SUSTAINABLE DESIGN CONSIDERATIONS FOR EMOTIONAL DURABILITY AND PRODUCT LONGEVITY THROUGH PRODUCT CARE ACTIVITIES BY REPAIR ENTHUSIASTS

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ABSTRACT

SUSTAINABLE DESIGN CONSIDERATIONS FOR EMOTIONAL DURABILITY AND PRODUCT LONGEVITY THROUGH PRODUCT CARE ACTIVITIES BY REPAIR ENTHUSIASTS

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Take-make-dispose behaviours as the basis of the linear economy model are challenged by the sustainable modes of consumption that aim to minimise the use of raw materials and waste production. The most prominent among these is the *circular economy* model, which resembles the production and consumption cycles to a living system, and proposes alternative systems where there is no such thing as waste but only food for another within the system (Ellen MacArthur Foundation, 2015). Therefore, the aim is to protect the value of the products for a more extended period, preferably through repair and maintenance activities to avoid creating waste and using raw materials for a new product. As the literature on product longevity shows, people pay more attention to protect and prolong the lifetime of the objects they feel attached to (Mugge et al., 2008). *Product care behaviours* that aim to extend products' lifetimes, such as repair and maintenance (Ackermann, 2018), are the examples of the protective behaviours that users exhibit, which also strengthens the user-product relationship (Hernandez et al., 2020). Therefore, this design research attempts to show the significance of product care behaviours to strengthen the

emotional bond between users and products that serve for product longevity. The secondary aim is to investigate the reflections of the *right to repair movement* and circular economy in the user-product relationship. To meet the study's objectives, nineteen semi-structured interviews with repair enthusiasts that are the members of repair initiatives are conducted, and some of the initiatives are visited for user observations to understand the *nature of repair* for end-users. There are five significant conclusions of the research that are informed both from related literature and the field study: 1) Product care is a *skill-oriented practice* that involves *creative processes*, 2) Product care activities transform or change the roles and perception of users, 3) Priorly obscure objects transform into identifiable sums of components that are *open to intervention* while users conduct product care activities, 4) Repair communities are significant actors of *teaching, encouraging and inspiring* product care activities that support the right to repair movement, 5) Product care activities create and strengthen the *emotional bond* between users and products.

Keywords: Circular Economy, Product Longevity, Emotional Durability, Product Repair and Maintenance, Product Care Behaviours

ÖZ

TAMİR MERAKLILARININ ÜRÜN BAKIM FAALİYETLERİ YOLUYLA DUYGUSAL DEVAMLILIK VE UZUN ÖMÜRLÜLÜK SAĞLAMALARI İÇİN SÜRDÜRÜLEBİLİR TASARIM ÖLÇÜTLERİ

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Doğrusal ekonomi modelinin imzası olan al-yap-at davranışlarına, hammadde kullanımını ve atık üretimini en aza indirmeyi amaçlayan sürdürülebilir tüketim biçimleri meydan okumaktadır. Bunların arasında en öne çıkan *döngüsel ekonomi* modeli, üretim ve tüketim döngülerini canlı bir sisteme benzeterek atığın olmadığı yalnızca bir başkası için gıda oluşturulan sistemler önerir. Bu nedenle, tercihen onarım ve bakım faaliyetleri ile ürünlerin değerinin daha uzun süre korumak ve böylece atık oluşturmamak ve yeni bir ürün için hammadde kullanmaktan kaçınmak temel amaçtır. Ürün ömrü ile ilgili literatürün gösterdiği gibi, insanlar bağlı hissettikleri nesneleri korumaya ve onların ömürlerini uzatmaya daha fazla özen gösterir (Mugge vd., 2008). Ürünlerin ömrünü uzatmayı amaçlayan onarım ve bakım gibi *ürün bakım davranışları* (Ackermann, 2018), kullanıcı-ürün ilişkisini de güçlendiren koruyucu davranışlara örnektir (Hernandez ve diğerleri, 2020). Bu nedenle, bu tasarım araştırması, kullanıcılar ve ürünler arasındaki *duygusal bağı* güçlendirmek için ürün bakım davranışlarının önemini ve güçlendirilen bağın ürün ömrünü uzatmaktaki etkisini göstermeye çalışmaktadır. İkincil amaç ise, kullanıcı-ürün ilişkisinde *tamir hakkı hareketi* ve döngüsel ekonominin yansımalarını

araştırmaktır. Çalışmanın amaçlarına ulaşmak ve son kullanıcılar için onarımın doğasını anlamak için, onarım girişimlerinin üyesi olan onarım meraklılarıyla on dokuz yarı yapılandırılmış görüşme yapıldı ve bazı girişimler kullanıcı gözlemleri için ziyaret edildi. Araştırmanın hem ilgili literatürden hem de alan çalışmasından edinilen beş önemli sonucu oldu: 1) Ürün bakımı, *yaratıcı süreçleri* içeren ve *beceri odaklı* bir pratiktir. 2) Ürün bakım faaliyetleri, kullanıcıların rollerini ve algısını dönüştürür veya değiştirir. 3) Önceden kimliğini gizleyen nesneler, kullanıcıların ürün bakım faaliyetlerini yürütmesiyle *müdahaleye açık*, parçalarının tanımlanabilir olduğu şeffaf ürünlere dönüşür. 4) Onarım toplulukları, onarım hareketini destekleyen ürün bakım faaliyetlerini *öğreten, teşvik eden* ve bu konuda insanlara *ilham veren* önemli aktörlerdir. 5) Ürün bakım faaliyetleri, kullanıcılar ve ürünler arasındaki *duygusal bağı* oluşturur ve güçlendirir.

Anahtar Kelimeler: Döngüsel Ekonomi, Uzun Ömürlülük, Duygusal Devamlılık, Ürün Tamir ve Bakımı, Ürün Bakım Davranışları

Dedication

To my mom and dad –the ultimate repairers, and to my beloved sister

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neighbour, thanks to *Elif Soycan*, with whom I started my professional designer career and who become one of the best colleague, thanks to *Ege Çakaloz* with who we sprout the first ideas for enhancing design education and supporting each other through the dark times before deadlines. Lastly, thanks *Tunahan Yıldız* for being a last minute life saver.

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CHAPTER 1

INTRODUCTION

1.1 Research Motivation and Background

Sustainability is a central research area for most disciplines today. Especially, the industrial design discipline, which was found as one of the most harmful professions (Papanek, 1971), seeks an opportunity to redeem itself from the bad reputation attached to its name since the Industrial Revolution. However, there are attempts in the discipline to change this perception. The boundaries of the profession are rapidly expanding through system thinking and service design, as indicated in the World Design Organization's (WDO) definition of industrial design (wdo.org, n.d.). WDO is also embracing the UN Sustainable Development Goals (SDGs) and organizing events on the topics of sustainable consumption and production. Moreover, design education is also transforming through the growing body of research and projects in the field of *design for sustainability*. Therefore, there is still a chance to escape the shadows of the past. As this is another work that aims "not to do any harm", I hope to contribute to the sustainability field by using a *designerly way of researching transition* towards linear to the *circular economy* by investigating the effects on and significance of the *transition for users*.

The linear economy model's signature is the *take-make-dispose practice* which draws its power from constant consumption of natural resources. Since the resources are depleting, the linear model is no longer viable and is challenged with the circular economy model that offers a closed-loop system in which materials are recovered and reused as many times as possible to eliminate waste production (Ellen MacArthur Foundation, 2015). The significance of the circularity lies in creating slower and tighter loops. When loops are slowed down, the products and materials can circulate longer without losing their value; when the loops get tighter, the energy

and labour needed for production decrease (Ellen MacArthur Foundation, 2015). Therefore, the purpose is to slow the production circle's pace, and keep them closer to the innermost cycle. The Butterfly Diagram (see Figure 2.2) that Ellen MacArthur Foundation provides information about how raw materials, energy, labour, and products circulate within the production system and displays biological and technical loops from smaller to bigger, inner to outer. The technical side where products are placed suggests -from inner to outer cycles- the first one should maintain their product through repair. If this is not possible, then reuse or remanufacture, and as a least wanted option, they should recycle the product. Therefore, the innermost cycle hosts the maintenance and repair activities that help prolong the product's lifetime and postpone raw material entrance into the system to produce a new product (Terzioğlu, 2017). As products stay for a more extended period with the user when it is repaired (Ackermann, 2018), Terzioğlu (2017) finds the innermost circle as an area of intervention for engaging users with the complex structure of the *circular economy* and changing their behaviours. Repair and maintenance work aiming to prolong the product's lifetime, called *product care activities* by Ackermann (2018), can also be a place to interact with the user's understanding of sustainability on a *personal level* (Walker, 2017) besides the economical, environmental, and social aspects of them. Therefore, understanding the *nature of repair* for the users and empowering them through their endeavours become a significant contribution.

Product longevity is not a straightforward concept that takes place when products are designed to last longer since users are the ones to decide to keep or discard a product (Stahel, 1986). Products can still be prematurely discarded without completing their *expected lifespan* when they complete their lifespan in user's perspective (Cooper, 2005). *Premature product replacement* (Cooper, 2005) can result from a weak bond between the user and the product, therefore providing space for users to develop an *emotional attachment* and empowering them through product care processes becomes more prominent for this study.

1.2 Significance of Research

Developing strategies for deeper user-product relationships is a fruitful area for designers to create various proposals. Creating an *emotional bond* between the user-product (Chapman, 2005) is one of the most significant ways of achieving that. While Mugge et al. (2005) suggest creating a *shared history through product personalisation*, Fuad-Luke (2008) proposes *halfway products* to personalise and increase user involvement in the production phase. On the other hand, Rognoli and Karana(2014) suggest that products *age in dignity* through usage can increase emotional engagement. Correlatively, Walker (2010a) *endure and evolve scenarios* to adopt the users changing needs to evolving products is another design proposal to increase user engagement with products. Although all these suggested strategies open space for user empowerment, it is still challenging for a designer to attribute personal meanings to products and predict the emotional reaction of users, which occurs beyond the designer's influence (Ozan & Doğan, 2014). That is why examining the relationship of maintenance and repair activities on emotional bonding and longevity can be a more concrete endeavour for designers to produce strategies that open space for *user intervention* and *empowerment.*

Another significant point to research the product care processes is the multi-dimensional experience it provides to users and the possibility to observe the transition of users, objects, and repair communities simultaneously. In other words, examining product care behaviours lies at the heart of where the transition of users, products and communities intersect with another. While the European Union's *Right to Repair Directive* (2019) has supported the *repair movement for bottom-up initiatives,* the rising number of scholarly works that examine repair experience for diverse user intentions and product groups (Terzioğlu, 2017; Özçelik, 2020) support the design field to understand the people's changing perception towards repair and maintenance. Moreover, the study of Hernandez et al. (2020) is one of the few studies that highlight the connection between repair practices and emotional durability and points out that this area has not been explored extensively yet. Therefore, this

research is constructed to investigate the transformative effect of product care habits on people, objects, and communities within an emotional durability perspective.

1.3 Aim of the Research

The literature on transitioning to circular economies suggests that empowering users during their attempts to repair and maintain their products is crucial in preventing premature product replacement. Therefore, this study first investigates how users are undertaking repair and related care works through which motivations and what are the limitations they are experiencing and witnessing while doing so. Therefore, semi-structured interviews with the participants from repair-related communities were conducted to understand the nature of product care works for people who are willing to extend their product's lifespans. Afterwards, the researcher interrogates the repair communities' effects on forming a caring habit in people. While doing so, the study aims to figure out the impacts of care habits on the formation of *emotional attachment* to products while also investigating how users regain their right to repair in creating circular economies.

1.4 Research Questions

The main research question is:

- What are the product care approaches adopted and applied by repair enthusiasts for extending product lifespan, and their significance for developing emotional attachment between users and objects within the scope of design for sustainability?

The sub-questions that support the main questions are:

- What are the enabling and limiting factors for adopting product care habits and behaviours through considering user, object and community?

- What are the user tendencies, approaches, attitudes and level of design intervention towards product care works?
- What are the levels of product's allowance for user intervention?
- What are the roles of repair communities in forming product care behaviours?
- How do product care behaviours affect the formation of emotional attachment, and what would be the design directions to influence those behaviours?

1.5 Structure of the Thesis

This thesis is split into the following five chapters to answer the research questions:

Chapter 1, *Introduction,* presents a guide about the thesis for the audience by providing a background to construct this work together with the aim, scope, significance of the study and the research questions.

Chapter 2, *Literature Review,* starts with explaining the transformation from linear to circular economy model, then continues with the importance given to the repair and maintenance works for extending the lifespan of products for achieving the transition to circularity. Afterwards, the prominent studies for extending the product lifespan are categorized and explained with examples. Lastly, the design research on enhancing user-product relationships through product care activities is discussed to create a background for the field study.

Chapter 3, *Methodology*, explains the conduct of the research through detailed information on the methods of sampling, recruitment, data collection and analysis.

Chapter 4, *Findings,* is the section where the emerging findings and insights from the field research is presented. They are divided into five categories which are respectively, *nature of the repair*, *users in transition*, *objects in transition*, *communities in transition*, *emotional durability and product care*.

Chapter 5, *Conclusion,* starts with an overview of the study and summarises the main conclusions by answering the research questions one by one. Lastly, it explains the limitations of the study and offers suggestions for further studies about empowering users in their attempt to repair and maintain their products for extending their use time.

CHAPTER 2

LITERATURE REVIEW

2.1 Transition Towards Circular Economy

The excerpt from Victor Papanek's (1971) book Design for the Real World: Human Ecology and Social Change emphasizes the detrimental effect of designers to the consumption culture:

> There are professions more harmful than industrial design, but only a very few of them. And possibly only one profession is phonier. Advertising design, in persuading people to buy things they don`t need, with money they don't have, to impress others who don't care, is probably the phoniest field in existence today. (p.9)

As a reply to Papanek's observation, Thackara (2005, p. 7) states that "This kind of blaming and shaming is counterproductive and unjustified. "Although it seems intimidating, this explicit articulation of the design profession status quo helped designers reconsider their duties and start creating new directions. Chapman and Gant (2007) support Papanek by stating, "It could even be said that, in today's new and enlightened age of sustainable awareness, design has become a lazy and somewhat cosmetic practice that erodes consumer consciousness to nurture promiscuous cultures of more, more and yet more" (p. 4). Also, they support Thackara by saying that putting all the burden of the consumption patterns on the designer's shoulder is neither fair nor productive. Chapman and Gant (2007, p. 6) find the question of "Why design anything at all?" as an essential point to start.

All these critical views helped the design field to be informed and redesign the way it operates. After the pioneers in the field of sustainability like Emily Carson and Victor Papanek, the body of work created has significantly grown. New methods and approaches have been studied to reshape the current consumption and production cultures (see Section 2.1.2). In the last few years, we are witnessing the rise of the *circular economy* (Ellen MacArthur Foundation, 2013a).

The emergence of the circular economy affects the field of design for sustainability for sure and made some significant changes. First of which is studying the production and consumption together and taking into consideration the whole life cycle of a product from pre-purchase to post-purchase. The other change is in the way users are perceived within the production and consumption processes. While they seemed as mere consumers of the products, with the circular economy, the importance of the active users is not ignored, and the contribution of their practices is included. That is why this section of the review is allocated for the circular economy. It will start by explaining the limitations of the linear economy and continue with the definition of circular economy and the explanation of the roots it's coming from. Afterwards, principles, advantages and approaches towards a circular economy will be illuminated. Lastly, the role of users within the circular system will be discussed.

2.1.1 Limits of the Linear Economy

Understanding the transition towards the circular economy, first, one should understand where this transition is coming from. Our prominent consumption culture is indicated as a linear economy in which raw materials enter the system, and consequently, the expected product exits together with the waste it produced (Mestre & Cooper, 2017). Therefore, the linear economy is defined by *take-make-dispose* practices, and it is highly dependent on using raw materials (Ellen MacArthur Foundation, 2013a). That is why depleting natural resources is a key factor that pushes for the transition, since the environment can no longer support the ever-increasing demands of the linear economy. Other factors than the resource-scarcity

are forcing companies to change direction, such as increasing material cost, price volatility and above all, the snowballing problem of waste (Ellen MacArthur Foundation, 2013b).

On the other hand, the circular economy aims to limit the usage of raw materials and the production of waste by creating close loops in which materials and products are recovered and reused as many times as possible (MOOC, 2020). It corresponds to a "model of closing material loops in an economically attractive way to decouple wealth from resource usage." (Van den Berg & Bakker, 2015, p.365). This economic model creates several circles to achieve close loops of production and consumption to prevent irresponsible resource use (Van den Berg & Bakker, 2015). Although there are other attempts to define the circular economy, Ellen MacArthur Foundation chooses to characterise it as a model that is "restorative and regenerative by design" (2015, p.5). Probably the most important characterisation of the circular economy is that it is inspired and informed by living systems (Ellen MacArthur Foundation, 2013a). Moreover, as the foundation indicates, the purpose of the model is to keep products, components, and materials within the closed loops as long as possible without compromising their function and value, while managing finite resources responsibly and creating renewable flows (2015).

2.1.2 Roots of Circular Economy

No one gainsays the fact that the circular economy model is informed from other schools of thoughts (Van den Berg & Bakker,2015), such as *cradle-to-cradle* (McDonough and Braungart, 2002), *natural capitalism* (Amory and Hunter Lovins and Paul Hawken, 2013), *biomimicry* (Benyus, 1997), *performance/sharing economy* (Stahel, 2006), *industrial ecology* (Lifset and Graedel, 2001), and *life cycle assessment* (Ayres, 1995).

These significant models that are the roots of the circular economy extend back to the 1970s; however, they could draw attention in the 1990s (Ellen MacArthur

Foundation, 2015). Lately, however, the circular economy is taking centre stage to meet the challenges of having responsible production and consumption systems (Hernandez et al., 2020). It is not in the interest of the industry alone but also of the scholars since it is recognised as a model that could operationalise wicked problems of sustainable development goals (Ghisellini et al., 2016; Kircherr et al., 2017; Hernandez et al., 2020).

2.1.3 Principles of Circular Economy

As mentioned in the earlier section, the circular economy is regenerated by observing living systems (Ellen MacArthur Foundation, 2013a). When we think of how to relate manufactured systems with living systems, a closer look at the diagram provided below could help us find an answer, as it holds the main principles within (Ellen MacArthur Foundation, 2011).

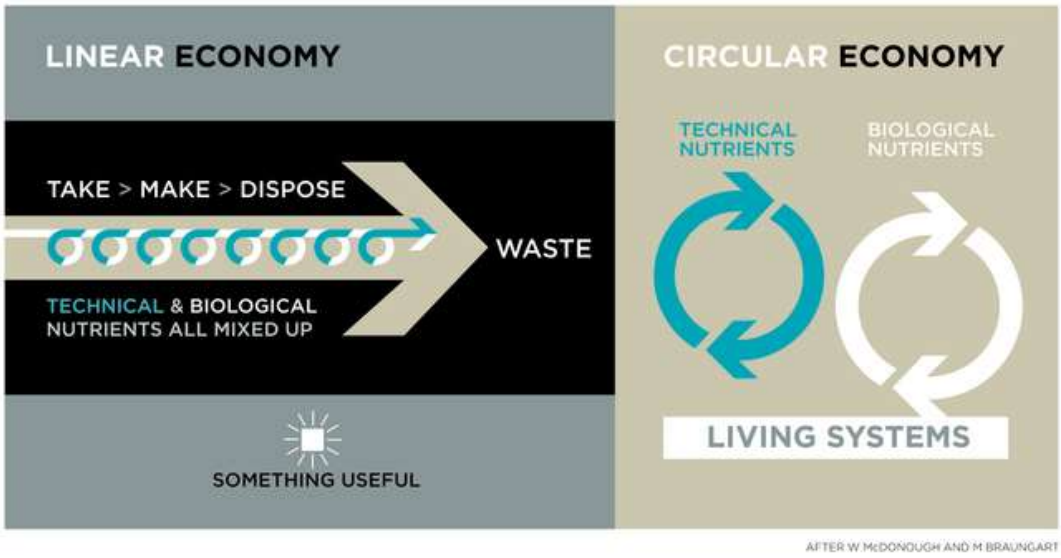


Figure 2.1 Linear economy and circular economy diagram. (Ellen MacArthur Foundation, 2011).

The first thing to keep in mind is, living systems do not produce waste; it only becomes some others' food within the system (MOOC, 2020). That is why, turning waste into a natural capital and preserving it is the first principle of circular economy (Ellen MacArthur Foundation, 2015). MOOC (2020) suggests that the redesigning of products with a consideration of their reuse and disassembly at their end of life can be a way to translate the idea of waste in the living system into our manufactured world. The second principle is to circulate products and materials within the system as long as possible in both the technical and biological cycles of the living systems (Ellen MacArthur Foundation, 2015). On the right half of the diagram above (see Figure 2.1), there are two concurrently working cycles; one corresponds to the technical cycle in which durables are produced with technical nutrients, and the other cycle called the biological cycle that produces consumables that are composed of biological nutrients (Ellen MacArthur Foundation, 2013b). The third and last principle is to provide a resilient system that is less dependent on finite resources and renewable by nature for the circular economy to operate correctly (Ellen MacArthur Foundation, 2013b). These three principles of circular economy can clear the way for achieving sustainability goals.

2.1.4 Approaches to the Circular Economy

The transformation from our current *take-make-dispose* linear economy to the circular one requires significant changes in the way we perceive production and consumption. To ease the transition phase towards the circular economy, two major approaches are adopted. One is slowing the flow of materials by circling products longer within the loop, and the other is keeping the loops as tight as possible to decrease the amount of energy spend to fuel the system (Bakker et al., 2014; Ellen MacArthur Foundation, 2015; Mestre & Cooper, 2017; Mugge, 2018; Terzioğlu, 2017b).

The first approach *slowing the loop* is also interpreted as the *power of circling longer* by Ellen MacArthur Foundation (2015), and it indicates extending the time spent in each cycle without losing the products and materials value (Terzioğlu, 2017b). The strategies of slowing the loop include designing durable products, postponing the replacement of the products through *emotionally durable design* (Chapman, 2005), and designing for maintenance and repair (Huang et al., 2016).

The second approach is called *power of inner circle* by Ellen MacArthur Foundation (2015), and it is illustrated with the circular economy systems diagram (Ellen MacArthur Foundation, 2019). The diagram (see Figure 2.1) displays biological and technical loops from smaller to bigger, inner to outer. The technical side suggests - from inner to outer cycles- first to maintain the product through repair, if it is not possible to reuse or remanufacture and as a least wanted option recycle the products. A quote from Stahel (2007, p. 10) explains which strategy to take into consideration for staying in the inner loop: "do not repair what is not broken, do not remanufacture something that can be repaired, do not recycle a product that can be remanufactured." The reason to keep the flow in the inner circle as much as possible is to minimize the material, energy and labour needed to produce goods (Ellen MacArthur Foundation, 2015).

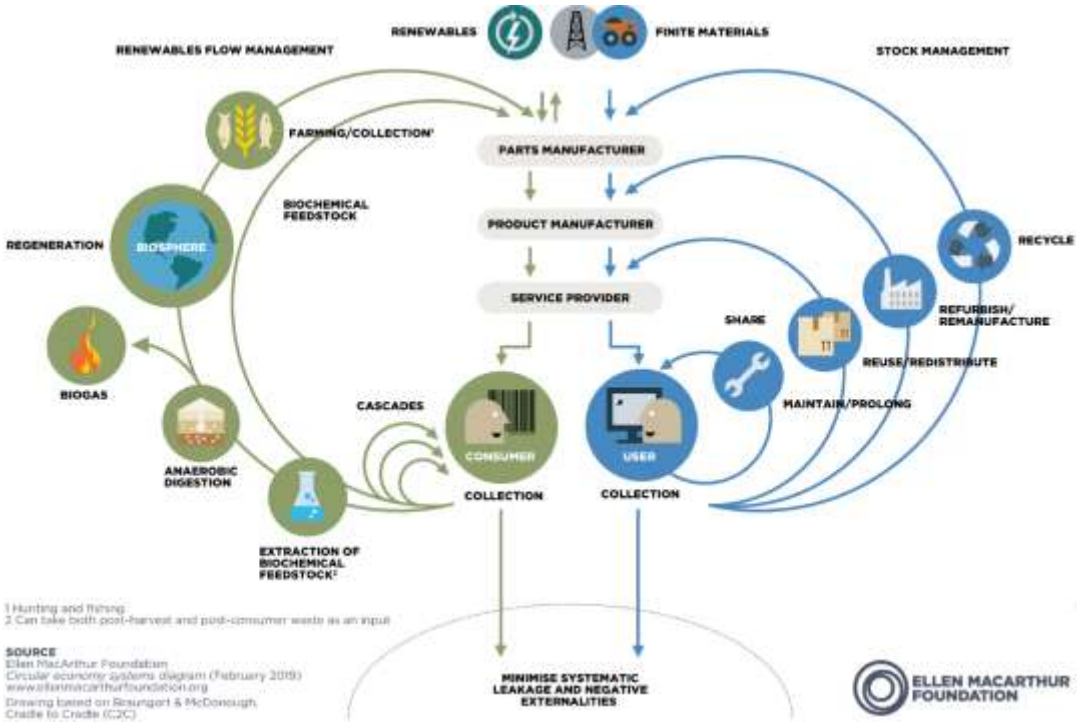


Figure 2.2 Circular economy systems diagram (Ellen MacArthur Foundation, 2019).

Slowing down and closing the cycles and keeping this in the innermost cycle is the primary purpose of the circular model. Therefore, the effectiveness of protection through repair becomes more apparent, since it prolongs the existing products' lifetime and eliminates the new material entrance to the system (Terzioğlu, 2017b). When a product stays in the innermost cycle longer through maintenance and repair activities, it means it is staying closer to the user for a more extended period of time (Ackermann, 2018). According to Terzioğlu (2017b), it can be an area of opportunity where the user can engage more easily with the complicated structure of the circular economy and change their behaviours.

2.1.5 Consumer's Perspective of and Engagement with the Circular Economy

Although the circular economy is popularised amongst different actors, probably the most dominant actor is the industry when considering the actions to be taken

(Hernandez et al., 2020). As supporting this view Hernandez et al. (2020) suggest, policymakers have oriented the majority of laws towards producers to achieve the circular economy model. Therefore, several business models have been generated during the process. However, it can be said this is a limited approach to accomplish a holistic model since the circular economy calls for all the actors within the network to take action. Since it is not about one manufacturer changing its production attitude, but all actors working coordinately to create meaningful flows of materials and information while fueling the system with renewable energy (MOOC, 2020). Coordination of all actors requires thinking in systems, a prominent characteristic of a circular economy (Ellen MacArthur Foundation, 2015). Thinking in systems helps us see "connections between people, places and ideas" (MOOC, 2020) consequently; it can assist us in excluding previously neglected actors like users.

Kircherr et al. (2017) examined the literature on circular economy, and a part is allocated to the definitions made by other authors for this model. They analyzed the data and concluded that consumers are not acknowledged as a major actor within the circular system and are merely included in the examined definitions of the circular economy. However, Ghisellini et al. (2016) point out the importance of the consumer role for enhancing the flows within the circular loops. This situation is indicating there is a literature gap in the understanding of consumers' perspective on the circular economy (Kircherr et al., 2017) since, according to Borello et al. (2017), there is a very limited amount of knowledge about consumer's interests and willingness to take a role in the circular economy model.

There are challenges to overcome to achieve the transition from linear to circular models, and the most prominent one is the role of consumers for Borello et al. (2017) since there is a significant transformation in their role from being a *passive consumer* to an *active user* (Terzioğlu, 2017b). The circular economy forms a realliance between users and businesses in which both parties are actively engaged in the circular processes and share the responsibilities (Terzioğlu, 2017b). That is why users need to be informed about the circular systems and products so that they can get involved in and value them (Prendeville et al., 2014) since the circular economy

will cause immediate changes in users' daily lives (Hobson et al., 2016). These changes include the demolishment of concepts such as ownership and newness of goods while getting familiar with the activities of repair, maintenance, and returning products (Camacho, 2018). Therefore, within the circular economy, the transformation from being a consumer to active users means slowing and closing the loops with a new perspective to the owned products working together with all stakeholders.

2.2 Product Lifespan & Longevity

In the previous section, a review on the transition from the linear economy to the circular economy, and the circular economy movement's principles and the approaches to achieve it are explained. Lastly, the importance of consumer's engagement within the circularity is remarked upon. It is clear that the inner and tighter loops are critical for spending less energy and material, as said in the former section (Ellen MacArthur Foundation, 2015). In Figure 2.2, the inner loops aim to slow down the consumption cycle by extending the product lifespan through maintenance, repair or reuse (Ellen MacArthur Foundation, 2019). Another essential point is engaging and empowering the users within the circular processes. That is why it is crucial to understand the notion of product longevity and the methods to achieve users' engagement with the circular economy.

Three main questions are interpreted in order to dive into the topic of product longevity and user-product relationship. The first one is on the causes of premature product replacement. In this part, the reasons for product disposal before they lose their functions are investigated by explaining the notion of obsolescence. The second question is how product lifespan is described and evaluated. The answers in the literature represent the varying perceptions of the stakeholders. For example, when a product is designed with a predetermined physical lifespan, users may have diverse perceptions about how long it should last, also called *emotional lifespan* by Chapman et al. (2018). Lastly, the strategies developed to prevent premature product

replacement and achieving product longevity are examined. The strategies found in the review are split into three. While the first set of strategies focuses on improving manufacturing and product durability, the second set focuses on systemic approaches that include various stakeholders. The last set of strategies is investigating users' actions and their relationships with the products.

2.2.1 Product Lifespan Definition

Products are designed and produced with a pre-assigned amount of usage time. Therefore, when the presumed time is over, the product is expected to be discarded, since it won't fulfil its aim anymore. Wiens (2017) accepts that products can malfunction, but he points out that the emergence of new technologies significantly contributes to the decrease in product lifespan. He clarifies this issue with the following sentence "Unlike the 30-year-old mixer on your kitchen counter that refuses to die, new technology -especially the smart devices with fancy, embedded electronics breaks more quickly" (p.26). Additionally, together with the decrease in product lifespan, consumer electronics' *expected lifespan* also decreases for their users, according to a study undertaken by Oguchi et al. (2016). This study shows, when users are asked to evaluate the lifespan expectancy towards their old and newer electronic products -such as computers and mobile phones- they tend to expect longer life from old products and shorter life from newer products (Oguchi et al., 2016). As seen, both the shortening lifespan of products and users' understanding of the decreased life expectancy from products are leading to rapid and premature product replacement.

Consumer product lifespan has been a hot topic of discussion for scholars in the field of *environmental sustainability* and *circular economy* since premature product replacement and disposal means to produce more and more waste while using the limited resources to create new consumer products (Mugge et al., 2005; Ozan, 2019). That is why diverse actors take various actions in the production and consumption network to prolong product lifespan.

Haines-Gadd et al. (2018) draw attention to the industry as a guilty actor of producing short lifespan electrical products and influencing the user behaviours towards unsustainable consumption patterns. Chapman's (2009) work adds another dimension to the situation that is policymaking. According to him, European Union's Waste Electrical and Electronic Equipment (WEEE) Directive (2008) enforced the industry to generate solutions and take action for the short product lifespan of electronic consumer goods, since the directive questions the amount of electrical and electronic waste that ended up in landfills. On the other hand, he highlights how the increased ecological awareness of consumers and designers has helped to speed up the process of searching for a solution. Stahel (1986) further states how users' role is more determining than the manufacturers' in terms of product lifespan. It is clear that the issue of increased product disposal rates calls all actors for action from consumers to manufacturers, policymakers and scholars. That is why in the next section, the reasons for rapid product replacement will be discussed in depth.

2.2.2 Reasons for Premature Product Replacement

In his literature review on product durability, Haug (2019) examines and lists the reasons for product replacement in detail, which shows how motivations behind product replacement can vary. While some authors in his literature review prefer to focus on technical failures that cause product replacement, most of them point out the significance of consumers' changing needs, tastes and understanding of newness as the determinants of replacement. Among different perspectives on categorising the reasons for product replacement, this work focuses on the categorisation of Cooper's made in 2004, grounded on Granberg's (1997) work that will be explained in the following section.

2.2.2.1 Product Obsolescence

Understanding why products are disposed of before they complete their actual lifetime goes from understanding the notion of *obsolescence*. Dictionary Cambridge (n.d.) defines the word by writing that it is "the process or fact of becoming old-fashioned and no longer useful. " However, this term becomes more involved in time than merely losing a product's sense of fashion or usefulness. Before diving into the complexity of the term namely, obsolescence, it is useful to divide it into two, as Granberg, B. (1997, in Cooper 2004 and Haug 2019) suggest: *absolute* and *relative obsolescence*. As Haug (2019) explains, *absolute obsolescence* appears due to the products' failures in terms of their physical performances, while relative obsolescence happens due to the factors apart from products' functionality. Cooper (2004) further explains absolute obsolescence by referring to Granberg's work which takes products' *intrinsic durability* as a basis in that case; therefore, the product becomes obsolete when it fails to resist wear-and-tear and material degradation, or if its quality of manufacturing is low. According to Cooper (2004), this means the *intrinsic durability* highly depends on the manufacturing process and manufacturers.

It is crucial at this point to introduce the term *planned obsolescence*, which is also known as deliberate or built-in obsolescence. Kramer (2012, p. 13) explains the term as a "business strategy in which the obsolescence (the process of becoming obsolete) of a product is planned and built into it from its conception, by the manufacturer." As the term first proposed by Bernard London in his writing *Ending Depression Through Planned Obsolescence* in 1932, he refers to planned obsolescence as a way to reinvigorate the economy and survive the Great Depression. He suggests products need to be planned as obsolete objects, so that newer products will be kept purchased by the consumers. Despite the good intentions at the beginning of the 30s, the term kept gaining a bad reputation later on. In 1960, Packard popularised the term with his work *The Waste Makers*. He identifies three types of obsolescence: function, quality and desirability. *Obsolescence of function* refers to a situation where a product in hand becomes obsolete when it's newer and better functioning version

breaks into the market (Packard, 1960). Maycroft (2009) gives an example for that "...legislation outlawing the 625 mercury battery, at a stroke, made the light meters on millions of the late 1960s and early 1970s cameras obsolete. New cameras with safer batteries rapidly replaced these models" (p. 18). *Obsolescence of quality* is about products being worn out or broken down at a prescribed time, usually not long after the purchase (Packard, 1960). Lastly, *obsolescence of desirability* occurs when consumer's perception towards a durable product wears out "because a styling or other change makes it seem less desirable" (Packard, 1960, p. 38).

After the term planned obsolescence interference, we can return to the relative obsolescence, which is quite interrelated with the obsolescence of desirability. Stevens (in Slade, 2007, p. 153) describes it as "the desire to own something a little newer, a little better, a little sooner than is necessary." Apart from desires, sometimes positive or negative emotions towards an object play a crucial role in its lifespan, according to Van Nes, Cramer, and Stevels (1999), which they defined as *psychological obsolescence.* Haug (2019) refers to Van Nes et al. (1999) work by stating their definition also corresponds to *emotional obsolescence*. Lastly, in this relative obsolescence section, Maycroft (2009) finds stylistic obsolescence as the "ideal type" amongst all since it allows the industry to quickly adapt it to many other product ranges. He supports his view by saying, "It is not just clothes that are deemed to be 'in' or 'out' of fashion but interior decor, foodstuffs, automobiles, book covers, household appliances even garden plants" (Maycroft, 2009, p. 24).

After years, product planned obsolescence still keeps its seat in the current economic model. As an article (n.a., 2009) on the Economist states, a neverending example can be the nylon stockings since they ladder quickly after purchase. Consumers need to discard them and buy new ones which please the garment sector instead of finding a solution to the laddering issue. Interestingly, nylon stockings were resistant enough for laddering back in the 50s when the DuPont company started to produce them (Rivera & Lallmahomed, 2016). However, planned obsolescence is not limited to the fashion industry. Today, there are more subtle ways of giving consumers reasons to discard their products in the consumer electronics industry. Wiens and Gordon-

Byrne, in their work *The Fight to Fix It* (2017), state that technology companies prevent consumers from repairing their products through i) not providing repair manuals; ii) not providing repair services; iii) not providing repair components which lead consumers to discard malfunctioning products and buy newer ones. As far as it is seen in the literature, the industry has been purposefully decreasing the quality of products, invoking newer desires to outmode former products, and eventually preventing consumers from repairing their products to extend their lifespans, so that customers can keep buying the latest products. However, there have been opposite views against products' premature replacement; in the following section, the strategies to prevent it will be discussed in detail.

2.2.3 Users' Perspective in Evaluating Lifespan

Product longevity is one of the key terms for establishing a circular economy and keeping the environmental impacts of mass consumption at reasonable levels (Oguchi et al., 2016). That is why it is essential to reduce consumption and waste by circulating the products longer within the loops of the circular economy (Ellen MacArthur Foundation, 2013b). However, achieving the durability of the products is not always the intention of the manufacturers. As seen in the former section, they use planned obsolescence -where products are meant to break not long after their purchase to keep consumers buying more and more- to shorten the products' lifespan. However, the decision on products' lifespan is a topic that needs to be discussed with the views of other actors in the network, which are users and products. While including all the actors, the environmental and economic viability of the production and sale should also be considered. That is why different approaches have been taken to evaluate the products' lifespan. While doing so, the questions raised about finding the ideal lifespan of a product, and in this section these answers of scholars in the field will be examined briefly.

To understand the environmental impact of a product, its life is examined in phases from the extraction of the raw materials needed for manufacturing to its disposal when it is no longer in use, which is called life cycle analysis (LCA) (Ayres, 1995). As an essential framework in industrial ecology, the approach of LCA assists "government and industry to determine appropriate standards (e.g., for eco-labelling), make product comparisons, verify environmental claims, and assess policy options" (Cooper, 2005, p. 56). Even though LCA makes it easier to calculate the environmental burdens that a product causes, other considerations need to be taken, such as deciding on the product's energy usage and waste reduction (Cooper, 2005). Which one should be prioritised is a critical question, according to him.

The work of Bakker et al. (2014) takes the prioritisation of energy efficiency over waste reduction as the focus of their research. They examined how the environmental impacts of refrigerators and laptops are positioned against their newer models with increased energy efficiency. According to their findings, decreasing the lifespan of a fridge can be more "eco-effective" than extending its lifespan, since the environmental impact of a discarded fridge is lesser than the energy consumption of old fridges (Bakker et al., 2014, p.12). However, extending the lifespan of laptops would probably be more eco-efficient, since they have a relatively shorter lifespan and low energy consumption than the fridges (Bakker et al., 2014). While concluding their research, they proposed the term "optimal product lifespan, " which describes the point where the energy needed to use a product matches the environmental impact that replacement of that product will cause (Bakker et al., 2014, p.12).

As seen, the environmental viability of a product is a strong consideration in evaluating its lifespan. Nonetheless, it lacks the perspective of a user. Many products that are designed and manufactured for durability can end up being in the depths of closets, while they function properly and this phenomenon is called "dead storage" or "product hibernation" (Bakker et al., 2014, p. 11). This situation brings into question how users evaluate their products' lifespan. Cooper (2004) suggests "expected product lifetime" as a term that includes users' perspectives within the product lifetime literature. The research undertaken by Oguchi et al. (2016) interpret

the expected product lifetime in three ways: “intended lifetime, “ “ideal lifetime, “ and “predicted lifetime. “ The first one corresponds to the time that users intend and willing to use their product. “Ideal lifetime, “ on the other hand, describes the ideal time of a product in which it should be in use. The third, “predicted lifetime, “ shows users’ predictions of how long a product can last. The study results suggest that it is crucial to identify these terms to understand the reasons for differentiation occurring between the actual lifetime and the expected lifetime of a product (Oguchi et al., 2016).

Another dimension in the user’s perspective towards product lifespan is the emotional engagement which can result in lengthening the “psychological lifespan” of a product (Chapman, 2005). If a user is not engaged with and willing to keep the product, its material durability wouldn’t mean much for product longevity (Chapman, 2005) since product lifetime is evaluated by both its physical lifespan and its psychological lifespan (Ko et al., 2011). As a supporting view, Haines-Gadd et al. (2018) state that to assist a more resilient relationship between user and product, the psychological lifespan of a product should be considered as much as its physical lifespan.

Within this section, the evaluation of a product lifespan with perspectives of manufacturers and users are briefly given. In the search for ideal lifespan, design scholars mention product’s physical and psychological lifespan, leading to the expected product lifetime. While the first motive is to optimise lifespan by increasing its durability, it is understood that it is not enough to achieve product longevity. Psychological lifespan is an essential aspect of product durability as much as physical lifespan. However, it is not an easy task to achieve as it is closely related to the perception and understanding of the user. Therefore, the user’s perspective towards product longevity needs to be further studied to be able to design long-lasting products.

2.3 Approaches to Product Lifespan

Life Cycle Optimization (LCO) approach has been taken by some researchers (Kim et al., 2006; Bakker et al., 2014; Haug, 2017) instead of lifetime extension since it is not environmentally preferable to extend every products' lifetime according to the study of Bakker et al. (2014) (see Section 2.2.3). To create circular products within the circular economy, it is crucial to understand lifespan optimization strategies that serve both economic and environmental sustainability (Bakker et al., 2014). Thereupon, they point out the need to apply "different hierarchies of product life extension" for different product categories "based on product characteristics and business constraints" (Bakker et al., 2014, p. 15).

Within this section, various strategies taken to optimize products' lifespan will be investigated. Haines-Gadd et al. (2018) examine the strategies aiming to optimize product lifespan in their work and divide them into two; first part includes the toolkits and frameworks that are more producer-focused, while the second part is more user-focused. They found that it is crucial to include users' perspectives while aiming for circular products, and it can be achieved through managing products' both physical and emotional lifespan. Although production and users are covered in that study, here in this review a third dimension is added as a systemic overview of the strategies. Therefore, the following section explains approaches to product lifespan in three segments as product-oriented, user-oriented and system-oriented approaches.

2.3.1 Product-Oriented Approaches

2.3.1.1 Design for Reliability and Durability

As Mugge et al. (2005, p. 39) indicate, "increasing the product's reliability and durability can reduce technical failure," which can lead to a long-lasting product lifetime. Although increasing the durability of products seems the first option to

achieve product longevity by the manufacturers (Ko et al., 2011), it is not sufficient to only address the physical durability of a product to prevent premature product replacement (Haug, 2017). Bakker et al. (2014) advise that to create long-lasting products, the emotional, aesthetic and physical properties of a product should be considered all together. Haug (2017) asserts that designing for *resilience* rather than *durability* can enhance the product lifespan, since the term durability itself may not cover all the aspects of product longevity. According to him, designing for durability may limit the designer's actions with enhancing products' physical properties, which is expected to gain the appreciation of users for a longer period of time. However, this expectation is not satisfied, since it is not possible for designers to foresee the changing tastes of users and fashion (Haug, 2017). On the other hand, if resilience is considered while designing a product, Haug (2017, p. 9) states the designer would design products that have the "ability to 'bounce back' than an ability to withstand external forces (i.e. 'durability')" which means they would ensure worn-out components are easily replaceable, newer technologies are adaptable and products' outer view can easily be altered according to changing user tastes and preferences.

2.3.2 System-Oriented Approaches

The second set of approaches directed to optimize the lifespan of products has a broader perspective than product-oriented approaches, which pays attention to the context in which all the stakeholders interact with each other and products. Within this context, Product Service System (PSS) and Integrated Scales of Design and Production for Sustainability (ISDPS) approaches will be explained briefly.

2.3.2.1 Product-service System (PSS)

In their work, Vezzoli et al. (2014) state that *design for sustainability* requires a "system innovation approach" (p. 29) since the product-oriented approaches like *Life Cycle Design and Eco-design* are not enough to overcome the obstacles in traditional

supply. As a favorable system approach, the Product-Service System (PSS) focuses not only on the products but instead the services that connect products with users and stakeholders in a “satisfactory” way (Vezzoli et al., 2018). Moving from a product-oriented understanding to PSS necessitates novel ways of interactions between producers and users where producers provide services of maintenance, repair and upgrading (Terzioğlu, 2017b) Since producers take the responsibility of the possible consequences of the products’ life cycle phases, they constantly seek for pro-environmental and socio ethical solutions (Vezzoli et al., 2014). By increasing the responsibilities of producers in the product life cycle from extraction of raw materials to post-use services, the reduction in resource consumption and waste is made possible. That is why shared ownership of goods and services can contribute to the circular economy (Ellen MacArthur, 2013). As an example of this approach, Patagonia (patagonia.com, n.d) is a textile company offering a new way of the producer-customer relationship that goes beyond sale (Ellen MacArthur, 2013). They produce environmentally friendly and durable garments and provide repair, refund, and second-hand market options for their customers. Apart from offering services, they empower their customers by their partnership with iFixit (ifixit.com, n.d.), which offers repair and care guides that help Patagonia users fix their items on their own (see Figure 2.3).

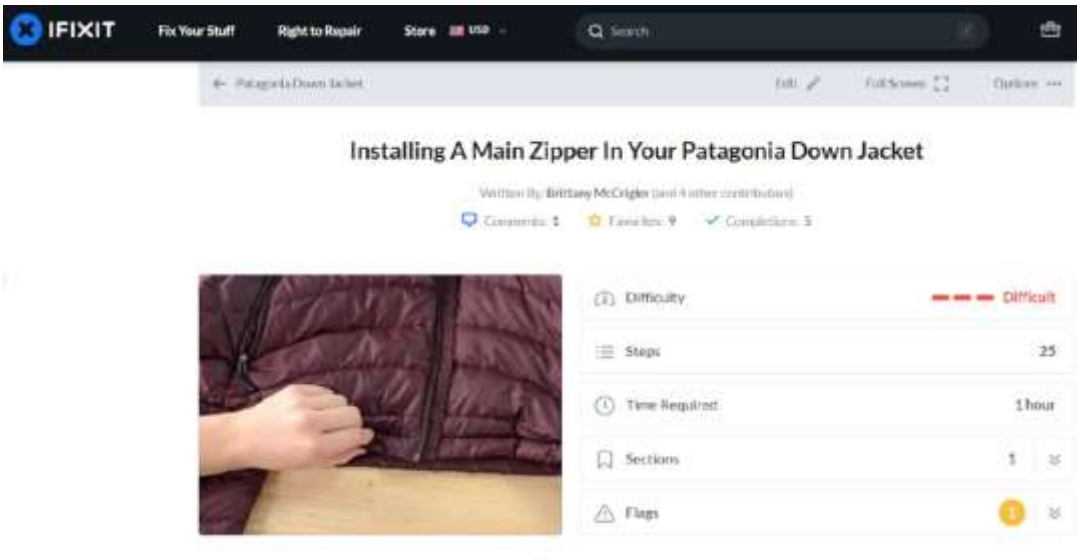


Figure 2.3 Ifixit website page that shows one of the Patagonia fixing manuals (Brittany McCrigler, n.d., ifixit.com).

2.3.2.2 Integrated Scales of Design and Production for Sustainability (ISDPS) Approach

Integrated Scales of Design and Production for Sustainability (ISDPS) is an approach that combines mass and local production scales to offer design solutions that consider the particular preferences and needs of users at the mass production scale while providing opportunities at the local scale for post-use services such as repair, reuse and upgrade which help strengthen the use of local knowledge and skills (Doğan & Bakırlıoğlu, 2020; Doğan & Walker, 2008; Doğan, 2007). One prominent concept in this approach is *localization* and engaging people's local knowledge and skills in the process of production and consumption (Doğan & Walker, 2008). Besides the importance of the localization aspect, other key points of the ISDPS approach include supporting users to be engaged with post-use scenarios of their products and empowering them to rebuild meaningful relationships with their material culture (Doğan, 2007). Walker (2011), in his design-led research, explores new ways of designing electronic products which are upgradeable, adaptable and evolving by allowing active user participation in the use and post-use phases. One of his design

explorations is the Pouch Phone (see Figure 2.4) which consists of phone components that are wrapped in a piece of fabric. This design is open to the user intervention in terms of ease of component replacement when it's malfunctioning or when an upgrade is desired, adding new parts; in that way, early product replacement can be prevented. Besides, the production of components at the local scale supports the local labour force, skills and knowledge, and eases access to post-use services like repair and maintenance for the users.

Figure 2.4 Pouch Phone (Stuart Walker, 2011).

2.3.3 User-Oriented Approaches

Haines-Gadd et al. (2018) make a distinction between the strategies targeted to optimize product lifespan. While designing for ease of disassembly, the notions of upgradability and recovery are more related to the activities of producers; however, design for building product attachment seems to be more related to users' experiences (Haines-Gadd et al., 2018). This brings the topic to the user-oriented approaches in prolonging lifespan, which mainly focus on *emotional durability* through creating *emotional attachment* (Chapman, 2005).

2.3.3.1 Emotional Durability

Emotional durability and longevity have kept receiving the attention of the design scholars in the product longevity field (Cooper, 2004; Chapman, 2005, Mugge et al., 2005, Verbeek, 2005; van Nes and Cramer 2005; Salvia et al., 2010; Hernandez et

al., 2020). Emotional durability is mostly studied through the creation of product attachment (Haines-Gadd et al., 2018) which is defined by Chapman (2005) as the power of the emotional bond between the user and the product. Increasing the strength of the emotional bond and thus the product attachment seems to be the way to achieve emotionally durable products. That is why there have been plenty of suggestions and methods to increase the possibility of emotionally durable design which will be discussed in this section.

2.3.3.1.1 Aging Gracefully

In the late 90s, a group of Dutch designers founded Eternally Yours which proposes some ways to extend a product's emotional lifetime with a focus on users engagement such as providing materials and forms that will evolve and *age gracefully* (Verbeek, 2005). It is also referred to as *aging in dignity* by Mugge et al. (2005) in their study that reveals methods for strengthening *person-product relationships.* This method still keeps its up-to-dateness for the designers. Here are two examples of objects aging gracefully: the first one is the Pick Fuji -a guitar playing pick that changes surface quality and color (see Figure 2.5). The more the user practices her/his guitar playing and wears down the pick, the more it changes its pure blue color to white color, which resembles the Mountain Fuji. In that way, wear and tear become something to be appreciated since it carries the signs of hardwork and mastering a skill.

Figure 2.5 Pick Fuji, designed by Tomohiro Ikegaya (designboom.com, n.d.).

The second example is Underskog (Upholstery fabric), designed by design scholar and practitioner Kristine Bjaadal in 2009 (see Figure 2.6). Her aim is to extend the lifetime of objects made with textiles which can easily become dispensable once they wear out. This upholstery fabric reveals its second layer with floral pattern after the top velvet layer is worn out. At this point, it can be helpful to introduce the term *aesthetic of imperfection* which attributes *dignity* to physically damaged so-called *imperfect* products (Salvia et al., 2010). “Signs of imperfection due to wear and use bear witness to the shared existence of an artefact and its user, potentially strengthening their relationship” (Salvia & Cooper, 2016, p. 15).

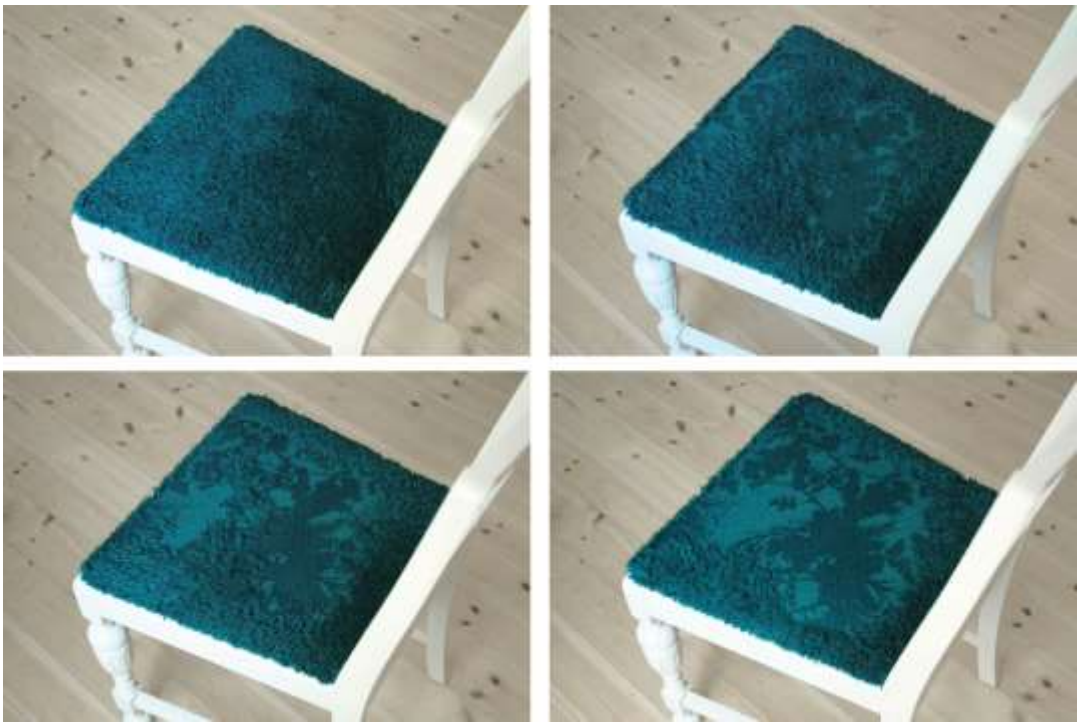


Figure 2.6 Underskog (Upholstery fabric) designed by Kristine Bjaadal, 2009 (kristinebjaadal.no, n.d.).

2.3.3.1.2 Product Personalization & Halfway Products

Another way of enhancing user-product relationships and extending the product's lifespan is by adding a layer of personal meaning (Ozan & Doğan, 2017; Mugge et al. 2009a; Fuad-Luke, 2008; Schifferstein & Zwartkruis-Pelgrim, 2008; Mugge et al., 2005; Chapman, 2005). Schifferstein & Zwartkruis-Pelgrim (2008) suggest increasing the likelihood of forming memories can increase the emotional reactions to the product, creating personal meaning and intensified attachment. *Product personalization* can be a design strategy that catalyses emotional bonding since it allocates a space for users' self-expression by changing the product's appearance or functionality to increase personal relevance (Mugge et al. 2009a). While some manufacturers provide opportunities for their customers to personalize their product by selecting the components' colors and textures or adding or removing some parts of the product, Fuad-Luke (2008) finds *this mass-customization* or *mass-*

personalization strategies insufficient in fulfilling the need of creating a personal meaning. He suggests designing *halfway products* where products are designed and manufactured to a certain degree, leaving space for users' active involvement to complete the production process. In this way, "user embeds their own creativity, stories and mistakes in the process of finishing the product, thereby cementing a personal narrative, memory and associations that differentiate this product from others manufactured at the same time." (Fuad-Luke, 2008, pp.95, 98).

Fuad-Luke gives an example of a halfway designed chair, *An Affair with A Chair* by Natalie Schaap (see Figure 2.7), in which she offers "a chair frame which the user must complete to obtain the final use-value and full functionality of a chair" (2009, p.98). Therefore, the chair takes its final form with the user's engagement. As an example of a halfway product, the chair's final look depends on its user's level of effort and imagination, which creates unique experiences and eventually deepens the user-product relationship. Similarly, Fuad-Luke (2009) states, once the users begin to be involved in the form creation process of the chair, they make the aesthetic of it personal and new layers of meaning are created.

Figure 2.7 An Affair with a Chair designed by Natalie Schaap (Fuad-Luke, 2009, p. 101).

Another example that activates users' in the design process is *The Things to Make* collection that is designed by France-based design collective Studio 5.5 (5-5.Paris, n.d.). This collection offers several items that need to be completed by the users themselves. For example, to complete *Tipi* and be able to use it as a tent, one needs to bring together the joints and a piece of fabric which are provided by designers and the objects he/she can find in nature (see Figure 2.8). Tipi offers an outdoor experience that connects the users with nature while embedding their personalities and preferences on the product in the co-designing process.

Figure 2.8 Tipi halfway tent that is designed by Studio 5.5. (5-5.paris, n.d.).

Ozan (2019) in her PhD study that investigates *halfway design*'s effect on sustainable consumption, draws attention to the dimension of localization where the local materials, skills and techniques are included in the co-design process of a lighting unit (see Figure 2.9). After conducting several generative sessions, in the last stage women participants who have previously attended diverse courses in craft-related techniques are recruited. The halfway design solutions provided by Ozan (2019) aim to empower those skills of the participants and make them more visible. Therefore, participants were asked to personalize the halfway lighting unit with their

embroidery skill. That is how the process of each participant and the resulting lighting unit become unique objects.

Figure 2.9 Halfway designed lighting unit by Ezgi Ozan Avcı. Adopted from Ozan (2019).

2.3.3.1.3 Systems Based Personalization for Adaptability and Upgradability

Doğan and Bakırlıoğlu (2020) introduce a taxonomy to differentiate the degrees of user involvement in product lifespan within the sustainability approaches, and when it comes to personalization of products, there is a separation between *product-oriented* and *system-oriented personalization*. As product-oriented personalization is exemplified in the former section, system-oriented personalization will be explained briefly under this section.

While there are practices such as mass-customization, Do-It-Yourself (DIY), and open design to personalize a product (Ozan, 2019), Doğan and Bakırlıoğlu (2020, p. 103) point out the significance of open-source system which can enable a design solution in which local and international stakeholders can be involved in all processes, and support the local economy instead of personalization solutions linked to a brand or a manufacturer since system-oriented personalization aims to include

all stakeholders (designer, manufacturer, user) in the whole phases of a product life cycle (design, production, use and after-use) effectively.

Figure 2.10 Fairphone that has a modular structure with open design sources (Fairphone.com, n.d.).

The Fairphone is designed and produced in a way to authorise users to personalize their phone on a systemic level by leaving space for adaptability and upgradability (see Figure 2.10). Although most of the product lifetime optimization strategies revolve around product enhancement by increasing material quality and durability, Fairphone strategy to design for adaptability and upgradability suggests a further step by challenging the technological obsolescence that leads to a premature product replacement. Mugge et al. (2005), adapts strategies to prevent technological obsolescence where the product still functions but is no longer able to compete with technologically advanced versions of it within the market. One of the solutions is, "implementing a modular or adaptable product structure allows consumers to incorporate the benefits of a new technology in their current product and/or to renew this product aesthetically" (Mugge et al., 2005, p. 39). Fairphone, which is designed and produced as the first modular phone, aims to extend the average lifespan of mobile phones from 2 years to almost five years by providing upgradable and easily replaceable modules to its user (Fairphone, n.d.). For instance, if the screen is broken, the user can easily purchase a screen module instead of a new phone. However, the term upgradability is not limited to ease of changing and repairing phone's

components, and it also means users are able to reach information on the software since Fairphone offers all open-source code to their users. The contribution of open source to product longevity will be discussed in the next section. However, it can be concluded from this example that design for adaptability and upgradability on a systemic level can help users personalise and embrace their products instead of discarding them immediately after technologically advanced versions are on the market.

2.3.3.1.4 Open Design

The influences of maker culture and communities of practice on individual's empowerment in production and design processes cannot be denied since these *creative communities* support the bottom-up movements (Manzini & Vezzoli, 2014) that attempt to overthrow top-down understanding of production and consumption. Communities can support individuals in transforming, personalizing and taking care of their own products by repair and maintenance activities which in result can empower them to be actively engaged in the realm of products. At this point, open design is a key term and needs a brief explanation. Open design is defined by Tooze et al. (2014) as a design process that allows everyone's contribution, regardless of being an amateur or a professional, to develop something together. Open design grew out of the Do-It-Yourself (D.I.Y.) movement where the design knowledge is shared freely and adopted to the different needs of individuals with the help of Web 2.0 and content generated by users themselves (Bakırlıoğlu, 2017). As an addition to D.I.Y., open design enables users to make use of local materials and manufacturing techniques which is an important aspect of design for sustainability (Ozan, 2019).

There are online communities that support open knowledge and open design to be spread all over the world, such as IkeaHackers.net, Openstructures.net, Instructables.com, Ifixit.com and Thingiverse.com. To illustrate, Openstructures is an online platform where people collaboratively design modular construction systems that encourages re-use and repair of parts and components (Openstructures,

n.d.), while Ikeahackers provides various manuals created by Ikea users who hack their product to transform it in a way that accommodates their own preferences and needs (Ikeahackers, n.d.). Apart from online communities, initiatives such as Repair Cafés (repaircafe.org, n.d) supports people to repair their products rather than tossing them to the garbage bin by bringing specialists on repair and people who have broken products together at Repair Cafés to share the repair knowledge. Also, digital fabrication laboratories worldwide, such as Fab Lab network, offer people open access to the tools and machines needed to refurbish, repair or simply design products (Fablabs.io, n.d.). The online communities and initiatives mentioned here are crucial in creating an alternative economy based on open knowledge, which "empowers the users to become user-researchers, user-designers, user-producers and user-repairers" (Bakırlıoğlu, 2017, p. 23).

2.3.3.2 The Implications of User Oriented Approaches for Product Longevity and Emotional Durability

Within this section, the approaches and strategies for extending product lifespan are explained in three levels which are: product-oriented, user-oriented and system-oriented. While, product-oriented approaches are the very first one to be applied by the manufacturers to increase durability and extend product lifespan (Ko et al., 2011), user-oriented approaches require a closer look of the designers since it has the power to enhance user-product relationships and slow down premature product replacement. After all, users are the ones to decide to keep or discard a product (Stahel, 1986). That is why to create a meaningful material culture that has personal relevance (Walker, 2006), the strategies that are improving the emotional durability of products are examined in detail as their main concern is to enhance user-product relationships. Although the strategies suggest such as product personalization, halfway products, resisting wear and tear by aging in dignity or finding the aesthetic in imperfection in digital DIY can open a space for user intervention and emotions, it is still limited by the current linear economy model and its rules. Therefore,

system-oriented approaches are also examined to see how each stakeholder within the product's life cycle network can contribute to a stronger emotional bond and eventually to a longer-lasting product. After reviewing the literature, if the aim is to offer a profound strategy to extend product lifespan, a focus should be on improving the user-product relationship and emotional bond through finding ways to apply it on a systemic level. Since users' emotional reaction occurs beyond the designer's predictions and influence, any attempts of embedding personal meanings to products is difficult for designers (Ozan & Doğan, 2014). Additionally, investigating all the stakeholders and establishing viable connections between them for improving user-product attachment can be even more difficult. That is why designers can explore emotional bond and longevity subjects through a more concrete area of intervention such as product care activities to create ways of empowering the user-product relationship.

2.4 Enhancing User-Product Relationship through *Product Care Activities*

Product care activities are defined as the sum of the behaviours that aim to prolong a product's lifespan, such as maintenance and repair (Ackermann, 2018). As maintenance and repair stand in the inner loop of the circular economy, implementing product care activities is a reasonable solution to keep the energy and labour needed to circulate at a lower level compared to recycling and remanufacturing options (Ellen MacArthur, 2015). Although the scholars indicate the significance and feasibility of repairing for the circular economy, user's perspective and their willingness to take action are mainly ignored (Ghisellini et al., 2016; Borello et al., 2017; Kircherr et al., 2017; Terzioğlu, 2017b) (See section 1.1.6.). However, users are defining the product's use-life by their action, and that is why to repair or discard the product is up to "users' motivations, perceptions, and choices" (Terzioğlu, 2021, p. 1). Understanding user's motivations for and limitations of the product care activities and empowering them in the process not only ease the transition from linear to the circular economy but also enhance the

user-product relationship. According to Terzioğlu (2017a), thanks to repair, people engage with products at a deeper level since solving the problem requires a detailed examination and understanding of a product's material, structure and way of working.

Terzioğlu (2017a) emphasises the role of design in empowering people within the repair process by designing repairable products. As a significant body of work in the product longevity studies, *design for ease of maintenance and repair* means "a set of design efforts to facilitate fixing devices by end-users and repair shops during the initial product's life cycle" (Huang et al., 2016, p. 1). Designers' effort to create products that are engaging users in repair activities or easing the process for them is increasing in number. Some of them will be given in this section as examples. Before diving into them, the environment that causes the expansion of work in design for ease of maintenance and repair needs to be clarified. That is why, first, the role of the *right to repair* movement will be explored, and then examples will be given and discussed.

2.4.1 Regaining Right to Repair

Manufacturers often prefer to sell brand new products instead of repairing the old ones and mostly discourage people from repairing by making repair inaccessible or too expensive (Wiens & Gordon-Byrne, 2017). The issue deteriorated beyond recovery for the electrical and electronic equipment (EEE), which created one of the most prominent waste issues, namely, e-waste (Cole et al., 2019). Wiens (2015) indicates consumer electronic's lifespan can be 2-5 times extended if they are adequately repaired; ironically, big tech firms are "limiting the distribution of repair information" by hiding user manuals and repair instructions from end-users and authorising only a few repair service providers while disregarding most of the small repair shops (Wiens & Gordon-Byrne, 2017, p. 27).

In 2015, “error 53” that turned iPhone 6 into a waste can help readers witness the positioning of big tech firms against users dramatically. Brignall (2016) depicts thousands of iPhone 6 users’ claims of how their phones are permanently disabled by accepting Apple’s latest updates after the phone has been repaired by unauthorised service. As one of the “error 53” victims, Photojournalist Antonio Olmos explains what happened to him to Brignall (2016). While Olmos was on a mission for *The Guardian* in Macedonia to compile news about the refugee crisis, he broke his phone screen. He couldn’t find an authorised repair service to fix it as there are no Apple stores in Macedonia. Since he urgently needed to fix his phone, he found a local repair shop to replace the broken screen and the home button, which turned out just fine. However, after weeks he received an update notification that he accepted, immediately after his phone was displaying “error 53”. When he took his phone to an Apple store in London, they informed him that it is irrecoverable and the phone is e-waste now. Although Apple tried to explain the problem as a measure of safety to *the Guardian*, Wiens & Gordon-Byrne (2017) still criticise Apple since the screens that repair shops used were not faulty, but not the original OEM screens company refuses to sell to independent repair shops. In their opinion, which has been started by eliminating small repair shops, hiding repair information from users and discouraging people from repairing, is now taken to the next step. Apple now threatens its users by blocking their devices through the control of products’ software (Wiens & Gordon-Byrne, 2017).

According to Wiens (2015), Apple is not the only tech company that discourages people from repairing. On the bright side, the increased control of the companies over products and people helps concerned users unite to *fight to fix it* (Wiens & Gordon-Byrne, 2017). People gathered and formed different groups to have a say about their products. For example, founded in the USA in 2013, The Repair Association aims to lobby to establish laws, standards, and regulations favouring repair (Wiens & Gordon-Byrne, 2017). Prior to this, iFixit’s stance against e-waste should be noted in building a community of encouraged users. Since the time it was launched by Wiens and Soules in 2003 as an online post on repairing an iBook, iFixit

is now a website that has reached over 10,000 repair guides that are open source (ifixit, n.d.) In parallel with these bottom-up activities, European Union (EU) introduced Waste Electrical and Electronic Equipment (WEEE) first in 2002 and has been updating it to reduce the carbon footprint caused by e-waste by bringing legal regulations to the field (Cole et al., 2019). Following these developments, an EU directive called *right to repair* is launched in 2019, which is "empowering consumers by giving them more possibilities of repairing their products instead of discarding them" (Hernandez et al., 2020, p. 1). Of course, it should be noted how bottom-up initiatives at the local level such as makerspaces, repair cafes and neighborhood associations are supporting the right to repair movement and leading the way for change (see Section 4.4).

Although the *right to repair* movement emerges from the problems of increased e-waste and reclaiming products' hardware and software ownership, the alliance of users against the tech companies monopoly of repair echoed and expanded to the other product categories and created an environment for scholars and designers to act upon by providing products and services that eases and enables repair. The following section will shed light on some of the examples offered in the design field regarding the right to repair.

2.4.2 Examples of Design for Ease of Maintenance and Repair

While there are many research projects, design proposals, and product examples that can be examined under the title of design for maintenance and repair, the examples described here intersect in terms of making the outcome of repair and maintenance *visible* and being handled by the end-users themselves as a *self-repair* task. Visible repair may require a further description by Terzioğlu (2017b, p.24) as "... the creative act of fixing an object with the aim of making something unique and beautiful out of it without hiding the damage, creating a new aesthetic language that honours the traces of the object's life".

2.4.2.1 Sugru

Sugru, as the first example of an enabling repair product, is mouldable glue. A variety of products can be fixed, from electronic goods to kitchenware. That is why it opens up a space for creative user involvement (see Figure 2.11). Sugru develops its community through the blog on their website and their Instagram accounts that provide inspirational examples of user experience with Sugru for others. Interestingly, various repair examples wear the traces of damage with pride, since the material allows to repair and upgrade and personalise. While the picture on the left in Figure 2.12 shows how to complete a missing component of a product, the right one shows how to connect split parts. However, the punch needle on Figure 2.12 that is repaired and upgraded reflects both the aesthetic and ergonomic concerns. While mixing colours to create a marbling effect opens a personalisation dimension in repairing, adding volume around the handle upgrades the product for comfortable grip (see Figure 2.12). The opportunity Sugru offers is that it allows the creative involvement of both low-skill and high-skill users while creating a space to share repair ideas and experiences.

Figure 2.11 Repair examples with Sugru (Sugru, n.d.).

Figure 2.12 Repaired punch needle with Sugru (Sugru, n.d.).

2.4.2.2 Remarkable

Remarkable by Humade are iron-on patches used to visibly repair textile products such as clothes and soft furnishings (see Figure 2.13). The Remarkable kit consists of “golden iron-on marks, a piece of felt, baking foil and a step by step manual” prepared to set “a new mindset against waste” by celebrating stains and imperfections in the textile and upgrading them through repair (Humade, n.d.).

Figure 2.13 Remarkable by humade provide imperfections to be aesthetically presented and to be embraced by the users (Humade, n.d.).

2.4.2.3 Reanim: The Medicine of Objects

Paris-based design studio 5-5, poses a critical view by their project *Reanim: The Medicine of Objects* (see Figure 2.14). Distinctive luminous green components such as chair seats or legs are designed to fix the damaged furniture to prolong its lifespan. However, as designers state (5.5 design studio, 2004), *the medicine of objects* is not offering a simple repair, restoration or transformation but a *reeducation of furniture* by a systemic intervention. To illustrate, the *doctor designers* used the weakest point of the chair in the right of Figure 2.14 -which is the missing leg- to rebuild the chair's second life around it instead of hiding the damage. That is how the luminous green leg is mounted. *The doctor designers* embraced the least wanted parts of broken furniture and made them visible in a surprising way by repair, hoping that objects can regain their *right to live.*

Figure 2.14 La médecine des objets by Studio 5-5 provides a repair option for broken furniture (5-5.paris, n.d.).

2.4.2.4 Do-Fix Kits

Some products on the market and a project exhibited by the design studio in visible design are briefly exemplified above, and now a Ph.D. research project conducted by Nazlı Terzioğlu (2017b) will be introduced and discussed. After researching the opportunities of visible repair for connecting users and products at a deeper level that

provides a new consciousness to users, she designed Do-Fix kits in response to her findings of the design studies and workshops. Consisting of four kits which are 3D-printed patches, kintsugi kit, textile patches, and plaster patches, Do-Fix kits are designed to encourage users to fix their product and create an engagement on a deeper level to their products (Terzioğlu, 2017b). Below, there are images of 3D-printed patches used on garments (see Figure 2.15). As the researcher inspired by traditional mending techniques like darning and patching used in garments' repair, 3D-printed patches offer users a way to adopt the " 'fun' and 'cool' aspects of the technology" in mending (Terzioğlu, 2017b, p. 122). The second image shows how a cracked ceramic cup can be repaired with the traditional Japanese repair method kintsugi (see Figure 2.16). Since originally used gold or silver filling materials are not available for many, the researcher provides a more accessible and easy to apply a version of kintsugi. The last image shows the textile and plaster patches and forms the last kits of the set (see Figure 2.17).

Figure 2.15 Do-Fix Kit: 3D-Printed Patches designed by Nazlı Özkan Terzioğlu. Adopted from Terzioğlu (2017b).

Figure 2.16 Do-Fix Kit: Kintsugi Repair Kit designed by Nazlı Özkan Terzioğlu. Adopted from Terzioğlu (2017b).

Figure 2.17 Do-Fix Kit: Textile and Plaster Patches designed by Nazlı Özkan Terzioğlu. Adopted from Terzioğlu (2017b).

As the examples of design for ease of maintenance and repair show, designers and researchers have several approaches to increase product care behaviours. While Sugru offers people an easy to understand and use tool for repair, Remarkable try to transform the perception of the repair's bad reputation by embracing stains on fabrics through design interventions. Project Reanim, on the other hand, has a critical approach towards repair and maintenance tasks by seeing broken objects as patients and designers as their doctors responsible for bringing them back to life. Lastly, Do-Fix Kits empowers users by providing tools and methods that ease the repair and maintenance processes. Apart from these four examples, there are design

proposals and projects offered in the field of design for ease of repair and maintenance. However, since these four contain elements that can inspire product longevity *and* emotional durability, they were explained briefly in this section. Considering the current literature and designers' approach towards empowering users in their attempts to repair and maintain their products independent of professional repairers and repair shops, the next chapter will explain how the field research is conducted accordingly.

CHAPTER 3

METHODOLOGY

The literature review on the intersection of the circular economy, the strategies for prolonging products' lifetime and user-product attachment, and the exploratory research on the field led to the development of research questions for which the field research has been planned. Within this methodology chapter, I will explain how this field research is conducted. The chapter starts with an overview of the study and continues with an explanation of the research strategy. Afterwards, the methods of population and sampling, data collection, and analysis are explained. The study is undertaken in three parts. The first was exploratory research to warm up to the field, after which pilot study is conducted, and it allowed me to discover the potential actors within the product care communities. According to the critics of the pilot study, the research plan is restructured to conduct the primary study.

3.1 Overview of the Study

The primary purpose of the research is to understand the link between *emotional durability* and *product care activities* and accordingly present design implications to enhance people's experience of product care activities. To do so, first, the motivations behind the product care activities are examined. The know-how of non-professional repairers is explored to see what kind of techniques and skills are involved in the process of maintenance and repair.

For this research, primarily non-professional repairers' motivations and experiences in product care activities are examined. Moreover, I want to explore these individuals as actors within the repair and maintenance network and observe repair communities' effects on the execution of such care behaviours. That is why the

majority of participants are recruited through their connections with associations and organisations which have concerns about the repair and maintenance activities.

Although I follow the news about centres, associations, and other social media channels on product care activities, I am not a member of any of them. However, I was familiar with those activities since I grew up in a family where discarding was not an option since everything can be fixed eventually. In consequence, my very first observations and talk-aloud sessions were with my immediate family. These first impressions of product care activities ultimately helped me form the initial research plan. Following this overview of the study, I will present the research stages within the next section.

3.1.1 Research Stages

There are three main stages of research that start with exploratory research and continue with fieldwork, splitting into two as a pilot study and a primary study. Fieldwork began with a pilot study, and it took about a month to conduct and analyse the results during January 2020. For this part, I ran three semi-structured interviews and visited two repair-related associations located in Ankara. After the analysis of the pilot work, I made revisions to the research plan to conduct the primary fieldwork, consisting of sixteen semi-structured interviews with non-professional repairer enthusiasts from March 2020 to July 2020.

3.1.2 Research as an Iterative Process

It is important to note that this research does not result from a linear process in which literature and fieldwork are done separately, one after the other, but instead it is an iterative and generative process which means reviewing of literature continues along with the field research and conversely field works are influenced constantly and evolve according to the literature. Figure 3.1 is visualising the research process.

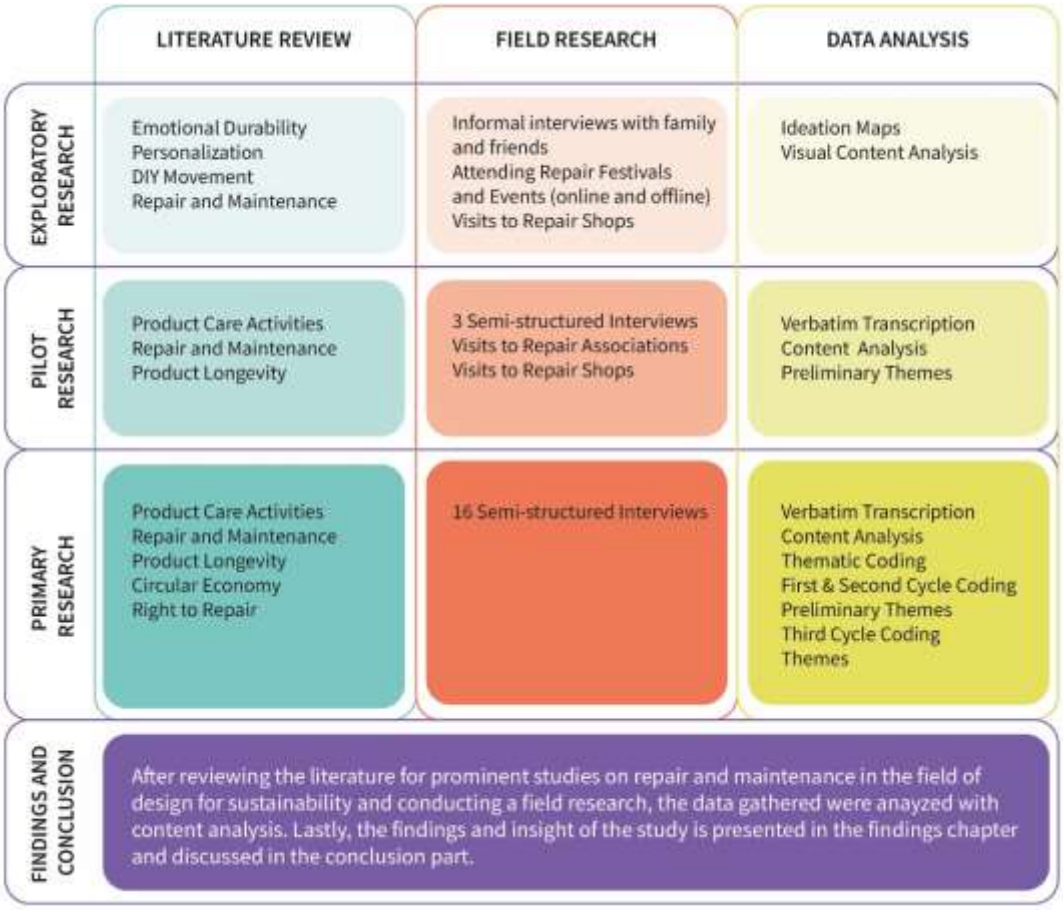


Figure 3.1 Research Stages.

3.2 Research Strategy

3.2.1 Qualitative Research Methods

Here in this section, I will explain how I decide on the methodology to construct the research plan and the methods to conduct it. This work is organised within the borders of a qualitative research approach. Since the research aims to see the nature of user intervention in product care activities, participants are interviewed and observed within their repair environment -when applicable. According to Robson and McCartan (2016), qualitative research mainly has three purposes: exploring, describing, and explaining a situation. While developing the research plan, my goal

was to examine the motivations of product care practices and discover the limitations while reviewing the whole process from start to finish. Salkind (2010) suggests qualitative researchers are keen on understanding the experiences of people within the social processes. That is why, the inter-field research is planned to understand *how* and *why* people take care of their products rather than for *how much* or *what* they repaired.

Robson and McCartan (2016) emphasise the compatibility of flexible strategies for such exploratory works by indicating how flexible design evolves during the data collection phase according to the changes in the understanding of the explored area. That is why, as mentioned in the previous section, this qualitative research is an iterative process where adaptable research design is applied. The direction of the work constantly evolved according to the data-driven from the field and literature. In continuing sections, I will explain my methods to conduct the research.

3.2.1.1 Data Collection Method

3.2.1.1.1 Semi-structured Interview and Participant Observation

To be able to retrieve detailed information on product care activities, the semi-structured interview is chosen as a method. Besides this, the participants are observed within their environment, where repair and maintenance activities are undertaken.

Interviewing method is preferred for this study since it suits the exploratory nature of the research (Gray, 2004). As Gray further elaborates on interviews, it is a *conversation* between people within which there are roles of the interviewee (participant) and interviewer (researcher) over the problem area. Semi-structured interview typology is applied since it is both structured to focus on the researcher's interests and flexible enough to retrieve unexpected narratives and descriptions from the interviewees (Brinkmann, 2008). Semi-structured interviews consist of open-ended questions that the researcher prepares before conducting the interviews

(Ayres, 2008). With the open-ended questions of semi-structured interviews, participants express themself comfortably as they are in a conversation; therefore, I could obtain in-depth information on the topic. As some of the questions aim to gather stories on repair and maintenance activities, these interviews are also affected by narrative interviewing style. Within this narrative interview, participants relate their experiences in a narrative format where there is an order of events reflecting the experiences in a personal meaning (Ayres, 2008).

Apart from semi-structured interviews, data was collected with a participant-observation method. The intention of using this method is to gather data in the natural setting of the participants where the investigated behaviours are experienced and explore the social meanings of these behaviours for the participants by observing and listening to them (Gray, 2004). While doing the interviews, the participants are visited in the field where they are executing the product care activities. Especially in the exploratory and pilot study phases, participants who are non-professional repairs are observed in their home environment or repair associations if they are a member of any. However, due to the Covid-19 pandemic and lockdowns, most of the primary study's interviews were conducted virtually. Therefore, participant-observations could not be pursued anymore, even though it is not intended in the planning of the research. Although this was not incorporated into the study, by getting images of the products and their work environment, the researcher had the opportunity to ask and relate the questions to their work setting.

3.2.1.2 Data Documentation Method

3.2.1.2.1 Interview Data

All of the interviews from the pilot and primary study were audio-recorded to support the credibility of the data analysis phase with the consent of the participant. Audio-recording during interviews also helped me keep the data safe and focus on the flow

of conversation rather than note-taking. Also, for the interviews that have happened in virtual settings, sometimes I took video records together with audio records.

3.2.1.2.2 Asking Photos of the Repair and Maintenance Stories

Apart from audial data, photographs and for some cases, videos were gathered from the participants for the pilot and primary research. Before coming to the interviews, the participants were informed about the conduct of the research. Therefore, they were asked to prepare 3-4 repair stories they will share, which means they need to take photos and videos of their repaired products and if possible, bring the products with them so that we can talk about specific user intervention cases. Except for the visuals coming from participants, I took photos of the setting, tools used or the repaired products with the participant's consent when I was able to visit the field before the pandemic break in 2020.

3.2.1.2.3 My Product Care Photo Album

In addition to the semi-structured interviews and participant observations, I created my own product care photo album (see Figure 3.2). I take photos of the products before, during and after the repair and maintenance activities that I managed. I used this album to get a glimpse of what users might be dealing with while repairing products from different categories. While doing so, my researcher position is inclined to a participant role which is acceptable in qualitative research. According to Robson and McCartan (2016), intersubjectivity is an integral part of qualitative research where the values of both researchers and participants are expected to be involved in the study.

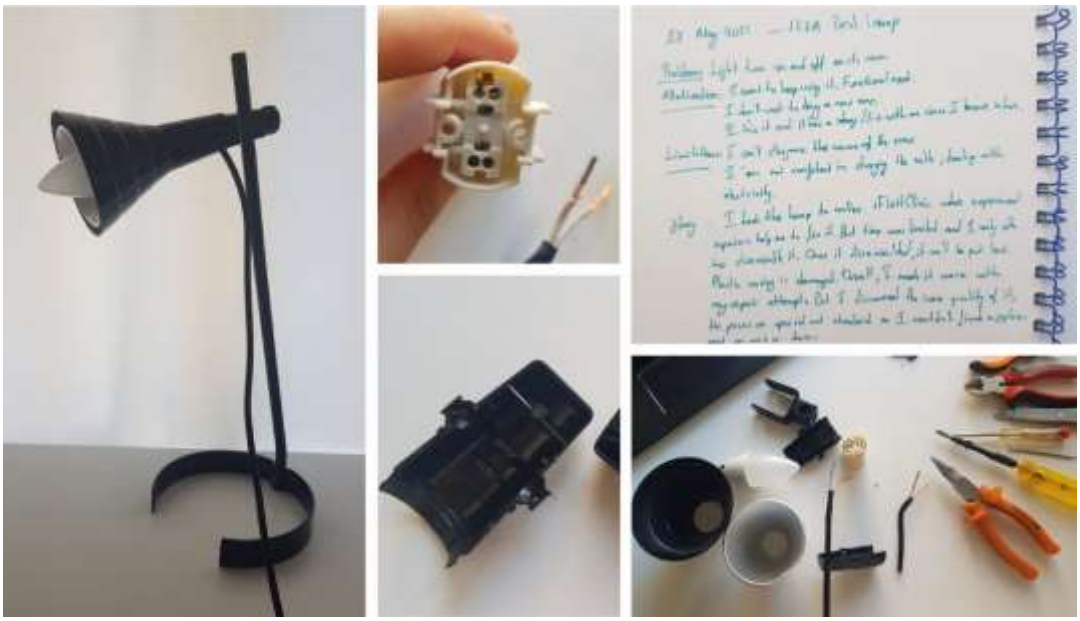


Figure 3.2 Collage from my product care photo album and notes about the repair process of my desk lamp.

3.2.1.2.4 Pinterest Board of Examples and Approaches

Forming a Pinterest board on the topic of product care behaviours helped me immensely to collect critical design examples together with repair and maintenance news from design-related sites like *designboom* (designboom.com, n.d.), *designmilk* (design-milk.com, n.d.) and *core77* (core77.com, n.d.) on the same board (see Figure 3.3). Visually representing the information and examples helped me to support my literature review with product design examples and elaborate on my field study.

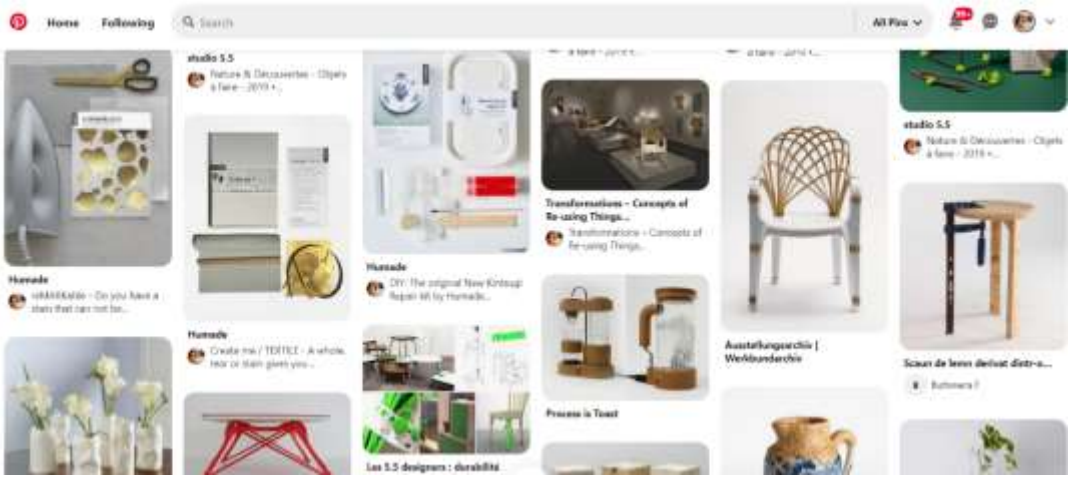


Figure 3.3 A screenshot of my Pinterest board on repair examples and approaches.

3.2.1.3 Data Analysis Method

3.2.1.3.1 Content Analysis

Interviews are the primary data set for this research, to analyse this textual data I used the content analysis method. The content analysis helps researchers cluster the broad qualitative textual information into manageable clusters to identify the relationships between these smaller contents (Julien, 2008). Although this method can both be used for quantitative and qualitative research, as Julien (2008) stated, an inductive approach is usually chosen for qualitative study. Since the intention is to understand participants' experiences on the investigated situation, it requires researchers to read the textual data profoundly and closely to extract the once ambiguous relationship between the clustered data sets. In my research, the data is analysed in an inductive manner, which is why I begin by reading the transcripted interview data (see Figure 3.5) in detail, again and again. Repeating coding cycles helped me detect the little connections in the broad set of data and create meaning out of it. After these, I gathered similar and relevant data as codes within the same categories. Then the related categories formed themes which are the key elements to deliver the research findings to the readers.

3.2.1.4 Recruitment Method

3.2.1.4.1 Convenience Sampling

The pilot study interviews are conducted with various actors within the repair and maintenance networks to explore the field. It includes a professional repairer, member of a repair association and a non-professional repair enthusiast. That is why the sampling method here is representative. After examining the pilot study's results, the recruitment method is changed to convenience sampling for the primary study. Convenience sampling indicates participants are chosen from the nearest and most convenient individuals (Robson & McCartan, 2016). After the convenient sampling, participants were asked if they knew anyone who could join the study. This method is called snowball sampling that attempts to find the next suitable participant by merely asking the previous participants of the interview (Ritchie et al., 2003).

3.3 Credibility and Dependability of the Study

For describing rigour, the terms of validity and reliability are preferred by the quantitative researchers; credibility and dependability, on the other hand, are used mainly by qualitative researchers (Given, 2008). When assessing the "goodness" and "soundness" of a qualitative study, Miller (2008, p. 909) suggests it is much more appropriate to question in an individualised contextual way than against widely applicable standards and criteria. Being coherent and transparent about the research stages, having explicit and convincing research results assures readers about the credibility and dependability of the study Miller (2008). Therefore, I did iterative analysis within three coding cycles and content analysis (see Section 3.7.3). I looked for contradictory and confirmatory data and supported the suggested conclusions by providing supporting examples, as Julien (2008) recommends. Apart from the efforts given for the study's credibility, the participants' cultural perspective and where the study is undertaken are also

included as determinants of the research results since the repair and maintenance behaviours are partially shaped according to daily life practices and habits of these participants. Therefore, I conducted this research, being aware that the results may vary slightly and new themes may emerge when carried out with participants from different places and cultures.

3.4 Ethics and Consent

Before starting the field study, ethics approval of the Applied Ethics Research Center of Middle East Technical University (METU UEAM) is received (see Appendix 1). While recruiting the participants, a consent form was sent to them (see Appendix 2), which has detailed information about the study and the researcher's contact information. For those who accepted to join the study, the researcher's scope and aim of the research are verbally explained and after written or verbal consent of the participants are taken.

3.5 Exploratory Study

My initial aim was to observe user interventions in action, discover users' motivations behind them, and explore the reflections of these data on the field. I paid attention in the literature to the different forms of interventions such as hacking, fixing, upcycling, repurposing, personalisation, repairing etc. However, to identify my research questions more specifically, I employed some methods during the initial stages of my research to explore the area of study. First, I conducted informal interviews with people nearby, such as family and friends, to observe the skills and techniques involved in the process of prolonging product lifetimes. And while doing so, I followed social media channels and tv shows related to user interventions to spot different types of activities. Apart from these, I attended virtual workshops and related events such as repair themed festival called *The Art and Craft of Sharing* in my hometown Mersin to meet with different stakeholders/actors involved in the

process. This festival helped me to widen my network in the field of repair. After this, I had a chance to interview a professional repairer for a pilot study in her atelier. As a result of these exploratory studies, I constructed a pilot study with semi-structured interview questions.

3.6 Pilot Study

With the exploratory research, I had a chance to see that there are different approaches to interventions that prolong products lifetime by different actors. To be more focused and able to receive details on the topic, I focus on repair and maintenance activities as a form of user intervention. However, I would still like to investigate similar approaches of different types of users, ranging from amateurs to professionals. That is why I conducted three semi-structured interviews, one of which was with a professional knitwear repairer. The second interviewee was an amateur individual that focussed on personalisation, repair and hacking activities to intervene with her products, and the last interviewee was a member of an repair-related association. These participants are asked to be prepared to tell their recent repair and maintenance stories before coming to the interviews. They arranged photos of their repaired product, and when possible, they asked to bring the product to the interviews. In that way, we were ready to talk about specific intervention cases.

3.6.1 Semi-Structured Interview Questions

The semi-structured interview questions are compiled under five sections: warm-up, motivations, repair process, limitations & strategies, and lastly, dreams & suggestions.

- Questions in the motivations section aim to understand the product types that participants are willing to repair and while repairing, what kind of concerns they have in mind.

- Questions in the repair process section are there to receive repair stories, including the techniques, skills, materials and tools used in the process.
- Questions of limitations & strategies section intended to gather information on obstacles preventing repair activities and strategies taken to overcome those.
- Questions of the last section, called dreams & suggestions, are asked to learn the possible routes for popularising repair and maintenance activities.

3.6.2 Site Visits

Interviews took place in a different setting for each participant. For example, in the case of a professional knitwear repairer, her atelier helped me observe the repair environment, machines and tools she is using and witness her conversations with customers. For the other interviewee, the interview took place in the repair association he is a member of. Therefore it gave me a chance to observe other members of the associations and the environment itself. For the other, the interview took place at a home setting where repaired objects were accessible.

3.6.3 Critics on Initial Findings and Revision of the Research Plan

After the verbatim transcription of pilot interview data and its analysis, some significant changes are made, and the primary study is constructed accordingly. The changes were made first in the pre-research arrangements and interview questions. Then, the focus of research is narrowed down to repair and maintenance activities. A poster is created and shared via social media channels to inform participants about the study (Figure 3.4). Lastly, the population and sampling criteria are rearranged.

It becomes evident that first, the focus of the research should be narrowed down further to receive relevant information on how to prolong product lifetime rather than how to change product appearance through user intervention. That is why I request

repair and maintenance examples before the interview session. However, as the pilot study indicated, people may need assistance in choosing the relevant examples or taking pictures in an informative way to communicate easily during the interviews. Therefore, for the primary study, interviewees will be reminded to offer more examples than needed. They will be discussed and chosen with the researcher before the interview. Creating a poster for the research call is decided to communicate the research aim and prerequisites more efficiently (Figure 3.4).

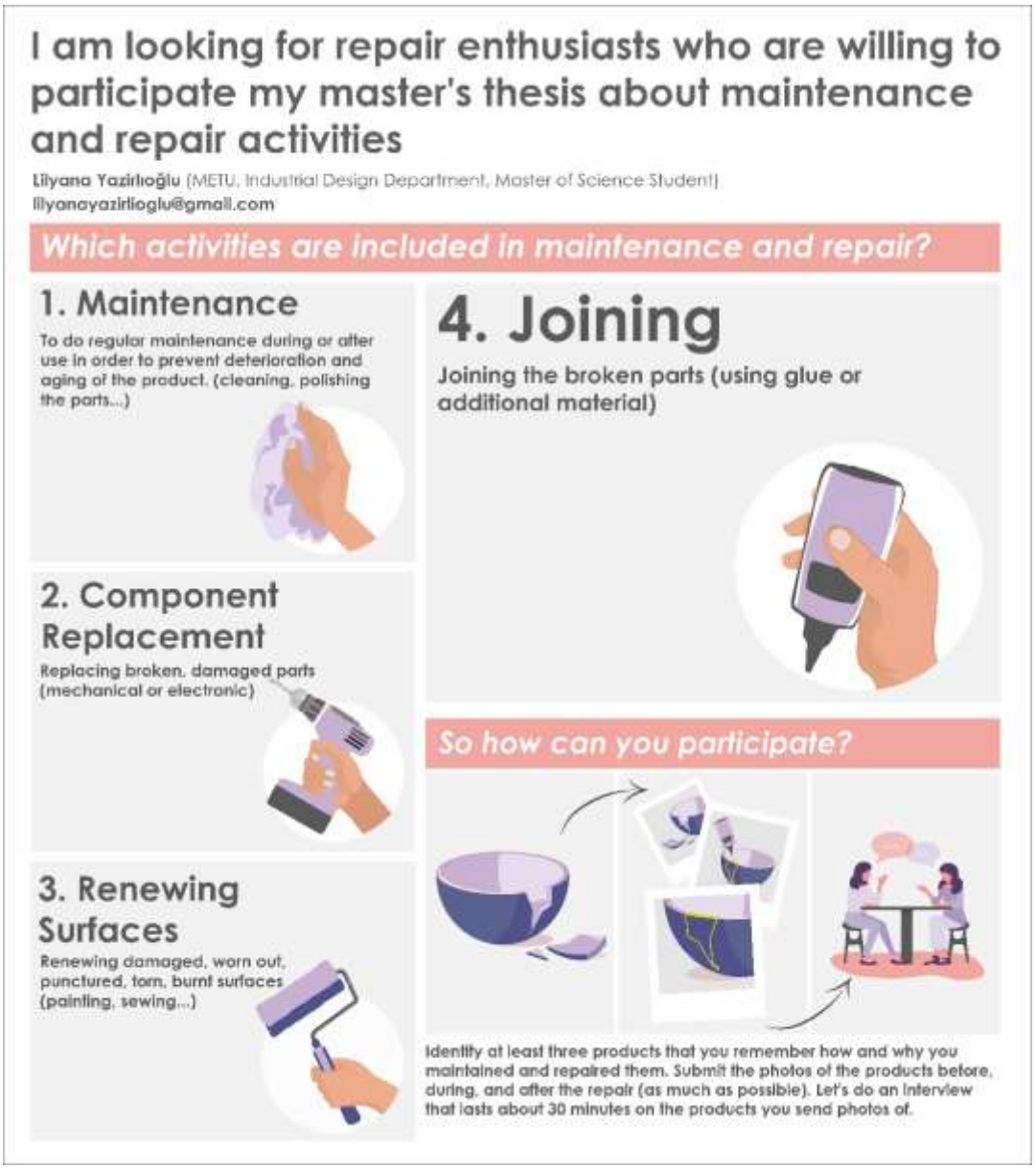


Figure 3.4 Poster for calling participants to research.

The semi-structured interview questions were revisited so that they would be in a way that people could tell their repair process as a story within a timeline. When needed, the researcher could ask the details on tools, methods, and stakeholders involved in the repair story.

For the pilot study, both professional repairer, a repair association member, and individual repair enthusiasts were recruited to briefly understand the repair network and its actors. It became more evident that the focus needs to be on non-professional individuals who are diverse in skill sets and have varying motivations (see Section 3.2.1.4). It is seen that individuals from repair communities are competent in the topic, and they bring individuals from different backgrounds around the same subject. Consequently, it seemed reasonable to recruit individuals who are the members of or somehow related to a repair community.

3.7 Primary Research

For empowering users in the practices aimed at prolonging the life of their products, it is essential first to understand the catalysts triggering those practices. That is why, in this research, I try to explore users' motivations and drawbacks regarding product care practices. The nature of product care activities is explored by examining repair stories on various product categories such as household appliances, consumer electronics, furniture, clothes, shoes, bags and accessories, decorative and hobby-related items.

Repair stories are gathered through interviews with non-professional repair enthusiasts to deepen the understanding of product care behaviours. The semi-structured interview is chosen as a data collection method. The participants are asked to send photos of their product examples before, during and after the repair takes place. That is how the researcher could decide before the interview, whether the repair story can add value to the study or not.

3.7.1 Semi-structured Interview Questions

Questions in the interview focus on user's motivations to take care of their products, required skill sets, tools and environments, limitations of executing product care behaviours and strategies developed to conduct repair and maintenance activities.

The question set has been tried in the pilot studies and reassessed by removing or adding some questions or simply changing the order of asking. While preparing the renewed version of questions (see Table 3.1), the part for asking the process of repair is extended. In this part, participants are asked to tell their stories from start to finish, and this part is repeated for each product repair (they were asked to bring 3 to 4 examples). For example, the 4th question set of the repair process is asked repeatedly for each product that participants brought. Repair and maintenance examples are not limited to specific categories to encourage participants to freely talk about their repair stories of everyday life. In this way, the focus is given to the individuals' motivations and drawbacks they are facing within the process itself.

Within the interview, open-ended questions were asked both to receive factual information such as "which tools have you use for this repair?" and narratives such as "how have you acquire the product care habits?" The original interview questions are prepared in Turkish since all participants' native language is Turkish. In Table 3.1, interview questions are translated into English.

Table 3.1 Semi-structured interview questions translated in English.

Warm up	11. How old are you and what is your profession? 12. How did you acquire your product care habits? (Family members, friends, repair initiatives, online platforms….)
Motivation	13. What is your main motivation in product maintenance? What makes your item worth repairing? (Personal value of the product, material value...)
Process	14. Can you share your maintenance and repair process from start to finish? (For each product they bring) a. What is your motivation for the maintenance/repair of this product? b. What was the cause of the error, how did you solve it? c. What constraints do you encounter in the process? (Material of the product, access to information…) d. What are your strategies when you cannot repair the product in your first attempt? Was there a product you decided not to repair? Why is that? e. Do you experience the process alone or with someone? f. What are the basic tools and materials you use for maintenance and repair, and in what environment do you do this? g. Does the repaired product carry the traces of the maintenance/repair you have done? Would you prefer it, why? h. What kind of products do you think would be easier to maintain and repair? (considering the mentioned product group)
Constraints and Strategies Perception of Product Care Behaviours General Evaluation	15. What kind of resources do you use when you need help with maintenance and repair? Can you give an example? 16. How do you evaluate the products you maintain and repair? What do you think about these products? How does this change with maintenance and repair processes? 17. Have you ever had a product repaired and not used? 18. Which kind of products do you think that are open to aesthetic and/or functional interventions during maintenance and repair? (Which products can you intervene more easily?)
Dreams and Suggestions	19. How do you think we can spread the product care habits? 20. Does anyone ask you for help in these matters? How do you help? (Knowledge, materials, tools…)

3.7.2 Population and Sampling

The interviews are carried out with non-professional repair enthusiasts in Turkey. Since repair communities are not widespread in Turkey, 15 participants from

different cities contributed to the study. Only 4 of them were female. In this thesis, availability sampling is employed based on the convenient accessibility of the participants. Participants are reached through their associations with the maker or repair communities. In the first phase, two repair associations within Ankara are visited, and members are asked to join the study. After this, the snowball method of sampling is used to reach other members of the same associations. However, members related to repair activities and willing to participate were limited in number. That is why a call for study is posted in a poster format (see Figure 3.4) on social media to reach out to other makers and repair communities via *Facebook* (facebook.com, n.d.), *Linkedin* (linkedin.com, n.d.), *Instagram* (instagram.com, n.d.), and *Twitter* (twitter.com, n.d.). The detailed information of the participants is given in Table 3.2. After the participant list there is Table 3.3 that listed the maker and repair communities that are contacted and called for participation.

Table 3.2 Participants list.

Participant	Sex	Age	Location	Occupation	Duration (minutes)	Type	Setting
P1	F	55	Mersin	Tailor	95	Pilot	Face-to-face
P2	F	30	Ankara	Architect	27	Pilot	Face-to-face
P3	F	53	Mersin	Professional Knitwear Repairer	47	Pilot	Face-to-face
P4	M	34	Ankara	Mechanical engineer	40	Primary	Face-to-face
P5	M	43	Ankara	Vocational high school teacher	33	Primary	Face-to-face
P6	M	?	Ankara	Retired optician	34	Primary	Virtual
P7	M	33	Ankara	Mining engineer	38	Primary	Virtual
P8	M	33	Ankara	Software engineer	55	Primary	Virtual
P9	F	39	Ankara	Teacher	38	Primary	Virtual
P10	F	33	Ankara	Photographer	38	Primary	Virtual

Table 3.2 Participants list. (cont.)

P11	M	71	Muğla	Retired Medical Device Producer and Repairer	43	Primary	Virtual
P12	M	?	Muğla	Accountant	42	Primary	Virtual
P13	M	?	İstanbul	Civil Engineer	42	Primary	Virtual
P14	F	28	İzmir	Industrial Designer	38	Primary	Virtual
P15	M	32	İstanbul	Business manager	38	Primary	Virtual
P16	F	31	Ankara	Research Assistant	53	Primary	Virtual
P17	M	22	Ankara	Mining engineer student	45	Primary	Virtual
P18	M	53	Mersin	Food engineer	52	Primary	Virtual
P19	M	24	İstanbul	Chemical engineer	106	Primary	Virtual

Table 3.3 The list of repair related communities that are contacted.

Maker Communities	Associations	Facebook Groups
Makers Ankara	Çiğdemim Derneği [Çiğdemim Association]	100. Yıl Evleri [100 Year Homes]
Makers İstanbul	100. Yıl Mahalle Atölyesi [100 Year Neighbourhood Atelier]	100. Yıl Sakinleri [100 Year Residents]
Makers Türkiye	Kültürhane	Ankara Ev Tadilatı [Ankara Home Repair]
Kadir-Has Fablab	Yeryüzü Derneği [Yeryüzü Association]	
Arçelik Garaj	Yeryüzü Derneği Repair Cafe [Yeryüzü Association Repair Cafe]	
Atölye İstanbul	Onaranlar Kulübü [Repairer Club]	
	İleri Dönüşüm Atölyesi [Upcycling Atelier]	

3.7.3 Data Analysis

The data analysis process is split mainly into two, first of which is made after the pilot studies by verbatim transcription of the interview data and analysed roughly to be able to reconstruct the research plan. The analysis of the pilot studies was conducted in January 2020. After this stage, the primary studies' interview data analysis is started by verbatim transcription of them, continued with several times reading and analysing using content analysis and thematic coding methods.

3.7.3.1 Transcription of Interview Data

All the interviews were voice recorded with the consent of participants. For some of the participants, video records are taken as well on an online conference software. Since fourteen out of sixteen primary interviews are conducted virtually due to the COVID-19 outbreak, it was easier to record voice or videos compared to the face-

to-face interviews. Verbatim transcriptions are made with recorded interviews by me using transcription software. Sixteen hours of audio data is translated into writings to be analysed word by word.

3.7.3.2 Content Analysis and Thematic Coding

After reading all the transcribed data of all the interviewees and putting small notes on them, I printed them out so that I could work on hardcopies (see Figure 3.5). I started to analyse my data through highlighting the quotes that seem important, and tried to label them by writing codes for them on the right side of the printed copies (see Figure 3.5). Working with hardcopies helped me go back and forth easily, and generate the initial codes, sub themes and themes accordingly. After seeing the whole data clustered roughly in themes, I moved my raw data to Google Sheets. There, first, I translated the Turkish data into English, then I included my insights about them and tried to reassign themes, subthemes, categories, and subcategories for each of them, forming my second cycle coding (Figure 3.6). While doing so, I didn't use any software other than Google Sheets.

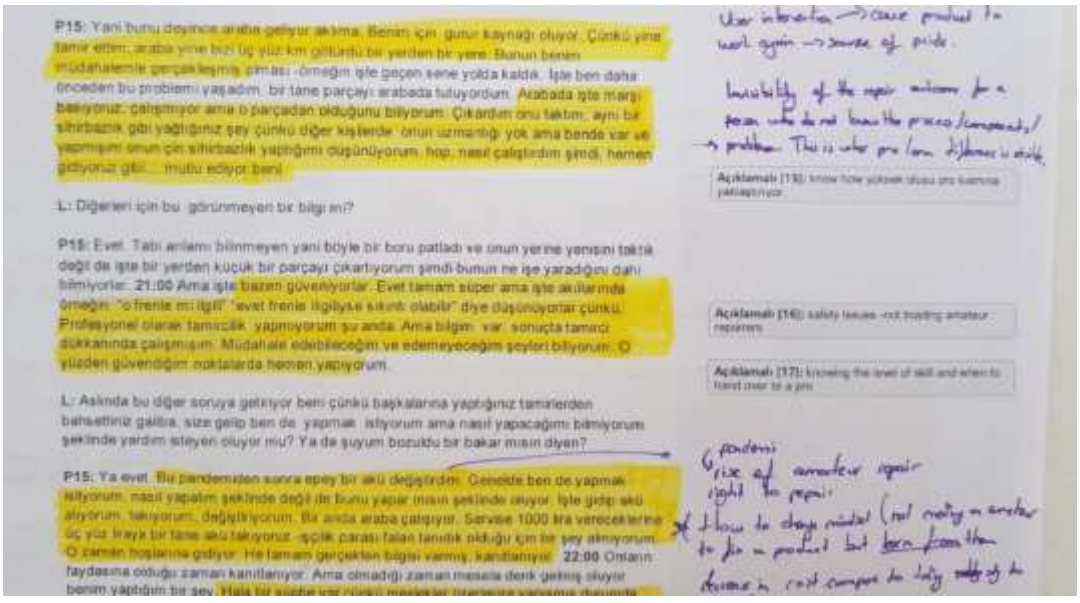


Figure 3.5 Close-up to a transcribed paper with highlighted parts and analysis notes.

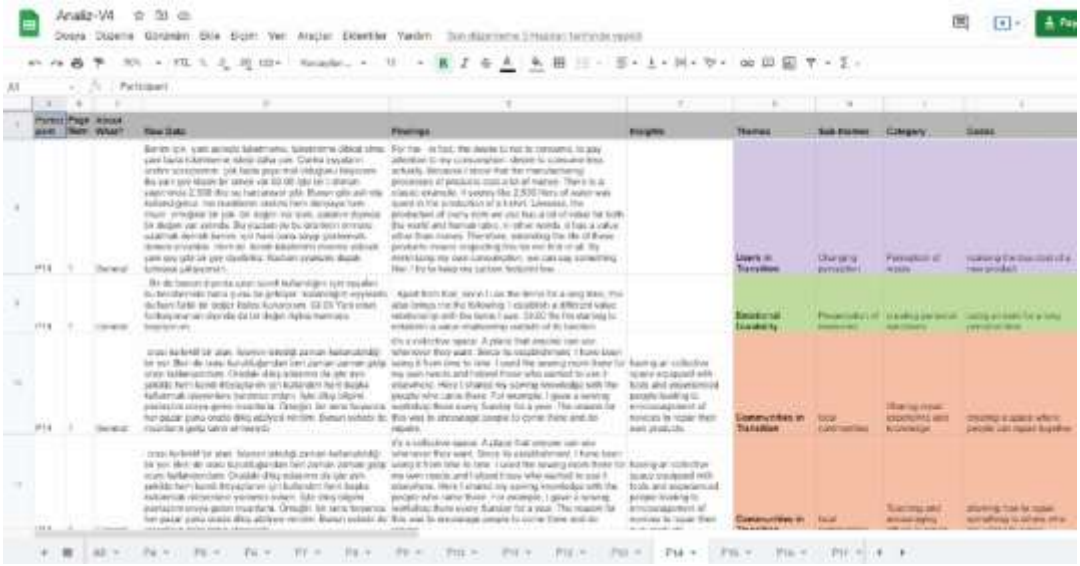
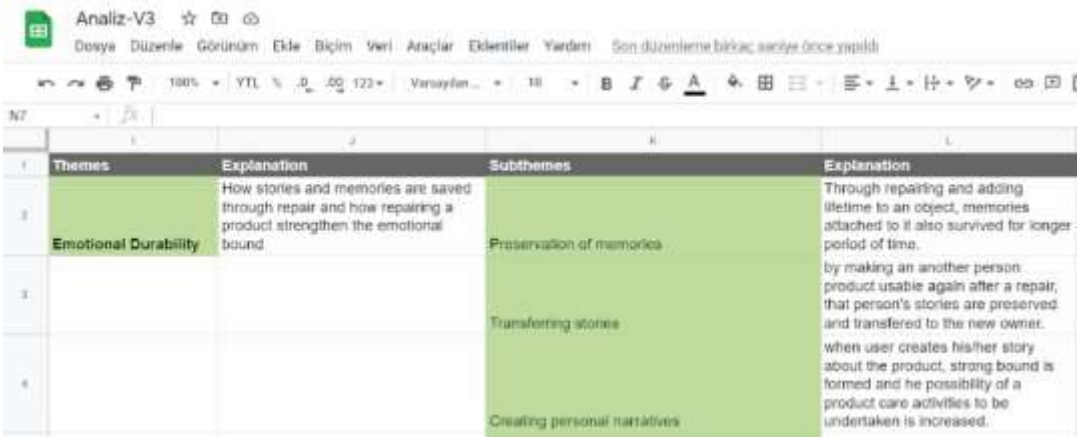


Figure 3.6 Data is translated to English and insights and codes are included. Each participant has its own separate sheet for coding.

After the second cycle, I organized a glossary of terms (see Figure 3.7) to write a brief explanation for each theme, sub-theme and category to ensure that each is significantly different from each other while still connected to form a consistent data set. As Ayres (2008) explains, the efforts of retaining the decontextualized data after coding connected with their sources and the research questions are the characteristics of qualitative research. For the third time, I went through all the data, made minor adjustments in some clusters, and made the final touch to the glossary of terms document (see Figure 3.8). The analysis phase is iterative since the coding develops the themes further while developing themes also enhances the coding stage (Ayres, 2008). This process has resulted in five main themes to be explained in detail in the findings section. All the data is filtered according to their clusters and each group is moved to a Miro Board (miro.com, n.d.) to easily zoom in and out and write down the sections (see Figure 3.9 and 3.10). Also, the Miro Board helped me to include images and videos of repair stories next to the data set so that the writing phase becomes much easier.



Themes	Explanation	Subthemes	Explanation
Emotional Durability	How stories and memories are saved through repair and how repairing a product strengthen the emotional bound	Preservation of memories	Through repairing and adding lifetime to an object, memories attached to it also survived for longer period of time.
		Transferring stories	by making an another person product usable again after a repair, that person's stories are preserved and transfered to the new owner.
		Creating personal narratives	when user creates his/her story about the product, strong bound is formed and he possibility of a product care activities to be undertaken is increased.

Figure 3.7 Initial glossary of terms with brief explanations of the themes and subthemes.

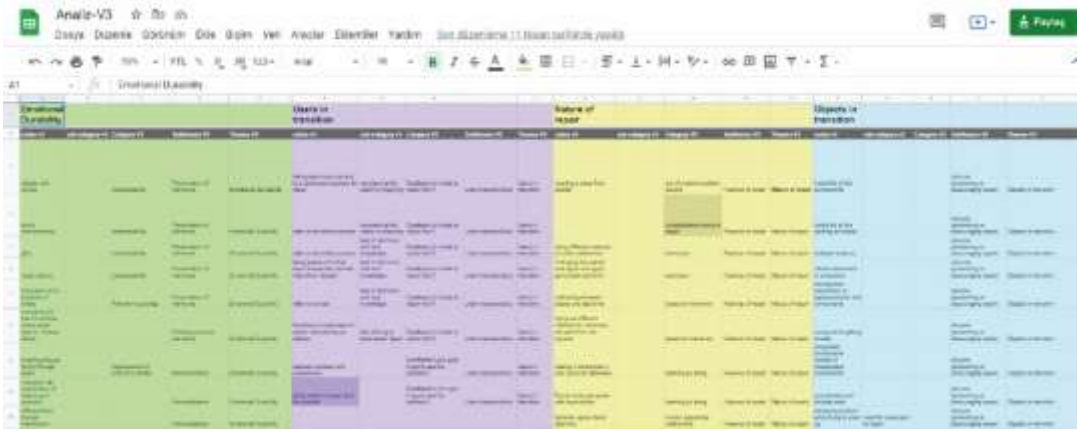


Figure 3.8 A part of the final glossary of terms.

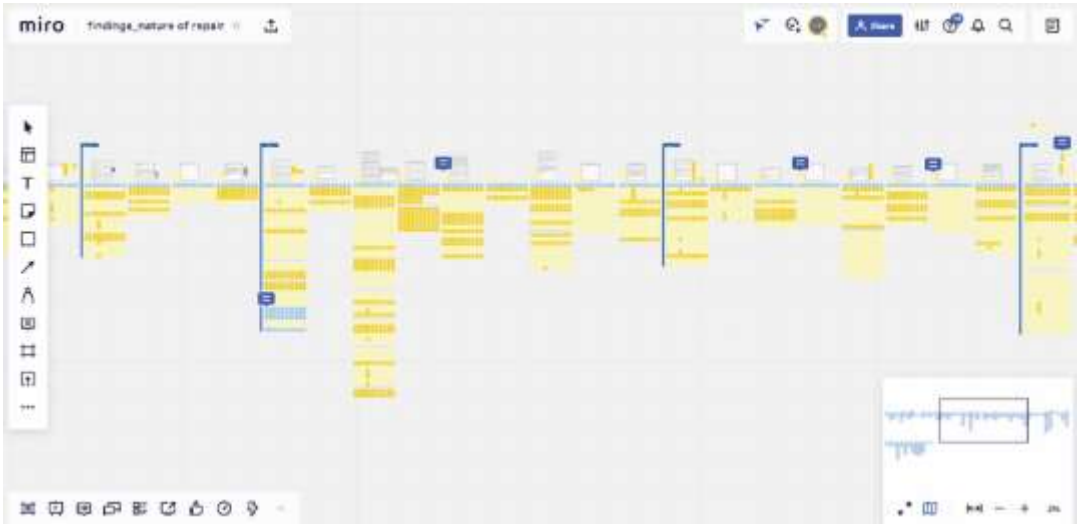


Figure 3.9 All data is inserted from Google Sheets to Miro Board.

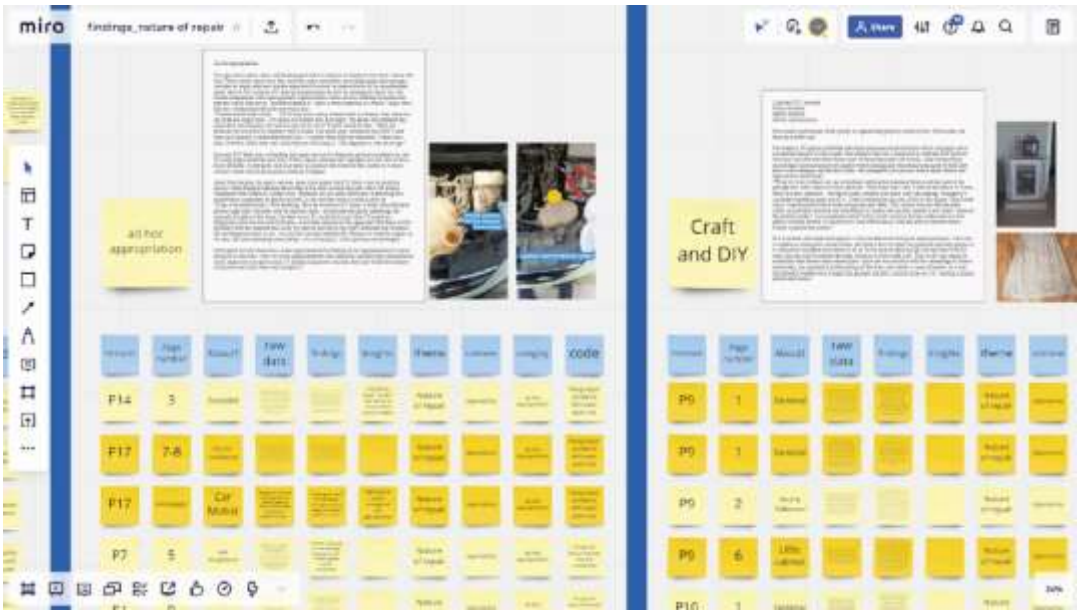


Figure 3.10 Miro Board close-up with each group has its own section for codes, photos and page to write down the findings.

3.7.4 Themes Developed After the Data Analysis

After the analyses of the interview data, I created five headings to discuss the findings:

1. **Nature of the Repair:** explains the features of repair, how it is conducted, and the aims, motivations, and limitations of this practice.
2. **Users in Transition:** discussing how users' perceptions change about repairability and product lifetime off an object. Also, six personas for different user tendencies for product care are created (see Figures 4.32 and 4.33).
3. **Objects in Transition:** investigates the transition of black-box and uninterpretable closed objects to the *open and transparent objects* that ease user interventions.
4. **Communities in Transition:** explains how creative communities protect their *right to repair* and how they operate on a local level.
5. **Emotional Durability and Product Care Activities:** argues how *emotional bond* and *product care activities* are reciprocal in nature.

CHAPTER 4

FINDINGS

4.1 Nature of Repair

This section describes the repair and maintenance processes for the repair enthusiast in seven headings. *Features of the repair* describe the learning phase of the product care behaviours. *The repair process* explains the steps taken to repair a product, from noticing the problem to reassembly. *The aim of repair* shows the different motives behind conducting repair and maintenance activities, while *considerations for repairing* exemplifies the different criteria for people to decide to repair or discard. *Approaches* present examples of diverse users' attitudes in repairing their products and *enabling factors* to introduce the conditions that ease the participants' decision to repair. Lastly, *limitations* draw attention to the user, product, space and system-related barriers that participants encounter while repairing.

4.1.1 Features of Repair

As a warmup phase for the nature of the repair chapter, this section explores the features of product care behaviours by explaining how they occur and what the process is like. The participants' repair and maintenance stories show that these behaviours are acts of creative problem-solving tactics that are based on trial error. There is a resemblance to a design process, and it continues with repair's being an exploratory search to fix the products. It is indicated that participants learned this practice by doing. Apart from these features, they exemplify how the nature of repair is unpredictable in terms of neither knowing the product will be fixed or not nor how much time and effort it will require. Since it is a practice that needs experience and learning some skills, some participants highlighted the importance of having a

master-apprentice relationship to acquire them and practicing with a person with expertise. These are the features that participants frequently mentioned. In this section, they will be exemplified for clarification.

4.1.1.1 Act of Creative Problem Solving

P6, explains how he repaired a wooden car toy (Figure 4.1) by sculpting the missing pieces from scratch instead of trying to find ready-made identical pieces:

> There are two things in front of him that beat like a drum. .... At the bottom, there is another piece that turns that mechanism, that is, one of those parts that allows the drums to hit - there are two parts, one of them was missing - I made a wooden part for it. That toy has become usable. ... I make them by carving the leftover woods I have.

Figure 4.1 Wooden car toy's broken arms are repaired by P6.

P17, on the other hand, finds alternative solutions to the problems that professional services demand a lot of money from. When the air conditioner in her mother's car had broken down (Figure air conditioner), the professional service told him that they needed to replace the air conditioner as a whole which would cost quite a bit of money. Then he tried to remove the air conditioner himself slowly and stuck together with the broken plastic pieces by using "Superglue and well... cigarette ash. ... When

I mixed superglue and cigarette ash, it became stronger." In this way, P17 found a creative and cheap way of solving the air-conditioner's problem.

Another creative problem-solving example is given by the P17 again. Instead of paying for repair service for changing his fryer's burnt-out engine, he bought another broken second-hand fryer of the same model for a lower price and re-used its components (see Figure 4.7).

The participants show their creative problem-solving skills over the repair stories they share. They are willing to try different methods such as carving a wood piece from scratch instead of finding mass-produced parts or using superglue to fix major problems that professional repairers demand a high price for. These alternative solutions for repairing products are discussed further as hacking interpretations in the section *Ad-hoc appropriation* (see Section 4.1.5.3).

4.1.1.2 Based on Trial-Error

Another tight connection of repair to a design process is that they are both learned through a process of *trial and error*. Since the participants are learning the repair and maintenance on their own or through the help of repair-related online and/or local communities, they are overcoming some difficulties during which they make mistakes constantly. For example, when P14 wasn't sure which adhesive is appropriate to use to stick the pieces of her broken bracelet (Figure bracelet), instead of consulting someone and waiting for them, she chose to go for trial and error and applied a type of glue to see if it would work or not. In addition to that, P15 explains the discovery phase through trial and error with the following sentences: "I intervene when something breaks down at home. Sometimes I can, sometimes I cannot, sometimes I get support from outside, or I break the piece, but again there is a learning process and a sense of achievement."

P10, on the other hand, speaks about improvisation during the implementation of a solution. She finds it easy to be spontaneous with painting her furniture (see Figure

4.12) “without making it a complex task”. This may be a result of a material and techniques allowance of trial and error together with being repeatable which is discussed further in the enabling factors chapter (see Section 4.1.6.4).

The participants welcome encountering errors as such an integral and natural part of the repair process. According to P19, if the repair is successful in the first attempt, there is definitely a serious problem:

> I always think there’s a problem if something works the first time I do it. Usually, nothing works on the first try. So I’m used to it too. The continuation of doing it is usually to repair it. So it feels like the end of a struggle; it’s a good feeling that I like.

However, the mistakes that are made during the process of product care practices are seen as valuable lessons that serve for the success of the next task. P19, says after trying and being unsuccessful at repairing his electric skateboard’s broken engine (Figure Skateboard) for 10 straight days, he could find an alternative solution and fix the engine in a day. Similarly, P12 - a repair enthusiast of electrical products- tells about the materials and components that he used improperly and burnt out during the repair of a wifi switch. After burning two switches, he learned what went wrong and on the third trial, he managed to repair it properly. Supporting this, P17 declares what he had learned from his initial unsuccessful attempts to apply spray paint on the repaired surfaces.

> The painting job is something I’ve done before. ... The basic logic of spray painting is already more or less the same. You know, if you spray at one point, it will flow and drip. You know that slick movement -with a flick of the wrist as much as possible. It is important to do a small amount of spraying with the so-called movement. Otherwise, paint bleeding will occur. So... I learned from my previous experience: it’s not just for the car, it’s the same rule when painting the wall or painting any small part.

Figure 4.2 Electric skateboard of P19 (Left), Close-up to the engine (Middle), Pieces of the broken engine (right).

Overall, experiencing trial and error during the repair helped participants to create a know-how on materials, components and techniques that guide them for their next endeavour. This phenomenon is strongly linked with a learning by doing method, which will be explained in the next heading.

4.1.1.3 Learning by Doing

While product care practices are undertaken, the repair enthusiasts may encounter some troubles during repair failures. Making the product worse than it was before is a very common experience for novice repairers (see Section 4.1.7.2.1.1). As one of them, P8 comment on learning from these mistakes as follows:

> Maybe you can make mistakes because you are not accustomed to it. Maybe since your hand is not used to it, you may accidentally remove a cable, you may break something, but I think everyone should start [to repair]. ... Maybe that's the thing that stops us the most: what if I break it completely? I think

> now maybe that thing has changed a bit [for me]. Let it be broken completely. Did you understand? I think it's much more valuable for you to learn it there and learn how to do it than to have someone repair it.

Of course, there are lessons taken for the next repair cases, as P8 mentions. For example, he says there are certain products that he didn't know he could have acquired to be more precise and spend less time and effort on the repair. After several unsuccessful attempts of repair, he searched and learned about the tools and bought them for the next repairs. As concluded from his insights, learning which tools to use and which methods to follow eases the repair task for novices. Similarly, after P4 learned how to fix a broken phone screen, then it was easier to help his friends who have the same problem. Moreover, P6 who frequently fixes music boxes, tells how most of the problem occurs due to the broken mechanism inside of it. Therefore, he knows where to look for a problem and how to quickly fix several music boxes and how to replace the broken part. We can visit a repair story P17 tells on how he painted his car's door handle (see Figure 4.42) to give one more example of how repair tasks get easier with keep doing them and get experienced in it. His previous attempts in painting lead him to understand the process on a deeper level and cultivate tacit knowledge.

> I used Scotchbrite like this - the scouring sponge - any paint you will make... it sticks better to the rough surface. You know, I'm telling this based on my previous experiences. I rubbed the green part of Scotchbrite very lightly on these parts and roughened the area a little more.

In conclusion, repairing is learned by practicing more and diverse repair cases. In each case, there are lessons to use for the next projects. In other words, the related experience participants gained while attempting to repair leads to valuable know-how that can be transferred to future repair cases.

4.1.1.4 Master-Apprentice Relationship

The role of the know-how on repairing is constantly mentioned by participants and for a beginner repairer, the importance of learning from more experienced ones is highlighted. This type of a learning process can be achieved through having a master-apprentice relationship which is described by P15 as follows:

> There must be a master-apprentice relationship. First of all, we have to do something together - but of course in the way that person [inexperienced] leads. He has to make a mistake because when he makes the mistake, I [experienced one] have to intervene. If he overcomes the obstacle when I intervene, it will also provide motivation to continue, and somehow the learning process will develop. In other words, I think it needs to be repaired with the observer effect.

P15 is a person who spent his childhood summers observing and helping his father in his vehicle repair shop, where he learned the basics of disassembling, diagnosis, problem-solving and assemble phases of repair. Just like P15, P19 also had a chance to experience master-apprentice relationships in a short internship with a luthier, after which he looked for virtual masters for other repair cases.

> There, I learned different ways to do many things that I have been doing for years and, more importantly, learn something. I learned to learn from someone. … For the first time, I had a master. It was a huge contribution for me. Then I tried to get some virtual masters from youtube. I said that if I am going on certain subjects, I follow people who I think can be my master in that subject and try to learn from them.

Apart from learning from a professional repairer, some participants mentioned how they experienced their master-apprentice relationship with their family. For instance, P17 says that: “You know, when I was a kid... I could fix my bicycle or other stuff myself. According to the things I learned from my father while I was watching him... it starts with those things”. P18 also supports the fact that improving his know-how on repair by observing his father:

> I mean he was curious and... he was a skillful person. There's probably something coming from there - we've seen habits. Because in my childhood, we did not proceed forty years ago like we did today, let's take everything and throw it out, let's buy a new one. In fact, the products of the ancients were much better than today's products in terms of durability. They would malfunction, and when they broke down, my late father would be repairing these things himself. I guess I got a habit from there.

As the significance of having a master-apprentice relationship on learning repair and maintenance tasks has repeatedly been indicated by participants, some of them also complain how low is people's interest in learning by observing and working with a more experienced person. P6 -volunteer repairer in an association- says young people are not willing to sustain the master-apprentice relationship and mostly stay away from the association's repair-related side. As such, P4 -another volunteer repairer of another repair-related initiative- says he usually works alone during the repair process because there are not many people coming to learn how to repair. They only want their products to be repaired. Therefore, although repair enthusiasts are open to learning new things and past repair experiences influence them, that does not seem to be widely applicable to other people, which might be a limitation for creating new master-apprentice relationships and transferring the know-how to newcomers.

4.1.1.5 Unpredictable Nature of Repair

The repair process is unpredictable in nature as the participants say it is not certain whether the problem will be solved or not. Even if the problem is solvable, they are unsure how much time, effort, or money that process will require. P19's electric guitar (see Figure 4.41) repair story shows how the lack of knowledge, skills or experience in repair may lead to misestimation of defining the amount of time and effort required to fix the problem:

> Since the electric guitar is very old, the frets, that is, there are straight lines of each note, those frets were flattened. ... I said I will change them. ... I will take it out and put a new one in its place. It seemed very simple to me. it seemed so; it's definitely not simple or something. I thought it was simple, because I was ignorant. ... repairing the electric guitar... something I liked and believed I could do. That's why I threw myself into something that I had never done before and that was actually difficult but looked easy when I looked at it.

In some repair cases, things didn't go as planned, and the participants faced repair failures. As the music box of P15 (Figure music box), after little pieces of the music mechanism went out of his control, he understands there is not much left for him to do besides lending it to a professional repairer.

> There is the point where you now see that a job is no longer irreversible. So from this point on, I can't do anything better, it seems like everything I do is getting worse. Because when the mechanism jumps out, tiny pieces come out and run out for me. That's the point.

Figure 4.3 P15's Cigarette box with music playing 'für elise'.

Similarly, P18 tells about a repair failure that happened to him while he was trying to fix a stereo.

> There is an old stereo, and there was a problem with the tape player of that stereo. I disassembled it, I tried to do it... I couldn't, I messed it up, I turned it off, it remains. I only use the record player and radio part; I do not use the tape player part for now. I'll do something at the first opportunity... I'll take it to a mechanic who understands these things.

To make viable predictions based on early experiences about repair, P19 puts emphasis on being experienced in it. After lots of repair failures and troubles about finishing it in promised time to a friend, he notices that one of the signs that show the expertise is to be able to know if a product can be repaired or not and if it is repairable, how much time and effort it will need and how much money will it cost. It takes time to decide on these, since there are always surprises one encounter during the repair as he mentioned.

In conclusion, repair tasks are unpredictable in nature, especially for those novices in the field. It requires expertise and seeing multiple cases to be more precise about how much resources should be invested in a repair case, which indicates being more like a master.

4.1.2 Repair Processes

To understand the nature of repair, this section explores the repair steps taken by the participants. The Figure 4.4 repair process shows the possible roots that people can take to fix or discard their products.

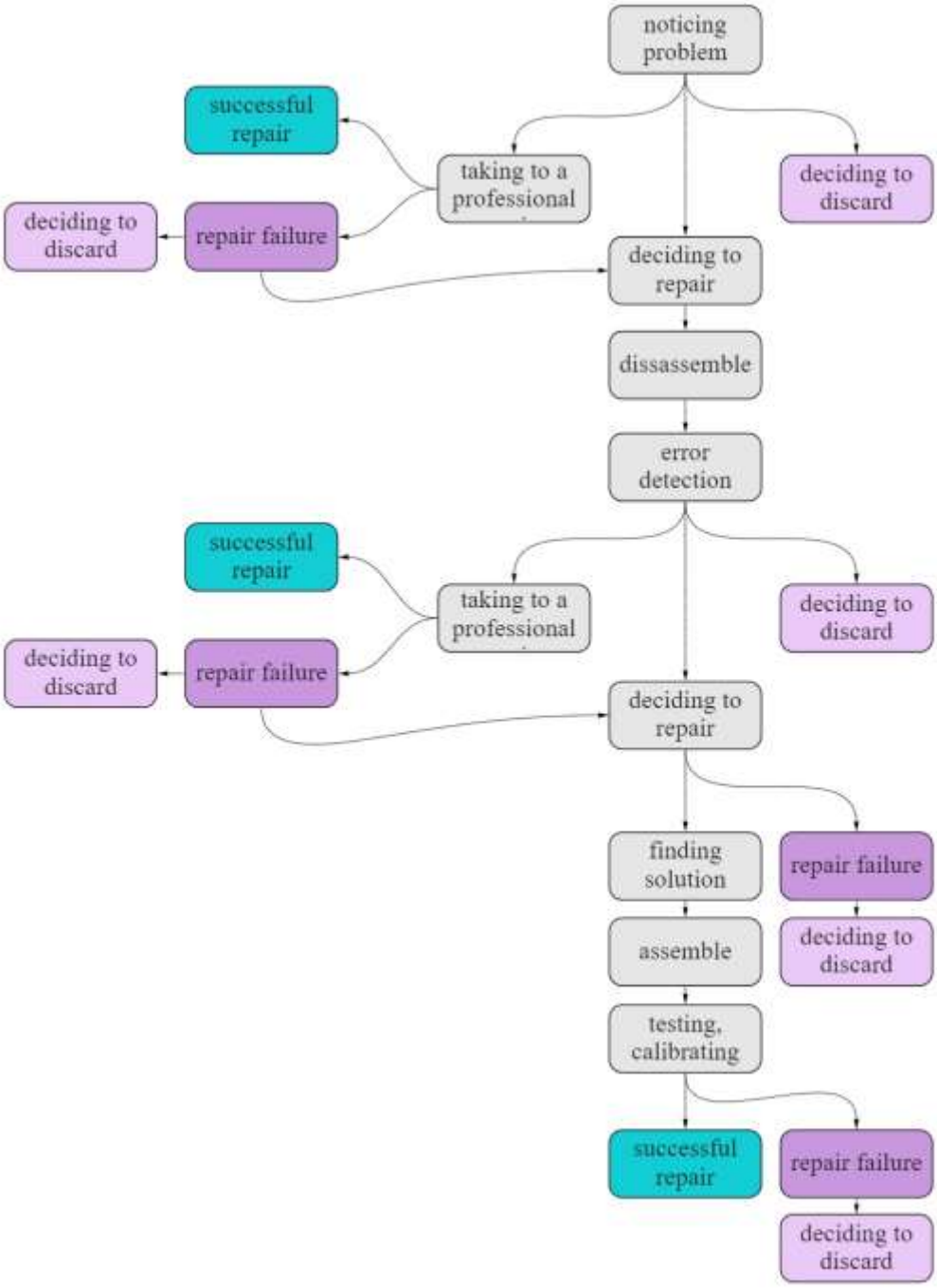


Figure 4.4 The possible actions for repairing products.

The repair process is starting with *noticing the problem* and deciding to take action about it. The problem may reveal itself with audio or visual feedback. When a vacuum cleaner creates "a weird noise", P9 understands that there is a problem with the way the product works. As in the case of P14's dress, the oil stain disrupts the visual integrity of the garment (see Figure 4.14). In some cases, the problem seems to occur suddenly without any indication, which causes people to say, "it was just working yesterday!" according to P11's observations.

Decision process comes right after noticing the problem. Decision is made whether the product will be discarded or repaired, if the latter is chosen, then it will be decided who will conduct repair -by the user her/himself or by a professional service. Of course, the participants usually have some measurements like money, effort and time needed for repair to decide whether to repair or discard the products which will be discussed in detail in the next section (see Section 4.1.4). When we look for the repairing decisions, the first option is to take the broken product to a service to make it fixed. However, in some cases, services cannot solve the problem -as in the case of P12's breadmaker. After the service declares that the breadmaker is not repairable, P12 tries to find his own way of repairing. He also adds that if the authorized service says the product can be discarded, he has nothing to lose; he can disassemble the machine without fear of making it worse (see Section 4.1.6.3).

Disassembly is crucial to see the components and detect the reason behind the error. However, sometimes it can be difficult to disassemble the products, "it can be more difficult than the repair itself" as P11 expresses and adds that major difficulties in opening up the devices is "to find where the screw is, under which tape - you need to know where the tape or something is stuck on or where the snaps or clips are." If one doesn't know these, they can damage the product while opening (see Section 4.3.1.3). That is why attention must be paid to, as he says. Some participants get help from online communities during the disassembly, like P17. While he was disassembling his fryer (see Figure 4.7), up to a certain point, he managed to do it alone. Still, then when things got complicated, he looked for help on the website ifixit (ifixit.com, n.d.) where people upload repair manuals, including disassembly

stages. Opening up a product can also help decide if the problem is solvable by the users themselves or it is beyond their capabilities and needs to be handed to a professional repairer. After managing to disassemble the product, the participants test and examine components to *detect the cause of error*. P11 describes his diagnosis procedure like this:

> First, there is one thing that is being questioned: what was the product doing, what was it not doing now, or what is it doing insufficiently, and then it is possible to decide on where the malfunction might be through that systematic steps, and then examine the components one by one and perform the repair.

P4 narrates the repair process of his broken phone screen. He thinks he did more than a simple component change (screen) since he investigated the actual reason behind the problem. That is how he explored the phone's structure and noticed that the reason the screen broke was actually because the metal frame of the phone was bent and jammed that glass screen. As this repair case was a diagnosis example, P4 gave another example for implementing solutions to fix the product after the diagnosis. He states that when he tries to see whether the product will work or not, he tries quickly done, non-durable repairs to see how to solve the problem. After that exploratory work, he repaired it in detail to finalize the process. If everything goes well, the product is assembled to make *testing and small calibration* during its usage, as P7 mentions.

Thus the process that starts with noticing a problem, continues with the decision of repairing or discarding and affected by the abilities and willingness of the users. Therefore, there are possibilities that the repair process can end with repair failures and discarded products, as shown in the Figure repair process.

4.1.3 Aim of Repair

In this section, the participants' motivations and aims to undertake product care activities are explained under seven categories which are *repair to regain*, *repair to*

spend less money, *repair for independence*, *repair for charity*, *repair for other individuals*, *repair to learn* and lastly, *repair to preserve the emotional value*.

4.1.3.1 Repair to Regain

The participants indicate their willingness to use their products for a longer time by regularly taking care of them both by repair and maintenance activities. Thus, they aim to increase the lifespan of products and consequently decrease the amount of waste produced (Ellen MacArthur, 2015). Another motive related to regaining is increasing the value of a retired product by repair and making it usable again, which will also be exemplified in this section.

P14 shows a photo of the shorts she repaired (see Figure 4.5) and adds she likes and wants to keep using these shorts for a more extended period. She says: “This is in a very repairable condition - the elastic is completely dismantled - but you know, I can sew this and continue to wear it until it wears down again.” Another example she gives is about people who think the garments fulfilled their lifespan when they got holes or stains. She argues that and tries to mend them to keep using them for a longer time.

Figure 4.5 P14 is replacing the worn elastic of her shorts to use it for a longer time.

P16 is another participant who uses some sewing skills to increase the lifespan of her fabric handbag (see Figure 4.6). Although she enjoys using her handbag, the lining

inside keeps piercing by the keys or other items in it. She also adds that the repair process is not very enjoyable for her but helpful in increasing the handbag's lifespan:

> I knew that if I sewed the lining, I could use it much longer, so I sewed the lining and tried to fix it. ... I also think a simple refurbishment is not something that will take a lot of my time. No matter how much I don't like sewing…

Figure 4.6 Unravelled lining of the fabric handbag is repaired by P16.

Participants also indicate their attempt to increase the value of a retired product by repairing them. They are motivated by making an unwanted item usable again. P5 declares his happiness and feeling proud about the products he repaired in association A since they are saved from "being a waste." P6 also articulates his happiness when he repaired products such as wooden toys (see Figure 4.1) that were left to association A and make them "usable again" for others. In association B, P4 also employed himself to make an unusable bicycle usable and valuable again (see Figure 4.9). After managing to repair and restyle it, he was satisfied with the result.

Decreasing waste is a complementary aim to increase the lifespan of a product. That is why the participants who reject the linear take-make-dispose system protest it by repairing and regaining their products from being a waste. Although the participants' behaviours will be examined and exemplified within the users in the transition section, a short quote of P4 explains repair to regain both the product and possibly waste related to it with the phone he repaired:

> The pleasure it gives me to fix the phone, in fact, is to remove one piece of waste from this world. If you're repairing your phone, you're not actually buying a new phone. And just as you don't buy a new phone, it means you are preventing your old phone from going to the landfill.

Repair to prolong product's lifespan is a strong motivation for participants, since they are willing to use their beloved products for a longer period of time while also wanting to decrease the amount of waste they produce.

4.1.3.2 Repair to Spend Less Money

One of the aims that participants keep indicating is to repair to save money by spending less on buying new products. Especially those who repair and upgrade electrical products indicate ever-increasing prices of newer products lead them to repair even though they seemed to complete their expected lifespan. For example, P7 mentioned the laptop (see Figure 4.29) he fixed for his father's friend, seven years old, and performed very slowly, since it has almost completed its lifespan. Still, the owner can't afford to buy a new laptop sold for sky-high prices in those days -as he expresses- P7 fixed it for him. Another one, P5, spent a considerable time fixing a fluorescent tube lamp both because not to let it turn into waste and, more importantly, because new lamps will cost too much money.

Besides the expensiveness of acquiring new products, people are also repairing the product on their own to save from money paid to the services. P17 is one of the participants who first investigates how much it will cost to take the broken item to the service then decides on repairing or making it repaired. For example, he tells about the fryer with a burnt-out engine (see Figure 4.7): they asked about 580 TL to repair it when he took it to authorized service. However, he found the second hand of the same device with a broken lid but a solid engine for 200 TL. Then he replaced the broken engine with the solid one to fix his fryer. Apart from these, as mentioned earlier (see Section 4.1.1.5), he found a way to repair his automobile's broken

component with superglue only after services asked him 350 TL to replace the component. Thus, in a way, he found a way of repairing his belongings to spend less money on services and professional repairers.

Figure 4.7 Fryer opened up and was ready for repair by P17 (left). Repaired and closed fryer by P17 (right).

As seen, people tend to repair the products on their own to decrease the expenses of buying a new product and repair services. However, sometimes, even if the products' physical life comes to an end, the owner may neglect it, and its lifespan may be increased by repair for not paying the price of a new product.

4.1.3.3 Repair for Independence

Another motive that comes to the foreground is repairing for independence. Most of the participants include their unwillingness to take their products to professional services because of the unpredictability of waiting time, insecurity about the pricing,

and suspicion about the quality of repair there. Also, they feel self-sufficient when they can cope with their repair cases. In this section, the drawbacks that lead repair independently will be exemplified.

P12 has a caravan and begins the journey soon as spring comes. He explains almost all caravan drivers he knew carry their large toolbox and spare material with them to take care of their own business unless there are significant malfunctions. Since in Turkey caravan is not a common sector that raised its mechanics and services, they are trying to handle repair and maintenance activities on their own as much as possible:

> Let's say you went to Erzurum with this caravan. Now, in Erzurum, you will not find any mechanic that can repair this caravan or parts of the caravan. Therefore, you have to call friends and learn how to solve that problem [on your own].

P19 is another participant that needs to find repair solutions for self-sufficiency. The drone he bought for hobby purposes constantly loses its parts or gets broken when he attempts to fly it through some obstacles. Even though he managed to fix it and ordered some spare parts for future cases, he realized they need to be ordered from abroad, and each piece arrives in a month or so. Consequently, he says that "I realized that if I'm going to get into this hobby, I have to fix everything myself." The drone repair is not the only hobby-related repair for P19. He also plays the electric guitar and takes care of its maintenance and repair on his own without counting on professional repairers (see Figure 4.41). He says, "Since I love to fix things since I was little, it doesn't come to my mind to have it fixed -especially the things I use a lot. So, I always try to see if I can fix it myself." That is why when he started playing the electric guitar, he also started repairing it on his own until he got stuck and couldn't find a solution. As a person who repairs for independence, P19 expresses:

> I want to experience the feeling of self-sufficiency. What if I produce the things I use... including what I eat and wear... I would be happier. Of course, I'm far from that right now, but repair feels like a dimension of it.

Figure 4.8 Drone set P19 owns (left). Drone's pieces that frequently get broken (on the right).

Besides the feeling of self-sufficiency, the other biggest motivation behind repairing on their own is not having to go to services or pro repairers -as participants articulate. Because they are uncertainties regarding how much time it will take or how much time the repairers will ask for solving the problem. P11 prefers to fix his car, since he doesn't want to take it to repair service, and both spend time, energy and money on it. Instead, he examines youtube videos in which "a man shows how to unscrew every single screw in a perfect way" to find a solution to the malfunction of his car. Additionally, P17 express his thought about not wanting to go to the services through these words:

> For example, something broke in my house. Either get in the car now, take it somewhere, spend gas, leave it there, come back two weeks later, waste time again, spend gas again, bring it back ... this is a burden for me. If I can fix something in my pyjamas at home instead, I would.

P12, on the other side, is having difficulties in trusting the repairers he is calling to his house since they are not dependable on timing. In the city he lives in, he says it is hard to quickly find a repairer or craftsman like in İstanbul or Ankara. That's why they are hard to reach. "They are a bit delicate. They both want a lot of money, and they also don't come. This forces you to do your own work." He gives an example about it: When his garden door broke, and it needed to be welded, he called for a repairer to do it. After agreeing on the day and the money, the guy didn't show up

and kept P12 waiting. “Then I searched online, and the welding machine was 250 lira. So I went and bought one welding machine on the Internet - an electric welding machine. I sat down and welded myself.” P12 is not the only participant who waited a long time for a repairer to show up. When her garbage disposal unit connected to the kitchen sink was stuck and not working, P16 called for its service to send a repairer to her house. Only after a couple of days, they came; meanwhile, she was unable to use the sink as well. Finally, after 5 minutes and 150 TL, they make the unit work again, for which P16 felt frustrated. She says, “I will try to open and repair it”, just not to count on the services for the following malfunctions.

The last but not the least reason to repair for independence is the participants’ suspicions on the quality of experts’ repairs. For example, P17 kept finding cheaper and alternative solutions to the malfunctioning products that experts asked a couple of hundred Liras for. Also, when he took the fryer (see Figure 4.7) to the authorized service, they diagnosed the malfunction immediately in a sloppy way without making a proper examination, he states. That is why he couldn’t trust their work and chose to examine the malfunction on his own. Moreover, he adds that services usually prefer to replace parts and bill you a lot instead of fixing a malfunctioning problem. That is why he avoids the services and gives a shot at repairing on his own.

To summarize this section, the examples of repair for self-sufficiency are examined as some participants prefer to care for their products on their own without asking for help to be independent. On the other hand, some others have hesitated about consulting authorized services and repairers because of the distrust and suspicions. It is also related to people’s changing perceptions about repairability and repair quality. That is why this issue will be further discussed under the *changing perception* heading (see Section 4.2.3).

4.1.3.4 Repair for Charity

Two neighbourhood level repair-related associations visited during the site observations aimed to repair for helping disadvantaged groups in their neighbourhood. In doing so, they first asked their neighbours to bring back to the associations their broken and unwanted products. In the case of association A, some members who are curious about the repair voluntarily fix the products as much as possible. Afterwards, they directly get the fixed products to people in need within the neighbourhood and arrange a swap festival [*takas şenliği*] twice a year to sell the rest of the products to raise money for uplifting their neighbourhood. At the festival, the members of association A display and sell only the second-hand products brought to them by the other neighbourhood residents. While some products can directly be displayed, some others are fixed by the volunteers beforehand.

As an association A member, P5 usually fixes laptops and phones for the neighbourhood inhabitants who cannot afford authorized services. For example, he fixed a student's phone which has mainboard failure by using the components of old phones that are brought to the association by the neighbourhood residents, or he also fixed a laptop with a broken casing and donated it to another student in need of a computer but cannot afford to buy one. While P5 take responsibility in these type of products and they are directly donated to the residents in need, P6 fixes other products like toys, jewellery, watches and music boxes in general and apart from the toys, these products mostly displayed and sold at the swap festival to benefit the association and raise bursary pool for disadvantaged students of the neighbourhood. The toys (see Figure 4.1), on the other hand, usually become gifts for the children coming to the association. P6 expresses his happiness about giving a toy as a gift to a child which is just repaired in the association by himself as follows:

> Our neighbours who come to the association also bring their children or grandchildren. When they arrive, giving them a toy as a gift and seeing that happiness makes us even happier than they probably do. ... Also, making a

> discarded toy useful again and giving it to a child... becomes a much more beautiful thing.

In the case of association B, it again starts with asking neighbourhood residents to bring their broken products there. People may either leave their product there to be repaired or donate it to someone in need. Alternatively, people can fix it for their own use together with the help of a volunteer member in the association. As P4 helps people repair their electronic products, P14 organizes sewing workshops for teaching and helping people repair their ripped, torn or not fitting garments.

Overall, these two associations set themselves a target of repairing products that residents of their neighbourhood brought and fixed them either together or without them to donate some of them to the people in need. The rest of the repaired and serviced products are displayed and sold at the festival to raise money for charity. Consequently, product care becomes a tool for pro bono by the volunteers of these associations.

4.1.3.5 Repair for Other Individuals

While the participants may volunteer in the associations to help people repair their products, they also help their friends and close circles in their daily life apart from an association context. These repair cases would aim at helping out a friend or a neighbour fix the products that they cannot do by themselves. For example, P4 says when someone has trouble with their computers in his workplace, they ask for his advice. He helps when he can or gives consultations, but when he thinks he cannot manage to fix it himself, he advises that person to take their product to a professional repairer or services.

P11, who consistently undertakes care activities both for himself and the others, expresses his happiness about helping out a friend regarding repair: “if I solved a problem of a friend of mine, that is, if I solved a problem that he could not cope with, I am happy. Otherwise, the repair doesn’t mean much to me anymore.” He adds that

he is paying more attention to the foreign friends who ask for help since their access to professional repair services can be more challenging. P19 is another participant who repairs for others independent of a repair association and enjoys the process. His family members, friends and even his friends' families ask his advice and help when they have a broken product. He says, "If I'm doing it for another person, like my mom's something is broken and I fixed it, I like the moment when I give it to her very much!"

P15 and P17 have different agendas in repairing for their friends. "They" convinced their friends to repair for them since they are aware that professional services will charge them high prices for the things that they can also do. P17 was listening to his friends when he was complaining about the service price to replace a component in his car and told him that he could do it for him gladly. However, he adds:

> Sometimes they [friends] can not trust. Okay, you replace it, but what happens if your hand slips? Let me get it repaired [at the service]. I say okay, I say go, and I say give 200 Liras to the repairer. I'll do it for a soda.

After resolving the hesitation, he convinces his friends to repair the car on his own. P15 went through similar situations as well, while a couple of his friends mention that they don't want or can't take their cars to services in the middle of the lockdown [due to Covid-19]. So he suggested changing the vehicle power supplies for them for free, which would make them happy.

Apart from feeling happy or making their friends spend less on services, some participants indicate their motivation to repair for friends to win their approval. For example, P7 smiles and reveals his true motivation in repairing his friend's hair straightener (see Figure 4.31) to win her approval with his repair skills. P11 also offers another example as a supportive of gathering others attraction to his repair skills by telling:

> These things do not happen without an audience, and there has to be someone to show. If there is no one to show when you do it... there isn't much of an incentive to do these things. Just to be able to say: Look, I did this.

On the other hand, these requests from close circles may become a burden for some participants. For instance, in the case of repairing a seven years old laptop (see Figure 4.29) for his father's friends, P7 was feeling unwilling to do that since it had already completed its lifespan in his opinion and kept him busy for some time: "This [repair] bothered me a bit. Since my father's friend asked, I had to do it. Because I can't deal with fixing people's computers any more." Therefore, repairing for someone becomes a repair for entreatingly, in the repair case of P7.

In summary, participants constantly repair in their daily lives for others, including friends and family members to help them, since they enjoy the process or want them to spend less on the services while also loving to gather people's attention on their repair skill and win their approval.

4.1.3.6 Repair to Learn

One of the aims of repairing for repair enthusiasts is to learn from the process. By opening up the product to diagnose the malfunction, they aim to learn its structure and working principles. Since the participants indicate their love for knowing how stuff works and can be repaired, they search and explore different ways of repairing it.

For some participants, it is not even to solve the problem but to test themselves as P5 indicates: "I only test myself, you know if it can be solved or not, why can't it be solved, why is my knowledge not enough to solve it." P8 also has a similar approach to repair. He says that his aim is not solely to make the product usable again but to open it up and learn about it. He adds: "It is not that important to do an excellent job but important to enjoy, learn and make it work again. That is enough for me. you become familiar with the objects in the end." Another person, P4, also expresses his

interest in figuring out how things work and how to fix them when they have problems in functioning. He states the more he learns about the product, the more it becomes familiar to him since he learns about its structure, components and working principles.

P19 says he learns a lot from undertaking different repair cases, and he uses this information on the following cases. “That’s why making repairs that I haven’t done before is a good motivation for me.” While choosing what to repair, P19 first evaluates if the products are worth his effort and time to repair, but besides this, learning from the repair is a solid motivation for him:

> If it’s something I’ve never done before and will teach something new, then it is an excellent motivation for me. So I usually compare it like this: Is it worth the time I’m going to spend on this... But my criterion before the money is what I will learn from it.

P19 also draws attention to the material and production techniques he learns besides the product’s way of working while he was repairing his electric skateboard’s broken engine (see Figure 4.2). During the process of trial and error, he found that the milling machine could work for him and started to use it. Afterwards, he added another skill to his toolbox. Additionally, after working with metal parts of the engine in the milling machine for some time, he expresses his familiarity with the material. Therefore, after repairing the engine, he gained new abilities and knowledge on new materials and machines. Similarly, P4 narrates on the techniques and materials he learned while he was repairing a discarded bicycle (see Figure 4.9):

> I cleaned everything, all the paint and stuff. In the meantime, I tried various methods. On the other hand, this is how I learn, and I like that learning process. How to remove the paint, I didn’t know how to do it... But at the end of summer, it was a very nice and usable bicycle... I mean, I like to look and search, to learn something new.

Figure 4.9 Bicycle left to the Association B (on the top). Repaired bicycle by P4 (on the bottom).

For the repair enthusiasts, the repair is a joyful learning process of getting familiar with the products' working principles together with the materials, techniques and machinery work involved in their production.

4.1.3.7 Repair to Preserve the Emotional Value

Repair and maintenance are a way to protect products from the traces of time and preserve the memories attached to them (Hernandez et al., 2020). While P18 defines his care actions as an "instinct to protect or continue using what you have." P9 takes action when "something valuable" for him loses its integrity and needs its owner's attention. P14 talks about the emotional value of the products to trigger her to repair them. She explains why she fixed her flatmate's owl-shaped magnet by referring to its *emotional value*:

> I dropped this on the ground, and it broke in half. ... Some traces of glue are barely visible in this. I felt responsible for it because I thought it might be something valuable for him [flatmate] and broke it. I mean, I thought it might have an emotional value, and I felt the need to repair it with this responsibility.

For P16, the motives behind mending her fabric handbag are to preserve the memories attached to it in which she finds reminiscent of her pass-away mother (see Section 4.5.1.2 and Figure 4.39). That is why she expresses how indispensable this handbag is for her, and she keeps mending it every time its lining is ripped.

In the case of a music box that is a family heirloom (see Figure 4.3), P15 felt the urge to repair it immediately to make it work again. Although he failed to fix it, his motives, as he narrates, were to keep the heirloom working again.

As these brief examples show, people tend to protect the products that they feel attached to. In this way, they repair and maintain to protect this *emotional valu*e and make it last for a longer time. Although this was a brief introduction to the repair for preserving memories and emotional values, more details will be provided within the next chapter of *Emotional durability and product care* (see Section 4.5).

4.1.4 Considerations for Repairing

There are some criteria users consider when deciding whether to repair their products or not. As findings suggest, the main criteria are the amount of time, effort, and money needed for repair, the expected lifespan of the object after the repair, and predicted visual satisfaction after the repair. After considering some or all of these criteria, the participants decide to repair on their own, have it fixed by a professional or discard the product as indicated in (see Figure 4.4). Each of the considerations will be exemplified in this section.

4.1.4.1 Efforts and Time Given

The time and effort needed for fixing a product most of the time is unpredictable by a novice practitioner, which is also mentioned in section 4.1.1.5. P4 also points out this difficulty in calculating the approximate amount of time and effort spent for repairing electronic products:

> I mean, there are probably things that I've put more effort into than they are worth. Maybe you've spent more effort on something that wouldn't need that much effort if it was done from scratch. But, because of that trial and error process, that repair can take a long time. If you could have guessed from the start, and said I'll do it, but it will take six months or something… But if you could do this, I suppose you'll never get into it.

Also, there are products left unrepaired because they are not worthy of the time and effort that they require. Sometimes, it is because a new one can replace that product at a lower cost or it loses its functionality and becomes technologically obsolete. The participants' reasons for not repairing their products will be discussed in detail in the *limitations* section (see Section 4.1.7).

4.1.4.2 Money Spent

Another criterion while deciding whether to repair it or not is the amount of money required to repair or buy a new product. For example, P4 chose to repair a washing machine on his own after he researched the cost. Since the machine has a broken component, a replacement is needed for repair. He looked for the price of the component on the market and asked a repairman for how much money he could fix it. After comparing the expenses, he decided to repair it on his own by buying a spare part. Moreover, sometimes the repair cost of a broken component can be equal to buying a new component and replacing it on your own in the case of laptops, as P5 explains. According to P7, people prefer to discard their product when the price is high for repair or buy a component. Supporting P7's view, P11 gives this example of the scale (see Figure 4.10) he fixed for his friend.

> I disassembled it and looked... I thought about how much they cost while disassembling - I do it as an amateur, so I don't look for anything commercial. I looked at how much it costs... The price of the scale is 120 TL. There are six large batteries inside. The batteries cost 80 TL. So there is no point in fixing

anything anymore. The tool's batteries are also dead, by the way. I also found a malfunction and repaired it. But generally, this job is of no value anymore. If you put half-day labour on a tool with a price of 120 TL and find the fault and repair it, there is nowhere left for this thing. Therefore, the American take-make-dispose system is valid.

Figure 4.10 Electric Scales repaired by P11.

As for some repair cases, money becomes a motivating reason to repair at home, in some cases, high component prices discourage participants from repairing their products, as discussed in the *limitations* section (see Section 4.1.7.4.1). After researching and predicting the cost, it is easier for the participants to decide to repair or discard the product.

4.1.4.3 The Expected Lifespan of the Object

Some participants indicated that before repairing, they consider the end results' durability and safety during usage. That is why they want to repair, if the products' lifespan will be increased considerably. On the other hand, if it won't add much to

the product life, they may give up on repairing. P5 talks about his experiences with repair services about laptops:

> The graphics card comes out. It is tiny, I should not say the pin's head, but there are tiny balls, solder balls. They put them on the integrated circuit, they heat them and when the integrated circuit gets hot, [solder balls] collapse, but there is no guarantee. You don't know if it makes contact there... It works, but it's not like a fabrication. After a while, it can break again with the effect of that heating. They don't give more than a six months warranty. In fact, they don't bother [to fix] because it needs too much labour.

In the case of fixing the broken bracelet (see Figure 4.28), P14 expresses her indecisiveness about how to repair it, and whether she should take it to a repairer or make it on her own. Because the bracelet has initially been joined with a soldering method and she can't perform it, she is not sure whether sticking the broken pieces with superglue will last long or not, but she gave it a try. Lastly, in the case of fixing a hair straightener (see Figure 4.31), P7 indicated his unwillingness, since he cannot find an original spare part, and he comes up with an alternative way that will approximately last for a year or so. However, since it is not a long-term repair, he usually would not do it, but the product belongs to his beloved friend who needed it to be repaired.

To conclude, the participants evaluate the expected lifespan of the broken product before they try to repair it since they wish to compensate the time and effort they spend on the repair process with the considerably increased product lifespan after the repair.

4.1.4.4 Aesthetics Concerns

Aesthetic concerns are also a strong determinant after money, effort and time to decide products' fate about the repair. Some participants like P9 and P13's main aim is to fix the visual disruptions in the products, so they repair for achieving visually

appealing objects. While P9 chooses the refurbishment activities for her furniture, she changes the visual language by applying a new coat of paint, sticks some visuals or adds some ornamental details made out of clay (see Figure 4.22). As she says, she tries to create unity out of different furniture pieces by restyling them as "vintage pieces." She expresses her feeling: "it is nice to see a visual language in the house. It satisfies me visually." P13, on the other hand, has a larger scale for restyling in mind. He and the repair association he is a member of try to repair the city through visual interventions (see Figure 4.11). He explains their motivations through the example of rainspout repair.

> The cities we live in are not very aesthetic - the fact that the aesthetics do not appeal to us could have remained like that for years... After we put this [repaired rainspout] in there, many photos came to us from different people. How beautiful you did, they said. It is actually to make people smile a little more with our temperament and aesthetic understanding and inspire.

Figure 4.11 Rainspouts are repaired visibly by P13 and other association C members.

While some are triggered by the visual disruption and repair products to satisfy themselves visually, some participants indicated their hesitation about making the products' appearance worse than it was. Sometimes the *fear of disrupting the product's visual quality* may even prevent a participant from repairing the product. For instance, P10 tells about her uncertainty in painting her laminated wooden chair (see Figure 4.12) since the wrong choice of paint or its inappropriate application may cause paint bleeding or peeling.

Figure 4.12 The laminated wooden chair is restyled with painting and changing the upholstery by P10.

For P16, the visual outcome was also a topic of hesitation while she was deciding to repair her handbag (see Figure white 4.6). When her handbag's lining is unravelled, she wanted to sew and repair it, but she is not trusting her sewing skills very much. Then realizing the lining won't be visible from the outside, even she does a bad-looking stitch relieved her and encouraged her to repair it. However, she added that "if there were something on the outer surface, I probably wouldn't have had the courage." Therefore, the idea of having amateur stitches to be visible on the outer surface of her handbag is not visually appealing for her. P14, who does repair

primarily based on her sewing skills, also talks about the visual drawbacks of the repaired garments. Although sometimes she can't manage to make proper stitches, she won't stop using the repaired item, but still, think about her "bad craftsmanship", and she wishes it had never happened to that object. She also gave another example about the earring she repaired but stopped using afterwards. When beads of one side were spilt, she managed to find similar beads to repair them and use them for some time. However, at some point, she felt:

> It was terrible, although it is perfectly balanced and they have the same number of beads... But I mean, it is not the same and looks ugly besides the other one, that is why I stopped using it. So I tried to repair it, and it didn't work.

Lastly, P14 again confesses that she prefers not to repair the aesthetically unpleasant objects, which is another perspective in repair considerations. Since she is already not pleased about the product's visual quality, it becomes unworthy of repair effort and extending its usage time.

Overall, the product's current and anticipated appearances are strong determinants for repairing it or not. While some participants are willing to change the current look and visibly repair the product, others prefer not to spend time or effort on products that will not be visually satisfying after the repair. Therefore, the aesthetic concerns in mind affect the execution of the repair.

4.1.5 Approaches

Participants' motivations differ greatly in approaching product care activities. While some of them execute *craft skills* and have *DIY approaches* to visibly repair their products, some are including digital technologies like 3D printing to produce components according to their own tastes in the comfort of their houses. The works of this first group are exemplified under the heading of craft and maker-oriented approach. There is a second approach called *ad-hoc appropriation*, in which repair is seen as a hacking activity. They fix major problems that require high service

charges with basic materials like superglue and execute repair in a critical way. Lastly, visual approach refers to the user preferences about hiding or displaying the repair results on the product. These four approaches, namely, *craft and maker oriented approach, ad-hoc appropriation,* and *visual approach* will be exemplified under this section.

4.1.5.1 Craft and Maker Oriented Approach

Craft and maker-oriented approach exemplify the repair works of participants where there is a visible change through product care activities by including some hand skill and machinery work to the process. While some of the participants focus on traditional methods such as painting, sewing, etc., some others include digital technologies such as 3D printing in the repair processes.

P9 applies craftwork into the repair processes of her furniture, which also helps her to personalize them by visible repair. She explains how she has been interested in craft and DIY projects since she was little and has made these a part of her professional life as well. After purchasing second-hand furniture, she applies wood painting and decorating techniques to hide their visible damages and fix their looks (see Figure 4.13). She exemplifies the process with a small cabinet she repaired and refurbished:

> When we were in İzmir my son or husband told me that someone threw a cabinet next to the garbage box, but it seems in bad condition. They didn't even care. I said, let me look at it. It was really in bad condition... The top of it was covered with mold, very bad looking. I thought, if I can make something good out of it... Then I realized the fun part is this! Then I took it and cleaned the molds, which took a long time and effort. This cabinet was not like the other [other second-hand furniture she refurbished] I cleaned the top part, sanded it and finally removed the molded surface. I use a material called "relief pasta" to cover the top surface and use it to make a wooden texture. It helped me to

clear off the messy look and gave a wooden texture. Finally I painted the cabinet.

Figure 4.13 Small cabinet repaired by P9.

P14 is another participant that applies a craft and hand skill during the repair processes. Since she can sew and similar works, she finds it easy to repair her garments and helps people in a community-led repair association to do so. In the case of repairing her beloved dress with oil stains, she first tried to remove the stain; however, it didn't work well. That is why she started to embroider little flowers onto stained parts. Since she was satisfied with the camouflage of flower embroidery, she repeated it on the endings of the dress and created a sense of pattern shown in Figure 4.14. In a way, her hand skill worked well to repair her garment and added value to it by creating a unique pattern and texture.

Figure 4.14 Embroidered flowers on a stained dress by P14.

In a craft-oriented approach, the participants exert their hand skills and find ways of including their tastes and preferences on the products they would like to see. That is how the repair process can be meaningful for creating emotional bonds between user and the product. There is another dimension of craft and maker-oriented approach, which includes the rapid prototyping technologies.

Association C -that P13 is a member of- are applying repair through the application of digital technologies. He indicates that they help the community to hack the city through repair with the use of rapid prototyping tools like 3D printers and so on. They focus on urban furniture or infrastructures that need repair. In some cases they describe the newly added pieces as repairing and hacking the city's look and identity. One of the examples P13 narrates is the component of a barge they produce by 3D printing (see Figure 4.15). Normally, when the barge's head part is ripped, the municipality replaces the whole product, since it is not repairable. Products being a waste because of a small component failure triggered this repair community to take action. P13 says, "we said let's fix it according to our own temperament, instead of releasing it to the world as a waste" Together with the other members, they modelled

and printed star wars characters' heads to replace the broken barges top part as seen in the pictures.

Figure 4.15 Barge without its top components (left), 3D printed heads to replace broken components of barges by P13 and members of Association C (right).

The 3D printers and computer-aided modelling programs are used frequently by the maker communities. P15 from another maker community, also makes use of his own printer at home to fix his products. He repaired an annoying tab (see Figure 4.16) that is too short to reach the sink with a yellow piece that he printed with his 3D printer after finding the model of that particular component on Thingiverse (thingiverse.com, n.d.). Although he wanted to intervene in the product by replacing it, the pandemic lockdowns prevented him from going to a store and buying a new one. Since he has his own printer at home and used to use open-source designs and printing components and products, he repaired the faucet using digital technologies.

According to these examples, it can be concluded that digital technologies and open source designs allow people to take action and be creative in finding repair solutions independent of traditional methods like going to a hardware store and buying an identical replacement component or disposing of the product and buying a new one (see Section 4.3.2). Moreover, the inclusion of hand skills and making process through the use of 3D printing adds a layer of creative problem solving for visible repair processes.

Figure 4.16 Yellow 3D printed plastic piece to fix the bathroom faucet by P15.

4.1.5.2 Ad-hoc Appropriation

For some participants, repair and hacking go hand in hand, according to the repair stories they told. These stories show how they hack the repair network by providing simple and unthought solutions to major problems that are expected to be costly or impossible to fix by an authorized repair service. For instance, P17 kept giving examples of how he repaired his car's broken components with super glue and cigarette ashes while services told him to replace the part and asked for high prices (see Figure 4.17). Another example P17 gives is repairing his friend's single chair with a broken leg only with nails and wood glue. His friends asked for help from P17 because his mother was a bit angry at the repair cost that a carpenter asked for the chair. Then, P17 says he can repair it since he has tools like wood glue, tormentor, etc. He says: "I poured a certain amount of glue. I squeeze them [broken parts of the leg] with the tormentor. I bang cross nails. It held it. It has been very solid, and they are still using it." In a way, P17 finds ways of hacking the repair services by fixing the products at almost no cost by using simple materials and tools. On that point, one also starts to question the reliability, quality and charges of repair services discussed earlier in section 4.1.3.3.

Figure 4.17 Car component P17 fixed with super glue. On the pictures, it is written “Superglue shock”, “for the master who says that the plastic is cracked, 350 TL is stuck”.

Apart from hacking the repair services, some participants like P15 find a way to hack the product while fixing a bathroom faucet that is too short to reach the sink with a 3D printed component resembling a water slide (see Figure 4.16). However, he had some difficulties in attaching this extra printed component to the faucet itself. In the end, they attach it with a cable tie.

> It has to be attached here. With anything. How do we attach it? I mean, it looks like a finished product right now, but here’s how to combine them - we decided we’ll print something, for example, I looked at this thing: I looked to see if I could find a part [free 3D model on thingiverse] like the tool sold in Koçtaş - a tool that connects to the upper part. But there will be problems with the diameter and so on, we have to edit the STL file [they download the 3d model file] and so on... we said, let’s not deal with the file. Because it won’t be simple, so we said, let’s find something from the top - it’s a bit eclectic. Such a process has developed.

Participants include themselves in the repair network by finding ad-hoc appropriations to repair products in two ways. First, by using simple materials like adhesives and nails, they challenge the costly repair services. Second, by finding unexpected solutions, they may break the integrity of a product and hack their way to repair it.

4.1.5.3 Visual Approach

While repairing, aesthetic quality has been a consideration for participants. However, the approach to aesthetic values differs significantly. While some of them want to keep the product in its original look after the repair and hide the signs of repair, some others welcome the changes that come with the repair and embrace the new look and identity of the product. These two approaches will be exemplified first as a hidden repair approach and second as a visible repair approach.

4.1.5.3.1 Hidden Repair

Some participants indicated that a pleasing aesthetic appearance of a repaired product is a sign of good repair. That is why they are keen on keeping products' aesthetic integrity and don't disturb the original look. P4 cares about the aesthetic view because it is a sign of the product that indicates endurance and ergonomy. In his opinion, repair makes the product more fragile. That is why if we see additional parts or repaired parts, it may point to the product's weaknesses. In furtherance, for P15, visual changes on repaired electronic products are signs of trouble. He says:

> So if the electrical outlet has been repaired - I can say that I like it better if it is not seen. Because when I repair it, for example, if I join it with a tape, it will be visible, but I think that it will not yield exactly the same as before.

Figure 4.18 Electrical outlet fixed by P15.

P18 also supports the idea of protecting the product's appearance during repair and upgrades. He gives examples of car modifications while saying he can't understand why and how people change their original pieces without thoroughly considering the "aerodynamic and dynamic structures and static conditions." He adds:

> In my opinion, a product or an item should be used in its natural and original way, whether it comes from the hand of a master or from a machine in its original state. So if you want to improvise something, you have to make it from scratch. When you try to transform something else into it, that naturalness disappears.

Overall, visual changes on different product types may imply or indicate different meanings. Thus some participants tend to keep the product's appearance as it was before the repair, first, to be sure about the safety and durability of the product, and second, to keep its "originality" and "naturalness" as it is. Therefore, their intervention through product care remains at the functionality level rather than incorporating visual changes.

4.1.5.3.2 Visible Repair

When it comes to repairing products by changing their look, it adds a new layer to the product care activities since it becomes a way of expressing identity and using personalization methods. For this approach, the participants consciously alter the product's aesthetic values while repairing or upgrading them.

As mentioned in the aesthetic concerns section, P9 and P10 refurbish their furniture by applying different colours, styles, and images, resulting in a product with a new identity created by its owner (see Figure 4.22). Again, P15, who fixes his faucet (see Figure 4.16) by adding a component he printed from his 3D printer, changed the whole product characteristic by the visible repair intervention. For them, visibility in the results does not need to be hidden but embraced and displayed with pride.

4.1.6 Enabling Factors

4.1.6.1 Availability of Time

Having free time is an essential factor in conducting repair and maintenance for the participants. Although they have intentions or desires to fix the products, they may find themselves drowning in the other responsibilities, and no time is left to deal with care activities. P18 admits that he was not an enthusiast of repairing on his own before his retirement:

> This is a bit related to people's time management. In other words, you are in the rush of daily life; you work intensely, you do not automatically want to deal with them [maintenance and repair] anyway... This has become a feature that started to settle in me after my retirement. I try to take care of the small needs of the house myself.

Another point in having time to fix it is to be in the covid-19 pandemic lockdown. P7 narrates how being at home and having spare time enabled him to repair his

forgotten bicycle: “it was rotten. So I fixed it and reactivated it... I did it when the corona homestay process started.” (see Figure 4.37) On the other hand, P15 had some products to fix around the house for a long time but couldn’t find the opportunity to do so. He tells about the faucet (see Figure 4.16) he repaired during the lockdown:

> We were constantly seeing it [problem], but we were not interested because the time spent at home was very limited. However, because of the pandemic, when you were in the house for a long time - the dripping faucet already has such problems - and the water not flowing there became even more disturbing.

Being retired, being in the lockdown and consequently having time to deal with product care activities become an enabling factor for those who wish to repair but cannot due to the high speed of daily life.

4.1.6.2 Availability of Tools, Components and Place

While people attempt to repair their own products, many factors enable them to do so. One of them is having easy access to materials, tools and components to repair. Sometimes availability is about having spare parts from older products. For the participants in association A, it is easy to find similar products and consequently replaceable components from the items left there. For instance, P5 says if he cannot fix a laptop, he will still dismantle it and store its working components to use in the following laptop repairs. P6 talks about another repair volunteer in the association who does not throw any iron that comes to them, even if it is not repaired. “He sets it aside. When another iron arrives -a broken iron- a part of that previous iron may work on that.” *Collecting and storing spare parts* enables future repairs in this way.

Apart from the associations, P19, a member of a maker community, explains how he repairs his drone’s broken engine (see Figure 4.8). He was having difficulty finding new components, therefore having an extra broken engine worked well for him: “I said that different parts of both [engines] are broken. If I combine them, I have one

fully working engine and one completely not working engine. That's how I fixed that engine."

Having spare parts or storing them is an enabling factor for the participants since instruments are ready and can start repairing. That is why participants tend to collect spare parts beforehand for smoothing the future repair processes. When P8 notices this, he immediately begins to "collect cables and other components for next repairs to use as a spare art." (see Figure 4.19) P12 is another one that buys and stores spare parts in case he needs them one day. He says: "That's why a vast hut was created for them in the garden. ... I built a hut in the garden of the house. They are standing in that hut. All my tools, tools, machines are standing there. I work there." This brings the topic around the availability of a place to undertake the repair activities.

Figure 4.19 P8's repair environment with tools, materials and spare parts he is collecting.

Repair enthusiasts in associations A, B and C found a way to create little ateliers where some tools, materials and spare parts are available to anyone who would like to use them. P6 says, "We have a lot of supplies there, from drills to screwdrivers to spare parts... If it can be done [fixed], if we have a part of it, we do it." P14 talks about how they formed a sewing atelier inside association B so that people, who want

to repair their garments but don’t have the tools and sewing machine, can get there to do so. After which, neighbourhood residents start to come and repair their belongings by using the atelier. Therefore, the participants assert that tools, components, and place enable people and encourage them to repair and maintain their products.

4.1.6.3 No Risk of Making It Worse

The participants argue that the possibility of making a product worse with the repair attempt causes them not to repair it at all. The loss of motivation due to the possible repair failure is explained in the *limitations* section (see Section 4.1.7.2.1.1); however, under this section, not having the risk of making the product worse with a repair will be explained as an enabling factor for participants.

For instance, P8 who started to repair just a year ago, tells about how he encouraged himself to open up the already discarded products. Since he is afraid of ruining the product while trying to fix it, when his friend was throwing his broken headphone away, he immediately asked him if he could have it. P8 says that if he discarded it already, he can look and try to fix it, he cannot break it further, so there is no risk of making it worse. Moreover, P17 explains that it is about “accepting to discard the product.” When his fryer (see Figure 4.7) already stopped working, and it is not possible to break it, even more, there is nothing left for him but to open and try to fix it. That is how he finds the courage to try to open it since “it is a complicated device and it is really narrow inside, so the places where the cables pass and so on.”

Figure 4.20 Already discarded headphone repaired by P8 without the risk of making it worse.

On the other hand, P12 dares to open electrical products after authorized services report they cannot fix them. For example, after he took his shaver (see Figure 4.21) to the service and they said it couldn't be repaired, he took it back and opened it to see the problem for himself. Somehow he solved the malfunction on his own, and the product worked again. Again, he refers to the no risk of making it worse by the following words:

> I opened it, unscrewed it, and said that I would do it if I could install it [new component]. If I could not, I would throw it in the garbage. I accept the risks. But I managed to fix it eventually. Even if I couldn't, it would go to the trash. So there was no problem. Either it is already broken, the service said they could not do it anyway. Well, even though it was trial and error, I dived into it, and it was fixed. So I usually do things like this.

Figure 4.21 Broken shaver that the authorized service couldn't fix is disassembled by P12 and batteries are replaced to make it work again.

Clearing off the risk of making it worse opens up the way for repairing for some participants. As this enabling factor can be an area of design intervention, to encourage repair enthusiasts more fear of making it worse can be further studied by the designers.

4.1.6.4 Repeatability of Repair Works

Some methods and techniques serve for product care behaviours to be iterative in nature. For example, wood painting allows P9 and P10 to fix or change the appearance and connotations that their furniture carries back and forth when they feel the need for it. P10 fixes the look of her outdated childhood furniture (see Figures 4.12 and 4.44) to make them belong to an adult room. Although she expresses her satisfaction with the final result, she still indicates the ease of changing the overall look, again and again, going back and forth with painting. P9, on the other hand, explains how she restyles the sideboard (see Figure 4.22) she bought second-hand by painting, decoupaging and using stencils:

I use Letgo [letgo.com, n.d.] to buy a sideboard. I managed to bring together the sideboard as I watch and learn from somewhere. Then I thought I could put some stripes on it then add some pictures... let's make it vintage, I said, I like vintage... I found decoupage papers. First, I made it in bright color, but then I realized it is not looking good and painted again to a darker color to create contrast. Then I apply a technique to make it look old. It's something that happens while I'm doing it, so this goes here and this goes well here... slowly, you know, visually, I did what I wanted to see.

Figure 4.22 Second-hand sideboard and pouffe P9 refurbished to match their style.

P9 also fixes the appearance of her show cabinet constantly (see Figure 4.43). She describes the process as follows:

Then I painted it to a color that I wish to see. Actually, then I repainted it, I looked at them (furniture set) and said I painted them all to the same color; it

would be better to include some whiteness over there... so I changed the overall look. Then I changed the handles of it.

As these visual repair examples of refurbishment suggest, the repair process can be iterative, and the participants find it easy to restyle and fix the appearance of their products by simply painting and applying some images or shapes with stencils. In a way, this repeatable process is triggered with the transformation of user tastes and preferences and results with the transitioning objects. Therefore, the method of repairing or the allowance of the object to repeatable user interventions enables objects to evolve in time with their users.

4.1.6.5 Gaining Confidence

Gaining confidence through experiencing multiple repair cases provides an easy start to repair for participants. They might have drawbacks if they haven't done something similar before. On the other hand, having experience of that technique, material or product encourages them to repair. For P4, he gained confidence in fixing the broken phone screen after managing to fix his phone. Afterwards, he offers his friends help to repair theirs since the task is familiar and more manageable for him now. For P17, too, changing the broken phone screen became a part of his daily life after he learned how to fix it. Moreover, acquiring a repair kit (see Figure 4.23) helped him to gain confidence, after which he kept fixing phones.

Figure 4.23 P17's phone repair kit.

Another aspect of gaining confidence -besides the experience is having the proper equipment- is being competent in using certain techniques. P12 explains his experience using the welding machine (see Section 4.1.3.3). So he started to learn to weld when his iron garden door needed a repair. After learning a new skill, he felt confident and used welding in installing a new pipe system in his garden and still does their regular maintenance.

Having confidence is a triggering point for a repair case where people decide to take action. If the problem is familiar to them, it is more likely for them to start repairing since they have experience in the material, product or repair technique.

4.1.6.6 Sharing the Repair Experiences

The participants point out the fact that they normally would have been accompanied by others while they do repair works like friends, family, neighbours or other members of the associations. However, since most of the interviews were conducted online when there were Covid-19 lockdowns in Turkey, most of the participants were doing repair work on their own for the moment. However, they repeatedly give examples of repairing together and sharing the experience with others. P4 highlights

the fact that he loves repairing products and enjoys the process, even more when he shares it with people. Seeing enthusiastic people about repair and teaching something to them makes him even more motivated.

People also asked the help of the participants, since they are like "experts" for them. For example, after P7 fixed his bicycle (see Figure 4.37) and shared the photos of the repair process and result, his friends called and asked for help to repair his dead stored bicycle, too. Having someone to consult about repairing and sharing the repair experience enabled P7 and his friends to repair more. P9, also tells a similar story about her friends asking help of her to repair her coffee table together:

> My friend has a coffee table to paint. It has a stain from a teapot. She asked me to repair it together. Usually, those things seem hard to do for people. That's why instead of starting to repair it on their own, they ask you to do it or do it together with them.

The quote above provides an important intervention point for designers since people who may not prefer to repair on their own can do it with the presence of others who seem to be more experienced than them. Also, not only being in the presence of a more experienced one is an enabler of new repair projects, but also having someone to do these activities together can be enough to be motivated. As P12 lives in a neighbourhood where everybody "helps each other in this matter [product care] ... There is sharing of ideas... there is sharing of tools." When one day his next-door neighbour brought a broken kettle asking how to repair it, he took his screwdriver to "either completely break it or fix it" together. He adds it is about helping out each other, trying to solve problems together. In a way, *repair is a medium for creating solidarity* between residents of this neighbourhood. The power of repair as a solidarity tool will be discussed further within the *communities in transition* section (see Section 4.4).

4.1.7 Limitations

Limitations of conducting repair and maintenance tasks will be investigated here, under four categories: *product-related*, *user-related*, *space-related*, and *system-related limitations*.

4.1.7.1 Product-Related Limitations

Product-related limitations are the ones that prevent users from deciding to repair or achieve their repair goals due to the nature of the product. While some products prevent repair because of their obscure nature that does not allow any user intervention, others are not worth repairing since they can be easily replaced with identical ones. These issues will be exemplified and discussed in the next sections.

4.1.7.1.1 Material Usage That Prevents Repair

What product is made of is another factor that affects the repair decision. In particular, the participants talked about the plastic casings and components that prevent the repair for themselves. P18 exemplifies the product's material effect on repairability by comparing two of his glasses. While one of his glasses (see figure 4.24) has plastic lenses framed by a metal piece, the second one has plastic lenses fitted within a plastic frame. While the first one dropped off his hands and its lenses popped up, P18 used his tiny electrician screwdrivers to quickly put them back in the metal frame since the lenses are locked in the metal frame with screws. Since then, whenever this happens, he has repeated the same repair. However, when the interview was continuing, he examined his second pair of glasses with plastic framing. He concluded that: "Unfortunately, it doesn't have screws. It's embedded in the plastic frame. If it breaks, we can't fix it. It looks like it should be replaced with a new one.

Figure 4.24 P18 metal-framed glasses before the repair (left) and after the repair (right).

P6 also makes a comparison between two materials for ease of repair for the toys. Since he can carve pieces for wooden toys (see Figure 4.1) but cannot do the same for plastic toys that left to association A for repair, he says:

> There's a toy car -a remote-controlled car... a piece of it is broken, but I need to find that piece for it. If I find it, I'll replace that broken piece with it. Now it's always on my mind, when another toy comes, I look for that part. It's a plastic piece. You know, if it were a piece of wood, I would carve it somehow. But since it is a plastic part... I couldn't find such a part. But the car is waiting for me.

Lastly, P16 compares the wooden toy that she repaired for her little daughter (see Figure 4.25) and plastic toys in general. While she notices how repeatedly she uses the word wooden, she explains why it is necessary as follows:

> Maybe that's why I keep saying it is wood. Because the plastics usually do not come out, but it breaks. But in wood, that is, it comes out of the junction point. So it's much easier to bring it back there. But plastics usually are one piece. If it is a single piece, a piece breaks, and it becomes more challenging to stick it back together when it is broken. These are [the wooden one] eventually separated from the junction points. Putting it together is much easier.

Figure 4.25 The wooden toy was repaired by P16 for her daughter (left). Sticking back the arm that comes off with adhesive (right).

The participants make comments and comparisons between products made of different materials but belong to the same product categories. These show plastic casings and components are mostly found challenging to repair and discouraged the repair decision. On the other side, detachable components like the glasses or easily replaceable or agglutinable components like in the wooden toys make the process more transparent and doable for the participants.

4.1.7.1.2 Black Box Products

The major product-related limitation for repairing is the object's disallowance of user intervention -in other words, objects being produced as a black box product. Primarily, black-box products are manufactured in a way to prevent access to their components and hide the repair information. Therefore, people are intimidated to repair these types of products or even if they try, they may face repair failures and make the product worse than it was. Although the black box products will be discussed under the heading of *objects in transition* (see Section 4.3), a brief introduction will be made with some examples within this section.

P11 simplifies the reason for black-box products as this: “The manufacturer never comes close to the concept of users being able to repair the product on their own. It is also not commercially viable.” Therefore, he says even the products were once closed with methods that are possible to be opened again by an end-user, nowadays they close them with adhesives to prevent users from opening and consequently repairing them. P5 exemplifies the *inaccessibility of components* in newer products by comparing them with their older versions. Since P5 has some experience with repairing laptops and cell phones for some time now, he can read the changes in products. As he says, broken laptops left to the association A usually need a battery change which was much easier for older models since one can detach the dead battery with one move (see Figure 4.26) and find a replacement for it with ease in stores. However, he adds how the new laptop models change the user’s access to the components:

> But you can’t even see the battery now. For example, your battery has failed, you will go and have it opened at the service. So that battery is already stuck in like in current phones. Today’s batteries are flexible like gel [li-polymer batteries]. I don’t know if you’ve seen those batteries; they can curl like dough. When removing that battery bends, you know it’s a battery failure. You can’t change it after a while. Now you need to pay for the service [to change it].

Figure 4.26 2013 model laptop that allows easy battery removal without using any tool. Representative photo from author's archive.

P5 also compares new and old models of cell phones repairability and complains that "Cell phones are no longer repairable." While you could see the whole electronic circuit once you open the back lid of old smartphones to make repair intervention, he argues that it is now hard even to open the new products. P19 has supportive thoughts about how new phones are not allowing user intervention. For instance, he criticizes the Iphone's structure: "Nothing in the iPhone is simple because they closed everything so you couldn't change it. ... I can't replace the iPhone's microprocessor because it's a closed -black box."

As participants indicated, the newer models of laptops and smartphones prevent the user from repairing the product by hiding the repair information and the components. In some cases, even if one manages to open and see the components of the black box product, it may be not possible to replace the components without going to authorized services since the product can be sealed and commercial tricks can be hidden from the user. Although there is more to explain about the black box products and how they limit the users from repairing independently, this was a brief

introduction with some examples. A detailed exploration of the topic will be provided under the heading of *objects in transition* (see Section 4.3).

4.1.7.1.3 Dispensable and Outdated Products

According to their owners, some products are not worth the effort, time, and money spent during their repair. That is why they are decided to be discarded or recycled instead of repaired and kept in use. Most of the time, these easily dispensable products have cheap and accessible alternatives for them in the market. P11 points out the significance of mass consumption in creating dispensable products:

> Millions of everything are produced, prices drop when millions are produced, and repair doesn't mean much when prices go down. This is so high that the refrigerator breaks down. You throw the big refrigerator away because a small part inside it is broken... It is not possible to motivate people. Everyone tends to get a new one.

P6 talks about the small repair tasks he does in association A without considering bigger and more expensive products. He fixes basic malfunctions. In his opinion, any person can fix something like changing a watch's battery but prefer not to do so. He says most people bring their watches with dead batteries to the association to be repaired and donated. Although it is a simple task for P6, he speculates the reason for not repairing it is the high price of a battery change at watchmaker compared to buying a new watch: "He goes to the watchmaker, the watchmaker says 20 TL for the battery. He says I have already been underpaid for this. Can 20 TL be given to the battery? then he throws it away." P11 similarly adds that "so strange things happen that it is easier from time to time to go and buy a new knife rather than sharpening it." These words show how the product's value is decreased, and it can be easily discarded and replaced.

Another point is about evaluating what type of products are worth keeping and protecting. "For example, a mouse, is it worth protecting? No, it is not," says P7. For

him, it is cheap and expendable products not worthy of repair. Or sometimes, the participant may have substitute products that make the broken products dispensable with ease. When P16's coffee pot's red handle was broken (see Figure 4.27), first she tried to stick it. But when it didn't work and can only be repaired in a repair shop, she decided to discard it since "There are three of them already. It's not an essential item for me. I don't use all three of them at the same time. Since it was so, not having one would not be such a critical thing."

Figure 4.27 Two pieces of the P16's coffee pot set: the solid one is with the red handle while the other's handle is broken (left). The connection detail of the red handle (right).

Lastly, *technologically obsolete* objects are also considered as dispensable products, not repair-worthy ones. For example, P7 indicates being capable of repairing does not always mean being able to use that product. He has a broken tube television that is repairable if he allocates time and effort for it. However, he sees no point in doing so since it has become technologically obsolete and replaced it with new generation television. Likewise, P11 refused to repair their broken stereo since it was cheaper to buy a new one compatible with flash memories, unlike the former one. He adds: "Even if I run that product, I will not be able to use it effectively afterwards. It stays broken sşnce it feels better not to repair it."

Overall, products seem to be dispensable and not repaired if they are decided to be unworthy of efforts, time, and money to be given to them. In most cases, there are cheaper versions of them, and they can be easily replaced with similar versions. On

the other hand, they can be repaired, but there is no point in repairing them, since they have already become obsolete. That is why products' nature prevents their owner from making a repair decision.

4.1.7.1.4 Being Important and Hard to Be Replaced

As a product's being easily dispensable prevents the repair decision to be taken, products being important and hard to be replaced also prevents some participants from repairing as they indicate. For instance, P8 explains why he didn't fix his friend's laptop even though he knew the cause of the problem and he used to do such repairs:

> Let's say you opened up that laptop, but somehow you couldn't disassemble it. What will happen? So you're screwed. You also have to do some work, you know, a laptop is an essential thing. That's why I hesitated, you know, what if I couldn't do it.

P8 also adds how acceptable it is to have hesitations about repairing a hard-to-be-replaced product like laptops and mobile phones within the Covid-19 lockdown since all the work and communication depend on them. The time spent repairing them is considered a lost time since they won't be in use in that period. Therefore, P8 says it is reasonable not to repair your phone since he cannot risk making it worse while trying to repair it and extend the unusable time.

4.1.7.2 User-Related Limitations

User-related limitations include first the user's *lack of skill, knowledge, and experience* to conduct the product care tasks and, therefore, not trusting themselves to conduct the work independently. Secondly, the user's *safety concerns* regarding the reliability of the repair process and repaired items are also user-related limitations. Afterwards, some examples of language barriers prevent people from

accessing proper repair knowledge on online repair communities. Lastly, the users' *loss of repair motivation* will be discussed within this section as a user-related limitational factor.

4.1.7.2.1 Lack of Skills, Knowledge and Experience

Some participants indicate their drawbacks about their ability to repair. While some do not have the hand skills to conduct a particular repair method, some others indicate they do not have much practice on the subject and are afraid to break the products even more. These reservations typically lead to not repairing or handing to a professional repairer, exemplified in this section.

4.1.7.2.1.1 The Fear of "What if I can't gather back what I disassembled"

The participants frequently articulate their fear of making the products worse than they were with their repair. As breaking down the product even further is a risk, sometimes it causes them to decide not to repair the product. For example, while repairing other individuals' computers, P4 sometimes hesitates because: "I like to fix things, but on the one hand, since I don't do this job professionally, I break it more while trying to fix it. And frankly, I don't want to take that risk in certain things." Continuing with the electrical products, P16 also indicates her unwillingness about repairing them by saying: "I may not be very confident in myself. So it feels like I might not be able to close back what I disassemble". P5, who frequently fixes people's laptops, is having drawbacks about changing a casing covering the laptop's screen since he learned from a professional repairer that "if a person disassembles a wrong screw, she easily breaks and makes it worse." P9 gives an example of a product category apart from electrical products. When she bought a second-hand winged chair, she wanted to repaint it and change the upholstery to give it a different look. However, she hesitated to do so, thinking, what if the paint bleeds into the

upholstery and makes it worse than it was. The thought that she wouldn't be able to make it look good after the repair held her back from refurbishing.

Although the reasons for hesitating or giving up from repairing are explained under the user's limitation section, P11 has a different perspective on the subject. He defines the level of expertise with *being aware of your repairing capabilities*:

> There is something I made up about repair: a good master is someone who knows what he can and cannot do. So if he jumps into what he knows he can never do, he will make it worse. He will destroy it, spoil it. In other words, people need to be aware of what they can and can't do at the beginning of this work.

To describe the self-evaluation of repair capability, P16's repair failure story about her luggage can be a good example:

> The zipper of the suitcase was ripped from the side. So when you pulled the zipper, there was a massive gap in between. I sewed the zipper myself, but it burst out again in some places due to the thread I used. Okay, I said to myself, use it now and then send it for repair. It's over you. I have said to myself that it is not in your area of interest anymore.

P5 found himself in a similar position when he tried to open up a tablet casing and eventually broke it. Later he learned he was trying to open the tablet's lid in the wrong direction. Consequently, the connecting tab broke. Now he is using the tablet without its lid since it cannot be joined back. He says: "It happened because I was trying to fix it myself. It's not really my area of expertise". Probably, he will be hesitating about future tablet repairs since he is aware that he can spoil the product.

Participants find themselves in a position where their repair skills, experiences, and knowledge is not enough to make that product work again. Moreover, the thought of "What if I can't gather back what I disassembled" causes them to hesitate or even give up on repairing.

4.1.7.2.1.2 The Fear of Handling Too Complicated and Delicate Repair Tasks

Sometimes the participants give up repairing because they believe the task is not manageable by themselves. For some, it is because the task requires complicated and delicate work beyond their skills and experience. For the others, it can be caused by not trusting their knowledge about using which methods and tools to repair that particular product. Primarily, a lack of one's skill, experience and knowledge of repair causes her to quit repairing and consult a professional repairer if she hasn't discarded the product yet.

P14 gives an example about how she thought repairing her broken bracelet (see Figure 4.28) is beyond her abilities due to the technique involved in manufacturing it:

> It would be better if they did not join with the welding method because, in daily life, it is not possible to reach the welder or to use the welding machine somewhere. And it creates confusion in the person: It's broken, I want to extend the lifespan of this. For example, if the repair had never been in my daily life, I would probably throw it away because I couldn't fix it.

Figure 4.28 P14's bracelet and its repair process.

P19 also was not sure how to fix his electric skateboard engine (see Figure 4.2). Even though he managed to fix it eventually, he had some troubles during the process since he wasn't sure how to fix it with which tools and methods. Therefore he applied *the trial and error method* and tried a couple of things during which he slightly injured

himself. However, some other participants gave up repairing when these types of issues went in their way. For instance, P14 tells how she finds a way to repair garments and keep using them. However, when it comes to the electrical products, she tries to make them repaired, but it doesn't work, she will be prone to let them go:

> If a cell phone is broken and I take it to the repair shop and it is still not working, there is nothing I can do about it anymore. I have no idea about it, you know, on an electronic device. I don't have that knowledge, and even if I search for that information on Google, it seems like it won't be enough.

As the complexity of the repair tasks increase, some participants' hesitations about repairing also increases. For instance, while P7 was repairing a laptop (see Figure 4.29), he replaced its modular components like its motherboard and hard disk. However, he points out that if the error was *within* the motherboard, then it required a detailed disassembly which would be difficult for him since it is a complicated task that needs delicate work. While P7 articulated his hesitation, P5 talks about how he won't repair a product that requires delicate work. As he explains, he constantly replaces components of broken mobile phones that are left to Association A. However, when it is about fixing the component itself rather than simply changing it, he prefers not to do so since it is delicate work that requires advanced technical skills and experience.

Figure 4.29 The hard disk that P7 removed from the old laptop to place a newer and faster one.

The participants feel hesitant about repairing a product that requires complicated and delicate repair work, mainly when repairing an electrical product. Since some of the participants think the repair is undoable by the user herself, they tend to discard the product or consult a professional repairer.

4.1.7.2.2 Safety Concerns

Sometimes participants may have safety concerns that may also prevent them from repairing. While in some cases people are uncertain about the safety of the repair process itself, other times people may hesitate about the security of a repaired product, in other words, *the reliability of the repaired product*.

When it comes to repairing electrical appliances, some participants express their hesitation about the safety of the repair process. To illustrate, P15 has a sharp separation between the things he repairs or doesn't. He says he doesn't try to fix electrical products such as a kettle since he is not knowledgeable on the subject. P5

gives another example about how his wife tried to fix a socket, and she didn't notice she has done it wrong:

> She did not make the proper connection. I saw it later after I took it off... She didn't connect the ground line. She put it in the wrong place. It works, but the ground line does not work. That's not good. Electricity requires a speciality.

P8 strongly advises repair novices like him to gather information about the intended repair task because it may create safety issues. He states it is crucial to do some research and then do the repair because without knowing what a person is dealing with, they can both hurt themselves and make the product worse than it was. For instance, he says some components of electrical products may emit radiation, and one cannot notice this without researching it. To illustrate, P19 attempted to replace his iPhone battery without knowing the risks that li-ion batteries can create for a non-professional repairer. When his Iphone's battery was dead, he thought he could change it, although he adds, "Apple has invented such a different tape [battery adhesive strip] just for them to be able to take it out" (see Figure 4.30). When the battery adhesive strip is pulled at a certain speed, the material loses its stickiness and continues to come off. Eventually, the battery is successfully removed. However, if it is pulled slower, the strip stays in sticky condition. On the contrary, if it is pulled fast, it shears off. Even though the battery can still be removed with a sheared off strip, it should not be bent or twisted in any circumstances since it can blow and cause a fire. However, P19 didn't know this, and eventually, the battery caused a fire, which he could put out quickly since the battery was not bent too much, luckily. After he tells this repair failure, he adds:

> That's a dangerous thing. If I'd known, I wouldn't have continued to repair after the tape broke up. So I would change the phone instead. That was the time I was most afraid of repairing something in my life. My phone started to burn in my hand.

Figure 4.30 Apple's iPhone 7 battery removal by pulling the special tape at a particular speed step by step. (ifixit.com, n.d.).

Apart from the risks that the repair process can create, the participants also have other safety issues regarding the reliability of the repaired product. For example, P7 fixed his friend's hair straightener (see Figure 4.31), which had a problem with its cord's connection to the device. It was creating both a safety risk for the user and hardship of usage. He called the manufacturer for a spare connection part which turned out to be not produced anymore. That is why he found his method to fix it by replacing the old part with a joint he did from scratch. Although he secured the cable with isolation materials, he still warned his friend: "I said, look, this is not the original version, I repaired it by modifying it. It's not very safe, so use it carefully and keep an eye on it. I don't take any responsibility in case of an electric shock." He still has hesitations about the end product since it wasn't fixed with its original components. On the other hand, P14 speculates the safety of using repaired dishware stuck by adhesives. She says:

> You cannot interfere too much with the products you use with food. If the plate breaks... I do not know if I will continue to use it even if I fix it because I don't know how to repair it in a suitable way for food.

Figure 4.31 Hair straightener repaired by P7 (left) and replaced cord connection (right).

The participants may feel insecure about repairing their products due to hesitations about the safety of the repair process or the reliability of the repaired products while they are in use again. For most of them, repairing electrical products seems inconvenient and unsafe particularly if the broken parts are not replaced with the original parts. Therefore, they need to be handled by knowledgeable and experienced people, as some indicate. However, P19 hasn't paid attention to the risks of replacing a phone battery and found himself in a dangerous position. Therefore, some others advise novice repairers to conduct research and notice the risky points before undertaking the repair.

4.1.7.2.3 Language Barrier

The participants face difficulties finding repair information and examples on the web, which are in the Turkish language. Although there is a flow of information on websites, blogs and forums, not knowing a language besides their native language, Turkish seems to limit them learning how to repair in online mediums. Or sometimes, they can be intimidated by a product interface that is in a foreign language.

P7 tells how he uses Youtube as a source to see disassembly and assembly processes of the products he aims to repair. However, he adds: “If you use only Turkish resources, it is limited. It is necessary to use English resources, so I do Turkish and English searches on YouTube’’. Similarly, P15 researches the web when he doesn’t have enough information about the objects that need care. When he includes English and German phrases for research, he can find the exact information he needs. He adds: “It [finding the information] both increases my ability to repair and increases my motivation. Because my knowledge is limited.” However, not everyone who likes and aims to repair has a second language to search similar cases and learn from the web. P17’s insights on the subject worths sharing:

> Because most people know how to use tools, but they have no English, no foreign language. I mean, for example, when I took my car into service in the industry, the repairer there said, “You know English... Can you search for it in English? Let’s see what we will find.” The biggest problem is that there is no Turkish source. Many people abroad do their repairs. It can also be done in Turkey. So the biggest problem is the resource shortage [in the Turkish language].

The language barrier is not only valid for research on the web. For example, P5 has a language barrier not because he wants to learn from online mediums about repair but because the laptop he wants to repair is communicating in English. Although P5 know laptop repair, he can’t figure out what to do since the interface is not Turkish since it broke down:

> So it’s a useless laptop. I’ll try another method, maybe... if it works, it’s okay. If not, I’ll give it to someone who understands, or it can be a spare part at most. But it is a working laptop. The system is working. Even though I wanted to format it to translate it into Turkish, it didn’t work.

Overall, even though participants are willing to learn more about repairing and applying the information on online sources, they found it limited to conduct research online only for Turkish sources. Therefore, if they don’t know a second or third

language, searching for repair information can become intimidating and discouraging for the participants.

4.1.7.2.4 Loss of Repair Motivation

Some participants indicate their loss of motivation to repair when they can't find anyone to share the repair experience with. Especially participants from the association A and B were complaining about the disinterest of people in repair activities. For example, P4 is sorry to say there are not many people around to work with even though they found the association B to repair with the neighbourhood residents. Due to the low interest of the people for joining the repair activities, repair atelier in association B didn't work out as founders aim to. P4 expresses how this situation is demotivating him to repair.

For association B, P6 tells a similar story. He complains about the new generation's not visiting them to learn from the amateur masters of the association. Therefore, he is curious about who will continue the repair works in the neighbourhood after them. Although he says some people still come to the association for repair, they come to make things repaired rather than learn how to repair:

> There is no one coming, but there are those who say can you fix this. Some people come to the association with a broken product in their hands. For example, friends who know that I am an optician bring their glasses to me: the handle is broken, the trash is broken, this is how it happened... I fix their glasses, for example.

On the other side, some participants are undertaking repair tasks independently since they are members of online communities. P9 says sadly, "I do these [product care] on my own. I wish I had someone else... I have some friends, but they are far away... I keep doing it on my own." However, some participants like P19 struggle to find people in online forums and social media channels to talk about the repair. He says that: "I look for certain people I trust and whose knowledge I have tried and judged

to be convinced of their expertise." However, he also adds that if he knew someone in real life who has similar problems about repairing, he would consult him first, but "I'm not asking because it doesn't exist."

Overall, the participants have difficulty motivating themselves to keep repairing even though they don't have other people to share the repair experience. Mainly, the participants that are connected to online repair communities only sometimes lose their motivation to keep up the work since they are having difficulty finding solutions to the problems on their own. On the other hand, in the repair-related associations, the members complain about the people's low interest in the repair atelier since not many people are willing to repair it together. Mostly they bring their products to get them repaired there rather than ***share the repair experience*** with members and learn from each other, which will be discussed in section 4.4 *Cultures and communities in transition.*

4.1.7.3 Space-Related Limitations

The participants who don't have access to an atelier declare the hardships of conducting repair and refurbishment activities in a home environment. The limited space sometimes causes them to discard rather than repair the products. For example, P17 explains how he uses the kitchen table as a repair corner for disassembling the broken fryer (see Figure 4.7). He puts the pieces he removed from the fryer into bowls, so it is easier for him to remove them from the table when it is time for dinner. He adds: "I don't have a large area like an atelier." However, for the bigger product's repair, he says space becomes a more severe problem. He refers to the examples abroad:

> For example, there are places like a repair shop, but there is no repairer. There is a lift. There is equipment and so on... you rent it hourly. Some people rent it for a reasonable rental fee. They do their maintenance and repairs themselves in this way.

P17 isn’t the only one limited by a small space. P8 also expresses the hardships of repairing and refurbishing at home. She says that she would like to upgrade more furniture, but she doesn’t have enough space to both do the work and use that much furniture. That is why she says she needs an atelier the most. P10 is another participant that refurbishes furniture in her home. Although she admires DIY works and upgrading, she says that she is not capable of doing all the things she wants since space limits her. While she tries to paint over her chair and bedroom furniture set, she had difficulties drying them out. Since she doesn’t have a workshop, she had to dry them on the balcony, which caused the project to take a long time to be finished.

Having a special place like an atelier equipped with essential tools and materials for repairing is an enabling factor as mentioned earlier (see Section 4.1.6.2). Having limited and small space and undertaking the repair activities in the home environment becomes a limiting point for participants. Therefore, providing common spaces that foster repairing can be a design intervention point that will be discussed in section 4.5.4.

4.1.7.4 System-Related Limitations

System-related limitations include the expensiveness and/or unavailability of the spare parts for repairing and also the exclusivist attitude of repair centres towards the users. Therefore, the limiting aspects of the repair ecosystem will be discussed within this section.

4.1.7.4.1 Expensiveness and Unavailability of Spare Parts

One thing that limits the repair decision significantly is the high prices of components and repair services compared to the price of a new product. For instance, P6 claims that people prefer to replace their wrist watches as soon as their battery runs out instead of replacing the battery in a watchmaker store since the battery price is so high. The decision to make it repaired or not also affects the small repair shops.

That is why P7 has some concerns regarding the effects of increased prices of components on small-scale repair shops:

> [Now] when you order a spare power card for television, they ask for at least 500 TL, but I used to measure that power card myself and replace one component [that is broken] on it for 5 TL and continue to run my television. That's why television repairers, radio repairers… are no longer there. They went bankrupt because most of them can no longer make that repair. As I said, consumers either throw away their televisions or have the card removed and put in a new one.

P19 also suffers from expensiveness or unavailability of components and materials: "my bigger problem now is accessing the material in most subjects. because it is really difficult to bring some pieces from abroad." Besides the expensiveness of components and services, he also talks about the hardship of ordering components from abroad, which costs a lot when converted to TL. However, P19 expresses his willingness to upgrade and repair some of his products, but the price of the components that need to be ordered from abroad limits him. Even though he manages to order some crucial components from time to time, there is also a product category that is not allowed to be ordered and stuck in the customs:

> One of the biggest problems of doing repair work in Turkey... if you are looking for particular parts or materials, especially electronics... They usually come from abroad. If you're looking for something with a battery, it can't come. ... It is a problem that makers suffer a lot. You can't import batteries because a certificate is required to import things with lithium batteries.

Another issue is the unavailability of spare parts when products have been used for some time. For example, when P7 was repairing his friend's hair-straightener (see Figure 4.31), he called the manufacturer for a spare part which turned out to be not produced anymore. Similarly, P15 have concerns about reaching out to spare parts in the use phase:

> They [producers] need to guarantee that you will reach spare parts after you buy the product. Because, for example, we buy a vacuum cleaner, it breaks down, we take it to the repair shop, they say they don't have engines anymore. But I bought this two years ago! Then it becomes garbage - inevitably, it becomes garbage. That's why they [producers] have to give a *spare part warranty* so I can fix it.

To conclude this heading, participants articulate the hardship of reaching repair materials and spare parts, some of which have to be ordered from abroad. However, some customs regulations limit the sale of lithium batteries since they require special certificates that individual repairers cannot provide. On the other hand, even if they manage to order the spare parts, they cost dearly. The *unavailability or expensiveness of acquiring repair components* makes it hard for one to make repair decisions.

4.1.7.4.2 Commercial Secrets of Repair Centres

As mentioned in the aims of repair section, some participants repair for not counting on repair services and are independent. However, some of them find it hard to escape from the authorized services in some repair cases. For example, when her garbage disposal unit connected to the kitchen sink was stuck and not working, P16 couldn't find any information on how to open the unit and take the stuck stuff off to repair it. That is why she had to call the authorized service to come and fix it:

> All he [repairer] did was dismantle the engine underneath and pulled an olive seed out of it because it squeezed, and it prevented the engine from turning. I gave him 150 TL just because he took the olive seed out of it, and it only took him five minutes. It made me very nervous. So I asked the man, "Can't I open this?"The answer he gave me was "no, you can't open it." However, I watched it while he was doing it. There was not much, so he made two screws, turned them and removed them. So this is, of course, a bit annoying, and it's like a money-making market. They do not want it to be done by you.

As P16 argues, the tips and tricks of opening and repairing a product are not shared with the users by the authorized services. *Commercial secrets of repair centers* cause people to sit and wait for someone to fix their problem. P17 also says if he had a repair manual for his fryer (see Figure 4.7) or a catalogue for spare parts, he could quickly solve its problem. But he also adds, "then, the authorized service would not do business." P5, have a supportive repair example about a laptop he couldn't fix. When he tried to hack the software to fix the laptop, he couldn't find any information about it and eventually paid repair services to fix it. However, he was eager to learn how they managed to do it:

> Here is the information [to fix the laptop]. There is a setting. You can only format it [laptop] if you change that setting. I couldn't find it on the forums. I searched a lot and couldn't find it. Even if you ask, they [repair services] won't tell you, of course, that commercial information.

Even though the participants were willing to repair their products, the *hidden tips and tricks* of repairing the products limit them from doing so. They eventually had to refer to authorized services that never share their *commercial repair secrets*. Therefore if the same problem reoccurs, then they have to call the service again.

4.2 Users in Transition

The former section, "nature of repair" helps understand how product care practices occur and what limits or motivates them. Within this section, user's behaviour and approach to product care activities will be clustered to clarify different user tendencies. Six personas will be introduced according to their level of involvement in care activities and their sustainability considerations. Afterwards, the dissolving borders between different user roles regarding professionalism and amateurism will be discussed. Lastly, the users' changing perception of *waste, product lifespan, product quality, repairability,* and *repair quality* will be explained and exemplified.

4.2.1 User Characteristics

Although the participants were chosen among the people who frequently undertake product care activities in their daily lives, *their level of engagement and motivation* to do them differ significantly. That is why six personas were created to identify different user attitudes and cluster them. The first three are formed to understand the participants' involvement in product care activities. *Involvement level* can range from conducting small maintenance tasks like regularly cleaning an iron to prevent cloggings to managing complex repair tasks like soldering the small components on a laptop's motherboard. Therefore *cautious, confident,* and *hobby-driven* personas representing the participants' different tendencies in engaging in product care activities. On the other hand, the participants have particular agendas for undertaking care activities, and their sustainability concerns can range from environmental to economic or political. Consequently, three more personas, *prudent*, *regainer* and *proactive,* are defined to explain those agendas. While the level of involvement and sustainability concerns are considered together, more personas can be created, such as confident-proactive, cautious-regainer, etc., to see participants' ability to engage and their perspectives on sustainability. The next part will explain the personas in detail with examples.

4.2.1.1 Level of Intervention - Cautious

Cautious persona (see Figure 4.32) refers to a person who tends to think twice before repairing a product. *Cautious* personas motto is **"*Think before repair.*"** Although they would like to fix it instead of discarding it, they first consider the safety of repair. For example, repairing an electrical product on their own without consulting a more experienced repairer is not likely to happen.

> I was a little scared of electricity. But it gave me confidence as I had the tester screwdriver. Because it lights up at the points where there is electricity, I paid more attention to those areas. Since I'm not an electrician, I don't actually

> touch the electrical stuff as a principle, but I did it because it was a small thing. Usually, I wouldn't change it [socket]. So I think it's safer to call an electrician just in case I do something stupid.

Even though *cautious* personas decide the repair process is safe to conduct independently, they still refer to some sources like repair manuals or online sources to be sure about the procedure to be followed. For example, P8 strongly advises that people who repair as an amateur should research how to use the tools and how to repair that particular product because something can be dangerous. We may not be even aware of it while repairing without looking on the web or asking experienced people or others: "There is a risky situation in electronic things. Here you pull the plug, but for example, the power may be accumulated in the battery. Many devices may have similar problems." That is why he first refers to any possible sources to acquire knowledge about the tools needed, the procedure for repair and the product itself.

Cautious personas are the ones who are conscious about their abilities for product care activities. When they examine the repair case, they evaluate themselves to see if their abilities are enough to solve the case. When they decide the task is beyond their skills, knowledge and experiences, they don't mind asking for help. For instance, when P12 narrates the repair story of his breadmaker, he says: "I do not disassemble a product I don't know [how to repair] and fix it myself. I can't handle it, but I will take it to a repairer. I will take it to its authorized service."

To sum up, the *cautious* personas are involved in the product care activities after researching the product and how to repair it. If they consider it a safe process and decide that their repair knowledge and experience are enough to solve the problem, they repair it. Therefore, they think thoroughly before taking action and usually ask the help of more experienced repairers when needed.

Figure 4.32 Three personas are created for describing the participants' level of involvement in care activities: Cautious, Confident, Hobby-driven.

4.2.1.2 Level of Intervention - Confident

Confident persona (see Figure 4.32) refers to the people who open up the product without hesitation to diagnose the cause of the error. Their motto is: **"*Bring me my screwdriver!*"** As one of the confident ones, P11 immediately opened up this breadmaker as soon as he noticed it creating strange noises. Once he opened it, he saw that the strap that turns the beater was torn apart. Since he disassembled the product and diagnosed the problem immediately, the malfunction was solved quickly.

These people are more experienced than *cautious* ones and can manage complex repair tasks in different product categories. That is why they don't give up repairing a product that they haven't done before, like the *cautious* ones. As noted before in the *Ad hoc appropriation* heading (see Section 4.1.5.3), P17 fixed his friend's single chair's broken wooden leg. Although the woodwork is not his area of expertise, he first wanted to look and try to fix it before handing it to a carpenter. P19 gives another example about trying to do the repairs he hasn't done before. When his refrigerator broke down, he immediately brought his toolset to open and diagnose the problem, but his friends wonderingly said: "How are you going to fix it? A repairman is coming for this stuff." However, for P19 the diagnosis phase is not only for the professional repairers:

> I may not be able to fix it, but I said that when the repairman comes, first he will look at what he will do to understand the problem, I can do it (diagnosis). Then, after the repairman looks at the problem, he will say that this or this causes it. If I can get to this point, I can have those tools, you know... Because there's a lot of stuff—the number of things you can fix with a hammer, screwdriver, and pliers, and the number of things you can fix with glue. If you add the duck tape and solder... You can actually fix anything.

As seen in the quote, *confidents* are the ones who question the line between professionalism and amateurism. Sometimes they even claim that that is no line. According to P17, a repairer is someone who has "a place to repair, more suitable equipment and hand skills. You know... that person has nothing more than me... If he does it in one hour, I give more time, but you know, I can do it myself."

The equipment plays a vital role for the *confidents*. They have the right equipment and are knowledgeable about how and where to use them. P11 warns the novices to use proper equipment for the repair task:

> Never disassemble it if there are no suitable tools to disassemble something. Everyone tries to open the flat head screwdriver with a Phillips screwdriver or vice versa or try to open it with the tip of the knife. If a person considers repairing, they must first obtain the tools suitable for the repair they consider to do -a suitable screwdriver set, suitable pliers, etc.

Overall, the *confidents* are positioning themselves between professional and amateur repairers who own proper equipment and know how to use them. More importantly, their first attempt after noticing a problem in the product is to open it up and see its cause without hesitation.

4.2.1.3 Level of Intervention - Hobby-driven

The ***hobby-driven*** persona (see Figure 4.32) is the representative of the participants who are curious about products' working principles and see repair works as their

hobby. Their motto is **"*Enjoy the repair!*"** Acquiring materials and equipment for repair is most likely for this persona. P8 expresses that when he gets the proper equipment, it gets him in the mood of repairing as well. Trying out new techniques with the equipment is also exciting for them. P19 confesses that sometimes he repairs using a specific technique. Since he loves soldering, he made a toy with LED lights with almost 1000 spots to be soldered.

This persona sees repair as a hobby to enjoy and mostly does it as a chilling activity. P17 says he clears his head with repairs. P19 describes the process for himself as: "it's a wonderful feeling to fix something, and you go into the flow while you're doing it, so your perception of time changes, you don't hear much or anything". P12 even says: "After the repair process, I enjoy it so much and drink a double raki!"

Besides repair becoming a hobby for the hobby-driven, repairing products of a hobby is also a common thing for them, especially when their hobby involves regular maintenance and repair. P19 explains the repair of his drone set (see Figure 4.8): "If you are using a drone, you know, something breaks every 15-20 flights. You know, this is part of your hobby. It may even be the reason why I'm in this hobby".

All in all, *Hobby-driven* ones have an urge to find out a product's working principle. Therefore, primarily their intention in repairing is to learn more about it rather than fix it. While repairing, they acquire special equipment and materials that lift their spirits to try new techniques. Lastly, they both repair as a hobby and find hobbies in which products require regular care activities.

4.2.1.4 Sustainability Concerns - Prudent

Some participants' sustainability concerns are economic-oriented; therefore, a ***prudent*** persona is created to represent this tendency of product care activities (see Figure 4.33). *Prudents'* main aim in product care is to keep their money by repairing instead of spending money on a new product. That is why *prudents* are the less

sustainably concerned ones among the other two -*regainer* and *proactive*. Their motto is: **"*Repair and spend less.*"**

As high prices of new products push one to repair more, *prudents* are the ones affected the most. P10 upgraded her childhood bedroom furniture (see Figures 4.12, and 4.44) into an adult bedroom instead of discarding and buying a new one since "it is an economising period". P4 explains how the economic crisis helps repair practices to be spread:

> In a place where phone prices are about 10,000 TL, when a phone breaks down, one cannot say that I should immediately throw it away and buy a new one. Instead, they are wondering if they can get this fixed. Economic constraints are pushing these people to repair it.

It is not only the new products' high prices that push *prudents* to repair but also the high prices of repair shops. They tend to repair themselves so that their "money won't go to others", as P4 says. He prefers to repair the thing he can get, so that he won't pay high service prices but only the materials and tools.

To sum up, *prudents* are considering sustainability in its first level of the economy. Therefore they tend to extend their products' lifespan by repairing and keep using them instead of replacing them with newer ones.

Figure 4.33 Three personas created for describing the participants' sustainability concerns: Prudent, Regainer, Proactive.

4.2.1.5 Sustainability Concerns - Regainer

Regainer (see Figure 4.33) is a reference to the people who understand the real costs while producing a new product. Therefore they tend to decrease their consumption and eventually their waste production. Their motto is **"*Environment first!*"** so their environmentalist approach to sustainability makes them more conscious than the *prudents*. After attending ecological literacy training, P13 realised "how much we pollute our world, how much waste we produce", and repairing became even more critical for him. Therefore, "the less damage I can do to the environment, the less waste I produce, the more I feel more valuable," he says.

For *regainers*, the cost of making a new product is clear, and they would like to minimize the energy, labour and raw material needed for production (Ellen MacArthur Foundation, 2015). P14 is a *regainer* who would like to decrease her consumption and eventually the amount of waste is produced by repairing:

> I know that the manufacturing processes of products cost a lot. There is a classic example. It seems like 2,500 litres of water was spent in the production of a t-shirt. Likewise, every item we use has a lot of value both for the world and human labour. In other words, it has value other than money. Therefore, first of all, extending the life of these products means respecting those for me. By minimizing my consumption, we can say that I try to keep my carbon footprint low.

Overall, a *regainer* is someone whose primary concern when repairing is decreasing waste and minimizing consumption since they are environmentally concerned and knowledgeable about how much money, energy, material, and labour are needed to produce new items.

4.2.1.6 Sustainability Concerns - Proactive

A ***proactive*** persona (see Figure 4.33) is engaged within the product care activities on a political level. They question their level of intervention to the products and ask for more by reclaiming their *right to repair*. Their motto is **"*Demand your right to repair*"**. Therefore, they can be described as more sustainably concerned since they take action both on an individual level and try to change the status quo by demanding new product structures with visible and simplified repair processes. For example, P16 questions the visibility of the maintenance and repair of her garbage disposal unit connected to the kitchen sink. She couldn't find any information on its manual or on the product itself. Therefore, this black box product and hidden repair script make her furious because they prevent her from solving even the slightest problems on her own.

As the previous example shows, *proactive* ones demand to undertake the fundamental product care activities on their own without depending on authorized services and professionals. P17 wants the product's pieces to be joined with screws that are not only able to be removed by professional repairers' equipment so that people can make minor repairs on their homes. In furtherance, P8 adds that the predefined roles of repairer and users create the differentiation between responsibilities. The most basic tasks like maintenance activities should not be dependent on the professionals, he says.

Continuingly, *proactives* express their desire to share the product responsibilities with manufacturers and services to own the product as much as the other stakeholders. P8 asserts that the biggest problem on the way of promoting product care habits is the companies. If they guide the users on their attempt to repair, they can share the responsibility of caring for that product together in collaboration. P8 suggests companies can lead the user by offering repair tips & tricks. Moreover, if the user fails to fix it, then they can take over, he adds.

To sum up, the *proactive* ones are politically engaged in product care activities and reclaim their *right to repair*. They demand visible repair procedures that can be undertaken without professional help -especially for the small tasks. Therefore, they aim to share product ownership with the manufacturers.

4.2.2 Fluidity in Roles and Dissolving Borders

The different user characteristics have been defined in six different personas both by evaluating their *level of involvement* and their *sustainability approach* according to their attitudes towards product care activities. However, there is no strict line between the personas. It is observed that the user roles are fluid and can be changed with the increased engagement in product care activities. For example, the more *cautious* ones experience diverse repair tasks, the more they become *confident* in care practices. While the transition happens, users create *in-between roles* that are hard to define and challenges the strict *professional-amateur distinction*.

4.2.2.1 Spillover of Repair

The spillover effect is described as the diffusion of one's behaviours and values from their particular life sphere to another (Edwards & Rothbard, 2000), such as from work-life to private life or vice versa. Some repair enthusiasts within the study blur the line between professionalism and amateurism with the spillover of product care behaviours from one sphere to another sphere of their lives. For example, P4 works in a company as a mechanical engineer. However, his hobby of fixing computers slowly became a part of his job description. Learning more about computers and how to fix their problems were his hobbies, so he integrated them into his professional life. Besides other duties, he also replaces parts of the company's computers and makes software updates when needed. He states repair for him is between a hobby and profession. That is why product care habits have a spillover effect from P4's private life to work-life.

On the contrary, the participants may also spillover the care habits from work-life to their private life. For instance, P6 is a retired optician who also made glass repairs professionally. He thinks his tendency to repair and maintain in association A is due to his profession and habits he acquired while working. Similarly, P18 has spillovered his care habits from work to home. While he was working as a food engineer, he was responsible for examining the hygiene and cleanliness of several food companies. Therefore, he sees cleanliness as a form of product care activities. He thinks he performs care activities at home because he tends to clean and protect the products.

The spillover effect has led to fluidity in users' roles and dissolving borders between professionals and amateurs. The spillover of product care behaviours can happen from work to home setting and vice versa.

4.2.2.2 Ease of Access to Repair Knowledge

Some participants find it easy to learn the repair basics from the web and improve their skills. With the ease of access to repair knowledge, participants claim they can even be "*professionals*''. P8 is a person who typically does not handle even the most basic repair task, but in the last one and a half years, he begins to do repair work regularly. He assumes this change is triggered by learning the repair basics with a simple web search. Now, he impatiently waits for someone's product to be broken so that he can have a look at it. P11 supports P8 about learning the tips & tricks of the repair processes quickly on the web. He narrates about the car repair who couldn't get it done in a professional service. They somehow couldn't diagnose the reason for the error. Therefore P11 searched in repair forums about his car's problem. He found a perfect explanation that defines and solves the issue. He adds how easy it is for him to reach the repair tricks other people provided on the web. P15 describes this situation as "*getting an expert opinion*." Getting information and seeing how people resolved similar problems about their products "both increases my ability to repair and increases my motivation. Because my knowledge is limited'' says P15.

An experienced repair enthusiast, P19 tells about how he directs his friend to learn how to conduct basic repair tasks. His friend was curious about learning repair because he thought if P19 could learn it, he can learn it too. Therefore, he asked P19 how to replace the broken screen of his phone. P19 found a video showing the repair steps and send it to him by adding, "Watch this video; if you get stuck, give me a call." However, after following the steps, his friend replaced his broken phone screen without calling him. The learning phase is accelerated by using online resources instead of teaching the process one to one. Therefore, the master-apprentice relationship (see Section 4.1.1.4) somehow moved to the virtual setting where everyone can be a master (professional) or an apprentice (amateur) and change their roles freely through practising and sharing care activities.

When it comes to the borders between professional and amateur repairers, P8 says separation was so sharp back then. Still, the ease of acquiring knowledge through the web on how to repair makes it possible for people to repair their items on their own. According to him, ease of access dissolves the borders of professionalism and amateurism for him. Once P8 entered the world of repairing through the information on the web, his understanding of professions has changed, and he explains it as follows:

> We always define it like this: I'm not a shoe repairer, but he is. Everyone has put a label like this on themselves. When an electrical product breaks, you have to go to the electrician because he seems to know about it. But when there is information [how to repair it], you can easily find all kinds of information. It is possible to train yourself to some extent. There is no need to put such a label on ourselves anymore. You can be everything, as long as you access knowledge about it.

P15 supports P8 about how people have predetermined roles in their heads for professional repairers. He says his friends are still suspicious about his repair abilities "because professions are stuck on us. Your word is valued if you wear overalls in the repair shop." He describes the situation further with these words: "Just like the

doctor's apron... but if you are not in the repair shop, there is a trust problem like 'stop, stop, do not do it, you will break it now' because I am not a professional repairer." Therefore, a person's title is still a determinant of the trustworthiness of the repair work they did for others. However, repair enthusiasts challenge this understanding by dissolving the sharp line between professional and amateur repairers.

The formerly well-defined border between professionalism and amateurism on repair has been dissolved with the empowerment of people through the online repair resources and ease of accessing them. When participants have access to repair knowledge and learn about the tips & tricks of the repair processes specific to certain products, they feel confident about conducting care activities independently. In a way, when participants are willing to learn new things, *the ease of access to repair knowledge* helps them blur the sharp line between professionals and amateurs. On the other hand, the repair learning experience through the master-apprentice relationship is not entirely removed but transferred to a virtual setting where it is possible to change roles between amateur and professional and create *in-between roles* more easily. Lastly, people's understanding of professions has shifted through conducting repair and maintenance tasks, since it helps them stop labelling people according to their profession like electrician, shoe repairer, etc., but allows people to create several roles for them apart from their professions.

4.2.3 Changing Perception

When participants are more involved within the care practices, they understand the product's structure, its background story of where it is coming from, etc. Therefore, they become active users instead of passive recipients of products. Accordingly, their perception towards *waste, product lifespan, product quality, repairability* and *repair quality* evolves.

4.2.3.1 Perception of Waste

Participants are approaching the concept of waste differently. For some, a product's material affects the decision of whether it will become waste or not. For example, P6 refuses to see a broken wooden toy going to waste or being burned up for heat since it is *worth fixing* and reusing for him. Therefore, he doesn't describe broken wooden toys as *waste.* The same thing is valid for the pieces of electrical products brought to association A. P6 says the other members who repair the electrical appliances in the association never throw away the parts of the products and keep them carefully as *spare parts for future repairs*. Rather than being identified as waste, these spare parts seemed like *precious* pieces. Therefore, the *perception of waste* is changed for the participants who regularly do product care works: objects and their pieces are perceived as repairable, precious things rather than simple waste.

4.2.3.2 Perception of Product Lifespan

Once a person starts to repair, they start to question to what extent the lifespan of an object should be prolonged. Although repairing and using extends the lifespan of the products, sometimes "fixing does not necessarily mean to be able to use it", as P7 verbalizes. He gives his repaired bicycle (see Figure 4.37) as an example.

> While increasing the lifespan of the product, the products themselves are becoming obsolete. For example, good bikes have aluminium bodies now. My [repaired] bike seems heavier [compared to new ones]. If I'm still trying to ride this bike after five years, I will be behind the technology. That's why it doesn't make sense to use it after a while.

Similarly, P16 gave up repairing her fabric sneakers after a couple of repairs, deciding that its lifespan is completed. Therefore, the *perception of a lifespan* is shortened for the already repaired items for some participants. Yet another consideration is keeping pace with technological progress, which changes the perception of repaired product's lifespan.

4.2.3.3 Perception of Product Quality

When participants are engaged within the repair works, then they discover the inside of a product, its working principles and components. Therefore, it becomes easier for them to evaluate a product's quality. Some participants explained how disappointed they were when they discovered some products' inner low quality. After P8 repaired his friend's headphone (see Figure 4.20), he decided that he won't purchase any product of that brand:

> When I opened the inside of the headphones, the first thing I saw was the poor quality of a product. You usually think it is very high quality, or you have no idea when you see it from the outside. But inside, for example, [manufacturer] knotted the excess part of the cable and put it, so there is no reason for the cable not to break anyway, and this is a good brand. I was surprised to see it.

P19 gives another example about his perception of product quality. When he disassembled his electrical skateboard (see Figure 4.2) to see why it was making strange noises, he saw that the engine's two metal parts were somehow melted with the heat and touching each other while creating a noise. He notices that the choice of cheap and inferior quality metal made the product be broken.

Overall, once the product is disassembled, the *inner quality* is revealed to its user. Afterwards, participants quickly evaluate the overall product quality, including its inner quality. Even in some cases, they can decide not to purchase anything from certain brands that offer products of lower inner quality.

4.2.3.4 Perception of Repairability and Repair Quality

The perception of repairability can be explained in two ways. The first is about considering the repairability of the product before handing it to a professional or throwing it away. The second is to criticize the *product's repairability* and demand repairable products as a *proactive* user (see Figure 4.33). For the first one, P8

provides an example. His perception of repairability completely changed when he started to repair on his own two years ago:

> When something is broken -whether mechanical, be it electric guitar or a torn carpet- my mood is this now: how can I fix it? This is a change for me. Instead of saying I don't know, I began to look at the problem because it is actually quite fun.

P12 criticizes the repairability and repair quality of his breadmaker. When he took it to an authorized service, they replied the product could not be repaired:

> They [service] said that it could not be done, it is an old model. ... It is now out of circulation. They said they don't have any spare parts; we can't fix it. Well, I said okay. I bought the machine back. I unscrewed all the screws to see where it was broken, and I saw that a strap was broken inside. Service told me that this strap is not produced anymore. I looked at it on online stores, and I wrote the model of the machine and the name on the strap. Here it is sold for thirty TL - forty TL. I ordered one, it came, connected it, and we are currently using the machine.

P12 felt angry and criticized the perception of repairability of the service by making a complaint to the brand: "they [service] said it could not be repaired. I found the fault by disassembling it on my own and bought the component online. I did it. I didn't expect this manner from you [brand]."

The more people are involved in the repair activities, the repairability of products increases for them. Even a person who usually doesn't repair begins to perceive broken products as repairable objects. On the other side, there are participants whose expectation of repairability doesn't match the authorized services'. Therefore, they criticize the repair quality of the professionals and demand more from them to reclaim their full right to repair.

4.3 Objects in Transition

While the former section examines the product care practices from the user's perspective, this section dives into objects' perspectives and discusses their openness to user intervention. This section is separated into two subheadings to analyse the *objects' acceptance for repairability*. The first one examines *obscure objects* that hide their repair information and don't let user intervention. The second one investigates the *open objects* that display their components and working principles so that people can quickly intervene with them.

4.3.1 Obscure Objects

Black box products are *obscure* in nature since they do not reveal their components or working principles to the users, and hide their repair and maintenance information as much as possible. Therefore, they mostly discourage or even prevent people from repairing their products. The reasons for objects to be defined as obscure will be listed and exemplified within this section. The first reason is about the objects refusing to be opened by the end-user; in other words, it is hard to open the product to diagnose the error. Sometimes, it is impossible to open it up without damaging the product's casing. Secondly, moving from mechanical to digital products makes it challenging for the end-users to be involved in repair since digital components are mostly assembled with robotic included production. The human eye and hand can't be that delicate. Lastly, the specialisation of the components used in production instead of universal ones increases the object's obscurity since it decreases the interchangeability of the components between different models and brands.

4.3.1.1 Opening the Product

Opening the obscure products can be challenging in two ways: first of which is the hidden opening details, and second is damaging the product while trying to open it.

4.3.1.1.1 Invisibility of How to Open the Product Up

Opening up a product to see its inner components can be problematic for obscure products that do not allow their end-users to do so. As P11 mentioned earlier, “The manufacturer never comes close to the concept of users being able to repair the product on their own.’’ Therefore, most of the time, opening these products is a mystery for the user since clips may be hidden with straps, some screws may be put in a place that is hard to see, and so on. P11 tells:

> As in the past, the productions were screwed and so on... Now, most of them are glued and closed while they were produced, never to be opened again. Even going so far that there are screws, it only works in the tightening direction. So you can’t open that screw with a screwdriver. In other words, the manufacturer never wants their product to be repaired. Or at least they don’t want anyone but themselves to interfere.

P17 also complains about disassembling some products because he can’t see where he should dismantle them. Even though he unscrews most of the screws, there are still one or two left in a place he can’t find: “but one screw has to be opened with special equipment, or it is in a very secret place. It is difficult for me to see. This is my biggest challenge.” Apart from finding the opening tricks of the products, P18 has a hard time disassembling dishwasher since its engine and lids are on the bottom:

> To interfere with this, you have to remove the machine from its location, lay it on its side, and open the bottom. Perhaps in such devices, it would be more beneficial to make the machine accessible from the side rather than tilting it sideways [to reach the bottom lid].

The participants express how much hardship obscure products cause the repair process from the beginning of disassembling them to properly diagnose the cause of the error. Sometimes product's screws are hidden, and the clips are invisible so that lids cannot be removed easily in small electrical appliances. Moreover, in the case of white goods, the lids can be in a place (back or bottom) that is not possible to open without removing the whole product from its place.

4.3.1.1.2 Damaging Product While Trying to Open it Up

Some obscure products discourage end-users from opening them since when they open, they get damaged. Especially, products with plastic casings break down when they are tried to be disassembled. P4 indicates certain cell phones are "impossible to open without breaking the case. When you were going to fix it, you would need a new case." P5 also talks about the high possibility of damaging the phone's screen (see Figure 4.34) when non-authorized services try to disassemble it:

> They cannot guarantee this. They say they might break the screen while trying to disassemble it, they warn you. If you accept, they will open. Something small can cause it to break. Without you noticing, it snaps.

Figure 4.34 Representative image for phone screen removal with proper equipment (iFixit.com, n.d.).

P5 complains about the non-repairers who try to open laptops before bringing them to association A. As he says, they break some parts while they try to disassemble them without any prior knowledge. That is why P11 states first one should be questioning how to open the product:

> One of the most critical difficulties is now disassembling the devices. In other words, you need to know where the screw is, under which tape -the tape or something is stuck on it- or where the snaps or clips are. Generally, there are some breakages and so on when opening.

P11 continues to talk about the scales (see Figure 4.10) he repaired, which was difficult to open since he can't see where the clips are placed: "I drilled a hole on one side to see the inside, hahaha... It is impossible to know where the clips are and where I should lift [the casing]. If they break, there will be difficulty in assembling them back."

As seen, even though people try to open the obscure product that hides its opening steps, they somehow manage to disassemble it. However, it may cause the product to be damaged, broken casings, etc. Nevertheless, for the ***confidents***, there are still ways of hacking the obscure products to be opened without damaging them.

4.3.1.2 Mechanical to Digital Products

Products are progressing from mechanical to digital, and this is found out to be the biggest challenge for the participants in their attempts to repair them since 1) the components of digital product are integrated on a single board rather than being independent pieces, 2) the miniaturization of the components makes it hard for a human to repair it, and 3) invisibility of components. All three reasons for obscurity in moving from mechanical to digital products will be exemplified below.

4.3.1.2.1 Integrated Components Instead of Independent Ones

P5 compares (see Figure 4.35) older and newer laptops he has been repairing. While the older ones have several lids covering each component, newer ones have one lid for whole components. That is why, while the older versions were allowing P5 to open only the problematic part and quickly replace the broken component, the newer versions would require him to disassemble the whole of them since they are not separate pieces but integrated into one component. Therefore, replacing only one component is not quite possible, but the several components that are integrated into one should be replaced altogether.

Figure 4.35 P5 shows the separate lids -highlighted with green- for each component of the laptop (left). New versions of the laptop's bottom casing is one-piece (right). Representative photo from author's archive.

4.3.1.2.2 The Miniaturization of the Components

Robotic-assisted assembly of the miniaturized components makes repair work challenging for the end-users since it requires delicate and laborious work to replace components with basic hand tools. P4 also complains about this issue:

> There is a thing, especially in new electronic goods, if they are broken, they say throw it, you know... because repairers could replace parts of the old television [to repair them]. As technology has developed, it has become harder to do these things since it became very robotic. Even if you find the part, you can't mount that part there. Instead of mounting it, you know it is easier to buy that card completely, and it is cheaper.

P7 is another participant who loses his motivation when dealing with obscure products. He says components get smaller with technological advancement. He finds it quite hard compared to older products regarding their repairability by their users without special equipment or with the naked eye. He adds, nowadays it is about changing a whole unit rather than a single component. The users can only repair it by removing a unit and putting another one which is not a cheap but forced option.

The users are having a hard time interfering with the miniaturized components that are assembled with robotic assistance in the production phase, which turns especially electronic appliances into obscure objects. The user's level of intervention decreases to change a whole unit with multiple components since each component is integrated and too small to replace without damaging the others.

4.3.1.2.3 Invisibility of Components

When the product is mechanical, some participants say they feel more comfortable repairing them compared to the products with digital components. P18 exemplifies the issue:

> Well, mechanical works, of course, are the ones that I can easily do. I don't have any problems with disassembling, putting together, connecting and so on. But here is the refrigerator, to give an example... it has a thermostat, and that thermostat is broken, how can you fix that thermostat? It has a button, you press it, and you reset it. It is... but if that thermostat has expired and lost its function, no intervention by you will save it. Then it looks like you have to call the specialist for the job...

As P18 indicated above, some components and their mode of operation are hidden behind a button that starts or stops the function. Therefore, it becomes invisible how to interfere with such obscure products and the end-users level of intervention is weakened and discouraged.

4.3.1.3 Invisibility of the Repair Process of a Software

The invisibility of the repair processes and the information of software together with software blockages are significant issues in electrical products. Although the main concern of this thesis is the mechanical repair and maintenance works, there are still software issues limiting the mechanical repairs.

P5 regularly fixes laptops that are left to association A. However, as he indicates, the laptops coming in the last few years have some software locks that he cannot manage to break on his own. Beforehand he somehow finds his way to solve software issues, but lastly, there have been some laptops he had a hard time understanding the software block off, and eventually, he couldn't fix.

P15 was used to repair his car by some mechanical part replacements or maintenance tasks, but he says newer cars with electronic adaptation systems for repair makes it hard for him to complete the repair on his own:

> Electronics also came into play in the signalling of mechanical and electrical parts, and for example, you detect the broken component. Yes, we detected it, removed it, and installed a new one. It says that you have to connect it to the device for the electronics to recognise it, which is available at authorized services only. The car will not operate if you don't connect it to that device. You take it to the repairman somehow; they connect it to the device, they say we made the adaptation on the computer. After that, it goes back to normal. This prevents you from repairing. You cannot repair it in any way.

Overall, the experienced participants can't help but compare the older and newer versions of the product they are used to repair regarding their repairability. The newer ones with the software are hard to repair by the end-users' efforts only.

4.3.1.4 Specialized Components Instead of Standardized Ones

Another feature of the obscure product is their use of specialised components rather than standardised ones. Therefore, it becomes harder for the participants to find a replacement for the broken component. For example, P7 tried to create his components when he couldn't find a spare part for the hair straightener he repaired (see Figure 4.31). However, if the piece would have been a standardised one, it wouldn't be hard to ***reach a spare part***. For P5, on the other hand, creating a component was not an option since he needed a laptop upper part plastic casings.

Although it is not that difficult to change it, as he said, the crucial thing is to find the exact casing that is produced only for that brand and the model: “It will be exactly the same. Otherwise it won’t fit. Even the series will be the same. For example, if this is the [brand name] M500, it will be the M500. No other. You can’t fix”. P11 adds another example to the ***interchangeability of the components*** between products by stating it is not quite possible for today’s products. When he can’t repair his friends’ products, they usually reply as “keep it. You will use its parts.” However, P11 asserts: “Such a thing never happens. It is one in a million chance to be able to use a part of any product elsewhere.”

Eventually, the products with specialised pieces instead of standard ones make it hard for participants to find the spare ones on the market or replace components between the different models of the same products.

4.3.2 Open Objects

Open objects are explicit and transparent objects since they reveal their components, working principles, and repair information to their users as much as possible. Therefore, they encourage the users to be part of the product care processes. As concluded from the participants’ repair stories, open objects are the ones that have:

1) visible and accessible components,

2) open-source components,

3) repair kits and manuals.

These three features that describe the product’s openness for product care activities will be exemplified and discussed in this section.

4.3.2.1 Visibility and Accessibility of Components

While some participants defined the black box products, they also defined open products and made comparisons between them. While the most mentioned examples were laptops and phones, the older models were found more ***open to user intervention*** since it is easier to see their components once the lids are opened. For example, P5 says he can easily replace batteries and hard disks of laptops that do not prevent access to its components (see Figure 4.26). He adds the ease of replacing the old phones' motherboards since it reveals itself once the back lid is opened without any difficulty.

For open products, 3D printers have been mentioned both by P15 and P19 as they appreciate ***the level of intervention*** in these products. P15 tells about how the 3D printers are such an example of open systems:

> The printer is a very open system. Since it is open-source, it can also be intervened. I've tried to collect it [to build it on his own] before. I collected all the mechanical components from the industrial site and ordered the electronic components from abroad. I like it very much because it is an open system. After all, I can see everything!

The ease of reaching components of an open product encourages participants for intervention. When the components are visible and accessible, their maintenance, replacement, and upgrade are possible to be undertaken by the users of the open products.

4.3.2.2 Open-Source Components and Products

The participants express their gratitude for open-source components and products which ease their way to care practices. The open-source products let them freely upgrade and personalise their products while repairing them. Maybe the most interesting example is the yellow piece P15 printed with his 3D printer for the

bathroom faucet that was too short of reaching the sink (see Figure 4.16). It is an interesting repair case since he uses an ***open structured product*** like a 3D printer to create an additional component. This component helped him to hack his black box faucet that prevents conventional intervention methods. Also, he uses the website Thingiverse (thingiverse.com, n.d.) to download ***open-source components*** created by other individuals who are dealing with similar problems:

> For specific problems that are ready-drawn [3D models] in Thingiverse, here you enter Thingiverse, and someone has already thought about it and drawn it. You take the STL file that suits you and print it directly.

P19 is another participant who appreciates the open-source information and says, "If that's open-source, that's great. So if it's something I can learn about, that's awesome." Before repairing, P19 sets criteria and asks: "Can I access information about it? So is there a larger world of knowledge about it than I can physically explore?" To be more explicit, he gives Arduino as an example: "Anything that is an Arduino, or anything that has a microprocessor, or anything open-source... is very easy to change and modify."

Therefore, being open-source becomes a significant measure for participants to decide to repair and enjoy the process since ***the allowance of user intervention*** for open-source products and components is higher than traditional repairing methods. Moreover, people can modify and upgrade their products while repairing them with open-source information while also including new application methods for other people who will use the interpreted data.

4.3.2.3 Products with Repair Kit and Manual

One of the attributions of the open products is that they carry the repair information and direct their users to undertake product care activities. The product's repair information can be communicated by providing a care manual, or the manufacturer can provide ***a repair kit for the possible breakage scenarios***. Providing a repair kit

also has been studied by Terzioğlu (2017b) by her design proposals called Do-Fix repair kits (see Figures 2.15, 2.16, and 2.17).

P16 expressed her appreciation when she found a repair manual and repair kit inside an inflatable pool box. The product contains the inflatable pool, repair kit and manual within a box:

> I was delighted that something like that came out of the box. Because those inflatable pools are products that can be punctured easily, they put both text explaining how to fix it and the spare part inside. I'm sure there are such products—that is, they can be deformed very easily, or their parts can come off very quickly... I think it is crucial and life-saving that there are parts that you can intervene in and bring the product back to life. Because if they didn't give me that part, I would think about how to fix it, how to glue it, or I would try to find a part... Maybe try to get a new one.

Most participants complained about finding repair information about their products since the manufacturers usually hide the information to only be repaired within their authorized services. However, *proactives* are fighting against this, since the repairability is only increased when information is provided about the products. It is also essential to include non-repairers within the process. For example, P16 says we want to encourage non-repairers for product care activities, then "the first step is to get such things [manuals or kits] out of the box of the product. It feels like you can encourage it when things like that happen." She also gives an example from clothes that come with thread and buttons for repairing them:

> It is like an incentive. Because searching for materials and figuring out how to do something is the hardest part of the process, how will I do it, where do I find the material? If you have the material, you repair it immediately.

The participants also measure the product's openness with how much repair information it provides. When a product comes with a repair manual and a repair kit,

it encourages users to repair it when needed since how to repair it with which tools and methods are shared by the manufacturers.

4.4 Cultures and Communities in Transition

This section investigates the product care activities from the communities perspective. As the cultures and communities give ***a context to the user and object relationship***, their effect on transitioning the care habits become significant. Being around people who already repair and maintain makes it easier for an individual to start or continue to do so with them since product care activities are ***socially constructed***. Therefore, within this chapter, first, the communities will be briefly introduced afterwards, their characteristics will be exemplified. Although the study initially aimed to investigate the repair-related initiatives, the analysis phase shows that the family and acquaintances also play an essential role in forming product care habits together with the online platforms about repair and maintenance. It is found out that the participants' close circle, their repair-related initiatives, and the online platforms they are using all make contributions to keep up with their behaviours targeting to prolong the lifespan of the products.

4.4.1 Close Circle: Family and Acquaintances

The participants frequently mentioned their family and acquaintances as a helper and advisor for them. For some of them, growing up in a family where product care activities are a part of their daily lives help them to form care habits quickly, as concluded from the interviews of P14, P16 and P18. As P14 tells about how she started to repair:

> The repair was a way in my life to prolong the lifespan of the items I used, but in fact, it was something I saw in my family. That's why the repair is not something I am unfamiliar with.

On the other hand, some of the participants have professional repairers in their family like P4, P7 and P15; it causes them to witness the repair and maintenance processes from a young age. P4, for instance, has family members who are already repairers in fields such as phone, tv etc. Therefore, ***growing up in this environment*** helped him to have some know-how about such devices, as he states.

Apart from that, having friends who are already familiar with repair activities encourages the participants to ask for advice before taking their broken product to a professional repairer or discarding it. For example, P12 has a "repair group" consisting of close friends who ask each other repair-related questions before consulting anyone else. Therefore, participant's close circle who are already interested in repair and maintenance works have a significant role in forming and supporting participant's product care behaviours.

4.4.2 Community-led Initiatives

As this study emphasises, the impact of community-led repair initiatives in forming caring habits in individuals is undeniable. For the study, the members from different scales of those types of communities have been interviewed from local communities that operate at the neighbourhood level to ***repair and maker associations*** that run through the big cities like İstanbul and Ankara. All these community-led initiatives support individuals in their endeavours to repair and maintain products by providing ***educational and inspirational gatherings*** like seminars and workshops, exemplified in the following headings.

4.4.3 Online Platforms

There are online platforms like forums, blogs, youtube channels, and websites about tips and tricks of product care activities. Those platforms are used as educational tools for those willing to repair their products but do not know how to do so. Most participants mentioned getting help from them while repairing or even deciding to

repair a product if they reach the repair information online. Therefore, the significance of the online platforms is obvious for repair enthusiasts as they are novices.

4.4.4 Characteristics of Communities

After a brief explanation of the different scale repair communities within the scope of the research, within this section, the characteristics of these communities will be exemplified. Four headings are formed to explain the features of these communities: *educational*, *inspirational*, *proactive,* and *sharing environment*.

4.4.4.1 Educational: Teaching and Encouraging Others to Repair

Most of the time, the lack of knowledge and skill discourages or prevents people from repairing their products. Therefore, more experienced and skilled individuals who participants can consult about the repair methods and techniques increase the likelihood of product care behaviours. While some participants directly ask for help from their close circles, the others go to the repair-related communities to learn more about the repair processes. Some of them search repair websites for learning. Repair-related communities and online platforms make repair knowledge accessible for people who would like to repair but are unsure how to do so.

P4 and P14 talk about association B and how they aim to encourage people to repair more by teaching them the basics. P4 says: “I think that if we motivate people more if we can guide them and make these things easier for them, it will become widespread.” P14 explains that association B is a “collective space that anyone can use whenever they want.’’ There is a room within the association where there is a sewing machine she uses for her own needs and to help those who want to use it. Later, the room hosted repair-oriented workshops given by P14:

> Here I shared my sewing knowledge with the people who came there. I gave a sewing workshop there every Sunday for a year. The reason for this was to encourage people to come here and do repairs. If people could not repair their belongings due to the lack of knowledge, it was to provide aid. For example, a part of a participant's bag has been torn, but he wants to use that bag more; he is sewing it.

P13, from association C, also tells about the educational aspect of their community through ***providing a collective space***. Since they exhibit their repair works (see Figure 4.15) through the city with the help of 3D printed CAD models, they offer guidance to their participants through the modelling and production phases:

> As a core team, we support people who have attended the workshops and do not know about making 3D models. We help people at all stages of the process of making something. We are entering this one-week production process after the training is over.

Besides the local communities, the online platforms also have a significant role as educators of repair and maintenance works. Especially, iFixit (iFixit.com, n.d.) is mentioned as a tool to learn how to disassemble electrical appliances with relatively complex structures. P17 uses this website when he has trouble disassembling obscure products since there are step-by-step explanations for opening them. However, most of the participants follow repair-related youtube channels to find videos about the similar repair issues they are dealing with and how other people solved them. As P15 says, "foreigners share a lot about their repair culture" so that he can quickly reach information about any repair case and allows him to "start repairing immediately." He also compares ***learning from online platforms*** with taking the product to a professional repairer:

> When you call a repairer, he comes and fixes it. He doesn't teach you, he doesn't have the concern to teach you, but now when we enter youtube, a guy called [name of the channel owner] was talking madly about how refrigerators

> and air conditioners are repaired. So it has made it a life purpose. Okay, I will not fix the refrigerator, but he makes you watch it.

Apart from the popularity of youtube channels and iFixit among the participants, P8 says he frequently uses Udemy (udemy.com, n.d.). Although he still learns the basics from youtube, for the specific tasks, he looks up to Udemy to learn details about the topics of electronics and software. For example, while he was repairing his friend's headphones (see Figure 4.20), he used the knowledge he acquired from an online class about electronics which turned out quite valuable for welding the damaged cable of the headphone.

Overall, it seems that the communities' first aim is to provide helpful information for the novices to join the product care activities and teach them the basics of it. While doing so, they share their experience and knowledge about different repair and maintenance cases to encourage them to join them.

4.4.4.2 Inspirational: Sharing and Popularising Repair Activities

Sharing inspirational product care examples help people to take part in the care activities, as the participants indicate. Therefore, when communities provide inspirational sources or examples, the product care activities are popularised through the audiences of these communities. According to P8, when repair enthusiasts support each other by showing their repair examples, they affect each other to do more. P8 expresses his feelings: "When you say 'Oh look, I've taken care of this, the person next to you says 'Oh then, I can do it too' or something like that... It brings people into the repair slowly and nicely." For example, he was encouraging his friends to do maintenance works of his laptops by showing how he had done his laptop, and send him photos during the disassembly:

> After sending the photo, he replied, 'Yeah, I will open it mine as well. I hope he did well. It is good when someone is saying, 'Look, this is how it is done, I

did it like this and that' etc. Even if you are not related to the topic, you become a part of it.

P14 talks about the importance of showing examples that inspire residents to join the ***product care activities for the local repair-related communities***. While she was giving repair-oriented sewing workshops, she noticed that people who were not into repair before began to bring their garments that hibernated "in their closets for years" (Bakker et al., 2014). She adds: "I think the existence of these places can encourage people to leave their house and repair [their garments] by saying 'It would be a different experience for me to learn repair, let me try.'" Similarly, P13 also talks about encouraging people to take action for themselves by motivating them with inspiring repair examples: "To encourage, to inspire... we can actually reach that ideal world with these kinds of things. We are trying to encourage, inspire and set an example [for people]".

The participants use online platforms like Pinterest and Instagram as inspiring tools for what Terzioğlu (2017b) referred to as visible repair and upgrade, reflecting users' tastes and preferences. P10 says she tracks the trends from Pinterest and watches DIY and craft videos a lot. Although she receives her inspiration from them, she doesn't apply them directly: "I think it creates a visual memory, then I ask myself how can I refurbish/repair something quickly, practically, compatible with me.... things like this [see Figures 4.12, and 4.44] come out. It is the result of that analysis, I guess." P10 also tells about how inspiring it is to see "before/after images of the repaired items" since most of the time people cannot think of "how to keep using their products." She adds: "Instead of simply throwing away, or donating or selling [the products].... maybe people could keep using them by upgrading or repairing. Putting those photos actually inspires people."

The participants are ***inspired by the repair examples*** provided to them through their close circles, local and online communities. The examples make it easier for product care behaviours to be attractive for novices and become popular among them. While

some beginners may see it as a new and fun activity, some others may find it as an appealing way to transform their product visibly.

4.4.4.3 Proactive

4.4.4.3.1 Raising Awareness About the Repairability of Objects

One of the aims of repair-related communities is to raise awareness about ***the repairability of the objects*** so that people can decrease the amount of consumption and waste they produce. Therefore, they try to tell about the products' journey from beginning to end and the linear consumption model. As a member of association B, P4 tries to spread care habits by sharing his knowledge about the subject with the neighbourhood residents. His main aim is to "ensure that people have the perception of 'this is fixable' instead of saying 'throw it away and get a new one' when something breaks". Similarly, P6 says in association A everybody tries first to save the products and repair them if possible.

P14 organised workshops for middle school students for a short period about "utilising waste to build something new." While doing so, the main point was to raise awareness about the waste production and short lifecycle of products:

> It is adorable that children do not see things like garbage. In those events, they were saying, 'I can transform this into this. Why are we throwing it away?' or they eagerly kept piling up such things at home for the next week.

Changing the perception of waste and raising awareness about product repairability is a crucial mission that local repair associations have undertaken. Especially shaping children's perception of waste can be an intervention area for designers to create design proposals to challenge the current linear economy model.

4.4.4.3.2 Creating Alternative Economic Cycles

While local communities take a role in changing people's attitudes towards product care behaviours, they also create small alternative economic cycles within these communities. As repair is only a part of their attempts to change the linear economy model, they try to minimise their consumption by using second-hand goods, repairing and transforming products within the community buildings. For example, association A pays attention to these issues the most. As P5 says: "Everything you see here has brought. So nothing is purchased here". They brought objects that are repaired and put into usage in association A. P6 explains that residents bring and donate their excessive products from home textile to electronic or kitchen wares to association A. If products require a repair, then they are repaired by the members and then given to the other residents in need. The additional products are sold during the swap festival, where they raise money for the resident students in need. Therefore, repair becomes a means of transforming the neighbourhood economic model with an alternative one in association A.

4.4.4.4 Sharing Environment

The repair communities of all the three scales -close circle, local and online- ***share environments for exchanging skills, knowledge and methods*** of product care behaviours. While P18 tells about two friends who also have care habits, he says they wait for each other to do the repair work together. On the other hand, local communities have repair ateliers to gather people around the care activities (see Figure 4.36). P4 explains they found a repair atelier within association B to have a common place for production and repair. They wanted to work like the Repair Cafe (repaircafe.org, n.d.) for gathering people around the repair activity. People may bring their broken stuff and make them repaired, and then that stuff can be donated to someone in need, or people can fix it in the atelier together with people there for their use. The place is aimed to be a ***gathering point for sharing the repair***

experience, rather than being a repair centre. P4 emphasises the differentiation between a sharing environment and a repair centre. Their wish as a local community is to share the repair phenomenon with the residents and create solidarity while repairing.

Figure 4.36 A view from association A.

Although the associations offer a space for exchanging skills, knowledge, tools, and methods, P4 and P6 say few people join them in the repair processes. Therefore, P4 states tools and materials can be equipped, but ***the need of having enthusiastic people to share the repair experience*** is more crucial. For local communities like association A and B, the point of gathering people is not repairing in the end but *repairing for community-building and solidarity*.

In the case of online platforms, P19 is a member of several maker communities which operate primarily as Facebook groups. For example, when he bought a 3D printer, he joined the group set up by other people who bought the same brand. He was both helping people and writing his questions to the people. However, when he learned to take care of his printer's problem, he quit the group. Other than that, when P19 became a member of a Sailing Club, he immediately attended their WhatsApp group allocated to talk about the repair and maintenance works of the sailboats. As

seen in the P19's membership to the maker and repair communities, it may be concluded the online platforms offer more fluid participation when compared to the local community.

In conclusion, some participants try to ***build a community around product care activities*** to share the repair experiences with novices in care activities. While doing so, repair ateliers within the local communities become a medium to transfer knowledge, skills, and experience. However, the participants who are members of online platforms show more fluid roles that change in shorter periods. Therefore, their online repair community's roles quickly change or finish when they change their repair interest and join other repair communities.

4.5 Emotional Durability and Product Care

As the study's one of the main research questions investigates the relationship between the formation of ***emotional attachment*** and conducting ***product care activities***, this section presents the findings of the emotional aspects in conducting care works. The first heading, ***preservation of memories,*** explains how some objects are worth preserving for their owner and cared more by regular maintenance and repairs. The following heading, ***reproduction of product identity,*** exemplifies how the participants increase their relevancy and ***develop an emotional bond*** between them and their objects. The last heading closes the section by explaining the participants' increased emotional attachment to the repaired objects.

4.5.1 Preservation of Memories

Certain products are worth more care for some participants than their other belongings since they carry an ***emotional value*** that is worth preserving for a longer time. Therefore, they perform preservative behaviours towards those products, such as maintaining and repairing them (Mugge et al., 2008). Generally, the protected products are irreplaceable for their owners. To comprehend more the reasons for the

irreplaceability of products, some examples will be provided under three categories: ***childhood and family reminiscences, objects having traces of a loved one,*** and ***objects with personal narratives.***

4.5.1.1 Irreplaceability: Childhood and Family Reminiscences

For some participants, preserving their childhood memories and family reminiscence are important motivators for extending their lifespan with product care activities. The childhood bicycle of P7 (see Figure 4.37) is a very precious gift to him from his father, and although it was rotten and outdated, he found a way to make it usable again. Since it was "the best bike of its time" and "so valuable" to him, he ***revived his childhood memories*** by repairing it. He tells the story of the day his father bought him the bike:

> 1997 Bianchi Uno. My father said to me: 'I promise you when you go to middle school, and I will buy any bike you want.' We bought this model for 72 TL, which can be considered the BMW of its time, especially its gear type. My father got in his car saying, follow me [with the bike], and I did. I was constantly changing gears. I was so excited that there was a possibility that I had a car accident. It was like everyone was looking at me. This bike, which I couldn't bear to throw for years, was lying on the balcony for more than ten years. I brought it back to life, as far as it goes...

Figure 4.37 P7's bicycle before and after the repair.

P15 is another one that tried to preserve the family reminiscence for a longer time. When his nephew broke the musical cigarette box (see Figure 4.3), he had an urge to repair it. Although his repair attempts made it worse, he eventually had it fixed by a professional. The box belonged to his parents for a long time and has lots of ***memories attached*** to it. Also, he adds: "I am currently using it as a photo box. Actually, this is a musical cigar box. My family lived in Germany for many years. That's a box of at least 30 years. It plays my favourite song: *'für Elise*."

P18, on the other hand, repaired a thirty-year-old seating group (see Figure 4.38) that is reminiscent of his passed away parents. Over the years, "various wear and tear occurred," and witnessing that was "very uncomfortable" for him. Therefore, he decided to buy some materials and tools to replace the upholstery underneath the winged chairs that loosen with time. While he talks about his motivation behind repairing them, he says, "It is a little bit due to my devotion to such memorable things. By repairing such a thing myself, I have kept that memory alive in some way."

Figure 4.38 P18' furniture set that is reminiscent of his pass-away parents.

For the participants P7, P15, and P18, the objects with their childhood memories or family reminiscences are ***irreplaceable and worth protecting***. Therefore, they find ways to maintain and repair them. Even though sometimes their attempts may be unsuccessful, they got it repaired by a professional repairer. Nevertheless, by protecting these irreplaceable objects, the participants found a way to ***revive the memories*** attached to them.

4.5.1.2 Irreplaceability: Objects Having Traces of a Loved One

For some participants, the product becomes irreplaceable and worth protecting when it comes from a loved one, and has traces of that person. As P4 says, "If a product comes from a friend or if you repair something coming from your friend, both ways it creates a value over the product. It creates a feeling." Therefore, people tend to care more about these types of products. P14 shows her broken bracelet (see Figure 4.28) that she recently repaired and tells its story:

> A friend of mine, whom I love very much, brought this bracelet to me from Armenia during his time there. They were gifts in a way that was related to everyone's personality, and he bought me this flower bracelet. I used it very fondly, and because I used it a lot, the green stone on it was broken. I glued

> that broken, wild-flowered round part and put it back to its frame. Now it is ready to be used again. On the one hand, it has an emotional value.

P16 gives an interesting comparison to explain the irreplaceability of her handbag (Figure two handbags) that has the traces of her beloved mother. She has two handbags that resemble each other very much, but one of them is from her passed away mother. These handbags consist of two layers: the lining is a thin fabric while the outer layer is perforated crochet, and since the lining can be damaged easily with sharp objects like keys, the handbags require to be mended once in a while. Since she enjoys using them, she repairs to extend their use time. However, she finds repairing the handbag that has the traces of her mother "maybe a little more pleasing... To know that I will use it again and again, to know that I will be carrying it with me..." She also includes this comparison:

> It also has a different colour, slightly different in shape, but they are very similar. I sewed it a few times, for example, but it also has a memory of my mother. A bag that I can never give up. So I guess I will keep sewing and using it. Maybe I can throw away the first one after a while, but I probably will never give up on the second one [from her mother], perhaps because it has her memory.

Figure 4.39 P16's handbags. The dispensable one on the left, while the one with emotional value is on the right.

The participants try to protect the objects with traces of their loved ones to ***keep their memories alive***. Even though they might have a very similar object like in the case

of P16, the one with the touch of a loved one still has more value for them and is worth more care.

4.5.1.3 Irreplaceability: Objects with Personal Narratives

The other aspect about the objects becoming irreplaceable for their owner is ***creating personal narratives*** for them. P4 says that he gets excited to use new products, opening up the package of them. However, he values it more to "have a story about that certain product rather than a new package." Therefore, participants created various stories while using their beloved products. P8, for instance, had an urge to fix its precious Athena statuette when the owl on her shoulder broke and fell (see Figure 4.40). While he was talking about why he wants to repair it, he says:

> I love Athena very much. There is a Medusa statuette opposite of her. They are rivals to each other, so when Athena's owl broke... I said it could stay like this. I mean, she fell into a funny situation [in front of Medusa] when her owl fell like that. Usually, she looks very ostentatious. That's why I thought I should fix her right away.

Figure 4.40 P8's Athena Statuette with a broken piece (left). After the repair Athena is positioned against the Medusa (right).

P16 has an example of a product with a narrative that her little daughter creates. The wooden cat toy (see Figure 4.25) her daughter loves to play with keeps losing its

parts, and P16 constantly repairs it by sticking the broken pieces back. She says her daughter likes the toy very much, and "Once in a while, she takes the cat on a trip. She's eager to walk the cat." Therefore by repairing the toy, again and again, P16 saves her daughter's narrative.

Sometimes objects take minor roles within a bigger narrative. When electric guitar was the main focus of P19's life when he was a teenager, he wanted to be an electric guitarist just like the rock stars he was a huge fan of (see Figure 4.41). Therefore, the electric guitar for him became something more than a musical instrument; he attached wishes, dreams and a cool career to it. Therefore, that specific electric guitar became something irreplaceable and worth protecting. He spent time both learning how to play and how to repair it on his own.

Figure 4.41 P19's electric guitar (left). P19 is repairing his electric guitar in a luthier's atelier (right).

In conclusion, even mass-produced products with identical appearances can be unique and indispensable when they take a role within the narratives created for them by their owner. This also increases the ***product's personal relevance*** to the owner, which will be discussed further in the following heading.

4.5.2 Reproduction of Product Identity

As it is discussed in the literature chapter, when a ***product's personal relevance*** is increased for a person, then it is more likely to feel an emotional attachment towards that product (Mugge et al., 2005). Product care has been used as a way by some participants to increase their products' relevancy for them. While doing so, they are ***reproducing the product's identity*** so that the new version can be a better fit for their tastes and preferences. ***Personalisation*** is remarked several times in literature as a method to reproduce a product's identity. Therefore, within this section, some personalisation examples through repair and maintenance works will be given. P17 tells about the repair of his first car's door handle (see Figure 4.42):

> This car is my first car. At that time, I was 18-19 years old, and I was a prep student, and I was working on the other hand. It's not a great car, but you know, it was a very good car for those ages. It's all white, a car that is constantly cleaned. A black door handle on a snow-white car! I didn't like it at all. So this started to stick out like a sore thumb. One day, I said, I'm going to paint it.

Figure 4.42 P17's repair process of car handle painting.

Therefore, he found a way to repair his car to change its appearance to fit the idea of a "great snow-white car" which appeals to him more. On the other hand, P9 transforms the "style" of her furniture to make them look like "vintage items," which pleases her eyes, as she indicates. She uses the wood painting technique to apply the vintage look to visibly repair their monotonous look so that they can look like they belong to each other:

> Vintage is not the trend or anything. That is why I like it. If I liked minimal things, I would have painted them in plain colours... the house has a style, you know... if you gather all diverse furniture, it looks irrelevant. It bothers my eyes, you would think why this piece is there. I work to create harmony between the products I bring, so I am making things that will go well together. That is why it is vintage.

Therefore, when she moved to Ankara and needed some pieces of furniture, she thought she could buy second-hand and paint them according to her wish since she has a hard time finding the things exactly she wants. She bought a sideboard from Letgo and transformed it into a vintage-looking one. Afterwards, she also purchased a second-hand pouffe (see Figure 4.22) and refurbished it in a way that it would look like it belongs to the sideboard:

> So, while doing the sideboard, I decided this will look good or not and repaint it. Then I said, I need a pouffe besides this sideboard, but I didn't like the ready-made ones, so I looked on Letgo to find a secondhand. I bought it and used fabrics to change the upholstery. I painted it like a sideboard to create a family of two.

Figure 4.43 Show cabinet that P9 refurbished to make it look vintage.

After making the sideboard and the pouffe, she also bought a second-hand show cabinet (see Figure 4.43) and changed its style and look to fit the rest of the furniture in her house. She says the furniture she refurbished looks pretty different and unique: "It is obvious that they are designed. You know, it saves them from mediocrity and gives my house such an identity! That's why I like it". P9 also indicates how liberating to play with the appearance of the products. While refurbishing her furniture into "vintage-looking" pieces, she says:

> I can, of course, buy ready-to-go products, but if I did it myself, I put effort into it, I could choose its colour, handle, I can put writing or painting anywhere I want. So it is up to me; I like to intervene in the product freely.

Similarly, P10 also uses wood painting to renew her childhood furniture to look like an adult bedroom (see Figures 4.12 and 4.44). Since her needs and preferences change over time, she wanted to refurbish the furniture accordingly. While doing so, she paid attention like P9 to ***create an object family through product care activities***:

> I didn't want to buy a new furniture set; therefore, I thought I could repurpose my furniture. If you walk into my room, you will see them as a set. However,

they were bought at different times and from different places. By using common details, I united them and wanted to create togetherness.

Figure 4.44 P10's refurbishment of her old childhood bedroom furniture. Bedstand and table.

She restyled the furniture by painting them in black and white, and she says: "Is this representing my style? I could have painted it in a different colour, but my mood back then was like that and now my room is black and white". Therefore, her chair, table, headboard, and bedstand are all black and white (see Figures 4.12 and 4.44). She created a ***togetherness*** by ***using common details*** (Marchand, 2009) like black handles in the drawers and bedstand (see Figures 4.45):

> I couldn't find a black handle on the market, and I searched so many places! Because back then, I was so obsessed that it should be black. Then I spray painted [square handles] in black. I even placed these handles on other furniture pieces that I bought from Ikea. Right now, all the handles in my room are the same.

Figure 4.45 The drawers before and after the refurbishment of P10 and the black handles on the left that are used for each furniture's handles.

She started to change her childhood furniture by painting "the outdated chair" to turn it into "a modern looking chair" (see Figure 4.12). After managing one piece, she wanted to create a furniture set by applying the same colours and details. However, her primary motivation behind painting and transforming her furniture comes from the wish to change their appearance and ***erase the memories attached*** to them.

> The furniture was not my choice... It represents the 90s family structure, and they were typical furniture sets on the market... it is a family decision. Outdated -I shouldn't say outdated. It was a modern set almost all parents were buying at that time. The patterns of the upholstery [chair], for example... Since it was not my choice, I was never happy about using it. That is why it never became an object I can connect to my childhood as "oh dear" since I didn't like them at all, ever. Therefore, I wanted to change them [their appearances].

Participants used their skills and creativity to reproduce the identities of their products according to their preferences. Therefore, they repaired the products' appearances by personalising them, which increased their personal relevance and helped ***develop an emotional bond*** between them and their objects. Also, interestingly this ***visible product care approach*** helps some participants to write object scripts from scratch by ***deleting unwanted connotations*** and adding desirable ones.

4.5.3 Embracing products

As the examples on former headings show, people tend to protect more the products they find irreplaceable. Moreover, when the product care activities are undertaken, the product becomes irreplaceable since the user and the object share a unique history worth protecting. Therefore, this last heading investigates how products are embraced after they are repaired.

4.5.3.1 Objects Becoming a Piece of Its Repairer

As concluded from repair stories, spending time and effort while repairing an object creates a special bond between the repairer and the product that participants see as worth protecting. For example, P6 explains why he kept with him some of the wooden toys he repaired instead of donating or selling for the association:

> I have three wooden toys. I did not give them. They are with me, at home. I don't know, maybe it's because I put more effort into them or created some of their parts from scratch, so I didn't take a ready piece and attach it. For example, I work on Pinocchio's legs for one night [see Figure 4.46]. However, it is a simple thing that is usually fabricated, things that come out of the lathe and are made in two seconds.

Figure 4.46 Wooden toys that P6 repaired and kept with him.

P4 feels deep devotion for the objects he repaired since they became a part of him. On the one hand, if he uses a product for a long time, he develops an emotional attachment. On the other hand, he repairs products that he has been using for a long time, and they become something he loves. Therefore, he both has an emotional attachment to the object he repaired, and he is repairing objects he feels attached to.

As such, P19 feels attached to the objects he has been a part of its production, repair or upgrades. He compares his two electric skateboards, one of which is bought ready-made, while the second one is put together by him (see Figure 4.2). While he only uses the first one, he constantly repairs and upgrades the second one. That is why he has "a feeling of pride" for the second one, as he says: "I invested time, effort, knowledge, resources, and in return, this feeling feeds me which is invaluable in my opinion, and I think it extends its lifespan because you keep repairing it".

Another participant who embraces her repaired products is P10. Although she didn't find her furniture trendy and stylish after she upgraded them, she felt "very good about" them since they came out of her hands: "When I look at them, I don't see the outdated furniture anymore. I think I made a new object, and I feel extra happy about making it on my own" (see Figures 4.12, and 4.44).

P14 also expresses her happiness about wearing her repaired dress with embroidery flowers (see Figure 4.14). Every time she wears the dress, she says she remembers the repair she made and the efforts she gave for it: “The idea of giving a new life to this dress makes me extra happy every time I wear it. I mean, wearing this dress used to make me happy, now it makes me even happier”.

Overall, the participants have developed an emotional bond for the objects they have repaired since it reminds them of the time and effort they allocated for that repair, and at the end, they have a result which they have control of. Also, their happiness about using the repaired items comes from the fact that they include themselves within the production and decision making phases of using the product.

4.6 Sustainable Design Considerations for Emotional Durability through Product Care Activities

For users to ***develop a deeper emotional attachment*** to their objects, their basic needs should be covered by the actors within the repair network to easily perform product care behaviours. When users are left alone with ***obscure objects***, they may lose their ***repair motivation***, as concluded from the field notes. Therefore, first, they need open products (see Section 4.3.2) that allow user intervention and second, they need someone to share the repair experience with. Designers and producers become significant actors for providing open products, while repair communities become actors for creating a shared environment for product care activities (see Figure 4.47). While explaining the possible contribution of the two actors, this section aims to present the implications of the findings and insights of the study for the area of design for sustainability that are discussed earlier.

As it is explained in the ***Objects in Transition*** section, when the designers design and produce products that are obscure in nature, users would have a hard time finding a way to interpret them, and thus mostly lose their motivation to repair and maintain them. On the other side, when the products are ***open to the user intervention***, the

users can access the components and repair them easily. Therefore, the design and production of products should be focusing on creating and proposing open products as described in the open object section. As concluded from the participants' repair stories, they can repair the products that have ***visible and accessible components***, since they quickly define ***those products' materials, components, and working principle***s. In line with that, if the production transforms into more open structured products, the user's access and ability to intervene in the product will be increased and empowered. Therefore, ***designing and manufacturing open source components and products*** is an important aspect to support individuals to take action in product care activities.

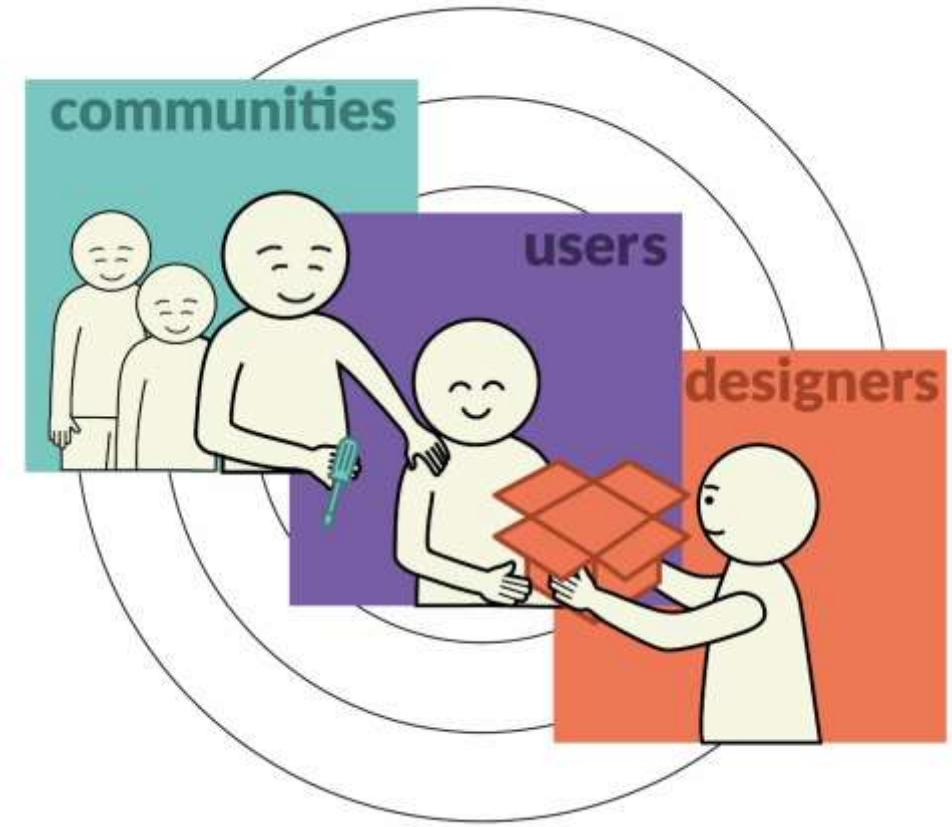


Figure 4.47 Visual showing how designers and repair communities can support users in product care activities.

Another consideration in designing and producing open products is ***the responsibility of designers to provide repair kits and manuals*** for possible breakage scenarios. Since the responsibility of the designers and producers continues after the sales and expands to the use and post-use phases, the strategies focusing on them should be further explored and developed. As mentioned earlier in the literature review, ***distributing the responsibility between actors*** for the use and post-use phases is crucial to inform people about the circular processes so that they can get involved in and value the *circular economy* (Prendeville et al., 2014). To form alliances between users and businesses where both parties are actively engaged in circular processes (Terzioğlu, 2017), the product care responsibilities should be shared between the producers, designers, repair centres, and the end-users. Therefore, designers are expected to design visible components and products for easy user intervention, and ***provide spare parts, repair kits and repair manuals*** for the products. When it comes to the end-user, they need to be informed and equipped for preventive maintenance tasks and basic repair tasks. However, when the task is complicated and requires delicate work, a professional repair centre should be in service.

There are other points that are not directly indicated by the interviewees, but found important by the author, like the ***repeatability of the repair*** and allowing room for making mistakes during the care activities. As seen in the sections called limitations and enabling factors, people may find it hard to intervene with products that quickly break down, so providing objects that can be repaired and upgraded more than one time and transformable as the user's tastes and preferences changes will be an opportunity for the users to feel free to intervene with them. Walker's (2010b) design proposal -*the temporal objects*- can be a good example from the literature. He suggests temporal objects adapt themselves to the quick changes in aesthetic preferences by being capable of continual transformation.

To sum up, the designers' and producers' roles within promoting the product care activities for the end-users are making the products that allow user intervention in terms of repair and maintenance. To do so, creating understandable repair and

maintenance steps, designing open source components and products, providing repair kits and manuals, and lastly, distributing care responsibility within the actors within the repair networks are seen as important points in empowering users in care activities.

Cultures and communities give a context to the user-object relationship. Therefore, the second prominent actor that should be involved more in end users' product care processes is the repair communities. As the field research shows, they are significant actors in encouraging and helping people to conduct product care behaviours; since these behaviours are ***socially constructed,*** how others react to these activities affects their likelihood of execution. That is why being in an environment where repair experience is shared and taught increases the possibility of the users to embrace and perform care habits. Since the care practices are still part of Turkey's culture and daily life, the participants tend to consult their close circle about repairing their product through going to neighbourhood level repair-related associations or as another option taking their broken products to the small repair shops instead of discarding them. ***Growing in an environment*** where product care activities were a part of participants' daily lives would shape their care habits, as explained in the *Communities in Transition* section (see Section 4.4).

The participants' repair stories starting within the close groups of family and friends have been expanded to local and online repair communities. The local communities, especially, are seen as a ***gathering point for sharing the repair experience*** through ***the exchange of skills, experiences, knowledge, and methods***. However, as mentioned earlier (see Section 4.1.1.4), the local communities are having ***difficulty in gathering enthusiastic people*** in the associations to join them in their attempts to create alternative economic cycles ***standing against throw-away society***. Therefore, design researchers and designers can provide alternative means for working on ***engaging non-repairers in the local repair communities'*** way of working. It seems crucial to be engaged with these groups as a novice repairer because although the repair information has been liberated in recent years and anyone with an internet connection can access it, there is still a need of transferring ***know-how and tacit***

knowledge about repairing which are developed by time through exploring and experiencing different repair cases with a ***trial and error*** (see Section 4.1.1.2) method. Therefore, the ***liberation of repair knowledge*** is not solely enough for the novices to safely conduct product care activities.

To do so, designers can search for alternative ways to empower local communities to ***build collective spaces*** where the non-repairers can be included in the sharing environment, and protect the identity of those spaces apart from being a repair centre. Also, these spaces offer people the tools, materials and places that are needed for conducting care activities. Providing a collective space for non-repairers and repair enthusiasts, and ***building a community around product care activities*** can provide people with the support, inspiration and knowledge they need in their attempt to stand against the linear economy's take-make-dispose behaviours.

As described above, when the two basic needs -***open products*** and ***community-supported repair***- are offered to users, it may be possible to create ***emotionally sustainable scenarios*** between the user and the products. As the study findings suggest, the multi-dimensional experience of repair and maintenance works change the user's perception of ***waste, product lifetime, product quality, repairability, and repair quality***.

The changing perception of the product's use and post-use phases comes from users' getting familiar with the ***products' inner structure and components*** and ***reclaiming the products' ownership***. Therefore, when people are engaged with product care activities, it is easier for them to be ***active users*** instead of ***passive consumers***. The increased level of engagement and motivation help people to gain confidence in product care activities and perform them proudly, which help them form an emotional attachment with their repaired and cared products.

It is seen in the *Users in Transition* section (see Section 4.2), there are different approaches towards sustainability (*prudent, regainer and proactive*), and different levels of user intervention (c*autious, confident, and hobby-driven*). Therefore, design proposals can revolve around ***the flexible solutions for different user tendencies***

towards care practices to meet the needs of each group. For example, there can be products with different levels of repair limits. While ***cautious*** users can be supported to undertake first-level repair and maintenance works, ***confidents*** can be provided with higher levels of openness. In other words, all users should not be limited to the same category. Some are more professional, so differentiation is needed for letting them control, fix their own product. A ***gradual repairability*** can be achieved. As a complementary to this design direction, the objects can be neither black-box nor open for those who have safety concerns about the repair processes, as mentioned earlier (see Section 4.1.7.2.2). Designers can envision ***in-between objects*** that allow users to undertake manageable repair tasks at home settings but still protect the cautious users from risky situations.

The objects that are ***worth repairing*** for the participants were in some ways ***irreplaceable*** for them (see Section 4.5.1). Especially childhood and family reminiscences, objects having traces of a loved one, and ***objects with personal narratives*** are found worth protecting. The participants try to keep the memories attached to those objects alive through care practices. However, even the mass-produced objects that have no emotional value for their owners can be irreplaceable with the intervention through product care activities, since objects become a piece of its repairer and it reminds the time, effort and resources the users allocated for its repair.

Apart from the ***unique history*** that people shared with their repaired items, repair and maintenance works offer ***space for user interventions*** so that ***product's scripts*** can be rewritten in a way that includes the ***desirable connotations*** and exclude the unwanted ones (see Section 4.5.2). That is how, the ***object's personal relevance*** is increased for its user and both the ***product's and owner's identity are reproduced***. The design implications for this situation can be offering ***open scripts for objects*** that can be easily filled and shaped by the users themselves. In some product care activities, the products can also be transformed aesthetically, as explained in section (see 4.1.5.4). Users' intervention in those cases would be more in line with the dimensions of personalization (see Section 2.3.3.1.3).

To sum up, the design research findings and insights suggest that in order for the users to develop deeper attachment towards their products and extend their lifetime, first the designers and producers should provide them with ***open products that open space for user intervention*** and have ***easy to follow repair and maintenance guides***. Secondly, the local repair communities should be empowered in their endeavour to spread the repair knowledge and experience with non-repairers to form community-supported repair points. After providing an alliance between users, repair communities and producers, then it is possible to foresee an environment for users to develop attachment towards their product through the product care activities. To support the formation of ***emotional value***, users can be provided with open script products that open space for users to ***reproduce the identity of their product through creating personal narratives***.

CHAPTER 5

CONCLUSIONS

This design research set out to understand the effects of ***product care habits*** on deepening the ***emotional attachment*** to products and investigate how users regain their ***right to repair*** together with the ***bottom-up repair initiatives***. To do so, I conducted 19 semi-structured interviews with the members of repair-related communities, and made site visits to some of the repair-related associations. The study's findings provide knowledge about how and why the repair and maintenance practices are undertaken by non-professional repair enthusiasts under which circumstances through which approaches. Within this chapter, first, I will present an overview of the research process. I will review the findings and insights from the field research together with the examined literature to discuss the prominent conclusions of the study in line with the research questions. Lastly, I will suggest some research implications for further studies and complete the chapter.

5.1 Overview of the Study

The thesis's first chapter introduces the problem area and my motivations to conduct this research by providing the aim and scope of the research while posing the research questions to be investigated in-depth in the related literature and field research.

To construct the research's aim, goals, and questions, in Chapter 2, I reviewed the related literature starting with the limits of the linear economy and the mandatory transition to sustainable models, among which *circular economy* was the prominent one. As this model suggests, empowering users to repair and maintain their product helps them decrease waste production and raw material usage (see Section 2.1). The

second section of the literature review investigates the approaches to product lifespan and longevity, split into three subsections: *product-oriented*, *user-oriented*, and *system-oriented*. Literature highlights the user-oriented approaches as the ones that can be related to empowering users in a circular economy model. Therefore, in the last section, the product care activities that aim to extend the product's lifespan and empower the user-product relationships are investigated within the design literature.

Chapter 3 provides information on the conduct of the field research—the details given on methods of data collection, documentation, recruitment, and analysis. I conducted field research with 19 repair enthusiasts that are members of repair-related initiatives. I completed semi-structured interviews and user observations, presenting my findings and insights in the findings chapter.

The following chapter, *Findings,* provides the analysed data within five sections: *nature of the repair*, *users in transition*, *objects in transition*, *communities in transition*, *emotional durability and product care*. The *Nature of Repair* section (see Section 4.1) describes the repair and maintenance processes for the repair enthusiast by explaining the process, considerations, approaches, aim of repair, enabling and limiting factors. The chapter explains the transformative effect of product care activities for users, objects, and communities. For users, the roles between amateurism and professionalism together with consumer and prosumer changes as soon as they are engaged with the repair activities. Moreover, I concluded that their perceptions towards waste, product lifetime, product quality, repairability, and repair quality significantly changes. After the *Users in Transition* section (see Section 4.2), I explained the transition from black-box objects that prevent user intervention from opening products that include users within the repair and maintenance scenarios within the *Objects in Transition* chapter (see Section 4.3). Later on, I presented the significance of repair communities in the section *Communities in Transition* (see Section 4.4). The following section, called *Emotional Durability and Product Care* (see Section 4.5), aimed to relate all the former topics with emotional durability, and presented some examples to show the link between developing emotional attachment and conducting product care activities. In the last part of the chapter, I presented

some *design implications* (see Section 4.6) derived from the findings to help designers and design researchers focusing on emotional durability and product longevity through product care activities.

This is the last chapter, and it concludes the study by offering a brief overview of the chapters. It continues by presenting the prominent conclusions derived from the literature review and field study. It finishes by providing suggestions for further studies.

5.2 Prominent Conclusions

There are five prominent conclusions of the study that are listed below. They will be explained in detail while answering each research question in the following section.

1. Product care is a ***skilled practice*** that involves ***creative processes***.
2. Product care activities transform or change the roles and perceptions of users.
3. Priorly obscure objects transform into identifiable sums of components that are ***open to intervention*** while users conduct product care activities.
4. Repair communities are significant actors of ***teaching, encouraging*** and ***inspiring*** product care activities that support the right to repair movement.
5. Product care activities create and strengthen the ***emotional bond*** between users and products.

5.3 Research Questions Revisited

The study's main aim was to explore and understand the nature of repair for non-professional repair enthusiasts to determine the relationship between emotional attachment formation and ***product care activities*** for product longevity. The secondary aim was to investigate the reflections of the ***right to repair movement*** and ***circular economy*** in the user-product relationship. Accordingly, to meet the

objectives of the study, qualitative research is conducted. Nineteen semi-structured interviews with repair enthusiasts who are willing to prolong the lifetime of their products are conducted. The data gathered in the field and the literature review provide answers for the research question and its sub-questions, which will be addressed one by one. The main research question is:

- What are the product care approaches adopted and applied by repair enthusiasts for extending product lifespan, and their significance for developing emotional attachment between users and objects within the scope of design for sustainability?

The sub-questions that support the main questions are:

- What are the enabling and limiting factors for adopting product care activities and behaviours through considering user, object and community?
- What are the user tendencies, approaches, attitudes and level of design intervention towards product care works?
- What are the levels of product's allowance for user intervention?
- What are the roles of repair communities in forming product care behaviours?
- How do product care behaviours affect the formation of emotional attachment, and what would be the design directions to influence those behaviours?

What are the product care approaches adopted and applied by repair enthusiasts for extending product lifespan, and their significance for developing emotional attachment between users and objects within the scope of design for sustainability?

Extending the product lifespan through product care activities is a creative process that resembles the design process itself. As the findings of the field research show, the repair can be an act of ***creative problem solving*** for the products that have no repair information (see Section 4.1.1). During the repair and maintenance of a

product, people mostly took an exploratory approach to figure out a solution that leads to the unpredictability of success in the repair attempts, resulting in the repair failures, as shown in Section 4.1.1.5, the repair attempts are also based on trial and error, and it is learned by doing. This process makes product care work a skill involving practice that needs to be learned in time through practising diverse repair cases. Therefore, the study shows ***product care is a skilled practice that involves creative processes.***

Some people have taken a hacking approach to conducting repair activities that prolong their products lifetime (see Section 4.1.5.3). These interventions helped them fix major problems requiring high service charges with basic materials like superglue and critically execute the repair. Although the sustainability of methods like gluing is open to the discussion, it still shows the possibilities that repair offers to liberate the products and interfere with them freely.

Apart from the ad-hoc appropriations, there are different approaches of the users. Some prefers craft and maker-oriented interventions that include hand skills and digital technologies for rapid production of broken components (see Section 4.1.5.1). There are also two visual approaches according to the users' preferences about hiding or displaying the repair results on the product: *hidden* and *visible*. While some are putting emphasis on making the product look like "its original," "not repaired," others change the overall look completely to display their "repaired look" with pride in which the personalisation dimensions appear to be more significant. Therefore, the user's approach to product care varies greatly, which results in the persona creation (see Section 4.2.1). This section offered a brief explanation of the product care approaches that are taken in the field research. A detailed discussion on its effect on developing emotional attachment and the roles of users, objects and communities during the process will be provided within the answers to the following sub-questions.

What are the enabling and limiting factors for adopting product care habits and behaviours through considering user, object and community?

Enabling Factors: The study's findings suggest having free time to allocate to repair activities and having easy access to materials, tools and components to repair are enabling factors for product care activities to take place. Also, the participants gain confidence by acquiring proper equipment and tools and thus feel secure by conducting product care practices (see Section 4.1.6.5). However, there are two major enabling factors for adopting product care habits, the first of which is ***eliminating the risk of making the product worse***. When products allow repeatable repair actions, the participants indicate they feel relieved to intervene with the broken objects (see Section 4.1.6.4). The other major enabling factor is found out to be sharing the repair experience with other repair enthusiasts to exchange knowledge, know-how, tips and tricks, which mostly happens when repair and maintenance are community supported (see Section 4.1.6.6.).

Limiting Factors: Several limiting factors prevent people from repairing their product which is comprehensively discussed in the literature. While Terzioğlu (2021) identifies these in her *repair motivation and barriers model (RMB),* she indicates that the accessibility of materials and methods, design-related problems, required skill and knowledge as some of the barriers. On the other hand, Hernandez et al. (2020) include the *lack of engagement and emotional attachment* as the limiting factors for people to adopt repair habits. The field research clusters the limiting factors into four categories by including the literature findings into account. These four categories are product-related, user-related, space-related, and system-related factors:

- While the ***product-related*** heading discusses the design and manufacture related issues that prevent repairability of the products, the major limitation is found out to have black-box products, which are further discussed in section 4.3.1.
- The other limitation is having dispensable and outdated products that are not worth protecting for an extended time and do not have emotional value attached to them. This is also related to the user's motivation for repair and

maintenance. Following that, there are ***user-related*** limitations which involve lack of skill, knowledge, and experience about the products way of working, structure and their repair processes that cause fear of "What if I can't gather back what I disassembled" or fear of handling too complicated and delicate repair tasks and result in the ***loss of repair motivation*** (see Section 4.1.7.2.4). In addition to the limiting factors indicated in the literature, the safety issues were found to be an essential constraint to start repairing or using a repaired item. Another limitation for users is the ***language barrier*** and ***unavailability of repair information*** in the Turkish language within the online repair communities (see Section 4.1.7.2.3).

- The other heading, ***the space-related*** limitation, includes the unavailability of repair environment not only with proper tools and materials but also with experienced people that show repair directions to novices in practice.
- The last heading within the limitations section investigated the ***system-related*** issues within the repair network, such as expensiveness and unavailability of spare parts and commercial secrets of repair centres that prevent even the most minor repair task to be conducted by the users themselves (see Section 4.1.7.4).

What are the user tendencies, approaches, attitudes and level of design intervention towards product care works?

Since the user tendencies towards product care activities differ significantly, six personas were created to understand the various approaches and attitudes towards the product care practices. While the ***cautious, confident,*** and ***hobby-driven*** personas are designed to see the level of participants' intervention, the second set of personas, ***prudent, regainer,*** and ***proactive***, are created to understand participants' sustainability concerns (see Section 4.2.1). More importantly, it is found out that ***the user's roles and perception become fluid when conducting product care activities***. This fluidity occurs in different layers, the first of which is the between the roles. While a ***regainer*** can be ***proactive*** after deciding to take action for the environmental

impacts of waste production and rapid consumption, a ***cautious*** user can be ***confident*** after experiencing multiple diverse repair cases. While the transition happens from one role to the other, users create ***in-between roles*** that are hard to define. That challenges the strict professional-amateur distinction, which is the second layer of the fluidity of user roles. The findings of the study suggest that when participants have access to repair knowledge and learn the tips & tricks of the repair process, they feel confident about conducting care activities independently without the help of a professional repairer. Therefore, when participants are willing to learn new things, and the repair knowledge is accessible, they can dissolve the borders between professionals and amateurs (see Section 4.2.2).

On another layer, practising product care works change the users' perception towards ***waste, product lifetime, product quality, repairability*** and ***repair quality***, since after opening a product and detecting its cause of the error and reassembling, it help users understand the product's structure and its working principles (see Section 4.2.2). Accordingly, the more people involved in the product care practices, the more they know about their way of working and engage within the repair and post-use phases of the products.

What are the levels of product's allowance for user intervention?

The literature shows that black-box products are one of the most limiting factors for product care activities. They prevent users from acquiring more profound knowledge about how products are working and repaired (Hernandez et al., 2020). As seen in the field, there are some ways that products become obscure and hide themselves from users' curious eyes. The main issue with the black box products is they are hard to open or sometimes even impossible to open without irrecoverably damaging them (see Section 4.3.1.1.2). Then, moving from mechanical to digital products has a crucial effect on a product becoming a black box. Since the components get smaller, the repair tasks become more delicate and require a high skill level. Moreover, the digital ones mostly hide their parts and don't give a clue about their repairability, forcing users to consult authorised services.

On the other side, open objects reveal their components, working principles, material information, and repair information to empower and encourage user intervention. The most mentioned features of open products for the participants were 1) having visible and accessible components, 2) having or allowing the integration of open-source components, 3) providing repair kits and manuals (see Section 4.3.2).

As seen, there are ***obscure products*** that prevent repair on the one hand, and ***open products*** that show their true nature to their users for enabling their intervention on the other hand. However, it is found that users can hack the black box products by repairing through ad-hoc appropriations explained in detail in section 4.1.5.3. Therefore, ***priorly obscure objects transform into identifiable sums of components that are open to intervention while users are conducting product care activities***. The phenomenon of increased transparency of the objects through repair processes is also indicated by the study of Özçelik (2020), in which she states that although the design of the product is a strong determinant of repairing or not, still to some degree, users can transform the products' characteristics by repairing and increasing black-box products' transparency. Thus, the literature and the field findings clearly show that the act of repair is an enabler of transforming products allowance to user intervention.

What are the roles of repair communities in forming product care behaviours?

Repair communities are significant actors of teaching, encouraging and inspiring product care activities that support the right to repair movement. As the cultures and communities provide a context to the user and object relationship, their effect on transitioning the product care habits becomes crucial. This research initially started by investigating the repair initiatives. However, findings suggest that ***growing in an environment*** where product care activities are an essential part of daily life encourages people to continue to conduct them, which is also evidence of how product care activities are ***socially constructed***. Therefore, while talking about repair communities, it includes the participants' close circles consisting of family and friends, community-led Initiatives, and online repair platforms. The roles of the

repair communities are as follows: Providing ***educational*** and ***inspirational*** examples, creating a ***sharing environment*** and being ***proactive*** to encourage others to join them and reclaim their right to repair.

Educational: The study shows the lack of knowledge and skill as a limiting factor that causes people to lose their repair motivation (see Section 4.1.7.2.1) and discourages people from repairing their products. Therefore, when repair communities provide an environment where experienced ones offer to share their knowledge and skills and teach others how to repair their product, people feel motivated and encouraged. Usually, sharing tips about the disassembly stages of the products on online communities, and giving workshops about teaching a skill to be used in repair in local communities become prominent ways of teaching non-repairers the basics (see Section 4.4.4.1).

Inspirational: Field research shows that people are ***inspired by the repair examples*** provided to them through their close circles, local and online communities. The inspirational examples of product care activities are popularised through the audiences of these communities. While some beginners may see it as a new and fun activity, others may find it an appealing way to transform their product visibly. Generally, it helps people feel that they can do these tasks (see Section 4.4.4.2).

Sharing Environment: Although the repair communities of all the three scales -close circle, local and online- ***sharing environments for exchanging skills, knowledge and methods*** **o**f product care behaviours, the repair ateliers within the local communities become a more prominent collective space that ***builds a community around product care activities*** to share the repair experiences with novices in care activities (see Section 4.4.4.3). This is also related to their proactive roles to unite people to reclaim their right to repair while creating alternative economic cycles, which will be explained in the following paragraph.

Proactive: The repair communities are committed to reducing waste by informing their members of the product's journey from the extraction of raw materials to use and post-use phases. Therefore, they try to raise awareness about ***the repairability of***

the objects so that people can decrease the amount of consumption. To do so, they prepare events such as repair ateliers, workshops about waste, movie nights, etc. All these efforts to stand against the throw-away society help them to create their alternative economic cycles in which repair is only a part of their attempts to change the linear economy model. They also try to minimise their consumption by using second-hand goods, repairing and transforming products within their repair association, and, most importantly, spreading the knowledge and including local communities in their alternative ways of production and consumption economy models (see Section 4.4.4.4).

How do product care behaviours affect the formation of emotional attachment, and what would be the design directions to influence those behaviours?

The study that Hernandez et al. (2020) conducted shows the connection between emotional attachment and repair activities. As they suggest, products that cannot evoke an emotional response in users are usually replaced quickly without completing their actual lifetime. On the other hand, when people feel attached to particular objects, they perform protective behaviours towards them like repair or maintenance to extend their lifetime (Mugge et al., 2008). The findings of the field research also support this. As seen in design research findings and insights, people tend to see the ***irreplaceable products worth repairing and protecting***, such as childhood and family reminiscences or the objects having traces of a loved one. Therefore, people protect the irreplaceable products to preserve the memories attached to those. However, few studies focused on the user's attachment to the "ordinary durable possessions", as Mugge et al. (2005) point out. Surprisingly, the findings of the field suggest, even the mass-produced objects that have no emotional value for their owners can be irreplaceable with the intervention through product care activities, since objects become a piece of its repairer, and it reminds the time, effort and resources the users allocated for its repair (see Section 4.5.3). This also creates a ***shared history*** between the user and the product that enhances the emotional bond. Therefore, this study's contribution is that ***product care activities create and strengthen the emotional bond between users and products, even for***

the products that have no emotional value for their owners beforehand. Providing open products for user intervention triggers the product care activities and helps create an emotional attachment to ordinary possessions.

A complementary point in increasing the value of a user-product relationship through product care activities is the ***reproduction of product identity*** through ***creating personal narratives*** (see Section 4.5.1.3). It is seen in the field that people can increase the ***product's personal relevance*** to them and ***develop an emotional bond*** by interpreting with them. Mugge et al. (2005) also remark the importance of increasing personal relevance to an object to feel attached to it. The field study findings show that the participants used their skills and creativity to reproduce the identities of their products according to their preferences. Therefore, they repaired the products' appearances by personalising them, which increased their personal relevance and helped ***develop an emotional bond*** between them and their objects.

5.4 Limitations and Future Directions

One of the major limitations of the study is having the pandemic breakout in 2020 through the data-gathering phase. During this time, the repair initiatives were unavailable for visits and user observation in the repair environment was no longer possible. Therefore, data is largely limited to online interviews. Also, during the times of uncertainty, it was harder to recruit people for the research. Consequently, what started as recruiting only the members of repair initiatives became recruiting a non-professional repair enthusiast even if they don't have a direct connection with a repair initiative.

Another limitation is about the sampling, since I included a range of repair initiatives from neighbourhood level associations to communities that operate through big cities of Turkey like Ankara and İstanbul, and the data provided from them differs in some ways make it harder to create a consistent data. Therefore, focusing on one of them could have been better; however, choosing either of them is also troublesome

since there are generally few people undertaking repair activities within these initiatives.

Lastly, the interviews are conducted in Turkish, both mine and participants' mother tongue, but they are translated to English. Therefore, the data is unavoidably affected by the researcher's inferences.

This thesis is structured to understand the nature of repair for non-professional repair enthusiasts willing to extend their products' lifetimes. However, further studies can be conducted by including non-repairers in the research to discover diverse user tendencies towards product longevity. As these research findings offer *six personas* according to their ***level of intervention*** and ***sustainability concerns***, further studies with larger sampling can increase the diversity of the personas created, and it may help create a fruitful intervention area for design proposals.

As another research direction for further studies within the product longevity through product care activities subject, there could be specific product categories to question and compare the level of user intervention and examine the changes in repair strategies. Since this study hasn't limited the participants with particular product categories to understand and observe the general approaches to repair and maintenance works. Further studies can evaluate the user's perception of repairability towards different product categories such as electrical appliances, furniture, garments, etc., providing concrete implications for product design.

The last research direction for the following studies can be to gather actors within the repair network and conduct generative workshop sessions to develop comprehensive solution scenarios for easing field study findings non-professional repair and maintenance by adopting ***research through design approach***. Therefore, more exploratory and generative approaches can be adopted to discover the implications of this study further.

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APPENDICES

A. ETHICS APPROVAL

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21 KASIM 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Çağla DOĞAN

Danışmanlığını yaptığınız **Lilyana YAZİRLIOĞLU'nun "Ürün Ömrünü Arttırmaya Yönelik Kullanıcıları Sürece Katan Tamir Odaklı Pratiklerin ve Deneyimlerin İncelenmesi"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **417 ODTU 2019** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof. Dr. Tülin GENÇÖZ
Başkan

Prof. Dr. Tolga CAN
Üye

Doç.Dr. Pınar KAYGAN
Üye

Dr. Öğr. Üyesi Ali Emre TURGUT
Üye

Dr. Öğr. Üyesi Şerife SEVİNÇ
Üye

Dr. Öğr. Üyesi Müge GÜNDÜZ
Üye

Dr. Öğr. Üyesi Süreyya Özcan KABASAKAL
Üye

B. CONSENT FORM

Görüşme için katılımcı izin formu:

Bu araştırma, ODTÜ Endüstri Ürünleri Tasarımı Bölümü yüksek lisans tezi kapsamında Lilyana Yazirlıoğlu tarafından yürütülmektedir. Araştırmanın amacı, kullanıcıları sürece katan tamir odaklı farklı pratiklerin anlaşılmasına yönelik kullanıcıların görüş ve deneyimlerini öğrenmektir. Görüşme sırasında elde edilen veriler yalnızca bilimsel amaçlarla, tasarım sürecinde, tez çalışmasında, bilimsel yayınlarda ve sunuşlarda kullanılacaktır. Katılımcıların kimlik bilgileri saklı tutulacaktır. Konuşulanları ve süreci daha sonra tam olarak hatırlayabilmek ve gözden geçirebilmek için görüşme kaydedilecektir. Görüşme sırasında fotoğraf makinesi, video ve ses kayıt cihazı kullanılacaktır. Görüşme yaklaşık 30 dakika sürecektir.

Bu formu imzalayarak yapılacak araştırma konusunda size verilen bilgiyi anladığınızı ve görüşme yapılmasını onayladığınızı belirtmiş oluyorsunuz. Formu imzalamış olmanız yasal haklarınızdan vazgeçtiğiniz anlamına gelmemektedir; ayrıca araştırmacının, öğrencilerin, ilgili kişi ve kurumların yasal ve mesleki sorumlulukları devam etmektedir. Çalışmaya katılım gönüllülük esasına dayanır. Araştırma, katılımcılar açısından herhangi bir risk taşımamaktadır. Görüşme sürecinin başlangıcında veya herhangi bir aşamasında açıklama yapılmasını veya bilgi verilmesini isteyebilirsiniz. İstediğiniz zaman gerekçe belirtmeksizin görüşmenin durdurulmasını talep edebilirsiniz.

Araştırmaya katkıda bulunduğunuz için teşekkür ederiz. Araştırma hakkındaki sorularınız için araştırmacıyla ve danışman hocayla ile iletişime geçebilirsiniz.

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Katılımcının Adı Soyadı Tarih İmza