

Examining clothing repair practices, core competences, techniques, tools and community structures involved in extending the life of garments

Abstract

The rise of fast fashion as a feature of post-industrial societies has distanced people from many of the habitual practices associated with caring for and valuing clothes. This includes both acquiring and applying the skills to make and mend clothes and understanding fibres and fabrics to develop deeper connections to materials. The principles advocated by a circular economy require societies to recover these once held values and restore our relationship with materials and practices to keep clothing in use for as long as possible and to reduce consumption. Such Circular Economy practices will require our societies to align with current socio-technical developments, where people are increasingly adopting technologies (through e.g. applications, tutorials), to support making and mending practices, and to play and express themselves creatively whilst keeping apparel in use.

The study aims to examine self-repair practices and repair services from practitioners' viewpoints, evaluating available support, and identifying challenges and opportunities to integrate repair practices more widely in society. The results suggest it is critical to develop the skills to mend and customise the garments people own and provide additional support for people to become custodians of clothes. This study is part of a larger project to identify opportunities where technology could intervene in a repair process and facilitate opportunities for people to reconnect with materials and acquire repair skills. To develop this idea, we designed an interview study to investigate practices of clothing repair to determine if and where such support might be welcomed.

Researchers conducted interviews with three groups of people - brands, repair practitioners and community initiatives to gather insights into repair practices, core competences, techniques, tools and community structures involved in extending the life of garments. Insights from the findings address some of the underexplored areas of a clothes repair practice across the three settings. We identify the important relationship of material knowledge to repair and the limited attention given to different types of repair tools and their application. As material skills and knowledge diminish across society it can undermine the drive to scale up the practice of repair. Knowledge from the findings will inform further research to map the repair process and break it down into stages to identify opportunities where digital tools could intervene to help facilitate aspects of the process for people across different settings.

Introduction

In 2018 consumers in the UK consumed clothing worth £60bn (Statista, 2019). Conspicuous consumption is fuelled by a market that exploits the need for immediate satisfaction, novelty and status building. This leads to types of consumer engagement that are detached and has implications for how people care and dispose of products. UK citizens discard one million tonnes of out-of-fashion or damaged clothing items per year (Environmental Audit Committee, 2019), a third of which ends up in household bins (Wrap, 2019) at a disposal cost of £34.6 million (Wrap, 2019), and two thirds is collected via charities and clothing banks (Environmental Audit Committee, 2019). In the UK, clothing lasts for an average of 3.3 years before it is discarded or passed on (Wrap, 2017).

The UK government has set a target of achieving 'zero avoidable waste' by 2050 (Defra, 2018). The Waste Resources Action Plan (WRAP) has identified three key strategies in its Sustainable Clothing Action Plan (SCAP) to achieve this target by: 1] extending clothing life; 2] tackling all stages of product life including reuse, recycling; 3] placing the consumer at the heart of the design process, developing new experiences, supporting self-expression and encouraging sustainable behaviour. These strategies are aligned with core principles of a Circular Economy (CE), particularly that of keeping products in use and valued for as long as possible (EMF, n.d); and one of the main ways to do this is to support people to value their clothing and the materials they are made from. In a CE, consumer behaviour is integral to the system for circulating products (Wastling et.al, 2018). It is in the interest of companies to make sure that users contribute to keeping materials in the cycle - otherwise material value is lost (Accenture, 2014).

The Wrap Clothing Longevity Protocol (2014) identifies the main reasons for garment failure as colour fading (particularly for jersey and woven fabrics) or fabric quality (most notably pilling in the case of knitwear and jersey) (Wrap, 2014). Other key issues are fabric breakdown including fraying and thinning (especially hems), general wear around the crotch of trousers, discolouration in white shirts (particularly collars) and holes in seams (including jacket linings), (Wrap, 2014). Information about the reasons for garment failure and types of damage is limited and tends to focus on damaged items that have been donated to end-of-life facilities that are discoloured, stained, shrunk or pilled or that have a missing button or a small hole (Klymkiw, 2017). Laitala, Klepp describe the impact of natural ageing on garments that can cause holes, rips, broken seams, loose buttons and faded colours among many other issues (Laitala, Klepp, 2018).

This paper reports on a study as part of the *Consumer Experience Digital Tools for Dematerialisation for the Circular Economy* project (CXDT). The project proposes that accessing material knowledge in an experiential way enables consumers to engage deeply with materials, which can empower and facilitate positive caring, repair behaviour. The CXDT project is an opportunity to understand how social, commercial and digital actors

come together to enable circular journeys of apparel in order to specify and consolidate three scenarios to innovate sensing and perceptual technologies and tools that promote a deeper level of engagement between consumers and materials to enable garment caring practices. To develop this idea we designed a programme of research to investigate practices of clothing repair to determine if and where the support from such technologies and tools might be welcomed.

In this paper we report on an interview study to examine repair practices, techniques, tools and core competencies practised by three settings - repair practitioners, brands and community initiatives. In the background section we describe the CXDT project scenarios, review the literature and practices to paint a picture of the current repair landscape and the practitioners involved in extending the life of garments. We then present our study design and the rationale involved in bringing our scenarios to drive the choice of participants, interview methodology, and our approach to the analysis of findings. We end with a discussion on how the findings relate to the current repair landscape and consider the influence of each scenario to the quality and type of practice performed to care for garments during use.

Background

The repair and reuse of clothing is considered integral to the circularity of textiles and a vital part of the transition to a Circular Economy (Schumacher and Forster, 2022), (Manoochehri et.al, 2022). The value of repair practices is recognised for their role in creating more sustainable wardrobes, reimagining and refreshing the clothes in them (Sojo, n.d), which helps reduce consumption habits (Common Objective, 2022). Extending product life is characteristic of a Circular Economy, which aims to remove the concept of waste to keep materials in use, ensuring they are reused, repaired, upgraded or refurbished (EMF, n.d). This model of production reduces our reliance on natural resources, puts existing clothing back into circulation and concentrates on “closing the material loop” in order to maintain the clothing resources that are already in use (Armstrong et al., 2015). Purkiss demonstrates the value of repair and reuse practices to circularity and describes them as “almost always the most environmentally friendly option” (2022: 3). Brands are building cross-industry partnerships with repair specialists as part of their commitment to reducing textile waste and offering an alternative to buying new clothes (United Repair Centre, n.d). Specialist repair businesses such as Make Nu and The Seam promote a culture of care with the aim of making clothes last and catering to every repair with design and integrity (Make Nu, n.d), (The Seam, n.d).

Purkiss distinguishes between DIY repair situations where repair is “carried out yourself” to “using professional services” (2022). This distinction reflects the increased choice available to consumers to regenerate a garment, highlighting both individual and system level factors

affecting repair (Korsunova et.al, 2023). Independent practitioners are offering repair and upcycling services often with a mission to celebrate the art of repair and invest in the clothes we already own and want to keep wearing (Yodomo, 2022). Other repair pathways available to consumers include accessing in-house aftercare and repair services such as that offered by Toast or Finisterre for their own products giving people access to functional or creative mending options (Toast, n.d), (Finisterre, n.d). For many of these brands repair services represent a key part of their business strategy, a market opportunity that can increase consumer loyalty (Hernandez, et.al, 2018). Alternatively, brands may offer advice for 'at home' care of garments or direct people to related services such as schemes that take back an old item, revive it and give it a new home (Reskinned, n.d). While small-scale and limited for consumers, some of these initiatives have started to scale-up to involve partnerships between brands working with external repair services or offering reuse options for reselling and rehoming unwanted clothes (Reskinned, n.d). The United Repair Centre offers clothing repair services to brands and recommends extending clothes life by repairing pre-loved clothing instead of buying new (United Repair Centre, n.d).

As an alternative to the more centralised, in-house brand offerings the market is witnessing a rise in businesses that specialise in repair and alteration services and connect people to networks of skilled craftspeople, makers and specialist teams that can repair or transform apparel (Common Objective, 2022). These commercial repair platforms are making it more convenient for consumers to connect with repairers in their local area and access repair services by using remote technology to take orders, communicate and pick-up and drop-off garments (Webb, 2023). The Seam uses a network of makers to repair garments either in person or using a courier or postal service (The Seam, n.d), while Sojo employs a customer-facing app linked to bicycle couriers to offer a streamlined clothing repair and alteration service that collects and returns clothing items to your doorstep (Sojo, n.d). The business model for these repair and alteration services fosters more connected, community-based setups that link makers, tailors and repairers to consumers using technological platforms and apps (Knowledge Hub, 2023).

The most performed repairs are reattaching buttons or repairing broken seams followed by mending holes or tears either by patching or darning (Laitala, Klepp, 2018). This corresponds with the standard repair services offered in the marketplace, which include button replacement, mending holes, patching and seam repair, which can be done in a variety of discrete or contrasting styles (Make Nu, n.d). Alongside general repair many companies are offering alteration and bespoke services that include different kinds of hand or machine embroidery, garment embellishment, dyeing and painting, sashiko, as well as garment upcycling and customisation (The Seam, n.d), (Della Yellow, n.d). Some of the items that can be repaired include knitwear, outerwear, shirts and blouses, dresses and trousers as well as shoes, handbags and jewellery (The Seam, n.d). Aside from the holes and split seams responsible for many garment failures, other issues include pilling, stains and moth holes

that can be addressed using debobbling, darning or simple embroidery stitch techniques that are often employed to create personal, visible repairs (McLaren et.al, 2015).

Despite the repair sector being integral to the circularity of textiles (Schumacher and Forster, 2022) commentators across the EU have identified barriers such as lack of time, interest, access to tools or ability that can limit the contribution of consumers to engage in clothes repair activities (McLaren and McLauchlan, 2015), (Schumacher and Forster, 2022), (Zhang, Hale, 2022). This is reinforced by a lack of motivation to mend clothes that can be linked to low levels of confidence, skills, limited access to competent people or repair services (Zhang, Hale, 2022), (Durrani, 2018). Recent literature on consumers' clothes mending practices shows a clear decline in the number of people undertaking repair, upcycling and altering activities (Laitala, Klepp, 2018). There is a perception by many people that the skills and competences they require are out of reach combined with a lack of time and confidence (Durrani, 2018). Additionally, the lack of economic incentives to repair a product have been recognised as a constraining factor inhibiting the repairs that people or third parties could do (Hernandez, et.al, 2020). These factors can directly affect people's ability to make behaviour changes toward more sustainable maintenance practices (Norum, 2013).

The Repair Mindset toolkit by Agency by Design describes the ability to problem solve as a critical skill for repair (2019). They connect this to core capacities such as looking closely, exploring complexity, finding opportunity in suitable tools and understanding the materials an object is made from (Agency by Design, 2019). Commentators recognise the value in educating consumers in basic sewing skills amongst other things that could increase the ability to engage in sustainable clothing maintenance practices (Norum, 2013). The ability to diagnose faults, analyse materials and anticipate repairability is linked to understanding the different parts and materials of a product (Korsunova et al., 2023). The existing research on repair describes many important aspects of its practice, but could benefit from an enhanced understanding of materials and their properties to improve competence. Creating closer relationships between consumers and materials can help to promote new product cultures and encourage people to become active custodians of materials (Petreca et al., 2022). Petreca et al. state that active manipulation and engagement with textiles can provide a better understanding of their properties (2015).

Ongoing challenges exist to encourage consumer participation in circular clothing activities, despite the environmental and societal benefits in retaining clothes for longer. Korsunova et al. describe the importance of consumer actions within a CE, linking this to repair and maintenance as important practices of everyday circularity (Korsunova et al., 2023). Different groups and stakeholders are promoting repair as a viable and appealing alternative to disposal, recycling or buying second-hand (Korsunova et al., 2023) but there remain considerable technical, behavioural and strategic obstacles to achieving clothing longevity

within the sector (Cooper et al., 2021). Additionally, there is little information to demonstrate that consumers connect these practices to sustainable behaviour (Laitala, Klepp, 2018), see repair as anything more than a reactive response to something broken (Crosby, Stein, 2020) or are motivated to engage in product care behaviour (Ackerman, 2018).

To address skills shortages and complement industry and practitioner-led offerings, individuals and communities are self-organising to develop grass-roots interventions to encourage and enhance people's propensity to repair (Korsunova, 2023). Activities in community-based settings correspond with an emerging world-wide repair movement that includes organisations, online fixing sites, social enterprises and repair cafes (Charter, Keiller, 2018). Community repair activities offer communal spaces where people come together and either learn how to mend first-hand or get assistance working alongside experts (Durrani, 2018). Community-centred repair workshops, repair cafés and communal garment-mending workshops are models of practice where people gather to learn from those who know how to repair, free of charge (Durrani, 2018) and volunteers help members of the public to repair and therefore slow down resource consumption (Charter, Keiller, 2018). Consumers have the chance to get involved, do repair for themselves and feel increasingly empowered by these community-based solutions. These opportunities demonstrate the importance of the sociomaterial context to build knowledge towards pro-environmental shifts in garment use practices (Durrani, 2018).

The current literature leaves certain areas underexplored in relation to the value of material knowledge within a repair process and its significance for facilitating different phases of the process. While the literature establishes the nature of material knowledge, describing it as a subjective experience (Petreca et.al, 2015) that is embodied (Durrani, 2018) there remain incomplete descriptions of how to apply this knowledge to repair. Additionally, we recognise there is limited appraisal of the different types of tools available for repair and their application in specific settings. These points will be returned to and considered further in the Discussion section below.

We have considered three scenarios to explore critical phases in the life of clothes, which we have used as a lens to analyse our data and compare repair practices across the different scenarios where it occurs: 1) 'I repair' (*During Ownership*): Supporting consumer-custodians to maintain and repair their garments by accessing/sharing mending and customisation techniques and facilitating the development of transferable skills with repairers. 2) 'The Brand repairs' (*Giving up Ownership*): Providing circular mechanisms to take back garments at the end of their life, and capture data on wear and degradation that will inform future cycles that the materials will engage in. 3) 'The Community repairs' (*Post Ownership*): Exploring with the community what the garment could become, and it being refurbished by others (e.g. repair shops).

Method

Researchers conducted semi-structured interviews with specialists working within the three repair settings. Interviews gathered insights into the current landscape of repair across the three scenarios to provide a more nuanced understanding of the types of activities taking place. Questions were designed to examine the services being offered, the motivation for offering them, and the experiences providers had with their customers. Questions requested details on specific practices as well as asking interviewees to discuss broader concerns that had an impact on their ability to operate in this space. To achieve a balanced representation of people from each setting, study participants were selected through purposeful sampling. The study was approved by the local ethics committee, and fourteen participants provided informed consent for their participation, see table 1.

Table 1. Participants' profile and distribution across settings

Scenario	Type of participants	Number of participants	Expertise	Experience (avg. years)	Participant Code
I repair	Independent repairers; Academics	4	Reknitting, bespoke visible mending, teaching core repair skills	12	P3; P6; P9; P10
The brand repairs	Designers; Businesses specialised in offering repair service; Fashion brands that offer repair service	8	Repair, refurbishment, creative mending, cleaning, alteration, re-manufacture bespoke pieces	8	P1; P4; P7; P8; P14
The community repairs	Collectives; Community groups	5	Teach repair skills, offer classes and workshops, education, repair shop	7	P2; P5; P11; P12; P13

Interview Questions

The interview questions were structured across four main areas, see table 2, which had a focus on the kinds of repair activities being practised to gather more information on the techniques and strategies employed to extend the lifespan of garments. The questions were designed to relate to the three project scenarios to identify who was engaged in repair activities and address any gaps in the literature. Questions on clothing longevity practices aimed to examine the barriers and opportunities for repair across settings and encourage interviewees to express their knowledge and beliefs. The concept of a sustainable practice referred to offering alternatives to consumption (Armstrong, et.al, 2014) and encouraging consumers to extend the life of clothes through repair. Sustainability was a concept that supported interventions that reduce clothing waste and promote responsible clothing use. We were keen to gather views on the nature of sustainable clothing practices particularly from the perspective of the interviewees. The interviews explored the quality of experiences people have with materials and the methods they employ to develop an understanding of their properties that can inform judgements, which guide further actions, caring decisions and behaviour. Finally, the questions aimed to probe strategies for identifying key actors and creating community to enable interaction and collaboration with consumers towards enacting a CE.

Table 2. Interview themes and questions

Theme	Questions and Focus
Repair Practices	Examines repair practices looking at tools as well as types and frequency of repair.
	<ul style="list-style-type: none"> ● What kind of repair or refurbishment service do you (or your company) offer? (RS) ● What things tend to be repaired most frequently? (FR) ● What are the key reasons for garment failure? (GF) ● What tools do you consider essential to the practice of repair? (RT)
Design for Durability	Investigates techniques and strategies to extend the lifespan of garments.
	<ul style="list-style-type: none"> ● What repair or customisation techniques do you rely on? (CT) ● How do you support consumers to creatively repurpose, embellish or upgrade damaged items through personalisation options? (FS) ● Are there any other sustainable practices and services (sharing, adapting, passing on, renting) that you'd like to offer in future? (SP) ● What do you consider are the barriers to mending? (B)

Materials Experience	Explores the experience of materials and their qualities.
	<ul style="list-style-type: none"> • How do you assess material properties to decide on a choice of repair technique, method of embellishment, matching a material for patching etc? (AM) • What are the typical mistakes that less experienced learners and novices make in their handling and knowledge of materials? (TM) • How do you support consumers/learners/citizens to interact with materials to understand them better? (SC)
Network, Society and Community	Identifies key actors, ways to build community to enable interaction and collaboration with consumers towards enacting a CE.
	<ul style="list-style-type: none"> • How do you connect, collaborate and create opportunities with your community and key actors involved in repair practices? (CC) • How do you use technology for social connection, collaboration and learning? (UT) • How can society scale up consumer demand for repair and customisation practices? (SU)

Analysis

The interviews were audio recorded and the collected qualitative data was transcribed verbatim to facilitate coding and analysis. During the coding process one author coded and one author revised the codes, and both worked together on devising themes and sub-themes for the results. All the authors revised the coding for the writing up process. The analysis was undertaken in two stages: In the first stage we used Thematic Analysis to identify emerging themes and patterns (Braun & Clark, 2006). In the second stage our decisions were informed by the three scenarios as sensitising concepts to explore the data further, particularly to inspire insights appropriate to the initial themes and codes, rather than as a rigid coding framework. This process facilitated the reasoning through and comparison across the different contexts provided by our diverse pool of participants, and to reach a coherent narrative to report in the analysis. In the first stage, the analysis was undertaken in various steps, beginning with data familiarisation of the whole set, which led to code generation, themes and sub-themes to create data sets from data that was selected specifically to relate to the project scenarios. Reading through the responses and becoming familiar with the data was the beginning of the process, followed by noting down ideas of interest and emerging patterns (Braun & Clark, 2006) and generating initial codes across the data sets based on the questions and requirements of each of the three scenarios. Codes were organised into groups linked by common relationships or new ideas, which could be used to expand initial themes, create sub-themes and related groupings. In the second stage, overarching themes were linked to the question headings and later to scenarios helping to highlight the key insights emerging from the study across different repair settings.

Findings

Our findings are reported through themes corresponding to our headline questions, specifically: The state of repair practices and tools; developing materials experience; garment life-extension strategies and techniques; building community, identifying societal challenges and ideas to scale repair. The findings distribute participants across the three CXDT settings as indicated in figure 1 to reflect their experience and areas of expertise. A figure has been used to organise the three scenario findings into sub themes using unique codes so they can be easily referred to in the following sections.

Key: Repair Service (RS), Frequently Repaired Items (FR), Reasons for Garment Failure (GF), Repair Tools (RT), Repair and Customisation Techniques (CT), Support Consumers to Repurpose (FS), Sustainable Practices (SP), Barriers to mending (B), Methods to Assess Material Properties (AM), Typical Mistakes (TM), Support Consumers with Materials (SC), Connect and Collaborate (CC), Use Technology (UT), Scale Up (SU).

I repair (S1)



Community repairs (S3)

Brand repairs (S2)

Figure 1. Overview of scenario findings depicting relationships and unique features.

Repair practices

This section examines repair practices, services offered, tools, types of damage and frequency of repair across the three scenarios developed for the CXDT project. The 'I repair' and 'community repairs' scenarios were offering educational opportunities as part of the services being offered, providing resources and support for people to build skills, "I offer core education on basic repair skills" P9. These actions brought people together to work in physical spaces, "We do a range of classes teaching repair skills" P13. Participants from the 'brand repair' scenario described utilitarian care services such as restoration or cleaning often with the capacity to perform bespoke, refurbishment, repair and "handle everything end to end" P14. Apart from repair, brands offered alterations and upcycling using a diverse range of practical techniques.

The reasons for garment failure were similar across all settings, citing wear and tear, poor materials and lack of reinforcement as the main issues. The 'I repair' scenario described the mismatch between person and garment as a form of garment failure, "I would see that conceptually as a kind of repair, repairing the emotional link between the person and the garment" P6.

Across all three scenarios interviewees reported similar damage types across garments, describing physical issues such as holes under the arms, ragged cuffs, worn knees as well as low grade textile materials and poor garment construction as factors limiting their lifespan. The 'I repair' and 'community repairs' scenarios both reported similar items that were frequently repaired such as knitwear, denim and outerwear, and the 'brand repair' scenario additionally addressed utilitarian repairs like fastenings; zips and clasps. This point linked to the type of tools employed, with brands often having access to more industrial tools that could be used to re-manufacture garments and address hardware and fastening failures "you need all the tools...If you're going to offer a full repair service you essentially need to be able to remanufacture" P7.

Garment life-extension techniques and strategies

Study participants in the 'brand repair' scenario generally described a more industrial approach to repair and customisation techniques, focusing on the pre-production design phase as part of an overall business strategy, "we manufacture all of our own products, we have the capacity to do all of those things", "all of those items that come back to us that have failed, we keep them. You know we go back to them" P7. The 'I repair' and 'community repairs' scenarios tended to advocate more active, DIY routes to "encourage people to repair for themselves" P5. They encouraged experiential, place-based services that prompted conversations about circularity and recommended durable practices. They often practised handwork and visible mending techniques to respond to the unique needs of each garment. The 'brand repair' setting supported people to access a variety of options and achieve their objectives by working in partnership with professional makers and repair specialists.

Participants described the limited understanding of clothing value in people, which can cause consumers to balance the cost of repair against purchasing new items. Brands emphasised the lack of skills and experience in people that required dedicated time to train new staff to learn techniques and processes. They stressed the challenges involved in creating a platform to make repair processes more efficient to increase consumer options, “our focus is on the techniques and on the platform to standardise these processes” P8.

Materials experience and damage assessment

Across all settings participants were physically interacting with damaged fabrics to assess their properties. The practitioners interviewed had high levels of material knowledge and were able to identify the material composition of garments to select suitable materials for patching damage. Participants acknowledged the complications in developing material knowledge in other people, “the most difficult part to understand [is] how the materials behave” P10, citing common mistakes made by less experienced practitioners. In client facing relationships customers often underestimated the labour involved in repair procedures or had high expectations of the outcome. To deepen people’s understanding of the process participants across all settings were giving customers advice and options. Participants from the ‘community repairs’ scenario described the value of the senses to recognise how materials wear and to increase material knowledge. Community hubs were empowering people to get involved in repair processes and facilitating meetups in physical spaces to support interactions with people to prompt a material dialogue. They were more likely to disseminate knowledge through social events and explain, “you’re strongly encouraged to sit with your fixer and kind of watch them fix the item and kind of have a conversation” as a way to improve attendees knowledge, P5. Brands compared repaired items to past items to build knowledge around materials, methods and time taken to fix. This information was used to train technology platforms to automate aspects of the assessment process and make it more efficient.

Network, Society and Community

All three scenarios initiated community building activities, “we engage people, we talk to people, we encourage people” P11. Brands developed partnerships with stakeholders and social media influencers to build loyalty, “our community is kind of interesting because we have some deeply embedded stakeholders”, P7. Many community initiatives were aligned with other organisations or local businesses with similar ambitions to promote wider sustainability themes. There was a focus on establishing hyper-local community offerings that explored the regional influence on services, translating local materials into upcycled goods, “micro-production for other businesses is one of the leading services that we offer now”, P2.

Technology was embedded within networking and collaboration activities across the three scenarios. The ‘1 repair’ and ‘community repairs’ scenarios are particularly focused on using technology to instruct people on repair practices, facilitate learning or offer online tutorials

and workshops. Providing people with web resources and online tutorials enabled them to disseminate core skills and share resources more widely. Brands and community initiatives were more likely to collate databases that could gather repair data to monitor the items they'd worked on, improve systems and services. Brands employed methods to standardise and streamline the repair process and were developing databases and platforms to track repaired items, "we are systemizing so much of this, because there is, as you know you can appreciate a massive overhead, especially in the UK associated with repairing items and [we] have to make very highly informed decisions around whether or not it's cost effective to repair" P14.

Discussion

Provision of services

The study set out to identify the strategies and services being developed across the three scenarios to promote positive repair behaviour and encourage people to adopt the role of custodian to prolong the life of clothes. It demonstrated pathways for engaging in repair activities such as following a DIY, self-repair approach, commissioning a repair professional or enlisting community-based services. This finding confirms the three types of repair categories identified by McQueen et al. accepting that hybrid models of repair also exist (2023).

Repair is described in the literature as a method of restoring a faulty or damaged clothing product to a fully functioning state during the use and maintenance phase (Zhang, Hale, 2022). However, the data suggests that garments can fail due to a mismatch occurring between person and garment and illustrates the need to address these relationships. A conceptual repair considers methods to make a garment more 'acceptable' to its owner (S1GF) so it can be used to its fullest extent (McQueen et al, 2023). The relationship people have with clothing is influenced in large part by social norms, which determine people's attitudes and ideas around what is considered acceptable to wear. Zhang and Hale (2022) describe the effect of social feedback to increase the pressure on people to conform to fashion trends, which can negatively impact a propensity to engage in repair actions. A number of brands indicated a shift towards visible mending as a form of upcycling that people selected for branded items as a "as a badge of honour", P14. This kind of decision making could suggest loyalty to a brand or a desire to belong to a group, which indicates a repositioning of repaired or pre-loved clothes as an expression of identity. Brands described this access to new upcycling opportunities as a sea-change in the provision of services that nudged people towards new behaviour and different ways of engaging in clothing practices as customers were more easily able to purchase repaired or pre-loved clothing. Participants from the brand repair scenario were keen to transform business models to offer repair, alteration and aftercare services for customers post-purchase. These services were designed to address the harmful effects of our clothing systems and explore alternative

strategies to overproduction. Brands had abandoned seasonal collections and were offering timeless, classic pieces to slow down fashion cycles and offer design pieces that had an enduring appeal. Brands and aftercare specialists recognised the value of good customer communication to improve product longevity and the benefits of collecting customer data to improve and expand repair services (Webb, 2023). By encouraging communication with consumers post-purchase, brands were increasingly able to gather essential product data that could feed into future design cycles and guide decision-making.

Barriers to repair

The study described a number of barriers to adopting repair either as a practitioner or as a customer commissioning a service. Participants from all scenarios stressed that people have a limited understanding of clothing value, which can cause them to balance the cost of repair against the low price of garments. This correlates with other studies suggesting it's cheaper to buy a new product than to repair a failing one (Hernandez, et.al, 2018) and that an emphasis on cost often motivates consumption decisions rather than environmental qualities (Amstrong et.al, 2015).

The findings described factors discouraging people from engaging in DIY repair such as low levels of confidence, lack of patience and limited material knowledge. This is corroborated by other studies that discuss a disinclination to carry out repair actions linked to a lack of confidence and a decline in actual skills (McQueen et.al, 2023), (Norum, 2013). To address these issues specialist practitioners and community co-ops described an “infrastructure of support”, P6, that could connect people to help validate their choices around repair work and build “people’s confidence in terms of making, as makers, as users rather than just as consumers”, P2. They recognised the central role of psychological factors particularly confidence, motivation or garment attachment to stimulate a willingness in people to begin a repair process and believe that they could achieve a successful outcome.

Knowledge and skills

Participants from the ‘I repair’ and ‘community repairs’ scenarios recognised the importance of disseminating the core knowledge and skills required to practise repair, supporting people to differentiate fibres and fabrics, make selection decisions and master tools to facilitate a creative workflow. Zhang and Hale reiterate the significance of skill-building campaigns to make repair more widespread, influence behaviour change and bring awareness to its environmental impact (2022). Establishing community offerings that connect people encouraged learning in the ‘I repair’ and ‘community repairs’ scenarios and equipped people with the knowledge of how to mend (Durrani, 2018).

The 'I repair' and 'community repairs' settings were keen to address the skills gap in society and reskill the population with the knowledge to make and repair clothes. They recognised the distance between communities and skills, and the implications of not making our own clothes or knowing anyone that made or repaired them. Participants from the three scenarios brought more understanding to the repair process, the types of tools employed in creative or utilitarian purposes and the skill required to use tools to problem-solve (Agency by Design, 2019). Participants from the 'I repair' scenario recognised how tools are not enough on their own, citing their role in developing competences as they become integrated and entangled within a mending practice (Durrani, 2018).

The literature presents few studies that explore the value of material knowledge to repair and its function within the overall process. However, participants from each scenario demonstrated the value of experiential, material knowledge to a repair process, which they applied to damage assessment, inspection of material properties and levels of degradation in order to select suitable forms of intervention. The findings outlined the difficulties people face when acquiring material knowledge, which is perhaps due to difficulty in articulating its significance as an often inaccessible subjective experience (Petreca et.al, 2015). Despite the knowledge existing for expert practitioners, the findings suggest that the system is imperfect and the process for judging material and damage properties can be a huge undertaking in labour time and effort to sort and organise large quantities of clothes. This finding could encourage educators to develop school curricula or training programmes to reskill people to stimulate more professions within the Circular Economy.

Technological tools were often deployed across the settings to support learning and provide people with resources, instructional videos, tutorials and reference materials. Some participants described the extensive reach of these resources citing 500,000 views for a video on mending denim trousers or 200,000 views for mending small holes in knitwear. There is little in the literature that quantifies the level of engagement in online resources, however, and while Durrani's study participants welcomed the accessibility of instructional repair videos on YouTube, they found it challenging to follow the instructions in them. As a result, they preferred receiving in-person guidance from an expert (2018).

Scaling Repair

Many of the companies, organisations and individuals operating across the scenarios were involved in endeavours to make repair more mainstream, modelling sustainable practices for clothes and trialling new business models, schemes and services that would expand their mission. Similar research describes the ability of community initiatives to increase the visibility of mending, create a 'propensity to repair' (Korsunova et.al, 2023), and feelings of self-reliance and empowerment in people (Durrani, 2018).

Participants held strong beliefs about the capacity of repair activities to reduce clothing consumption as an essential element of a circular economy (McQueen et al, 2023). These

beliefs catalysed action across the scenarios and led participants to identify and target strategies to improve clothing longevity and influence behaviour change in people. Many participants were involved in activities that reframed business activities to incorporate socially beneficial ideals that would lead towards more pro-environmental, social and economic engagement. Brands involved in providing aftercare services were developing processes to standardise craftsmanship, which were considered an important part of scaling activities, linked to more efficient assessment, price points and time management. Participants from community-based settings were keen for local governments to consider the value of repair as a profession, finance salaries for professionals and make the services regularly available. The 'community repairs' scenario was advocating for the extra social, wellbeing benefits that can come from working locally and engaging with people to host volunteer-led events. They appealed for the practical benefits to be recognised more widely, which would increase demand for repair, drive scale-up and strengthen communities. Participants were calling for more awareness of the practical as well as the social, economic and systemic benefits of repair to society and asking for more involvement from governments, brands and manufacturers to raise its profile and reach. Technologies were often used to drive different forms of social organisation, raise awareness of environmental issues, develop community links and enable people to feel part of a movement. For the 'community repairs' scenario technologies were adopted to quantify repair as a way to serve the community and measure the impact of their activities. These initiatives validate other studies calling for laws and directives to provide physical and digital infrastructure to promote repair (Hernandez, et.al, 2018).

Conclusion

The study revealed the types of repair practices and pathways operating across the three scenarios and identified the strategies being developed to promote active engagement in repair behaviour. The findings from the study are presented in figure 1 and organised into the relationships, similarities and unique features from across the 3 scenarios. The figure represents the main contribution of the study and can be considered a critical resource that maps the current repair landscape, which can be used to navigate the services, activities, support and features that influence garment care.

The knowledge and insights generated by the study are being used by the CXDT project team as a springboard for further research. This involves developing concept cards to map the repair process, examining the core competences, activities and techniques required to initiate a repair procedure. A more nuanced understanding of repair processes can identify opportunities where digital tools could support people and teach them essential practical steps within the different settings.

To our knowledge there are no previous studies that present a holistic view of the activities or relationships between repair practices across the three scenarios identified in this study. We hope that this work will empower consumers to select the most appropriate pathway to

mend and care for garments to extend their lifespan. Additionally, the insights are offered as a platform for academics, practitioners and designers within and outside the repair community to identify the challenges and opportunities to integrate repair practices more widely in society, examine the spaces where repair is performed and bring deeper knowledge of its practice.

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To comply with data access requirements the data that contributed to this paper is available in the table found in the Appendix. (Additionally, the data transcribed from each interview is available: https://drive.google.com/drive/folders/10K4zwaraDvkyBsoCdl8Ph28-s97F8tlit?usp=drive_link) and uses the CC BY licence described above.

Bibliography

Accenture (2014), Circular Advantage: Innovative Business Models and Technologies to Create Value in a World without Limits to Growth.

Ackermann, L, (2018) Design for Product Care: Enhancing Consumers' Repair and Maintenance Activities, *The Design Journal*, 21:4, 543-551, DOI: 10.1080/14606925.2018.1469331

Agency by Design (2019), Repair Mindset toolkit.

Armstrong, C.M., Niinimäki, K., Kujala, S., Karell, E and Lang, C (2015), Sustainable product-service systems for clothing: exploring consumer perceptions of consumption alternatives in Finland. *Journal of Cleaner Production* 97, 30–39.
<https://doi.org/10.1016/j.jclepro.2014.01.046>

Braun, V and Clarke, V (2006), Using thematic analysis in psychology, *Qualitative Research in Psychology*, 3:2, 77-101, DOI: 10.1191/1478088706qp063oa

Charter, M and Keiller, S (2018), Repair cafés. Circular and social innovation, in: *Designing for the Circular Economy*. Routledge.

Common Objective, (2022), Why Mending Matters: Fashion's Repair Market Opportunity, Common Objective, 7 December, <https://www.commonobjective.co/article/why-mending-matters-fashion-s-repair-market-opportunity>. Last accessed 29 August 2023.

Cooper, T., Oxborrow, L., Claxton, S., Hill, H., Goworek, H., McLaren, A and West, K (2021), CLOTHING DURABILITY DOZEN STRATEGIES TO IMPROVE DESIGN AND TESTING FOR CLOTHING LONGEVITY, Nottingham Trent University.

Crosby, A and Stein, Jesse, Adams (2020), Repair, Environmental Humanities, 12:1, DOI 10.1215/22011919-8142275

Defra (2018), A Green Future: Our 25 Year Plan to Improve the Environment.

Della Yellow (n.d), <https://www.della-yellow.com/>. Accessed 29 August, 2023.

Durrani, M (2018), People Gather for Stranger Things, So Why Not This? Learning Sustainable Sensibilities through Communal Garment-Mending Practices, Sustainability 10, 2018. <https://doi.org/10.3390/su10072218>

Durrani, M (2018), Designers by Any Other Name: exploring the sociomaterial practices of vernacular garment menders, DRS2018, DRS Biennial Conference Series

Ellen McArthur Foundation (EMF) (n.d), The Circular Economy in Detail: Deep Dive, <https://ellenmacarthurfoundation.org/the-circular-economy-in-detail-deep-dive>. Accessed 1 September 2023

Environmental Audit Committee (2019), Fixing Fashion: Clothing Consumption & Sustainability.

Finisterre (n.d)., Lived & Loved, Repair Workshop, <https://finisterre.com/collections/repairs-lived-loved#3>. Accessed 30 August 2023.

Fisher, T, Cooper, T, Woodward, S, Hiller A and Goworek H (2008), Public Understanding of Sustainable Clothing: A report to the Department for Environment, Food and Rural Affairs. Defra, London.

Hernandez, Ricardo, J., Miranda, Constanza and Goñi, Julian (2020), Empowering Sustainable Consumption by Giving Back to Consumers the 'Right to Repair', Sustainability 2020, 12, 850; doi:10.3390/su12030850

Kant Hvass, K (2014), Post-retail responsibility of garments – a fashion industry perspective, Journal of Fashion Marketing and Management 18, 413–430. <https://doi.org/10.1108/JFMM-01-2013-0005>

Klymkiw, S (2017), Measuring The Impact Of Repair, 2 August, <https://www.traid.org.uk/measuringtheimpactofrepair/>. Accessed 1 July 2023.

[Knowledge Hub, \(2023\), Sojo - the UK's first clothing repair app connects users to local seamsters via bike, https://knowledge-hub.circle-lab.com/article/18590?n=Sojo---the-](#)

[UK%27s-first-clothing-repair-app-connects-users-to-local-seamsters-via-bike. Accessed 30 August 2023.](#)

Korsunova, A., Heiskanen, E and Vainio, A (2023), Consumer decision-making on repair in a circular economy: A process model based on experiences among young adults and stakeholders in Finland. *Journal of Cleaner Production* 405, 137052.

<https://doi.org/10.1016/j.jclepro.2023.137052>

Laitala, K, and I, G Klepp (2018), 'Care and Production of Clothing in Norwegian Homes: Environmental Implications of Mending and Making Practices', *Sustainability*, 10.8 , 2899

<https://doi.org/10.3390/su10082899>

Make Nu (n.d), Manifesto, <https://www.makenu.co.uk/about-us>. Accessed 29 August, 2023.

Manoochehri, S., Schlupe, M., Dams, Y., Mehlhart, G., Bekkevold Lingås, D., Marin, G., Nicolau, M and Colgan, S (2022), ETC/CE Report 6/2022 An overview of Europe's repair sector.

Mclaren, A and Mclauchlan, S (2015), Crafting sustainable repairs: practice-based approaches to extending the life of clothes, in: *Product Lifetimes and the Environment (PLATE) Conference Proceedings*, Nottingham, pp. 221–228.

McQueen RH, Jain A, McNeill LS, Kozlowski A., (2023), The role of resources in repair practice: Engagement with self, paid and unpaid clothing repair by young consumers. *Textile Research Journal*. 2023;93(3-4):576-591. doi:[10.1177/00405175221123067](https://doi.org/10.1177/00405175221123067)

Middleton, J. (2015) Mending. Routledge Handbook of Sustainability and Fashion.

Edited by Kate Fletcher and Matilda Tham. P.262

MSRC (2022), Consumer Experience Digital Tools for Dematerialisation for the Circular Economy, <https://www.rca.ac.uk/research-innovation/projects/consumer-experience-digital-tools-for-dematerialisation-for-the-circular-economy/>. Accessed 4 September 2023.

Norum, P.S (2013), Examination of Apparel Maintenance Skills and Practices: Implications for Sustainable Clothing Consumption. *Fam Consum Sci Res J* 42, 124–137.

<https://doi.org/10.1111/fcsr.12047>

Petrecă, B, Baurely, S and Bianchi-Berthouze, N (2015), How do designers feel textiles? *ACII*, pp. 982-987. IEEE.

Petrecă, B, Baurley, S, Hesseldahl, K, Pollmann, A and Obrist, M (2022), The Composer Tool: Investigating Consumer Experiences in the Circular Economy. *Multimodal Technol. Interact*, 6, 24. <https://doi.org/10.3390/mti6040024>

Purkiss, D (2022), Considerations for the design of a UK Repairability Index, UCL Big Repair Project.

Reskinned (n.d), Repurposing Old Gear For New Adventures, <https://takeback.reskinned.clothing/finisterre>. Accessed 4 September 2023.

Repair What You Wear (2023), Introduction to Education, <https://repairwhatyouwear.com/education/> . Accessed 30 August, 2023.

Reskinned (2023), About Reskinned Clothing, <https://www.reskinned.clothing/about>. Accessed 10 July 2023

Schumacher, K.A and Forster, A.L (2022), Textiles in a circular economy: An assessment of the current landscape, challenges, and opportunities in the United States. Front. Sustain. 3, 1038323. <https://doi.org/10.3389/frsus.2022.1038323>

Sojo (n.d), How It Works, <https://www.sojo.uk/how-it-works>. Accessed 29 August, 2023

Statista (2019), Consumer Spending on Clothing & Footwear in the United Kingdom from 2005 to 2018.

The Seam (n.d), Pricing Guidelines, <https://www.theseam.uk/pricing> . Accessed 29 August, 2023.

The Seam (n.d), Connect with local, specialist Makers to repair and transform your wardrobe, <https://www.theseam.uk/> . Accessed 29 August, 2023.

Toast (n.d), TOAST Repair, <https://www.toa.st/pages/toast-repair>. Accessed 30 August 2023.

United Repair Centre (n.d), Manifesto [WWW Document]. URL <https://unitedrepaircentre.com/manifesto/> . Accessed 24 July 2023.

Wastling, T, Charnley, F and Moreno, M (2018), Design for circular behaviour: Considering users in a circular economy. Sustainability 2018, 10, 1743.

Webb, B (2023), Net-a-Porter launches repairs and alterations with The Seam [WWW Document]. URL <https://www.voguebusiness.com/sustainability/net-a-porter-launches-repairs-and-alterations-with-the-seam>. Accessed 18 July 2023.

Wrap (n.d), Textiles 2030 Circular Design Toolkit.

Wrap (2019), Textiles: Market Situation Report.

Wrap (2019), Fibre to Fibre Recycling.

Wrap (2017), Valuing our Clothes: The Cost of UK Fashion.

Wrap (2014), Clothing Longevity Protocol.

Yodomo (2022), Interview with Visible Mender Tessa Solomons of Tessa the Dresser <https://yodomo.co/blogs/news/interview-with-visible-mender-tessa-solomons-of-tessa-the-dresser>. Accessed 10 July 2023.

Zhang, L.; Hale, J., (2022), Extending the Lifetime of Clothing through Repair and Repurpose: An Investigation of Barriers and Enablers in UK Citizens. Sustainability 2022, 14, 10821. <https://doi.org/10.3390/su141710821>

Appendix

Table 1. Scenario Findings

	I REPAIR (S1)	BRAND REPAIRS (S2)	COMMUNITY REPAIRS (S3)
Theme and ID			
Repair practices			
Services and Practices RS	Visible mending, educating core repair skills, knitting to rework items	Repair, refurbishment, bespoke, visible and creative mending, cleaning, alteration, re-manufacture, upcycling	Education, teaching repair skills, classes and workshops, community engagement, social connection
Repair tools RT	Needles, thread, pins and scissors, tools integrated with competences	Tools to manufacture and remanufacture, sewing machines, human factor	Sewing kit, darning mushroom, wools, threads, scraps for patches
Frequently repaired items FR	Knitwear; jumpers and cardigans, crotch in denim jeans, t-shirts	Hardware, fastenings, hems, colour fading, shoes, handbags	Crotch area, denim, trousers, knitwear, outerwear
Reasons for garment failure GF	Lack of reinforcement, moth holes, natural occurrences, wear and tear, mismatch between person and garment	Wear and tear, poor materials, poor fitting, lack of care, strain through use	Seams come undone, lack of reinforcement, holes, moth holes, wear and tear, piled, stretched, discoloured
Garment life-extension techniques and strategies			

Repair & customisation techniques CT	Expressive mending, hand embroidery, swiss darning, weave darning, reknitting	No seasonal collections, make classic pieces, design, manufacture, learn from mistakes, patching, darning, machine sewing, substituting components	Invisible repair, alteration, upcycling, hand sewing, visible mending, Sashiko, darning, embroidery
Forms of Support FS	Workshops, peer validation, increase confidence, discussion, support the process, infrastructure	Online education, face-to-face, focus on aesthetics	Workshops, signpost, do it for themselves, give options, increase confidence, discussion, support the process, social side, sit with a fixer
Sustainable Practices SP	Engage other services to swap and exchange clothes	Offer 3 rd life products, don't do discounts or seasons	Sit on education committee, offer a showcase space and pattern archive
Barriers B	Lack of skills and competence, time and confidence, getting stuck during process, cost, value of clothes, awareness of practices	Lack of skills and experience in staff, (repair) demands time, achieving efficiency and standardisation	Garment pricing, value of clothes, mindset
Materials experience and damage assessment			
Assessing material properties AM	Material behaviour, fibre types, reading the label	Materials knowledge, learning from mistakes, matching materials, mono-materials	Handle, drape, sorting, feeling and handling, physical connection with materials, fabric sorting, reading the label, discussion
Typical mistakes TM	Limited material understanding, underestimate extent of damage, select unsuitable techniques	(Customer) has high expectations of repair	Limited material understanding, impatience, lack of awareness, amateur
Supporting Customers SC	Provide advice, listen, anticipate future damage, show examples	Advise on the process, answer questions, disseminate information, educate, show possibilities	Engagement, social events, sit with a fixer, disseminate resources, knowledge transfer

Network, Society and Community			
Connect and collaborate CC	Provide resources, tutorials and reference materials, create community, facilitate engagement	Create partnerships, develop and engage community, facilitate engagement	Provide spaces, face to face interaction, thriving volunteer programme, micro-production
Use of technology UT	Online workshops, videos, instructions on website	Share information on social media, gather data, build internal database, share files online, free download, standardisation	Online workshops, instructional videos, digital repair forms, database, online marketing
Scale up demand for repair SU	Create a repair infrastructure, education, increase opportunities for knowledge sharing	Evolve business models, permanent spaces on high street, standardisation, repair as a profession	Mindset shift, replicate community offer, permanent offer, social prescribing stream, national campaigns