, but is less likely to negotiate when it comes to sense of style. Generally justifying clothing purchasing decisions by including ‘vintage’ items in their wardrobe, the target consumer is style conscious and willing to spend money on brands that relate to their individual style.
- **Value:** The consumer perceives value in the overall styling, whether it relates to their desired image, status of brand or personal sense of style and sense of quality – where and out of what it’s made and the attachment they feel to the item.
- **Status:** If the item has a story to tell, this consumer likes to share it. It is an added bonus if the story is an example of their ‘effort’ towards sustainability. Personal history and length of ownership are bragging points for this consumer. Quality, style, innovation and exclusivity of purchased products are seen as examples of personal character.

Having personal input into their clothing helps this consumer indentify with their garments. They are opinionated and like to share ideas, experiences and critique and appraise the products they use. Offering insight and involvement into the company and or brand is added value to this consumer and likely to result in repeat purchasing and loyalty.

**PSYCHOGRAPHIC**

Urban dwelling, social, likes to be noticed and part of a scene. Is influenced by popular/underground urban culture, domestic and global, but also takes part in the growing popularity of outdoor recreation, such as, mountain biking and running. They are aware of environmental issues and are active if efforts are tangible, fulfilling and require little commitment e.g. buying local and cycling to work. They view work life balance as being of great importance. They will blend leisure activities together as a representation of self, i.e. goes to a late night gig and mountain biking in the same weekend and is proud to talk and display both as being an integral part of their identity. Sub cultures are no longer so strictly defined; the increase of active lifestyles within urban culture is creating a blend of markets that this consumer is a part of.
Qualitative research

The purpose of this qualitative research is to gain a stronger understanding of product and consumer emotional attachment. This project uses semi-structured in-depth interviews to explore the latent and manifest factors that determine garment attachment, and long-term ownership of first-owner garments. The interviews helped develop an understanding of factors that contribute to why we form bonds with our first owner clothing.

This research does not delve into consumer views on sustainable clothing. Existing literature and research is in-depth and the data is readily available for me to draw from. As I believe, and subsequently translate into my concept, sustainable clothing should not rely on environmentally focused consumer behaviour, manifest motivation for users purchasing or not purchasing sustainable products is not crucial to my research at this point. There has been research done in regards to long-owned clothing and emotional attachments. I consider a gap to exist in the research about user attachment to new/first-ownership garments. Many of the respondents in Niinimaki’s 2009 survey identified a strong emotional bond to the oldest garment by way of a connection to another person, “they could be inherited, a present, or simply represent someone close, be they mother, grandmother, another relative or friend” (Niinimaki and Koskinen 2011, p. 169). Likewise in Kate Fletcher’s Local Wisdom project user stories, delivered on the website under the title Users’ Craft and Wisdom, are overwhelmingly dominated by attachment to garments stemming from links to other people. Grouped into umbrella categories such as My community, Transfer of ownership, Connections, and many more users explain their love for the garments are due to the history embedded into it by previous owners, whether the owners are known to the user or not. Whilst garments with a pre-existing history are a definite factor in product attachment and an example of the strength of emotional attachments, it does not explain how attachments are created to new items; the bulk of what we consume. I would like to explore first-owner attachments to garments. By first-owner I refer to garments the user has selected of their own accord at time of purchase, or at a minimum has personally chosen to utilise the garment, and why/how they became attached to the product. I would like to explore this topic further and uncover any latent factors that determine a garment’s life-time with the user. As the research is exploratory it makes sense to carry out qualitative research, in the form of in-depth interviews. The reason I wish to do interviews is to gain an insight into how attachments are made. Nicole Van Nes’ (2010) research about product replacement uses qualitative research aimed to develop a well-defined list of factors that contribute to the motivation to replace a product”. Van Nes carried out 20 interviews with people who had recently replaced a product. The interviews where semi-structured and in-depth allowing Van Nes to “uncover a chain of reasoning for replacing the product”. The qualitative research was done to define the factors that influence product replacement, followed by quantitative surveys to determine the importance of these factors. Inspired by Van Nes’ research I will be using similar research methods.

Due to time restraints on this project, qualitative research was carried out and will be furthered in a future study. Three respondents were chosen; as the research is exploratory, the methodology used was in-depth interviews. This project uses semi-structured in-depth interviews to explore the latent and manifest factors that determine garment attachment, and long-term ownership of first-owner garments. The interviews helped develop an understanding of factors that contribute to why we form bonds with our first owner clothing. Interview notes were recorded but future data analysis will be carried out in accordance with Rubin & Rubin’s Qualitative interviewing: the art of hearing Data (2012). Findings and interview notes can be found in the workbook.