

Enhancing product repairability through sustainable business models

An assessment of the 'consumer repair journey',
business management and future legislation

Tung Dao

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Abstract

The current linear economic model has created low-priced and on-trend products but at the cost of shaping lifestyles that demand fast and unsustainable consumption. Product repair, the process of maintaining the functionality of items by correcting a defect should, in theory, improve resource security and material efficiency. The transformation of current repair practices requires the comprehensive engagement of consumers and different business stakeholders, including manufacturers, retailers and repair service providers. In particular, the repair journey that consumers go through when deciding whether or not to fix an item involves a set of complex decisions and actions. Moreover, each manufacturer, retailer or brand may have its own strategy towards keeping up with – and gaining competitive advantage from – improvements in technology, changes in fashion, consumer demand and cost-efficiency. This PhD aimed to (i) identify influences upon the ‘repair journeys’ that consumers go through when deciding whether or not to fix a faulty item and (ii) determine how businesses could support consumers in their repair journeys, particularly through business innovation for product repairability.

Consumer focus groups and in-depth business interviews were employed. Four consumer groups provided insights into consumers’ repair journeys, which comprise an identification of product faults and repair need, information search and evaluation of alternatives, repair in action and post-repair evaluation. These group discussions revealed the complexity of the consumer repair journey and the significance of current business practices during it. In particular, the factors influencing consumers’ intentions, their translations into behaviours and the need for support from businesses at each stage of the repair journey were identified. Interviews were conducted with 21 companies that manufacture or sell products or provide aftersales services, in three product sectors - clothing, furniture, and electrical and electronic equipment. These identified opportunities for and challenges to sustainable business innovations intended to promote repairable products and repair services. Business support needs from government were then explored, followed by proposals for future legislation. The data collected were transcribed by the author and then coded and thematically analysed using NVivo software.

The research firstly demonstrates novel use of the Theory of Planned Behaviour, intention-behaviour gap concept and buying decision process to study consumers’ repair journeys. This contributes to understanding the importance of product design, the provision of repair information and spare parts, and the quality of aftersales services in intentions to repair and their translation into behaviour at each stage of repair journeys.

Secondly, the findings explain the requirements for sustainable business model innovation beyond product repairability as a part of companies’ strategic development and business management. They also provide directions for business practitioners to consider interventions that go beyond design strategies and product features, supportive services during the use of products, and consumers’ repair journeys. As a result, the findings can help

business stakeholders to structure their sustainable activities more effectively and anticipate key challenges through collaboration between business stakeholders and customer-focused innovation.

Finally, a contribution is made to understanding potential implications of future policies which aim at influencing or supporting behaviour changes during consumers' repair journeys and business model innovation, with reference to the Right to Repair and the EU's Circular Economy Action Plan.

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Author's declaration and publications

I declare that the information in this thesis is original work by the author, Tung Dao. A list of publications by the author related to this thesis are as follows:

DAO, T., COOPER, T. and WATKINS, M., 2021. Business innovation for product repairability: implications for future policies. In: Proceedings of 4th Conference on Product Lifetimes and the Environment (PLATE 2021). Limerick: University of Limerick, Ireland

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DAO, T., COOPER, T. and COLE, C., 2018. Commercial repair as a potential approach to sustainable business. In: Proceedings of The Asian Conference on Sustainability, Energy and the Environment. Kobe: Art Centre of Kobe, Japan.

CHAPTER 1. Research background and introduction

This chapter introduces the rationale for this PhD by demonstrating the significance of product repair to sustainable production and consumption and the current state of knowledge on this topic. Then it describes the research scope, considering product sectors and human generations, followed by objectives and the outline of this thesis.

1.1. Product repair for sustainable production and consumption

Section 1.1.1 provides an overview of repair, product repairability and agents participating in repair process. The next two sections (1.1.2 and 1.1.3) discuss the importance of product repair to sustainable production and consumption.

1.1.1. Definition of product repair

In the literature, damage and repair embody many contradictions. Repair is widely known for bonding, sealing, adjusting or replacing worn or defective parts (Salvia *et al.*, 2015) to restore a faulty, damaged or worn product to an acceptable or usable condition (Cooper and Salvia, 2018) or even to redefine or personalise a product (Graham and Thrift, 2007). Damage may lead to innovation (Jackson, 2014) and repair can make something work better (Burnham, 2011), create and destroy narratives, embrace old and new (Spelman, 2002). Repair operation often includes ‘product identification, failure identification, disassembly and reassembly, replacement of spare parts and restoration to a working condition’ (Bracquené *et al.*, 2018, p.11). However, it may also be associated with upgrading when replacements are superior to the original material or components (Salvia *et al.*, 2015), seeking to improve product quality or performance. Breakage, therefore, may potentially generate an opportunity more than a threat or end (Graham and Thrift, 2007) and repair can be defined as a way to ‘extend the durability of the old but also the appearance of the new’ (Jackson, 2014, p.223). Additionally, Graham and Thrift (2007, p.1) consider maintenance and repair together as they both keep modern societies going; additionally, they can be a source of variation, improvisation and innovation. Nevertheless, user-based repair and maintenance (Salvia *et al.*, 2015; Ellen MacArthur Foundation, 2016; Harmer *et al.*, 2019) can be feasible only if they were designed for.

A repair process may be associated with a complex or fragmented set of activities that include participation of different organisations and individuals. A report for the UK’s Waste and Resources Action Programme (WRAP) (Parker *et al.*, 2012) listed repair routes based on geographic locations: at home, on the high street and at the manufacturing base. Repair can be done at home by the owner, their family or friends, so-called Do-it-yourself (DIY) or self-repair. The concept of a self-repairer has emerged from the ‘fixer movement’, supported by social, community and digital enterprises and organisations such as iFixit, The Restart Project and Repair Café International Foundation (Charter and Keiller, 2014, 2016; Ellen MacArthur Foundation, 2016; Dermody, Nagase and Berger, 2020). If the owner needs support, community-based repair events registered with The Restart Project and Repair Café International or launched by local sustainability activists and researchers are growing in

popularity, through which repair work can be done either by the owner under instruction of professional people or by voluntary repairers, such as Farnham Repair Café and Nottingham Fixers. Another option is commercial repair which is offered by specialist independent repairers, manufacturers, retailers or authorised agents such as insurance, warranty or repair service providers (Parker *et al.*, 2012; Cooper and Salvia, 2018).

In this PhD, repair is restoring functional or aesthetic value of a faulty or worn product to an acceptable or usable condition. Table 1 shows the main repair routes considering where repair work to consumer products takes place.

Table 1: Main consumer repair routes (developed from Parker *et al.*, 2012, p.8)

Repair location	Repair agent
Home	DIY consumer
	Independent
	OEM agent
	Leasing manager
Community event/ facilitated repair events	DIY consumer
	Voluntary DIY repairer
High street	Retailer
	Independent
Return to base	OEM agent

Past research suggests that the reparability of a product can be characterised by the owner, the product and the context (Cooper and Salvia, 2018). In other words, the consumers' engagement in the circular economy, including repair activities, are influenced by economic, social and psychological factors (European Commission, 2018). Reparability may depend on personal values, attitudes, beliefs, habits and attachment to the product (Cooper and Salvia, 2018). Sennett (2009) classified repairs into two types – 'static repair' and 'dynamic repair'. The former is concerned with replacing 'like-for-like' parts. The latter requires deeper thinking that 'may change the object's current form or function once it is reassembled' (ibid, p.200) such as patching worn jeans or removing stain from furniture. He also added tools designed for restorers are likely to encourage repair that is fit-for-purpose-only, whilst all-purpose tools can be used to explore repair in various and innovative ways. However, the lack of knowledge, tools and skills (DEFRA, 2011; Dewberry *et al.*, 2016; Cooper and Salvia, 2018) may prevent consumers from identifying the right approach and even stop them considering repair.

Therefore, repair can reevaluate or devalue an object, or in some cases do both (Gregson, Metcalfe and Crewe, 2009). This can explain the product owner's fear or frustration of failures in repair (McCollough, 2010; Department for Business, Innovation and Skills, 2014). In addition to consumers' psychological factors, poor design of products, such as inappropriate joining techniques and low-quality materials, can hinder fixing them when they are faulty or broken (Slade, 2006; McCollough, 2010). These problems can reduce the likelihood that items will be fixed and can even cause further damage during repair. When it comes to the context, the inconvenience of repair can be generated by challenges in, and the waiting time to find a reliable repair shop (Page, 2014) and spare parts, especially when they are sourced from overseas ones requiring lengthy transportation (Graham and Thrift, 2007; Scott and Weaver, 2014). Transparency of information provision regarding the repairability of products and the cost of replacement parts and labour were addressed by the European Consumer Organisation BEUC (Maurer and Pacht, 2015). Without such information, consumers may assume that repair is often related to high labour cost and over-priced spare parts when comparing to costs of replacement (Watson, 2008; McCollough, 2010; European Environment Agency, 2017). As a result, replacement appears preferable when consumers consider cost-effectiveness and trends in products (McCollough, 2010; European Environment Agency, 2017).

In general, transformation into higher levels of sustainable production and consumption through product repair requires governmental interventions, new business models and grassroots repair initiatives. The current consumerist – throwaway culture, is driven by economic, commercial and political pressures (Bracquené *et al.*, 2018; Cooper and Salvia, 2018; European Commission, 2018, 2019). The following two sections reflect upon the significance of these transformations in detail. Recently, Benelux – a politico-economic union and formal international intergovernmental cooperation of three neighbouring countries, Belgium, Netherlands and Luxembourg (Bracquené *et al.*, 2018), and the Joint Research Centre funded by European Commission (European Commission, 2019) developed two scoring systems for the repairability of electrical and electronic products. In short, they both strongly suggest considering product design, information provision and servicing. However, many hypotheses regarding the implications of these scoring systems appear to be questionable, considering their commercial viability, consumers' understanding of the scoring, rapid change in market demand and technology.

1.1.2. Growth of interest in product longevity

Interest in product longevity has increased in both academic studies and government reports. Academic research has explored this topic from various disciplines such as consumer behaviour and expectations toward product lifetimes, design approaches and tools, lifetime extension solutions, product-service systems, and business models (Cooper *et al.*, 2015; Bakker and Mugge, 2017; Nissen and Jaeger-Erben, 2019). Many academic studies were cited in a European Parliament report (2017) and submitted to UK Parliament Environmental Audit

Committee's (2019, 2020) calls for evidence considering clothing and electronic waste and the Circular Economy.

International conferences, such as Product Lifetimes And The Environment (PLATE), encompass product lifetimes in the context of sustainability and attract the participation of academic researchers, policy makers and industry representatives. Eco-design, reuse, recycling and repair of products were popular topics in PLATE 2019 (Nissen and Jaeger-Erben, 2019) and PLATE 2021.

The European Commission adopted the new Circular Economy Action Plan in March 2020 (European Commission, 2020a). This new action plan announced initiatives along the entire life cycles of products, particularly considering how to improve product design, promote circular economy processes and encourage sustainable consumption.

1.1.3. Product repair and sustainable production

Repair could represent a sustainable alternative to replacement as it could improve resource security and material efficiency by maintaining the functionality of products (Graham and Thrift, 2007; Stahel, 2010; Jackson, 2014; Salvia *et al.*, 2015) and delaying disposal (King *et al.*, 2006; Oakdene Hollins, 2013; Cooper and Salvia, 2018). Preliminary work exploring different strategies for reducing waste suggest that repair may require the least additional energy and material when compared to recycling and remanufacturing (King *et al.*, 2006).

The next four paragraphs address the significance of environmental impacts for three industries (e.g. electrical and electronics, furniture and textiles industries) and explain the rationale for studying these three product sectors in this PhD.

Recent studies addressed concerns about wastes generated from the production and consumption of furniture, textiles and electrical and electronics products and their harm to the environment. 670,000 tonnes of furniture, more than 310,000 tonnes of WEEE (WRAP, 2012a) and 350,000 tonnes of clothes (WRAP, 2017) go to the landfill every year. A striking feature of repair can be the saving of furniture, textiles or electrical and electronic goods, which account for the highest proportion of annual bulky waste in the UK; over 50% of discarded items can be reused directly or after slight repair (WRAP, 2012a).

According to the Global E-waste Monitor report, electrical and electronic product manufacturing has contributed significantly to the growth of the global economy and digitalisation (Balde *et al.*, 2017). Nonetheless, this industry has also produced considerable e-waste problems as each person generates more than six kilograms of e-waste on average, equivalent to globally 44.7 million metric tonnes every year. A letter sent to the European Commission on behalf of 38 European organisations by Right to Repair Europe campaigners argues replacing 600 million smartphones every year in Europe generates more than fourteen million tonnes of CO₂e, exceeding yearly emission of Latvia (Mikolajczak, 2020). Their analysis, which was confirmed in a report by the European Environmental Bureau (EEB, 2019), indicated that by extending Europe smartphones' lifetime by just one more year could

save over four million tonnes of carbon dioxide, the equivalent to taking two million cars off the roads. Each computing, IT product and mobile repaired is expected to save nearly 202 kg CO₂e (Privett, 2019), equivalent to the amount produced from driving a petrol- or diesel-fuelled car for 1,000 kilometres.

Similarly, clothing production is another major contributor to environmental resource scarcity, climate change and social issues. It has been suggested by the Environmental Audit Committee (2019) that expanding garment lifetime, through repair, can effectively reduce their environmental footprint. For example, extending their life by an extra nine months could save between 20 and 30 percent of carbon, waste and water footprints, respectively (WRAP, 2017). Fashion production was reported to generate about 1.2 billion tonnes of CO₂e every year, greater than international maritime shipping and flights combined (Ellen MacArthur Foundation, 2017). Significantly, a T-shirt or a pair of jeans, accounting for one kilogram of cotton, consumes between 10,000 and 20,000 litres of water within their production (WRAP, 2012b). In respect to social issues, 77% of seventy-one leading UK retailers were reported to have modern slavery practices at some stages within their supply chain (Lake *et al.*, 2016). The majority of global garment workers have poor working conditions and live in poverty because of a lack of a living wage (Fashion Revolution, 2018). This is especially true of those at the bottom of the value chain such as working in factories or farms (Environmental Audit Committee, 2019). Cost competition, particularly in fast fashion, has increased the severity of these problems. However, approximately \$500 billions of value is lost annually due to the underutilising garments and the lack of recycling (Ellen MacArthur Foundation, 2017). If every piece of clothing was used for about three years then, besides the environmental benefits, there would be a decrease of nearly £5 billion annually in the costs of resources related to the supply and disposal of clothing (WRAP, 2012b) and the associated social costs. For these reasons, extending product lifetimes such as through mending clothes has a potential to save these costs.

The latest Global Market Insights report (Global Market Insights, 2019) emphasises the rapid growth of global market size in the furniture sector to approximately the same level as the electronics and electrical industry. Environmental and social concerns have also arisen in furniture manufacture, which generated over 800,000 metric tonnes of CO₂e in 2017 in the UK alone (Sönnichsen, 2019). According to the Furniture Industry Research Association (FIRA), sofas generate the highest carbon footprint, among domestic furniture products, of 90 kg CO₂e, followed by 88 kg CO₂e from sofa beds and 72 kg CO₂e from desk chairs (FIRA, 2011). Foams and fillings make up around 45% of a sofa's carbon footprint, followed by 20% textiles and 15% timber and board. A recent report from the World Wide Fund for Nature UK (WWF-UK) uncovered that seventy-four UK retailers, including DFS, Harrods and Harvey Nichols, could not provide responsible sourcing information or any policy and statement relating to this (Drewe and Barker, 2016). For example, many of them could not clarify the timber's country of origin (i.e. where the forest is), but only the import partner country (i.e. where the timber is imported from). Irresponsible sourcing has led to significant environmental and

social concerns, particularly the destruction of natural forests, illegal logging processes, low income in producer countries, corruption and tax evasion (ibid).

It is widely held by critics that obsolescence, both functional and aesthetical, is embedded within product design. The intention of generating demand for new sales, thus requires frequent product replacement (Cooper, 2004; King *et al.*, 2006; Slade, 2006; Graham and Thrift, 2007), regardless of environmental and social impacts from over-production. King and his colleagues emphasise two reasons that cause product replacement: functional and fashion obsolescence (King *et al.*, 2006). The former is associated with physical failures that require product repair, whilst the latter is concerned with products that lose their appeal because of a new product with different or additional features is introduced into the market.

Conversely, merely focusing on the environmental impacts and oversimplifying the economic factors may be inadequate. The existing literature focuses mostly on the consumers' perspective, and recommendations for businesses are sometimes questionable concerning commercial viability. For example, a behavioural study on consumers' engagement in the circular economy (European Commission, 2018) suggests businesses should provide detailed information about the characteristics of repair services, such as whether the service is provided by the authorised or an independent service provider. These initiatives are expected to generate consumer behaviour changes and sustainable transformations of repair practices. The research of the Joint Research Centre (European Commission, 2019) on reparability scoring systems also encourages manufacturers to incentivise innovative changes in product design, repair facilities, information and other forms of support. Whilst these two large-scale studies, funded by European Commission, take economic considerations into account, they are limited to spare parts and labour costs, without considering other operating costs (e.g. inventory management, reverse and forward logistics) and organisations' revenue streams (e.g. profitability of commercial repair and its influence on sales performance). Business model innovation, in theory, is essential to create sustainable strategies. Lüdeke-Freund (2010) argued that a sustainable business should generate 'superior value' to customers and be instrumental in the sustainable development of the company and society as a whole. Therefore, providing repairable products and commercial repair services should be beneficial not only to consumers but also product and service providers.

1.1.4. Product repair and sustainable consumption

The current, linear economic model has been successful in creating low-priced and on-trend products but at the cost of shaping lifestyles that demand fast and unsustainable consumption. Previous studies suggest that the decline in repair is associated with a throwaway culture and unsustainable consumption (McCollough, 2009; Cooper and Salvia, 2018), even though 77% of consumers in the EU claim to prefer making an effort to fix their products to replacement (Eurobarometer, 2014). The Joint Research Centre (European Commission, 2018) suggests that the main reasons for low engagement of consumers in repair are high costs, and inconvenience caused by inappropriate design, a lack of repair

manuals and difficulty in obtaining spare parts. Similarly, 80% of surveyed consumers suggested that manufacturers should make digital devices more repairable (European Commission, 2020b) and more than 160 million garments could be brought back into use if repaired (unpublished Consumer Clothing Behaviour Survey 2011, cited in WRAP (2012b)).

The benefits of product repair have recently generated interest among the general public through initiatives and political discussion in regard to transforming the throwaway culture. More than 2,220 repair cafés all over the world currently registered with the Repair Café Foundation and a VAT reduction on repair work introduced in Sweden and the Czech Republic. Indeed, 20 states of the USA had introduced Right to Repair legislation by 2019, and two protests, in December 2018 and January 2019 in Brussels, called for EU member states to defend the right to repair. In September 2019, the Right to Repair Europe campaign was launched by repair businesses and environmental organisations, including the European Environmental Citizens Organisation for Standardisation (ECOS) and European Environmental Bureau (EEB), to pressure policymakers into adopting legislative measures to support and encourage repair.

However, consumers' preference for product longevity might vary across different product sectors. Gnanapragasam et al.'s (2018) study on consumer perspectives in eighteen product sectors found that the longevity of electronic goods, furniture and large kitchen appliances appeared more important than for clothing and small household appliances. This result seems to be in line with that of Joint Research Centre (European Commission, 2018) in which participants expressed higher personal interest in repairing large or expensive objects, such as white goods or smartphones, and lower for fashion or personal items such as clothes. However, repairability can be influenced by the owner, the product and the context (Rosner and Ames, 2014; Cooper and Salvia, 2018). Therefore, the following three sections (1.2, 1.3 and 1.4) provide a comprehensive synthesis of the literature to demonstrate the current state of knowledge on opportunities for and challenges to repairing electrical and electronic equipment (EEE), clothing and furniture and gaps in the literature.

1.2. Current state of knowledge about EEE repair

Considering both the literature and practice, breakage in the EEE sector can be seen in four categories: worn-not-torn, faulty-but-functional, faulty-not-functional and irreparable. 'Worn-not-torn' items are more likely aesthetically damaged, such as a phone with broken screen or casing (Wieser and Tröger, 2016). For 'faulty-but-functional', there should be something wrong with the products that may affect their performance, but they are still functioning – such as low suction in a vacuum cleaner, as mentioned in Salvia et al. (2015). Products are both faulty and dysfunctional can be classified as 'faulty-not-functional'. For example, a vacuum cleaner can stop working after a loss of suction (Salvia et al., 2015) or due to a breakage of the power button. Finally, 'irreparable' objects are those that suffered irreversible damage. However, the repairability of a product may be subjective as it can rely on personal values, economic cost, attitudes, beliefs and habits (Cooper and Salvia, 2018).

These may generate a gap between the actual and perceived brokenness of vacuum cleaners (Salvia *et al.*, 2015).

Considering the two types of repair classified by Sennett (2019), common failures of small household EEE listed in Bovea *et al.* (2017) appeared to need 'static repair' through replacing 'like-for-like' parts. Nevertheless, some repairs may need more time and effort to seek spare parts and repair information. Repairability scoring systems developed by iFixit in a partnership with Greenpeace (Greenpeace, 2017), BENELUX (Bracquené *et al.*, 2018) and the Joint Research Centre (European Commission, 2019) and recent American and European campaigns for rights to repair are likely to make repairs more 'static'. For example, they urged governments to require manufacturers to provide repair manuals and spare parts so that various repairers can easily replace broken parts. Repairers can range from DIYers and voluntary repairers at community events to commercial repairers including manufacturers, retailers, authorised agents (such as KRCS Group Ltd authorised by Apple, or Domestic and General Insurance PLC) and independent service providers who are repairers from nationwide companies (such as Pacifica Group), high-street shops or call-out services.

Product repair in EEE has received much attention in academic and practical research, ranging from psychological consumer behaviour to product design and multidisciplinary approaches. In academic research, several psychological behaviour studies investigated consumer attitudes towards repair, considering different small appliances (Bovea, Pérez-Belis and Quemades-Beltrán, 2017; Pérez-Belis *et al.*, 2017) or focusing on a particular product, including vacuum cleaners (Salvia *et al.*, 2015) and mobile phones (Wieser and Tröger, 2016).

The two Spanish studies, by Bovea, Pérez-Belis and Quemades-Beltrán (2017) and Pérez-Belis *et al.* (2017), focused on common failures, challenges to repair from the perspective of professional repairers, the influences of consumers' decisions for getting items repaired (particularly considering repair costs and time of use after repair) and rationales for not getting them repaired. The most common minor repair reported in the study was changing power cables in cheaper items (including hand blenders, juicers, sandwich makers, hairdryers, irons and toasters). More various and expensive repair work was found for more expensive appliances, such as replacing motors in vacuum cleaners, variable resistors in coffee makers and circuit boards in heaters. Other minor repairs were associated with replacement of outer components such as power buttons, handles and wheels. Prior to this, a preliminary Canadian study (Déméné and Marchand, 2015) took a similar approach – focusing on commercial repairers' perspectives, to identify motivations for and barriers to professional and DIY television repair through interviews with three authorised repairers, two independent home repairers and an independent supplier of spare parts. This study raised concerns about high repair costs compared to replacements, the complexity of new TVs' designs and their electronic components. Several studies on vacuum cleaners (Salvia *et al.*, 2015; Harmer *et al.*, 2019) addressed the impacts of consumers' perception of product brokenness (i.e. which was closely connected to machines' conditions, their interests in maintenance (e.g. emptying the container of dust to preserve suction power) on product

lifetimes and barriers to repair (e.g. inconvenience and high cost of repair compared to replacement). Similarly, a mixed-method study on mobile phones (Wieser and Tröger, 2016) demonstrated the importance of perceived obsolescence – considering ‘basic functionality, up-to-datedness and ability to keep up with social practices’ (p.1) – in repair and replacement decisions.

Despite their interest in psychological consumer behaviour, these academic studies have been limited to personal values, attitudes (i.e. beliefs about outcomes), personal capabilities (e.g. repair knowledge and skills) and perceived barriers to repair. Situational factors and habits, in theory, can influence pro-environmental consumption, particularly locking people into unsustainable behaviours despite their best intentions (Jackson, 2005). McCollough (2009) proposed an empirical model, tested on televisions, explaining the interrelationship between the decreased demand for repair services and the lower employment of repairers, higher repair costs and cheaper replacements, to clarify the rationale behind consumers’ behaviour changes. Although this approach is noteworthy, it fails to take into account whether these challenges are perceived or actual, and whether they vary and are transferable across different products and product sectors. Furthermore, a major criticism of consumer research on sustainable consumption generally is an oversimplification of intention-behaviour gaps (Bagozzi, 2000; Davies, Foxall and Pallister, 2002; Morwitz, Steckel and Gupta, 2007; Carrington, Neville and Whitwell, 2010), which is also ill-defined in the literature on repair behaviour. This limitation is further explained in Chapter 2.

Several environmental organisations have also attempted to define product repairability. A report of the UK’s Waste And Resources Action Programme (WRAP) (Parker *et al.*, 2012) provided a comprehensive review of the literature, current practices and potential business models that facilitate the increase of EEE repairs, including home, high-street and ‘return to base’ repair routes. The Reuse and Recycling EU Social Enterprises Network (RREUSE, 2013) conducted a qualitative study to extensively gather reuse and repair centres’ insights into the repairability of products such as fridges, washing machines and dishwashers, focusing on common causes of breakdowns and challenges to repair. An increase in DIY repair practices, either at home or through community events, was noted in a report of the Ellen MacArthur Foundation in a collaboration with eBay, HP and iFixit (Ellen MacArthur Foundation, 2016).

A narrative synthesis of barriers to repairing EEE from the owner, product and context is presented below in Table 2, Table 3 and Table 4.

Table 2: Barriers to EEE repair to the owner

Barriers to the owner	Narratives
Lack of knowledge, tools and skills	<p>Lack of knowledge about even simple tasks, such as changing fuses (Parker <i>et al.</i>, 2012; Cole and Gnanapragasam, 2017b) and about existing repair ventures (Cole and Gnanapragasam, 2017b)</p> <p>Smartphones: apart from battery and screen replacement, other repairs requiring specialist skills and tools (Parker <i>et al.</i>, 2012; Greenpeace, 2017)</p> <p>Computers and laptops: lack of knowledge of and confidence in software fixes, requiring different sets of tools (Parker <i>et al.</i>, 2012)</p>
Lack of time	<p>Time-consuming repair of glued-based assembly, compared to screw-based design (Raihanian Mashhadi <i>et al.</i>, 2016)</p> <p>Computers and laptops: high frequency of use preventing repair (Parker <i>et al.</i>, 2012)</p>
Fear of quality of repair work	<p>Consumers dissatisfied with the outcome of repair provided by a service (McCollough, 2009), lack of trust in commercial repairers (Cole and Gnanapragasam, 2017b), lack of confidence in self-repair (Cole and Gnanapragasam, 2017b)</p> <p>Smartphones: loss of data (Parker <i>et al.</i>, 2012)</p>

Table 3: Barriers to EEE repair from the product

Barriers from the product	Narratives
<p>Difficulty to disassemble</p>	<p>Joining technologies prevent separation of components and lead to damage of components during separation, such as epoxy resin adhesive bonding (Ijomah and Danis, 2012, p.)</p> <p>Computers and laptops: LCD screens and soldered PCBS difficult to remove undamaged (Parker <i>et al.</i>, 2012)</p> <p>Televisions: LCD screen and case clipped together (Parker <i>et al.</i>, 2012)</p> <p>Smartphones, tablets and laptops: devices designed to be difficult or costly to replace (Greenpeace, 2017)</p> <p>Microwaves: different types and sizes of screws, snap-fits, plastic support to mount and affix PCBs to the inside of the case unit, making replacement of PCBs time consuming and causing damages to the board and connector cables (Dindariana, Gibsona and Quariguasi-Frota-Neto, 2012)</p> <p>Washing machine: electronic control board sealed with resin and door hinges fused to the machine (RREUSE, 2013)</p> <p>Refrigerator: controller keypad built into the door, impossible to access the resistor, gas tube integrated into the cabinet, irremovable rubber seals (RREUSE, 2013)</p> <p>Dishwashers: heating resistors fastened and clipped to the case (RREUSE, 2013)</p> <p>Small appliances: hidden screws, different tools required to open non-standardised screws (Bovea, Pérez-Belis and Quemades-Beltrán, 2017)</p>
<p>Difficulty to diagnose faults</p>	<p>Microwaves: strange noises, failure to start up, sparking when powered on, faulty turntables, rust (Dindariana, Gibsona and Quariguasi-Frota-Neto, 2012)</p> <p>Washing machines: specialised tools and software designed for fault diagnosis and only available to the after sales service providers of the manufacturers (RREUSE, 2013)</p> <p>Refrigerator: difficult to locate leaks of gas due to tubes integrated into the cabinet; specialised tools only available to the after-sales service providers of the manufacturers (RREUSE, 2013)</p>
<p>Low-quality materials</p>	<p>Non-durable material, leading to breakage during repair (Ijomah and Danis, 2012)</p> <p>Smartphones: budget products more likelihood to break or lose functionality (Wieser and Tröger, 2016)</p>

<p>Non-standardised parts</p>	<p>Inconvenience of repair due to variety of and rapid change in design (Raihanian Mashhadi <i>et al.</i>, 2016)</p> <p>Small household appliances (e.g vacuum cleaners, hand blenders, coffee makers, heaters, juicers, irons, sandwich makers, hair dryers and toasters): difficulty to find standard parts (Bovea, Pérez-Belis and Quemades-Beltrán, 2017)</p> <p>Refrigerators: difficult to find exact electronic boards and rubber sealants (RREUSE, 2013)</p> <p>Dishwashers: difficult to find replacement motors, electronic boards, dishwasher tray and accessories due to rapid change in design (RREUSE, 2013)</p>
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Table 4: Barriers to EEE repair from the context

<p>Barriers from the context</p>	<p>Electronics and electrical items</p>
<p>Lack of information on the repairability of products and costs of parts</p>	<p>Many manufacturers' repair guides only available to authorised repairers, and not independent repairers and consumers (Ellen MacArthur Foundation, 2016)</p> <p>Smartphones: manufacturers failing to make repair manuals available (Greenpeace, 2017)</p> <p>Washing machines: accessing repair manuals to diagnose faults only for official after-sales service providers of manufacturers (RREUSE, 2013)</p> <p>Refrigerators: lack of availability concerning technical information of parts, such as information about the compatibility of thermostat sensors and appliance models (RREUSE, 2013)</p>
<p>Expensive/unavailable spare parts</p>	<p>Expensive spare parts, even for high-end products (Ellen MacArthur Foundation, 2016)</p> <p>Decline in the availability of parts due to rapid changes in technology, models and production overseas (Parker <i>et al.</i>, 2012)</p> <p>Vacuum cleaners: the range of parts supplied depending on manufacturers (Parker <i>et al.</i>, 2012)</p> <p>Computers and laptops: parts only available within three years, keys of keyboard unavailable to purchase individually (Parker <i>et al.</i>, 2012); lack of infrastructures of diagnostic and repair parts (Rosner and Ames, 2014)</p> <p>Game consoles: parts sourced from Far East, with five-month lead time (Parker <i>et al.</i>, 2012)</p> <p>Televisions: manufacturers do not make parts available beyond three years (Parker <i>et al.</i>, 2012), retailers prefer to sell entire products instead of keeping parts in stock due to rapid change of technology (Déméné and Marchand, 2015)</p> <p>Washing machines: ball bearings pressed into the plastic casing of the drum and only the complete casing, including the drum, available in the market (RREUSE, 2013)</p>

<p>Better offer of replacement</p>	<p>Washing machines: advancing technologies and more energy-efficient models (Parker <i>et al.</i>, 2012)</p> <p>Smartphones: free replacement offered on a contract (Parker <i>et al.</i>, 2012); new products increasing perceived obsolescence of older ones (Wieser and Tröger, 2016)</p> <p>Computers and laptops: more complex electronic circuits, increased power requirements, higher speed processors, new components and material technologies making old products obsolescent, lower price of new, refurbished or remanufactured products (Parker <i>et al.</i>, 2012)</p> <p>Televisions: dilemma of budget-range products from China and Taiwan and high repair labour costs in the UK, replacement preferred by manufacturers and consumers, on-going process of innovation e.g. digital TV (Parker <i>et al.</i>, 2012)</p>
<p>High costs of repair: high labour cost and over-priced spare parts</p>	<p>High cost for logistics of parts and labour (McCollough, 2009)</p> <p>Washing machines: drum replacement costs a quarter of the price of a new appliance (Parker <i>et al.</i>, 2012)</p> <p>Vacuum cleaners: repair costs in the UK exceed the EU average (Parker <i>et al.</i>, 2012)</p> <p>Computers and laptops: screen replacement costs nearly a quarter of the price of the new device (Parker <i>et al.</i>, 2012)</p> <p>Televisions: replacement cost for LCD screen higher than the TV original cost of the TV (Parker <i>et al.</i>, 2012)</p> <p>Fridges freezers: replacement cost of a burnt-out motor higher than that of a new machine (Parker <i>et al.</i>, 2012)</p> <p>Dishwashers: high replacement price of new motor, pump and electronic boards (RREUSE, 2013)</p> <p>Small appliances: repair cost similar to buying a new one (Bovea, Pérez-Belis and Quemades-Beltrán, 2017)</p>
<p>Insufficient or inappropriate repair service</p>	<p>Televisions: challenges to independent repair shops' survival due to high price of parts that leads to labour margins to make repair more economic; manufacturers' monopoly behaviour in providing repair services; rapid technological advances and the need for high-performance equipment (Déméné and Marchand, 2015)</p> <p>Washing machines: difficulty to stock up key used spare parts such as electronic boards, timers and pumps due to the sheer volume of different models (RREUSE, 2014)</p>
<p>Voiding warranty</p>	<p>Laptops and computers: manufacturers make warranty provision void if repairs are attempted (Rosner and Ames, 2014)</p>
<p>Influences of other people</p>	<p>Smartphones: societal and peer pressure to own the latest phone (Wieser and Tröger, 2016)</p>

Previous work has provided both theoretical and practical underpinnings which support the fixer movement and environmental campaigns to fight for rights to repair, encouraging changes in product design, the provision of spare parts, repair manuals and repair services. These have been considered significant in the repairability scoring systems of iFixit (Greenpeace, 2017), BENELUX (Bracquené *et al.*, 2018) and the Joint Research Centre (European Commission, 2019), which are aimed at providing a legal framework for the policymaking process, increasing business responsibility and raising consumers' awareness. However, these scoring systems suffer from a lack of evidence of commercial viability, which has not been explored in academic research.

Another neglected area in this field is whether consumers' experiences of repair journeys vary across different products, and whether and how their attitudes and experience towards a specific product could influence those of other products.

1.3. Current state of knowledge about mending clothes

Repair in this product sector often includes mending wear and tear by using stitch-based techniques such as darning, sewing on buttons and stitching hems (Middleton, 2014). Mending, including visible and invisible repairs, to return clothes to working order. Common repairs and alterations include sewing a button, darning or patching a hole, taking a hem up or down, dyeing an item, replacing a zip, redesigning an item and replacing a pocket (WRAP, 2012b). Mending a garment, in practice, can be either 'static', 'dynamic' or both. For example, a pair of worn jeans can be mended through patching holes, modifying them (e.g. shorts) or upcycling (e.g. wallets).

Before the Second World War, repair and alterations, either at home or in an industry context, was normally for economic reasons (Gwilt, 2014). The labour costs associated with repair work was affordable, when compared to the price of new materials at that time. Mending clothes has traditionally been a home activity and until recently would have been regarded as a regular part of women's role (Allwood *et al.*, 2006). Potential repairers can be users and designers or who enacts a repair, whether it is a professional service, voluntary work or home DIY (Harvey, 2016). Professional repair can also be found at tailors or dry cleaning shops; however, high costs of labour appear to make this repair route unattractive in many cases (Allwood *et al.*, 2006). An emerging approach to encourage and motivate DIY repairs is participatory activities led and facilitated by practitioners (Harvey *et al.*, 2015) and community repair projects such as Repair Cafes. These activities are expected to reframe mending as a social and enjoyable affair (Gwilt, 2014b; McLaren and McLauchlan, 2015) and give participants an opportunity to add personal touches that could help to 'engender the sense of individuality and self-definition' (Chapman, 2005, p.109). Several fashion brands have started offering repair services at their stores for free (such as Nudie Jeans) or for a fee (such as Levi's). Patagonia and Nudie Jeans have also launched repair tours, aimed at raising public awareness of extending the life of garments through repair and offer free repair services to customers in the USA and European countries (such as the UK, France, Switzerland, Austria, Germany and Italy).

However, many garments are still disposed of (YouGov, 2012; WRAP, 2017), around one in five consumers could use more than 50% of their unworn clothes if they were repaired, equating to approximately 166 million garments (WRAP, 2012b). Several studies have introduced and conceptualised clothes mending and their challenges from design-led and social-led perspectives with regard to sustainable consumption, particularly focusing on community-based repairs (Dilys, 2011; Gwilt, 2014b; McLaren and McLauchlan, 2015). Considering barriers to the garment owner, most participants in participatory design or public engagement events held by McLaren and McLauchlan (2015, p.225) argued that darning is not only 'time-consuming and laborious', but also generate 'scruffy and messy looking' clothes in practice which are considered 'not appropriate for the workplace'. These are consistent with the findings of an earlier study (WRAP, 2012b) which discovered that consumers would prefer repair if they cannot afford to buy new garments and have the necessary skills, spare time, repair kit and sewing machine. However, Middleton (2014) argued that the stitch-based techniques often require low-cost equipment, basic skills and not much time. In addition to competences and time, visible repairs appear to negatively influence consumer behaviour as found in the research for Defra (Fisher *et al.*, 2008). Imperfect garment surfaces and visibly worn or damaged clothes were associated with economic hardship (Black, 2008; Kelley, 2009). People who mend clothes may need confidence to accept the potential altered aesthetic (Harvey, 2016). Moreover, repair techniques and skills in practice vary across different fabrics and locations of damage, which can challenge self-repair in different ways and complicate commercial services. For instance, Clothes Doctor, the first UK digital clothing maintenance service provider, offers a wide range of repairs e.g. mending holes in various fabrics (i.e. wool, cashmere, denim, cotton and silk) in different positions (i.e. on surface, in seam or pocket), replacing zips, buttons, hook or beading, fixing unrolled hems, relining jackets, reversing T-shirts' collars and rehydrating leather garments.

A comprehensive consideration of fast fashion is essential to assess barriers to mending from not only the owner's perspective, but also the product and context. The fast fashion industry, characterised by low prices and non-durable garments, has boosted remarkably (Fisher *et al.*, 2008; Laitala *et al.*, 2021), offering a wide range of readily available replacements and leading to clothing being considered 'throwaway' (Birtwistle and Moore, 2007). In other words, consumers seem to no longer need repair skills (Middleton, 2014) and attempt to interact with damaged garments as products are presented to them as 'complete and closed' (Fletcher, 2008). Fisher *et al.* (2008) and (Laitala *et al.*, 2021) argued that clothing mending depends mostly on skill level, the affordability of professional repair service and the opportunity for a quick and cheap replacement. In the same vein, participants in the research of Gibson and Stanes (2011) and Goworek *et al.* (2015) admitted that they often avoided mending clothes due to lack of time and skills and cheap prices of new garments. Low-quality 'fast fashion' items may be less easy to repair than higher quality products (Allwood *et al.*, 2006; Laitala *et al.*, 2019). A similar result was evidenced in a study of Risannen (2011), even though clothing products can be purposely designed for repairs or alterations. The enjoyment

that consumers have when purchasing new products, replacing the old and worn ones, seems to significantly challenge the needs of repair (Harvey, 2016), especially when repair and alterations services were found to have a prohibitive cost (Fisher *et al.*, 2008; Laitala *et al.*, 2021).

According to Fisher *et al.* (2008), skills and habits with regard to mending clothes appear to have declined. Contrastingly, about one-third of the UK population would bring unused clothes back into use if they had necessary skills or time to alter or repair clothes. Harvey (2016) developed a 'Repair Thinking' framework as a solution for these problems. This framework aimed to re-conceptualise (through encouraging co-design and a consideration of consumers' mending skills) and promote emerging principles of repair in the contemporary context. For example, it calls for 'openness' and 'social value' with regard to creative and innovative mending (i.e. visible repair) and skills sharing. This framework is in line with the recommendations from the studies of Gwilt (2014) and McLaren and McLauchlan (2015) on facilitated mending events. Armstrong *et al.* (2015) developed eight scenarios of potential dematerialisation product-service systems (PSS) and studied the consumer perception of them. One focused on repair, providing repair, tailoring and alteration to improve the fit for five years after purchase for a fee. However, this scenario was not valued by participants who did not anticipate wearing something for a long time, especially those aged 34 and under.

In general, previous work in clothing has provided a generic understanding of opportunities for and challenges to mending without considering the psychological complexity of consumer behaviour and changes which can be influenced by demographic factors (e.g. age and gender), habits and support from businesses and the government. The current state of knowledge is also limited to psychological behaviour, without considering opportunities for commercial repair and the roles of manufacturers and retailers in supporting sustainable consumption through DIY and professional garment mending.

1.4. Current state of knowledge about furniture repair

The Furniture Industry Research Association (FIRA) divides this product sector into four categories: kitchen, domestic, office and contract furniture (FIRA, 2011), as shown in Table 5. Contract furniture is an extension of the office sector which also includes contracted products for commercial premises such as hotels, restaurants, conference centres, schools and care homes.

Table 5: Four categories of furniture (revised from FIRA, 2011)

No.	Category	Sub-category	Narratives
1	Kitchen and dining		Wall unit, line unit, base unit, storage unit, worktops, appliance housing, base sink unit, dining table and chair
2	Domestic	Bedding	Bed, divan and headboard
		Upholstery	Sofa, armchair, footstool, electric chair and sofa bed
		Home office	Workstation, desk and chair
		Storage	Cabinets, chest of drawers, wardrobe
3	Office	Office chair	Task chair and visitor chair
		Office storage	Desk high pedestal, bookcase, wooden filling cabinet, tambour, steel pedestal and cupboard
		Office desk	Rectangular desk, bench desk, wave desk and workstation
4	Contract	Office	Chair, storage and desk
		Other	Dining table, dining chairs and waiting room beam seating

Repair in furniture is generally associated with restoration and conservation. Repair is to restore furniture, make it sound, functional and good-looking through mending, cleaning, painting and polishing (Phelps cited in Wilmering, 2004; Ackermann L., Tuimaka M., Pohlmeier A., 2019). Repair can also include treatment strategies allied with conservation rules (Wilmering, 2004), to respect and conserve their authenticity, especially antique furniture items. For example, damaged components can be repaired but original surfaces should be preserved. Rivers and Umney (2003), two former furniture conservation experts at Victoria and Albert Museum, classified repairs into different types of damage (Table 6).

Although furniture repair is traditionally undertaken by independent joiners and cabinetmakers, since the late 20th century it has also become a popular pastime of people who love DIY and are significantly influenced by manuals and how-to books (Wilmering, 2004), this cultural shift has yet to be investigated in the context of sustainable production and consumption. Commercial repair in this sector appears to be commonly provided by service providers such as Staingard and FIRA International, as recommended on the website of Association for British Furniture Manufacturers (BFM). FIRA International provides both commercial sector furniture repair and consumer services. Besides commercial repair, community-based furniture repair has not been mentioned in the reports of Repair Café

International Foundation (2019) and its practice seems to be infrequent (Charter and Keiller, 2016).

Repair strategies or treatment options appear to depend on the construction of furniture, techniques of component bonding and surface decoration, the position and size of the damage (Table 6). Therefore, furniture repair appears to be ‘dynamic’ as it requires more thinking (Sennett, 2009). However, it also depends on personal taste (Wilmering, 2004) in which consumers can decide to opt either for ‘static’ work focusing on restoring the functionality of items, or a ‘dynamic’ option considering the aesthetic and historical value (Table 6). presents potential technical challenges that emerged from different strategies to fixing specific faults (Rivers and Umney, 2003). However, reupholstery is not covered in these strategies. Challenges to reupholstering furniture can be re-webbing or fixing inner springs (Ryan, 2003).

In general, there is a significant need for research into consumer behaviour towards repair decisions and influences on behaviour changes, including the consumer perception of furniture damage (e.g. worn-not-torn, faulty-but-functional, faulty-not-functional and irreparable). Furthermore, research into promoting furniture repair practices from business and government perspectives should be considered. Due to the dearth of research on furniture repair, this PhD adopted damage types and repair strategies presented in Table 6.

Table 6: Furniture damage types and repair strategies (developed from Rivers and Umney, 2003)

Repair strategies	Technical challenges
i. Loose and broken joints	
Dismantling joints to remove degraded glue, check the fit of the joint and tighten it if necessary and provide a clean and well-prepared surface for adhesive bonding	Damage fragile decorative surface Cause further damage when dismantling other components or joints to fix a single joint
Adding wedges or dovetail keys (or butterfly joints) to stiffen joints	Damage fragile decorative surface Cause further damage when dismantling other components or joints to fix a single joint Cause joint failure due to undue stress when adding wedges Cause further damage when joint dependent on wedges and shrinkage (as wood dried to provide a tight joint, such as Windsor chairs made from unseasoned wood) or dovetail keys (because wood movement is restrained)

Fixing butt joints in which two pieces of wood glued together	<p>Damage fragile decorative surface</p> <p>Cause further damage when dismantling other components or joints to fix a single joint</p> <p>Lose material or change the shape or overall dimensions of components when re-planning edges to make them straight and true over the entire length, such as between tabletops and legs)</p>
Fixing knuckle joints (used to attach fly rails or legs to the main carcass frame) through replacing metal pivot pins by the same ones or wood and drilling a larger hole if necessary	<p>Damage fragile decorative surface</p> <p>Cause further damage when dismantling other components or joints to fix a single joint</p>
Cutting new parts, adding new wood or reinforcing broken parts with veneer, splines, loose tongues or dowel (normally for severely deteriorated joints)	<p>Damage fragile decorative surface</p> <p>Cause further damage when dismantling other components or joints to fix a single joint</p>
ii. Shrinkage check and splits (due to a reduction in relative humidity)	
Filling splits with veneer or silicone	<p>Offer an aesthetic improvement but devalue the object (for antiques)</p> <p>Make the repaired split more obtrusive than the original one</p>
Adding fixings (such as slot screws or shrinkage plates)	Cause further damage if fillings or fixings restrain movement across the grain
iii. Broken hinges	
Fixing rule joints by a refitting/ replacing hinge	<p>Cause warping or swelling of a drop leaf and hinge plate due to faulty fitting of hinges (e.g. loose hinges, poorly aligned screw, wrong size of screws)</p> <p>Lose material due to replacing damaged wood beneath the hinge before refitting the original/ new hinge.</p>
iv. Warped wood	
Counter-veneering the wood (because components veneered on one side only)	Involve major intervention, including dismantling and reassembling components which seems to be impossible for compressed furniture
v. Split wood and lost parts	

<p>Replacing a section (or adding new wood into the surface of wood) and reinforcing its joint by a dowel or false tenon</p>	<p>Position and type of damage dictate the joint used</p> <p>Should be treated immediately to prevent loss of pieces, damages and contamination of break surfaces with dirt or grease</p> <p>Need to balance the best aesthetic (e.g. suitable transverse and radial) integration with minimal loss of original material (when adding dowels or false tenons)</p>
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1.5. Extended producer responsibility and sustainable business model

This section presents the interconnection between extended producer responsibility and sustainable business models, with consideration of the repair context.

Extended Producer Responsibility (EPR) is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle (European Commission, 2014). Regarding product longevity, producers should retain physical or financial responsibilities over their products and invest in alternative business models for product lifetime extensions (Bakker and Schuit, 2017). Thus, EPR could also encourage and govern these responsibilities. For example, a report to European Commission (2018) recommended producers to focus on R&D in sustainable products and investments in sustainable business models and repair, reuse or recycle facilities.

Previous research claimed that the lack of producer responsibility was one of major barriers to repair (besides consumer behaviour), including lower product quality and high cost of repair (King *et al.*, 2006; Parker *et al.*, 2012; Cooper and Salvia, 2018). Similarly, a recent study found that many manufacturers were not responsible for and could not control further distribution downstream of spare parts for repair work (Bracquené *et al.*, 2018). This study in BENELUX also argued that producer responsibility should consider improving the availability of spare parts for repair work. Therefore, it suggested companies shifting their business models such as from selling products to selling services or product-service integration (i.e. out-of-warranty repair services provided by manufacturers, retailers or brands with pay-per-repair billing or monthly or yearly subscriptions). Business model innovation for sustainability could embrace these shifts (as discussed later, in Section 2.4.2).

1.6. Human generations and consumer behaviour

This research focuses on generation X consumers, who were born between 1965 and 1981, and generation Y consumers between 1982 and 1998. These two generations, generation X and generation Y (also referred to as 'Millennials'), are interesting to researchers and practitioners because they have substantial purchasing power and, at the same time, represent the majority of the workforce. According to United Nations Population Division, 'Yers' and 'Xers' account for about 45 per cent of the total population in the world and the highest proportion of global adults (cited in Tilford, 2018). They are forecast to make up 70 per cent of global labour by 2020 (Manpower Group, 2016).

1.6.1. Generation X

Generation X is characterized by technological and media awareness, and being sceptical and pragmatic (Littrell, Jin and Halepete, 2005; Jackson, Stoel and Brantley, 2011; Lissitsa and Kol, 2016). However, Xers have been seen as 'digital immigrants' whilst Yers are 'digital natives' (Bennett, Maton and Kervin, 2008). For that reason, many Xers still rely on traditional search and decision-making methods when shopping (Heaney, 2007). Although the proportion of Internet users among generation X is lower compared to generation Y, many more of them prefer online shopping (Heaney, 2007; Lissitsa and Kol, 2016). Many members of generation X grew up in a period with economic uncertainty and both parents in the workforce; therefore they became independent and have a strong self-study and technical ability (Eisner, 2005; Shaw and Fairhurst, 2008). Moreover, generation X was claimed to focus more on money making, whilst generation Y preferred making meaning of their life (Asghar, 2014). Each generation may have different preferences for repair and expectation of repair outcomes (e.g. to save money or environmental costs, or to enjoy repair work).

Valentine and Powers (2013) and Şchiopu *et al.* (2016) argued that Generation X appeared to look for high-quality products and services, trying to get as much information as possible and comparing different options before purchases. These authors also claimed that generation Y relied more on online comments and posts due to having fewer life experience and family responsibilities. The studies of Şchiopu *et al.* (2016) and Dabija, Postelnicu and Dinu (2018) also found that many members of generation X only recommended the brands which they had positive experience with, to other people. Previous research stated that this generation made purchase decisions mostly based on recommendations on reliable blogs and forums, instead of word-of-mouth suggestions (Mitsis and Foley, 2012). Members of this generation may also make repair decisions based on recommendations of other people.

1.6.2. Generation Y

Generation Y is perceived as the first high-tech generation (Norum, 2003) and is considered consumption-oriented and sophisticated shoppers (Wolburg and Pokrywczynski, 2001; Jackson, Stoel and Brantley, 2011). Shopping has been regarded, by Yers, as an entertaining and recreational hobby (Bakewell and Mitchell, 2003), rather than a simple act of purchasing. They appear to look to their peers to determine the value of a product and believe in the reliability of their peers' opinions rather than information from traditional media or company sources (Mangold and Smith, 2012). Consequently, generation Y's loyalty is liable to change quickly, particularly depending on trend and the popularity of brands, and focuses on quality and style rather than price (Reisenwitz and Iyer, 2009). Eastman and Liu (2012, p.58) argued that 'Yers' appear to be driven towards 'status-seeking consumption' as 'a means of displaying wealth and purchasing power'.

Yers seem to proactively use the internet and social media to gather information and engage in entertainment (Moore, 2012). For example, the 'selfies' phenomenon within Yers, 'recording every moment of their life and watching others', results in the proliferation and

overconsumption of fast fashion (Felsted and & Kuchler, 2015). Consequently, young people often end up consuming low-cost disposable products to stay fashionable.

However, Keeble (2013) has yielded a contradictory finding that Yers who are 'tech-savvy' and value the versatility of mobile devices such as smartphones, to stay connected, informed and engaged on global issues that are personally important. In particular, they are significantly concerned about social and environmental issues (Mangold and Smith, 2012). With Meister and Willyerd (2010) claiming that this generation is seen as 'the most socially conscious generation of the past five decades'.

1.6.3. Summary

These generational cohorts appear to have different experiences, values, attitudes and preferences that remarkably affect their consumption patterns and shopping behaviour (Parment, 2011, 2013) and preference for seeking information. The internet and digital innovations, including using social media, appear to encourage overconsumption and affect the perception of product obsolescence in generation Y. However, social media can also provide an efficient platform for sustainability communication, educating and engaging young consumers on sustainable consumption, through 'the interconnectivity of users and their exchange of experiences and advice' (Strähle and Gräff, 2017). This PhD studied factors that could influence repair journeys of each generation such as how to identify product faults and repair need and how to make informed repair decisions.

Additionally, males from both generations were reported to shop more than females (Kenan, 2010), especially when buying electronic products (Lissitsa and Kol, 2016). The potential of online shopping reduces with age for Xers due to tradition barriers, whilst the probability increases with age among Yers resulting from the growth of their families (ibid). In the light of disagreement between findings in the literature, this study also investigated potential impacts of other demographic factors such as gender on repair behaviour among each generation.

1.7. Problem statement, research aim and objectives

There is both academic and anecdotal evidence that product repair can be a key approach to sustainable production and consumption (Section 1.1).

Previous studies have illuminated opportunities for and challenges to product repair in electronic and electrical equipment, clothing or furniture items (Sections 1.2, 1.3 and 1.4). However, there is a dearth of literature which would enable a comprehensive understanding of repair decisions across these three product sectors.

The complexity of pro-environmental behaviour change involves conflicting influences (Jackson, 2005). Barriers to repair work characterised by the product, its owner and the context (Cooper and Salvia, 2018) can generate 'a gap between the willingness to engage and actual engagement' (European Commission, 2018, p.176), or differences between decisions and actions. However, no existing studies have considered the entire journey that consumers

go through before, during and after deciding whether or not to repair broken items and whether to go through a DIY or commercial route. Additionally, questions regarding the consumer experience of intention and behaviour gaps when thinking about and starting to repair a broken object need to be investigated, including whether consumers more often intend to repair a product themselves but end up using a commercial agent, or the other way around. Considerations should also focus on whether consumers' habits, such as information search methods, and gaps between perceived and actual barriers influence intentions and final behaviour.

In addition to the influence of consumer psychology, repairability is also associated with product design, repair information, spare parts and the services which are expected to be delivered by manufacturers and retailers. Recommendations for these transformations have been proposed in the literature (Section 1.1.3), through the fixer movement and campaigns for right to repair (Section 1.1.4), particularly in EEE (Section 1.2) and clothing (Section 1.3), but lack a consideration of commercial viability. These recommendations may require business innovations at organisation or industry levels (i.e. the EEE, clothing or furniture industries). Nevertheless, each manufacturer, retailer or brand may have its own strategy towards keeping up with – and gaining competitive advantage from – improvements in technology, changes in fashion, consumer demand and cost-efficiency. For these reasons, opportunities for and challenges to adopting and executing these innovations should be identified to propose implications for business management and future regulations.

Furthermore, previous research provided the recommendations for business changes based on studying consumers' behaviour and their understanding of product durability and repairability (DEFRA, 2011; European Commission, 2018) or product design (European Commission, 2019). Several studies focused solely on EEE (Parker *et al.*, 2012; RREUSE, 2013) or clothing products (Armstrong *et al.*, 2015; Environmental Audit Committee, 2019) rather than across different product sectors.

To bridge these knowledge gaps, the overall aims of this research project were to:

- i. Identify influences upon the 'repair journeys' that consumers go through when deciding whether or not to fix a faulty item
- ii. Determine how businesses could support consumers in their repair journeys, particularly through business innovation for product repairability.

It sets out to do so by developing three main objectives, as shown in Figure 1.

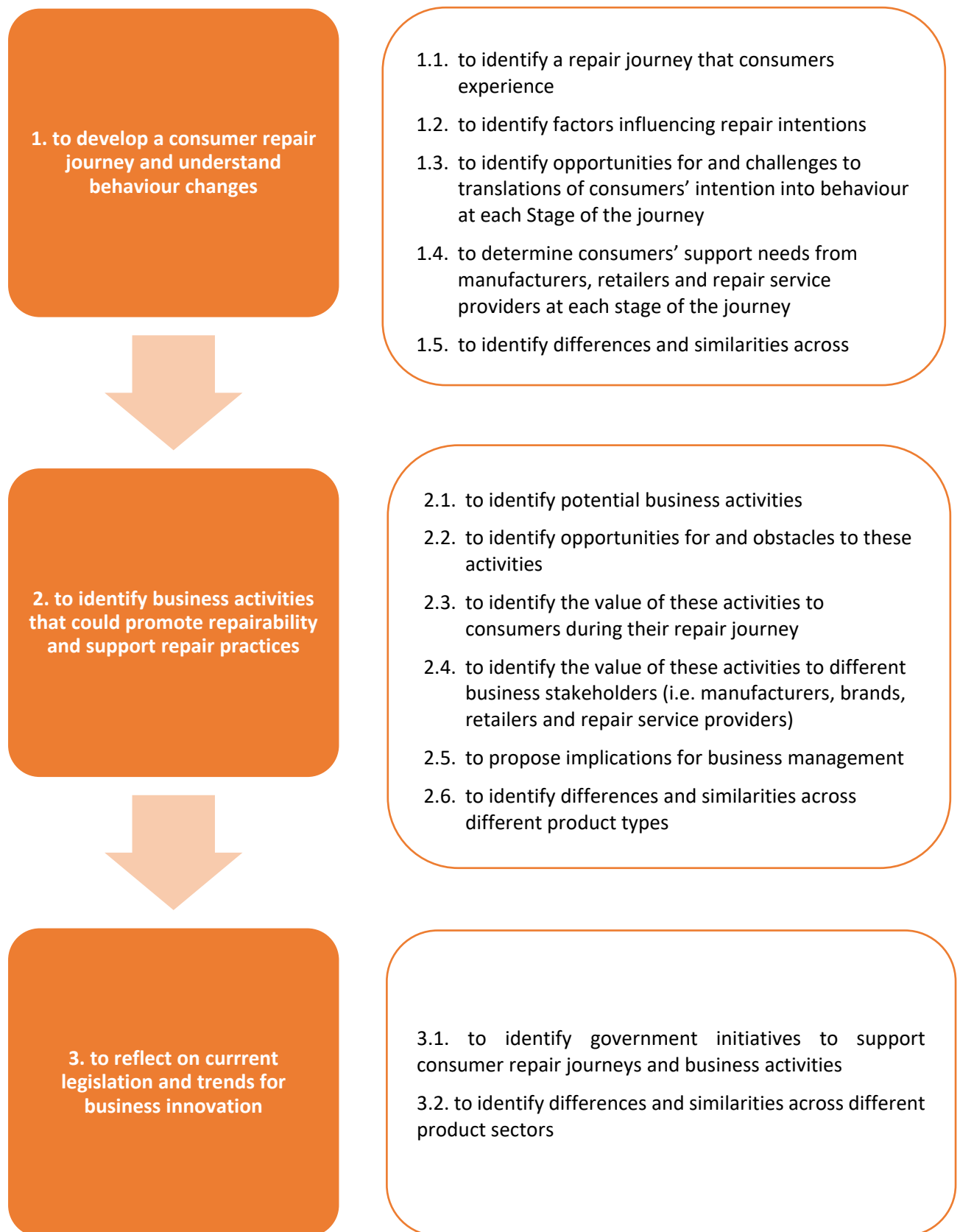


Figure 1: Main objectives and sub-objectives

The research focused on the business-to-consumer (B2C) market because it aimed to fill the gaps in previous consumer studies (Sections 1.2, 1.3 and 1.4) and utilised previous findings to set foundations for potential business innovation activities in this market (Section 2.5). Furthermore, B2C products are also the focus of most of fixer movement and campaigns for right to repair (Section 1.1.4) and the EU circular economy action plan (European Commission, 2020a). Findings from this research provided evidence for assessing relevant legislation implications, particularly in the B2C market. The research also recommended the collaboration between and contributions of different business stakeholders (e.g. manufacturers, retailers, brands and repair service providers) to support consumer repair journeys in this market.

This research presents a new approach to the study of consumer behaviour changes and business innovation for product repairability. The research drew upon multi-stakeholder perspectives (e.g. of consumers, product and service providers) to explore repair practices. It firstly captured a repair journey that consumers experience. It then investigated the influences of both internal and external factors on the consumers' rationale to choose DIY repair or get items repaired by professionals. This research thereby provides evidence of consumer behaviour changes (e.g. what could influence intentions and their translations into behaviour), across the three product sectors, for business interventions to target consumers at each stage of their repair journey.

The research then captured business practices and their learning points for business practitioners when adopting and executing business innovation for product repairability and repair services. These findings were the foundations for proposing implications for business management and future legislation considering the value to different business stakeholders and consumers.

1.8. Thesis outline

CHAPTER 1 has set the context, described the rationale behind the selection of the topic and clarified the research scope, aims and objectives.

CHAPTER 2 begins with theoretical foundations, considering common theories and models for the study of the psychology of consumption behaviour and sustainable business practices. This chapter then provides reflections on these theories and models, before proposing conceptual frameworks and novel approach to capture and understand consumers' repair journeys and business innovation for product repairability.

CHAPTER 3 discusses the chosen philosophical perspectives and research approach, design and methods. The chapter justifies the sampling and analysis strategies, and specifies the validity and reliability measures to be undertaken.

CHAPTER 4 presents and analyses findings from four qualitative consumer focus groups, particularly on the 'consumer repair journey' and factors influencing intention and their translation into behaviour. It is followed by CHAPTER 5, which provides a discussion of

these factors and propose recommendations for business interventions on the consumer repair journey.

CHAPTER 6 presents analytical findings from twenty-one business interviews. It begins with opportunities for and challenges to adopting and executing the business activities for product repairability and repair services. The chapter then discusses support needs for the relevant business innovation. It is followed by CHAPTER 7, which discusses implications for business management and future policies based on a summary of opportunities for and challenges to the business innovation.

CHAPTER 8 revisits whether and how this thesis meets its aim and objectives. It then draws original contributions to knowledge, discusses limitations and suggests further research.

CHAPTER 2. Theoretical foundations

This chapter provides the rationale behind the choice of behaviour model initially used to understand consumers' repair behaviour, particularly the Theory of Planned Behaviour (Section 2.1.1). As the review of the chosen model presents some issues (Section 2.1.2), the later sections introduce the 'consumer repair journey' concept (Section 2.2) and suggest a conceptual framework to resolve the problems identified and to reflect the complexity of real-life repair decision making (Section 2.3).

Section 2.4 discusses the overarching foundations of the current research on sustainable business model innovation and Section 2.5 presents a literature review on nine potential business activities promoting reparability and repair practices. Finally, a conceptual framework is proposed to investigate opportunities for and challenges to adopting and executing the nine business activities (Section 2.6).

2.1. Understanding sustainable consumption and repair behaviour

This section gives an overview of two behaviour models, the Theory of Reasoned Action and Theory of Planned Behaviour, which are widely used to study sustainable behaviour and identifies their limitations.

2.1.1. Behaviour models to understand behaviour

The most widely applied theories of social behaviour are the Theory of Reasoned Action developed in 1975 by Fishbein and Ajzen, the Theory of Planned Behaviour established in 1986 by Ajzen and Madden and Theory of Interpersonal Behaviour defined in 1977 by Triandis. This conclusion emerged from a comprehensive literature review that explored consumer behaviour theories to inform the debate on sustainable consumption (Jackson, 2005).

The Theory of Reasoned Action (Figure 2) introduced the mediating role of intention that revolutionised understanding of the relationship between attitude and behaviour. Intention is posited as the immediate antecedent and key determinant of behaviour and influenced by attitudes and subjective norms.

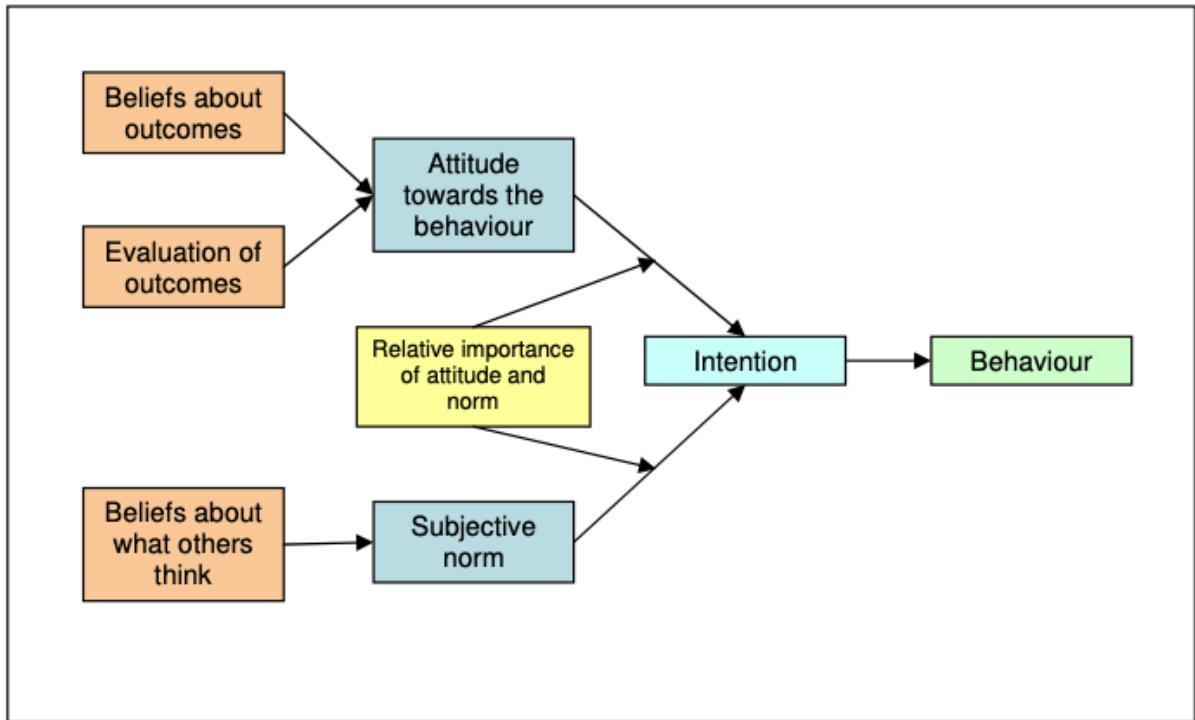


Figure 2: Theory of Reasoned Action (Jackson, 2005, p.46) (after Fishbein and Ajzen, 1975)

Beliefs about and evaluation of outcomes might lead to an attitude towards specific behaviour (Fishbein and Ajzen, 1975). These behavioural beliefs, in theory, can produce a positive or negative attitude toward the behaviour itself. Ajzen (2020) clarified that the negativity and positivity of each anticipated outcome appear to contribute to the overall attitude and the perceived probability of the outcome generated by the behaviour.

The second major influence on intention, subjective norm, was defined as a person's beliefs about what other people important to him or her think of the given behaviour (Fishbein and Ajzen, 2010; Ajzen, 2020).

Figure 3 presents elements of the Theory of Planned Behaviour (TPB), which was developed as an extension of Theory of Reasoned Action (TRA). TPB includes a measure of perceived behavioural control (PBC) as an additional indicator of both intention and behaviour. PBC is defined as personal belief concerning how easy or difficult performance of the behaviour is likely to be. Such belief is concerned with subjective probability that a given facilitating or inhibiting factor will be present in the situation of interest (Ajzen, 2020). Control factors can include required skills and abilities, the availability or lack of time and other resources (such as spare parts or tools for repair), and cooperation by other people. These control factors can be taken as an indicator of actual behaviour control, as people who are confident about their ability to master a particular activity are more likely to succeed than those who lack self-confidence (Ajzen, 1991).

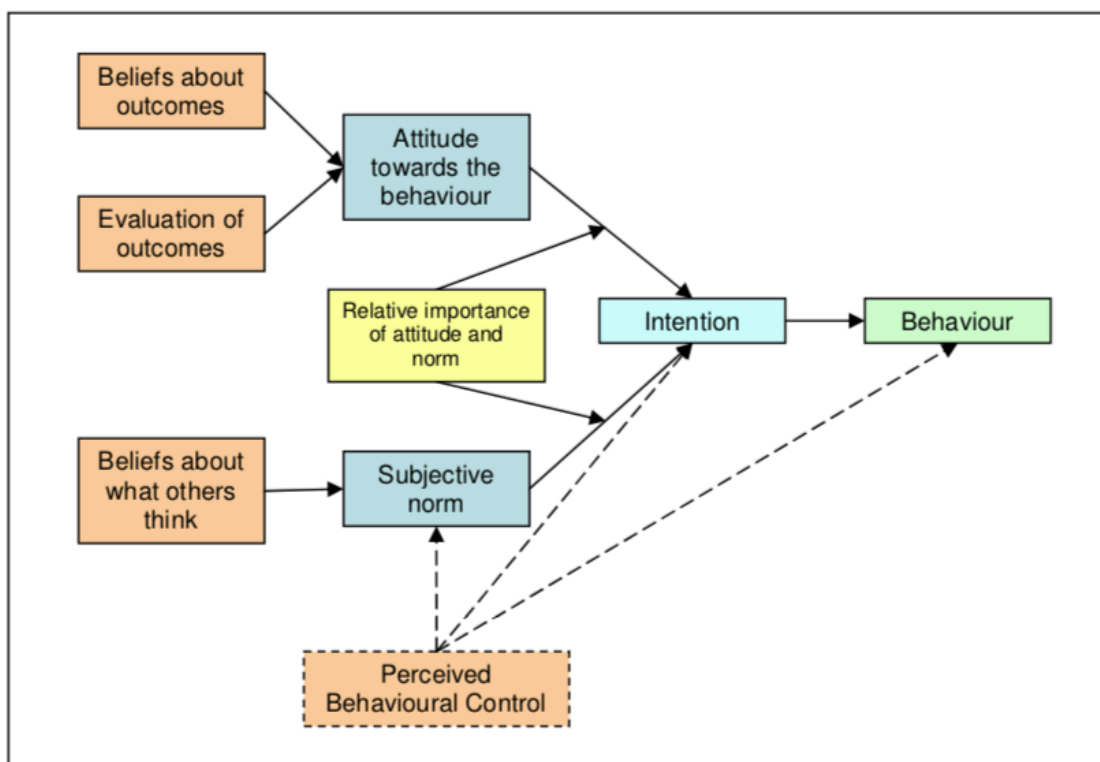


Figure 3: The Theory of Planned Behaviour (Jackson, 2005, p.49) (after Ajzen, 1991)

TRA and TPB have been employed to explore behaviours in a wide range of contexts. TPB, for example, was applied in more than 150 different contexts at the time of writing (Armitage and Conner, 2001). The literature has addressed the use of TPB in studying dieting, family planning, voting, smoking, drinking, choice of transport mode and food, internet use, and understanding and predicting consumers' purchase behaviours (Jackson, 2005). Many studies have utilised this model to explore pro-environmental behaviour (Jackson, 2005; Hassan, Shiu and Shaw, 2016), including recycling behaviour, energy consumption, food choice, water conservation, green purchases, physical activities and the use of technologies (McDermott *et al.*, 2015; Riebl *et al.*, 2015; Yadav and Pathak, 2017; Ajzen, 2020; Hirschey *et*

al., 2020). The theory was also employed to study ethical consumer behaviour and Fair-Trade shopping (Shaw and Shiu, 2003; Chatzidakis, Hibbert and Smith, 2007).

An illustration of Theory of Interpersonal Behaviour is presented in Figure 4. This theory has been used far less than Theory of Planned Behaviour because of its greater complexity and the lack of parsimony (Jackson, 2005; Araújo-Soares and Pesseau, 2008). Furthermore, Araújo-Soares and Pesseau (2008) claimed that there has been a dearth of clear guidelines for the operational definition of variables in the Theory of Interpersonal Behaviour.

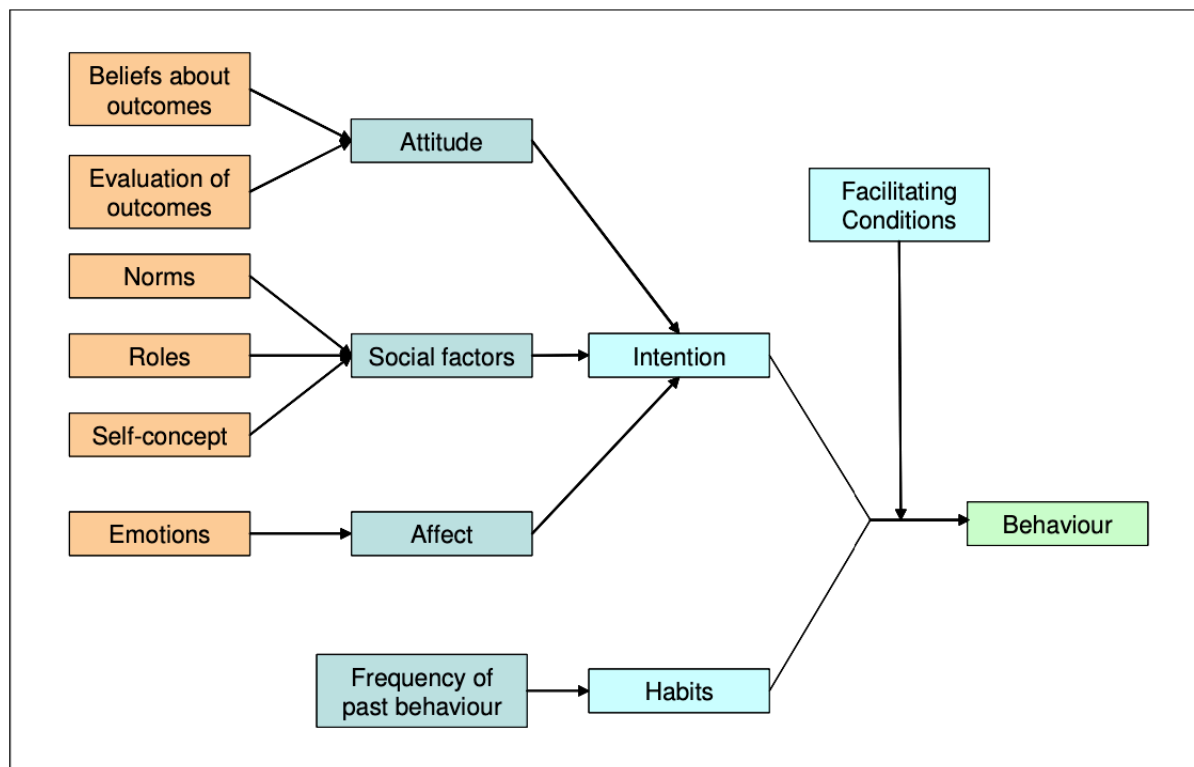


Figure 4: An explanation of Theory of Interpersonal Behaviour (Jackson, 2005, p.94)

TPB was often used with quantitative methods to statistically test relationships between impact factors in most of the studies mentioned above. The theory has also not been used to study repair behaviour. For these reasons, this PhD applied this theory with the use of qualitative methods to study consumer repair intention and behaviour. The employment of Planned Behaviour Theory helped to achieve the research aim (i.e. to identify influences upon the ‘repair journeys’ that consumers go through when deciding whether or not to fix a faulty item), particularly through the application of the definition of intention, which is an immediate antecedent and key determinant of behaviour. Key direct determinants of intention – attitude and subjective norm – were also incorporated into the conceptual framework (Section 2.3). The theory was also applied to study the impacts of beliefs about and evaluation of repair outcomes on attitude and perceived behavioural control on subjective norm (Sections 2.3.1 and 2.3.2).

2.1.2. Issues concerning the Theory of Planned Behaviour

Three key issues in the TPB are the oversimplification of translating intention into behaviour, facilitating conditions' impacts and the lack of consideration of personal habit and previous experience.

Firstly, intention in the TPB is posited as the immediate antecedent and key determinant of behaviour and influenced by attitudes and subjective norms. This oversimplification of the complexities associated with translating intentions into behaviour has been criticised in subsequent studies (Bagozzi, 2000; Davies, Foxall and Pallister, 2002; Morwitz, Steckel and Gupta, 2007; Carrington, Neville and Whitwell, 2010; Hassan, Shiu and Shaw, 2016). Jackson (2005) claimed that at the time of writing the literature mostly focused on studying the correlation between intention and antecedent (i.e. attitudes and subjective norms), whilst intentions have generally been taken as 'being good predictors of behaviours' (p.48). Similarly, a critical literature review on ethical consumption (which considered the use of public transport, recycling household wastes and purchasing eco-friendly or fair-trade products) revealed that both TRA and TPB have been employed extensively to investigate factors that influence intention, and to a limited extent, behaviour (Hassan, Shiu and Shaw, 2016). Measuring variance (i.e. mostly in quantitative studies) in intention cannot sufficiently understand relevant behaviour (ibid). This finding is also in line with that of Andorfer and Liebe (2012), addressing the lack of understanding of how intentions may or may not translate into actual behaviour. Consumers may have beliefs about positive outcomes of repair (i.e. repair can help to extend their products' lifetimes) and they thereby intend to fix their items themselves. However, they may end up with replacements due to the lack of repair skills.

The literature also addresses the importance and limited understanding of the intention-behaviour gap in both research and industry (Carrington, Neville and Whitwell, 2010; Andorfer and Liebe, 2012). In particular, many studies on pro-environmental consumer behaviour focus on examining the attitude-intention gap, assuming that intentions will, effectively, determine behaviour (Shaw and Clarke, 1999; Shaw and Shiu, 2002; Glasman and Albarracin, 2006; Ozcaglar-Toulouse, Shiu and Shaw, 2006; Arvola *et al.*, 2008; Vermeir and Verbeke, 2008; Pickett-Baker and Ozaki, 2008; Polonsky, Garma and Grau, 2011; Urien and Kilbourne, 2011; Grimmer and Bingham, 2013; Grimmer and Woolley, 2014). These studies also acknowledge their constraints, particularly overly focusing on attitude-intention gaps and disregarding intention-behaviour gaps, which are also limitations in TRA and TPB. In the same vein, studies have demonstrated that consumer attitudes and behaviours are crucial for optimising product lifetimes (Bayus and Gupta, 1992; Heiskanen, 1996; Cooper and Mayers, 2000; Cooper, 2004; Van Nes and Cramer, 2005; Evans and Cooper, 2010; DEFRA, 2011; Cox *et al.*, 2013) although they did not investigate whether and how the intention-behaviour gap influences the final action.

Secondly, TPB appears to focus more on intrinsic (personal) factors (e.g. attitude, subjective norm, PBC) than extrinsic (external or situational) ones. Actual behaviour appears to be highly context-sensitive (Gawronski and Cesario, 2013). Researchers have identified that

consumers who have a positive attitude and intention towards sustainable consumption do not always behave consistently at the point of purchase. For example, intentions alone are not a guaranteed predictor of purchasing locally produced foods (Campbell and Fairhurst, 2016); in this study, the environment in which the products were sold had potential to influence purchase decisions, through offering consumers a wide range of local food categories, eye-catching displays, enhanced customer service, or product samples. Similar findings on contextual factors' impacts on the translation of ethical purchase intention into actual behaviour emerged from other studies. For example, Belk claimed that consumers may be influenced by external factors from the surrounding environment and people (Belk, 1975) or even interact with them (Bagozzi, 2000). Consequently, people may come to a store with the intention of purchasing an item but then leave without the item in their shopping bag. The Model of Pro-environmental Behaviour (Kollmuss and Agyeman, 2002) captures an extensive lists of both internal and external factors that affect behaviour. However, this model focuses only on actual behaviour without considering the relationship between intentions and behaviour and factors that influence intentions.

Facilitating conditions as the moderator of the effects from intention and habits are regarded by Jackson as a similar concept to Stern's notion of external contextual factors (Jackson, 2005). Stern (2000) defined such external contextual factors as follows: interpersonal influences, community expectations, advertising, government regulations and other legal and institutional factors, monetary incentives and costs, physical difficulty of specific actions, capabilities and constraints provided by technology and the built environment, the availability of public policies to support behaviour; and various features of the broad social, economic and political context.

Consumers may favour repairing their broken products, but they may not behave accordingly, mostly due to the inconvenience (DEFRA, 2011; European Commission, 2018). The inconvenience was concerned with using repair services, looking for spare parts or tools, or disassembling the items for repair. This may explain why a study for WRAP found that more than 50% of discarded items can be reused directly or after slight repair (Parker *et al.*, 2012).

Moreover, the TPB does not account for personal habit and past experience that factor into behavioural intention and motivation. These factors might block, derail or oppose an individual's intention (Gollwitzer and Sheeran, 2006). For example, repair decisions may depend on the owner's habits, besides their values, attitudes, beliefs and attachment to the product (Cooper and Salvia, 2018).

A conceptual framework is proposed below (Section 2.3) to study repair behaviour, with due consideration of the three limitations of TPB. This PhD investigated factors (e.g. attitudes, subjective norms, perceived behaviour controls, habits, previous experience and facilitating conditions) that can influence repair intentions and the translation of these intentions into behaviour.

2.2. Buying process and consumer repair journey

The Five-Stage Model developed by Dewey (2012) is a framework to evaluate customers' buying decision process (Figure 5). An actual purchase decision is part of this buying process and thus capturing and understanding this can help brands or marketers intervene and influence outcomes of their customers' purchases (Kotler and Armstrong, 2015).

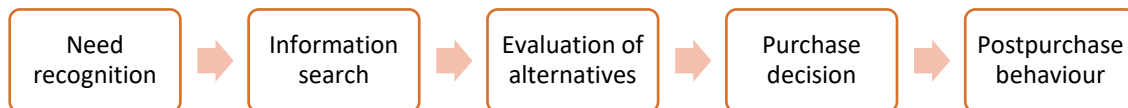


Figure 5: Buyer decision process (Dewey, 2012)

A consumer's buying process often starts with need the need recognition stage, which is normally identifying what the problem or need is, whether the product or service is required, and how he or she is likely to feel after making the purchase (Kotler, 2001; Kotler and Armstrong, 2015). The need can be initiated by internal (e.g. hunger, thirst) or external (e.g. social media, advertising billboard) stimuli (Kotler *et al.*, 2013). Marketers often utilise advertisements to trigger particular consumers' wants.

The information search stage is when consumers put effort in to identify and observe various sources of information, supporting their buying decisions. However, some consumers may not seek more information if motives for purchase are significant and 'satisfying products are near at hand, and consumers are likely to buy them' (Kotler, 2016, p.184). The wide range of sources that consumers can seek information from include personal sources (e.g. family members, friends or acquaintances), commercial sources (e.g. advertising, dealers, manufacturers' or retailers' websites), social media and consumer rating organisations (such as Which?). An increase in consumers' awareness and knowledge of brands and product features can arise from obtaining more information (Kotler and Armstrong, 2015). Many consumers may utilise online reviews in the decision-making process (Gursoy, 2019), especially in the current era of online shopping. However, consumers can decide not to purchase a product due to the overload or unhelpfulness of information (Branco, Sun and Villas-Boas, 2018). Moreover, consumers appear to focus on a limited number of sources, considering consumer perceptions of the resources' reliability, based on previous experience (Liebesny, Balestrin and Kenny, 2016).

At the stage of evaluating alternatives, a consumer often compares different products' or brands' attributes, considering whether they can deliver the value he or she wants (Kotler *et al.*, 2013). To increase the likelihood of being evoked at this stage, brands need to understand what benefits consumers prefer or seek, and which product attributes will most influence their decision-making. In practice, consumers use a series of evaluation processes, rather than a simple and single one (Kotler and Armstrong, 2015). Evaluations sometimes can be very rational, when consumers carefully consult online reviews and friends, but there may be no evaluation in other cases. Product images (Chen-Yu and Kincade, 2001) and reference

groups (Robinson and Doss, 2011) were evident in affecting evaluations, influencing the perceived quality and expected performance of fashion items.

The fourth stage is when the purchase takes place. During this time, consumers may form an intention to buy the most preferred product or brand because they have evaluated all the alternatives and estimated the value of the items or services to them. However, a final purchase decision can be disrupted by situational factors and negative feedback from other people. Situational factors can include the price point and terms of the sale at the time of the purchase, store atmosphere, time pressures and constraints, the presence of discounted goods, shopping experience and other unexpected situations, such as losing a job or a retail store closing down (Kotler *et al.*, 2019). Kotler *et al.* (2013) also suggested that the final purchase decision can mainly be disrupted by negative reviews from other customers. Consumers with a specific online purchase goal, prior to browsing the Internet, may be more likely than others to decide not to purchase after seeing negative feedback (Weisstein *et al.*, 2017). Consumers appear to seek to avoid risk and are less sensitive to gains than losses (Kahneman and Tversky, 1979), which could result in terminating the buying process at this stage.

The final stage is when customers assess whether they are satisfied or dissatisfied with their purchases. This post-purchase behaviour may influence future purchases (Dewey, 2012) – whether to buy the product again or alternatives (either similar products from other brands or substitutes). Businesses appear to engage their customers with post-purchase communications, such as through customer satisfaction surveys or birthday wishes, in an effort to influence their feelings about their past and future purchases.

The consumer element of this thesis is framed around the concept of a ‘consumer repair journey’ (Figure 6) which was inspired by and developed from the Five-Stage Model (Dewey, 2012). Regarding the first stage of the consumer repair journey, the owner may need to identify the problem with a product and consider whether it is broken and needs repair. At the second stage, the consumer may seek information such as how to do DIY repair or where to get the product repaired, to inform the repair decision. Then, the consumer may consider alternatives (including replacement) at the next stage. At the fourth stage he or she may decide either to repair the item, to get it repaired by someone, or choose a different option or go for an alternative. Finally, the consumer may evaluate the outcome of the repair decisions.

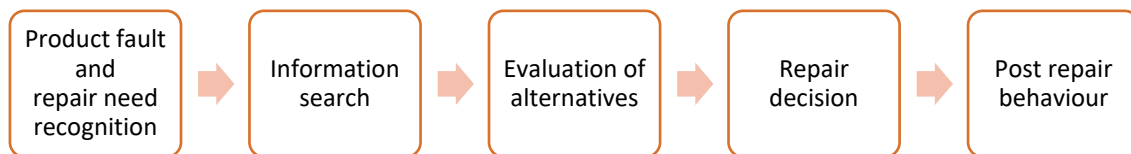


Figure 6: The proposed consumer repair journey

Both internal and external factors can influence the buying process of consumers, as discussed above, and this thesis employed this logic to identify factors that could affect the consumer repair journey. These factors were aligned with those in the conceptual framework, as proposed below (Section 2.3). Moreover, while many consumers often pass through five stages of the buying process in a fixed, linear sequence, some stages (such as evaluation of alternatives) may occur throughout the process (Kotler and Armstrong, 2015). This research investigated similar trends, such as the continuity or repetition of any particular stage, throughout consumer repair journeys.

2.3. Conceptual framework to understand repair behaviour

The current research proposes a framework (Figure 7) to overcome the limitations inherent in the Theory of Planned Behaviour (Figure 3), which is widely used by sustainable consumption researchers. The proposed framework further explored determinants of intention and behaviour, but also recognised the importance of studying potential gaps between these two elements. Attitude, subjective norm, perceived behavioural control, perceived habit and perceived facilitating factors were integrated and investigated at each stage of the 'consumer repair journey', thereby ensuring that the conceptual framework reflects the complexity of real-life repair decision making. These elements are discussed in the following sub-sections. Orange arrows indicate the relationships between elements which were adopted from the Theory of Planned Behaviour (Ajzen, 1991). Blue arrows are newly proposed with a consideration of the limitations discussed in Section 2.1.2.

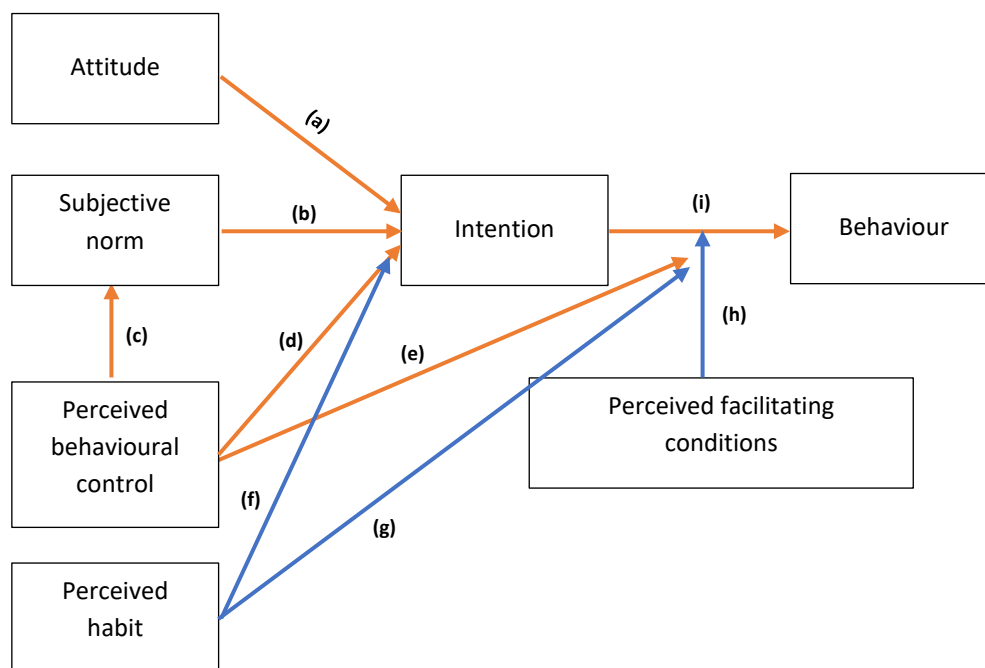


Figure 7: Conceptual framework to understand repair behaviour

The research considered three types of products that were either fixed by the owner, a commercial repairer or a non-commercial repairer. These three repair routes and their actors are shown in Table 7.

Table 7: Repair routes

Repair route	Narratives
Self-repair	DIY user
Commercial repair	Retailer
	Manufacturer
	Insurance provider
	Authorised repairer
	Independent repairer
Non-commercial repair	DIY family member/ friend
	Voluntary DIY repairer at community event/ facilitated repair event

2.3.1. Attitude and subjective norm

Two direct determinants of intention in TPB – attitude and subjective norm – are incorporated into the conceptual framework, arrows (a) and (b). Attitudes are derived from beliefs about outcomes and evaluation of outcomes, or so-called ‘perceived consequences’ and ‘value of consequences’ respectively (Jackson, 2005). Beliefs about and evaluation of outcomes of different repair routes may vary at different stages of repair journeys. If the identification of product faults is challenging, commercial repair would be preferable at the first stage (i.e. product fault and repair need recognition). If consumers could easily find instructions to do DIY repair, this type of repair would be preferable at the second stage (i.e. information search).

Subjective norm is concerned with what other people important to him or her think of and approve the given behaviour.

2.3.2. Perceived behavioural control

Perceived behavioural control (PBC) is personal belief in how easy or difficult the performance of the behaviour is likely to be in the Theory of Planned Behaviour, PBC is assumed to moderate the effect of subjective norm on intention, arrow (c) and (d) in Figure 6. This PhD investigated consumers’ personal belief in how easy or difficult it is to perform

product fault and repair need recognition, information search, evaluations of alternatives, repair decisions and post-repair evaluations, with a consideration of different repair routes.

Actual behaviour is assumed to moderate the influence of intention on behaviour (Ajzen, 1991). Because actual behavioural control is usually much more difficult to measure, PBC can be used as a proxy for actual control to predict behaviour (Ajzen, 2020). This PhD adopted this logic which is illustrated in Figure 7.

2.3.3. Perceived habits and facilitating conditions

Actual habits and facilitating conditions were not directly observed but were acquired about through consumer group discussions. For this reason, only 'perceived habits' are included in the framework – arrows (f) and (g) as they were remembered and described by the participants, rather than being objectively observed. Similarly, it was considered more appropriate to use 'perceived facilitating conditions' – arrow (h). Perceived habits and facilitating conditions can be associated with a wide range of determinants (Section 2.1.2). For instance, habits of how and when to find necessary information or to choose DIY, commercial and non-commercial repair in the past can influence repair decisions thereafter.

Perceived facilitating conditions can be interpersonal influences, community expectations, advertising, government regulations and other legal and institutional factors in regard to product repairability and repair practices. Perceived facilitating condition can also be monetary incentives and costs, physical difficulty of specific actions, capabilities and constraints provided by technology and the built environment that support or hinder repair decisions.

2.3.4. Intention and actual behaviour

Intention is the immediate antecedent and key determinant of behaviour in both the Theory of Reasoned Action and the Theory of Planned Behaviour. This is also one of their key limitations (Section 2.1.2). Therefore, besides investigating factors influencing intention, this research also studies what could influence the translation of intention into actual behaviour, arrow (i).

2.4. Understanding sustainable business model innovation

2.4.1. Sustainable business models

Interest in sustainable business models has increased rapidly, as evidenced by a significant number of articles in special issues of the Journal of Cleaner Production (Vol. 45, April 2013; Vol. 281, January 2021) and Organisation and the Environment (Vol. 29, Issue 1, March 2016; Vol. 33, Issue 3, 2020). There is also a growing range of review articles in the recent years such as by Bocken *et al.* (2014); Dentchev *et al.* (2016); Schaltegger, Hansen and Lüdeke-Freund (2016); Evans *et al.* (2017); Lüdeke-Freund and Dembek (2017); Geissdoerfer, Vladimirova and Evans (2018). A systematic literature review (Geissdoerfer, Vladimirova and Evans, 2018, p.403) claimed that sustainable business models are widely recognised 'as a modification of the conventional business model concept, either by incorporating concepts,

principles or goals aimed at sustainability, or integrating sustainability into their value proposition, value creation and delivery activities’.

A review by Lüdeke-Freund and Dembek (2017) identifies five features of major beliefs and concepts that underlie sustainable business models (SBMs) research and practice. Firstly, an explicit sustainability orientation which integrates ecological, social and economic concerns guides the development and implementation of sustainable business models. In particular, this normative grounding considers models in which sustainability concepts, directed at improving the triple bottom line performance (Clinton and Whisnant, 2014), shape the driving force of an organisation and its decision making (Stubbs and Cocklin, 2008). The next three features focus on an extended notion of value creation and value capture and consider various stakeholders, not just customers. For instance, concerns have arisen which question the traditional definition of value and success, balance between customer and societal needs (Schaltegger, Lüdeke-Freund and Hansen, 2012) and the link between business success and well-being of its stakeholders, including local communities, suppliers, employees and customers (Stubbs and Cocklin, 2008). SBMs should reflect an appropriate distribution of responsibility towards each stakeholder, economic costs and benefits with a consideration of ecological and social impacts (Boons and Lüdeke-Freund, 2013).

The final approach lies in an extended perspective on the wider system in which an SBM is embedded. This considers a value network where SBMs can satisfy different stakeholders’ need, through the creation and delivery of aesthetic, psychological, philosophical or monetary value (Upward and Jones, 2016). These five normative stances bear a close resemblance to five SBM propositions proposed by Evans *et al.* (2017), as follows:

- i. Sustainable value incorporates economic, social and environmental benefits conceptualised as value forms.
- ii. SBMs require a system of sustainable value flows among multiple stakeholders including the natural environment and society as primary stakeholders.
- iii. SBMs require a value network with a new purpose, design and governance.
- iv. SBMs require a systemic consideration of stakeholder interests and responsibilities for mutual value creation.
- v. Internalising externalities through product-service systems enables innovation towards sustainable business models.

However, there seems to be a gap in both research on and practice of SBM that should be institutionalised in academia, industry and government (Evans *et al.*, 2017; Lüdeke-Freund and Dembek, 2017; Geissdoerfer, Vladimirova and Evans, 2018). This thesis applied the working definition of SBM proposed by Geissdoerfer, Vladimirova and Evans (2018, p.404), particularly, SBMs are business models that ‘incorporate proactive multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders, and adopt a long-term perspective’.

2.4.2. Business model innovation for sustainability

Business model innovation is associated with modifying or altering the configuration of either one, several or all individual elements of a business model (Chesbrough, 2010; Johnson, 2010). Business model innovation can be seen as innovative strategies that react to challenges in the organisation's environment or diversify products and services (Mitchell and Coles, 2003; Geissdoerfer, Bocken and Hultink, 2016). It is normally aimed at breaking out of intense competition (Lindgardt *et al.*, 2009) due to ongoing changes in the business environment and customers' needs (Romero and Molina, 2009). BMI can 'affect the entire business model or individual or a combination of its value proposition, value creation and delivery, and value capture elements, the interrelations between the elements and the value network' (Geissdoerfer, Vladimirova and Evans, 2018, p.406). Value networks involve a wide range of roles and organisations with various needs (Den Ouden, 2012) and expected benefits (Argandoña, 2011).

SBM innovation aims at characteristics of an SBM, particularly processing sustainable development through creating positive benefits or minimising negative impacts for the environment, society, the organisation and its stakeholders, and adopting solutions to foster sustainability in its value proposition, creation and to capture elements of its value-network (Geissdoerfer, Vladimirova and Evans, 2018). For that reason, SBM innovation should consider propositions that benefit all stakeholders in the network. Different business strategies may change value flows and affect stakeholders' satisfaction and the sustainable development of the network (Shaw, 2010; Evans *et al.*, 2017).

Besides academic studies, SBM innovation has generated interest and gained attention in political discussion, particularly the EU circular economy action plan (European Commission, 2020a). SBM model innovation in a circular economy aims to generate circular business models that can close, slow, intensify, dematerialise and narrow resource loops, in addition to generating long-term and sustainable value to multi-stakeholders (Bocken *et al.*, 2016; Geissdoerfer *et al.*, 2018). Bocken *et al.*, (2016) have proposed four innovative business model strategies for slowing loops: access and performance model, extending product value, classic long-life model and sufficiency-driven model. Table 8 shows these strategies with a consideration of promoting product repairability and repair services that have the potential to reduce materials consumption or create slower resource loops (European Commission, 2012, 2015, 2020a).

Table 8: Business innovation strategies for slowing resource loops
(adapted from Bocken *et al.*, 2016)

Innovative business model strategies for slowing loops	Definition	Examples within repair context
Access and performance model	Providing the capability or services to satisfy user needs without needing to own physical products	Leasing products provided with maintenance and repair services
Extending product value	Exploiting residual value of products – from manufacturers, to consumers, and then back to manufacturing – or collection of products between distinct business entities	Collecting unwanted items, repairing or refurbishing then reselling them
Classic long-life model	Business models focused on delivering long-product life, supported by design for durability and repair for instance	Selling repairable products associated with long functional life span
Sufficiency-driven model	Solutions that actively seek to reduce end-user consumption through principles such as durability, upgradability, service, warranties and reparability and a non-consumerist approach to marketing and sales (e.g. no sales commissions)	Developing brands and services for consumption-reduction, including repair and maintenance

Innovation for sustainability can be proposed and executed at the design or manufacturing stage, and at any level of a company, from strategic to operational (Waage, 2007). For example, sustainable innovation can occur when designing repairable products or investing in facilities for repair services. However, Bocken, Rana and Short (2015) suggest that sustainable business innovation should be embedded in an organisation’s DNA and integrated through all of the activities of the business. Repair and maintenance are also recommended to be considered in the environmental layer of the triple-layered business model canvas (Joyce *et al.*, 2016).

2.4.3. Sustainable business model framework

Sustainable innovation is often characterised by systems thinking and radical innovation (Boons *et al.*, 2013). Similarly, ‘business model innovation for sustainability can drive innovation across internal business functions, across supply chains and on a broader level, across industries’ (Bocken, Rana and Short, 2015, p.70). SBM innovation is challenging, as firms need to engage with the larger system of which they are a part, rather than just dealing with the production process or a product component which they may have more control over. Value is no longer generated solely by a firm, but by collaboration through either informal or formal alliances (Beattie and Smith, 2013).

Bocken and Short's Sustainable Business Model framework (Figure 8) illustrates the complexity of innovation across these boundaries, considering value proposition, value creation and delivery, and value capture. The value creating logic of this framework consider the three critical questions: How value is provided and to whom? How is value provided? How does the company make money and capture other forms of value? This framework has been widely used to study sustainable business model innovation (Geissdoerfer, Vladimirova and Evans, 2018). The success of sustainable business models has been investigated through a consideration of these three elements (Richardson, 2008; Boons and Lüdeke-Freund, 2013), their interrelation and interactions between different stakeholders (Geissdoerfer, Bocken and Hultink, 2016). For instance, Bocken and Short (2016) applied this framework to explore insights into sufficiency as a driver for SBM innovation. They investigated business model strategies for the sufficiency through studying six businesses and considering three elements of the framework and benefits distributed across different stakeholders in the supply chain.



Figure 8: Sustainable business model framework (Bocken and Short, 2016, p.44)

Business models are often concerned with how the company defines its strategy for competition through the product or service design it offers to its market (Rasmussen, 2007; Richardson, 2008). The strategy should consider how the product or service is monetarised, what it costs to produce, how it differentiates itself from other firms by the value proposition, and how the firm integrates its own value chain with those of other firms in a value network (Rasmussen, 2007, p.2). Value proposition in a SBM framework is concerned with a product or service, customer segments, customer relationships and value offered to customers, society and the environment. Value proposition appears to be the core of a sustainable business model as it allows the simultaneous creation of value for multiple stakeholders, such as customers, shareholders, suppliers, and partners, and also for the environment and society (Bocken et al., 2014; Donaldson and Preston, 1995; Tyl et al., 2015). Baldassarre et al. (2017) addressed the importance of communication and collaboration between stakeholders. These help to identify and understand stakeholders' needs and interests which can be combined into a more enriching value proposition. Communication and collaboration should focus on

brainstorming the problem, testing the product or service for a superior problem-solution fit (such as through co-design for repairability as mentioned in Section 2.5.1).

Value creation and delivery in a SBM framework are associated with resources, suppliers and other partners who are crucial for creating and delivering value to customers, society and the environment. Bocken, Boons and Baldassarre (2019) drew out the intention to systematically investigate sustainable value creation with a consideration of businesses' fundamentals (i.e. sustainability aims associated with the reduction in negative value and increase in positive benefits) and their interactions with other stakeholders (e.g. the nature of business dependencies and competition). They addressed the importance of the business purpose, the potential impacts of innovation on the current business model, and its dependencies on other stakeholders. An organisations' success should be directly linked to the well-being of its various stakeholders, including local communities, suppliers, partners, employees and customers (Stubbs and Cocklin, 2008).

Value capture in a SBM framework is relevant to cost structures and revenue streams, but also the value captured for society and the environment. It depicts how the value generated for these stakeholders can be transformed into value advantageous to the focal company (Geissdoerfer, Vladimirova and Evans, 2018) and its business partners. However, it seems challenging when designing business models to capture the economic value through delivering social and environmental benefits (Schaltegger, Lüdeke-Freund and Hansen, 2012). Challenges to SBM development or innovation are presented in the next section.

2.4.4. Challenges to SBM innovation

A comprehensive literature review (Evans *et al.*, 2017) identified six key challenges to SBM innovation by considering the triple bottom line, mindset, resources, technology innovation, external relations, and business modelling methods and tools (Table 9).

Table 9: Challenges to SBM innovation (Evans *et al.*, 2017)

Challenge	Description
Triple bottom line	The co-creation of profits, social and environmental benefits and the balance among them.
Mindset	The business rules, guidelines, behavioural norms and performance metrics prevail in the mindset of firms and inhibit the introduction of new business models.
Resources	Reluctance to allocate resources to business model innovation and reconfigure resources and processes for new business models.
External relationships	Engaging in extensive interaction with external stakeholders and the business environment requires extra effort.
Business modelling methods and tools	Existing business modelling methods and tools, e.g. Osterwalder and Pigneur (2010) and Johnson <i>et al.</i> (2008), are few and rarely sustainability-driven.
Technology innovation	Integrating technology innovation with business model innovation is multidimensional and complex.

These challenges were found in previous studies, considering SBM innovation and sustainability-driven change management. The classic business model generally aims to generate a profit from the repetition of sales over time, whilst a key success factor of SBM innovation is the co-creation of economic, social and environmental benefits and the balance among them. This requires redefining the purpose of business (Stubbs and Cocklin, 2008) – profits are an outcome, and a facilitator, of environmentally and socially sustainable activities. However, in pursuing this approach, all the studied businesses faced challenges from changing cultures and attitudes, both internally and externally. Those businesses struggled to get ‘the buy-in and proactive support from their stakeholders, such as staff, the board of directors, the shareholders, business partners, customers, communities, and financial market analysts’ (*ibid*, p.113).

Schaltegger, Lüdeke-Freund and Hansen (2012, p.111) remark that sustainability-oriented risk management can require a wide range of changes, such as ‘renewing production processes, changing value network partners, or approaching new market segments’.

Nevertheless, these changes can be hindered by lacking a change readiness mindset and a resistance to allocating resources to new business models. Bocken and Short (2016) addresses the challenge that come from conflicts with business continuity in the classic business model form. Although many businesses attempt to embrace strategies for sustainability, they still used traditional innovation patterns which were aimed at the growth of business and profitability (Ehrenfeld, 2009), due to the lack of sustainability-driven business modelling methods and tools (Björkdahl and Holmén, 2013; Girotra and Netessine, 2013; Yang, Vladimirova and Rana, 2014). Geissdoerfer, Bocken and Hultink (2016) confirmed that there has been a lack of business tools that help business practitioners to identify value propositions for sustainable business models.

Moreover, the complexity of external stakeholders' interests and expectations and efforts to interact with them could significantly challenge SBM innovation. In particular, creating 'shared value' across stakeholders is difficult to realise in practice (Porter and Kramer, 2011), considering value to customers, business shareholders and investors. For example, 'companies' innovation efforts primarily focus on improving existing technologies and production systems, such as through increased energy and resource efficiency' (Baldassarre *et al.*, 2017, p.175). Businesses may oversimplify other key drivers of successful sustainable innovation, including understanding customer needs to combine technological efficiency with customer benefits (Keskin, Diehl and Molenaar, 2013) and to stimulate more sustainable consumption patterns (Daae and Boks, 2015). It was also evidenced in Bocken and Short (2016) who found that several businesses struggled to persuade shareholders and investors of the focus on a long-term approach, rather than short-term profit maximisation through mass-production or built-in obsolescence. This was claimed by the authors to result from shifting the focus on price into quality and durability.

Furthermore, the integration of technological innovation and SBM innovation is complex and multidimensional. Previous research argued that inability to identify the feasible business model for a new technology or solution was one of the key challenges to business model innovation (Chesbrough, 2010). For example, 3D printing may improve the availability and accessibility of spare parts, but businesses may have second thoughts when considering remarkable initial investment in printers. Other concerns can be associated with whether businesses could benefit from the investment, who should have the access to the geometric drawing of spare parts considering intellectual property protection, or how to ensure the efficient supply of materials for cutting the parts.

2.5. Potential business activities promoting product repairability and repair practices

A business model is seen as 'a system of interconnected and interdependent activities that determine the way the company does business with its customers, partners and vendors' (Amit and Zott, 2012, p.42) and sustainable business innovation should be embedded in an

organisation’s DNA and integrated through all the activities of the business (Bocken, Rana and Short, 2015).

This section describes nine business activities, promoting product repairability and repair services and embracing business innovation beyond product repairability (e.g. making products more repairable), which emerged from the literature (Table 10). The innovation can go beyond making products more repairable, repair information and services more available or accessible. There should also be consideration of product-service integration.

**Table 10: Business activities
for improving the repairability of products and promoting repair services**

Business activities	Sources
Design for repair and codesign	Graham and Thrift (2007); Parker <i>et al.</i> (2012); RREUSE (2013); Charter and Keiller (2014); Wieser and Tröger (2016); Dewberry <i>et al.</i> (2017); European Commission (2018)
Provision of diagnostic and repair manuals, and instructional support	Lee Woolf <i>et al.</i> (2012); Ellen MacArthur Foundation (2016); Ackermann, Mugge and Schoormans (2018); Bracquené <i>et al.</i> (2018); European Commission (2018, 2019)
Promotion of repair benefits and repairable products	European Commission (2018) and business practices, such as IKEA’s circular store, Patagonia’s and Nudie Jeans’ repair tours
Choosing repair over replacement within warranties	DEFRA (2011); Lee Woolf <i>et al.</i> , 2012; Armstrong <i>et al.</i> (2015); Wieser and Tröger (2016)
Integration of repair and reuse	Lee Woolf <i>et al.</i> (2012); Parker <i>et al.</i> (2012); Ellen MacArthur Foundation (2016)
The exchange model and temporary replacement model	DEFRA (2011); Parker <i>et al.</i> (2012)
Fixed-cost model and fixed lead-time return model	DEFRA (2011); Parker <i>et al.</i> (2012)
Localised repair service network and shared data	Lee Woolf <i>et al.</i> (2012); Charter and Keiller (2014); Dewberry <i>et al.</i> (2017)
A transparent spare parts and tools supply chain	RREUSE (2013); Ellen MacArthur Foundation (2016); Raihanian Mashhadi <i>et al.</i> (2016); European Commission, (2018)

These nine activities can embrace business model strategies for slowing loops (Table 8): access and performance model (i.e. leasing products with maintenance and repair services included, extending product value (i.e. collecting, repairing and then reselling unwanted items), classic long-life model (i.e. producing repairable products with long functional life span), and sufficiency-driven model (i.e. developing brands and services for consumption-reduction, including repair and maintenance solutions). Each is discussed in turn below.

Moreover, each activity may require innovation in different aspects of businesses, such as product design development and testing, customer relationship management (CRM), repair manual design, content marketing or marketing campaigns, the generation of stable revenue streams from repairable products and repair services, forward and reverse logistics of faulty and repaired products, repair service quality management, supply chain management of spare parts and distribution of repair information (e.g. manuals and spare parts). Supportive technologies can also be crucial for participatory design, communications with customers in repair services and resale in second-hand marketplaces.

2.5.1. Design for repair and codesign

A focus on design characteristics is a vital solution for product repairability and the possibility of the other proposed repair activities at the grassroots level.

Repairable products need ease of deconstruction, and use of universal and replaceable components (Graham and Thrift, 2007). In the same vein, the European Commission (2018) recommends that manufacturers should stop using proprietary fasteners and non-reversible means in design such as glue, rivets or snap locks. Moreover, components should be easily replaceable (e.g. by removing screws) without causing any damage to the function of the item. Simplification and standardisation of components, such as screws, motors and pumps, across different brands and product models, may increase product repairability considerably. These strategies can generate better interoperability of components across different devices and models (RREUSE, 2013).

Product repairability has been linked to the concept of upgradability. Products should be designed to be easily and safely maintained, repaired and upgraded. Modular products have been built on these concepts. For example, modularity may extend the lifespan of smartphones, making them repairable and allowing consumers to keep up with fashion trends (Wieser and Tröger, 2016). Graham and Thrift (2007) suggest that digital products should be redesigned fundamentally around what they can deliver rather than how fashionable they are. In the same vein, a modular system can provide a value-added garment for consumers through its adaptability at an attainable price, facilitating repair and alterations (Gwilt, 2014). Allwood *et al.* (2006) provided ideas of garment design that facilitate repair and upgrade, including removable cuffs and collars on shirts, and removable panels on dresses.

However, Ackermann, Mugge and Schoormans (2018) argue that motivation, particularly in emotionally durable design, plays an essential role in product care. Attachment between a product and the owner can be maintained and enhanced through their meaningful and conscious interactions in care activities, including maintenance and repair. Slow design (Fuad-Luke, 2002) is a promising approach as it encourages putting more efforts and time in design processes, including conducting research on consumers' real-life repair experience. Similarly, Harvey (2016) proposed the 'repair thinking' concept embracing the environment that includes the designer and user dynamic. In both approaches, participatory design or co-design is crucial, encouraging stakeholders such as designers, makers, retailers and

consumers to be actively involved in the design process. Touchpoints can be expanded through apps and local businesses. In particular, local enterprises can make greater contributions to participatory product design as they have a better understanding of local user behaviour (Dewberry et al., 2017). As can be seen in practice, some Hackerspaces may act as incubators for new products and enterprise development (Charter and Keiller, 2014).

Changes in design and codesign for repair, in theory, can embrace innovative business model strategies for slowing loops, particularly the classic long-life model and sufficiency-driven model. Businesses can apply the former strategy to diversify their product ranges, through producing and selling repairable products, in addition to current ranges. In the latter strategy, start-ups or existing companies can develop their own brands for solely repairable products or repair services. Both the strategies may require innovation in product design development and testing, CRM and supportive technologies (i.e. to support touchpoints in participatory design).

2.5.2. Provision of diagnostic and repair manuals, and instructional support

Diagnostic and repair manuals have the potential to save repairers' time and ensure the ease and safety of repair work. Such manuals should be designed for both DIY and professional repair. In particular, these 'how-to-fix' guides should help consumers who have either basic or advanced knowledge to conduct repair (Lee Woolf *et al.*, 2012; Ackermann, Mugge and Schoormans, 2018), increase their skills (Ellen MacArthur Foundation, 2016), save time and ensure a smooth and safe repair process (Bracquené *et al.*, 2018). Examples of information and advice supporting self-skilling and home repair at a basic level are replacing a filter on a dishwasher and sewing a button onto a shirt (Lee Woolf *et al.*, 2012).

The manuals can be in written or video formats and open access. Recent evidence of the European Commission (2018) highlights that manufacturers should include instructions for self-repair of minor product breakdowns, with consideration of safety, in user manuals or on the internet. Design for disassembly and safe repair was expected to be taken into consideration from the design and manufacturing stages (Parker *et al.*, 2012), as discussed in 2.5.1.

Repair manuals should be detailed and clear, and associated with support through responsive call centres, live chats or email boxes to give further instruction and advice. Fault diagnostic should be described and presented in troubleshooting tree, and repair advice should be provided to assist fault diagnosis and repair work (Bracquené *et al.*, 2018). Signposting to spare parts services was also suggested for being included in repair manuals (Lee Woolf *et al.*, 2012). Manufacturers can either provide failure diagnostics and disassembly support or directly collaborate with subcontractors to deliver the services (Bracquené *et al.*, 2018). For example, the repair services of Infoteam resulted from the investment in call centres which helped to do preliminary fault diagnosis and the field engineer teams reaching out to customers' homes (Parker *et al.*, 2012). This company provided repair and remanufacture services as an agent for OEMs of consumer electronics products. The report

on Benelux countries also recommended that repairability information should 'detail necessary repair tools and their availability, information about type and number and location of connections, and an index for spare parts suggesting where to get them and their cost' (Bracquené *et al.*, 2018, p.18). These criteria can likewise be found in the product-specific scoring systems proposed by the Joint Research Centre (European Commission, 2019); however, this proposal was limited to laptops, vacuum cleaners and washing machines.

Nevertheless, open-ended instructions are more appropriate in some cases, such as mending clothes, in which consumers and repairers can make creative decisions. For example, as reknitting techniques depend on the specifics of the original garment, colour, scale and gauge of the alteration (Harvey, 2016), the instructions should be open enough for knitters to adapt but detailed enough to be of use during a complex repair process.

Besides the content, the clear manual's structure is of high importance in easily retrieving the required information (Bracquené *et al.*, 2018) as these can make repair easier; otherwise the consumer might simply replace the product (European Commission, 2018). In particular, repair manuals should be 'easily accessible, readable, understandable or self-explanatory, free of charge and as simple as possible' (Bracquené *et al.*, 2018, p.18). Fault diagnosis software and/or hardware and repair guides should be publicly available, where relevant, to support self-repair and repair work by different business stakeholders (European Commission, 2018). For instance, independent third parties, including reuse and repair centres and independent service engineers should have rights to access diagnostic and repair instructions provided by manufacturers (RREUSE, 2013; Bracquené *et al.*, 2018). In practice, Dyson's website provides customers with step-by-step diagnostic advice relating to common faults experienced for different models of vacuum cleaners, without requiring them to pick up the phone (Parker *et al.*, 2012). Similarly, HP freely shares fault diagnostic and repair manuals that enable customers to repair their devices and maintain their quality (Ellen MacArthur Foundation, 2016). A later study suggested using Quick Response (QR) codes to retrieve a link to access repair manuals from phones conveniently (Bracquené *et al.*, 2018).

Repair manuals and instructional support, in theory, can facilitate repair work of consumers, professional repairers and refurbishment service providers, extend lifetimes of current products in the market and new repairable products. For this reason, the provision of repair manuals and instructional support generally can be part of innovative strategies through extending product value, classic long-life model or sufficiency-driven model. These strategies should be concerned with the innovation in repair manuals design (e.g. manuals structure and troubleshooting tree) and distribution (e.g. open and quick access from phones through QR codes), and in customer responsiveness (i.e. to respond to and fulfil related inquiries in a timely manner).

2.5.3. Promotion of repair benefits and repairable products

This business activity is aimed at promoting the benefits of repair and overcoming perceived barriers for consumers. Product repairability can be included on the product label

or the manufacturers' and retailers' websites. A recent study funded by European Commission (2018) indicated that 'offering a label about the length of reparability for products should be part of any government's strategy that aims to influence consumers in their purchasing decisions' (p.75). As a practical example, product reparability is a core value of Fairphone who build repairable phones, publicly shares how-to repair tutorials and repair service procedure, and sells spare parts. A wide range of marketing campaigns, repair events and websites have been launched by brands to promote the value of repair to the environment and consumers (e.g. saving costs, saving the environment). An IKEA showcase 'circular store' in Greenwich offers repair stands and a 'Learning Lab' where customers are trained to upcycle, repair and prolong products' lifetime by experts (Business Green, 2019). Significantly, Patagonia and Nudie Jeans host repair tours in many parts of the world to repair broken clothes, including replacing zips, buttons, patching and sewing on patches, aiming to encourage consumers to accept repair as a cultural norm.

Removals of 'manipulative consumer marketing campaigns' (Bocken and Short, 2016) and the promotion of repair benefits and repairable products can help to moderate sales of cheap products. This activity thereby can be essential to all four innovative business model strategies for slowing loops. These promotional activities can influence consumers' purchases of new products and raise their awareness of the value of repair, the availability of sustainable brands, their repairable products and repair services. These activities may also require innovation in content marketing or marketing campaigns (e.g. considering the use of product labels or repair events) to promote product reparability principles to the general public.

2.5.4. Choosing repair over replacement within warranties

Most of EEA Member States have a legal warranty of two years which is in line with the Consumer Goods Directive 1999/44/EC. However, Sweden has raised it to three years, to five years in Norway, or to six years in Ireland and the UK for some products. There is no specific duration for warranties in Finland and Netherlands. Dissimilar durations across different products or regions may create confusion for consumers; whilst producers may establish the warranty durations based on product prices and statements from sellers (Maitre-Ekern and Dalhammar, 2016).

Moreover, consumers can freely choose between repair or replacement in some countries such as Portugal and Greece. Contrastingly, sellers in France have rights to refuse to repair if it involves disproportionate costs. Cost concerns and the unavailability of spare parts can often result in making direct replacement the most straightforward option (Bracquené *et al.*, 2021). Additionally, the difficulty to non-destructively disassemble products for repair was assumed in the literature to contribute to the costs associated with repair (*ibid*). Many studies suggested revisiting policies, including legal warranties, to promote product durability and reparability (Maitre-Ekern and Dalhammar, 2016; Dalhammar, 2019; Svensson-Hoglund *et al.*, 2020; Milios, 2021). A study in the BENELUX context (Bracquené *et al.*, 2018) and another funded by European Commission (2019) addressed the importance of requiring manufacturers to supply spare parts for a certain

duration to support repair practices. These proposals only focused on 'priority parts' which were defined as likely to fail and important to repair operations. However, non-priority parts sometimes need to be replaced; whilst their unavailability can hinder repair work and lead to replacement of new products.

Repair information regarding the process, parts, labour, delivery and repair duration could be provided to encourage consumers to purchase repairable products and accept repair as a remedy for failure under warranties. Making the terms and conditions of warranty agreements clearer can help consumers more easily see the extent of the cover during their purchasing decision process (DEFRA, 2011). For example, information relating to product repairability and warranty coverage is suggested to be included in the current EU Energy label or the EU Ecolabel (RREUSE, 2013; European Commission, 2018). These are expected to encourage and attract both businesses and consumers to choose repair over replacement as a remedy in warranty claims.

Business models that offer warranties can embrace slowing loop strategies, either in extending product value, classic long-life model or sufficiency-driven model. A transparent warranty scheme can increase brand reputation, particularly showing the reliability of products and manufacturer responsibilities for product lifetime (DEFRA, 2011), thus repair facilities and support centres should be available to assist warranty claims as an aftersales service. Aftersales services can also be outsourced from third-party specialists (e.g. repair companies, local repair shops) to expand the repair network; however, service quality and responsiveness should be taken into consideration. Warranties should be offered as standard by manufacturers, not third party service providers (DEFRA, 2011; Lee Woolf *et al.*, 2012), because warranties with professional repairers certified by manufacturers were expected to improve consumers' perceived cost-efficiency and the service quality of repairs (Lee Woolf *et al.*, 2012). Innovation in business models should also be associated with warranties that support repair whatever the type of product as they can provide an effective measure for supporting reuse and repair markets (Wieser and Tröger, 2016). For clothing, Armstrong *et al.* (2015) propose a potential business model which provides repair, tailoring and alternations to improve fit for five years after purchase.

2.5.5. Integration of repair and reuse

The integration of repair and reuse can embrace innovative business model strategy for slowing loops that aim to extend the lifetimes of broken items and unwanted parts by giving them a second life. These parts and products may be sourced from manufacturers, retailers, reuse organisations, charity shops, asset management companies, household waste recycling centres or waste transfer stations. Repair and reuse can take place in the same organisation or outsourced (i.e. collaborating with third-party service providers to perform repair work). As a result, the use of broken parts and unwanted products is prolonged, and the flow of materials is slowed down throughout the value chain.

Broken items, after being collected, can often be repaired and resold to new users, which requires investment and innovation in logistics and second-hand marketplaces. For example, Edinburgh Remakery, a social enterprise company, has played a pivotal role in empowering communities to repair and reuse through hosting repair workshops and selling donated furniture, electronics and electrical items. Similarly, members of the Reuse Network collect unwanted products and then repair and resell them in a partnership with large retailers such as IKEA, Dixons and John Lewis (Furniture Reuse Network, 2015). Furniture Village has worked closely with DS Smith Recycling with a similar reuse scheme (Furniture News, 2013). These initiatives can generate value to the companies and prevent waste from going to landfill.

Additionally, businesses can use second-hand parts in their repair services or sell them to DIYers. Comprehensive collaboration between manufacturers, collection schemes, recyclers, research organisations and online marketplaces (e.g. eBay and Facebook) are necessary to harvest second-hand components and facilitate their sales (Ellen MacArthur Foundation, 2016). Furthermore, companies can provide solutions for charity shops to disassemble donated items safely to collect spare parts, especially for electrical and electronics items (Parker *et al.*, 2012). Trade-in affordable and second-hand parts can result from a tight collaboration between re-use organisation and professional services (Lee Woolf *et al.*, 2012). This model could be applied to large and small electrical items, which are often not considered cost-effective to repair due to the high cost of obtaining spare parts (WRAP, 2013; Cooper and Salvia, 2018). This kind of integration has the potential to provide end-of-life solutions for used and obsolete assets, increasing business revenues while requiring minimum set-up costs (Parker *et al.*, 2012).

2.5.6. The exchange model and temporary replacement model

These two models are aimed at improving the convenience of, and consumer satisfaction with, repair services. A replacement for a faulty product can be delivered to the customer within a promised lead-time and in the same visit that the broken one is collected.

A report to WRAP presents the 'exchange model', which was adopted by two case studies, as an opportunity to increase re-use and repair practices (Parker *et al.*, 2012). In this model, a repaired or remanufactured product of an equivalent age, quality or condition was exchanged for the broken item. For instance, Sony Computer Entertainment Europe asked customers to return faulty game consoles to service centres for refurbishment to an as new condition and replacements with refurbished machines were offered within 24 hours. Repaired products were added to buffer stock to be sent to next customers requiring replacement. Similarly, Infoteam – a nation-wide repair and refurbishment service provider – offered remanufactured equivalent models of game consoles, computers and tablets to consumers, which were delivered by couriers within 24 hours and in the same visit that the broken ones were collected

A report to DEFRA (2011) proposed the ‘temporary replacement model’ to remove barriers to repair services, particularly uncertain service lead-times. The report suggested providing an equivalent product (e.g. laptops or mobiles) for the consumer’s temporary use during the repair. Giving a replacement to customers while waiting for repairs can be raised as a courtesy of the service provider.

The exchange and temporary replacement model can embrace innovative business model strategies for slowing loops which are associated with access and performance model, extending product value, classic long-life model or sufficiency-driven model.

2.5.7. Fixed cost model and fixed lead-time return model

The two models are expected to ensure the transparency of repair costs and duration, and to improve the convenience and efficiency of repair services.

Businesses adopt the ‘fixed cost model’ through offering repair at a cost that does not depend on the nature of the fault, and covers callout, parts and labour for a home visit. The key to the success of this model is the transparency of the service, including providing information about the comparison of the repair cost with the cost of replacement, and offering a warranty after fixing a product (Parker *et al.*, 2012). The aim is to overcome the obstacle of price uncertainty when commissioning a repair (WRAP, 2013). Dyson offers out-of-warranty repair at fixed prices associated with 12-month post-repair warranties. Prices are published and booking can be made on the website.

A report to DEFRA (2011) proposed the ‘fixed lead-time return model’ in which businesses commit to an explicit service lead-time, returning the repaired product within a specific period. This model is expected to improve the convenience of repair through removing uncertain turnaround time of repair services.

The fixed cost model and fixed lead-time model also seem to embrace innovative business model strategies for closing loops concerned with selling repairable production with long functional life span or developing brands and services for consumption-reduction.

2.5.8. Localised repair service network

Previous studies argued that common barriers to using commercial repair services are low quality, responsiveness and availability of repair services and their high costs (Parker *et al.*, 2012; European Commission, 2018, 2019). Consumers thereby lose their trust in the quality of repair services and prefer replacement (European Commission, 2018). Localisation of repair services may contribute to improving the service network of manufacturers or brands and its responsiveness to customer inquiries. The involvement in the repair service markets from producers and brands may enhance the participation of consumers in extending product lifetimes (Bracquené *et al.*, 2018; European Commission, 2018). This innovative business activity can range from launching new services at brands’ or retailers’ store to outsourcing the service from third-party providers. Innovations may also be required in supply chain management, marketing activities and technologies (e.g. 3D printing).

Repair services should be characterised by ‘direct and long-term contact with customers, and the development of elaborate collaborative networks with various stakeholders in the supply chain’ (Armstrong *et al.*, 2015, p.31). Manufacturers and retailers can accredit and promote local businesses as reliable spare parts retailers and repair service providers. Previous studies recommended that businesses should focus on advertising repair services (Lee Woolf *et al.*, 2012) and mapping service locations in local communities (Charter and Keiller, 2014) to enable consumers to find reliable service providers. A previous study also suggested that holding open innovation spaces, especially for hacking and adaption (Dewberry *et al.*, 2016), such as Hackspaces, is a promising approach.

Moreover, each stakeholder can contribute to the quality and time-efficiency of the repair services and related support (e.g. 3D printing, open innovation spaces) at a local level. Previous research indicates that 3D printing can lead to business opportunities as the technology has been efficiently used in Hackspaces to print replacement components to enable product repair and extend the product lifetime (Charter *et al.*, 2014). A WRAP report compliments Regeneris – an aftermarket service provider - on their strategy of outsourcing partners for both in- and out-of-warranty repair, remote diagnostics, parts management, call centre support and OEM accredited technical repair centres (Parker *et al.*, 2012).

Big data can help large companies to understand and deliver flexible systems of supply, maintenance and upgrade (Dewberry *et al.*, 2017) to improve services throughout the network. Data on consumer trends, behaviour and feedback regarding repair activities can be collected through local retailers, repair shops or via apps and websites and shared among stakeholders for improvement of repair services and customer relationship management. These initiatives have the potential to help business to optimise the turnover of spare parts stock and minimise costs. Data can also help to develop repairable design through co-design with a consideration of challenges to repair. Companies which offer repair support can gain further profit from spare parts and services and also enhance their image and future sales (Ackermann, Mugge and Schoormans, 2018).

A localised repair service network can be part of innovative business model strategies in a classic long-life model or sufficiency-driven model. These activities can slow loops by supporting the design and production of repairable products and the development of brands and services for consumption-reduction.

2.5.9. A transparent spare parts and tools supply chain

A robust spare parts supply chain is expected to contribute to the increase of consumers’ and business stakeholders’ participation in repair though eliminating challenges such as expensive costs, and parts only being available in limited geographical locations, within specific durations or to authorised business partners (Raihanian Mashhadi *et al.*, 2016; European Commission, 2018). This business activity should also be associated with codesign for repairable products and the transparency of the information about the availability of spare parts (e.g. where and how to order) and their prices. For these reasons, improving the

availability of spare parts and their accessibility needs to be concerned with the collaboration between product manufacturers and all parts of the supply chain (Ellen MacArthur Foundation, 2016), including spare parts producers and suppliers, retailers, repair service providers and customers.

Parts and tools should be supplied publicly and be easily accessible both online and at physical stores, with manuals and machine code and firmware updates offered at a reasonable cost, for a minimum period following the production of the last product batch. The European Commission (2018) has urged manufacturers to ensure cheaply available parts and components in addition to repairable products. Although France was the first country to implement legislation that forces manufacturers to inform consumers about the duration of spare parts availability, the decree does not mention how consumers must be informed (Bakker and Schuit, 2017). Similarly, RREUSE (2013) and Ellen MacArthur Foundation (2016) both emphasise the importance of these elements in product lifetime extension. In particular, accessibility to parts and tools should not be limited to authorised actors; as repair options can only be enabled in full by making spare parts and relevant information available to a range of stakeholders, including individuals as well as commercial and non-commercial organisations.

A traditional approach to offering accessibility to spare parts is regularly found in clothing; for example, including buttons inside shirts and ensuring universal fabric patches, branded parts, and other fixings purchasable from haberdashers (Harvey, 2016). In practice, problems with accessibility to spare parts and tools to facilitate repair work can be solved if they are either offered for free or sold online or at local retailers. For example, replaceable parts of classic toasters and kettles online can be ordered on Dualit's website, whilst Herman Miller chair components can be purchased at its certified dealers.

2.6. Conceptual framework for business study

In this thesis, the nine proposed business activities are used to indicate changes in promoting product repairability and repair services. The first activity (Section 2.5.1) addressed product features and design strategies, whilst the next two (Sections 2.5.2 and 2.5.3) were related to the provision, availability and accessibility of information. The remaining activities (Sections 2.5.4-2.5.9) considered services offered during the use of products. These nine activities may require innovations in different aspects of businesses such as technologies, product design, marketing activities, CRM, logistics and service management.

Table 11 shows a conceptual framework that includes the nine activities and their value to consumers and repairers (Columns a and b), which emerged from the literature (Section 2.5). Considering these activities, the current research adopted the value creating logic of the SBM framework (Figure 8, Section 2.4.3) to identify opportunities for value proposition, value creation and delivery and value capture of each activity (Column d). Based on recommendations for businesses in previous studies (Section 2.5), this PhD utilised value proposition (i.e. what value is provided), value creation and delivery (i.e. how value is

provided) of the nine activities and presented them in business activity cards. These cards were used in interviews with businesses to (i) investigate the suggested value proposition, value creation and delivery and (ii) explore value capture through business practices. Section 3.4.3 discusses the use of these business activity cards in detail.

The five propositions for SBM innovation (Section 2.4.1) developed by Evans *et al.* (2017) were employed to investigate their implications (Column c). Key challenges to SBM innovation from previous studies (Section 2.4.4) were then identified in considering the adoption and execution of these activities (Column e).

Findings from this business study were then synthesised with consumers' support needs from businesses during repair journeys from the consumer study (Sections 4.3 and 5.2) to propose implications for business management (Section 7.2) and future regulations (Section 7.3).

Table 11: Conceptual framework to study business innovation for product repairability

Innovative business activities (a)	Value to consumers/ repairers (b)	Five propositions for SBM innovation (c)	Opportunities for SBM innovation through product repairability (d)	Challenges to SBM innovation through product repairability (e)
Design for repair and codesign	Improving the repairability of current products and the future availability of repairable products	<ul style="list-style-type: none"> • Sustainable value incorporates economic, social and environmental benefits. 	<ul style="list-style-type: none"> • Opportunities for value proposition of innovative business activities – What value is provided and to whom, considering consumers society and environment? 	<p>Triple Bottom Line</p> <p>Resources</p> <p>Mindset</p> <p>External relations</p> <p>Technology innovation</p> <p>Methods and tools</p> <p>Challenges to SBM innovation</p>
Provision of diagnostic and repair manuals, and instructional support	Easing fault diagnostics and repair work	<ul style="list-style-type: none"> • SBMs require a system of sustainable value flows among multiple stakeholders. • SBMs require a value network with a new purpose, design and governance. 	<ul style="list-style-type: none"> • Opportunities for value creation and delivery – How is value provided, considering contributions of the focal company and its business stakeholders (e.g. manufacturers, brands, retailers and repair service providers)? 	
Promotion of repair benefits and repairable products	Widely promoting the benefits of repair and helping consumers to overcome perceived barriers	<ul style="list-style-type: none"> • SBMs require a systemic consideration of stakeholder interests and responsibilities for mutual value creation. 	<ul style="list-style-type: none"> • Opportunities for value capture – How does the focal company make money and capture other forms of value? 	
Choosing repair over replacement within warranties	Attracting consumers' preference for repair over replacement as a remedy for faulty products	<ul style="list-style-type: none"> • Internalizing externalities through PSS enables innovation towards SBMs. 		
Integration of repair and reuse	Improving the availability of second-hand spare parts and reused products after being repaired			

Exchange model and temporary replacement model	Improving the convenience of and consumer satisfaction with repair services			
Fixed-cost model and fixed lead-time return model	Improving the convenience, transparency and efficiency of repair services			
Localised repair service network	Improving the network of repair services, its responsiveness to local needs and consistency in quality			
A transparent spare parts and tools supply chain	Improving the availability of spare parts and tools			

CHAPTER 3. Methodology

This chapter reviews different philosophical worldviews in Section 3.1 and sets out the research methodology that was used to develop research design in Section 3.2. It demonstrates the rationale for combining two qualitative research strategies of inquiry (phenomenology and grounded theory) and two research methods (consumer focus groups and business interviews). The design of these two research methods is detailed in Sections 3.3 and 3.4. Section 3.5 explains the analysis method adopted and addresses the value of applying NVivo to the research. Finally, Section 3.7 clarifies validity and reliability strategies that ensured the research quality and rigour, and prevented or minimised the drawbacks of qualitative research.

3.1. Philosophical worldviews and research approaches

The research design process often begins with philosophical assumptions or paradigms. These are sets of common beliefs that are shared among scientists to understand and address problems in research projects (Creswell and Poth, 2007). In the same vein, Kuhn (2012, p.45) defined a research paradigm as ‘a set of shared beliefs and agreements of scientists about how problems should be understood and addressed’. Researchers should be aware of these assumptions’ influences on the conduct of inquiry and make them explicit in writing the study (Bryman, 2015). For instance, research paradigms or worldviews can be characterised by the way their proponents answer ontological, epistemological and methodological questions (Guba, 1990). These questions are explained as follows:

- Ontology: What is the nature of the ‘knowable’ or ‘reality’?
- Epistemology: What is the nature of the relationship between the knower (the inquirer) and the known (or knowable)?
- Methodology: How should the inquirer go about finding out knowledge?

Creswell (2017) developed a framework for research which indicates interconnections of worldviews, design and research methods (Figure 9). He addressed the importance of worldviews as ‘a general philosophical orientation about the world and the nature of research that research brings to a study’ (p.6). The proposed philosophical worldview shapes an appropriate research approach.

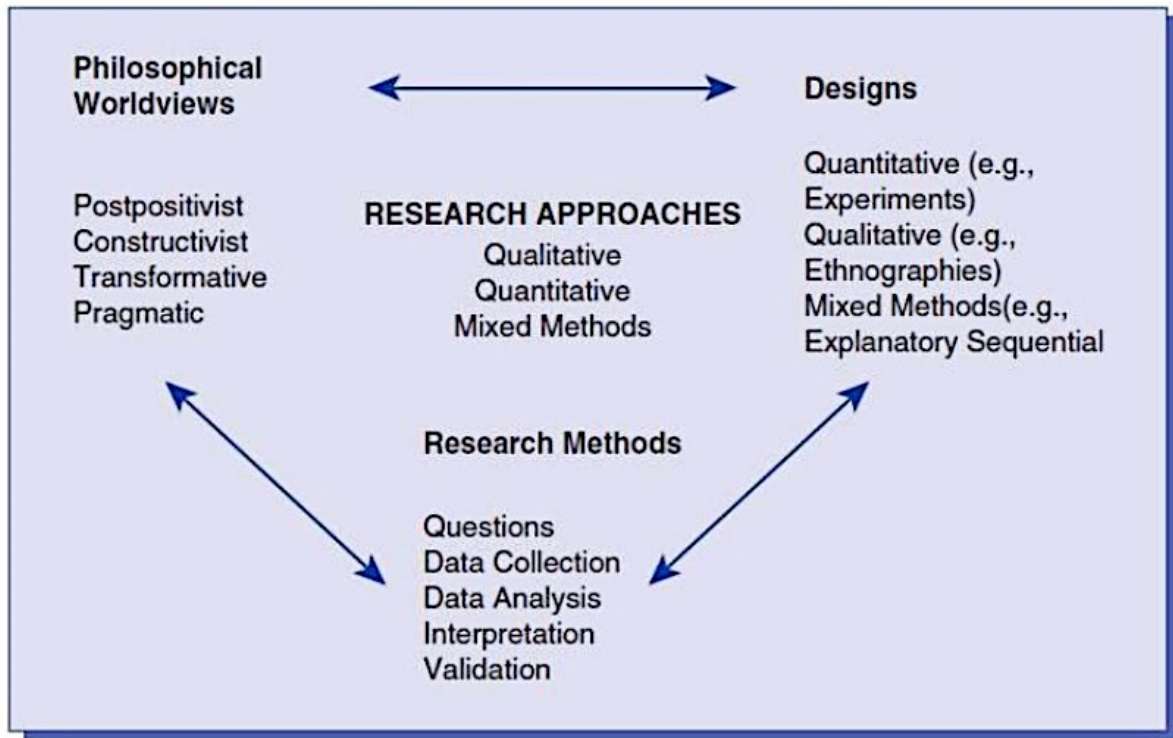


Figure 9: A framework for research – the interconnection of worldviews, design and research methods (Creswell, 2014, p.5)

Creswell (2014) also indicated that research worldviews or types of belief that are held by individual researchers often suggest a qualitative, quantitative or mixed methods approach in their research. He highlighted four worldviews which have been widely discussed in the literature: postpositivism, constructivism, transformative and pragmatism. Their major elements are presented in Figure 10.

Postpositivism	Constructivism
<ul style="list-style-type: none"> • Determination • Reductionism • Empirical observation and measurement • Theory verification 	<ul style="list-style-type: none"> • Understanding • Multiple participant meanings • Social and historical construction • Theory generation
Transformative	Pragmatism
<ul style="list-style-type: none"> • Political • Power and justice oriented • Collaborative • Change-oriented 	<ul style="list-style-type: none"> • Consequences of actions • Problem-centered • Pluralistic • Real-world practice oriented

Figure 10: Four Worldviews (Creswell, 2014, p.6)

The next section presents the rationale for choosing the constructivist worldview and qualitative approach to achieve research objectives.

3.2. Research design

Research approaches are plans and the procedures that help researchers to translate broad assumptions into detailed methods of collecting, analysing and interpreting data (Creswell, 2017). A constructivist worldview aligned with qualitative approach was employed in this research as its inquiries match those assumptions identified by Crotty (1998).

Firstly, a constructivist worldview focuses on seeking individuals' understanding of the world and development of subjective meanings of their experiences (Crotty, 1998). This PhD research focuses on how consumers and business stakeholders (e.g. manufacturers, brands, retailers and repair service providers) construct meanings of product repairability and repair practices that they have engaged with. A constructivist worldview and semi-structured interview method was employed through the consumer focus groups and business interviews (Sections 3.3 and 3.4). These enabled participants to share their views, in their own words, of challenges and opportunities for the consumer repair journey and innovative business activities.

Secondly, this worldview holds a philosophy about 'how humans engage with their world and make sense of it based on their historical, social and cultural perspectives' (Creswell, 2017, p.8). Different stakeholders, including manufacturers, brands, retailers, repair service providers and consumers were encouraged to provide their personal insight into repair practices they experienced. In particular, consumers were asked to identify factors influencing their repair journeys and support needs from business stakeholders. Businesses were asked to describe opportunities for and challenges to adopting and executing innovative activities promoting product repairability and repair services, followed by the identification of support needs from government.

Finally, the generation of meaning should arise in and out of interaction with a human community. Constructivists address the importance of human interactions to construct the meaning of a situation and qualitative approaches can support this purpose (Creswell, 2017). Therefore, a constructivist worldview was applied to develop meanings from the data collected and transform them into concise messages for different audiences – policymakers, business practitioners, environmental activists and the general public.

3.2.1. Qualitative research strategies of inquiry

There are five qualitative strategies of inquiry: narrative, grounded theory, ethnography, case study and phenomenology (Creswell and Poth, 2017). The following paragraphs explain why the phenomenology was employed and why other methods were not chosen in this research.

Narrative research is described as informal gathering of data and restoring of stories, through using a chronology (Creswell and Poth, 2017). The current research did not choose the narrative strategy as this strategy is to explore an individual's life (ibid).

Grounded theory strategy aims to generate a theory for a social process which is shaped by participants' views. Corbin and Strauss recommended to collect a large amount of data to produce a general explanation (2007). The current research did not satisfy this requirement as it adopted theoretical foundations from previous studies on consumer behaviour and sustainable business model innovation.

Ethnography focuses on studying an entire culture-sharing group (Harris, 1968), particularly patterns of values, behaviours, belief and language of the group (Creswell and Poth, 2017). The current research, by contrast, utilised a limited and distinct sample (Sections 3.3.4 and 3.4.4). For example, the consumer study included the participation of people from two generations (X and Y) and with different sexes. The business study invited business practitioners from various industries (EEE, clothing and furniture), and different types (e.g. manufacturers, retailers, brands and repair service providers) and size (e.g. multinational and national) of organisations.

Case study research investigates a sample within a real-life contemporary setting (Creswell and Poth, 2017), through using multiple sources, such as interviews, observations, documents and artefacts (Yin, 2003). The current research only conducted focus groups with consumers and interviews with businesses to gather insights into repair journeys and business model innovation through product repairability, respectively.

This research applied and developed the focus on aspects of the phenomenon of repair which is of emerging interest of governments, researchers, environmental activities and consumers (Section 1.1). A phenomenology approach, initiated by Edmund Husserl, aims to seek descriptions of a phenomenon's essence from those who have experienced it (Manen, 1997; Teherani *et al.*, 2015); specifically, in the current research, their experience of repair journeys and business model innovation through product repairability. Phenomenological research is to descriptively identify 'what was experienced' and 'how it was experienced'

(Teherani *et al.*, 2015), such as collecting common lived experiences of making repair decisions and interpreted diverse phenomena for different products. In addition to studying individuals' lived experience, phenomenological research studies the way people perceive and understand phenomena (Smith, 2018). The current research investigated understanding of product repairability, perceived factors influencing the 'consumer repair journey' and the adoption and execution of business activities promoting product repairability and repair services.

Phenomenological research primarily uses interviews to collect data and produce themes to describe the essence of a lived experience (Creswell and Poth, 2017). Therefore, this research employed interviews and focus groups (a particular type of group interview or discussion) (Sections 3.2.2, 3.3.3 and 3.4.3), and a thematic analysis method (Section 3.6.1). As a result, new definitions and insights were developed to inform or reorient the way people understand (Laverty, 2003) challenges to and opportunities for a consumer's repair journey and innovative business activities through product repairability.

3.2.2. Research questions and research methods

Collection procedures in qualitative research involve four basic types: observation, interviews, documents, audio-visual materials (Creswell, 2017). Considering strengths and limitations of each method (Creswell, 2017, p.188), Table 12 shows the rationale for choosing interviews, rather than observations, documents and audio-visual materials.

Table 12: Rationale for choosing data collection method

Data collection type	Description	Rationale for decision
Observations	<ul style="list-style-type: none"> • Researcher has first-hand experience with participants. • Research can record information as it occurs. • Unusual aspects can be noticed during observation. • Useful in exploring a topic that may be uncomfortable for participants to discuss. 	<p>This type was not employed because:</p> <ul style="list-style-type: none"> • The current research aimed at collecting lived experience and personal insights rather than having a first-hand experience with participants whilst collecting data. • Lived experience and personal insights could be collected in discussions with individuals or groups of people.
Documents	<ul style="list-style-type: none"> • Involves meeting minutes, newspapers, journals, diaries or letters • Obtains the language and words of participants 	<p>This type was not employed because:</p> <ul style="list-style-type: none"> • Public or private documents cannot provide lived experience and personal insights into opportunities for and challenges to repair journeys and business model innovation through product repairability.

	<ul style="list-style-type: none"> • Can be accessed at a time convenient to the researcher – an unobtrusive source of information • Represents data to which participants have given attention • As written evidence, it saves a researcher the time and expense of transcribing. 	<ul style="list-style-type: none"> • The documents may not be authentic or accurate for this PhD research and its research questions.
Audio-visual materials	<ul style="list-style-type: none"> • Involves photographs, videotapes, art objects, computer messages, sounds or film • May be an unobtrusive method of collecting data • Provides an opportunity for participants to directly share their reality • It is creative in that it captures attention visually. 	<p>This type was not employed because:</p> <ul style="list-style-type: none"> • The current research aimed to collect data through discussions with participants or among them. • Audio-visual materials are often used to enable ethnographic research to study an entire cultural or social group and communicate findings; whilst this research adopted a phenomenological approach.
Interviews	<ul style="list-style-type: none"> • Useful when participants cannot be directly observed • Participants can provide historical information. • Allows researcher control over the line of questioning. 	<p>This type was employed because:</p> <ul style="list-style-type: none"> • It allowed collecting lived experience (i.e. historical information about repair journeys) and insights into business model innovation. These kinds of data were not able to be directly observed. • Semi-structured interviews provided the investigator with some control but also encouraged participants' discussions.

Interviews were employed after considering research objectives, and the advantages and limitations of all four types of qualitative data collection. Creswell (2017) classified interviews into four sub-types: face-to-face, telephone, focus group and email interview. Besides focus group and face-to-face interviews, Skype interviews were also used in this research. The term 'business interview' is used to refer to both face-to-face and Skype interviews with businesses. In some situations, business interviews included more than one interview; further information is given in Section 3.4.

Four common limitations of interviews (e.g. focus groups and one-to-one interviews) are (i) indirect information filtered by interviewees, (ii) information provided in a designated place rather than natural field setting, (iii) interviewees' responses biased by researcher's presence and (iv) unequally articulate and perceptive interviewees (Creswell, 2017). Although the observation method can prevent these limitations, it cannot collect historical information about previous experience in repair and the adoption and execution of business innovation

for product repairability. Discussions on how the researcher minimised the limitations of interviews are included in the following sections.

Table 13 shows links between the stages, the main- and sub-objectives and the methods selected to answer research questions. This study incorporated three stages, which were designed to address the three main research objectives. The research employed a multi-method approach to achieve these objectives: literature review, focus group, business interview and idea generation (i.e. synthesise the data collected in the other three methods).

Table 13: Methods linked to stages, objectives and research questions

Research questions (RQ)	Sub-objectives numbered in	Methods
Stage/ Objective One: Developing a consumer repair journey and understanding consumer behaviour		
i. Which model should be used to understand repair intention and behaviour?	1.1	Literature review
ii. What could influence consumers' intention to repair?	1.2	Focus group
iii. Are there any intention-behaviour gaps at each stage of consumers' repair journey?	1.3	Focus group
iv. What could be opportunities for translations of consumers' intention into behaviour at each stage of their repair journey?	1.3	Focus group
v. What could be challenges to translations of consumers' intention into behaviour at each stage of their repair journey?	1.3	Focus group
vi. What are consumers' support needs from manufacturers, retailers and repair service providers at each stage of their repair journey?	1.4	Focus group
vii. Are there any noticeable similarities and differences in data when comparing repairing different products?	1.5	Focus group
Stage/ Objective Two: Identifying and evaluating business activities that could promote repairability and support repair practices		
viii. Which business activities could promote product repairability and repair practices?	2.1	Literature review + business interview + idea generation from focus group findings
ix. What could be opportunities for adoption and execution of the proposed business activities?	2.2	Business interview
x. What could be challenges to adoption and execution of the proposed business activities?	2.2	Business interview
xi. Whether and how the proposed business activities could benefit consumers during their repair journeys?	2.3	Business interview + idea generation from focus group findings

xii. Whether and how the proposed business activities could benefit different business stakeholders (i.e. manufacturers, brands, retailers and repair service providers)?	2.4	Business interview
xiii. What are implications for business management?	2.5	Business interview + idea generation from focus group findings
xiv. Are there any noticeable similarities and differences in data when comparing different products?	2.6	Business interview
Stage/ Objective Three: Reflecting on current legislation and trends for business innovation		
xv. What government interventions might be effective in supporting consumer repair journeys and the adoption and execution of the proposed business activities?	3.1	Business interview + idea generation from focus group findings
xvi. Are there any noticeable similarities and differences in data when comparing different products?	3.2	Idea generation from focus group and business interview findings

The following sections justify the selection of focus group and business interview methods.

3.3. Consumer focus groups

3.3.1. Focus group method

This method is defined as an organised discussion of a selected group of individuals to share their views and experiences on a topic, involving interaction amongst group participants (Powell and Single, 1996; Gibbs, 2012). Leung and Savithiri (2009) and Breen (2006) address major advantages of this method; capturing richer data, and saving time and money when compared to individual interviews. Focus groups allow the investigator to interact directly with respondents and observe nonverbal responses which may carry information that either supplements or contradicts verbal answers.

Furthermore, the method facilitates discussion amongst participants, building upon each other's ideas through 'piggybacking' (Leung and Savithiri, 2009) and social interaction within a group. Thus, the group discussion captured more accurately how opinions and ideas regarding repair journeys were formulated and exchanged. Similarly, Marshall and Rossman (1995) indicate that the most attractive advantage of a focus group is creating a learning environment where participants can exchange their views and experience the research as an

enriching encounter; they are able to learn how others perceived and interpreted challenges and sought support for repair decisions for different kinds of products. Moreover, this method allowed researchers to look beyond the facts and to learn or confirm factors influencing repair journeys proposed in the conceptual framework (Figure 7). For example, participants could work together to identify and map out common challenges to and opportunities for translations of consumers' intention into behaviour at each stage of their repair journeys. Moreover, similarities and differences between sexes and generations could also be identified from the data.

3.3.2. Pilot focus group

Initially a pilot focus group was conducted to evaluate the feasibility of the research design and questions and investigate whether research plans were appropriate and components should be modified or altered. Testing the research design and capturing its practice were crucial to finalising the research questions and clarifying the research scope.

The pilot study focused on investigating consumers' repair journeys (Section 2.2), their intention-behaviour gaps at each stage and whether emotional attachment influenced repair decisions. A proposed consumers' repair journey was piloted to identify individuals who intend to, and actually do, repair their broken items. This journey was inspired by and developed from the Five-Stage Model of (Dewey, 2012), in which the five stages are a framework to evaluate customers' buying decision (Figure 5).

Three key findings emerged from the pilot study. Firstly, four stages of the consumer repair journey, instead of the five, were evident for products (not under warranty) that were either fixed by the owner or a professional repairer. For this reason, a modified four-stage journey was applied to four focus groups (Figure 11). Moreover, some participants in the pilot study stated they had skipped information searches and alternative evaluations when they had prior experience of fixing the same or similar products. This preliminary finding was taken into account in the main study to seek further confirmation.



Figure 11: The proposed consumer repair journey (inspired by Dewey, 2012)

Finally, the pilot study suggested that capturing the complexity of behaviour change towards product repair required a comprehensive understanding of owners' motives influenced not only by product characteristics such as product design and emotional value, but by the facilitating conditions (e.g. repair costs, duration of repair work and the availability of spare parts and repair services). These factors were found in the pilot study to have

influenced both the intention and its translation into actual behaviour of most participants. As a result, the research focus shifted from studying emotional attachment to investigating a wider range of factors (presented in Figure 7 – the conceptual framework) that could determine intention and support or hinder translating intention into behaviour at each stage of the consumer repair journey. These factors were classified into the product, the owner and the context categories, inspired by Cooper and Salvia (2018).

3.3.3. Focus group design

The four focus group studies captured the complexity of behaviour changes during the consumer repair journey and identified impact factors. Each focus group consisted of three sections: an introduction section, an exploration of the consumer repair journey, and a concluding section. The second section included four sub-sections which were named following four stages of the consumer repair journey. The focus group guide is shown in Appendix 3. Leung and Savithiri (2009) describe how it is advisable to include five categories of questions: opening questions to warm-up, introductory questions, transition questions, key questions to focus on main areas of concern and concluding questions (Leung and Savithiri, 2009).

Table 14 demonstrates how the five question categories were applied to focus group design.

Table 14: Examples of five question categories

Question categories	Examples	Rationale
Opening questions	<p>Across the three product sectors, what broken products did you ...personally repair?</p> <p>...send or take to a repair service?</p> <p>...intend to repair but you changed your mind later?</p> <p>(The question was shown on a screen; names of products were recorded and written on a board by an assistant)</p>	<p>To warm up and create a welcoming environment.</p> <p>To identify participants’ characteristics (e.g. being dominators or quiet in a group) and their shared interests or opinions (e.g. preference for repairing particular products, common factors influencing the three repair decisions – personally repaired, sent or took products to a repair service, or intended to repair but changed mind later.</p>
Introductory questions	<p>Please briefly share the reason why you repaired some products, but not the others.</p>	<p>To describe the focus of this study on comparing repair experience across different products.</p>
Transitions questions	<p>How did you know that your items needed to be fixed?</p>	<p>To notify a transition to the next section – stage one of the proposed consumer repair journey.</p>

Key questions	What factors made you plan and act differently in identifying the repair need? Do you think the factors were internal (from yourself) or external (from the product or the context)?	To identify opportunities for and challenges to translations of consumers' intention into behaviour (one of the three main research objectives).
Concluding questions	<p>Would you like to add any other ideas on this stage?</p> <p>Would you like to add any other comments to our discussion today?</p>	<p>To welcome further ideas of participants at the end of:</p> <ul style="list-style-type: none"> • Each stage of the consumer repair journey • A group discussion session.

Questions were designed following key rules proposed by Smithson (2000) to ensure they could be easily understood, encouraged discussion and information sharing, and allowed participants to offer their opinions or expand upon basic answers. Follow-up questions, such as 'What makes you think or say that?', 'How do others think about his/ her idea?' and 'Would you like to add any idea on this question?', were utilised to seek further clarification of answers and encourage group discussion.

The investigator, holding a moderator role in focus groups, took care to deal tactfully with challenging different types of participants, including self-appointed experts, dominators, shy and quiet people, to ensure the efficiency of discussion. In particular, the investigator referred to concise guidelines from Breen (2006): listening attentively with sensitivity and empathy, having adequate knowledge of the topic, keeping personal views out of the facilitation and appropriately managing group dynamics. Moreover, the investigator respected ideas of all group participants regardless of their education, experience and background. An assistant moderator – one of the investigator's colleagues - kindly helped to run two audio recorders during each session and took notes, to allow the moderator to focus on the talking during the group discussion. The records were transcribed by computer-assisted software (Section 3.6.2) and checked by the investigator. All of the participants in group discussions were asked to complete and sign off a consent form (Appendix 4).

3.3.4. Focus group sampling

Krueger and Casey (2000) suggest that conducting three or four focus groups might help to determine the point of saturation, when hearing the same range of ideas and not getting new information. Four consumer focus groups were designed to last not more than 120 minutes and carried out in Nottingham; these allowed the investigator to identify common opportunities for and challenges to consumers' intention and behaviour and their support needs from businesses and the Government at each stage of their repair journey. Saturation point was identified in the fourth session in which no new information or themes appeared and emerged.

A focus group should include about eight participants as participants in a large group are likely to break off to talk in sub-groups and leave others out of the discussion (Anne and Cox, 2008). In contrast, a group of fewer than three people appears too difficult to keep the conversation going in enough depth for the participants not to feel intimidated by the situation. For these reasons, the recruitment aim was for each group session to have, on average, eight participants.

Table 15 shows the number of participants in the four focus groups and their demographics.

Table 15: Four focus groups and their demographics

Group	Number of participants	Generation		Gender	
		Xers	Yers	Male	Female
1	10	1	9	2	8
2	7	1	6	2	5
3	8	4	4	5	3
4	9	9	0	5	4
Total	34	15	19	14	20

Paper- and e-posters for participant recruitment (Appendix 1) were circulated within Nottingham Trent University, in targeted Facebook groups (e.g. residential community groups), and in high street shops and restaurants in Nottingham. Participants were recruited via the convenience sampling method (Saunders, Lewis and Thornhill, 2012), and requested to answer an online pre-qualification questionnaire (Appendix 2). More than 110 registrations were received and participants were then selected following two requirements, as follows:

- i. People were born between 1965 and 1998 – Generation Xers born between 1965 and 1981, Generation Yers born between 1982 and 1998.
- ii. People had experience of making decisions about repairing furniture, clothing, and electrical and electronic items, whether Do-It-Yourself (DIY) or professional repair.

The need for balanced sampling was also taken into account when reviewing responses to the pre-qualification questionnaire and selecting participants, particularly considering generation, product type experience and gender. For example, the first three discussion groups attracted more Yers and the fourth recruited only Xers to ensure the balance.

3.4. Business interviews

3.4.1. Qualitative interview

Qualitative research is designed to capture interviewees' own perspectives when initial research ideas are open-ended, whereas quantitative research is aimed at maximising the validity and reliability of measurement of key concepts when investigating a clearly specific set of research questions (Bryman, 2015). In addition to using a set of research

questions, qualitative researchers also often use prompts (i.e. different dimensions of possible answers) and probes (i.e follow-up questions) to seek participants' own perspectives. Due to the dearth of literature on product repair, the qualitative interview method was utilised, to explore relevant phenomena and generate a comprehensive synthesis from diverse perspectives, including those of consumers and business stakeholders – manufacturers, brands, retailers and repair service providers. The process of qualitative research was inductive and generated meaning from the data collected (ibid). Moreover, qualitative interviews give an opportunity to identify and have a fuller understanding of the experiences of respondents (Weiss, 1994). As each business in the current research had its own strategy, constraints and opportunities, tailoring interviews questions based on interviewees' responses was beneficial to exploit their full stories and gather rich data.

However, an inductive approach was also employed to form a foundation of knowledge on and bridge the knowledge gaps in business innovation for product repairability. In particular, the business interviews focused on nine innovative business activities that emerged the comprehensive literature review (Section 2.5). Section 3.4.3 discusses interview design in detail.

Qualitative interviews can be semi-structured or unstructured. Semi-structured interviews include a degree of structure but give participants space to pursue particular topics that they are interested in (Leidner, 1993); this method was used. It was essential to explore concepts of product repairability and sustainable business in detail, reflect on the current state of knowledge, and capture repair practices in the business world. Flexibility in semi-structured interviewing also allowed the investigator to encourage participants to elaborate on potential business activities that promote product repairability. As suggested by Mazmanian, Orlikowski and Yates (2013), the investigator incorporated any new business activity or model that emerged in an interview into conversations in subsequent interviews. Considering the need for confidentiality, the investigator asked the interviewees to confirm that they would allow the investigator to share their ideas and descriptions of their companies (as shown in the third column of Table 17).

Advantages and disadvantages of in-person and Skype interviews are discussed in Section 3.2.2. Skype interviews are similar to telephone interviews but share similarities with in-person interviews as interviewees and interviewers are able to see each other (Bryman, 2015). The investigator controlled the flow of questioning following an interview guideline and the line of conversation. Skype interviews were more advantageous in comparison to in-person interviews (ibid). For instance, Skype interviews were convenient for participants and the investigator, negating the time and financial costs of travelling, preparing meeting rooms and conducting safety checks. Convenience also encouraged busy businesspeople to participate in the research. It was more easily to reschedule a Skype interview when necessary. For that reason, 14 Skype interviews and 7 in-person interviews were conducted in this research. Due to some potential pitfalls of qualitative interviews, a wide range of

validity and reliability strategies were carefully applied and constantly considered, as discussed below (Section 3.7).

3.4.2. Pilot business interview

Three pilot interviews were conducted to evaluate the feasibility of the research design and research questions. Bryman (2015) suggests nine steps in formulating questions for a qualitative interview guide which are presented in Figure 12 and these were applied to developing, testing and revising the interview guide in the current research.

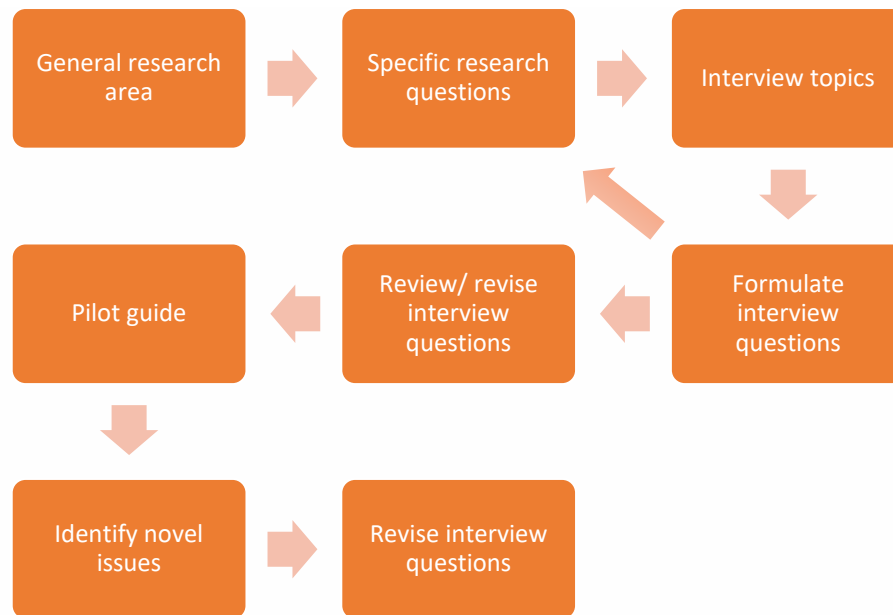


Figure 12: Formulating questions for an interview guide (Bryman, 2015, p.470)

The revision of interview questions, considering the line of questioning and wording of questions, was conducted with the support of six senior lecturers and researchers at School of Architecture, Design and the Built Environment, School of Arts and Design and Business School. Following this, five pilot semi-structured interviews were undertaken with different business stakeholders, including manufacturers, brands, retailers and repair service providers. For these, the convenience sampling method was used, taking into account the variety of industry sectors, company size and business stakeholders.

The results of pilot interviews indicated positive responses both in flow and interpretability. However, they indicated that the proposed business activities (Section 2.5) should be shared with participants in advance; to reduce the time spent clarifying information on the cards, to limit the duration and keep participants focused within sixty to ninety minutes.

3.4.3. Business interview design

All participants were asked to sign a consent form (Appendix 6), to confirm that they were informed that all responses would be kept confidential, and that names of companies

and interviewees would never be revealed in any report or publication. Acknowledgement of confidentiality and anonymity and a requirement of the ethical approval could enhance research validity (Robson, 2011) because these elements helped to protect the privacy of participants and encourage them to share honest answers. As a result, the data collected closely corresponded to real-world practices.

The line of questioning in interviews followed the guideline set out in Appendix 5. Interviews were structured into five themes (Table 16), which aimed to generate particular outcomes within less than 45 minutes per interview.

Table 16: Interview themes and expected outcomes

Themes	Expected outcomes
Theme One: The prospect of product repairability in the company	<ul style="list-style-type: none"> Identify importance of repairability concept in the organisation and its products and services (compared to published material). Capture current practices of promoting product repair and repair services, referring to the proposed business activities.
Theme Two: Benefits of your business activities to customers, the environment and society	<ul style="list-style-type: none"> Identify whether and how business activities promote and support sustainable consumption, particularly in purchase and repair decisions (considering each stage of the consumer repair journey). Identify benefits of the business activities to the environment and society. Identify whether and how the business serves Xers and Yers differently.
Theme Three: Internal and external factors that influence your business activities	<ul style="list-style-type: none"> Identify barriers to and opportunities for the nine business activities, including internal resources and external collaboration.
Theme Four: Benefits of your business activities to different business stakeholders	<ul style="list-style-type: none"> Identify whether and how the activities contribute to the sustainable innovation of the business and its stakeholders.
Theme Five: Potential for your business's growth through a greater focus on product repairability or repair service development	<ul style="list-style-type: none"> Identify the potential for business growth and support needs from government.

In addition to the interview guide, the nine potential business activities that are expected to improve the repairability of products and promote repair services were printed

on paper cards (Figure 13) and used during the interviews. These nine business activities were developed from idea generation, which is further explained in Section 3.5.

Each card presented a business activity and its description. The first card addressed product features and design strategies, whilst the next two were related to the provision, availability and accessibility of information. The remaining cards included services offered through the use of products. Referring to the nine business activity cards as a directives of sustainability practices in the businesses supported the flow and focus of the interview conversations. Most participants appreciated this sharing of knowledge synthesis from the critical review of the literature. The cards inspired participants to proactively assess the feasibility of adopting and executing the business activities. Therefore, interviews took longer than planned, lasting between sixty and ninety minutes, rather than forty. However, this resulted in more in-depth and insightful data.

BUSINESS ACTIVITY CARDS

Tung Dao, Tim Cooper, Matthew Watkins

#product repairability
#repair decisions
#repair services
#DIY repair

 NOTTINGHAM TRENT UNIVERSITY
tung.dao2015@my.ntu.ac.uk

Manufacturers **develop repairable products**, gathering ideas and comments from different actors (e.g. suppliers, retailers, service providers, repairers, consumers).

S01 REPAIRABLE PRODUCTS, CO-DESIGN

This activity is aimed at improving the repairability of current products and the future availability of repairable products.

It includes at least one of the following strategies:

- **Standardisation** of components
- **Simplification** of components
- **Safe-to-repair** design
- Design for **disassembly** and **upgrade**.

Manufacturers and retailers develop **post-repair scorecards** and encourage repairers and consumers to use them to evaluate the quality of repair work and their satisfaction with the product's repairability. The scorecards are applied to both DIY and professional repair work. Recorded data are used for continuous improvement of product design.



Manufacturers develop and share **diagnostic and repair manuals**, and provide **instructional support**.

Retailers **promote the availability** of these manuals and support. Repairers have access to and utilise the manuals.

S02 DIAGNOSTIC & REPAIR MANUALS, INSTRUCTIONAL SUPPORT

- This activity is aimed at easing fault diagnostics and repair work.
- Diagnostic and repair manuals are designed for both **DIY and professional repair**, whilst considering the **safety implications**. The manuals can be in paper or electronic (written or video-ed) form, and are open access.
- Instructional support, including **responsive call centres**, **live chats** or **email boxes**, are set up to give instructions and advice on fault diagnostics and repair work.



Manufacturers, retailers, repair companies and repair shops **focus on raising consumers' awareness of the benefits of repair**.

They also **prioritise the promotion and sale of repairable products** through 'nudges' and information provision.

S03 PROMOTION OF REPAIR BENEFITS & REPAIRABLE PRODUCTS

- This activity is aimed at promoting the benefits of repair and overcoming perceived barriers for consumers.
- **Marketing campaigns, repair events and websites** promote the value of repair to the environment and consumers (e.g. saving costs, saving the environment).
- Product repairability is included on the **product label**, and the manufacturers' and retailers' **websites**.



For **manufacturers' guarantees and extended warranties**, manufacturers and retailers **provide repair** for broken products, to satisfy consumers who prefer this, **rather than offer a replacement**.

S04 REPAIR OVER REPLACEMENT WITHIN WARRANTIES

- This activity is aimed at encouraging and attracting businesses' and consumers' preference for repair over replacement as a remedy for faulty products.
- **Repair information** regarding the process, parts, labour, delivery and repair duration is provided to **encourage consumers to purchase repairable products and accept repair as a remedy**.
- **Repair facilities and support centres** are available to **assist warranty claims**. The repair service can also be outsourced from third-party specialists (e.g. repair companies) to ensure its quality and responsiveness.



Manufacturers, retailers, repair companies and repair shops **integrate reuse with repair**.

S05 REUSE & REPAIR INTEGRATION

- This activity is aimed at extending lifetimes of unwanted parts and/or broken products by giving them a second life. These parts and products may be sourced from manufacturers, retailers, reuse organisations, charity shops, asset management companies, household waste recycling centres or waste transfer stations.
- **Reuse parts in repair services** – businesses use second-hand parts in their repair services or sell them to DIYers.
- **Reuse repaired items** – broken items, after being collected, are then repaired and resold to new users.



Figure 13: Nine proposed business activities promoting product repairability



Figure 13: Nine proposed business activities promoting product repairability (cont.)

In semi-structured interviews, researchers refer to an interview guide but also have the freedom to ask questions that are not included in it, reacting to interviewees' responses (Bryman, 2015). This flexibility in semi-structured interviewing was exploited to evaluate and validate the proposed business activities. Participants were first asked to choose the cards that could describe their current business activities. Then they were asked to select which of the remaining cards could be potential strategies for their businesses. The rationale for choosing the two sets of cards was then further explored through asking questions on the first four themes (Table 16). The cards that did not support the participants' business were studied further in theme five.

As with all research methods, Interviews have weaknesses and may not be used appropriately. Researchers may ask overly specific questions in a way that will lead interviewees (Miles, Huberman and Saldana, 2013; Bryman, 2015). This was carefully considered when designing and piloting the interview guide and questioning interviewees.

Moreover, because the quality of an qualitative interview may be dependent upon recall (Arksey and Knight, 1999), the business activities were shared to interviewees via emails before meetings, and prompts and probing questions were flexibly utilised to encourage fuller and richer responses.

3.4.4. Business interview sampling

Samples for qualitative studies are typically smaller than those in quantitative studies as qualitative approaches seek subjective meanings rather than generalising hypotheses (Crouch and McKenzie, 2006). Theoretical saturation is the most common technique to identify purposive sample sizes (Bryman, 2015). A wide range of factors influencing saturation should be taken into account, such as research scope, its design, the nature of the research topic and the quality of data (Morse, 2000). Bryman (2012) argues that it is possible to estimate the number of interviews necessary in advance. Referring to practical guidance on an appropriate sample size for a qualitative study with grounded theory methodology suggesting a range between 20 and 30 (Creswell and Poth, 2007) or 30 and 50 (Morse, 1994). One with phenomenology should include 5 to 25 interviews (Creswell and Poth, 2007), or at least six (Morse, 1994).

The investigator planned to conduct between 20 and 30 business interviews, having considered the three research objectives, the quality of four consumer focus groups and the employment of phenomenology methodology. Qualitative research with a large sample size is labour intensive and time consuming, considering both data collection and analysis (Mason, 2010). Moreover, from a review of 560 studies, Mason suggests PhD researchers understand the concept of saturation and its impact on their studies, including limitations, to improve research defensibility. An estimation of sample size should also support designing and budgeting a research project (Thomson, 2011). The identification of the number of 21 interviews and saturation point resulted from comprehensively concerns about necessary resources (i.e. time and budget) and similar findings emerged from on-going data analysis (e.g. repeat comments on the proposed business activities). Furthermore, the scope of the study and comparisons between groups in the sample (e.g. between different product sectors and industries, between different business stakeholders – manufacturers, brands, retailers and repair service providers) were considered in sampling (Warren, 2001).

Table 17 shows a list of interviewees who participated in the current research.

Table 17: List of interviewees

Product sector/ industry	Interview code	Type of company	Product range	Job title
Electrical and	EE01	British brand of electrical appliances	Small kitchen appliances, coffee machines, irons, vacuum cleaners	Director of Product Development/ Chief Strategy Officer

electronic goods	EE02	Swedish multinational home appliance manufacturer	White goods, ovens, microwaves	Senior Director of Customer Care
	EE03	South Korean multinational electronics manufacturer	White goods, TVs	Former General Manager
	EE04	British manufacturer of cleaning appliances	Vacuum cleaner	Director of Customer Service
	EE05	UK high-street repair service provider	Phones, tablets	Regional Director
	EE06	Dutch modular phone brand	Phones	Circular Innovation Lead
	EE07	UK domestic appliance and heating repair service provider	White goods, brown goods	Chief Executive Officer
Furniture	FN01	Swedish multinational furniture retail group	Office, living room, bedroom and kitchen furniture	Sustainability Developer
	FN02	American office furniture manufacturer	Office desks, tables, chairs	Environmental Specialist
	FN03	British maker of long-lasting home furniture	Shelving system, tables, chairs	Managing Director
	FN04	UK service provider of business consultancy, training, product testing, inspection and repair	Office, living room, bedroom and kitchen furniture	Technical Development Manager
	FN05	British furniture online retailer	Home office, living room and bedroom furniture	Co-founder
	FN06	British furniture repair service provider	Office, living room, bedroom and kitchen furniture	National Account/ Sales Manager
	FN07	British multinational clothing, footwear and furniture retailer	Home office, living room and bedroom furniture	Technology Manager
Clothing	GM01	Swedish multinational fashion brand	Denim products	Sustainability Coordinator and Environmental Manager

GM02	British multinational online and catalogue fashion brand	Womenswear, menswear and children's wear	Head of Technical Services
GM03	British multinational retailer of clothing, home and food products	Womenswear, menswear and children's wear	Sustainability Specialist
GM04	British fashion brand with stores in London and Nottingham	Menswear	Director
GM05	Independent British fashion brand	Womenswear and menswear	Two Creative Directors
GM06	British social enterprise – developing an online marketplace of seamstresses and tailors in London	Womenswear and menswear	Founder
GM07	British digital repair and alterations service provider	Womenswear and menswear	Founder

A set of inclusion attributes were proposed and applied to defining and selecting an appropriate sample (Robinson, 2014). Bryman (2015) classifies sampling into two levels – organisations and members of organisations. Considering the first level, companies invited in this research ranged from multinational to national manufacturers, brands, retailers and repair service providers, across the three product sectors. At the second level, appropriate participants need to have some knowledge and be able to relate it to the context of the research (ibid).

The interviewees shown in Table 17 were recruited through both formal and informal networks (MacDougall and Fudge, 2001). From formal networks, contacts were made through visits to trade fairs (e.g. Furniture Show), community events (e.g. repair cafes), international conferences, such as the Product Lifetimes And The Environment conference 2019 (PLATE), the Sustainable Consumption Research and Action Initiative conference 2018 (SCORAI) and the Asian Conference on Sustainability, Energy and the Environment conference 2018 (ACSEE). Contacts from informal networks included recommendations from the supervision team and research colleagues. Moreover, the investigator also utilised search engines on LinkedIn, Google and Facebook to seek direct or personal contacts and indirect contacts such as customer service departments to ask for referrals. Additionally, a snowballing technique was employed in that initial interviewees became informants to recruit later participants (Robson, 2011).

3.5. Idea generation

Table 18 presents the ideas that were generated in this research and how they were derived. The idea generation was associated with the reflection on the literature and the synthesis of the consumer and business studies.

Table 18: Ideas and their sources

Ideas	Sources
Nine proposed business activities promoting product repairability (Figure 13)	A critical review of previous academic, environmental, non-governmental and governmental organisations' studies (Table 10) provided ideas for proposing these business activities.
Differences across the three product sectors (Section 4.2.5)	Consumer group discussions of repair journeys (Sections 4.2.1- 4.2.4) suggested key patterns of the differences across the three product sectors.
Recommendations for business interventions on the consumer repair journey (Section 5.2)	Group discussions of consumers' support needs from businesses (Section 4.3) provided ideas for potential business interventions.
Highlights for EEE, clothing and furniture industries in the modified business activity cards (Figure 20)	Business interviews (Sections 6.1-6.9) suggested ideas for business implications in each industry.
Business innovation for improving consumers' repair experience in repair journeys (Section 7.2.4)	The synthesis of recommendations for business interventions on the consumer repair journey (Section 5.2), findings about differences across the three product sectors (Section 4.2.5), value creating logic to consumers and society (Table 21) and the highlights for business implications in each industry (Figure 20).

3.6. Thematic analysis and computer-assisted analysis

3.6.1. Thematic analysis

Thematic analysis focusses on identifying and examining themes or patterns of meaning (Daly, Kellehear and Gliksman, 1997; Lapadat, 2010). Thematic analysis is one of the most common and flexible analytical methods used within qualitative research and its different approaches, including grounded theory and phenomenological analysis (Braun and Clarke, 2006; Guest, MacQueen and Namey, 2012). Results of thematic analysis are accessible and suitable for communication to a wider audience, particularly to policymakers, business practitioners, environmental activists and the general public (Braun and Clarke, 2006; Lapadat, 2010).

The current research adopted six phases of thematic coding analysis, as proposed by Braun and Clarke (2006). Phase one involved familiarisation with data when the investigator

transcribed interview records, repeatedly read transcripts and took notes at the same time. Phase two was the generation of initial codes in which interesting features were identified and coded across the entire data set. In this phase, the investigator also applied a deductive coding method that referred to a 'start list' of codes prior to fieldwork (Miles, Huberman and Saldana, 2013). The list was developed from the research's conceptual frameworks, research questions, interview guideline and key variables (such as product sectors, opportunities for and challenges to proposed business activities, perceived facilitating factors influencing the translation of intention into behaviour).

Searching for themes was the key task in phase three, to gather relevant codes into potential themes. Phase four was aimed at reviewing themes and constructing thematic networks. After that, in phase five, themes were clearly defined, named and redefined based on on-going analysis to ensure the consistency of themes and their appropriateness across the analysis of group discussions and individual interviews.

The pattern coding technique suggested by Miles, Huberman and Saldana (2013) was also employed in phases three, four and five to fully take advantages of thematic analysis – identifying commonalities, relationships, overarching patterns, theoretical constructs and explanatory principles (Lapadat, 2010). Examples of pattern codes based on this research process are presented in Table 19.

Table 19: Examples of pattern codes

Pattern code	Consumer study	Business study
Categories	<ul style="list-style-type: none"> • Intention at each stage of the consumer repair journey (Section 2.3) • Actual behaviour at each stage of the consumer repair journey 	<ul style="list-style-type: none"> • Practices of each business activity promoting product repairability
Causes or explanations	<ul style="list-style-type: none"> • Similarities and differences between participants' plans and actions at each stage of their repair journeys • Factors that made participants plan and act differently 	<ul style="list-style-type: none"> • Opportunities for innovative business activities promoting product repairability • Challenges to innovative business activities promoting product repairability
Relations (e.g. among factors or people)	<ul style="list-style-type: none"> • Whether the information collected at stage two supported repair action at stage three of the consumer repair journey • Participants support needs from government 	<ul style="list-style-type: none"> • Importance of collaboration between business stakeholders • Importance of collaboration between businesses and consumers (Section 2.6)
Theoretical constructs (considering elements of theoretical frameworks) (Sections 2.3 and 2.6)	<ul style="list-style-type: none"> • Determinants of attitude (e.g. beliefs about outcomes of repair and evaluation of repair outcomes) or perceived behavioural control (e.g. repair skills or knowledge) • Determinants of repair intention (e.g. attitude, subjective norm or perceived habit) • Similarities and differences between participants' repair journeys and the proposed journey 	<ul style="list-style-type: none"> • Value position for each innovative business activity: What value is provided and to whom? • Value creation and delivery of each innovative business activity: How is value provided? • Value capture of each innovative business activity: How does the company make money and capture other forms of value?

Finally, integration and interpretation of themes and findings were conducted to produce the report at phase six, through display techniques such as tables, clustered matrix and cognitive maps, and extracting related examples to support arguments. Figure 14, Figure 15, Figure 16 and Figure 17 show common intention-behaviour gaps at each stage of participants' repair journeys in the consumer study. Table 21 presents the potential for collaboration in sustainable business innovation through product repairability, which emerged from the interviews with business practitioners. Opportunities for and challenges to sustainable business innovation beyond product repairability are summarised in Table 22.

3.6.2. Computer assisted analysis – NVivo

NVivo software is a powerful tool and was used for the data analysis process, with three major advantages. Firstly, it provided an organised and structured approach to analysis and allowed the investigator to keep track of the coding progression and make notes of emerging ideas through memos. Secondly, it provided a safe storage system for various related materials, including the literature and transcripts of consumer focus groups and business interviews. Finally, as revising codes is necessary such as between different phases of the thematic analysis (Section 3.6.1) (Miles, Huberman and Saldana, 2013), NVivo supported the relabelling of codes.

3.7. Validity and reliability

Validity and reliability are different types of measures for achieving the quality, rigour and wider potential of research through certain methodological and disciplinary conventions and principles (Mason, 2017). Qualitative validity refers to whether a researcher checks for the accuracy of his or her findings by adopting particular procedures (Gibbs, 2008) such as producing detailed interview guidelines, cross-checking transcriptions and peer debriefing (e.g. by experts and practitioners). Qualitative reliability considers whether a research approach is consistent across different projects and researchers (ibid). Bryman (2015) concludes that validity ensures the integrity of conclusions generated from a piece of research and reliability is concerned with the repeatability of a study's results. The following sub-sections detail how validity and reliability issues were taken into account in the current research.

3.7.1. Validity

Researchers are advised to incorporate multiple validity strategies both to assess the accuracy of findings and to convince readers of that accuracy (Creswell, 2017). LeCompte and Goetz (1982) emphasise the importance of considering external and internal validity. Internal validity is concerned with whether there is a correspondence between researchers' observations and theoretical ideas they develop (ibid). External validity refers to whether findings can be generalised across social settings (ibid). The investigator utilised different strategies to achieve the two types of validity. In particular, rich and thick descriptions of study settings (i.e. a clear and detailed guideline for focus groups and business interviews, backgrounds of participants) were generated to standardise the focus groups and the set of business interviews, and to convey the findings. Rights to refuse to answer any question or withdraw any response within and after the study, were addressed in a consent form to encourage participants to answer freely and anonymously. They were asked to sign off the form prior to or at the beginning of focus groups and business interviews.

Reflectivity, through cross-checking records and transcriptions when transcribing and analysing the data, was essential to prevent bias. To support this, all focus groups and business interviews were fully audio-recorded so that the investigator and supervision team could ensure the consistency and accuracy of themes and their meaning. The investigator

used different data sources of information to develop an understanding of phenomena (Patton, 1990), such as identifying and exploring repair practices of different products from various perspectives, including manufacturers, brands and retailers, repair service providers and consumers. Such triangulation in data collection helped to build a coherent justification for themes underlying these practices. The investigator participated in community activities to develop an in-depth understanding of relevant phenomena in the field, including being a committee member of Nottingham Fixers and a proactive member of The Restart Project in London. Both the communities are volunteer groups who help people learn how to repair broken household items, including furniture, clothing, electronics and electrical products, jewellery, watches, and bikes. Running such events was very useful through observing and understanding consumer behaviour towards repair decisions in practice. A key benefit of joining the Restart Project was being kept up to date with national and global initiatives that either support or hinder repair activities.

To ensure the validity of interpretation, peer debriefing was applied in which the investigator welcomed reviews of and questions about research methods and findings from experts and practitioners. They ranged from academics to business practitioners attending peer-reviewed international conferences, including the Product Lifetimes And The Environment conference 2019 (PLATE), the Sustainable Consumption Research and Action Initiative conference 2018 (SCORAI) and the Asian Conference on Sustainability, Energy and the Environment conference 2018 (ACSEE). The investigator also received feedback and advice from sustainability activists from The Restart Project in London, the International Repair Café organisation and Nottingham Fixers. Peer debriefs also included senior researchers and lecturers at Nottingham Business School, the School of Architecture, Design and the Built Environment and the School of Art and Design at Nottingham Trent University. Furthermore, the investigator sought comments from participants in business interviews by following up with them after interviews.

3.7.2. Reliability

Compared to quantitative research, reliability is less important for qualitative research (Golafshani, 2003); however, researchers should take it into account in designing research, analysing data and judging the quality of study (Patton, 2002). For these reasons, the investigator minimised the risk of technical issues by testing audio-recorders before each interview and minimised environmental distractions by requesting participants to meet in quiet rooms. Transcripts of focus groups and business interviews were carefully checked to prevent mistakes during transcription. All raw data and data analysis was kept for audit purposes. The researcher also consistently compared data with the codes and definition of codes to prevent drifts in coding (Gibbs, 2008). For example, codes' definitions were written in memos for referencing and auditing, and even cross-checking.

CHAPTER 4. Results of consumer study

4.1. Consumer repair journey

The literature suggested a wide range of factors influencing repair decisions (section 1.7). It is unclear that if there is a distinctive set of steps that most consumers go through before deciding whether to repair or not. A scientific method was employed to determine what goes into the proposed repair journey (Section 2.2) and conceptual framework (Section 2.3) and what businesses could support consumers during their repair journeys.

In the consumer repair journey, four stages, instead of five, were defined in the pilot focus group (Section 3.3.2) and four group discussions (Section 3.3.4): (i) identification of product faults and repair need, (ii) information search and evaluation of alternatives, (iii) repair in action and (iv) post-repair evaluation. Many participants in group discussions sought information about different repair routes and their alternatives (such as buying second-hand or new products) and evaluated these options at the same time. The four stages are discussed in detail in the next section.

4.2. Intention and translating intention into behaviour on the consumer repair journey

This section presents results of group discussions that explored consumers' intention and behaviour throughout their repair journeys. Sub-sections firstly discuss factors that influenced participants' intention at each Stage of their repair journey. Potential gaps between intention and actual behaviour and impact factors are then discussed in reference to the proposed framework (Figure 7) and participants' responses to the question 'What factors made you plan and act differently' at each stage of their repair journeys (Appendix 3).

4.2.1. Stage 1 – Identification of product faults and repair need

The empirical study suggested that easily recognised product faults, consumers' interests in repair, high levels of their competences and confidence were key impact factors of both consumers' intention to identify product faults themselves and translating this intention into actual behaviour.

Most focus group participants initially discovered the faults of broken items themselves, especially with garments and furniture. Faults in these product sectors seemed to be more obvious compared to those of EEE.

A finding from conversations in the focus groups was that enjoyment in repair was one of the common motives at this stage.

'I actually enjoy the process of repairing something and getting some satisfaction.' (3P1)

In particular, the focus groups suggested that males might be more interested in EEE repair, whilst more females are keen on mending clothes – *'You've got something you enjoy more than others [other items]'* (2P2). For that reason, relatively more male participants than

females indicated that they had identified the faults of EEE. There seemed to be no clear difference between sexes when discussing preferences for furniture repair.

Figure 14 shows potential intention-behaviour gaps at this stage. The left-hand box shows intention, whilst the right-hand box presents the lack of a gap (top) and the reasons why a gap might occur (bottom).

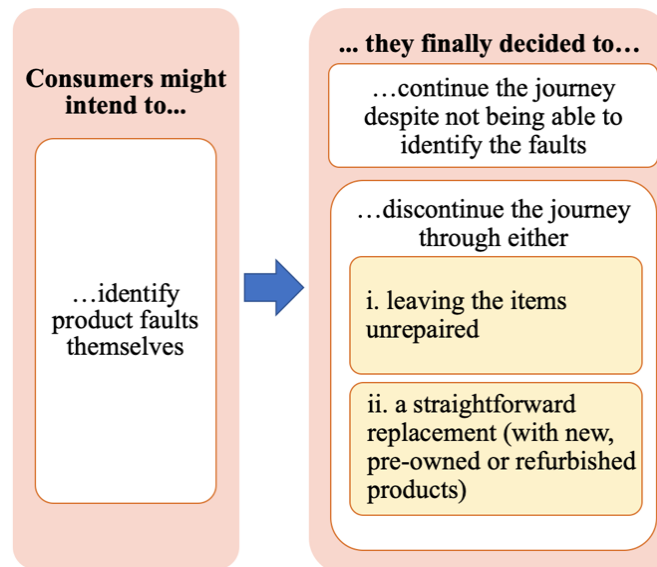


Figure 14: Intention-behaviour gaps at Stage 1

Common obstacles to consumers identifying faults themselves were a lack of skills, knowledge or confidence. These perceived challenges generated an intention for some participants to get someone to diagnose product faults. Other participants made the same decision even though they intended to identify the faults themselves. This means they continued their repair journeys even though they had not been able to identify the fault or, as expressed by one participant, *'did not even know where to begin'* (3P5). They sought information and help from other actors (e.g. family members, friends or colleagues) to make a more informed decision at the next stage. Some were afraid that diagnostic work might lead to further functional, or aesthetic, damage. Fear of data loss was a considerable concern for those who intended to self-identify problems affecting digital devices, particularly when disassembly was necessary. Two female participants had contacted their insurers; they had registered digital devices (a laptop and a mobile phone) in insurance schemes which covered repair needs. In other words, they could identify a need for repair but left identification of the exact faults to the insurers.

Moreover, a requirement for tools could challenge identification of product faults:

'It's going to take a lot of time...waiting for tools to arrive, learning how to use them potentially.... If you've never used them before, it becomes more effort.' (2P4)

For example, to find and buy an appropriate screwdriver to use with screws of an uncommon size or shape, such as those with a triangle-shaped head, might require an unacceptable amount of time and money.

Repair needs were mainly characterised by the owners' perception of the monetary value of the products and concerns about time constraints. Consequently, several participants gave up on the journey, leaving their items unrepaired or purchasing a replacement, either before or after trying to identify product faults, due to the perceived challenges – repair costs appeared expensive and uneconomical or repair work seemed time-consuming. For example:

'I don't think they're [fast fashion items] something that's worth fixing to start with, value-wise.' (1P6)

'Cost is a major factor. That's why I've still got my [unrepaired] bed.' (1P10)

Intentionally buying cheap products appeared to result in a straightforward replacement when product faults were identified (3P6), particularly for small appliances (e.g. kettles and toasters), flat-packed furniture and fast fashion. The task of mending clothes requires certain interests and motivations to complete, as it is time consuming (2P6).

Leaving an item unrepaired could also result from several reasons, such as the requirement of investment in tools and the lack of repair competences, as evidenced in the case of 1P3's bed:

'I would have to go out and I would have to buy the tools. And I know nothing about DIY. I know nothing about furniture. I don't know if I have to sand things down or use wood glue or whatever it is. Is it worth the investment in the tools? If you're only going to need it for this one thing and hopefully this item never breaks again, is it worth spending that amount of money on this particular item?'

However, in some cases, emotional connection to products can strengthen the owners' commitment to repair (2P3, 2P4). In other cases, owners left broken items unrepaired when faults were considered minor, such as aesthetic damage or a slightly degraded performance. Repair or replacement would only be undertaken if the product did *'actually stop working'* (1P5). A few participants said that the availability of substitutes was a consideration. For instance, an owner might have more than one phone or be able to use a spare desktop computer rather than spend time fixing a broken laptop.

The data, in general, suggested that product faults, interests in repair, levels of competences, confidence and emotional connections to products contributed to forming intention to identify the faults themselves and translating this intention into behaviour. Genders and product types could be associated with the differences in the levels of participants' interests, competences and confidence and lead to the generation of the intention get someone for diagnosis. Moreover, the lack of tools could challenge the identification of product faults. However, repair needs (i.e. after finding the faults) might be

decreased or even eliminated if owners perceived the monetary value of products low and repair time-consuming. The next stage helped owners to make more informed decisions.

4.2.2. Stage 2 – Information search and evaluation of alternatives

During this stage consumers seek information to inform their repair decisions on how to fix broken items. The empirical study indicated that consumers could either keep their intended repair route or redefine their intention – going for another repair route or terminating their repair journey, after getting the information.

Potential gaps between intention and behaviour were captured in group discussions and shown in Figure 15.

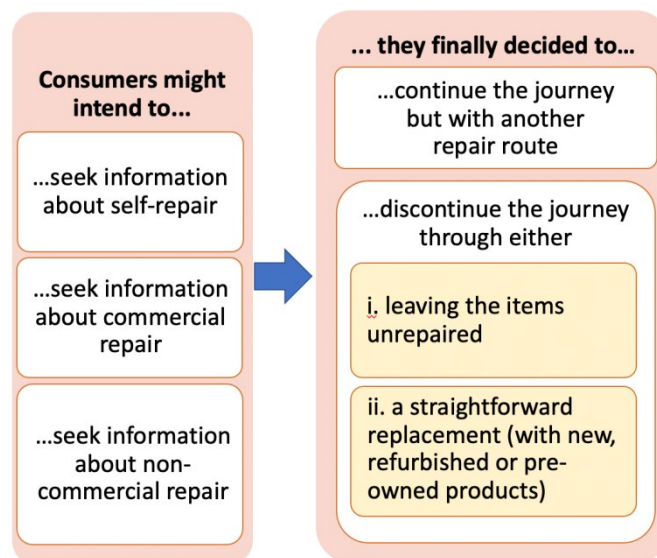


Figure 15: Intention-behaviour gaps at Stage 2

Researching repair instructions on the internet was seen as a learning process which could either take only five minutes or much longer (4P5). Thus, a willingness to learn and desire to have a '*sense of [learning] achievement*' are crucial to information search for any repair route (4P5). Repair instructions were often considered in self-repair, whilst the information about where and how to get reliable repairers were mostly concerned with commercial and non-commercial repair.

Several participants who intended to do DIY repair often read manufacturers' manuals, although some complained about the usefulness of the information provided. Product manuals, as suggested by many retailers, could help disassemble products to do repair. However, these manuals seemed not to support the repair journey, but even stopped several participants from thinking about self-repair. Some assumed that this might be linked to manufacturers' or brands' monopolisation of repair services.

Most participants sought instruction or advice from friends or family members or from the internet. Participants who lacked repair experience seemed to rely on their friends or family members' competences and previous experience.

YouTube videos helped owners to *'assess the level of skills needed'* and to identify *'whether you're willing to try to [learn new skills and] build confidence'* (3P3). Group discussions suggested that willingness to seek information and to learn repair knowledge and skills correlated with repair interests:

'I know nothing about electronics and have no interest in trying to learn about it. Sewing... is interesting. I did needlework at schools and textiles and all of that stuff.' (1P3 – a generation Yer, female)

'I could have gone out to learn how to sew. But I didn't want (to) ... For most things, I'd rather just pay an expert.' (3P1 – a generation Xer, male)

Across all the group discussions it was apparent that both Generation X and Y participants actively engaged in online searches to seek repair instructions. Common channels mentioned included YouTube and iFixit (the latter being an e-commerce business supplying spare parts and publishing free repair guides for electronics products). Similarly, participants indicated that suppliers of components for textile crafting and mending facilitated DIY repair through instructional videos. Nevertheless, several drew attention to overly generic or incomprehensible explanation of instructors such as vloggers (creators of online videos) and their audience. For that reason, consumers may still give up on the repair journey due to perceived obstacles even though they have more information. A participant in focus group 3 (3P2) recommended that instructional materials should be designed for a wide audience, considering different levels of competence. Moreover, these challenges were added to by complicated product design, irreversible closures, or vulnerable components.

Several participants sought instruction or advice from repairers at local shops, or customer service staff at the manufacturer or retailer. However, the group discussions suggested that it was challenging to find reliable repair service providers. Although some relied on reviews such as those on Google Maps, others doubted the reliability of reviewers. As claimed by a participant, *'it probably is now easier to fix things yourself if you're prepared to have a go'*, due to a wide range of online instructional materials, compared to getting trustworthy local repairers (4P7). In each session at least one person did not trust a repairer's or engineer's competence at local shops, manufacturers, or retailers. There was a consensus that referrals from family, friends or acquaintances would provide an expectation of reliable repair services. However, *'their recommendation is limited to the experience that they have had'* (3P2).

A few participants, especially who lacked repair experience, sought advice or help from repair cafés:

'Having those communities [repair cafés] ... sort of hooks for sharing that knowledge is really good to encourage repair.' (3P3)

Although most participants expected to get more information that support their decisions on how to fix broken items, some people left items unrepaired after foreseeing high repair costs or a time-consuming repair process. For example, a participant in focus group 4 (4P6) stated that she generally gave up on getting items fixed if the repair took four days or more or costed more than buying new products, unless the old items had a certain level of sentimental value. Similar opinions were recorded, as follows:

'I actually took my jeans to a seamster in town... [but he said that] it would cost you more than the cost of the jeans to replace the pocket.' (1P7)

'I usually look at the [repair] cost, as well as how old is the product that I want to repair. If it is an old product, I'll just think it's not worth it, because down the line it's going to get broken again; so it's better if I replace it.' (1P8)

'I don't feel comfortable doing that [self-repair], I'd rather pay somebody, so I don't break it.' (1P2)

Participants in the focus groups also mentioned that they shared the same thoughts as many bloggers and vloggers about the durability of contemporary products, for all three types of products. Modern products seem not to be designed for long lifetimes which made repair irrational:

'It doesn't seem to make rational sense repairing something that may not last much longer ...[when] ... the cost of replacing it with a new item is so small.' (3P2)

Significantly, fast fashion items might not be worth mending, which is often associated with timing and monetary cost, when they are *'wearing away and... just going to wear away again'* (1P2). Referencing online complaints about the high cost of repair, one participant consequently left his phone unrepaired:

'I can't bear to throw it away, but I also don't dare to take it into Apple for a quote. It's going to cost me a lot of money.'

At the same time as looking for information about a specific repair route, participants also considered alternative options, including other repair routes or replacing the product.

It was evident that fear of repair failure stopped some consumers from continuing their repair journey or shifted their intention from self-repair to non-commercial or commercial repair, or the reverse. Most participants identified repair costs as a factor when considering whether or not to choose commercial repair. Independent repair shops were often preferred to authorised businesses due to cheaper prices.

Some participants refrained from self-repair through a concern that disassembly would cause further damage or void the manufacturer's warranty. Furthermore, a few participants were most concerned about using non-original electrical and electronic components due to the unavailability or the high price of genuine ones. Safety concerns (e.g. electric shocks or leakages) were raised both during repair and thereafter.

During this stage several participants aimed to explore their perceived competence limits with regard to self-repair or to check the cost of commercial repair (2P6, 2P1, 3P3, 3P1, 3P6). Meanwhile, they became more confident with their decisions, either continuing or giving up their repair journey. However, decisions were not always rationally made but often associated with a dilemma:

'Where's the line between repair by ourselves and paid repair? Why wouldn't we go to somebody?' (2P6)

Moreover, despite several participants having previous experience, they chose commercial repair due to its convenience.

A growing realisation of the need for specialist tools, either during or after getting more information, could hinder repair activity at this stage. Sewing machines were usually required both for DIY clothes mending and furniture reupholstery even though sewing machines for the former were claimed to be less expensive than for the latter. In some cases, specialist screwdrivers were required for self-repairing EEE. For example, 4P9 admitted that her intentions towards self-repair for either furniture or EEE could not be translated into actual behaviour if she was unable to borrow specialist tools from community libraries. Similarly, 1P9 often borrowed tools from her son, who is a plumber; otherwise, she could have added the cost of tools to her calculations for self-repair.

Additionally, evaluation of different repair routes could be informed by the expected outcomes. There seems to be *'a right way or a couple of ways to fix'* electronic and electrical products (3P3). By contrast, clothing and furniture repair could deviate from the original design or intention, and be associated with upcycling or changing products' structure or appearance, depending on the owner's taste and needs and, whether or not he or she wanted to simplify the repair (3P3). For that reason, many participants were most worried about final finishes after repair in these two product sectors – *'getting into it to work is one thing but getting it done to the [original] quality is challenging'* (3P3). For instance, 1P6 was confident in sanding and painting wooden furniture, whilst 3P1 was proud of his webbing skill, but not sewing fabrics with regard to reupholstery.

Alternative evaluations could also be influenced by referrals, such as by family members and friends:

'I don't mind asking and if somebody has a good suggestion or a good recommendation, I'm more than happy to take it.' (1P1)

When considering replacements and the financial and environmental costs of new items, several participants preferred to replace broken items with pre-owned products (e.g. bought in second-hand marketplaces such as eBay or car boot sales or given by parents or friends), including refurbished products.

However, there was evidence that some consumers would skip this second stage if they already had knowledge or experience of fixing a product with the same or similar problems. For example:

'It's very clear to me ... sanding stuff [furniture] down and painting it.' (1P7)

'Picture frames had fallen off the wall and then cracked. Glue them back together.' (1P10)

In general, the willingness to learn new knowledge influenced intentions to seek relevant information, such as repair instructions for self-repair and where and how to get reliable repairers for commercial and non-commercial repair. However, consumers could continue or give up their repair journeys based on the usefulness of the information. Both Generation X and Y participants actively engaged in online searches to seek repair instructions. The information provided by other people (bloggers, video makers, friends, family members, local independent repairers, or volunteers at repair cafés) could depend on their competences and previous experience. Thus, product owners could be demotivated, inspired or more confident after getting the necessary information.

The perceived costs and time consumption of repair and requirements of tools could influence products owners' decisions. As consumers might seek alternatives (e.g. other repair routes or replacements), they could compare the costs (e.g. money, time and emotional value) and effort required for different options and their potential outcomes (e.g. new products with the latest design or technology, further damage to current items or reduced environmental costs through repair).

4.2.3. Stage 3 – Repair in action

Consumers might intend to choose one of the three repair routes but later decide to discontinue or to continue the journey using another route. The data suggested that Stage 3 could occur with, after or without Stage 2. As Stage 2 helped to make informed decisions, several participants were more confident in their chosen repair routes at Stage 3. However, some others had to look for further information when starting or during the actual repair. A few skipped Stage 2 if they had the same or similar repair experience before.

Figure 16 illustrates these potential intention-behaviour gaps.

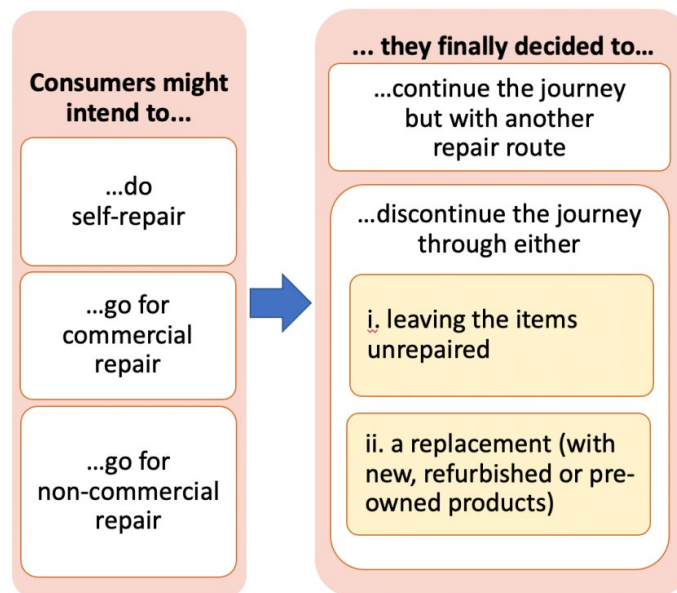


Figure 16: Intention-behaviour gaps at Stage 3

There was some consistency in obstacles to repair, including high cost and lack of time and skills, at Stage 3 compared to the previous stage. Over-estimation of personal skills or underestimation of repair time and cost at the previous stage could influence consumers' behaviour at Stage 3. For example, 4P8 often tried to repair broken items himself, but if they took more than ninety minutes he sent them to professional repairers. Furthermore, wrong diagnosis of product faults could influence what people intended to do or actually did, or extended their repair journeys:

'Occasionally you get to a point where you realise that the thing that you thought was wrong with it isn't actually what the fault is... and there's something else. So you put the repair down while you go in research again.' (3P1)

It was claimed by a female participant that seeking online instructions could take hours (3P3). For that reason, she had to leave items unrepaired till the next weekend, even two or three weeks thereafter, to buy the necessary tools or materials and then fix them. For example:

'For repairing a chair, the first thing I did was (I) went out and bought like spray paint, but it took me several weeks to get around to a sunny day where I could take it out and spray it up and that kind of thing.' (3P3)

In contrast, 4P4 fixed loose parts or worn covers on furniture straight away, as these faults 'annoyed' him whenever he looked at the items.

In addition to time constraints, the inconvenience of repair could also result from the unavailability of local services:

'For my parents... the reason sometimes they get things fixed is because of the ease of access [to local repair services]. If it's easier for them to just order a new one and they can just do that on their phones, they'll do that. Where my grandparents live in the countryside... they're not near stuff and they've got more time, so they quite enjoy that whole repair process. Whereas my parents, they just don't have time.' (1P5)

The convenience of DIY repair was often influenced by the availability of tools. For instance, if there were no DIY stores near 2P1's property or 1P9 could not borrow tools from her son, their broken items would be left unrepaired or fixed by commercial repairers. Likewise, 1P1 received both mental and physical support, such as getting encouragement, tools or parts from a flatmate – a skilful seamstress – and translating repair intention into action for her worn clothes and damaged furniture:

'I probably wouldn't have undertaken [repair] if I didn't have her there.' (1P1)

Similar support could also be found from family members or at community repair events such as local repair cafes. 1P10 often got help from her mother for mending clothes and from her granddad for repairing EEE.

Moreover, intention-behaviour gaps were sometimes associated with unexpected situations such as spare parts or tools being out-of-stock, accidental damage in the disassembly process, long-queues for customer service, or fitting non-OEM components. The data suggested that there were concerns about voiding warranties or causing further damage when fitting non-OEM components.

There were also several instances where participants reported an intention-behaviour gap resulting from other commitments or an urgent need to use the item. For example, if a consumer had a mindset of *'I don't need that specific cleaning product or that specific thing'* for some time, more products could be fixed, and no replacements were needed (3P3). Nevertheless, the necessity of broken items (3P7) or worrying over losing parts (3P6) could sometimes speed up the translation of repair intentions into actual behaviour. 3P2 explained that this is dependent on *'how people are committed to repair'*. Commitment to self-repair seemed to be fragile when 2P2 had no relevant repair experience. However, he added that self-confidence was built up gradually after every repair and it supported his commitment to repair work, even for different product types.

Some products could have been repaired by consumers if they had been designed for ease of repair and spare parts were available to the public:

'Variability and complexity in parts are the biggest challenges to repair electronics... New items are designed and built to be cheap, not repairable. You can't get repair done without damage.' (3P1)

One participant ended up seeking help from her friend, a skilled mechanical engineer:

'I took the washing machine apart... then I realised I couldn't do it. I got a friend around to help me deal with that one.' (1P8)

'Quite often what I started was a simple, straightforward job ... ended up having somebody to sort out the mess I've made.' (1P9)

Some participants felt that there had been a lack of practical skills such as design and technology and mending taught in their schools, compared with older generations. This resulted in their lacking confidence in self-repair and, in the case of clothing, using professional seamstresses.

'A fear of failure... it's just being aware of where my skills lie and not wanting to learn anything new or destroy anything' (1P3).

1P2 shared a similar thought when mentioning unprofessional DIY repaired jeans that could 'rip-off' again and make him embarrassed in public. 1P3 admitted that both her parents never did DIY repair and she stayed away from self-repairing furniture.

'I cannot imagine myself in B&Q buying wood and hammers and things like that... And my parents don't attempt to fix anything. They get a handyman in to do it. In my mind, I would love to be able to do it myself. I've watched videos and things like that, which is how we came up with the idea. But from a practical perspective I'm just going to call somebody to do it, when I get around to it.' (1P3)

Growing up in families where repair was done often could inspire product owners to act similarly and their motivation could remain at a high level throughout the repair journey (3P2, 3P3). On the other hand, they could also be demotivated to do self-repair if they witnessed the repair failures of family members (3P3, 3P4).

In every focus group at least one or two participants doubted the competence of repairers in either independent shops or retailers. In one case this concern had resulted in a replacement being preferred. However, DIY could sometimes be preferable because people seemed to have *'a lot more access'* to online repair manuals and more easily sought help from people *'who have enough time and enthusiasm to look at the problem'*, such as volunteers at repair cafes (2P4). 1P5 said that most of the retailers she experienced had to send broken items away for repair, either OEM or central service hubs, due to the lack of in-store facilities. This made her prefer local independent repair shops, where repair could be done promptly, sometimes within an hour.

Several participants indicated that they left clothing items unrepaired in their lofts or home workshops, so then they could fix those garments at a time. This approach could take less time, rather than finding tools and preparing sewing machines for every repair. However, this solution generated a controversial discussion, when a few participants admitted that they never actually mended their damaged clothing. With a similar mindset, 3P2 *'got a pile in the corner of things'* which were waiting to be fixed for a long time. This participant added that

'there's an imperative when something is essentially needed to get it fixed somehow' and local repairers could provide him with a service if urgent.

Data from the group discussions suggested that the necessary information found at Stage 2 decided the intention at Stage 3, considering repair routes. Over-estimation or under-estimation of personal skills of repair time and costs at the Stage 2 could generate inappropriate intentions or mediate their translations into behaviour. Similar to previous stages, high cost, the lack of time, confidence and skills were also challenges to this translation. Additionally, the availability of tools and advice from other people for DIY and doubts about repairers' competences challenged the relevant repair routes. Finally, consumer behaviour at this stage could also be hindered by unexpected situations such as spare parts or tools being out-of-stock, accidental damage in the disassembly process, long-queues for customer service, or fitting non-OEM components.

4.2.4. Stage 4 – Post-repair evaluation

At this stage participants reviewed the entire journey to identify differences before, during and after repair between their expectations of and satisfaction with repair outcomes, and between their intention at the beginning and behaviour taken that led to the outcome. Figure 17 presents these differences.

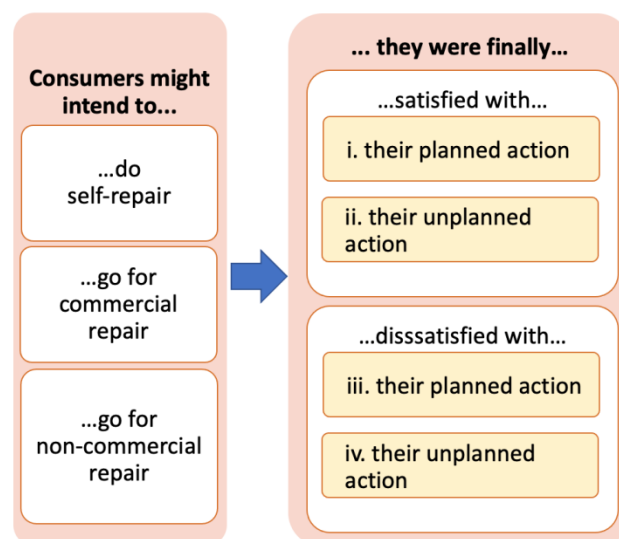


Figure 17: Intention and satisfaction gaps throughout the repair journey

Satisfaction with self-repair decisions was reported to be generated from the enjoyment in undertaking self-repair, the lower cost and extending the product lifetime. For example, 1P1 was grateful to her flatmate for loaning a sewing machine and sharing textile offcuts, which have generated her interest in and a habit of self-repair, rather than seeking local service providers as before. What mattered most to participants was whether the functionality of products returned after repair. There also appeared to be a difference by

generation: relatively more Generation Y participants expressed a link between their motives for repair and environmental sustainability.

Most participants who succeeded in fixing a broken item indicated that they would be willing to self-repair the same or similar items in future. For instance, both 2P4 and 2P6 indicated that they carefully considered different repair routes and only chose self-repair if they were totally confident with their abilities. For that reason, they were satisfied with most of the repair work they did. In particular, 2P4 would rather take broken items to professionals if she thought she could damage their aesthetic value; otherwise, she would mend them herself, especially garments. However, she often made straightforward decisions for those with functional faults, getting them repaired by service providers. Either they *'will be broken at the end... or be fixed'*; she did not regret her repair decisions (2P4). In contrast, repair is one of 4P9's hobbies and every journey provided her with an enjoyable experience and learning points. Thus, she seemed not to be disappointed with any repair decisions, regardless of their outcomes: *'I would feel bad if I didn't try to repair something'*. Additionally, similar to 4P9, a few other participants agreed that an emotional bond could be enhanced after self-repairing their items; however, several regretted their decision and wondered if commercial repair would have been a better choice. Key reasons for this were a recurrence of faults or inability to resolve the problem. For instance, 1P2 regretted attempting to shorten curtains which was seen as a waste of time and resulted from *'overestimating [her] abilities'*, and caused them further damage. She finally took them to a seamstress, which she did not regret.

Two participants criticised manufacturers for the high cost of spare parts for DIY repair, which made this repair route uneconomical and forced them to use authorised services. Others indicated that repetitious faults were caused by *'low quality second-hand parts'* or that the items had *'nearly ended (their) lifetime'*. Moreover, 1P9 indicated that satisfaction with fixing broken items can be achieved if the actual time does not exceed the time estimated and based on suggestions from online repair instructions, friends or family members at Stage 2.

Regarding commercial repair, most participants got items fixed by other people only after realising they were not able to do self-repair. For this reason, some participants accepted repair outcomes thereafter. For example, 1P5's satisfaction with commercial repairers resulted from their ability to restore aesthetic and functional value of broken items and reasonable repair costs.

'If I have paid for it then I'm happy if it's aesthetically pleasing. If it looks good... nice and new, then I'm happy. And if I've saved money, if I know that I can compare the price somewhere else, then I'm happy that I've got the cheapest, I'm satisfied. But otherwise, I don't fix much myself.' (1P5)

Several other participants had been frustrated when they had spent money on repair services or spare parts, but the quality of the repair did not meet their expectations. In some cases, the same faults recurred after repair work.

In addition to the consensus on challenges to self-repair – knowledge, experience and confidence concerns of product owners – 2P2 added that situational factors, such as the unavailability of specific parts, influenced his decisions for self-repair. He sometimes felt that he had no other choice than *'sending items back to manufacturers'* for repair, and he then accepted any outcome thereafter.

It was evident in all of the group discussions that previous experience can influence future decisions and actions undertaken in future repair journeys either positively or negatively, and regardless of the repair route. For example, a few participants preferred self-repair due to losing trust in commercial services; whilst one participant admitted to not being willing to self-repair electronics again:

'What do I think about repairing electronic products? No, I do not have good experience of trying to repair those myself.' (1P10)

Participants' satisfaction with repair outcomes also varied across different product types. Repair of clothing and furniture products seems to be *'a bit more bespoke'*, which *'makes them individual and improves some of the original... in a unique way'*, compared to that of EEE (4P8). For this reason, 2P2 was *'more than happy'* with his repair work, especially with chairs in his pub that he repaired to *'a standard better [more steady] than the original was'*. In contrast, 1P5 was not really satisfied with the aesthetic of her sofa cushion after self-repair but was grateful that it at least saved the life of the item without paying for a service:

'I flip the sofa cushion around. Just keep it under, the messy side... when no one's visiting. Then when people are around, the posh side is up.' (1P5)

1P7 and 4P6 shared a similar mindset. For example:

'I don't think I've been dissatisfied but, at the same time I have that thing of knowing that it would look better if a professional had done it.' (1P7)

2P2 believed that replacing different components of EEE whenever they were broken could make the entire items work. For that reason, he did not regret any repair journey he experienced.

The data also suggested that the satisfaction with repair outcomes was mostly associated with the return of products' functionality, recurrence of faults, and aesthetic damage, with consideration of repair costs (e.g. money and time). However, a few participants did not regret their decisions regardless of the outcomes as they valued the experience gained from their repair journeys. The success of DIY repair could make consumers more willing to self-repair the same or similar items in future. Emotional bonds could be also enhanced after self-repairing their items. Moreover, participants' satisfaction with repair outcomes varied across different product types as clothing and furniture could require more bespoke repair, compared to EEE. Finally, manufacturers could be more responsible by making repair cheaper and product disassembly easier.

4.2.5. A summary of differences across the three product sectors

Table 20 provides a summary of differences across the three product sectors, considering the impact factors at each stage of the consumer repair journey, presented in Sections 4.2.1- 4.2.4.

The data suggested that four factors – the nature of product faults, enjoyment, confidence and preference for cheap products – had different impacts on repair journeys when considering the three sectors. Many participants in the group discussions claimed that it was often more challenging to identify product faults of EEE products. These appeared to have complex designs, which made faults less obvious, compared to clothing and furniture products. EEE repair was of greater interest to males, whilst more females enjoyed mending clothes.

In addition to functional damage, the fear of further aesthetic damage could affect consumers' confidence in their ability to repair clothes and furniture and data loss was a concern when fixing EEE products. Some ranges of cheap products, such as low-priced small appliances, fast fashion or flatpack furniture, could also influence repair intentions and behaviour at Stage 1 due to perceived high repair costs versus cheap low-priced replacements.

In many cases, the information collected at Stage 2 might hinder the translation of repair into behaviour. Warranty void or safety warnings (e.g. electric shocks, leakages or flammability during or after repair) and expensive parts and tools were mentioned in group discussions when considering EEE and furniture products. The data also suggested that wrong fault diagnostics could result from the complexity of EEE product designs, which hindered repair at Stage 3.

Post-repair evaluations at Stage 4 might depend on whether repair could return functional or aesthetic value. Many participants were satisfied with their repair work if EEE products could operate in the same conditions as before the breakage. For clothing and furniture, many participants required the return of both functional and aesthetic value; however, some were happy with whatever was the outcome, as these kinds of repair allowed bespoke work.

Table 20: Differences at each stage of the consumer repair journey across the three product sectors

Impact factors	EEE	Clothing	Furniture
Stage 1 – Identification of product faults and repair needs			
The nature of product faults	More challenging to identify product faults as they are less obvious	Less challenging to identify product faults as they are more obvious	Less challenging to identify product faults as they are more obvious
Enjoyment in repair	Interest of many males	Interest of many females	N/A
Confidence	Fear of further functional damage and data loss	Fear of further functional and aesthetic damage	Fear of further functional and aesthetic damage
Preference for cheap products	Cheap small appliances	Fast fashion	Flat-packed furniture
Stage 2 – Information search and evaluation of alternatives			
Possibility of voiding the manufacturer's warranty	Using non-original electrical and electronic components due to the unavailability or the high price of genuine ones	N/A	N/A
Safety concerns	Electric shocks or leakages	N/A	Flammability of upholstered furniture
Expensive tools	Uncommon or specialist screwdrivers	N/A	Sewing machines
Stage 3 – Repair in action			
Complex product design	Wrong diagnostic of product faults due to complex design	N/A	N/A
Stage 4 – Post-repair evaluation			
Functional and aesthetic value	Preference for professional repair to maintain functional value	Preference for professional repair to maintain both functional and aesthetic value Bespoke repair	Preference for professional repair to maintain both functional and aesthetic value Bespoke repair

4.3. Consumers' support needs from businesses

Three key types of support needs for consumers were identified when participants were asked to discuss what help manufacturers, retailers and repair service providers could provide at each Stage of the consumer repair journey. The responses were associated with the improved availability of and access to (i) repairable products, (ii) repair services and customer support, and (iii) product-service integration.

Group discussions suggested that standardisation and simplification should be considered at the design phase, as these would improve the repairability of products and support repair decisions at each of the first three stages. For example, at Stage 1 identification of faults and repair need, including disassembly, should be easily achieved. At Stage 2 informative repair manuals should be provided and at Stage 3 spare parts should be supplied efficiently and cost-effectively.

Moreover, design for disassembly were also addressed in the discussion groups. In particular, 2P2 believed that products can be designed to be safe for owners to repair most faults. This participant said that repairability seems not to be addressed during the design phase of a product – manufacturers *'just don't bother to design it so that you can repair it safely'* (2P2). 4P9 added that products should be *'serviceable'*, particularly durable and repairable, rather than just be attractive. They should be designed for disassembly for repair – not requiring special tools and their parts' numbers should be included either on the parts or in manuals (4P8). This would ease finding information about relative troubleshooting and spare parts on the internet (4P8).

Repair manuals should be developed and made easily accessible to support owners' repair journeys. In addition to providing written manuals, 1P5 and 1P7 suggested that manufacturers share instructional videos on their websites for better visuals (e.g. be visible on homepage and designed with a single goal – for repair instructions) and easier access (i.e. with a single click on homepage). These materials should be designed for consumers who do not have any specialist knowledge or experience (1P4). 1P4 clarified that they should indicate which repairs can be done by consumers and which should be done by professional repairers. A list of reliable service providers should include in repair manuals (1P3). For self-repair of EEE and furniture products:

'You can try this. If it does not work, you'd better go to see a professional.'
(1P4)

3P2 added that repair manuals should *'help identify whether the issue is a simple repair or whether you can buy parts yourself to do to repair it yourself'*. Manufacturers should be expected to provide *'a very clear breakdown'* at point of sale: *'if this part fails and you send it back to us, we will charge you this much to fix [it]'* but *'if you are insisting on fixing yourself, here are the instructions'* (2P4). Additionally, manufacturers should include phone numbers of call centres on instructional documents supplied with products or published on their websites, so that consumers can contact them for advice regarding faults (2P4).

When discussing improved availability of, and access to, repair services and customer support, 1P9 shared an insight into the helpfulness of live chats in which customers can communicate virtually with businesses and share photos or videos of broken products. 1P9 found that it was time consuming and challenging to explain problems or diagnose faults through phone calls. Live chats could also save this participant's time from travelling to a physical store.

It was apparent that many participants thought that improving the repairability of products might support the provision of repair services and thereby leverage commercial repair. For instance, several participants indicated that if independent repairers had access to original spare parts, consumers would have more options of service providers at their convenience. They also noted that if more people used commercial repairers, such authorised or independent repairers would benefit from more stable incomes. Several participants, such as 1P1, 1P2, 1P5 and 1P8, expect manufacturers and retailers to improve their repair processes, particularly through reducing waiting and turnaround time, and their staff competences:

'Having people in-store that can tell you, that'd be more helpful [than sending items to the OEM].' (1P5)

'If they employ experts, that makes a big difference because they get a repair that works, and you get it quickly... rather than having a list of people who don't really know very much and will have a go but don't necessarily do a good job.' (4P9)

Several participants, such as 1P1 and 4P7, complained of customer service agents' repair knowledge that had a negative impact on repair journey. For example, 1P1 expressed her disappointment with *'waiting for 45 minutes on the phone... or live chat... to talk to somebody only for them to tell [you]: Oh I'm sorry you have to bring it in, or we can't fix it.'*

1P8 suggested that businesses should cover call charges when customers ring them for aftersales services or advice.

'I'm going to spend a lot of time just waiting for them to answer a call... and I don't know if they're going to actually fix it.' (1P8)

Lastly, group discussions indicated that an integrated product-service offering provided by manufacturers and retailers could facilitate consumers' repair journeys. For example, several participants recommended that there should be more manufacturers extending their products' lifetimes through the provision of repair services with pay-per-repair billing, or monthly or yearly subscriptions. Transparency of repair service costs was crucial for informative decisions during customers' repair journeys (1P6, 1P9):

'A lot of companies don't put how much it's going to cost online; you actually have to take the device there. I kind of put it off because I don't know what cost to expect.' (1P6)

Several participants expressed concern that the cost of making products repairable and providing responsive aftersales support could be passed to consumers through higher retail prices. Businesses who currently are locked into the dominant linear business model may also oppose investment in product repairability:

'If you sell something that is like a throwaway item, you can't invest the time in good customer support or repair service.' (4P7)

However, several participants indicated that they would be willing to pay higher prices for repairable products. For instance, 2P2 doubted the reliability of cheap products which would generate more cumulative costs, such as more frequent breakdowns and costs for replacements. This participant also expected manufacturers to offer products with confidence in their quality and lifetimes through an extension of warranty periods without additional cost for consumers. Similarly, participants, such as 4P7, 4P8 and 4P9, suggested manufacturers shift from linear business models to more sustainable ones, enabling product lifetime extension through integration of product and service.

CHAPTER 5. Discussion on the consumer study

5.1. Factors influencing intention and translating intention into behaviour on the consumer repair journey

This qualitative research study included a detailed exploration of consumers' intentions and behaviour at each stage of their repair journeys (Figure 18).

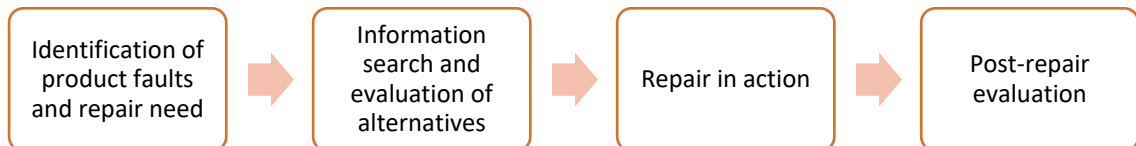


Figure 18: Four stages of the consumer repair journey

The findings revealed that a wide range of factors could influence intention and the process of translating intention into behaviour in the consumer repair journey, as shown in Figure 19. This figure is a modified version of the proposed model in Section 2.3. Solid line arrows indicate influences claimed by the majority of participants, whilst dotted line arrows show influences suggested by several participants.

Results of the consumer study confirmed the interrelations between factors (orange arrows) in the original Theory of Planned Behaviour (Figure 3). Blue arrows indicate the confirmation of assumptions presented in the conceptual framework (Figure 7). Green arrows present modifications of the framework. The next two sections discuss the rationale behind these arrows. The influence of perceived behavioural control on subjective norm (arrow c in Figure 7) was not found in any group discussion.

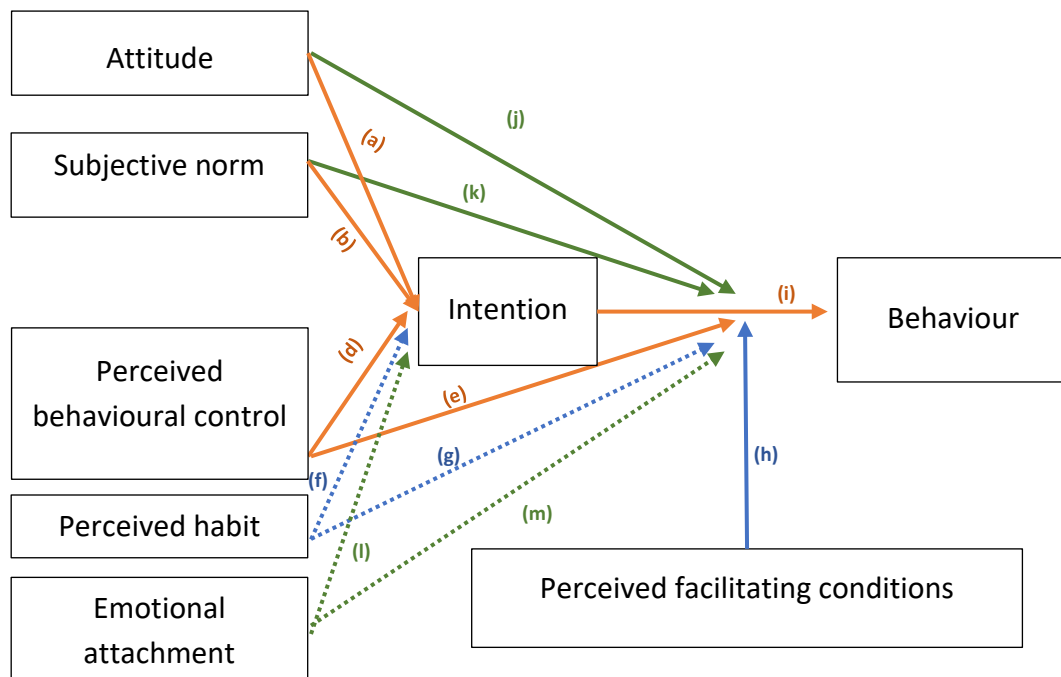


Figure 19: Modified model to understand repair behaviour

5.1.1. Factors influencing intention to repair on the consumer repair journey

Findings from the analysis of collected data revealed that an intention to choose self-repair, commercial repair or non-commercial repair could be significantly influenced by attitude, subjective norm and perceived behavioural control (arrows a, b, d in Figure 19). These factors also generated different intentions, such as whether to start repair journeys and how to identify product faults (at Stage 1), whether to get more information to inform repair decisions or consider alternatives (at Stage 2, presented in Section 4.2.2), and whether to do DIY repair or get products repaired by someone (at Stage 3).

Attitude was associated with perceived benefits or outcomes and interests in different repair routes and related actions at each stage of consumers' repair journeys. Beliefs about and evaluations of outcomes lead to an attitude towards the given behaviour and this attitude towards the behaviour can influence people's intention to act in the given way (Fishbein and Ajzen, 1975, 2010). The majority of participants intended to do self-repair throughout their repair journeys and also to self-diagnose product faults at Stage 1 because of enjoyment from self-repair or expectation of cost-saving. Enjoyment from self-repair was also a key motive for

seeking related information (i.e. repair instructions) at Stage 2. An intention to choose a commercial or non-commercial repair route mostly resulted from negative perceived outcomes of self-repair; particularly fear of causing functional or aesthetic damage through disassembling items to diagnose faults at Stage 1 or starting the repair work at Stage 3.

The research also identified similar findings in previous studies that information search could negatively and positively impact consumer intention (Andorfer and Liebe, 2012; Liebesny, Balestrin and Kenny, 2016; Branco, Sun and Villas-Boas, 2018; Gursoy, 2019). Satisfaction with getting the required information – such as how to do self-repair, where to find suitable spare parts or reliable repairers, or in what way repair cafés can help – and willingness to learn and a desire to have a sense of learning achievement were crucial at Stage 2. These factors helped to shape clear plans for seeking the information from the right channels on the internet (e.g. YouTube or websites of spare parts suppliers), advice from repairers at local shops, or customer service staff at the manufacturer or retailer. The data collected also suggested that with the information at Stage 2, consumers could confirm their perceived benefits generated at Stage 1 and even explore more benefits of their chosen repair routes and alternatives (e.g. consider other repair routes, leave items unrepaired or choose replacements). Moreover, information about risks of chosen repair routes or benefits of alternatives could influence the translation of intention into behaviour (discussed below, in Section 5.1.2). It also seemed that perceived negative outcomes of repair work could remain perceived if they were not confirmed at Stage 2.

Subjective norms were evidenced in the collected data that answered the research questions: whether and how people who were important to participants influenced their intention. For example, several participants from families that engaged in DIY repair activities appeared to prefer self-repair.

Perceived behavioural control (PBC) was evidenced in participants' perceptions of how easy or difficult it is to act following intention, similar to the definition in the literature (Section 2.3.2). PBC could be found in several situations in which participants' perception of lacking confidence in specific skills or knowledge generated an intention among some of them to get someone to diagnose product faults, rather than doing so themselves. A lack of confidence was also identified as one of the main challenges to self-repair in previous studies (Parker *et al.*, 2012; Harvey, 2016; Cole and Gnanapragasam, 2017a). However, this kind of PBC also generated an intention in the self-repair of products for many participants, particularly in furniture and garments, for which product faults were easily recognised and participants gained more confidence at Stage 1 of their repair journey. At Stage 2, several participants' perceived difficulties in finding reliable repair service providers (i.e. due to doubts about the reliability of the service from customer reviews) or appropriate instructional videos (i.e. which match their skills and knowledge) which generated their intentions to seek advice from family members or friends, instead of from the internet. Behavioural controls could remain perceived in previous repair journeys and affect future journeys if they were not confirmed. For example, several female participants never tried to self-repair EEE because

of not believing that instructional videos could help them. A few male participants shared similar statements when considering self-mending their clothes.

Similar to previous studies on sustainable lifestyles such as recycling or purchasing sustainable products (Kumar, Manrai and Manrai, 2017; Rosenthal, 2018), perceived habits shaped the specific intention of some participants (arrow f in Figure 19). For example, from the beginning of their repair journeys several males claimed that they very often intended to self-repair EEE or furniture, whilst a few females intended to self-mend clothes. At Stage 2, some participants often tried to do internet research prior to asking advice from family members or friends, while the approach of others was the other way round. The emotional bond to products could also generate the intention of repair at each stage of the repair journey to maintain the emotional value (arrow l in Figure 19).

5.1.2. Factors influencing translating intention into behaviour on the consumer repair journey

The empirical study suggested that attitude, subjective norm and perceived behavioural control mediated translating intention into behaviour (arrow i in Figure 19) in consumers' repair journeys (arrows e, j, k), especially at the first three stages. Post-repair evaluation by consumers at Stage 4 helped to confirm the actual impacts of these factor groups (attitude, subjective norm and PBC) when they compared expectation and satisfaction with repair outcomes considering different intentions and behaviour that led to the outcomes.

Attitude could arise from interests in extending product lifetimes through repair and in relevant information search, and expected benefits from repair (e.g. lower costs from extending product lifetimes, reduce environmental impacts). Attitude was a key influence for putting consumers' plans into actions (Campbell and Fairhurst, 2016; Grimmer and Miles, 2017) throughout their repair journeys. The group discussions on evaluating post-repair at Stage 4 suggested that every journey provided an enjoyable experience and learning points which seemed to generate positive attitudes to future repair. By contrast, at the first three stages of repair journeys, perceived drawbacks, such as uneconomical repair costs or time-consuming repair work, hindered the translation of intention to diagnose product faults, seek repair instructions or repair services, and start self-repair or get someone to fix broken items. Moreover, low expectation of product durability, particularly for small appliances, flat-packed furniture and fast fashion, appeared to make investments of time, effort and money in repair seem irrational.

This research echoed previous studies' findings about subjective norms which considered how people who were important to participants influenced their intention into behaviour (Carrington, Neville and Whitwell, 2010; Hassan, Shiu and Shaw, 2016; Grimmer and Miles, 2017). Many participants who lacked repair experience seemed to rely on their friends' or family members' attitudes towards repair, competences in repair work and previous experience. It seemed important for consumers to interpret the information

provided by reference groups such as friends and family members. For that reason, several participants asked someone's help to diagnose faults regardless of their intention at Stage 1 or to fix their items regardless of the information collected at Stage 2. However, over-estimation of personal skills or under-estimation of repair time and cost at Stages 1 and 2 could generate intention-behaviour gaps at Stage 3.

Perceived behavioural control was often associated with consumers' lacking confidence in specific skills or knowledge to act following their initial intention. This could result in the consumer getting someone to diagnose product faults or fix the items, giving up self-repair, not following instructions or advice about DIY repair found at Stage 2, or terminating repair journeys. Confidence in personal abilities was a crucial success factor of self-repair (i.e. to maintain a commitment to self-repair) according to many participants when considering post-repair evaluation at Stage 4. Ajzen (1991, 2020) argued that people who are confident about their ability to master a particular activity are more likely to succeed than those lacking self-confidence.

In addition to attitude, subjective norm and perceived behavioural control, facilitating conditions - particularly product design, the availability of repair information, previous experience and the convenience of alternatives (considering different repair routes, leaving products unrepaired or going for a replacement) - mediated the translation of intention into behaviour (arrow I in Figure 19). The collected data echoed the impacts of these factors on consumers' repair behaviour found in the literature (Sections 1.2, 1.3 and 1.4) while providing additional insights on their complexity at different stages of repair journeys.

Product design was liable to hinder repair or particularly disassembly. A requirement for an uncommon or expensive tool or further damage caused when disassembling items could inhibit self-identification of product faults at Stage 1 and repair work at Stage 3. Perceived or actual obstacles (e.g. time constraints or costs) to finding and buying an appropriate tool, such as a screwdriver, seemed to hinder disassembly of a product, either to diagnose the fault at Stage 1 or to actually fix the problem at Stage 3.

Manufacturers' manuals and repair instructions provided by either manufacturers, spare part suppliers or YouTubers could help consumers to build confidence, but also confirmed perceived challenges and made them afraid of repair failures. Failure could void manufacturers' warranties or cause further damage to products or harm owners. For such reasons, although some participants continued on the self-repair route, others preferred the commercial or non-commercial repair route or terminated their repair journey after foreseeing a time-consuming or challenging repair process, or the high cost of self-repair, non-commercial or commercial repair. Doubts about the usefulness of product manuals, online repair instructions and reviews of repair service providers could also generate intention-behaviour gaps at Stage 2. A consensus of concern about the durability of products or prematurely obsolete design among bloggers or vloggers and product owners could also mediate translating intention into behaviour or the termination of repair journeys at this Stage.

Relevant repair experience or growing up in families where repair work was common could provide background knowledge to support the interpretation of instructional information gathered at Stage 2 and maintain self-confidence during repair journeys. By contrast, over-estimation of personal skills or under-estimation of repair time and cost at previous stages could influence behaviour negatively at Stage 3.

The convenience of repair evidenced by participants was concerned with borrowing tools from family members, living near to repair cafés, getting immediate advice or help to repair from friends or local repair shops, purchasing replacements. By contrast, the inconvenience of repair could result from the unavailability of local repair services, spare parts and tools, long-queues for customer services, accidental damage in the disassembly process, urgent need to use the item or concern about competence of repairers or their service quality.

Participants also suggested that facilitating conditions could remain perceived as several participants terminated repair journeys or switched to another repair route and could not experience the actual impacts of those facilitating factors. For example, several participants assumed that designs of electronic products challenged repair work, but they admitted they never tried disassembling these products to actually see how easy or difficult it was to fix them.

Post-repair evaluation at Stage 4 could help to clarify the impacts that also can influence future decisions and actions undertaken in future repair journeys (either positively or negatively and regardless of the repair route). For instance, several male participants caused further damages to their garments which prevented them from undertaking DIY clothes mending in the future.

Moreover, other factors, including perceived habits and emotional attachment to products, were evident in mediating the translation of intention into behaviour (arrow g and m in Figure 19). Perceived habits, such as the frequent use of the internet by both Generation X and Y participants, appeared to speed up their research on repair instructions. Moreover, participants also revealed that emotional connections to products could strengthen owners' commitment to repair and to complete their entire repair journeys. They could put more effort in getting information and asking advice from different sources, carefully select appropriate repair routes to minimise further damages, or disassemble and fix the items with more care.

5.2. Recommendations for business interventions on the consumer repair journey

Consumers may have different sets of intentions, acting according to their initial intention or discontinuing the repair journey at any stage due to perceived or actual challenges. Some perceived challenges or their actual impacts might only be confirmed at a later stage of the journey. Furthermore, appropriate and sufficient interventions and support from businesses are crucial if consumers are to make informed repair decisions. Three main support needs from businesses were proposed in Section 4.3 based on participants'

comments with a consideration of different product sectors (Section 4.2.5): improved availability of and access to repairable products, repair services and customer support, and offering product-service integration. This section proposes recommendations for businesses based on these consumer support needs to fulfil the research objective 2 () and to set foundations for the proposal of business management implications (Section 7.2.4).

Improved availability and provision of and giving consumers access to repairable products should be considered by more manufacturers, brands and retailers, through design strategies for disassembly, standardisation, and simplification, and promotion of these product features. The findings of this study echoed the importance of initiatives recommended by a consumer behavioural study on product durability and repairability (European Commission, 2018) and a study by the Reuse and Recycling EU Social Enterprises network (RREUSE, 2013). Product design was an essential facilitating condition in translating intention into behaviour in the consumer journey (Section 5.1.2). For that reason, these design strategies should ease the disassembly of products to diagnose their faults at Stage 1 and to fix the problems at Stage 3. These strategies could particularly reduce the complexity of EEE products (Table 20). Moreover, standardised and simplified design should help consumers to easily find the right information (e.g. appropriate repair instructions and compatible spare parts) and understand the structure of products at Stage 2. Additionally, promotion of these product features and repair benefits (e.g. cost-savings and environmental sustainability) should support consumers' beliefs about positive outcomes of repair and should generate relevant intentions (e.g. repair to prevent purchases of new items, particularly low-priced small appliances, fast fashion or flatpack furniture (Table 20) and reduce environmental impacts) during repair journeys. The focus on functional value for EEE products and both functional and aesthetic or bespoke value for clothes and furniture should be considered when promoting repair outcomes (Table 20). This consideration could have positive impacts on repair intentions and satisfaction with repair work.

The clarification of repair manuals, designed for DIY and commercial repair, could prevent consumers from wrongly perceiving challenges to each repair route, discontinuing their repair journeys and ending up with a replacement or leaving products unrepaired. Improved manuals could also help to improve consumers' confidence in their abilities and prevent the fear of data loss when fixing EEE products or further aesthetic damage to clothes or furniture (Table 20). More males could be more confident and interested in mending garments; more females could be willing to EEE products.

Moreover, it is essential to increase consumers' awareness of product repairability, its potential benefits and risks, and the feasibility of different repair routes. Findings from the study suggested that consumers might not have the intention to repair their broken items (or get them repaired by others) due to not wanting to waste time and effort fixing cheap or prematurely obsolete products. Therefore, besides offering repairable products, manufacturers and brands should improve the availability of and access to repair manuals and spare parts and inform customers about them at the point of purchase (i.e. to help to

shape customers' intention to repair broken products) and during the use phase (i.e. provide appropriate information at Stage 2 of the consumer repair journey). For example, repair manuals should be included in product packaging or consumers should be informed where to find repair instructions at the point of sale. Businesses should also provide consumers with the information about what types of repair work could void warranties or require special tools, to inform consumers when purchasing different types of products (Table 20). Participants considered instructional videos to provide better visuals and explanations compared with written instructions. Moreover, future repair journeys can be streamlined, such as by eliminating or speeding up Stage 2, if consumers have already experienced similar product faults during previous repair journeys and have gained the necessary competencies (e.g. where to find helpful instructions easily and how to apply them successfully) to process later stages. Additionally, Generation Y participants indicated more often than others that their repair behaviour decisions were motivated by environmental sustainability. This should be considered in promoting repairable products and repair benefits.

To improve the availability of and access to repair services and customer support, more manufacturers, brands and retailers should provide responsive online support; improve staff competences and service turnaround. These should help shape consumers' beliefs about positive outcomes of repair services – which should be easy, successful and quick. Some challenges to commercial repair could be perceived wrongly in previous repair journeys and influenced future journeys of several participants; therefore, the improved availability of information about repair services and customer support should generate consumers' perceptions of how easy it is to act following an intention to choose commercial repair.

Additionally, both X and Y generations expressed a preference for seeking repair instructions and recommendations for reliable commercial services online, a facilitating condition that supported translating intention into behaviour. Responsive online support, competent staff and quick product turnaround should also improve the convenience of commercial repair, as the unavailability of local repair services, long-queues for customer services and urgent need to use the item made many participants give up seeking commercial repair on their repair journeys. This could become a habit of not choosing commercial repair thereafter.

Product-service integration strengthens the relationship between product and service and should facilitate consumers' repair journeys. If product owners have a clear understanding of who might offer them help (e.g. instructions or advice for fault diagnostics or DIY repair) or a repair service, they may not need to diagnose the problem after noticing the fault at Stage 1. For that reason, product-service integration was expected by most of the participants to help to streamline repair journeys. Many women, in particular, seemed to engage more actively in the entire repair journey and to enjoy self-mending clothes, rather than electronic and electrical products. By contrast, many men were more interested in DIY repair of electronic and electrical products than garments. Product-service integration should

ease repair journeys, especially when self-repair may require significant commitment, interest and competence.

CHAPTER 6. Results of business study

This chapter presents outcomes of business interviews regarding potential business activities that can promote product repairability and repair services. The first nine sections (6.1 to 6.9) cover the nine business activities that were generated from the literature review (Section 2.5). Each section discusses opportunities for and challenges to adopting and executing every activity. The final section outlines the support needs for the proposed innovations (Section 6.10).

6.1. Design for repair and codesign

6.1.1. Business opportunities

This section constitutes three parts (i) the extent to which design creates the potential for repair (ii), the process by which repair work is realised (meetings, feedback, scorecards), and (iii) the benefits of realising the opportunities.

(i) A focus on design characteristics is vital for product repairability and the possibility of the other proposed activities at grassroots level. Five design strategies proposed in Section 2.5.1 – standardisation, simplification, design for safe repair, disassembly and upgradability – were discussed in the business interviews.

Product repairability in design has been considered to different extents, considering the three product sectors and various business stakeholders – manufacturers, brands, retailers and repair service providers. Various combinations of any of the five design strategies were found in the design process of companies, depending on their interests in repair routes. For example, one interviewee from a British national repair service provider argued that many household appliances, such as washing machines, tumble dryers, fridges and freezers, are more repairable currently than in the past (EE07). This interviewee clarified that *‘there were a lot of more individual components in an appliance in the past; whereas nowadays there are a lot of modules’*, which eased his technicians’ repair work. For example, *‘a washing machine, 20 years ago, had a mechanical timer and a number of mechanical switches and dials ... today, all of those components are combined into a PCB.’* Many refrigerator doors were designed for upgradability, such as through replacing plastic doors with stainless steel ones or different colours (EE02). Similarly, EE03, EE04 and GM02 asserted that any branded manufacturer should take durability and repairability into the consideration at the design phase. One interviewee was proud of her company’s vacuum cleaners, which are easily to be disassembled and safe to repair by consumers:

‘Most customers over the last six years are used to us... sending out parts [for self-repair].’ (EE04)

This interviewee’s company also planned to launch a new range of modular products which customers can upgrade with a longer-lasting battery. Product repairability was taken into account in the design process:

‘Simplification of components... reduces costs [of production] whilst making it [the product] easier to service.’ (EE02)

Moreover, product teardowns were practised at the final check before the mass production stage to *‘make sure that technicians can easily access and service the product.’* (EE02). This interviewee added that smarter appliances, benefiting from Internet of Things, have been developed to support remote fault diagnostics.

Regarding telecommunication devices, one interviewee claimed *‘it is definitely easier to repair newer mobile phones’* because *‘they are more simplified than those produced three or four years ago.’* (EE05) An interviewee from a Dutch modular phone brand claimed that the company employed all five design strategies above. The company utilised standard components, such as cameras, resistors and connectors which are outsourced from the many suppliers to the industry. However, it innovatively *‘designs the phones’ architecture which brings those components together’*. *‘Every module is contained in a plastic housing... just like a final product’*, thus *‘any person with their hands can dismantle and repair it... with a normal Philips screwdriver’*. For example, batteries can be purchased online and replaced by customers, making repair cheaper without the need for a professional repair service. This simplification also made the phones upgradable, especially with cameras – *‘customer can do this [upgrade] themselves... very easy’*.

Similarly, many furniture items produced by FN01 and FN02 were repairable because their products need to comply to *‘very strict rules... of standardisation and design for disassembly.’* (FN02). In other words, products must go through a process where product developers and service technicians identify which components could be disassembled and spare parts must be available for supply throughout the use phase. Similarly, another interviewee was *‘absolutely opposed to the process of locking customers out of their products.’* (FN03). For more than 60 years, the company used *‘materials that are easy to be repaired’* and standard screws so *‘anybody with a regular screwdriver can repair’*. However, discussions on flatpack furniture remain controversial. For example, one interviewee argued that it *‘has potential for repairability’* as consumers can themselves assemble, disassemble and replace components (FN01). On the contrary, an interviewee asserted that *‘a lot of flat pack furniture is almost impossible to repair, whereas traditional... timber with French polishing of wax finishes can be repaired quite easily.’* (FN04).

Considering textile products, jeans were claimed to have the highest repairability as they could be repaired many times by attaching new fabric and building layers on worn areas (GM01). Nevertheless, an interviewee from a Swedish multinational fashion brand indicated that durability and repairability of jeans were essential to gaining more customers. The repairability of other garments were considered by interviewees from fashion brands and retailers for a variety of reasons (discussed in Section 6.1.2).

(ii) Codesign or participatory design is an approach to design that encourages different stakeholders, including manufacturers, brands, retailers, repair companies and consumers, to

participate in the design process (Section 2.5.1) and was used in this study to consider their repair needs. Various associated processes that leverage the codesign concept were identified from the interviews, including product teardowns to ensure achievement of design strategies for repairability and identification of common spare parts to ensure the related supply chain resilience. Furthermore, the importance of collating constructive feedback about product design and repair practices was addressed by many businesses.

For example, an interviewee believed that quality-focused meetings, hosted by brands, with participation of key manufacturers and repair service providers can permit the brainstorming of ideas, *'making products more repairable... and eliminating the fault in the first place.'* (FN07). A Technology Manager from this British multinational clothing, footwear and furniture retailer claimed that product R&D directors are essential in these meetings (FN07). Similarly, data about common failures reported by a third-party company were fed into product lifespan testing at manufacturing sites for continuous improvement (EE01). In contrast, an American officer furniture manufacturer worked closely with more than 60 retailers in London selling preowned and refurbished products, supplying them with *'guidance about retaining the core [value] of products'*, and also collected *'feedback on which parts they [the retailers] are replacing most often'* (FN02).

A Senior Director of Customer Care of Swedish multinational home appliance manufacturer described how his customer relation management (CRM) systems, which include a mobile app, is an efficient communication platform between customers and the company's field technicians, customer service and product design team (EE02). They could communicate and share repair experience via online comments, live chats, video calls and even pre-recorded videos of onsite repair practices.

Participants in codesign activities can range from manufacturers, brands, retailers to repair companies and consumers, depending on which repair routes is considered when designing new products. Most of the service providers did not directly participate in the design process but share practical insights into product repairability with manufacturers. These practices seem to be aligned with the 'shared data' described in Section 6.8. For example, data on *'what the most common repairs are'*, *'which button is most likely to fall off first'* (GM06), *'what types of items are easy to repair'* or *'which ones are more difficult to repair'* (GM07) can help fashion brands create repairable and longer lasting garments.

A British domestic appliance and heating repair service provider (EE07) provided *'feedback on the types of repair and components needed'* to many brands and retailers as this company nationally offers repairs in and out of guarantee. In particular, the company conducts *'a formal process'* to provide a report of repair practices and requests for design modifications for continuously improved services, considering safety and efficiency. These practical contributions were also confirmed in the interviews with EE05 and FN06. Two interviews (GM07, EE05) indicated that repair workshop managers and product development managers (EE05) play important roles in providing feedback about product design to manufacturers. A Sales Managers and her colleagues from a British furniture repair service

provider (FN06) were sometimes invited to review manufacturers' prototype models before finalising their designs. An interviewee argued that consumers often listened to retailers' recommendations for reliable products, while retailers received product feedback from consumers (EE02). A Technical Development Manager from the UK's major service provider of business consultancy, training, product testing, inspection and repair emphasised that data collected when providing repair services significantly contributed to consultancy projects associated with product design and development.

Post-repair scorecards (i.e. to collect customer feedback about product repair or service after repair) were expected by many interviewees to help the recording of data for continuous improvement of product design. For instance:

'Every single manufacturer that we work with has a scorecard that records everything from our performance – how quickly we repaired items, how many for our first fixed percentages, how many we fixed on the first attempt... all the way through to the appliance performance – how often the breaking down [occurs] and what [which] components are required.' (EE07)

An online portal which included 'quality grading' of repair services and product design was a 'revolutionary scorecard' to improve the repairability, as claimed by two interviewees from Swedish multinational fashion brand (GM01). Moreover, repairability criteria in scorecards could also be used in questionnaires in surveys, focus groups or interviews. For example, customers were invited to focus groups to evaluate product design and aftersales services (GM02). Participants are granted credits to be used in future purchases. Other businesses, such as EE04, FN06, FN07 and GM07, collected feedback about repair practices from customers and engineers via emails, whilst a UK's major domestic and heating repair service provider created a smartphone application for similar evaluation purposes (EE07). As a marketplace provider of garment repair services, GM06 allows every customer to 'leave a review on the (online) platform and the profile of the maker [seamstress]' (GM06).

(iii) A wide range of benefits to different stakeholders were identified in the interviews. The majority of interviewees claimed that repairable design could and should prevent replacement and consequent use of raw materials and ease DIY repair. Considering benefits to business stakeholders, repairable design and codesign should result in decreases in production and warranty costs, increases in brand awareness and loyalty, and the improvement of repair services

Standardisation of components could reduce production costs due to economies of scale (EE04, EE07). A Technical Development Manager from a large British service provider of business consultancy, training, product testing, inspection and repair reported that because his organisation 'deals with replacements and returns, costing around 10 million a year', improving the repairability of products should minimise or even eliminate these costs for manufacturers and brands.

Besides monetary benefits, design for durability and repairability was expected to reduce the use of raw materials (FN05), improve or maintain positive brand image (EE03, EE04, EE07) and be aligned with governmental regulations, such as Right to Repair in the USA (EE07). These changes in product design could also help to increase customer satisfaction, brand loyalty, gain more customers (GM01, FN04) and strengthen brand customer relationships (FN01). For example, *'making good quality products... lasting a long time'* (FN03) was the growth ethos of a British furniture maker of long-lasting home furniture. This business was claimed by the interviewee to be rated as an outstanding example of sustainable SMEs by Financial Times. This high-end furniture brand aimed to educate consumers about saving the Earth and building emotional bonds with wooden items.

Design for repair can result in increasing *'serviceability of products'*, which eased technicians' repair work at a Swedish multinational home appliance manufacturer (EE02). Similarly, a UK's high-street repair service provider and an American office furniture manufacturer claimed that repairable design could provide benefits for repair or refurbishment service providers, such as through ease of disassembly and reassembly. A British multinational clothing, footwear and furniture retailer also shared that the increased product repairability (i.e. easing disassembly and reassembly) could also improve the productivity of engineers when assembling new products or recovering those damaged during the delivery process.

Moreover, repair service should be offered at *'a minimum of inconvenience for the customer'* (EE03). For instance, *'the way you [the engineer] approach a customer's problem and the speed at which you can approach that is very, very important to any manufacturer'* and *'when the engineer leaves the [consumer's] house, the product was repaired and the customer is very happy'* (EE03). Additionally, a former General Manager at Swedish multinational home appliance manufacturer recommended that retailers should suggest customers buying products designed for repair and made by reliable manufacturers, to increase customer trust and loyalty (EE02).

6.1.2. Challenges

Data collected suggested four key challenges to design for repair and codesign. They include R&D innovation in product design, consumers' preference for replacements, conflicts between product lifetime extension and sales-driven business goals and risk of DIY repair to consumers.

Design for safe repair was opposed on grounds of increased manufacturing cost, claimed by several interviewees. For example, a Director of Product Development of British brand of electrical appliances argued that *'designing a product purely with reparability in mind'* could *'cost more to produce in China than a product they have produced, on a much greater scale, which has not really taken any consideration of repairability.'*(EE01). Moreover, this interviewee asserted that the small domestic appliances market is *'extremely competitive'* in which *'price sensitivity on products is paramount'* as many supermarket

chains, such as Tesco, Morrison's and Asda, join in and compete on price. He also declared that consumers prefer *'cheap'* small domestic appliances and *'drive the cost of manufacture down'* (EE01). Similarly, a Senior Director of Customer Care of a Swedish multinational home appliance manufacturer claimed that its refrigerator doors were replaceable but more expensive than entire new machines because they were *'bulky and expensive parts to ship'* (EE02). A Regional Director of the UK's high-street repair service provider shared the same thoughts and explained that *'manufacturers will make decisions based on what's easiest for them'* and boosts product sales volumes at their retailers (FN05).

Some interviewees considered product design as a reflection of consumer demands. For instance, many customers were *'more interested in quality than repairability'* and preferred commercial repair to undertaking DIY work themselves (EE02). Similar examples were:

'White goods now have smart technology... people are preferring to replace ... rather than spending a couple of hundred pounds to replace bearings or whatever in the washing machine.' (EE03)

'Furniture has become like fashion and people may just not want to keep their pieces of furniture looking the same.' (FN04)

Due to uncertain demand for repair and the high cost of spare parts, repairable products may be not worth fixing. For instance, *'sofa beds are 100% repairable'*, but there were uncertainties about their repair costs because the repair work was undertaken on a small scale (FN05). Consequently, an interviewee from the electrical and electronic industry raised a concern about more and more local repair shops going out of business *'because of the commercial aspect of it'* (EE03). Designing products for repair should consider the *'labour cost [of repair] versus material cost [of products]'* because low value products might not be economically feasible to be repaired (FN01).

For garments, a Sustainability Specialist from a British multinational retailer of clothing, home and food products stated that many customers were not interested in repairing their clothes but *'nothing can stop you [consumers] from repairing things if you want to.'* (GM03). This interviewee argued that garments should be designed for durability, rather than repairability. Fallen buttons, zips and hems were the most common faults which were claimed by the interviewee to disappoint many customers.

The collected data suggested that many recent products were designed to catch up with or create new market trends (e.g. technology or fashion). In the case of electronics and electrical items *'standardisation is not the way to go'* as it *'stifles creativity and improvement'* (EE03). In the same vein, in fashion, standardisation can *'destroy the uniqueness of the product... in an industry where differentiation is the most important selling point'* (GM03) and standardisation is *'not really in nature'* (GM04). These two interviewees (GM03, GM04) raised a concern about standardisation of production which might limit the creativity and differentiation in fashion design. Differentiation should be generated not just between brands

in competition but also between products made by a producer (GM03). Design for repair should not be *'looked at in isolation'* because fashion brands *'are here to sell people new clothing and new clothing is what people want'* (GM04).

A few interviewees from the electrical and electronic industry were worried about safety issues. It was challenging to identify *'how much you [manufacturers] can allow consumers to repair their own products'* due to safety concerns (EE01). For example, repair work might require breaking seals between parts, which could lead to water or food leaking, damage the machine, or cause electric shocks. Similarly, a design for safe repair products should be carefully considered due to various levels of user competencies – *'can an 80-year-old person repair?'* (EE04). This interviewee indicated that customers would take product warranty into account rather than repairability when purchasing new products because they expect manufacturers to fix faults (EE04).

For the above reasons, retailers may not be interested in design for repair because *'what they always want is to sell new products'* (EE03). This also means that codesign is unlikely to happen with retailers who fully outsource products from manufacturers in the Far East or who make some visual changes for branding identity in products made by others. These visual changes only require *'minimal investment'* (EE01).

In the same vein, the collection of post-repair data through surveys, manufacturers and retailers *'cannot guarantee customers will fill them in'* (GM02) and might need a full-time analyst (GM01, GM02). Furthermore, two interviewees claimed that they could not find consistency in data analysis as different garments and furniture products were damaged or worn in different ways and required different treatments (GM07, FN04). In many cases, customers were dissatisfied with garment repair outcomes as they disliked visible mending (GM07).

6.2. Repair manuals and instructional support

6.2.1. Business opportunities

This subsection discusses the different means by which repair information that supports repair decisions could be communicated, through recorded materials, including paper or online documents and videos, or through interactions with call centres or in-store staff (Section 2.5.2). The data suggested that the information ranged from diagnostics, repair and maintenance instructions and recommendations for reliable repair service providers. The data collected suggested that transparent and efficient communications between businesses themselves and with consumers were essential supplements to repairable design, particularly easing repair processes in the use phase. Although these activities might not generate direct incomes, they might share similar motives according to S01 – improving positive brand image, customer satisfaction, brand loyalty and gaining customers.

Diagnostic and repair manuals have potential to save time, ensure the ease and safety of repair work, and increase the confidence of repairers, and support sustainable branding.

An Environmental Specialist from an American multinational office furniture manufacturer suggested that user guides should include both *'installation and disassembly instructions'* (FN02). Customer services should provide any support with regard to providing *'access to those manuals or further clarification if needed'* (FN02).

Different methods of distributing information about repair instructions were identified through the interviews. Considering the clothing product sector, repair manuals were attached to *'repair kits'* which could be ordered online and then posted to customers for free at a Swedish multinational fashion brand (GM01). Moreover, customers could easily seek advice from repairers in most of this brand's stores. In contrast, technical service and sustainability team at a British multinational online and catalogue fashion brand developed and *'put some films on the website to explain to customers how they can do it [repair]'*, such as mending holes or shortening jeans.

Similarly, a British brand of electrical appliances asserted that 30 or 60 second instructional videos could significantly educate consumers about product cares, support maintenance processes and fault diagnosis (EE01). These videos were claimed to reduce paper consumption for hard copies of manuals and misdiagnosed failures, which currently accounted for 90% of its call centre's workload. A British social enterprise developing an online marketplace of seamstresses and tailors shared the same thought about shifting to digital manuals to reduce waste from, and costs of, paper and packaging (GM06).

An interviewee from the EEE sector provided paper-based manuals and videos that clarified which product components were replaceable, whether by consumers or service technicians (EE02). These guides were accessible on the company's website and YouTube channel. They classified replacing consumables or motors (i.e. in washing machines) as DIY repair; whilst repair that required *'working on a high-power electric range'*, such as replacing control boards, should not be done by consumers. His business used *'Google searchable terms'* in these materials and assigned a responsive call centre to *'make sure all the tools [manuals] are easy to use and easy to access... and customers find the right information quickly'* (EE02). *'Searchable terms'* were also claimed to be a key to improved traffic to the website of this Swedish multinational home appliance manufacturer.

A British manufacturer of cleaning appliances (EE04) and a Dutch modular phone brand (EE06) offered both online written manuals and instructional videos on how to replace or repair the components or so-called *'repair guides'*. A call centre was also responsible for *'talking through a repair'* if customers had further queries after watching the videos (EE04). The Dutch modular phone brand collaborated with an online spare parts supplier to develop *'high quality repair manuals and instructional videos'* and product teardown movies (EE06). This brand provided links to those videos for its customers with their purchases of spare parts. An interview from the furniture sector claimed that he was proud of his company's well-trained and skilful staff which was crucial for high quality aftersales services and happy customers, regardless of locations and time zones (FN03). Another interviewee asserted that his UK's high-street repair service provider significantly invested in facilities and staff

competencies at a central repair centre to respond to queries that local branches were not able to answer (EE05).

Contact information of repair service providers should be recommended in user manuals for commercial repair. For example, interviewees from two UK's repair service providers (EE07 and FN04) claimed that most of their customers knew their services on suggestions in manufacturers' manuals. These two interviewees were both proud that they supported many brands and retailers to deal efficiently with consumers' queries and complaints with regards to aftersales services. An interview from a British multinational clothing, footwear and furniture retailer (FN07) also expressed his appreciation for the UK's major service provider of furniture product inspection and repair (FN04) which, he claimed, kept customers satisfied.

In addition to repair, maintenance instructions were critical to product lifetime extension, particularly for kettles or vacuum cleaners, which should be *'designed in a way that consumers can descale them... or replace filters'* (EE01). It was also said to be essential to develop *'care guides... to educate consumers in terms of how to care for garments'* to prolong their lifetimes (GM02). The founder of a British social enterprise which developed an online marketplace of seamstresses and tailors stated that her seamstresses could support fashion brands to create helpful contents for product care instructions (GM06).

Besides instructional support for diagnosis and repair, it was argued by several interviewees that a professional call centre to provide reasonable and transparent repair costs (EE07, GM07) or pricing guidelines published on the company's website (GM06) was vital to improving the customer experience.

6.2.2. Challenges

Key challenges to the development and distribution of repair manuals – including (i) the lack of collaboration between stakeholders and customers' perceived needs, and (ii) potential risks through misinterpretation – emerged from the conversations with businesses.

The development and distribution of repair manuals required the participation of different stakeholders, including internal collaboration between product development and customer service teams (e.g. to find solutions for easing DIY and professional repair), and external collaboration between manufacturers and brands (e.g. to share the information about the availability of manuals at the point of sales and provide instructional support during the use phase). In practice, this proposed activity (S02) attracted the attention of a specific stakeholder but *'the rest of the business is barely interested... in putting it on the general agenda'* (EE01).

Several interviewees from the furniture industry asserted that there is no need to develop repair manuals. *'Furniture is a very simple product most of the time'* (FN04), so consumers can *'refer back to assembly instructions'* (FN07). A Sustainability Specialist from a British multinational retailer of clothing, home and food products shared a similar view, about the unnecessary of developing repair manuals as (GM03). She explained that instructions to

fix common problems, including fixing hems, replacing zippers or sewing buttons, were *'readily available'* on the internet *'if we produce our own information... we might not be adding value to a lot of information that is already out there'* (GM03). Several other interviewees from the fashion industry expressed an opposite point of view, that brands must educate their customers about *'sustainable consumption'* through making *'repair as easy as possible'* (GM06) with a provision of repair manuals and spare parts (GM02). However, a Head of Technical Services at a British multinational online and catalogue fashion brand raised a concern about a need for a professional customer service team to help with customer inquiries or explain the instructions required (GM02).

For electrical and electronics items, electrical and gas safety was the most considerable obstacle mentioned in the interviews, as unclear instructions could *'cause fire in [customers'] houses or flooding'* (EE03). Consumers could *'interpret the wording [in manuals] differently'* (EE03). In the worst scenario, consumers might not use *'user guides and information in the boxes (of new products)'* as they did not want to go through *'lots of pages'* but preferred *'a quick index for the most common things [faults]'* (EE04). Online electronic manuals were claimed to be preferable in such situations.

6.3. Promotion of repair benefits and repairable products

6.3.1. Business opportunities

Promotion of repair benefits and repairable products (Section 2.5.3) could be customised to companies' marketing strategies and tactics and strengthen brand awareness. Product repairability and supportive aftersales services could be utilised as indicators of sustainable or high-quality brands in the three industries.

Electrical and electronics products could be designed for repair to increase a certain *'level of marketing awareness'* (EE01). For example, a Dutch modular phone brand focused on *'green consumers'* who bought its phones with *'either environmental or social concerns'* (EE06). Promoting tangible benefits, such as replaceable batteries, is crucial to making such messages explicit. Regarding benefits to the society and environment, design for repair could lead to *'less effort to keep their [consumers'] devices working for longer time'* and *'that results in resource efficiency, which is ultimately one of our codes [unique selling points]'* (EE06). Even though repairability was not explicitly advertised at a Swedish multinational home appliance manufacturer, the interviewee asserted that most of his customers expected products to last 10 or 12 years (EE02). This manufacturer's branding was claimed to focus on high quality products and after-sales services that customers could *'ring the manufacturer'* to report breakages and ask for spare parts, even after the warranty period ended (EE02). For service providers, quality commitment statements are crucial to winning new customers and earning their loyalty – *'they are going to get a consistent, high level of service... we provide them with a (post-repair) guarantee'* (EE07).

In the same vein, several interviewees from the fashion industry stated that aftersales services generate a helpful driver for word-of-mouth and customer satisfaction (GM01,

GM02). In particular, promotions of these services were aligned with advertising product repairability that resulted in *'changing the mindset [of consumers] about repair'* and bringing more customers to the Swedish multinational fashion brand (GM01). An interviewee from a British multinational fashion brand argued that *'biggest brand messages about sustainability is longevity'*, such as communicating that *'if something could be repaired... it lasts even longer'*. Repair and care guides were published on the brand's website to educate consumers about product lifetime extension, sustainable consumption and their impacts on the planet. Publishing a transparent repair pricing guideline on the website was also a supportive action undertaken by a British online marketplace developer and a British provider of repair services (GM06, GM07), supporting consumers to make rational choices between repair and replacement.

Customised marketing messages could be essential to businesses which deal with a wide range of customers and omnichannel retailing with both a physical and digital presence. For example, FN02 designs different messages for different customers (i.e. from public sector organisations, to SMEs and end-users) in the competitive furniture market. In particular, the company's sustainability professionals *'try to influence what clients want'* through environmental messages associated with their various needs *'because some clients are interested in costs, some in quality... some in a particular look or aesthetic'* (FN02).

In addition to communication methods such as the company's website and word-of-mouth, a UK's high-street repair service provider utilised social media platforms such as Twitter to express its growth ethos and its staff help to spread positive messages such as *'love for repair'* (EE05). Similarly, another interviewee from the clothing industry suggested an optimistic message promoting *'just a small amount of money and a small amount of effort'* to repair an item or get it repaired (GM06). This interviewee provided an example of using *'promotions with a scene showing people what a garment looked like before, and then what the repair process was... basically to show how it is possible to get the repair done, and then showing them what the finished product looks like and what [how] somebody enjoys the item'*. Sharing successful repair stories was claimed to help consumers *'overcome barriers [to repair]'* and promote the brand (GM06).

At the same time, encouraging customers to *'honestly and openly'* share their experiences of products and aftersales services to the company's social media is *'increasingly important'* to the improvement of trust in a brand (FN03). Moreover, promotion of the product repairability and repair services was a strategic action to position the brand at *'the higher end of the market'* of a British manufacturer of cleaning appliances (EE04). The Director of Customer Service from this brand also claimed that these kinds of promotion could also showcase an extended producer responsibility associated with after-sales services in addition to that at the end of products' lives (EE04). A Technology Manager of a British multinational clothing, footwear and furniture retailers claimed that collaborations with reliable aftersales service providers, such as FN04, could also build customers' trust in and loyalty to manufacturing or retailing brands (FN07).

Creative marketing campaigns could take other forms, besides advertising, such as repair events and product care workshops. For instance, a Swedish multinational; furniture retail group launched a series of free workshops to educate customers on *'how to repair, how to care or even how to upgrade products'* (FN01). These could strengthen the brand's *'connection with customers during the use phase'* and *'increase the probability for second and third sale'* (FN01). Similarly, a Swedish multinational fashion brand successfully applied both offline and online communication methods, including paper booklets available at stores, social media and website content to share tips and hints on maintenance, repair and reuse (GM01). Moreover, two interviewees from this brand stated that fabric shown in display windows and sewing machines' noise at stores efficiently promote free repair services in their own way. The brand was also differentiated due to a new marketing model, a mobile repair station on tour, which brings repairs to high street shoppers to raise their awareness of repair benefits in the UK and overseas.

Among all interviewees from 21 companies, only a Circular Innovation Lead from a Dutch modular phone brand agreed with the concept of repairability labels because repairable products offered by *'green companies'* deserved to be awarded these labels.

6.3.2. Challenges

The business study found that the promotion of repair benefits and repairable products were outside of many businesses' and their consumers' interests. The collected data suggest two key reasons: (i) consumers' preference for replacement of newly designed and cheap products and (ii) constraints on businesses' resources (e.g. finance, labour and facilities).

Considering many consumers' preference for newly designed and cheap replacements, an interviewee argued that *'the first [purchasing] decision criterion is what do I need, what do I like... then how the price is'* prior to considering sustainability (FN01). Two interviewees claimed that many consumers were locked into unsustainable consumption, buying fast fashion garments without considering repairability or whether to repair them when worn (GM03, GM07). A founder of a British digital repair and alterations service provider admitted that the value proposition for its services was challenging when consumers, particularly from young generations, *'buy a dress for 30 pounds'* as *'they are not going to repair it for 30 pounds'* (GM07). A Senior Director of Customer Care of a Swedish multinational home appliance manufacturer stated that many young customers were also those who most often moved houses, and they preferred replacements and therefore did not take product repairability into consideration in their purchases (EE02). When they *'move into a new home, they want a whole new kitchen... and a new set of appliances'* (EE02).

For the above reasons, brands might be unwilling to invest in promoting repair benefits. An interviewee explained that this type of unwillingness could result from limited financial and human resources, which could be only enough for the introduction of new products and improving their sales (FN04). Moreover, a Director of Product Development

from a British brand of electrical appliances asserted that there was a dearth of evidence of a reduced carbon footprint arising from repair compared with replacement by energy-efficient products. A former General Manager of a South Korean multinational electronics manufacturer posed a similar thought: *'it is not always the best thing to repair a 10-year-old washing machine because... for the environment, it is actually better with the new technology and the materials in the product'*. This also suggested an unclear rationale for including repairability in product labels.

Another significant challenge to repairability labels indicated by a Chief Executive Officer from a UK's domestic appliances repair service provider was associated with the variety of product models. He claimed that *'by the time you [manufacturers] have been able to gather all of the statistics that you [manufacturers] need to produce a label on that particular model of appliance, that model has been replaced and would not be on sale'* (EE07). As repairability includes product disassembly, spare parts and repair service availability and their costs, one interviewee suggested that *'summarising all of repairability information into a concise product label... is very difficult'* (FN02) and another that *'there is nowhere on any of our products'* to put repairability labels (FN04).

Lastly, upscaling and multiplying repair workshops might be problematic due to the substantial requirement for workshop space, the availability of spare parts and machines, and the need for competent staff (FN01).

6.4. Choosing repair over replacement within warranties

6.4.1. Business opportunities

This innovation aims to encourage and attract both businesses and consumers to choose repair over replacement as a remedy in warranty claims (Section 2.5.4). Offering in-house or outsourcing repair services or supplying spare parts for consumers' self-repair were practised at several businesses and resulted in increased numbers of repaired items. For example, in the electrical and electronics industry, *'large appliances come with the parts and labour and an in-home warranty'*, whilst *'a lot of those small appliances do not come with a parts and labour warranty. They just come with a parts warranty.'* (EE02). Considering vacuum cleaners, the company might just send customers spare parts and encourage them to fix the items by themselves or tell them to use repair services at independent shops. Similarly, a British manufacturer of cleaning appliances also posted spare parts (e.g. filters, brush bars) to customer homes for self-repair within warranty periods (EE04). Moreover, this manufacturer also claimed that sometimes it might fix broken items outside of warranty periods for customer goodwill (EE04).

When it comes to the furniture industry, under warranty agreements, a Swedish multinational furniture retailer group's customers needed to visit local dealers to get spare screws and connectors for free. Moreover, the company also sent out technicians for repair or offer third-party refurbishment services if requested by customers. The interviewee proposed that *'the benefits are reducing waste... and transport costs obviously. If we are*

supplying parts rather than replacements, there is a reduction in the amount of transport required.' (FN02). A Managing Director of a British maker of long-lasting home furniture defined its sustainable growth ethos through *'offering a lifetime warranty'* (FN03). In other words, the company provided repair services throughout product lifetimes for decades even though *'it's never been written down'* (FN03).

Communications between business stakeholders and consumers were essential to prioritising repair over replacement. It was a key success factor of a British multinational clothing, footwear and furniture retailer that resulted in *'doing between 36 and 40 thousand home visits a year to inspect and repair... all of (our) furniture, whether it is upholstery, solid or foil furniture'* (FN07). In particular, in every warranty claim, a third-party service provider checked the availability of spare parts at its warehouse; otherwise, this retailer delivered to customers' doorsteps within 24 hours, before the visit of engineers. Similarly, an online British sustainable furniture retailer normally asked customers to take some images of the fault and explain either in emails or phone calls (FN05). The retailer then contacted the factory to decide to repair items at either the customer's home or manufacturing sites.

As one of the pioneers of a business model based on slowing garment consumption, a Swedish multinational fashion brand was claimed to repair jeans for free without hesitation as this made the brand stand out (GM01). A Head of Technical Services from a British multinational online and catalogue fashion brand shared a similar perspective, indicating that it was *'bound to repair the item for the customer... for up to two years'* (GM02).

Manufacturing warranties were typically limited to specific durations or conditions, whilst extended warranties could be offered by either manufacturers or retailers, as they can both enable consumers to get items repaired and benefit professional repair service providers (FN06 and GM07). For this reason, an interview from a British multinational clothing, footwear and furniture retailers briefly mentioned the potential launch of a *'partner programme'* covering alterations and repair after sales, which should be *'very beneficial to sustainability efforts'* of either large or small fashion brands (GM07). The programme could be seen as trial insurance on clothing for five years:

'Instead of having to pay £100 to repair something that gets damaged after two years, you [consumers] will need to pay an amount upfront. This makes the customers think about the five-years' worth when they are purchasing the item rather than just thinking about it as a spontaneous purchase.'

Regarding benefits to business stakeholders, this business activity was expected to help to position the brand at a higher end of the market (EE02, EE04, FN02, FN03) and increase brand awareness associated with a sustainable grow ethos (GM02). It was also claimed to generate profits for repair service providers, from providing after-sales services within warranties on behalf of manufacturers, brands or retailers (FN06, GM07)

6.4.2. Challenges

Key challenges emerged from the analysis of collected data: (i) customers' preference for a replacement or refund, (ii) underestimation of reverse and forward logistics costs, and (iii) conflicts between business stakeholders' interests in customer care.

Straightforward replacements or refunds for broken products within warranty periods were assumed by several interviewees to be an essential courtesy of manufacturers' or retailers' responsive services. For that reason, some interviewees (EE04, FN01, FN05 and F06) suspected that many consumers preferred a replacement over repair within the warranty period. For example:

'With vacuums, what is longevity for customers? When do they stop thinking I need a new one? Is it when the product dies or when it performs low performance? Is it driven by the technology that is come out?' (EE04)

A Sustainability Developer of a Swedish multinational furniture retail group doubted about the percentage of customers who would be interested in this business activity (FN01).

Misinterpretation of customers' preferences might influence their satisfaction and perception of the brand. For instance, providing parts for repairs, instead of replacements, *'leaves customers with older products'*; an interviewee wondered if its customers would have a sufficient sustainability motivation to accept this option under warranty claims (FN02). This interviewee – an Environmental Specialist from an American office furniture manufacturer – proposed that brands *'need to take into account all of those behaviours'* and relationships with customers. A National Sales Manager of a British national furniture repair service provider shared a similar recommendation to manufacturers and brands for considering the customer relationship and service quality management (FN06).

There would be considerable costs for repairers, and reverse and forward logistics issues (e.g. collecting broken products, delivering them to repair centres and returning repaired items to customers) if repair services were offered, rather than straightforward replacements or refunds. In addition to posting spare parts to customers:

'...the downside to that approach...(is that) you might need to provide more technical specialists to fit that part or component. There may be costs implied by sending technicians out.' (FN02)

Many cases of furniture repair of an American office furniture manufacturer were *'not economical to repair'* and *'easier to replace'*, unless technicians could repair broken items *'within a couple of hours in the consumer's home economically'* (FN02). In other words, *'it's not worth to go in and take a piece of furniture out to somewhere to repair it.'* (FN04). For that reason, a Technical Development Manager of a UK's service provider of business consultancy, product testing, inspection and repair emphasised the importance of the design process, making products *'very simple to repair (so) that you can do the repair in an hour'*.

An interviewee from a Swedish multinational home appliance manufacturer gave an example of a broken oven caused by an electrical fault which *'blew out two control boards, three wires, the touch panel and something else'* for which replacing these parts would cost double the cost of buying a new oven (EE02). Small refrigerators or air conditioners could be *'very inexpensive, which made repair uneconomical'* (EE02). The interviewee from this business, a Senior Director of Customer Care, stated that fixing broken TV screens was only reasonable if their backlights were replaceable, as *'new screens are quite expensive'* due to high import costs.

Any sustainability innovation or adoption, including offering repair within warranties, needed to *'go through all functions – it is about sales, marketing, customer relations and for sure the recovery department, the quality department. It is a massive stakeholder management that you need to make this work'* (FN01). Thus, replacement within warranties seemed more convenient not only to consumers but to manufacturers, brands and retailers.

Further, a wide range of manufacturers *'do not have the ability to do repair... The cost to them of replacing the garments is probably 40% of what they are actually selling... so it just makes financial sense to them to replace anything damaged'* (GM07). Many retailers offer replacements without hesitation as a courtesy, for which related costs were borne by manufacturers or brands (EE01). A CEO of a UK's domestic appliance and heating repair service provider offered warranties on behalf of many manufacturers; however, repair or replacement decisions were made by these partners, not by the company (EE07). A Technology Manager from a British multinational clothing, footwear and furniture retailer admitted that *'somewhere in our system, that communication gets a little bit lost'* which led to entire products being replaced rather than components, subcomponents or individual fittings (FN07).

Compared to EEE and furniture, many faults in garments could be considered as *'reasonable wear and tear'* (GM03), depending on customers' frequency of use – e.g. suits might be more durable than shirts (GM05) – and the care of products, including washing and drying (GM04). This was claimed by most interviewees to make warranties for clothing less viable.

6.5. Integration of repair and reuse

6.5.1. Business opportunities

The data suggested that the integration of repair and reuse (Section 2.5.5) could extend the lifetimes of broken items and unwanted parts by giving them a second life. Reuse of repaired items was also associated with refurbishment and upcycling.

This business activity was adopted by manufacturers, retailers or third parties with investment in infrastructures and staff for product collection, deliveries, repair, storage and resale of repaired items. For example, a British brand of electrical appliances collected pallets of returned products (e.g. cooking appliances, food preparation and vacuum cleaners) from

retailers such as Argos when replenishment vans came back. Those pallets were then transferred to a third party, which had facilities and staff to inspect and independently decide either to repair and resell the items or to dispose of them. Before disposal, parts might be harvested and stored in warehouses for future repair work. This service provider profited from the products sold in the second-hand market and recompensed the retailing brand accordingly.

Similarly, a CEO of a UK's domestic appliances repair service provider claimed that the company was paid to work on behalf of manufacturers and brands to offer aftersales services (FN07). These also included making independent decisions for products which were not repairable or replaced by new items. By contrast, a Dutch modular phone brand was able to *'collect working modules from the devices posted by customers [to a service centre in France] that we then can use in repairs'* (EE06).

At a Swedish multinational furniture retail group, recovery department was responsible for the assessment of the faulty products' condition and whether they were able to be repaired and resold 'as new' or put in a *'bargain area'* (FN01). This approach was not part of an American office furniture manufacturer's business model as it was stated by its Environmental Specialist that relevant providers and retailers had their necessary expertise and facilities (FN02). The company was also claimed to provide intensive support through providing manuals and spare parts to service providers and retailers to improve the quality of refurbished items.

In addition to mending worn jeans for free, a Swedish multinational fashion brand also collected irreparable jeans through 'exchange schemes' in which the collected items were either repaired for resale, repurposed into shorts and caps, or cut into patches to use in future repairs (GM01). Customers were asked to drop their irreparable jeans at nearby stores and given 20% discount vouchers for their next purchases. Repairers at the brand's stores collected those jeans and handed them to drivers of replenishment vans when they went back to warehouses. A creative team then decided what to do to the garments.

An independent British fashion brand identified an opportunity for reusing fabrics from garments or curtains to create bespoke jackets (GM05). The company also utilised spare buttons to make creative patterns on their garments.

Considering benefits of this activity, several interviewees argued that they could earn profits from reselling repaired items (EE01, FN01) or utilising harvested parts for repair services (EE06, GM01). At the same time, these actions could also contribute to building a sustainable brand image (GM01). Repair service providers were also claimed to benefit from reselling repaired items or providing relative logistics solutions for manufacturers, brands and retailers (EE01, FN02, FN07).

6.5.2. Challenges

Three key challenges identified from the data: (i) concerns about quality of second-hand components and stock management issues, (ii) uncertain customers' response to the

use of second-hand spare parts in repair work or when purchasing repaired second-hand items, (iii) the lack of economic feasibility and staff competences regarding repairing broken items and harvesting unwanted parts.

The practice of reusing parts in repair work was limited at the interviewed businesses. A former General Manager of a South Korean multinational electronics manufacturer warned that manufacturers *'need to be careful when using second-hand components... and it depends on product to product as well'* (EE03). The interviewee argued that *'a power supply and a filter [in a washing machine] ... generally either have a quite long life, and if they fail, they just fail'*. In contrast, reusing a door catch for a washing machine, dishwasher or microwave was not recommended by this interviewee as technicians *'do not know how much life is left in that component'* (EE03). A CEO of a UK's domestic appliances repair service provider shared the same opinion, worrying about the quality and potential risks of using second-hand parts in repair work– *'the risk is just too high'* (EE07).

Several interviewees raised a concern about customer needs for using second-hand spare parts in repair and purchasing repaired items. For instance, an American office furniture manufacturer reused some components in repair but only if *'the client is asking for a certain quality and that may be a balance of cost, quality, time and the state of the original product'* (FN02). This furniture manufacturer was claimed that these were bespoke requirements based on individual customer inquiries and *'not determined by any given standard'* (FN02). Similarly, with a director of a British fashion brand asserted that reusing repair items should *'come down to the consumer needs'*, which was claimed to be unclear in the current market (GM04). She added that the company could *'advertise (and resell) repaired items if consumers buy them'*.

Moreover, several interviewees indicated that reusing spare parts required specialist expertise to improve their feasibility, considering both technical and economic factors. For example, a set of *'specialised skills'* is required for different kinds of repair – *'that is why, for example, Oxfam only repair certain types of items'* (GM04).

Repair might enable reuse and thereby generate income. A Senior Director of Customer Care at a Swedish multinational home appliance manufacturer argued that *'getting a product in a consumer's home... can be more expensive than what you can get out of it'*, whereas recyclers could pick it up for free (EE02). Many small domestic appliance brands, in particular, were said to regard repair work as uneconomical for products priced under £40 (EE01). It was also suggested by a Head of Technical Services from a British multinational fashion brand that pre-loved items sold on its website required a significant amount of work that could *'blow my mind in terms of how you would set that up'* (GM02). In particular, the brand needed to take beautiful photos of individual items to attract customers and deal with expensive costs for photography, marketing content development and inventory management.

6.6. The exchange model and temporary replacement model

6.6.1. Business opportunities

Findings from the interviews show that current practice of these two models (Section 2.5.6) was limited due to apparent challenges, discussed in Section 6.6.2.

A temporary replacement product was occasionally offered for customers' use during repair work by a Swedish multinational furniture retail group and a Swedish multinational fashion brand (FN01, GM01). These interviewees stated that this activity brought convenience to customers and improved their satisfaction with repair services. Similarly, a temporary replacement (i.e. office chair) was sometimes offered following customer demands at an American office furniture manufacturer because bespoke services and products were claimed to be its key competitiveness.

Interviewees from a Dutch modular phone brand, a Swedish multinational furniture, a UK's service provider of product testing, inspection and repair, and a British fashion brand (EE06, FN01, FN04, GM02) claimed that both models – exchange and temporary replacement models – could be more feasible when businesses retain product ownerships, such as in rental services. Rental service providers can collect broken items, offer exchanges for equivalent products, then repair the broken ones and add them to buffer stock for future customers. These providers can also offer temporary replacement to customers when waiting for their rental items to be fixed. The rationale for these suggestions was associated with significant need for investment in staffing, the supply chain and logistics. It was claimed that these investments could only be worthwhile if they generated both environmental and economic sustainability for businesses.

The innovation required a business model such that manufacturers or retailers are still the *'owners of leased [furniture] products'* (FN01) or *'owners of devices... so they have to repair them'* (EE06). Similarly, a promising target market of the Swedish furniture retailer group could be fixed term contract workers who need furniture for specific employment durations or consumers who preferred more frequent furniture and appliance refreshments (FN01). In addition to furniture and EEE, certain garments were suggested by a Head of Technical Services as suitable for rental, especially wedding dresses and items for bridegrooms and bridesmaids (GM02).

Regarding the benefits to stakeholders, a Technical Development Manger expected that businesses' earnings could come from leasing products and consumers *'can get refreshed new products'* (FN04). Moreover, manufacturers might need to improve their product design to facilitate servicing items during and after each rental contract, particularly:

'It [this innovative business activity] will encourage them to look at how they make and how they design to make it [a product] more repairable or reconfigurable, re-manufacturable' (FN04).

6.6.2. Challenges

The data collected suggested two main challenges: (i) the lack of economic feasibility, and (ii) concerns about inventory management, logistics and standard issues of second-hand products.

Concerns were raised by most of the interviewees, calling into question the economic feasibility of these models. For example, a Technical Development Manager of a UK's service provider of product testing, inspection and repair asserted that these two models '*do not work from a financial point of view*' (FN04). He provided examples of multinational or large national manufacturers and retailers who were '*very good at selling new products*' to gain profits and would be unable or unwilling to offer exchange and temporary replacement models. Following the same train of thought, a Sustainability Developer of a Swedish multinational furniture retail group and an Environmental Manager of a Swedish multinational fashion brand addressed the substantial investment in the supply chain and logistics required to facilitate these activities if offered to every customer (FN01, GM01).

Similarly, a Chief Strategy Officer from a British brand of electrical appliances and a Director of Customer Service from a British manufacturer of cleaning appliances EE01 and EE04 were also critical of these models. They explained that inventory management, collection and delivery of products in different conditions (e.g. unwanted, broken and repaired items) seemed uneconomical and time-consuming (EE01, EE04). These features were claimed to conflict with the expectation for the models (Section 2.5.6) – improving the convenience of, and consumer satisfaction with, the repair service. For a British national furniture repair service provider, its National Sales Manager stated that making the necessary effort to complete a repair within one visit was its first priority to meet the customer's expectation.

Another challenging factor reported by an interviewee was that consumer behaviour towards receiving refurbished products might vary across different product types (EE01). In particular, most participants in his company's market research on rental products tended to be against refurbished food processors but would accept refurbished irons. The interviewee thus assumed that hygiene concern would be one of the most notable barriers to both the temporary replacement model and exchange model. Regarding garments, a Founder of British digital repair and alteration service provider argued that product conditions were not '*the factor that makes people decide whether they want something... but how it looks on them, whether it suits them and whether it looks cool*' (GM07). She claimed that a similar garment might be not the one that a customer wanted (such as a different size or colour) to receive in the two proposed models.

6.7. Fixed-cost model and fixed lead-time return model

6.7.1. Business opportunities

The two models in this activity are designed to ensure the transparency of repair costs and duration of the repair (Section 2.5.7). The cost and return time for repair work should be fixed and independent of the nature of the fault.

In the fixed-cost model, transparent repair costs are published on the website and in a detailed price list in stores with supportive and responsive customer services. In particular, interviewees associated the model with service quotes provided by customer service departments (EE07) or price lists published at stores or on websites (GM02, GM03, GM07). A Founder of a British digital garment repair and alteration service provider explained that publishing a list of estimated repair costs and providing actual costs as soon as the company received products helped to reduce the risk of variation between the two costs (GM07). Similarly, a Head of Technical Services at a British multinational fashion brand suggested that a detailed price list that could make repair service transparent and helped its *'shop teams'* serve customers easily (GM02). However, this interviewee also addressed the importance of shop teams' expertise in giving accurate quotes through precise diagnostics to identify parts and labour hours needed for repair.

In the case of the fixed lead-time model, the collected data suggested that well-trained and responsive repairers and call-centre staff members, and efficient CRM software were key success factors of making turnaround time of quotes for repair work and repair duration independent of the nature of the fault. The turnaround time of quotes should also include the time for diagnosis to offer appropriate service prices; whilst the repair duration is from the start of repair work to its completion, including parts acquisition. For example, a British manufacturer of cleaning appliances was claimed by its Director of Customer Service to employ all the three factors to ensure a maximum of five working days for repair services, from when faulty products arrived at its repair centre. Similarly, a British national furniture repair service provider could keep its promises to complete repair work within five working days if at the customer's property (FN06). This company has more than 170 furniture technicians, whilst a UK's domestic appliances repair service provider employed about 140 engineers to ensure service coverage across the UK. To minimise waiting time, the latter company's call centre shared with customers five-day availability of local or nearby engineers. A Technology Manager from a British multinational clothing, footwear and furniture retailer argued that working closely with a national service provider was crucial for responsive aftersales services, including repair' (FN07). This collaboration helped to guarantee a five-day lead-time between receipts of customers' enquiries and first visits to their homes. However, two interviewees argued that they could not inform customers of the total repair lead-time until they knew whether parts needed to be ordered from manufacturers (EE07, FN07).

The fixed-cost and fixed lead-time models were claimed to bring convenience to consumers and improve customer satisfaction through maintaining consistency of costs or

lead-time of repair services (GM02, EE04). Moreover, repair service providers could earn profit from repair services and logistics solutions for guaranteeing fixed costs and lead-time on behalf of manufacturers, brands and retailers (EE07).

6.7.2. Challenges

Three key challenges emerged from the analysis of empirical data: (i) the complexity of product faults and designs, (ii) uncertain availability of spare parts and variation in their prices, and (iii) concerns about inventory management and logistics. These three challenges could generate comprehensive impacts on both the fixed-cost and fixed lead-time models.

In the case of the fixed-cost model, complexity of product faults and designs could result in higher logistics and labour costs. For instance, many faults in digital products (e.g. phones, tablets and laptops) could not be fixed at local branches of a UK's high-street repair service provider (EE05). In many circumstances, these products must be shipped to its 'excellent centres' equipped with precise and advanced machinery, served by more skilful technicians. Transporting faulty products to these centres were claimed by this interviewee to generate extra costs. These centres were also purpose-built for storing high volumes and varieties of spare parts. However, the interviewee also complained about the variation in prices of parts, such as screens, which depended on phones' sizes and models; nearly a hundred new models could be introduced every year. Changes in design of different product models were also claimed by a Sustainability Developer of Swedish multinational furniture retail group to challenge setting fixed repair costs and lead-times (FN01). Therefore, he recommended that more research on these two models should be conducted to investigate their feasibility with a consideration of various product models.

Furthermore, a Senior Director of Customer Care from a Swedish multinational home appliance manufacturer argued that publishing fixed repair costs was difficult for large manufacturers and retailers because labour rates could vary across different countries and cities (EE02).

The fixed lead-time model might put pressure on customer services and repairers as the repair lead-time was claimed to be influenced by various factors, especially product faults (FN03, FN05) and availability of spare parts (EE07, FN07). For instance, '*a scratch on wood... can be repaired within customers' homes*', whilst re-lacquering a dining table might take eight hours and needed to be done at a workshop in which there was '*a good air circulation*' (FN06). The location might also affect the lead time, considering the time for customer visits, or deliveries of broken and repaired items between customer houses and central repair centres.

A Managing Director of a British furniture maker of long-lasting home furniture argued that businesses '*need to deal with each case as it comes up*' (FN03). A co-founder of a British sustainable furniture online retailer explained that a retailer must '*check with the factory on their resources*' so that a customer could be informed about how long the repair would take (FN05). According to a Technology Manager from British multinational clothing, footwear and

furniture retailer, some components, such as fabrics for reupholstery, might take more than one month to arrive, including two weeks to be made (FN07).

Due to limited capacity and quality-focused service, a Swedish multinational fashion brand, a British multinational online and catalogue fashion brand and a British digital garment repair and alterations service provider could only provide guiding lead-times rather than guaranteed ones (GM01, GM02, GM07). For example, repaired products could be returned within seven to ten days (GM07) or fifteen days (GM01, GM02). A Head of Technical Services explained that customers might be disappointed with a breach of promise if the company could not keep its promises (GM02). This interviewee also argued that collections of broken garments and returns of repaired items were handled by vans used for stores' replenishment deliveries to minimise operational costs. For this reason, repair lead-times depended on replenishment dates and times.

Moreover, customer requests to reschedule appointments might extend the service lead-time both for them and other customers (EE03). It was also claimed by a Director of Customer Service at a British manufacturer of cleaning appliances that failure to meet with allocated lead-times might result in a replacement being offered as a courtesy (EE04). In some cases at a UK's domestic appliances repair service provider, customers could not wait for two or three days to get products repaired and replacements were preferable due to their convenience (EE07).

6.8. Localised repair service network

6.8.1. Business opportunities

The localisation of repair services might contribute to improving the service network, its responsiveness and quality assurance (Section 2.5.8). This section presents (i) localisation of businesses' repair services, (ii) their key success factors and (iii) benefits when adopting this activity.

(i) The empirical study suggested that the localisation could be associated with directly recruiting and managing repairers or outsourcing services from repair service providers. For example, a Regional Manager from a UK's high-street repair service provider claimed that the company launched more than 1,000 shops in the UK to meet customer demand as *'everyone has got a mobile phone now... (which) was not the case 10 – 15 years ago'* (EE05).

Some other interviewees indicated that their services were offered by both in-house and outsourced technical teams. In particular, a CEO of a UK's domestic appliances repair service provider stated that 140 UK-wide employed and certified engineers could cover 90% of UK postcodes (250,000 repairs a year) and local subcontractors served the remaining. A British national furniture repair service provider also developed a network of more than 170 furniture technicians, employed and locally self-employed, across the UK (FN06).

Besides repair service providers, several manufacturers also employed the similar approach (EE02, EE04). For instance, a Senior Director of Customer Care from a Swedish

multinational home appliance manufacturer provided an example in the USA where 180 technicians were responsible for 20 states and more than 3,000 authorised local service providers covered the rest of the country (EE02). A Director of Customer Service from a British manufacturer of cleaning appliances claimed that the technical team at the headquarter planned to work with a third-party repair company to provide high-quality services for their new high-end products (EE04).

By contrast, a few interviewees, particularly those from retailers, expressed their preference for out-sourcing option. For instance, a co-founder of a British sustainable furniture online retailer emphasised the importance of collaboration with a nationwide service provider in the localisation of repair services. He assumed that the collaboration *'could potentially speed up repair... which will help with customer loyalty'* (FN05). In the same vein, a Sustainability Developer of a Swedish multinational furniture retail group shared the company's plan for outsourcing services from a third-party business to *'manage customers, spare parts, manage the knowledge and information on how to repair'*, especially for out-of-warranty products. The retail group was claimed by the interviewee to undertake repair within warranty in its local stores as usual.

(ii) Three key success factors for both in-house and outsourced services emerged from the analysis of collected data: (a) staff training and service auditing throughout the service network, (b) shared data and knowledge and (c) technological advance.

Several interviewees emphasised the importance of regular staff training and service auditing in service quality assurance. For example, at a UK's high-street repair service provider, regular training and service auditing provided by regional directors significantly contributed to improved customer services and the increase in successful repair cases done in local branches, rather than central *'excellent centres'* (EE05).

Similarly, an interviewee, who was a General Manager of a South Korean multinational electronics manufacturer, assigned representatives of quality team to *'take a day out, go and sit alongside technicians in vans and visit every customer'* every three months to observe repair practices (EE03). An administration team at a British national furniture repair service provider was responsible for scheduling service appointments, whilst internal auditors did *'check the technicians' reports'* and manage the success rates of both the employed and self-employed workers (FN06). The interviewee proudly shared that *'there is a combination between employed and self-employed but to the end-customers there is no difference'* in the service quality (FN06).

A CEO of a UK's domestic appliance repair service provider also explained that their training programmes – accredited and provided internally by its quality management team or externally by manufacturers – enabled a consistent quality of servicing nationwide (EE07). A Senior Director of Customer Care at a Swedish multinational home appliance manufacturer addressed the importance of collaboration with national repair service provider in service

localisation through *'having a formal agreement, monitoring, managing and working with them and staying active with them'* (EE02).

The importance of collaboration, particularly through shared data and knowledge, and ongoing communication between internal and external stakeholders concerning local service quality, emerged in many interviews. In addition to the service auditing discussed above, the interviewee from the South Korean multinational electronics manufacturer also claimed that reviewing customer feedback received through emails or calls was a helpful method to identify opportunities for continuous improvement (EE03). By contrast, an American office furniture manufacturer claimed to work closely with service companies to collect relevant data for product development and customer relationship management, which were *'parts of agreements with service providers'* (FN02). Similar data were collected and shared between a British multinational clothing, footwear and furniture retailer and its service partner, aiming to continuously improve furniture products and aftersales services:

'We have a big database... a lot of details, the exact times [of repair]. We can look at individual reports and photographs, a data analyst working with me, trawling through the data and looking for product trends and issues.'
(FN07)

A CEO of a UK's domestic appliances repair service provider suggested that manufacturers should require authorised repairers to report each repair case, considering what makes the fault and whether the product could be more easily disassembled and safely repaired (EE07). In return for these contributions, repair service providers who passed the training were suggested by this interviewee to be granted access to manufacturers' technical information because it was crucial for service quality and its lead-time (EE07). A Technical Development Manager of a national furniture product testing, inspection and repair service provider expressed his pride at his staff competencies:

'Manufacturers' skill is making things; retailers' skill is selling things... Repair is a different skill. They have to be able to cover the whole of the country or more than 100 nations around the globe. We can support...having technicians all around the country.' (FN04)

This interviewee also addressed significant contributions of his organisation to high-quality aftersales services and repairable design of many furniture manufacturers and retailers in the UK, through giving constructive feedback and advice (FN04).

Technological advance should be associated with CRM system, 3D printing technology, Internet of Things, repair service locator and online marketplace. In the case of CRM system, both a Technical Development Manager of a UK's product testing, inspection and repair service provider (FN04) and a CEO of a UK's domestic appliances repair serviced provider (EE07) emphasised the significance of the system. At the former, each technician was provided with a tablet to communicate and report all information related to the service, including sharing videos and photos of product faults in the system (FN04). Four technician

supervisors around the UK managed these databases and provided real-time support or additional training for technicians to ensure the service quality and customer satisfaction (FN04). At the latter organisation, a mobile CRM system was designed for any communication between manufacturers, office-based staff, on-site engineers and customers (EE07). The system also facilitated sharing data (e.g. customer requirements, product faults, spare parts demand and supply, and repair outcomes) between the company and its local subcontractors in the service network.

For outsourcing aftersales services, a Technology Manager of a British multinational clothing, footwear and furniture retailer suggested service providers adopting 3D printing technology and machines to reduce inventory and transportation costs of spare parts, whilst improving the convenience of repair (FN07). In the case of electrical and electronic products, the Internet of Things or *'connected appliances'* was claimed by a Senior Director of Customer Care of a Swedish multinational home appliance manufacturer to speed up repair services through quicker data sharing and more accurate identification of faults and solutions (EE02).

Two interviewees from a Swedish multinational fashion brand shared positive feedback from their customers in the interview about a store locator tool on the website (GM01). This tool was claimed to significantly help to pinpoint the nearest stores for repair services or authorised repair partners.

A founder of a British social enterprise was proud of creating an online marketplace aiming to *'make clothes tailoring accessible and affordable to everybody'* and increase consumers' confidence when wearing their garments after either alternations or repair. The interviewee expected to help approximately seven million seamstresses to connect to customers throughout the UK. Sharing a similar philosophy, a British digital repair and alterations services provider for garments regarded itself passionate about being *'a real game-changer'* to change consumers' mindset and approach to sustainable consumption (GM07). Its customers were claimed by its founder to easily order repair and alterations online, booking fitting on consultation sessions if necessary, posting worn clothes to a central workshop and just waiting for items to be repaired and arrived. The interviewee expressed her pride of partnerships with fashion brands in aftersales services, particularly product care packages or extended warranties, to encourage both retailers and consumers to extend product lifetimes (GM07).

(iii) The data suggested that this activity could generate both financial and non-financial benefits, including improved customer satisfaction, product design and service quality, and attracting new customers or positioning the brand at a higher end of the market. In particular, several interviewees claimed that providing a wider service network through service localisation could improve customer satisfaction through ensuring service responsiveness and quality (EE02, EE04). Moreover, many interviewees shared an idea of working closely with service providers which could assure the quality of repair services (i.e. through regular training and communications) and the efficiency of spare parts supply (i.e. considering costs and delivery time) (EE02, EE04, EE07, FN05, FN07). Service localisation was

expected by an interviewee to reduce costs because it could replace the current process of sending products to manufacturing or repair sites (FN05).

Service providers could earn profits from a wider service network and partnerships with manufacturers, brands and retailers (EE05, EE07). At the same time, they were claimed by several interviewees to produce regular reports of repair practices and then share them to manufacturers (EE05, EE07, FN06) or to provide brands with verbal or written advice about product repairability (GM06, GM07). The interviewees suggested that these shared data were beneficial for continuous improvement of product design and repair services. Furthermore, with accurate expertise and facilities, third party service providers could offer manufacturers, brands and retailers with solutions for repair services, logistics and customer management to support positioning the brand at a higher end of the market through the development of product-service integration (EE04, EE07). According to a statement of a co-founder of a British sustainable furniture online retailer, the localisation of repair services could also be an efficient marketing strategy to fuel the growth of this retailer, which focused on sustainability – *‘making sure you [customers] make the most of your products’* (FN05). In the same vein, a few interviewees emphasised that expanding the repair service network attracted new customers who never knew about the brand before or who desired to use products and services in a way that minimised environmental impacts (GM01, GM06).

6.8.2. Challenges

Three key challenges emerged from the analysis of empirical data: (i) limited financial and human resources and unclear returns on further investment, (ii) concerns about service quality management and (iii) uncertain customer demands for repair services.

The empirical study suggested that limited numbers of staff members, their competencies and further investment hindered service quality, spare parts inventory management and logistics and CRM. In particular, a Swedish multinational furniture repair group was recommended by its Sustainability Developer to further explore the possibility of upscaling instore repair workshops and providing repair outside of warranties due to significant investment and uncertain customer demands for out-of-warranty repair (FN01). Larger scale repair services for out-of-warranty claims would need the comprehensive development of resources and competencies, including proficient repairers and an efficient spare parts supply and CRM. The company was claimed to be in the process of mapping the necessary capabilities to apply this service logic and expected to gain value from it in the long term.

A former General Manager of a South Korean multinational electronics manufacturers claimed that many manufacturers *‘would love local repair and repairability’*; however, returns on investment *‘get harder and harder’* and might make these expectations *‘realistically not achievable’* (EE03). Meanwhile, this interviewee also stated that more retailers focused on online markets and *‘have no interest in repairing – that is the manufacturers’ responsibility’*.

In the same vein, an Environmental Manager of a Swedish multinational fashion brand addressed that constraints upon skilled staff and warehouses for materials and parts could limit the upscaling of repair services. This interviewee claimed that repair service teams were the face of the entire organisation; thus, it launched an online portal to collect information on each repair case, including a diary of faults, customers' contact details and feedback. Despite the richness of the data gathered, its analysis was not utilised due to lack of human resources. Customer satisfaction data revealed that the lead time of repair services and work standard of new employees were currently major concerns, but adding more staff and training were claimed by the interviewee to increase the operational costs of stores.

A Head of Technical Services from a British multinational online and catalogue fashion brand still doubted the need for expanding its repair service network (GM02). Its repair hub in the UK was currently responsible for garments, which were collected in only two London stores. The interviewee suggested that the company might need an efficient and sufficient logistics infrastructure *'that is spread out across the country'* and an administrator at each local store to facilitate garment collection and return. Additionally, a new IT system was claimed by the interviewee to be crucial for throughput and customer relationship management (GM02). Alternatively, a sewing team could be recruited and allocated at every store to serve the local market. However, a Director of another British fashion brand raised a concern that brands would then need to pay for seamstresses sitting at stores even there was no demand for repair work (GM04). Several interviewees indicated that wider service coverage might also cause disruption and challenge quality management (EE07, GM01, GM02, GM03, GM07). For example, there might be *'a delay in obtaining the spare part, that then leads to a delay in the repair process'* (EE07). A CEO of a UK's domestic appliances repair service provider addressed that *'we do get consumers that express dissatisfaction; those consumers generally make a complaint and about the length of time.'* (EE07).

A Sustainability Coordinator of a Swedish multinational fashion brand (GM01) emphasised a need for investment in repair staff in their stores (GM01), whilst a British digital repair and alterations service provider was opposed to upscaling services due to quality concerns (GM07):

'If we would shorten the waiting time... we would need to invest in much more staff' (GM01).

'You can't basically get huge scale efficiencies because every item is different... so I think it works better as a small business' (GM07).

Unlike the case of the Swedish multinational fashion brand (GM01), the utilisation of current retailing locations to expand the repair service network was claimed by a Head of Technical Services not to be feasible for her British multinational online and catalogue fashion brand as its retail partners seemed not interested in this initiative (GM02). This interviewee indicated that retailers preferred investment in pushing more sales rather than extending product lifetimes.

A Sustainability Specialist from a British multinational retailer of clothing, home and food products responded to removing in-store repair and alteration services from its business that *'it is a very difficult business model to scale up'*, whilst *'there is not enough consolidated demand'* in every store and consumers could go to local dry cleaners to find similar services (GM03). The interviewee suggested that consumers were looking for *'repair cafés'*, where they *'can either go to learn or have stuff fixed'*.

The data suggested that many businesses and consumers were locked into the linear economy which appeared to result in several interviewees' concerns about consumer demands for repair service. For instance, a Director of Customer Service from a British manufacturer of cleaning appliances claimed that manufacturers and brands might need to redefine the value proposition for their products to ensure customer needs for repair services are met, as those who preferred cheap products were unlikely to consider repairability and aftersales services (EE04). For that reason, this interviewee shared the information about her business plan for outsourcing repair services, limited to their premium products, from a third-party company. This strategy aimed to position the brand at a higher end but prevent significant investment in localising service centres in different parts of the UK and their associated cost:

'Logistics costs to make sure every repair centre in every town in the country is supplied with parts is [are] huge. You have to have a support service internally, which is another big cost, to be able to give them support and make sure that they are working to the standard that you want' (EE04).

However, a Director of a British fashion brand was opposed to a change in its value proposition: *'We are a fashion company... repairing is not very fashionable'* (GM04).

Furthermore, a Technical Development Manager of a UK's product testing, inspection and repair service provider claimed that regulations on fire safety significantly hindered local furniture repair or reupholstery businesses:

'It is quite difficult... to prove that a product complies with the regulations.'
(FN04)

Additionally, a CEO of a UK's domestic appliances repair service provider admitted that *'a couple of manufacturers'* do not share technical information for repair with the company. Moreover, two Creative Directors of an independent British fashion brand suggested that price points for garments and repair services could determine what was offered on high streets: more fashion stores than repair shops (GM05). A National Sales Manager of a British furniture repair service provider shared that many consumers were not aware of *'how extensive the repairs can be done... they are not aware that the repairs can actually take place. So, they just assumed that they would need to replace them [broken items]'* (FN06). This interviewee, therefore, suggested that manufacturers and retailers educate consumers about product repairability at the point of sale.

6.9. A transparent spare parts and tools supply chain

6.9.1. Business opportunities

The current literature indicates key challenges to repair work associated with parts and tools could be their expensive cost, and parts only being made available in limited geographical locations, within a specific duration or to authorised business partners (Section 2.5.9). The collected data suggested that these problems could be solved if they were either offered for free or sold online or at local retailers.

The empirical study also revealed that business innovation through a more transparent spare parts and tools supply chain at the businesses could support both DIY and commercial repair and eliminate restrictive practices of access to spare parts and tools. Publishing availability information, ordering processes and retail prices of spares parts and tools, and working closely with business partners to ensure sustainable supply and reasonable prices were discussed in the interviews with businesses. Key benefits of this innovation ranged from development and improvement of a sustainable growth ethos, brand awareness and customer relationship, and earnings from selling spare parts and tools for DIY repair or within repair services.

Several interviewees claimed that their customers could easily purchase spare parts and tools from the manufacturer's website (EE02, FN02, FN03) or at local retailers or distributors (EE02, FN01, FN02) by referring to products' model number (EE02). Additionally, some businesses, such as a British sustainable furniture online retailer and a Swedish multinational fashion brand, also took orders by phone when customers sought advice about product fault diagnostics or repair from the customer services department (FN05, GM01). Spare parts or '*repair kits*' were then posted to consumers for DIY repair (GM01).

Components that were essential for repair services within warranties should be offered to consumers for free (EE02, EE04, FN03). However, free parts were sometimes provided out of warranty at a British furniture maker of long-lasting home furniture and a British multinational online and catalogue fashion brand to '*establish a close relationship with customers*' (FN03, GM02). A Swedish multinational fashion brand even produced two different versions of '*repair kits*' – advanced and simple (GM01). The latter was offered for free to encourage more customers to mend their clothes. Similarly, a Sustainability Developer from a Swedish multinational furniture retail group stated that common screws and connection parts were '*available in stores for consumers to easily to pick them free*' (FN01).

Collaboration with business partners, considering demand forecasts, inventory management and deliveries, helped to shape the resilience of spare parts and tools supply chain and maintain their prices at reasonable levels. In particular, forecasting the demand for spare parts was claimed by a Technical Development Manager of a UK's furniture product testing, inspection and repair service provider to be vital for the efficiency of their supply and economic repair (EE04), because '*stock is money*' (FN04). Inaccurate forecasts could cause disruptions to the supply or increase inventory costs which might be passed to consumers.

However, a Sustainability Specialist of a British multinational retailer of clothing, home and food products argued that consumables for clothing repair such as zips, buttons, threads and yarn were not expensive (GM03). They could be purchased in bulks with discounted prices and did not require much warehouse space (GM03).

A regional director at a UK's high-street repair service provider claimed that regional managers often provided its local branch network with recommendations for stock levels (EE05). They were also responsible for the procurement process and supplier relationship management to ensure the quality of spare parts and tools and appropriate lead-time, and cost-efficiency of their deliveries.

A British furniture maker of long-lasting home furniture indicated that being close in location or '*central to the supply chain, within about two hours of most of the suppliers*' was a key success factor for its responsive spare parts supply. Besides collaboration with spare parts suppliers, manufacturers should also work closely with repair service providers to predict demand and ensure just-in-time deliveries of parts to technicians or customers for commercial repair (FN04, EE04, EE07). This recommendation was given by a Technical Development Manager of a British furniture product testing, inspection and repair service provider, a Director of Customer Service of a British manufacturer of cleaning appliances, and a CEO of a British domestic appliances repair service provider. This kind of innovation was claimed by interviewees to be a key part of growth ethos of a Dutch modular phone brand, a Swedish multinational fashion brand and a British furniture maker of long-lasting home furniture (EE06, GM01, FN03). Improving the reparability of products was a critical step to build these sustainable brands and their customer trust, and develop environmental awareness of employees, business partners and customers. In particular, a Circular Economy Lead expressed his pride in his brand for producing modular phones which played a significant role in educating consumers about sustainability (EE06); whilst many consumers were claimed by an Environmental Manager to be impressed with free repair services of her fashion brand (GM01). A Managing Director was proud of generating value for society and environment through supplying spare parts, keeping products longer and passing them down to family after repair (FN03).

Several interviewees also emphasised the potential of this activity, particularly in strengthening relationships with customers through offering spare parts for free or at reasonable prices (EE06, GM01, FN03). Furthermore, an interviewee argued that selling parts can also be profitable (EE06). An efficient supply chain for parts could support value capture for repair service providers, making commercial repair more economically feasible at a British manufacturer of cleaning appliances and a UK domestic appliances repair service provider (EE04, EE07). Two interviewees also claimed that the success of repair services, whether within warranty or out-of-warranty, could help to improve customers' satisfaction (EE04, FN02). Moreover, a Senior Director of Customer Care stated that investing in spare parts supply could improve its transparency, enhance brand reputation and ensure compliance with regulations on the availability of spare parts at his organisation, a Swedish multinational

home appliance manufacturer (EE02). The investment was associated with launching a website for online purchases of spare parts with the provision of parts finding and repair instructions, and guaranteeing parts to be produced in-house or outsourced and supplied within promised durations (such as 7-10 years for spare parts of large domestic appliances).

6.9.2. Challenges

Three key challenges emerged from the analysis of empirical data: (i) concerns about inventory and logistics management, (ii) consumer preference for replacement of newly designed and cheap products and (iii) risks of DIY repair.

A Director of Customer Service from a British manufacturer of cleaning appliances argued that many manufacturers might struggle to make spare parts available, even within warranties (EE04). Financial issues relating to the stock management of spare parts were confirmed by a small appliance brand (EE01) and a phone manufacturer (EE06). For the latter manufacturer *'some certain parts are custom-made'*, but it needed to *'meet minimum order quantities for other parts'* (EE06). Interviewees from two furniture retailers said that many manufacturers might still be locked into linear production, which could inhibit collaboration on local additive manufacturing of spare parts (FN01), especially when factories were located overseas, to save labour costs (FN05). A National Sales Manager of a British furniture repair service provider complained that many conventional parts arrived about twelve weeks after orders were made and overseas shipping generated *'extra cost to manufacturers'* (FN06). These problems were claimed by a Managing Director of a British furniture maker of long-lasting home furniture to be even worse after Brexit (FN03).

A Chief Strategy Officer of a British brand of electrical appliances and a Technology Manager of a British multinational clothing, footwear and furniture retailer claimed that their businesses and many other retailers currently dealt with a wide range of competitive brands to develop and introduce new products. This meant retailers *'lack for capability of securing spare parts from the brands to satisfy customers'* (FN07) or *'it does not make sense to try and provide spare parts'* for most current products (EE01). According to a statement of a Director of Customer Service from a British cleaning appliances manufacturer, replacement might be preferable to repair due to economic reasons, considering repair and logistics costs, especially for relatively cheap products such as small household appliances (EE04). Similarly, the cost of a TV screen replacement was claimed by a CEO of a UK's domestic repair service provider to be *'disproportionate to the price that customers pay for new TVs'* (EE07).

Safety issues and a lack in repair competences were significant concerns when discussing the supply of spare parts. For instance, in the case of kitchen appliances such as ovens or cooker knobs, disassembly for repair might damage electrical or gas connections and put consumers or unqualified repairers at risk (EE03). This manufacturer's representative was reluctant to sell spare parts directly to customers due to *'a bitter experience of standing up in a county court'* after a customer's fingers were *'badly damaged when trying to fit a steel band on the door sealer on a washing machine'* (EE03). Fire safety concerns also limited the

furniture reupholstery practices at a UK's furniture product testing, inspection and repair service provider (FN04).

Moreover, many consumers might not be skilful enough for DIY repair such as replacing collars of shirts or zips of jackets. For that reason, customers of a British multinational online and catalogue fashion brand were encouraged to send their items back to a repair workshop to be fixed, rather than get spare parts for self-repair (GM02). Adding spare buttons to garments could improve the convenience of repair, but also generated waste if unused (GM02, GM06). By contrast, a Sustainability Specialist of a British multinational retailer of clothing, home and food products argued that her businesses avoided stocking spare parts for fashion items '*because they are non-standard and unique*' (GM03). This appears to be a significant reluctance to invest in the improvement of spare parts and tools supply chain for garment repair.

6.10. Support needs for business innovation beyond product repairability

Two key categories of support needs emerged from the analysis of empirical data, including collaboration between business stakeholders and government legislation and financial incentives.

6.10.1. Collaboration between business stakeholders

The data suggested that sustainable business model innovation beyond product repairability, through the nine proposed activities would require collaboration, particularly contributions from various business stakeholders (e.g. material suppliers, manufacturers, retailers and service providers) and customers. These contributions might include (i) financial investment, (ii) human resources, (iii) facilities for product development, testing and repair services, and (iv) initial ideas, on-going feedback, or efforts to deliver information promoting repairable products and support repair practices. An overview of potential collaboration in sustainable business innovation beyond product repairability is presented in Table 21. As a Sustainability Developer from a Swedish multinational furniture retail group suggested, '*It is a massive stakeholder management that you need to make this work*' (FN01). For this reason, Table 21 shows each innovative business activity (column a) and necessary contributions and value creating logic of different business stakeholders (column b, c, d and e).

Different groups of business stakeholders (e.g. manufacturers, retailers or brands, and repair service providers) might provide similar or the same comments on innovative activities, which are presented in merged boxes in Table 21. The retailers and brands also shared similar ideas, which are presented in Column (d). However, it should be noted that retailers in clothing and furniture industry may be the same as (or control) the brand, though not always. In the electrical and electronics industry, the retailer sells the manufacturer's branded appliances, and the retailer rarely controls the brand.

Table 21: Contributions and value creating logic of different business stakeholders

Innovative activities (a)	Contributions and value creating logic (b)	Business stakeholders		
		Manufacturers (c)	Retailers/ brands (d)	Repair service providers (e)
S01 – Design for repair and codesign	Contributions	<p>Consider repairability in the design process (EE02, EE03, EE04, FN02, FN03); conduct product teardowns at the final check before the mass production stage (EE02)</p> <p>Encourage different stakeholders (e.g. customers, field technicians, customer service and product design team) to participate in design phase (FN02), to share design ideas and repair experience via surveys (EE04, FN06), a mobile app and online platforms (EE02)</p>	<p>Collect common failures from aftersales service providers and conduct product lifespan testing for continuous improvement (EE01)</p> <p>Consider repairability in the design process or proactively engage with designers to provide feedback about product designs (EE06, FN01)</p> <p>Encourage customers to share design ideas and repair experience via surveys (FN07), focus groups (GM02), online platforms (GM01)</p> <p>Host quality-focused meeting with manufacturers and repair service providers to co-design products (FN07)</p>	<p>Evaluate product repairability through completing manufacturers’ scorecards (EE07)</p> <p>Provide or support product development and testing, consultancy, warranty and repair for manufacturers and retailers (FN04)</p> <p>Survey product repairability and repair service through emails sent to customers (GM07)</p>
	Value creating logic	<p>Improve/ maintain positive brand image and increase customer satisfaction, brand loyalty and gain more customers (EE03, EE04, EE06, EE07, FN01, FN03, FN04, GM01)</p> <p>Reduce production cost through simplification of components due to economies of scale, easier repair service (EE02, EE04, EE07) and decreased repair costs (FN04).</p>		<p>Support repair process and improve its efficiency, through easing disassembly and reassembly (EE02, EE05, EE07, FN02, FN07).</p>

S02 – Provision of diagnostic and repair manuals and instructional support	Contributions	<p>Provide user guides which include installation, care and disassembly instructions (EE01, FN02, GM01) and clarify which products are replaceable, whether by consumers or service technicians (EE02)</p> <p>Provide repair advice through call centres (EE04) or in stores (GM01)</p> <p>Develop instructional videos (e.g. product teardown or repair movies) and share them on websites (EE06, GM02)</p> <p>Employ Internet of Things to support remote fault diagnostics (EE02)</p>	<p>Support brands to develop high quality repair instructional documents (GM06) and deal with customers’ queries about aftersales services (EE07, FN04)</p> <p>Provide reasonable and transparent repair costs or pricing guidelines (EE07, GM06, GM07)</p>	
	Value creating logic	<p>Online instructional documents, particularly videos, could reduce paper consumption for hard copies of manuals and workload of call centres’ staff – who deal with misdiagnosed failures (EE01, GM06).</p> <p>Transparent and efficient communications between businesses and with consumers (through the provision of diagnostic and repair manuals, and instructional support) are essential supplements to repairable design – to improve positive brand image, customer satisfaction, brand loyalty and to gain customers.</p>	<p>Earn profits from providing instructional support on behalf of manufacturers, brands or retailers (EE07, FN04, FN06, GM07).</p>	
S03 – Promotion of repair benefits and repair products	Contributions	<p>Promote and encourage consumers to purchase high-quality products aligned with high-quality after-sales services (EE02, GM02)</p> <p>Produce customised marketing messages to omnichannel retailing and different ranges of customers to influence and satisfy their needs for repairable products or repair services (FN02)</p>	<p>Promote tangible benefits of repairable products (associated with publishing product care and repair guides) to educate consumers of their consumption’s impacts on the environment and society (EE06, GM02)</p> <p>Develop creative marketing campaigns – such as repair events and product care workshops (FN01, GM01)</p>	<p>Publish a transparent repair pricing guideline on the website to inform consumers’ repair decisions (GM06, GM07)</p> <p>Promote optimistic messages of repair work – such as benefits of repair work to extending product lifetimes, narratives of repaired products, staff’s and customers’ enjoyment of repair outcomes (EE05, GM06)</p>

	Value creating logic	After-sales services and repairable products could generate a helpful driver for word-of-mouth and customer satisfaction (GM01, GM02), increase brand awareness and promote sustainable growth ethos (FN02)	Repairable design and repair services us a unique selling point to gain customers (EE06, GM01) or position the brand at a higher end of the market (EE04)	Quality commitments in products and repair services are critical to winning new customers and earning their loyalty (EE07) Brand awareness and service standards could be promoted through optimistic messages of completed repair work (GM06)
S04 – Choosing repair over replacement within warranties	Contributions	Provide spare parts and labour for repair within warranties, either in customers’ homes (EE02) or central workshops (FN03, GM02) to prevent replacements. Provide free spare parts, such as through the post (EE04) or local dealers (FN02), to encourage consumers to self-repair items		Provide after-sales services within warranties on behalf of manufacturers, brands or retailers, through partnerships (FN06, GM07)
	Value creating logic	Position the brand at a higher end of the market (EE02, EE04, FN02, FN03) Increase brand awareness associated with a sustainable business development (GM02)		Earn profits from providing after-sales services within warranties on behalf of manufacturers, brands or retailers (FN06, GM07)
S05 – Integration of repair and reuse	Contributions	Collect broken items in stores for repair and resell or harvesting parts for future repair (GM04, FN01), or outsource third parties for these services (EE01, FN07) Collect unrepairable items and harvest parts for future repair (EE06, GM01)		Collect broken items either to repair then resell them or to harvest parts for future repair on behalf of manufacturers, brands or retailers, through partnerships (EE01, FN07)
	Value creating logic	Earn profits from reselling repaired items (EE01, FN01) or utilising harvested parts for repair services (EE06, GM01)		Earn profits from reselling repaired items or providing logistics solutions (i.e. for collecting, storing and delivering spare parts, broken and repaired items) for manufacturers, brands and retailers (EE01, FN02, FN07)

S06 – The exchange model and temporary replacement model	Contributions	<p>Provide temporary replacement for customers’ use while waiting for repair work (FN02)</p> <p>Provide temporary replacement or exchange equivalent model in rental services (EE06, FN01, FN04, GM02)</p> <p>Invest in the supply chain and logistics to facilitate these two models (EE01, EE04, FN01, GM01)</p>		
	Value creating logic	Improve customer satisfaction with repair services (FN01, FN02, GM01)		
S07 – The fixed-cost model and fixed lead-time return model	Contributions	<p>Provide spare parts at fixed, more reasonable cost and on-time (FN07, EE06)</p>	<p>Work closely with manufacturers to ensure that spare parts are supplied at fixed or reasonable cost and on-time (EE04, EE07, FN05)</p> <p>Invest in facilities at central repair centres and the logistics between these centres and high-street stores (GM02)</p>	<p>Invest in facilities at central repair centres and logistics between these centres and high-street branches (EE05)</p> <p>Work closely with manufacturers to have access to spare parts at reasonable costs and on-time (EE05, EE07)</p>
	Value creating logic	Improve customer satisfaction through maintaining consistency in cost and lead-time of repair services (GM02, EE04)		Earn profits from repair services, logistics solutions for manufacturers, brands and retailers (EE07)
S08 – Localised repair service network	Contributions	<p>Work closely with service providers to assure the quality of repair services (through regular training and communications) and the efficiency of spare parts supply (considering costs and delivery time) (EE02, EE04, EE07, FN05, FN07)</p>		<p>Provide manufacturers, brands and retailers with solutions for repair services, logistics and customer management (EE04, EE07)</p> <p>Produce regular reports of repair practices and share with manufacturers (EE05, EE07, FN06)</p> <p>Provide brands with verbal or written advice about product repairability (GM06, GM07)</p>

	Value creating logic	<p>Improve customer satisfaction through providing a wider service network, ensuring its responsiveness and quality (EE02, EE04)</p> <p>Attract new customers (GM06) or position the brand at a higher end of the market through the development of product-service integration (EE04)</p>	Earn profit from a wider service network and partnerships with manufacturers, brands and retailers (EE05, EE07)
S09 – A transparent spare parts and tools supply chain	Contributions	<p>Investigate spare parts to be offered to professionals or consumers for safe repair (EE03, FN04, GM02)</p> <p>Sell spare parts and tools online (EE02, FN02, FN03) or at local retailers (EE02, FN01, FN02)</p> <p>Work closely with suppliers to ensure responsive spare parts supply and accurate demand forecast (FN03)</p>	Support manufacturers in forecasting demand for spare parts and tools (FN04, EE04, EE07)
	Value creating logic	<p>Increase brand awareness and promote sustainable growth ethos (EE06, GM01, FN03)</p> <p>Earn profit from selling spare parts and tools (EE02, EE06, FN02, FN03)</p> <p>Strengthen relationships with customers through offering free spare parts (FN01, FN03, GM01, GM02)</p>	Ease commercial repair through increased availability of spare parts and tools at better prices (EE04, EE07)

As demonstrated in Table 21, collaboration for initial and on-going investment in R&D, infrastructure, staff development, and logistics, operations and quality management were regarded as success factors for innovative businesses. Moreover, collaboration through sharing data and efficient communications concerning common faults and repair practices were crucial to developing repair manuals, training in-store or home-visit technicians and staff providing instructional support at call centres.

Table 21 also presents the value creating logic of different business stakeholders which was addressed in interviews as motives for contributing to the innovative activities. The data suggested that the absence of any contribution and collaboration between business stakeholders might arise from conflict between or misinterpretation of business objectives. Businesses could be concerned about trade-offs between extending product lifetimes and sales-driven business goals, and uncertainty over the likely return on investment of business innovation.

6.10.2. Government legislation and financial incentives

Almost all interviewees suggested that government legislation, particularly through a reconsideration of product standards, and financial incentives were essential to reshape the economy, change business practices (i.e. adopting and executing the nine innovative activities) and enable sustainable consumption (i.e. extending product lifetimes through product repair). These initiatives were expected by the majority of the interviewees to minimise or overcome challenges to the proposed business innovation and encourage contributions from different business stakeholders with consideration of their value creating logic (Table 21).

The majority of interviewees anticipated that government would reconsider product standards, in particular to improve repairability and prevent premature obsolescence. They thought that new products should be designed for repair and supplied with repair information (including repair manuals), spare parts and repair services. For example, Directors of two British fashion brands urged governments to investigate and introduce a clear set of criteria to inform customers about sustainable garments and fast fashion and to direct public attention to the benefits of repair (GM04, GM05). An interviewee suggested that low quality garments should have been prohibited by governments as they were considered not worth mending (GM05). However, another interviewee expressed that there was more focus on sustainable production and retailing (e.g. using renewable energy at factories or stores and recycled materials in new products or packaging) than to repair and codesign repairable products, which could be feasible only if *'the government says everybody has to make repairable products'* and offers practical guidelines. Similarly, the integration of reuse and repair could be promoted if it was *'part of legislation about extended producer responsibility'* (EE02).

In the same vein, the electronics and electrical industry needs to be reshaped with new legislation, particularly the right to repair and product standards on repairability, to

change the behaviour of consumers, and overseas components suppliers and manufacturers (EE01, EE04). However, a Senior Director of Customer Care from a Swedish multinational home appliance manufacturer emphasised a need for consistency in regulations, such as consistent definitions and the availability of common spare parts in different parts of the world (EE02).

Non-compliance with standards (e.g. products designed for premature obsolescence, not for disassembly and repair) could be penalised, such as through taxation. As suggested by a Managing Director of a British furniture maker of long-lasting home furniture, manufacturers practising pre-mature obsolescence *'should be penalised and charged'*(FN03). Likewise, high taxes on businesses *'to cover the end of life... can focus their minds on extending product lifetimes'* (FN04). These initiatives were expected by a Technical Development Manager of a British furniture testing, inspection and repair service provider to extend producer responsibility and change manufacturers' perception of repairability (FN04).

Many interviewees claimed that reconsidering product standards would extend producer responsibility and enable collaboration between different business stakeholders, including local and overseas manufacturers, brands, retailers and repair service providers. For instance, these requirements were expected by a Circular Innovation Lead of a Dutch modular phone brand and a British national furniture repair service provider to *'trickle up'* the supply chain: they *'will put more pressure on manufacturers (FN06) and suppliers will need to comply with the requirements'* (EE06).

A Director of Customer Service of a British cleaning appliances manufacturer emphasised that the *'right to repair will give you [manufacturers] competitive advantages.... If we did not do it [design for reparability] and everybody else does it, we are going to lose ground'* (EE04). Similarly, a Chief Strategy Officer of a British electrical appliances brand warned that manufacturers might need to *'plan to ensure that they do not get caught'* if such legislation was introduced as it could generate *'a general shift in an entire industry'* (EE01) through preventing disposing of old items to *'meet energy ... or water consumption regulations'* (EE03). Manufacturers and retailers were claimed by several interviewees to overly focus on competing on creating energy-efficient products (EE01, EE02, EE03). New requirements for product standards might also support consumers' purchase decisions concerning repairable products and repair work and reshape the economy such that consumers preferred repair to replacement (EE01, EE04).

Financial incentives could be in the form of tax breaks or research funding. Tax breaks should be offered to businesses who provide aftersales or repair services (FN02, GM01) as this could make repair preferable over replacements (FN05). A Circular Innovation Lead of a Dutch modular phone brand (EE06) argued that tax breaks should also make spare parts and repair services cheaper. Meanwhile, *'tax rebates for the amount of R&D work'* on product repairability was expected by a Chief Strategy Officer of a British electrical appliances brand to drive manufacturer behavioural changes (EE01). Tax rebates were also recommended by several interviewees to be applied to creative marketing activities that promote repairability

(EE05, FN01). Governments should *'provide a dialogue point between companies, consumers, organisations and legislators on how and what is the best way you [manufacturers or retailers] are promoting this [repair]'* (FN01). Moreover, some interviewees anticipated that governments would fund research involving partnerships between business stakeholders or between business stakeholders and research bodies. For example, governments were expected by a Sustainability Developer of a Swedish multinational furniture retail group to fund collaborative research on why repairable products were expensive to make and costly to repair (FN01). More research should be done to investigate *'clever solutions'* to improve the transparency of spare parts and tools in the supply chain (FN01, GM02) and undertake case studies of fixed-cost and fixed lead-time models (FN05).

CHAPTER 7. Discussion on sustainable business model innovation

This chapter firstly provides a synthesis of the empirical data and the literature on opportunities for and challenges to sustainable business innovation beyond product repairability (Section 7.1). Section 7.2 outlines how the findings can be translated into business management guidelines. Finally, Section 7.3 discusses implications for future policies that can support sustainable business innovation.

7.1. Sustainable business model innovation: opportunities and challenges

All of the different types of repair activity represented in the nine business activities in the literature (Section 2.5) were adopted and executed in the interviewed businesses. Table 22 presents a summary of opportunities for and challenges to those business activities, which represent sustainable business model (SBM) innovation, and their value to businesses, consumers and society. The need for a multi-stakeholder perspective is emphasised in the literature (Section 2.4) as business model innovation and transformation requires consideration of value throughout operations planning activities (Freeman, 1984; Bocken, Rana and Short, 2015). In the same vein, SBM innovation entails the development of value propositions that embrace value creation for different stakeholders, including business stakeholders as well as consumers and society and the environment (Stubbs and Cocklin, 2008; Boons and Lüdeke-Freund, 2013; Baldassarre *et al.*, 2017; Bocken, Boons and Baldassarre, 2019).

Opportunities for most of the business activities proposed at the outset of this study were identified and supported by the data through interviews on businesses' practices and their value to consumers and the society (Table 22, column b and c). The content in these two columns are derived from Sections 6.1.1, 6.2.1, 6.3.1, 6.4.1, 6.5.1, 6.6.1, 6.7.1, 6.8.1 and 6.9.1.

Moreover, many interviewees suggested that adopting more than one activity could generate more comprehensive value to consumers and society. For example, some interviewees (e.g. EE04, EE06, FN02) indicated that adopting business activities S01, S02 and S03 could ease DIY repair and educate consumers on how to do this correctly and safely. Longer warranties could be offered when products become more repairable through an integration of S01 and S04 (EE04). Consumers could have more access to second-hand products, which were repaired and sold at cheaper prices, if S01 and S05 were adopted by manufacturers and brands (EE01 and FN02). Adopting S07 and S08, or integrating S01, S08 and S09, could help consumers get faulty items fixed more easily (EE02, EE03, FN04 and GM07). These benefits can indicate that integration of business activities could eliminate or minimise key challenges to the engagement of consumers in repair (Section 1.1.4) and satisfy their support needs from businesses during repair journeys (Section 4.3).

The data also suggest two key trends in value to businesses: (i) the ease of commercial repair processes, either within or out of warranty, and (ii) benefits to brand management – including improving customer satisfaction and brand loyalty, gaining more customers (e.g. through repairable products or repair services) or positioning the brand at a higher end of the market. This means the proposed activities might support repair activities of both consumers and businesses. The second trend can also support Sabbaghi *et al.* (2016), who found that the majority of participants in their consumer survey indicated that product repairability could influence their loyalty and future purchases. Only opportunities for the exchange model and temporary replacement model did not seem to have potential to the businesses. The former might be limited to the games consoles industry. The data also illustrates how concerns about hygiene and emotional attachment, especially for clothes and food processors, may prevent consumers from using the exchange model, as reported by Parker *et al.* (2012). The latter was initially proposed in a report commissioned by DEFRA (2011) which recommended giving a temporary replacement to customers while waiting for repairs as a courtesy of the service provider.

There are some trends in the data that reveal considerable challenges to companies engaging in sustainable business model innovation (Table 22, column d). The content in column d is derived from Sections 6.1.2, 6.2.2, 6.3.2, 6.4.2, 6.5.2, 6.6.2, 6.7.2, 6.8.2 and 6.9.2. Common challenges were (i) consumers' preference for replacement of fashion and newly updated technology products, (ii) constraints on businesses' resources (e.g. finance, labour and facilities), and (iii) lack of collaboration between business stakeholders.

Considering the first challenge, some doubt was cast upon consumers' interest in repairable products and repair services (Section 1.1.4 and empirical data presented in Sections 6.1.2, 6.3.2, 6.4.2, 6.5.2, 6.8.2 and 6.9.2). The doubt could lead to businesses' concerns about incomes from the innovation and its impacts on current revenue streams. Companies might prefer to use a classic business model, which generates a profit from repeat sales and selling more units over time. This challenge confirms findings from a study of six business cases by Bocken and Short (2016). The present study also suggested that constraining the growth rate, particularly reducing sales revenues and limiting market penetration, may make sustainable business models less attractive to business stakeholders and investors. This finding is also in line with the literature (Schaltegger, Lüdeke-Freund and Hansen, 2012; Evans *et al.*, 2017) which addressed difficulties in co-creating profits (i.e. stable incomes for different stakeholders), social and environmental benefits and the balancing between them when shifting to sustainable business models. Table 21 presents benefits in the form of value creation to different businesses, consumers or the society which could be seen as opportunities for adopting or executing each business activity. Moreover, similar to Evans *et al.*, (2017) and Geissdoerfer, Vladimirova and Evans (2018), the current study found that many businesses struggled to reconfigure and allocate resources to business model innovation or new business models. This might result in a need for contributions by different business stakeholders as demonstrated in Table 21.

However, the data collected suggests that the lack of these contributions and collaborations between the stakeholders might result from either conflict between extending product lifetimes and sales-driven business goals or unclear returns on investments into innovation. The reason for both might be that businesses need to extensively interact or collaborate with external stakeholders that requires extra resources and effort (Boons and Lüdeke-Freund, 2013; Evans *et al.*, 2017), such as encouraging customers' and other business stakeholders' interests in repairable products and repair services. Conflicts of interest can hinder the companies' utilisation of value create opportunities (Table 21) which differ from their current business model and its logic.

Table 22: Sustainable business innovation beyond product repairability

Innovative activities (a)	Opportunities		Challenges (d)
	Business practices (b)	Value creating logic (c)	
<p>S01 – Design for repair and codesign</p>	<p>Repairable design could include five strategies – standardisation, simplification, design for safe repair, disassembly and upgradability.</p> <p>Combining any of the five design strategies could be considered in the design process. This varies depending on businesses’ interests in repair routes.</p> <p>Codesign could encourage the participation of different stakeholders in the design stage, which can be associated with the following processes:</p> <ul style="list-style-type: none"> • Product teardowns held at the final check before the mass production stage could ensure achievement of design strategies. • Identification of common spare parts (used in repair routes) could support the supply chain resilience. • Constructive feedback about product design and repair practices could be collated in Customer Relationship Management (CRM) systems, collaborative R&D meetings, scorecards, formal or informal reports. <p>Participants in this activity could range from manufacturers, brands, retailers to repair companies and consumers, depending on which repair routes are considered when designing new products.</p>	<p>To consumers and society:</p> <p>Products could be easy to be disassembled and upgraded and repaired by consumers easily and safely.</p> <p>Products’ lifetimes could be extended, preventing replacements and additional use of natural resources.</p> <p>To businesses:</p> <p>Repairable design could ease repair processes and save costs (of labour or replacements) within warranties.</p> <p>Standardisation of components could reduce product costs due to economies of scale.</p> <p>Extending product lifetime through easing professional or DIY repair could improve brand image, customer satisfaction and brand loyalty and thereby gain customers.</p>	<ul style="list-style-type: none"> • High cost of R&D innovation in repairable design, whilst many consumers are sensitive to price. • Consumers’ preference for fashion and newly updated technology products. • Conflicts between extending product lifetimes and sales-driven business goals. • Risks of DIY repair, especially in EEE (such as electric shocks).

<p>S02 – Provision of diagnostic and repair manuals and instructional support</p>	<p>Provision of diagnostic and repair manuals and instructional support could be associated with communications through recorded materials, including written or video formats, or through interactions with call centres or in-store staff.</p> <p>The information could range from diagnostics, repair and maintenance instructions and recommendations for repair service providers.</p>	<p>To consumers and society:</p> <p>This activity could help consumers and repairers to save time, increase their confidence, ensure the ease and safety of repair work.</p> <p>This activity could also educate consumers about product care and repair.</p> <p>To businesses:</p> <p>This activity could provide transparent and efficient communications between businesses and with consumers (which are essential supplements to repairable design), to improve brand image, customer satisfaction and brand loyalty and thereby gain customers.</p>	<ul style="list-style-type: none"> • Lack of collaboration between stakeholders. • Customers’ lack of perceived needs, skills and experience. • Potential safety risks through misinterpretation of instructional information.
<p>S03 – Promotion of repair benefits and repairable products</p>	<p>Promotion of repair benefits and repairable products could be customised to marketing strategies and tactics.</p> <p>Businesses could make marketing messages explicit with the use of product repairability and supportive aftersales services as indicators of sustainable or high-quality brands.</p> <p>These messages could be delivered in paper leaflets, product labels, social media, website content, in-store services or repair workshops in the form of:</p> <ul style="list-style-type: none"> • Quality commitment statements • Repair and care guide 	<p>To consumers and society:</p> <p>This activity could educate consumers about their consumption’s impacts on the environment and society.</p> <p>This activity could also support consumers’ rational choices when purchasing new products and repairing broken ones – such as with transparent pricing guideline and benefits of repairable products.</p>	<ul style="list-style-type: none"> • Consumers’ preference for replacements of newly designed and cheap products (due to no longer being in the habit of repair and ‘locked-in’ easy replacements). • Constraints on businesses’ resources (e.g. finance, labour and facilities).

	<ul style="list-style-type: none"> • Transparent repair pricing guideline supporting repair decisions • Benefits to the environment of product lifetime extension through repair • Repair tips and experience • In-store repair workshops 	<p>To businesses:</p> <p>Appropriate marketing messages could strengthen brand awareness.</p> <p>Supportive aftersales services could be a helpful driver for word-of-mouth and customer satisfaction.</p>	
<p>S04 – Choosing repair over replacement within warranties</p>	<p>Choosing repair over replacement within warranties could be associated with offering in-house or outsourced repair services</p> <ul style="list-style-type: none"> • Repair services offered at local shops or customers' homes either by brands, retailers or third-party service providers • Spare parts posted to customers or collected at local dealers. <p>Communication between different business stakeholders and with customers is crucial for this activity, particularly quality repair work and quick turnaround time</p>	<p>To consumers and society:</p> <p>More broken items within warranties could be repaired rather than being replaced.</p> <p>To businesses:</p> <p>This activity could increase brand awareness associated with a sustainable company growth ethos, and position the brand at a higher end of the market (e.g. attracting customers who prefer options to extend product lifetimes).</p> <p>Repair service providers could earn profits from providing after-sales services within warranties on behalf of manufacturers, brands or retailers through partnerships.</p>	<ul style="list-style-type: none"> • Customers' preference for a replacement or refund. • Underestimation of reverse and forward logistics costs. • Conflicts between business stakeholders' interests in providing relevant customer care.

<p>S05 – Integration of repair and reuse</p>	<p>Integration of repair and reuse could be associated with collecting broken items for repair and then reselling or harvesting parts for future repair. These services could be implemented by manufacturers, brands or retailers or outsourced from third parties through partnerships.</p>	<p>To consumers and society:</p> <p>Consumers could purchase repaired products or second-hand parts at cheaper prices.</p> <p>Fewer broken items or unwanted parts to be disposed of.</p> <p>To businesses:</p> <p>This activity could increase brand awareness associated with a sustainable company growth ethos, and position the brand at a higher end of the market (e.g. attracting customers who prefer options to extend product lifetimes).</p> <p>This could also generate profits from reselling repaired items or utilising harvested parts for repair services.</p>	<ul style="list-style-type: none"> • Concerns about the quality of second-hand components and inventory management issues. • Uncertain customer demand for purchasing repaired items. • Lack of economic feasibility and staff competences for repairing broken items and harvesting unwanted parts.
<p>S06 – The exchange model and temporary replacement model</p>	<p>There were no clear opportunities for the exchange model and temporary replacement model found from the empirical data.</p> <p>However, these models could be more feasible if being offered in rental services. When a rental item is broken, it can be either temporarily replaced by or exchanged for another one. The broken item can be fixed and returned to the customer or offered to another one.</p>	<p>To consumers and society:</p> <p>This activity could bring convenience to consumers.</p> <p>More broken items could be repaired and reused.</p> <p>To businesses:</p> <p>This activity could improve customer satisfaction with repair services.</p>	<ul style="list-style-type: none"> • Lack of economic feasibility. • Concerns about inventory management, logistics and standard issues of second-hand products (e.g. hygiene and product safety).

<p>S07 – The fixed-cost model and fixed lead-time return model</p>	<p>In the fixed-cost model, repair costs could be published on the website and in a fixed and detailed price list in stores, supportive and responsive customer services</p> <p>In the fixed lead-time model, well-trained repairers could be a key success factor of making the repair duration independent of the nature of the fault. Besides, call centres and CRM software are essential to communications between office-based staff, field engineers and customers.</p>	<p>To consumers and society:</p> <p>Fixed costs and lead-time of repair work could bring certainty to consumers.</p> <p>To businesses:</p> <p>These models could improve customers' satisfaction with and trust in repair services.</p>	<ul style="list-style-type: none"> • Complexity of product faults and designs. • Uncertain availability of spare parts and variation in their cost. • Concerns about inventory management and logistics.
<p>S08 – Localised repair service network</p>	<p>A localised repair service network could be aimed at improving the service network, its responsiveness and quality assurance. This could be associated with either directly recruiting and managing repairers or outsourcing services from repair service providers.</p> <p>The efficiency of spare parts supply, improved staff training and shared data (including reports of repair practices, spare parts demand and suggestions for service improvement) were key success factors. 3D printing could contribute to an efficient spare parts supply.</p>	<p>To consumers and society:</p> <p>Consumers could get their broken items repaired more easily.</p> <p>To businesses:</p> <p>This activity could improve customer satisfaction by providing a wider service network and ensuring its responsiveness and quality.</p> <p>This could also help businesses to attract new customers or position the brand at a higher end of the market.</p>	<ul style="list-style-type: none"> • Limited financial and human resources and unclear return on investment into repair facilities, staff training, spare parts logistics and CRM system. • Concerns about service quality management. • Uncertain customer demand for repair services.
<p>S09 – A transparent spare parts and tools supply chain</p>	<p>A transparent spare parts and tools supply chain could be associated with offering these items for free or sold online or at local retailers. Consumers could easily refer to products' model numbers and parts' serial numbers to find the right parts.</p>	<p>To consumers and society:</p> <p>This activity could help fulfil consumers' repair decisions, either for DIY or commercial repair, due to increased availability of spare parts and tools at better prices.</p>	<ul style="list-style-type: none"> • Concerns about inventory management and logistics. • Consumers' preference for replacement of newly designed and cheap products.

	<p>Collaboration between spare parts suppliers, brands, retailers and repair service providers could be essential to forecasting demand for and just-in-time deliveries of spare parts and tools.</p>	<p>To businesses:</p> <p>This activity could increase brand awareness, promote sustainable growth ethos, and strengthen relationships with customers through offering spare parts for free or at reasonable prices.</p> <p>Businesses could also earn profits from selling spare parts and tools for DIY repair or within repair services.</p>	<ul style="list-style-type: none">• Risks of DIY repair, especially in EEE (such as electric shocks).
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7.2. Implications for business management

This section translates key findings from the business interviews into two key learning points that may help companies to better adopt and execute sustainable business model innovation beyond product reparability.

7.2.1. SBM propositions through business activities promoting product reparability

The semi-structured interviews with businesses were undertaken to evaluate and validate the proposed business activities, which were developed from a comprehensive literature review (Section 2.5). Interviewees were first asked to choose the cards that could describe their business's current practices; then they were asked to select which of the remaining cards described potential strategies for their businesses (Section 3.4.3).

Based on the responses of interviewees, the investigator modified the nine business activity cards to provide guidelines for other businesses adopting and executing the business activities following consideration of the opportunities and challenges presented in CHAPTER 6. In particular, each modified card (Figure 20) had two sides – one was for generic guidelines for the three industries (e.g. EEE, clothing and furniture) and the other highlighted any difference across the industries.




S01
REPAIRABLE PRODUCTS, CO-DESIGN

This activity is aimed at improving the reparability of current products and the future availability of repairable product.

Repairable design could include five strategies – standardisation, simplification, design for safe repair, disassembly and upgradability. Combining any of the five design strategies could be considered in the design process. This varies depending on businesses’ interests in repair routes.

Codesign could encourage the participation of different stakeholders in the design stage, which can be associated with the following processes with the participation of manufacturers, brands, retailers, repair companies or consumers:

- Product teardowns held at the final check before the mass production stage could ensure achievement of design strategies.
- Identification of common spare parts (used in repair routes) could support the supply chain resilience.
- Constructive feedback about product design and repair practices could be collated in Customer Relationship Management systems, collaborative R&D meetings, scorecards, formal or informal reports. Scorecards can be used to evaluate the quality of repair work and the reparability of products.



S01
REPAIRABLE PRODUCTS, CO-DESIGN

Highlights for EEE industry


- Design for safe repair needs to consider the potential risks of electric shocks when disassembling and reassembling components.
- Upgradability strategy for repairable design could be associated with using replaceable longer-lasting or more energy-efficient batteries.
- Price competition and energy efficiency could generate more interests of many producers and consumers, compared to product durability or reparability.
- Due to high logistics costs, many bulky spare parts of large appliances could be more expensive than entire new machines.
- Standardisation could limit creativity and technology improvement.

Highlights for clothing industry

- Jeans could be more repairable (than other garments) due to the durability of the material.
- Standardisation could limit the uniqueness of fashion products.

Highlights for furniture industry

Flatpack furniture products could be more repairable, through easy disassembly and reassembly, if they are made from durable materials.



S02
DIAGNOSTIC & REPAIR MANUALS, INSTRUCTIONAL SUPPORT

This activity is aimed at easing fault diagnostics and repair work.

Diagnostic and repair manuals are designed for both DIY and professional repair, whilst considering the safety implications. The manuals can be in paper or electronic (written or video-ed) form, and are open access.

Instructional support, including responsive call centres, live chats, email boxes or interactions with in-store staff, are set up to give instructions and advice. The information could range from diagnostics, repair and maintenance instructions and recommendations for repair service providers.



S02
DIAGNOSTIC & REPAIR MANUALS, INSTRUCTIONAL SUPPORT

Highlights for EEE industry

- Repair manuals need to specify which repair is DIY work (e.g. replacing consumables or motors) and which is professional work (e.g. control boards that require working with a high-power electric range).
- Care guides need to be attached to repair manuals, to instruct consumers to do regular maintenance, such as descale kettles or replace filters. Products should be designed for easy regularly maintenance.
- Electrical and gas safety must be addressed in repair manuals.

Highlights for clothing industry

Consumers need to be educated about how to care for garments to prolong their lifetimes and minimise worn and torn issues.



S03
PROMOTION OF REPAIR BENEFITS & REPAIRABLE PRODUCTS

This activity is aimed at promoting the benefits of repair and overcoming perceived barriers for consumers.

Promotion of repair benefits and repairable products could be customised to marketing strategies and tactics.

Businesses could make marketing messages explicit (e.g. saving costs, saving the environment) with the use of product reparability and supportive aftersales services as indicators of sustainable or high-quality brands. These messages could be delivered in paper leaflets, product labels, social media, website content, in-store services or repair workshops in the form of:

- Quality commitment statements
- Repair and care guide
- Transparent repair pricing guideline supporting repair decisions
- Benefits to the environment of product lifetime extension through repair
- Repair tips and experience
- In-store repair workshops



S03
PROMOTION OF REPAIR BENEFITS & REPAIRABLE PRODUCTS

Highlights for EEE industry

In addition to energy efficiency, websites and product labels should include product reparability to support consumer purchase decisions.

Highlights for clothing and furniture industry

In addition to costs and the promotion of aesthetic value (i.e. the look of product), websites and product labels should include product reparability and quality information to support consumer purchase decisions.

Figure 20: Modified business activity cards



S04
REPAIR OVER REPLACEMENT WITHIN WARRANTIES

This activity is aimed at encouraging and attracting businesses' and consumers' preference for repair over replacement as a remedy for faulty products.

Choosing repair over replacement within warranties could be associated with offering in-house or outsourced repair services such as:

- Repair services offered at local shops or customers' homes either by brands, retailers or third-party service providers
- Spare parts posted to customers or collected at local dealers.


Communication between different business stakeholders and with customers is crucial for this activity, particularly quality repair work and quick turnaround time.



S04
REPAIR OVER REPLACEMENT WITHIN WARRANTIES

Highlights for EEE industry

- Many products come with a warranty that covers parts only and excludes labour. The inclusion of labour costs in warranties could encourage retailers' preference for repair.
- A replacement could be safer than repair of electric faults due to safety concerns after the repair.



S05
REUSE & REPAIR INTEGRATION

This activity is aimed at extending lifetimes of unwanted parts and/or broken products by giving them a second life.

Integration of repair and reuse could be associated with:

- **Reuse parts in repair services** – businesses use second-hand parts in their repair services or sell them to DIYers.
- **Reuse repaired items** – broken items, after being collected, are then repaired and resold to new users.

These services could be implemented by manufacturers, brands or retailers or outsourced from third parties through partnerships with repair companies, reuse organisations, charity shops, asset management companies, household waste recycling centres or waste transfer stations.



S05
REUSE & REPAIR INTEGRATION

Highlights for EEE industry


Safety concerns could prevent many businesses from implementing this activity. However, working modules could be safely reused for future repair if every module contains a group of components and is placed in a plastic housing.

Highlights for clothing industry

Competent service teams are critical for making creative patterns on collected garments and parts.

Highlights for furniture industry

The provision of manuals and spare parts to service providers and retailers is essential to improving the quality and safety of repaired or refurbished furniture.




S06
EXCHANGE MODEL, TEMPORARY REPLACEMENT MODEL

This activity is aimed at improving the convenience of, and consumer satisfaction with, repair services.

A replacement is delivered to the customer within a particular duration and in the same visit that the broken one is collected.

- **'Exchange model'** – a repaired or remanufactured product of an equivalent age/quality/condition is exchanged for the broken item.
- **'Temporary replacement model'** – an equivalent product is provided for the consumer's temporary use during the repair.

These models could be more feasible if being offered in rental services. When a rental item is broken, it can be either temporarily replaced by or exchanged for another one.



S06
EXCHANGE MODEL, TEMPORARY REPLACEMENT MODEL

Highlights for clothing industry

Clothes for special events could be for leased (with repair services included) such as evening gowns, wedding dresses, items for bridegrooms and bridesmaids.

Highlights for furniture industry

Potential market for leased furniture integrated with repair services could be consumers who often relocate for work or love frequent refreshments of home décor styles and furniture.

Figure 20: Modified business activity cards (cont.)



Figure 20: Modified business activity cards (cont.)

Table 23 presents how the five propositions for SBM innovation proposed in the conceptual framework (Table 11) could be delivered through the business activities that promote product repairability. The findings in this table emerged from the synthesis between Table 21, Table 22 and the modified business activity cards (Figure 20). In particular, column (a) provides a list of the nine business activities that promote product repairability. Column (b) classifies the value created in each activity (Table 21 and Table 22) into three categories of benefits which are considered in the first proposition (i.e. economic, social and environmental benefits conceptualised as value forms).

Column (c) refers to value creating logic to business stakeholders (Table 21), consumers and society (Table 22) which contribute to the system of sustainable value flows among these stakeholders in the second proposition. Figure 21 demonstrates these value flows that form a value network in the third proposition (i.e. a value network with a new purpose, design and governance), presented in column (d).

Value creating logic to different stakeholders and their required contributions are aligned with the fourth proposition (i.e. a systemic consideration of stakeholder interests and responsibilities) in column (e). Column (f) presents opportunities for internalising externalities, such as the internalisation of repair services, and the production or supply of spare parts and tools, when considering the fifth SBM proposition for each business activity.

Table 23: Propositions for SBM innovation through business activities promoting product repairability

SBM proposition (a)	Economic, social and environmental benefits conceptualised as value forms (b)	A system of sustainable value flows among multiple stakeholders (c)	A value network with a new purpose, design and governance (d)	A systemic consideration of stakeholder interests and responsibilities (e)	Internalising externalities (f)
S01 – Design for repair and codesign	<ul style="list-style-type: none"> • Economic benefit: reduced costs of repair processes, production of standardised products and improved sustainability brand images • Social benefit: products easily and safely disassembled and upgraded and repaired by consumers • Environmental benefit: extended product lifetimes (i.e. more products to be repairable and repaired), the prevention of replacements and additional use of natural resources. 	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure 21)	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Manufacturers or brands could internalise repair services that could help to internalise the identification of common product failures and spare parts for the improvement of product design for repair.
S02 – Provision of diagnostic and repair manuals and instructional support	<ul style="list-style-type: none"> • Economic benefit: support for repair service businesses (e.g. easier and safer repair work) • Social benefit: improved consumer awareness about product care and repair • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure 21)	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Manufacturers or brands could internalise repair services that could help to develop practical instructional documents based on their repair practices.

<p>S03 – Promotion of repair benefits and repairable products</p>	<ul style="list-style-type: none"> • Economic benefit: increased demands for repairable products and repair services • Social benefit: improved consumer awareness about the impacts of repair on the environment, more informed and rational purchase and repair decisions • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	<p>Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)</p>	<p>Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure 21)</p>	<p>Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)</p>	<p>Manufacturers or brands could internalise repair services or spare parts supply that could help to provide transparent information (e.g. the availability and costs of repair services and spare parts) to support consumer purchase and repair decisions.</p>
<p>S04 – Choosing repair over replacement within warranties</p>	<ul style="list-style-type: none"> • Economic benefit: increased profits of repair service providers from providing after-sales services within warranties • Social benefit: increased consumers and businesses’ preference for repair over replacement • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	<p>Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)</p>	<p>Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure 21)</p>	<p>Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)</p>	<p>Manufacturers or brands could internalise repair services that could ease repair work within warranties.</p>
<p>S05 – Integration of repair and reuse</p>	<ul style="list-style-type: none"> • Economic benefit: increased profits from reselling repaired items or utilising harvested parts for repair services • Social benefit: repaired products or second-hand parts at cheaper prices for consumers with low incomes 	<p>Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)</p>	<p>Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure 21)</p>	<p>Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)</p>	<p>Manufacturers, brands or retailers could internalise the collection of unwanted items and harvest parts for their future repair.</p>

	<ul style="list-style-type: none"> • Environmental benefit: extended product lifetimes (e.g. fewer broken items or unwanted parts to be disposed of), the prevention of replacements and additional use of natural resources. 				
S06 – The exchange model and temporary replacement model	<ul style="list-style-type: none"> • Economic benefit: increased demands for repair services or retail services (which accommodates any of the two models) • Social benefit: increased convenience of repair • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure 21)	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Manufacturers, brands or retailers could internalise repair activities within rental services.
S07 – The fixed-cost model and fixed lead-time return model	<ul style="list-style-type: none"> • Economic benefit: increased demands for repair services that guarantee fixed costs and lead times • Social benefit: improved certainty of repair work, considering fixed costs and lead-times • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure)	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Manufacturers or brands could internalise repair services that could minimise variations of repair costs and lead-times.
S08 – Localised repair	<ul style="list-style-type: none"> • Economic benefit: upscaling of commercial repair 	Value creating logic to business stakeholders	Between manufacturer, brand/retailer, repair service provider, customer/society and	Value creating logic to business stakeholders (Table	Manufacturers or brands could expand their network of repair centres (e.g. locate their repair centres across

service network	<ul style="list-style-type: none"> • Social benefit: quality and responsive repair services offered locally to support the repair practices of society • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	(Table 21), consumers and society (Table 22)	natural environment (Figure)	21), consumers and society (Table 22)	the regions or countries or acquire local repair service providers).
S09 – A transparent spare parts and tools supply chain	<ul style="list-style-type: none"> • Economic benefit: increased profits from selling spare parts and tools for DIY repair or within repair services. • Social benefit: fulfilled consumers’ repair decisions due to increased availability of spare parts and tools at better prices. • Environmental benefit: extended product lifetimes (i.e. more products to be repaired), the prevention of replacements and additional use of natural resources. 	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Between manufacturer, brand/retailer, repair service provider, customer/society and natural environment (Figure)	Value creating logic to business stakeholders (Table 21), consumers and society (Table 22)	Manufacturers or brands could internalise their production of spare parts and tools such as through 3D printing.

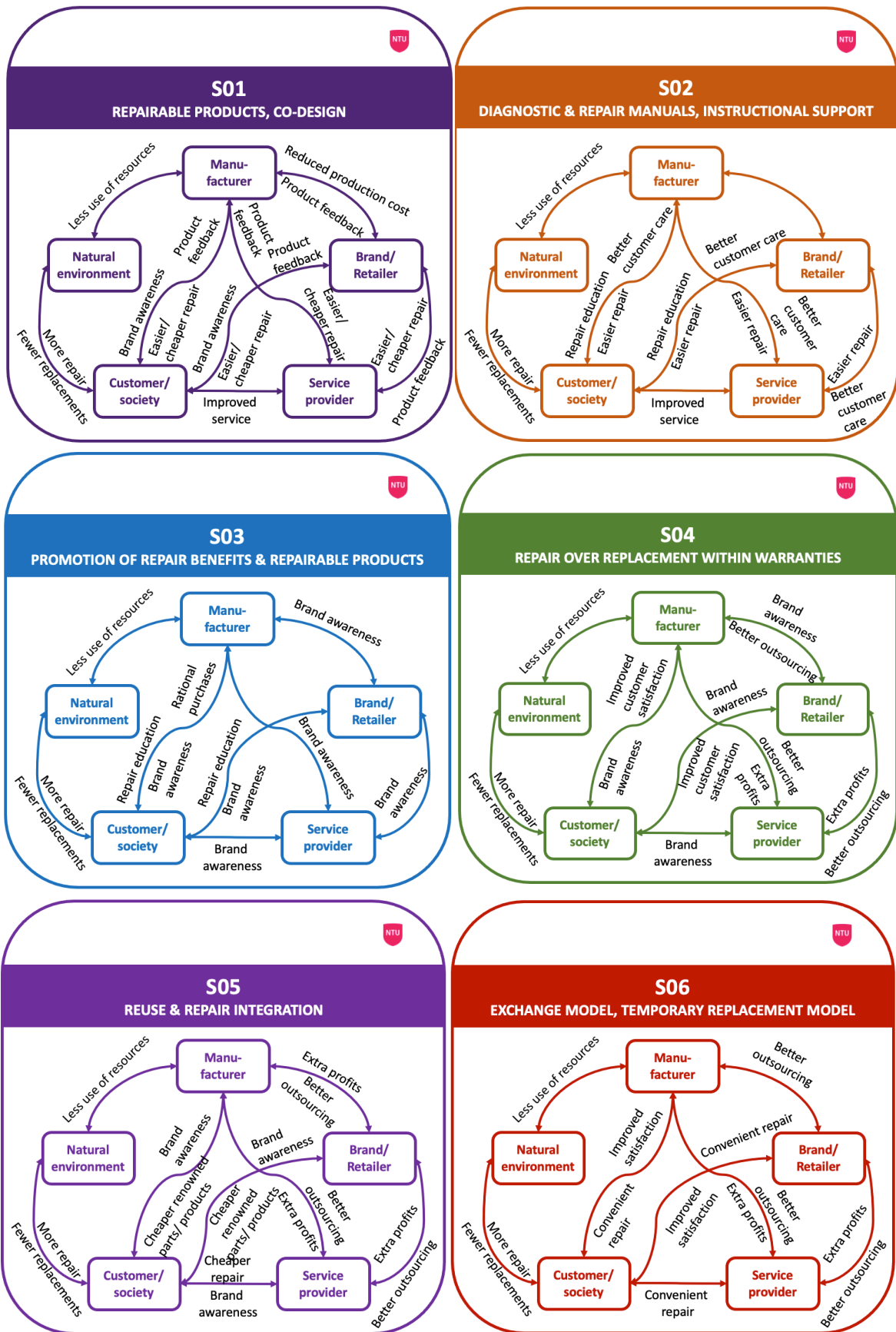


Figure 21: Value network of SBM innovation through business activities promoting product repairability

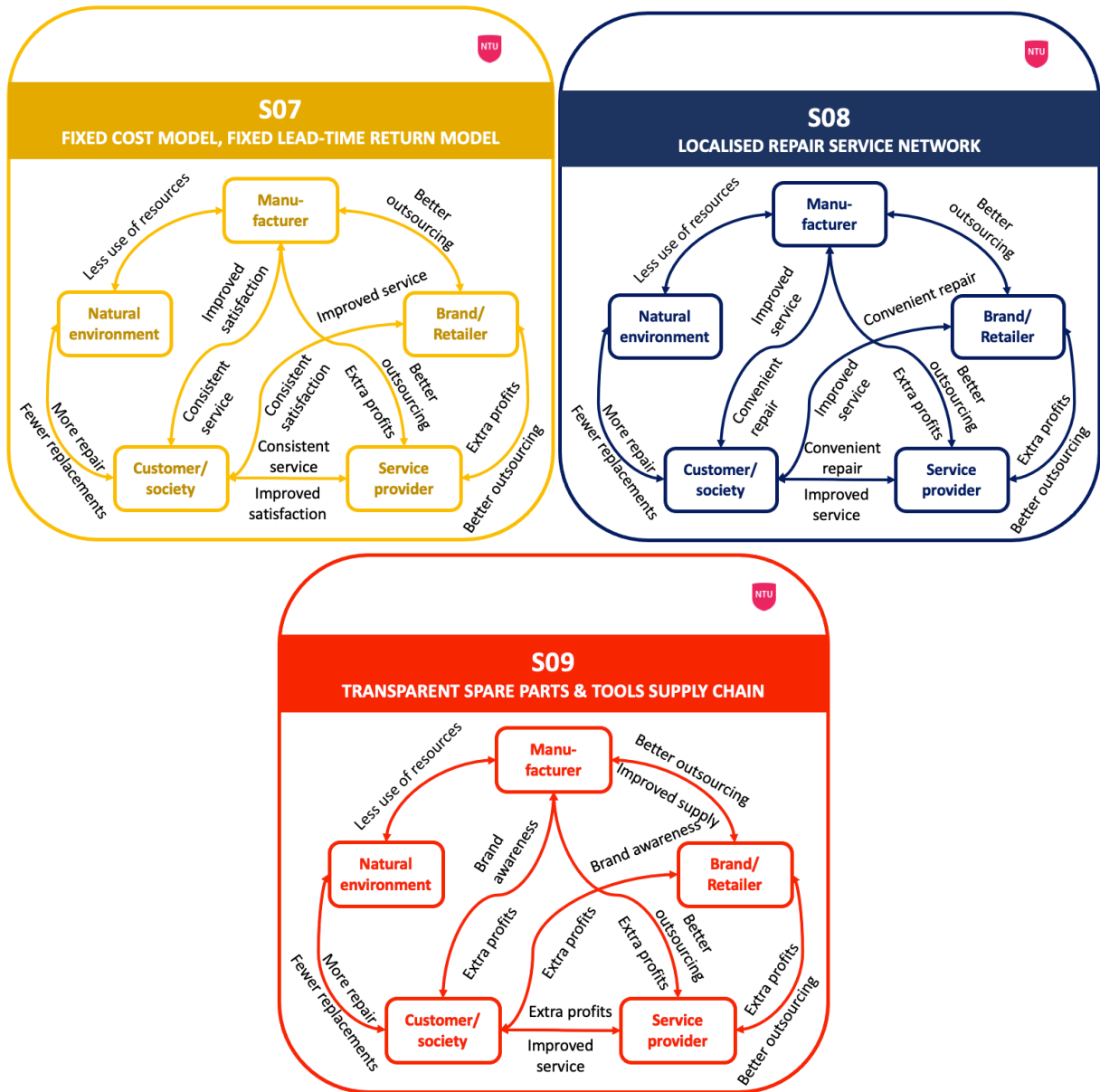


Figure 21: Value network of SBM innovation through business activities promoting product repairability (cont.)

7.2.2. Collaboration between business stakeholders

The interview data indicates that collaboration is essential to most of the sustainable business model innovations beyond product repairability (Table 21). This confirms previous evidence, for example by Bocken and Allwood (2012) and Bocken, Rana and Short (2015). In particular, collaboration is crucial for achieving business successes and tackling sustainability issues which extend beyond business boundaries, such as co-design for repairable products, development and provision of repair manuals, and efficiency of spare parts supply. Partnerships with repair service providers might help manufacturers, retailers and brands to diversify their aftersales services, including repair within and out of warranties or integration of reuse and repair. The utilisation of service providers' resources (e.g. labour and facilities) through partnerships might generate a more reliable and consistent source of income for them, and improve customer satisfaction with manufacturers' and retailers' brands or position them at a higher end of the market. These were described by Yang et al. (2016) as 'uncaptured value' in current business models. Yang et al. (2016) suggested that sustainable business model innovation 'can be more easily achieved by identifying the value uncaptured in current business models, and then turning this new understanding of the current business into value opportunities that can lead to new business models with higher sustainable value' (p.3). For that reason, business practitioners engaging business model innovation could use the findings presented in Figure 20, to understand the potential of adopting and executing the innovative business activities, including suggestions for different industries, and Table 21, to consider which value can offer potential to their businesses and make plans for appropriate contributions by themselves and their business partners.

However, different companies may have distinct business strategies that focus on different types of value. Some forms of uncaptured value may benefit some business stakeholders but not others. For that reason, this research suggests adopting 'sustainable business thinking', as proposed by Bocken, Rana and Short (2015). This approach encourages integrating consideration of both positive and negative outcomes of business activities on multiple stakeholders, including business stakeholders, employees, customers and society. This approach can help to identify unintended impacts on these stakeholders and alternative solutions that offer consensus alignments between stakeholders' interests as a foundation of collaboration or partnership. It is essential to clarify value opportunities, value missed, value destroyed, and value captured when adopting or executing a particular SBM innovation. Clarity of different value types increases the likelihood that collaboration will (i) minimise dependency on less sustainable business models and (ii) maximise contributions to SBM innovation through innovative activities beyond product repairability.

7.2.3. Consumer-focused innovation for repairability

Consumer-focused innovation was perceived by interviewees as a key success factor of the proposed activities in the empirical study, to generate value to customers and society and businesses. A key characteristic of sustainable business model innovation as prescribed by Schaltegger, Hansen and Lüdeke-Freund (2016, p.2) – developing 'integrative and

competitive solutions by either radically reducing negative or creating positive external effects for the natural environment and society', including consumers – was confirmed in the data. In particular, design for repair and codesign (S01) might generate positive value (Table 21) through developing new repairable products for consumers, and the other business activities (i.e. S02-S09) might support consumers' repair decisions and practices relating to these new products.

The proposed activities are in line with the sufficiency-driven business model innovation strategies, proposed by Bocken and Short (2016). For example, their 'extending product life' strategy, that proposes products built-to-last, repairable and upgradable, could be associated with the five design strategies in S01. This may benefit customers such as through life cost savings. Their 'demand reduction services' strategy, aiming at assisting consumers in reducing consumption, could be delivered through the provision of add-on services such as offering repair over replacement within warranties (S04), providing repair services at fixed cost or with fixed lead-time (S07), expanding repair service network (S08) and improving the transparency of spare parts and tools supply chain (S09). Their 'moderating sales and promotion' strategy could be aligned with eliminating manipulative consumer marketing campaigns and providing repair manuals and instructional support (S02) and promoting repair benefits and repairable products (S03). These are essential to ensure that consumers are fully cognisant of buying repairable products and repair decisions. Consumers may not be good at considering future benefits and costs (e.g. monetary and environmental costs) or 'may struggle to finance high upfront costs and continue to buy cheaper, less durable, products' (Bocken and Short, 2016, p.58). Their 'direct reuse' strategy could include the integration of repair and reuse (S05) to create second-hand markets – collecting broken items for repair then resell or harvesting parts for future repair. Finally, their 'no ownership' strategy could integrate the exchange model and temporary replacement model into rental services.

Moreover, most of the proposed activities were claimed to improve customer satisfaction and brand loyalty which might result from integrating customers to business product design, marketing information and service development, and improvement at both strategic and operational levels (e.g. improved service quality and lead-time). This integration has also been recommended in the literature on sustainability marketing (Hult, 2011; Sheth, Sethia and Srinivas, 2011) and business model innovation (Bocken, Rana and Short, 2015). For example, customer-focused innovation beyond repairability could consider incorporating customers into product and repair manual development and studying their behaviour towards repairable products and repair services (e.g. through surveys and interviews). These activities might help to design products for safe and easy DIY repair and develop consumer-friendly repair manuals which were claimed by interviewees to improve customer satisfaction and brand loyalty. This echoes a finding of Sabbaghi *et al.* (2016) concerning the impact of repair experience on consumers' future purchase decisions and purchase recommendations to friends and family. It is also in line with the 'user-driven innovation' concept which involves

potential customers, users or other stakeholders in the experimental and iterative design process (Baldassarre *et al.*, 2017). This kind of innovation can result in developing solutions that are ‘meaningful for people and profitable for business’ (ibid, p.1). At the same time, these business activities might help to improve the design and ease professional repair of current products – to extend their lifetimes and reduce the environmental impacts of disposing of them. Consumer-focused innovation might also support forecasting demands for repairable products and spare parts, and create customised or ‘market-focused’ sustainability marketing messages and initiatives (e.g. repair workshops or tours) which are based on the market-oriented needs and interests (Hult, 2011). These innovative activities aim to promote and educate customers about these product ranges and repair benefits.

7.2.4. Business innovation for improving consumers’ repair experience in repair journeys

This section discusses findings from a synthesis of the consumer study (CHAPTER 4) and the business study (CHAPTER 6). The consumer study proposed recommendations for business interventions (Section 5.2) based on the findings on consumers’ support needs at each stage of their repair journeys (Section 4.3). Three recommendations were the improved availability of and access to repairable products, repair services and customer support, and offering product-service integration.

These recommendations aimed to support consumers to act according to their initial intention or prevent them from discontinuing their repair journey at any stage due to perceived or actual challenges. Their validity was justified through the findings on value to consumers and society of the business innovation for product repairability and repair services (Table 22).

Improving the availability of and access to repairable products were claimed in the consumer group discussions to support repair decisions at each of the first three stages (Section 4.3). The five design strategies (S01 in Table 22) should support the identification of faults and repair needs at Stage 1 and repair work at Stage 3. For example, these strategies should ease the disassembly of products (e.g. no special tools required or no safety concerns) as many consumers raised their concerns about product design at these 2 stages (Sections 4.2.1 and 4.2.3). Additionally, the standardisation and simplification in product design should help consumers to easily find the right information (e.g. appropriate repair instructions and compatible spare parts) and understand the structure of products at Stage 2 (Section 4.3). Consequently, more products could be easily repaired by male and female consumers, regardless of product sectors (Table 20). Moreover, these five design strategies could prevent functional and aesthetical obsolescence of products (Section 1.1.3). The former is associated with physical failures that require product repair, the latter is concerned with products that lose their appeal because a new product with different or additional features is introduced into the market. Most participants from both the generation X and Y indicated that what mattered most to them was whether the functionality of products returned after repair (Section 4.2.4). Thus, improved product designs to ease repair work, with consideration of

the five design strategies, is crucial for supporting consumer repair journeys and their future repair decisions. Simplification and upgradability strategies, such as through modular products, could also help maintain their functional and aesthetic value as consumers would be able to upgrade and repair their products when necessary.

Furthermore, the business study found that the promotion of product features built on the five design strategies and repair benefits (e.g. cost-savings and environmental sustainability) could educate consumers about environmental impacts of their purchases and repair work (S03 in Table 22). Perceived negative outcomes of repair work could affect intention and behaviour (Sections 5.1.1 and 5.1.2). For that reason, this business activity should support consumers' beliefs about positive outcomes of repair, generate relevant intentions (e.g. repair to prevent purchases of new items and reduce environmental impacts) and translate them into behaviour during repair journeys. As repair was not often considered after Stage 1 for many cheap products, such as low-priced small appliances, fast fashion or flatpack furniture (Table 20), businesses should inform consumers that purchases of repairable products and their repair costs could be cheaper than frequent replacement of cheap items. Moreover, the promotion of regaining functional value for EEE products, and both functional and aesthetic or bespoke value for clothes and furniture after repair could have positive impacts on consumers' repair intentions and their satisfaction with repair work (Table 20). Businesses should also provide consumers with the information about what types of repair work could void warranties (e.g. using non-original components) or require specialist tools (such as uncommon screwdrivers or sewing machines) to support consumers' purchase decisions for the three different product types (Table 20).

In addition to repairable products, the provision of diagnostic and repair manuals and instruction support (S02 in Table 22) were claimed by many interviewees to help consumers to save time, increase their confidence, ensure the ease and safety of repair work. The consumer study revealed a similar finding that the clarification of repair manuals, designed for DIY and commercial repair, could prevent consumers from wrongly perceiving challenges (Section 4.3). For instance, informative repair manuals, including the provision of parts' numbers, troubleshooting instructions for DIY repair, lists of reliable service providers at Stage 1 and 2, should support relevant repair routes, prevent consumers from discontinuing their repair journeys and ending up with replacement or leaving products unrepaired. Informative repair manuals could also increase consumers' confidence in their ability to repair clothes and furniture, and prevent their fear of causing further aesthetic damage to these kinds of products or data loss when fixing EEE products. More males could be more confident and interested in mending garments; more females could be willing to EEE products (Table 20).

Moreover, many participants from both generations X and Y claimed that their satisfaction with DIY repair was dependent on the differences between the actual and estimated repair time, based on repair instructions (Section 4.2.4). Product teardowns held

at the final check before the mass production stage (S01) would help to provide accurate information in repair manuals.

The consumer group discussions also addressed their expectation of spare parts being supplied efficiently and cost-effectively to facilitate repair work at Stage 3 (Section 4.3), particularly EEE and furniture products (Table 20). This expectation was in line with the integration of repair and reuse and the transparent spare parts and tools supply chain (S05 and S09 in Table 22). For instance, consumers and repairers could purchase second-hand or new parts at better prices and thereby fulfil decisions for either DIY or commercial repair, particularly making repair more economical and both generations satisfied with repair work (Section 4.2.4). The fixed-cost model (S07) could also bring certainty to consumers when considering the cost of repair work.

Second, the improved the availability of and access to repair services and customer support could have positive impacts on the consumer repair journey (Section 4.3) and generate value to consumers (Table 22). In particular, interactions between customers and call centres or in-store staff or live chats could provide useful advice and support (e.g. where to find helpful repair manuals and spare parts easily) during the consumer repair journey (S02 in Table 22). The four focus groups also suggested the reduced waiting and turnaround time of repair services, and improved staff competences or service network, such as through the collaboration with local repairers (Section 4.3). These changes should help to shape consumers' beliefs from the two generations about positive outcomes of repair services – which should be easy, successful and quick, and prevent recurrence of faults (Section 4.2.4). Considering the value to consumers of business innovation, the temporary replacement model (S06 in Table 22), fixed lead-time return model (S07) and localised repair service network (S08) could embrace these changes.

Finally, product-service integration models – such as the provision of repair services with pay-per-repair billing or monthly or yearly subscriptions and rental services – should be considered, in addition to the nine proposed business activities. The recommendation for product-service integration aimed to facilitate consumers' repair journeys through (Section 5.2). The transparency of repair service costs was crucial for informative decisions of many consumers in the group discussions during their repair journeys (Section 4.3). This transparency feature was also the value of the fixed-cost model (S07 in Table 22) to consumers. Moreover, the product-service integration could streamline repair journeys (Section 5.2) as consumers already knew where to get reliable instructions or advice for fault diagnostics at Stage 1 if businesses provided necessary support (S02 in Table 22). Consumers might not need to diagnose the problem after noticing the fault at Stage 1 as they could send broken products to repair services which were parts of monthly or yearly subscriptions or paid-per-repair. Similarly, consumers could also contact rental service providers, as repair is part of rental agreements. Several participants in the group discussions indicated that they would be willing to pay higher prices for repairable products and integrated services (Section 4.3). Choosing repair over replacement within warranties (S04), the exchange model or

temporary replacement model (S06) could make more broken items repaired and bring convenience to consumers.

7.3. Implications for future policies

The literature indicates that government reports and academic studies focus on consumers' perspectives (Section 1.7). This section presents policy options based on interests and expectations of business stakeholders (i.e. the businesses interviewed). The data collected reveal business support needs from governments, particularly a reconsideration of product standards and aftersales services requirements, and the introduction of financial incentives (Section 6.10.2) to reshape the economy and enable sustainable business model innovation and consumption.

Some interviewees expected governments to reconsider product standards, particularly improving product repairability to prevent premature obsolescence. New products should be designed for repair and, at the point of sale, supplied with repair information, including the availability of repair manuals, spare parts and repair services. Disqualification of product designs and the provision of repair information could be penalised, such as through taxation. This finding about product standards and aftersales services requirements supports recommendations in a European Commission (2018) consumer behaviour study. A reason for this might be that these requirements can extend producer responsibility and enable collaboration between business stakeholders, including local and overseas manufacturers, brands, retailers and repair service providers. Key challenges to and enablers of sustainable business model innovation (Section 7.1) are both associated with these collaborations. Moreover, these requirements might influence consumers' purchase decisions concerning repairable products and repair journeys, according to many interviewees.

Governments' financial incentives are associated with tax breaks or rebates and research funding. Many interviewees suggested that other governments should consider the VAT reduction on repair work which was introduced by Swedish and Czech governments (Section 6.10.2). Moreover, tax reform could take the form of reducing VAT rates for businesses that produce repairable products, spare parts and provide repair services. These tax breaks could make repair more affordable. Tax reliefs should be applied to businesses which conduct R&D work on improving product design and repair services or creative marketing activities that promote repairability. These tax reliefs aim to encourage and support companies to work on relevant innovative projects and they can reduce their tax bill or claim payable cash credits. Additionally, many businesses expected governments to fund research under partnerships between business stakeholders or between them and institutions such as research centres and universities. This would support business transformation and product or service diversification to meet market demands.

In general, reconsideration of product standards and aftersales services requirements, and the introduction of financial incentives could enable sustainable business model

innovation and support business to overcome challenges. They would encourage businesses to incorporate the proposed activities into their business models, commit to sustainability objectives (e.g. generating incomes from repairable products and repair services instead of over-selling cheap or non-durable items) and provide strong and consistent communication about these objectives to other business stakeholders and consumers.

CHAPTER 8. Contributions and conclusions

8.1. Revisiting the Aims and Objectives

The aim of this research was to (i) identify influences upon the ‘repair journeys’ that consumers go through when deciding whether or not to fix a faulty item and (ii) determine how businesses could support consumers in their repair journeys, particularly through business innovation for product repairability.

In order to meet this aim, three objectives were formed. The first was to develop a consumer repair journey and understand behaviour changes. The second was to identify business activities that could promote product repairability and support repair practices. The third was to reflect on current legislation and trends for business innovation.

In fulfilment of the first objective, four focus groups were conducted and their results are presented and discussed in CHAPTER 4 and CHAPTER 5. This consumer study identified a repair journey that consumers often experience (Section 4.1). The study then investigated factors influencing repair intentions and their translations into behaviour at each stage of the repair journey based on the Theory of Planned Behaviour and considering the three product sectors – EEE, clothing and furniture (Sections 4.2 and 5.1). Findings on consumers’ support needs from businesses also emerged from the focus group discussions (Section 4.3). These findings were foundations for the recommendations for business interventions in the three industries on consumer repair journeys (Section 5.2).

The second objective was achieved in CHAPTER 6 and CHAPTER 7. Through the thematic analysis of business interviews, key opportunities for and challenges to adopting and executing business strategies that promote product repairability and repair services were identified (Sections 6.1-6.9) and summarised in Section 7.1. The synthesis of data collected in the consumer and business studies provided foundations for the implications for business management in the three industries (Section 7.2). The implications range from guidelines for businesses to develop value propositions through adopting and executing the nine proposed activities (Section 7.2.1), collaboration between business stakeholders (Section 7.2.2), consumer-focused innovation (Section 7.2.3) to the improvement of consumers’ repair journeys (Section 7.2.4).

The third objective was fulfilled by the business study. This study identified support needs for business innovation from government (Section 6.10) which constituted the evidence for proposing future legislation (Section 7.3).

The next section presents contributions to knowledge (Section 8.2) based on findings from both the consumer and business studies. The chapter ends with discussions of research limitations (Section 8.3) and suggestions for future studies (Section 8.4).

8.2. Contributions to knowledge

8.2.1. Consumer repair journey and intention-behaviour gaps

A gap in knowledge was identified when exploring the entire journey that consumers go through before, during and after deciding whether or not to repair broken items and whether to go through a DIY or commercial route (Section 1.7). The findings from this PhD revealed that many consumers experienced the repair journey of four stages: (i) identification of product faults and repair need, (ii) information search and evaluation of alternatives (e.g. different repair routes or replacements), (iii) repair in action and (iv) post-repair evaluation. However, their intentions and behaviour at each stage is dependent on various factors.

Many studies have utilised the Theory of Planned Behaviour to explore pro-environmental behaviour e.g. (Jackson, 2005; Hassan, Shiu and Shaw, 2016). However, there are three key issues in this theory: (i) oversimplification of translating intention into behaviour, and the lack of consideration of (ii) facilitating conditions, (iii) personal habit and previous experience (Section 2.1.2). This PhD investigated the factors that could influence intentions and the process of translating intention into behaviour at each stage of the consumer repair journey (Section 4.2).

The consumer focus groups suggested that an intention to choose self-repair, commercial repair or non-commercial repair could be influenced by attitude (e.g. perceived benefits or outcomes and interests in different repair routes and related actions), perceived behavioural control and subjective norm (Section 5.1.1). These factors could also generate different intentions at different stages of the repair journey, such as whether to start the journey and how to diagnose product faults (at Stage 1, presented in Section 4.2.1) and whether to find more information to inform repair decisions or consider replacements (at Stage 2, presented in Section 4.2.2), whether to do DIY repair or get products repaired by friends or commercial repairers (at Stage 3, presented in Section 4.2.3). Perceived habits could also form the specific intention, such straightforward intentions to self-repair EEE or furniture products (for some male participants) or self-mend clothes (for several females). Habits of using the internet could shape the intention of online research prior to asking advice from family members or friends.

Moreover, attitude, subjective norm and perceived behavioural control were found to mediate translating intention into behaviour in consumers' repair journeys, especially at the first three stages (Section 5.1.2). These translations could also be influenced by facilitating factors (e.g. product design, the availability of repair information and the convenience of alternatives), previous experience, perceived habits and emotional attachments. At Stage 4, post-repair evaluations helped to justify actual impacts of these factors when comparing expectation and satisfaction with repair outcomes considering different intentions and behaviour that led to the outcomes.

The exploration of consumer repair journeys and consumer support needs (Section 4.3) provided evidence for proposing recommendations for business intervention. The three

recommendations were the improved availability of and access to repairable products, repair services and customer support, and offering product-service integration (Section 5.2). These recommendations aimed to encourage consumers to act according to their initial intention or prevent them from discontinuing the repair journey at any stage due to perceived or actual challenges.

Previous studies have mostly focused on consumer behaviour in repairing either EEE, clothing or furniture products (Sections 1.2, 1.3 and 1.4). This PhD contributes new theoretical and practical knowledge through findings on consumer repair journeys and implications for business management and future legislation across these three product sectors (Sections 4.2.5, 5.2 and 7.2.4). Design strategies for product repairability could reduce the complexity of, and ease, repair work. The data suggested that the fault diagnostics and repair of EEE products, particularly at the Stage 1 and 3 of repair journeys, were more complicated than mending clothes and fixing furniture. The promotion of repair benefits (e.g. cost-savings and environmental sustainability) should support consumers' beliefs about positive outcomes of repair. The promotion of repair outcomes should be customised for different product sectors: a focus on functional value for EEE products, and both functional and aesthetic or bespoke value for clothes and furniture. This could have positive impacts on repair intentions at Stage 2 and satisfaction with repair work at Stage 3. These kinds of promotion should also generate relevant intentions (e.g. repair to prevent purchases of new items, particularly low-priced small appliances, fast fashion or flatpack furniture and reduce environmental impacts), especially at Stage 2, when consumers could find information supporting their repair journeys.

Furthermore, the improvement of manuals could help to increase consumers' confidence in their abilities and prevent the fear of data loss when fixing EEE products or causing further aesthetic damage to clothes or furniture. More male consumers could be more confident and interested in mending garments; more females could be willing to EEE products since the beginning of their repair journeys (i.e. at Stage 1). The increased confidence and interests could also encourage both genders' preference for repair over replacements at Stage 2 and willingness to fix their items at Stage 3, and to complete their entire repair journeys. Moreover, businesses should provide consumers with information about what types of repair work could void warranties or require special tools to support consumers' purchase decisions for the different product types (Table 20).

8.2.2. Innovative sustainable business activities through product repairability

Past studies provided recommendations for business changes based on studying consumers' behaviour and their understanding of product durability and repairability (DEFRA, 2011; European Commission, 2018) or product design (European Commission, 2019). There is a dearth of research on how these recommendations could be adopted in business practices. To bridge this knowledge gap, this PhD recruited the participation of 21 businesses from EEE, clothing and furniture industries (Section 3.4.4) to study their innovative activities for product repairability and repair services.

The businesses reflected upon their business practices to identify opportunities for and challenges to adopting and executing the innovative activities and their value to consumers, society and different business stakeholders) (Section 7.1). Common trends in value to businesses were: (i) the ease of commercial repair processes, either within or out of warranty, and (ii) benefits to brand management. The later included improving customer satisfaction and brand loyalty, thereby gaining more customers or positioning the brand at a higher end of the market. Three key challenges were (i) consumers' preference for replacement of fashion and newly updated technology products, (ii) constraints on businesses' resources (e.g. finance, labour and facilities), and (iii) the lack of collaboration between business stakeholders. These findings confirmed the validity of the conceptual framework to study business innovation for product reparability (Section 2.6). Considering these opportunities and challenges, the research modified the nine activity cards (Figure 20) which aim to provide both generic guidelines for the three industries (e.g. EEE, clothing and furniture) and highlight any differences across these industries.

The findings of value to different business stakeholders, consumers and society (Table 21 and Table 22) also helped to confirm the validity of the Sustainable business model framework (Bocken and Short, 2016, p.44) (Figure 8). In other words, the research validated the methodology of employing the concepts of value proposition, creation, delivery and capture to study business innovation for product reparability, as proposed in the conceptual framework (Table 11). Table 23 presents how the five propositions for SBM innovation proposed in the conceptual framework (Evans *et al.*, 2017) could be delivered through the business activities that promote product reparability. Each of the nine business activities could generate economic, social and environmental benefits (i.e. proposition 1). Economic value could range from the reduced cost of repair processes and the production of standardised products to the upscaling of commercial repair (e.g. easier and safer repair work, sustainable profits from increased demand for repair, after-sales services within warranties or selling spare parts). Social benefits could be associated with improved consumer awareness about product care and repair and their impacts on the environment, the increased certainty, convenience and safety of repair work, and the availability of spare parts and tools at lower prices. Environmental benefits could be the extension of product lifetimes (i.e. more products to be repairable and repaired) and the prevention of replacements and reducing the use of natural resources.

Figure 21 provided recommendations of how businesses could identify the value propositions 2, 3 and 4 through the nine business activities, with consideration of value flows that form a value network. All of the activities could generate value to different business stakeholders (e.g. manufacturers, retailers or brands and repair service providers), consumers and society. A systemic consideration of these stakeholder interests and responsibilities was the key success factor of adopting and executing these activities at the businesses interviewed. However, in some cases, internalising externalities (i.e. proposition 5), such as the internalisation of repair services, and the production or supply of spare parts and tools,

could support the sustainable development of businesses (e.g. extra revenues, increased brand awareness or higher-end position).

This PhD thereby filled a knowledge gap in business innovation for product repairability and repair services and proposed implications for business management. Findings from the business interviews suggested two key implications: collaboration between business stakeholders (Section 7.2.1) and consumer-focused innovation for repairability (Section 7.2.3). The former echoed the literature on sustainable business model innovation (Bocken, Rana and Short, 2015; Geissdoerfer, Vladimirova and Evans, 2018). In particular, the collaboration between business stakeholders could solve sustainability issues and achieve business successes through extending business boundaries. This PhD re-addressed the benefits of integrating the consumer perspective into business innovation for product repairability such as making product design or service solutions meaningful for people and profitable for business. The value of this integration to multi-stakeholders were also found in previous studies on sustainability marketing (Hult, 2011; Sheth, Sethia and Srinivas, 2011) and business model innovation (Bocken, Rana and Short, 2015).

Another implication – business innovation for improving consumers' experience in their repair journeys considering different product sectors and customer types – emerged from the synthesis between the consumer and business studies (Section 7.2.4). Consumer needs for business interventions emerged from the consumer study and their value to businesses and consumers were justified in the business study. The improved availability of and access to repairable products, repair services and customer support, and offering product-service integration could be crucial for forming consumers' intentions to repair or preventing the discontinuation of repair journeys at any stage due to perceived or actual challenges.

The five design strategies – standardisation, simplification, design for safe repair, disassembly, and upgradability (S01) – could ease fault diagnostics at Stage 1 and repair in action at Stage 3 of repair journeys. The consumer study suggested that what mattered most to generation X and Y when identifying repair needs at Stage 1 was whether the functionality of products returned after repair. For this reason, improved product designs that are aligned with the five design strategies and ease repair work are crucial for supporting repair journeys and the future repair decisions of both generations X and Y. Furthermore, businesses should consider the guidelines for each of the three industries (Figure 20). For example, business practitioners from the EEE industry should carefully consider the potential risks of electric shocks when disassembling and reassembling components. Those in the furniture industry should take the durability of materials into account when designing repairable flatpack furniture.

Diagnostic and repair manuals, instructional support (S02) could prevent consumers from wrongly perceiving challenges at Stage 1 and could save time, increase their confidence, and ensure the ease and safety of repair work at both Stages 2 and 3. Considering different product sectors, informative repair manuals could increase consumers' confidence in their

ability to repair clothes and furniture, and prevent their fear of further aesthetic damage to these kinds of products or data loss when fixing EEE products. Consequently, more males could be more confident and interested in mending garments; more females could be willing to repair EEE products. Product teardowns held at the final check before the mass production stage could provide accurate information in repair manuals about the estimated repair time. The consumer study suggested that differences between the actual and estimated repair time could influence the level of satisfaction with repair among consumers in both generations X and Y.

The promotion of product features and repair benefits (S03) could educate consumers about environmental impacts of consumers' purchases and repair work. This business activity could help to form consumers' beliefs about positive outcomes of repair, generate relevant intentions and support the translation of intentions into behaviour. Consequently, there could be a decrease in production and consumption of cheap products such as low-priced small appliances, fast fashion or flatpack furniture, and increased demand for repairable products and repair services. To support consumer purchase decisions for different product types, businesses should provide consumers with information about what types of repair work could void warranties (e.g. use non-original components) or require specialist tools (such as uncommon screwdrivers or sewing machines).

The consumer study suggested that the efficient and cost-effective supply of spare parts were crucial for repair work at Stage 3. This was in line with the integration of repair and reuse (S05) and the transparent spare parts and tools supply chain (S09). Considering the former in the EEE industry, safety concerns could prevent businesses from implementing this activity. However, working modules could be safely reused for future DIY or commercial repair if every module contained a group of components and was placed in a plastic housing. Competent service teams are critical for making creative patterns on garments and parts in the clothing industry to meet consumers' expectations and requirements. The provision of manuals and spare parts to service providers and retailers is essential to improving the quality and safety of repaired or refurbished furniture. Reducing the variety of product models (e.g. through the standardisation and simplification of product designs) could support the supply of spare parts and tools (S09) and ease inventory management. This change could also ease repair journeys through quicker and more accurate fault diagnostics and information search at Stage 1 and 2, and easier and safer repair work at Stage 3.

The localised repair service network (S08) could improve the network of repair services, its responsiveness to local consumer needs and consistency in quality. The consumer study suggested that the reduced waiting and turnaround time of repair services, and improvements in staff competences or in the service network, such as through collaboration between local repairers, could shape consumers' beliefs from the two generations about positive outcomes of repair services – which should be easy, successful and quick, and prevent recurrence of faults. In addition to service quality, businesses should ensure data security, which was essential for consumers to choose commercial repair in the business study. Fashion

brands and retailers could consider partnerships with local dry cleaners for the service localisation, as many of them already offer similar quality repair services. 3D printing of spare parts could make repair of bulky furniture more economical by reducing the need to send broken products to an external workshop for repair.

Activities that promoted repair over replacement within warranties (S04), an exchange model and temporary replacement model (S06), and a fixed cost model or fixed lead-time return model (S07) could increase the number of items that are fixed and bring convenience and certainty (e.g. repair costs and time) to consumers. These benefits could also be delivered through product-service integration models such as the provision of repair services with pay-per-repair billing or monthly or yearly subscriptions and rental services. The product-service integration could streamline the repair journeys of consumers from the two generations and across the three product sectors.

8.2.3. Practical evidence for political discussions

This PhD proposed two complementary policy options for supporting sustainable business innovation for product repairability. The first, through a reconsideration of product standards and aftersales services requirements, may extend producer responsibility and enable collaboration between business stakeholders. These changes could encourage manufacturers, brands, retailers and repair service providers to contribute to innovative activities to better capture opportunities and overcome challenges (Table 21). The second, by governments' financial incentives (e.g. tax breaks, tax rebates or research funding), could support the development and production of repairable products, creative marketing activities and the improvement of repair services.

The integration of these two approaches could support business transformation and product or service diversification, and disrupt the throwaway culture at the same time. They would encourage business to incorporate innovation for product repairability into their business models and commit to sustainability objectives. The objectives should be delivered through the provision of consistent communications with business stakeholders and consumers and the necessary support throughout product lifetimes and during repair journeys. For these reasons, the two proposed policy options should be considered in the discussions of Right to Repair and future action plans for the Circular Economy. The two contributions to knowledge mentioned in Sections 8.2.1 and 8.2.2 would also be foundations for these discussions.

8.3. Research limitations

A larger sample of interviewees from businesses could have been beneficial to this PhD. Representatives of businesses in the interviews provided their personal understanding of business innovation for product repairability and repair services and insights into their own business practices.

Convenience sampling was another limitation of the consumer study. Results and discussions from this study will not be generalisable to the UK population as all participants were from the Nottingham area.

This PhD research avoided, as much as possible, bias from the interviewees (Section 3.7). For example, the Environmental Specialist from an American office furniture manufacturer (FN02) and Head of Technical Services (GM02) preferred talking more about sustainable product design and repair work than their companies' profitability, which is also important in sustainable business innovation. Different business practitioners could have reached distinct conclusions and provided different recommendations.

Another limitation was that time spent on discussions varied across different product sectors in the consumer group discussions or on different business activities in the business interviews. Due to time limits, several discussions focused on some products or business activities more than others.

Finally, some questions about intention and behaviour gaps used technical language. Some participants in the group discussions might not always use the correct terms as defined in the Theory of Planned Behaviour. More valid answers to the identification of these gaps and the factors influencing them could ideally be attained if they were provided with technical terms in advance.

8.4. Suggestions for further research

Considering the scope, findings and limitations of this research, further studies are suggested as follows:

- Conduct quantitative studies on consumer repair journeys at the national or EU level. Consider the demographic (e.g. generations other than Xers and Yers, incomes) and cultural contexts behind repair behaviour and practices.
- Explore the application of the 'consumer repair journey' and business innovation for product repairability and repair services to other product sectors.
- Conduct case study research to investigate business innovation for product repairability and repair services from perspectives of different departments in businesses such as procurement, product design, marketing, production, logistics and customer services.
- Conduct experiments with product prototypes using design strategies for repairability and investigating consumer repair journeys with these products.
- Investigate the effects of the proposed implications for business management when adopting and executing business innovation for product repairability and repair services.
- Measure the social, economic, and environmental impacts of business innovation for product repairability and repair services.

- Measure quantifiable positive and negative impacts on businesses of business innovation for product repairability and repair services.
- Test the proposed policy options.

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Appendix 2. Focus group registration form

Focus group registration

18/09/2021, 19:34



Focus group registration

Dear Sir/ Madam,

I am Tung Dao, a PhD student supervised by Prof. Tim Cooper and Dr. Matthew Watkins from the Product Design department at Nottingham Trent University (NTU). I am undertaking a study on people's decisions to repair their possessions if they break.

I hope you will be able to participate in the focus group titled 'What prevents you from repairing broken products, and what motivates you to repair them?'. It will provide an opportunity for you to share what influenced your intention and behaviour towards fixing your broken item(s).

- Time: Friday, March 1st, between 15:00-17:00
- Venue: at the NTU city campus

Invitation, more background information and the venue, date and time will be sent before the focus group to those filling this form.

If you know others who might be interested in this research, please do share the link with them.

All participants will receive £20 AMAZON VOUCHER.

Thank you.

Kind regards,
Tung Dao - tung.dao2015@my.ntu.ac.uk

Note: The study has been approved by the university ethics committee.

minhtungdao@gmail.com [Switch accounts](#)



*Required

Email *

Your email address _____

Full name *

Your answer _____

Gender *

Female

Male

Prefer not to say

Other: _____

Year of birth (YYYY) *

Your answer _____

Employment status *

- Full-time employment
- Part-time employment
- Not in paid employment
- Self-employed
- In full-time education
- In part-time education
- Retired
- Prefer not to say
- Other: _____

The highest level of education you have completed *

- No formal educational qualifications
- GCSEs/ O-Levels/ CSEs (usually taken at the age of 16)
- A-Levels, BTEC/ technical/ vocational training (usually taken up to the age of 18)
- Technical/ vocational training (usually taken over the age of 18)
- First university degree (e.g., BA, BSc)
- Higher degree (e.g., MA, MSc, PGCE, PhD)
- Other professional qualification (e.g., teaching, nursing, accounting)
- Prefer not to say / Do not know

Have you had experience on repair in the UNITED KINGDOM? (Tick all that apply)

*

- Yes. I PERSONALLY repaired an item.
- Yes. I sent/ took an item to a repair SERVICE.
- No. I INTENDED to repair my item but I CHANGED my mind later.
- No. I have NOT considered repairing any broken item (Please skip the next question)

What product(s) did you repair/ get repaired/ intend to repair? (Tick all that apply)

- Furniture item (home/office)
- Clothing or soft furnishing item
- Electrical or/and electronics item
- Other: _____

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Appendix 3. Focus group guidelines

STRUCTURE AND AGENDA

- 1 moderator and 1 assistant/ note taker
- Duration: approximately 120 mins
- No. of participants: 8-10

OBJECTIVES:

- 1) Identification of the gaps between consumer intention and behaviour at each stage of the consumer repair journey: this outcome will be input (a) to interviews with businesses to identify the match between consumers' intention-behaviour gaps and businesses' constraints. Then, this will be evidence for proposing potential initiatives to support consumers throughout their repair journey.
- 2) Identification of consumers' support needs from manufacturers, retailers and repairers: this outcome will be input (b) to interviews with businesses to identify the match between consumer demand and business supply for the support.
- 3) Identification of differences between young and older generations. This outcome will be input (c) to interviews with businesses to consider different initiatives to specifically support different age groups.
- 4)

No.	Time estimation	Key item/ question	Leading questions	Notes
1	15 mins 15:05-15:20	INTRODUCTION	<p>Welcome and introduction about</p> <ul style="list-style-type: none"> <input type="checkbox"/> The structure and objectives of the session <input type="checkbox"/> Records, moderator and note taker <input type="checkbox"/> Emergency exits and toilets. <input type="checkbox"/> Brief introduction about the proposed consumers' repair journey <input type="checkbox"/> The scope of the session <ul style="list-style-type: none"> ○ You are welcome to share your experience of repairing any broken products you have had. 	<input type="checkbox"/> Slides

			<ul style="list-style-type: none"> ○ However, the products should be from the furniture, clothing, soft furnishing or electronics and electrical product sectors. ○ Your items could be repaired either by yourself or a professional repairer (e.g. a tailor, a plumber, a technician, a mechanist, a carpenter, etc...) <p><input type="checkbox"/> Across the three product sectors, what broken products did you... personally repair?/ ... send/take to a repair service?/... intend to repair but you changed your mind later? Please briefly share the reason why you repaired some products, but not the others.</p>	<input type="checkbox"/> Follow-up sheet
2	95 mins	EXPLORATION OF THE CONSUMER REPAIR JOURNEY		
2.1	<ul style="list-style-type: none"> • 25 mins <p>15:20-15:45</p>	<p>Stage 1: Identifying repair need</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identification of the gaps between intention and behaviour and their reasons (influence of actual behavioural control - ABC and situational context - SC) <input type="checkbox"/> Identification of needs of supports from manufacturers, retailers and repairers <input type="checkbox"/> Identification of differences between 	<ul style="list-style-type: none"> <input type="checkbox"/> You might have different experiences of repairing different broken products, what do you think about the prospect of repair in general? <ul style="list-style-type: none"> ○ Did you think about repair because you wanted to save money, the product was special, you are an ethical consumer or any other reasons? <input type="checkbox"/> Did you generally think of repairing by yourself first or seeking the help of your family member, or a professional repairer from a shop/ retailer/ manufacturer? <input type="checkbox"/> How did you know that your items needed to be fixed (<i>relating to their condition worn-not-torn, faulty-but-functional, faulty-not-functional or irreparable</i>)? <input type="checkbox"/> <i>There are some products you used every day, some others you might use sometimes. Please recall the moment that you identified there was something wrong with your product. What did you do to do to identify that your products needed to be repaired?</i> <ul style="list-style-type: none"> ○ Did you disassemble your items to find the faults yourselves or seek advice and helps from other people, such as friends, parents, repair shops, retailers or manufactures? What factors made you decide to choose either option? ○ Was what you did differently from what you already planned? What did you do differently from what you plan? 	

		<p>young and older generations</p>	<p>□ <i>To identify the repair need, some of you might intend to disassemble the items to find the faults yourselves. Some others might intend to seek advice and helps from other people, such as friends, parents, repair shops, retailers or manufactures. However, in the both scenarios, you might change your mind after that. What factors made you plan and act differently in identifying the repair need?</i></p> <ul style="list-style-type: none"> ○ Do you think the factors where internal (from yourself) or external (from the product or the context)? Such as: <ul style="list-style-type: none"> ▪ Internal factors: <ul style="list-style-type: none"> ⇒ Did a preference for an easy solution generate the difference (between what you planned and acted)? ⇒ Did a lack of time/ tools/ skills/ knowledge about repair generate the difference? ⇒ Did a fear of repair work failure generate the difference? ⇒ Did a previous experience of repair generate the difference? ▪ External factors: <ul style="list-style-type: none"> ⇒ Did the design of the products generate the difference? Such as low-quality materials, non-standardized parts, surface coatings, inappropriate joining technique. ⇒ Did high prices for spare parts/ labour costs generate the difference? ⇒ Did an insufficient repair service generate the difference? ⇒ Did a lack of transparency of information regarding manuals/ spare parts/ repair services generate the difference? ⇒ Did concerns about the legitimacy of the information generate the difference? ⇒ Did rapid changes in technology/ fashion generate the difference? ⇒ Did influences of your families/ friends generate the difference? ○ <i>Were these challenges unexpected? If you were not in that specific situation, would you do exactly what you had planned? Why (not)? For</i> 	<p>□ Did a preference for an easy solution generate any barrier to identify the repair need?</p>
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			<p>example, in the previous focus group, a woman rang customer service of a manufacturer to ask for advice on identifying faults of her washing machine. One staff noted down her report and promised to call her back to give instructions. However, no one called back, that woman decided to buy a new machine.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Have you faced the same challenges that other participants mentioned (considering the different/ same/ similar products)? If not, why not? <ul style="list-style-type: none"> ○ Is it easier to identify the repair needs of some products than others? Can you compare the situation for furniture, clothing or soft furnishing, and electrical and electronic items? <input type="checkbox"/> What could manufacturers, retailers and repairers do to help you to identify the repairability of products easier? In general? Do you think your suggestions should be applied differently across different product sectors? <ul style="list-style-type: none"> ○ Changes in product design (technology, aesthetic, function or material) ○ Improvement of repair services and infrastructure, the convenience of repair, transparency of price and costs ○ Enhancement of emotional bond ○ Promotion of transferable skills and task knowledge, knowledge about the repairability of products and repair services 	
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No.	Time estimation	Key item/ question	Leading questions	Materials
2.2	<ul style="list-style-type: none"> • 25 mins 15:45-16:10	Stage 2: Searching for information and evaluating alternatives <ul style="list-style-type: none"> <input type="checkbox"/> Identification of the gaps between 	<ul style="list-style-type: none"> <input type="checkbox"/> What kinds of information did you look for to make repair decisions for your products? <ul style="list-style-type: none"> ○ Could you find the information you wanted? Where did you get the information from? 	

		<p>intention and behaviour and their reasons (influence of actual behavioural control - ABC and situational context - SC)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identification of needs of supports from manufacturers, retailers and repairers <input type="checkbox"/> Identification of differences between young and older generations 	<ul style="list-style-type: none"> ○ Do you think searching for information on repairing a furniture product is easier than a clothing or soft furnishing product? How easy or difficult is it to find information on repairing electrical and electronic items? ○ How easy or difficult is it to find useful information on DIY repair? How easy or difficult is it to find a reliable professional repair service? <input type="checkbox"/> Tell us about the options you considered at this stage <ul style="list-style-type: none"> ○ Did you compare replacement with repair? If so, how did you compare them? What did you do to evaluate the alternatives? Did you act differently for different kinds of products? (<i>try to cover different product sectors</i>) ○ Did you consider different types of repair, DIY and using a repair service? How did you compare the different options for repair? What did you do to evaluate the alternatives? Did you act differently for different kinds of products? (<i>try to cover different product sectors</i>) ○ Were there any sources that helped you to identify the repair need, such as paper manuals, friends, family, the internet or staff in repair shops? <input type="checkbox"/> Did you do differently from what you already planned when thinking about searching for information for your repair decisions? <input type="checkbox"/> <i>Some consumers might plan to search for information on either DIY repair or professional repair services, but then they might act differently. Did anything make you plan and act differently in searching for information?</i> <input type="checkbox"/> <i>Some consumers might plan to compare repair with replacement, but then they might act differently. Did anything make you give up comparing repair with replacement?</i> <input type="checkbox"/> <i>Some consumers might plan to compare DIY repair with professional repair services, but then they might act differently. Did anything make you give up comparing DIY repair with professional repair services?</i> <input type="checkbox"/> Do you think the factors where internal (from yourself) or external (from the product or the context)? Such as: <ul style="list-style-type: none"> ▪ Internal factors: 	
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			<ul style="list-style-type: none"> ⇒ Did a preference for an easy solution generate a difference (between what you planned and acted)? ⇒ Did a lack of time/ tools/ skills/ knowledge about repair generate the difference? OR did a lack of time generate any barrier to your search for information? ⇒ Did a fear of repair work failure generate the difference? OR did a fear of repair work failure generate any barrier to your evaluation of repair potential? For example, a too complicated instructional video may make you afraid that you may cause more damage to your broken items. ⇒ Did previous experience of repair generate the difference? ▪ External factors: <ul style="list-style-type: none"> ⇒ Did the design of the products generate the difference? Such as low-quality materials, non-standardized parts, surface coatings, inappropriate joining technique. ⇒ Did high prices for spare parts/ labour costs generate the difference? ⇒ Did an insufficient or inadequate repair service generate the difference? Such as lengthy travel, waiting time, low quality ⇒ Did a lack of transparency of information regarding manuals/ spare parts/ repair services generate the difference? ⇒ Did concerns about the legitimacy of the information generate the difference? ⇒ Did rapid changes in technology/ fashion generate the difference? ⇒ Did influences of your families/ friends generate the difference? ○ Were the mentioned challenges unexpected? If you were not in that specific situation, would you do exactly what you had planned? Why (not)? ○ Have you faced the same challenges that other participants mentioned, considering both the products repaired by the owner and the products 	
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			<p>repaired by professionals? If not, why not? Between different ways to approach/ access the information?</p> <ul style="list-style-type: none"> ○ Did you face the same challenges that other participants mentioned (considering the different/ same/ similar products)? If not, why not? □ What could manufacturers, retailers and repairers do to support your search for information? In general? Do you think your suggestions should be applied differently across different product sectors? <ul style="list-style-type: none"> ○ Changes in product design (technology, aesthetic, function or material) ○ Improvement of repair services and infrastructure, the convenience of repair, transparency of price and costs ○ Enhancement of emotional bond ○ Promotion of transferable skills and task knowledge, knowledge about the reparability of products and repair services 	
2.3	<ul style="list-style-type: none"> • 30 mins 16:10-16:40 	<p>Stage 3: Repairing products</p> <ul style="list-style-type: none"> □ Identification of the gaps between intention and behaviour and their reasons (influence of actual behavioural control - ABC and situational context - SC) □ Identification of needs of supports from manufacturers, 	<ul style="list-style-type: none"> □ Did you decide to fix your items immediately after the previous stages in the repair journey or postpone the repair because you felt okay with the current condition of the items? And why? □ During the repair process, did you act differently from what you already planned before starting the repair? <ul style="list-style-type: none"> ○ Have you ever bought parts and tools but then you decided not to repair the items for some reasons? What were the reasons? ○ Have you ever planned to repair your product by yourselves, but then you took it to a service for repair, or the other way round? □ If there was a difference, what factors made you plan and act differently in repairing products? <ul style="list-style-type: none"> ○ Do you think the factors were internal (from yourself) or external (from the product or the context)? Such as: <ul style="list-style-type: none"> ▪ Internal factors: <ul style="list-style-type: none"> ⇒ Did a preference for an easy solution generate a difference (between what you planned and acted)? 	<p>Did a preference for an easy solution generate any barriers to your repair action?</p>

		<p>retailers and repairers</p> <ul style="list-style-type: none"> □ Identification of differences between young and older generations 	<ul style="list-style-type: none"> ⇒ Did a lack of time/ tools/ skills/ knowledge about repair generate the difference? ⇒ Did a fear of repair work failure generate the difference? ⇒ Did previous experience of repair generate the difference? ▪ External factors: <ul style="list-style-type: none"> ⇒ Did the design of the products generate the difference? Such as low-quality materials, non-standardized parts, surface coatings, inappropriate joining technique. ⇒ Did high prices for spare parts/ labour costs generate the difference? ⇒ Did an insufficient or inadequate repair service generate the difference? Such as lengthy travel, waiting time, low quality ⇒ Did a lack of transparency of information regarding manuals/ spare parts/ repair services generate the difference? ⇒ Did concerns about the legitimacy of the information generate the difference? ⇒ Did rapid changes in technology/ fashion generate the difference? ⇒ Did influences of your families/ friends generate the difference? ○ Were the mentioned challenges unexpected? If you were not in that specific situation, would you do exactly what you had planned? Why (not)? □ Have you faced the same challenges that other participants mentioned, considering the different/ same/ similar products? If not, why not? <i>(Try to cover different product sectors)</i> □ Have you faced the same challenges that other participants mentioned, considering between those repaired by themselves and those got repaired by professionals? If not, why not? □ What could manufacturers, retailers and repairers do to encourage consumers to turn their thinking into positive action towards repair? In general? Do you think your suggestions should be applied differently across different product sectors? 	
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			<ul style="list-style-type: none"> ○ Changes in product design (technology, aesthetic, function or material) ○ Improvement of repair services and infrastructure, the convenience of repair, transparency of price and costs ○ Enhancement of emotional bond ○ Promotion of transferable skills and task knowledge, knowledge about the reparability of products and repair services 	
2.4	<ul style="list-style-type: none"> • 15 mins 16:40-16:55 	<p>Stage 4: Evaluating post-repair</p> <ul style="list-style-type: none"> □ Identification of the gaps between intention and behaviour and their reasons (influence of actual behavioural control - ABC and situational context - SC) 	<ul style="list-style-type: none"> □ Have you ever regretted your decisions on repairing or having the item repaired? <ul style="list-style-type: none"> ○ What factors influence your regrets? ○ How satisfied are you with the repair work undertaken? Was the quality of the repair satisfactory? If the repair was undertaken professionally, do you think it was good value for money? ○ What could manufacturers, retailers and repairers do to increase your satisfaction with the quality of the repair? □ Have you ever regretted your decisions on NOT repairing or having the item repaired? <ul style="list-style-type: none"> ○ What factors influence your regrets? 	
3	<p>05 mins 16:55-17:00</p>	CONCLUDING	<ul style="list-style-type: none"> □ Would you like to add any other comments to our discussion today? 	

Appendix 4. Informed consent form for consumer focus groups

NOTTINGHAM TRENT UNIVERSITY

Proforma: Research Consent Information Sheet

Project Title	Product repair – A potential approach to sustainable consumption: a study on consumer repair journey
Principal Investigator	Tung Dao
Project Group	The Sustainable Consumption Research Group
Supported By	Research Council UK – RCUK/ESRC

What is the purpose of this study?

This study aims to identify the challenges and motivations to consumers' product repair decisions.

What are we asking you?

Tell us about why and how you decided (not) to repair your items. You are contributing to a focus group with other participants.

How we would like to use the information provided

The collected information will be used for my PhD study on product repair culture and practices.

Compliance with the Research Data Management Policy

Participant's data will be stored on the principal's personal single password protected laptop.

Nottingham Trent University is committed to respecting the ethical code of conducts of the United Kingdom Research Councils. Thus, in accordance with procedures for transparency and scientific verification, the University will conserve all information and data collected during your interview in line with the University Policy and RCUK Common Principles on Data Policy (<http://www.rcuk.ac.uk/research/datapolicy/>) and the relevant legislative frameworks. The final data will be retained in accordance with the Retention Policy. All data will be anonymised and made available to be re-used in this form where appropriate and under appropriate safeguards.

What are the possible risks or discomforts?

Your participation does not involve any risks other than what you would encounter in daily life. If you are uncomfortable with any of the questions and topics, you are free not to answer.

What are my rights as a research participant?

- You have the right to withdraw your consent and participation at any moment: before, during, or after the interview. If you do wish to withdraw your consent please contact me using my contact details as above.
- You have the right to remain anonymous in any write-up (published or not) of the information generated during this interview.
- You have the right to refuse to answer to any or all of the questions you will be asked.
- You also have the right to specify the terms and limits of use (i.e. full or partial) of the information generated during the interview.
- You have the opportunity to ask questions about this research and these should be answered to your satisfaction.

If you want to speak with someone who is not directly involved in this research, or if you have questions about your rights as a research subject, contact Professor Michael White, Chair for the Joint Inter-College Ethics Committee (JICEC) at Nottingham Trent University. You can call him at 0115 848 2069 or send an e-mail to michael.white@ntu.ac.uk.

What about my Confidentiality and Privacy Rights?

Participation in this research study may result in a loss of privacy, since persons other than the investigator(s) might view your study records. Unless required by law, only the study investigator, members of NTU staff and the sponsoring organisation - RCUK have the authority to review your records. They are required to maintain confidentiality regarding your identity.

Results of this study may be used for teaching, research, publications and presentations at professional meetings. If your individual results are discussed, then a code number or a pseudonym will be used to protect your identity.

Audio/visual recordings

Permission to use audio or visual recordings of your participation, for presentations in the classroom, at professional meetings or in publications, is requested below, as this may be necessary to understand and communicate the results.

Any recorded data will be kept confidential and in a secure place in line with the Research Data Management Policy and destroyed in line with the current RCUK/University Guidelines.

Who should I call if I have questions or concerns about this research study?

You can find me, Tung Dao, via my email address tung.dao2015@my.ntu.ac.uk

CONSENT FORM PROFORMA

Focus group title: What prevents you from repairing broken products, and what motivates you to repair them?

Dear Research Participant,

This study aims to identify the challenges and motivations to consumers' product repair decisions.

There are a number of questions we would like to discuss with you. However, you only need to respond to the ones which you want to. This focus group will last no longer than two hours. All interviews and discussions may be recorded and transcribed into text form with identifying features removed (e.g. names and places). Relevant quotations may then be included in the final report. All recordings will be stored securely and remain confidential.

All participation in the project is voluntary. If do you agree to be part of the project, we would like to use the information to develop a report; but your name and identity will remain anonymous. If you decide at any stage, you no longer want to be part of the project, just let us know and we will make sure any information you have given us is destroyed.

This project has been reviewed by, and received ethics clearance through, the Nottingham Trent University Joint Inter College Ethics Committee.

Please read the following statements:

I have read the above project description, and had an opportunity to ask questions about the research and received satisfactory answers to any questions.
I have had sufficient information to decide whether or not you wish to take part in the study.
I understand that I am free to withdraw from the research at any time by informing the researcher of this decision.
I understand that the information I give will be treated in the strictest confidence.
I agree to take part in the study.
I agree that this interview can be recorded by audio and video devices.
I understand that quotations, which will be made anonymous, from this interview may be included in material published from this research.
I am willing to participate in an interview as part of this research project.
I understand that anonymized data may be used in other studies in line with the University Research Data Management Policy

I confirm that data obtained from the study can be used in the final research report. I understand that the data will be used anonymously: names, places and identifying details will be changed.

Full Name _____

Date _____

If you have any questions please contact me, Tung Dao via tung.dao2015@my.ntu.ac.uk

In line with the Research Data Management Policy, requests may be made to use data from this study for other projects. If you do not wish your anonymized data to be used for future studies please tick here

Appendix 5. Business interview guidelines

Aim: The current research will focus on

- i. studying business initiatives and models that create and promote repair services and repairable products to identify potential value to consumers and different business stakeholders.
- ii. capturing business practices to identify barriers to and opportunities for the repairability of products on the current market.

Sampling: About 21-25 semi-structured interviews will be conducted with the participation of

- i. heads/managers/directors/coordinators of sustainability/ environmental/ customer service department of manufacturers and retailers
- ii. business managers of repair service providers.

Businesses will be selected for the interviews concerning the proposed activities which emerged from the literature and consumer focus groups. In other words, the criteria to select samples are: the company appears to have taken a positive view on product repairability and adopts at least one listed activity. The more activities are implemented, the more preferable the companies are in this research. Companies adopting different activities are preferred in this research. A practical consideration is data availability and access to the organisation. The research expects to have 7-9 businesses from each industry, including textile, furniture and electrical and electronics, engaged in the interviews.

Research questions:

- i. Where do consumers gain value in the proposed activities? How do the activities support consumers at each stage of their repair journey?
- ii. What is value of the proposed activities to the business?
- iii. What is value of the proposed activities to business stakeholders, including manufacturers, retailers, repair companies and repair shops?
- iv. What are business constraints for each activity? Can they be resolved by the integration with other proposed activities or any other solutions?
- v. What are variations in implementing each business activity across different product sectors?
- vi.

Time	Section – questions – probe – prompt (* Important)	Purpose of section
3	<p style="text-align: center;">INTRODUCTION</p> <ul style="list-style-type: none"> <input type="checkbox"/> Introduce myself and the research <input type="checkbox"/> Purpose of this interview <input type="checkbox"/> The interview will last 40 minutes. <input type="checkbox"/> Confidentiality <input type="checkbox"/> Get permission to record <input type="checkbox"/> There is no right or wrong answer <input type="checkbox"/> Feel free to ask for repetition or clarification of the questions at any time. 	
7	<p style="text-align: center;">Theme 1: The prospect of product repairability in the company</p> <ul style="list-style-type: none"> <input type="checkbox"/> To what extent are your products repairable?* <i>Note1 (compared to the secondary data)</i> <input type="checkbox"/> What is the prospect of your products becoming more likely to be repaired in the future? * <i>Note1</i> <input type="checkbox"/> Here are cards of business activities that generate and promote product repairability. Which card(s) give the best description of your business activities?*<i>Note2 (compared to the secondary data).</i> <ul style="list-style-type: none"> <input type="checkbox"/> Probe: Please use blank cards to write any other activities rather than those already mentioned.* <input type="checkbox"/> Tell me reasons for choosing these cards.* <ul style="list-style-type: none"> <input type="checkbox"/> Probe: Please tell me if and how these activities are connected.* <i>(compared to the secondary data)</i> <input type="checkbox"/> Probe: Has your business always conducted these activities? When, how and why were they introduced? <p><i>Note1: These questions are for manufacturers and retailers. For repair companies or repair shops, questions are: What do you think about the repairability of the products that your customers bring here? Do you think what manufacturers could do to produce more repairable products in the future?</i></p> <p><i>Note 2: For businesses that are expected to consider product repairability in the future, questions are: Here are cards of business activities that generate and promote product repairability. Are there any</i></p>	<ul style="list-style-type: none"> <input type="checkbox"/> To understand the role of repairability concept in the organisation, products or services (compared to published material or company website) <input type="checkbox"/> To identify in what way the business promotes product repairability and repair services (with the proposed activities)

	<p>that could support your business growth? If yes, tell me the reasons for choosing these cards. If not at all, why?</p>	
<p>10</p>	<p>Theme 2: Benefits of your business activities to customers, the environment and society</p> <ul style="list-style-type: none"> <input type="checkbox"/> In these activities (on the selected cards), are you targeting different age groups (<i>OR would you target different age groups</i>)? For example, people born in the 1960s and 1970s, who will now be between aged 38 and 54 (the so-called Generation X), and those born in the 1980s and 1990s, who will be between 21 and 37 (the so-called Millennials)? Do you think the attitude and behaviour towards repair of people in the two generations differ? <ul style="list-style-type: none"> <input type="checkbox"/> Prompt: Do their expectations of repairability differ? <input type="checkbox"/> To what extent do you think your customers take product repairability into account in their purchasing decisions?* <input type="checkbox"/> Could you give examples of how the activities on these cards help to avoid unnecessary consumption or premature obsolescence?* How about helping to reduce resource use? <input type="checkbox"/> To what extent do you think these activities (on the selected cards) support (<i>OR could support</i>) your customers' repair decisions?* <small>Note</small> <ul style="list-style-type: none"> <input type="checkbox"/> Prompt: How do you help your customer to diagnose the product fault?* How do you enable your customers to easily get their items repaired?* Do you encourage your customers to repair by themselves?* If yes, in what way?* (<i>compared to the secondary data</i>) <input type="checkbox"/> Probe: Have you ever received any feedback on these activities from your customers?* Were they positive or negative comments or suggestions for improvement? <input type="checkbox"/> Probe: What could you do better to improve your customer satisfaction with these activities (on the selected cards)?* <p style="text-align: center;"><i>Note: For companies that are expected to consider product repairability in the future, questions are: What could you do to help your customers to diagnose the product faults? What could you do to support your customers' searching for information and evaluating alternatives? What do you do to enable your customers to easily get their items repaired or repair by themselves?</i></p> 	<ul style="list-style-type: none"> <input type="checkbox"/> To identify whether and how the business activities promote and support sustainable consumption, particularly in purchase and repair decisions (considering each stage of the consumer repair journey) <input type="checkbox"/> To identify benefits of the business activities to the environment and society <input type="checkbox"/> To identify whether and how the business differently serves Generation X and Y

	<input type="checkbox"/> What do you think the barriers are for the people who don't use your service or product (regarding the selected cards)? How could you help them to change their mind?	
7	<p>Theme 3: Internal and external factors that influence your business activities</p> <input type="checkbox"/> What resources are (<i>OR could be</i>) required to support the activities (on the selected cards)?* such as materials, infrastructure, human resources, technology etc. <ul style="list-style-type: none"> <input type="checkbox"/> Probe: Is there (<i>OR could there be</i>) any constraint on these resources?* <input type="checkbox"/> Probe: What are (<i>OR could be</i>) the trade-offs with other activities?* <input type="checkbox"/> In what way and locations can (<i>OR could</i>) your customers find the product or service mentioned in the selected cards?* Prompt: Can (<i>OR could</i>) they find the product or service online, or from wholesalers, from retailers, or directly from the manufacturers? <ul style="list-style-type: none"> <input type="checkbox"/> Probe: To what extent do existing distribution channels meet your customers' current needs?* <input type="checkbox"/> Please name the business stakeholders who are (<i>OR could be</i>) engaged in these activities.* (such as suppliers, manufacturers, retailers and repair companies or repair shops) <ul style="list-style-type: none"> <input type="checkbox"/> Probe: How important are (<i>OR could be</i>) your stakeholders in supporting the activities (on the selected cards)?* <input type="checkbox"/> Probe: Describe any issues that you have (<i>OR could have</i>) in working with these stakeholders in these activities.* Could you or your stakeholders do anything to resolve these issues? 	<input type="checkbox"/> To identify barriers to and opportunities for the business activities, including internal resources and external collaboration
5	<p>Theme 4: Benefits of your business activities to different stakeholders</p> <input type="checkbox"/> What is (<i>OR could be</i>) the relative importance of these activities to your business (relating to the selected cards)?* <ul style="list-style-type: none"> <input type="checkbox"/> Probe: Do (<i>OR could</i>) the activities generate profitable or sustainable revenue streams/ regular income?* Does (<i>OR could</i>) ever-changing technology or trends in fashion influence your revenue streams in general and that relating to these activities? <input type="checkbox"/> Probe: Besides revenue, is there (<i>OR could there be</i>) any competitive advantage that you can gain from these activities?* (Prompt: How about gaining brand loyalty and winning over consumers from your competitors?) 	<input type="checkbox"/> To identify whether and how the activities contribute to the sustainable development of the business and its stakeholders

	<ul style="list-style-type: none"> <input type="checkbox"/> What is (<i>OR could be</i>) the relative importance of these activities to your business stakeholders (e.g. suppliers, manufacturers, retailers, repair companies and repair shops)?* <input type="checkbox"/> Probe: How do manufacturers (and retailers) benefit from your business activities, if applicable? 	
5	<p>Theme 5: Potential for your business growth through a greater focus on product repairability or repair service development</p> <ul style="list-style-type: none"> <input type="checkbox"/> Do you think your business has potential for growth through the activities (on the selected cards)?* <ul style="list-style-type: none"> <input type="checkbox"/> Probe: What are (<i>OR could be</i>) the biggest barriers to the growth?* <input type="checkbox"/> Probe: What could the government do to enable you to overcome the barriers?* <input type="checkbox"/> Here are the cards you didn't choose before. Are there any that could support your business growth? If so, how and in what way?* <input type="checkbox"/> Prompt: Do you need any support from the government to start launching these activities more easily? If so, how and in what way?* <input type="checkbox"/> Why do you think the activities on the remaining cards might not support your business growth?* 	<ul style="list-style-type: none"> <input type="checkbox"/> Identify potential for the business growth and support needs from the government
3	<p>WRAPPING UP</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ask whether anyone has any other comments <input type="checkbox"/> Thank participants for their contribution <input type="checkbox"/> Reiterate what is being done with the results of the discussion 	

NOTTINGHAM TRENT UNIVERSITY

Proforma: Research Consent Information Sheet

Protocol Title	Commercial repair as a potential approach to sustainable business
Principal Investigator	Tung Dao
Project Group	The Sustainable Consumption Research Group
Supported By	The UK's Engineering and Physical Sciences Research Council (led by Prof. Tim Cooper)

What is the purpose of this study?

The interview will focus on:

- studying business initiatives and models that create and promote repair services and repairable products to identify potential value to consumers and different business stakeholders
- capturing business practices to identify barriers to and opportunities for the repairability of products on the current market.

What are we asking you?

Tell us about your own perspective on:

- the value of product repairability to your customers, your business and your business stakeholders
- barriers to and opportunities for creating and promoting repairable products and repair services.

The interview structure is shown in the last page of this document.

How we would like to use the information provided

Findings will provide evidence for business stakeholders interested in improving product repairability and promoting repair services as a form of business model innovation, and for policymakers to regulate and support these business strategies.

The knowledge emerged from this study is also expected to contribute to generating policy instruments to stimulate engagement of consumers and business stakeholders in repair practices.

Compliance with the Research Data Management Policy

Nottingham Trent University is committed to respecting the ethical code of conducts of the United Kingdom Research Councils. Thus, in accordance with procedures for transparency and scientific verification, the University will conserve all information and data collected during your interview in line with the University Policy and RCUK Common Principles on Data Policy (<http://www.rcuk.ac.uk/research/datapolicy/>) and the

relevant legislative frameworks. The final data will be retained in accordance with the Retention Policy. All data will be anonymised and made available to be re-used in this form where appropriate and under appropriate safeguards.

What are the possible risks or discomforts?

Your participation does not involve any risks other than what you would encounter in daily life. If you are uncomfortable with any of the questions and topics, you are free not to answer.

What are my rights as a research participant?

- You have the right to withdraw your consent and participation at any moment: before, during, or after the interview. If you do wish to withdraw your consent please contact me using my contact details as above.
- You have the right to remain anonymous in any write-up (published or not) of the information generated during this interview.
- You have the right to refuse to answer to any or all of the questions you will be asked.
- You also have the right to specify the terms and limits of use (i.e. full or partial) of the information generated during the interview.
- You have the opportunity to ask questions about this research and these should be answered to your satisfaction.

If you want to speak with someone who is not directly involved in this research, or if you have questions about your rights as a research subject, contact Professor Michael White, Chair for the Joint Inter-College Ethics Committee (JICEC) at Nottingham Trent University. You can call him at 0115 848 2069 or send an e-mail to michael.white@ntu.ac.uk.

What about my Confidentiality and Privacy Rights?

Participation in this research study may result in a loss of privacy, since persons other than the investigator(s) might view your study records. Unless required by law, only the study investigator, members of NTU staff and the sponsoring organisation [details] have the authority to review your records. They are required to maintain confidentiality regarding your identity.

Results of this study may be used for teaching, research, publications and presentations at professional meetings. If your individual results are discussed, then a code number or a pseudonym will be used to protect your identity.

Audio/visual recordings

Permission to use audio or visual recordings of your participation, for presentations in the classroom, at professional meetings or in publications, is requested below, as this may be necessary to understand and communicate the results.

Any recorded data will be kept confidential and in a secure place in line with the Research Data Management Policy and destroyed in line with the current RCUK/University Guidelines.

Who should I call if I have questions or concerns about this research study?

You can find me, Tung Dao, via my email address tung.dao2015@my.ntu.ac.uk.

CONSENT FORM PROFORMA

Dear Research Participant,

This study aims to identify the barriers to and opportunities for the promotion of repairable products and repair services. One area that we want to explore is whether businesses could increase their revenue from after-sales services and gain greater customer loyalty and business brand reputation. Findings will provide evidence for business stakeholders interested in improving product repairability and promoting repair services as a form of business model innovation, and for policymakers to regulate and support these business strategies. The knowledge emerged from this study is also expected to contribute to generating policy instruments to stimulate engagement of consumers and business stakeholders in repair practices.

There are a number of questions we would like to discuss with you. However, you only need to respond to the ones which you want to. The interviews will last no longer than 40 minutes. All interviews may be recorded and transcribed into text form with identifying features removed (e.g. names and places). Relevant quotations may then be included in the final report. All recordings will be stored securely and remain confidential.

All participation in the project is voluntary. If do you agree to be part of the project, we would like to use the information to develop a report; but your name and identity will remain anonymous. If you decide at any stage, you no longer want to be part of the project, just let us know and we will make sure any information you have given us is destroyed.

This project has been reviewed by, and received ethics clearance through, the Nottingham Trent University Joint Inter College Ethics Committee.

Please read the following statements:

I have read the above project description and had an opportunity to ask questions about the research and received satisfactory answers to any questions.
I have had sufficient information to decide whether or not you wish to take part in the study.
I understand that I am free to withdraw from the research at any time by informing the researcher of this decision.
I understand that the information I give will be treated in the strictest confidence.
I agree to take part in the study.
I agree that this interview can be recorded by audio devices for face-to-face interviews or Skype application for online ones.
I understand that quotations, which will be made anonymous, from this interview may be included in material published from this research.
I am willing to participate in an interview as part of this research project.
I understand that anonymized data may be used in other studies in line with the University Research Data Management Policy

I confirm that data obtained from the study can be used in the final research report. I understand that the data will be used anonymously: names, places and identifying details will be changed.

Full Name _____

Date _____

If you have any questions please contact me, Tung Dao via tung.dao2015@my.ntu.ac.uk

In line with the Research Data Management Policy, requests may be made to use data from this study for other projects. If you do not wish your anonymized data to be used for future studies, please tick here

INTERVIEW STRUCTURE

Time	Section	Purpose of section
3	Introduction	
7	Theme 1: The prospect of product repairability in the company	<ul style="list-style-type: none"> <input type="checkbox"/> To understand the role of repairability concept in the organisation, products or services <input type="checkbox"/> To identify in what way the business promotes product repairability and repair services (with the proposed activities)
10	Theme 2: Benefits of your business activities to customers, the environment and society	<ul style="list-style-type: none"> <input type="checkbox"/> To identify whether and how the business activities promote and support sustainable consumption, particularly in purchase and repair decisions (considering each stage of the consumer repair journey) <input type="checkbox"/> To identify benefits of the business activities to the environment and society <input type="checkbox"/> To identify whether and how the business differently serves Generation X and Y
7	Theme 3: Internal and external factors that influence your business activities	<ul style="list-style-type: none"> <input type="checkbox"/> To identify barriers to and opportunities for the business activities, including internal resources and external collaboration
5	Theme 4: Benefits of your business activities to different stakeholders	<ul style="list-style-type: none"> <input type="checkbox"/> To identify whether and how the activities contribute to the sustainable development of the business and its stakeholders
5	Theme 5: Potential for your business growth through a greater focus on product repairability or repair service development	<ul style="list-style-type: none"> <input type="checkbox"/> Identify potential for the business growth and support needs from the government
3	Wrapping up	