EXTENDING THE LIFESPAN OF SMALL KITCHEN APPLIANCES FOR SUSTAINABLE DESIGN: A RESEARCH ON PRODUCT MAINTENANCE AND REPAIR WITH TECHNICAL SERVICES IN ANKARA

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ABSTRACT

EXTENDING THE LIFESPAN OF SMALL KITCHEN APPLIANCES FOR SUSTAINABLE DESIGN: A RESEARCH ON PRODUCT MAINTENANCE AND REPAIR WITH TECHNICAL SERVICES IN ANKARA

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Growing environmental issues from global climate change, contamination and depletion of renewable and non-renewable resources to waste disposal have been resulted from unsustainable production and consumption patterns. Most of the mass-produced products are designed and produced for short lifespans without considering environmental and social effects. Since small kitchen appliances are lower priced compared to other household appliances, when a part of the product is broken, the whole product is disposed of even if most of the product parts still function well. Various strategies have been taken into account in the process of product design to incorporate sustainability criteria for product longevity such as design solutions tailored to local needs and preferences, product maintenance and repair, and product part replacement and reuse, etc. This thesis presented here introduces outcomes of a research and provides new insights into maintenance and repair of small kitchen appliances. To explore that interviews were conducted with authorized technical services and repairmen in Ankara. The conclusions from this research provide a substantial basis to better understand the problem areas for extending product lifespan such as product breakdown reasons, permanently attached product parts, planned obsolescence and technical obsolescence etc. The results suggest that maintenance and repair should be considered at the early stages of the design process.

Keywords: Product Longevity, Sustainable Product Design, Small Kitchen Appliances, Product Maintenance and Repair

ÖZ

SÜRDÜRÜLEBİLİR TASARIM İÇİN MUTFAKTA KULLANILAN ELEKTRİKLİ KÜÇÜK EV ALETLERİNİN ÜRÜN ÖMRÜNÜN UZATILMASI: ANKARA'DAKİ TEKNİK SERVİSLERLE ÜRÜN BAKIMI VE ONARIMI ÜZERİNE BİR ARAŞTIRMA

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Küresel iklim değişikliği, yenilenebilen ve yenilenemeyen kaynakların kirletilmesi, tüketilmesi ve atıkların işlenmesi gibi çevresel sorunlar sürdürülebilir olmayan üretim ve tüketim alışkanlıklarından kaynaklanmaktadır. Seri üretimde, ürünlerin çoğu kısa ömürlüdür, çevresel ve sosyal etkileri dikkate alınmadan tasarlanmakta ve üretilmektedir. Elektrikli küçük ev aletleri diğer elektrikli ev aletlerine göre daha düşük fiyatlı oldukları için, ürünün herhangi bir parçası arızalanınca diğer parçaları kullanılabilir durumda olsa dahi ürün elden çıkarılmaktadır. Ürün tasarım sürecine sürdürülebilirlik ölçütlerini dahil ederek ürün ömrünü uzatmak amacıyla; yerel tercihleri ve ihtiyaçları karşılayan tasarım çözümleri, ürün bakım ve onarımı, ürün parça değişimi ve tekrar kullanım gibi çeşitli stratejiler göz önünde bulundurulmaktadır. Bu çalışma bir araştırma projesinin sonuçlarını göstermekte ve mutfakta kullanılan elektrikli küçük ev aletlerinin bakım ve onarım sürecine yeni bakış açıları getirmektedir. Bunun için Ankara'da teknik servislerle ve tamircilerle görüşmeler yapılmıştır. Bu araştırmanın sonuçları mutfakta kullanılan elektrikli küçük ev aletlerinin (ör. gıda hazırlama, ısıtıcılar ve pişiriciler) bakım ve onarım süreçlerine odaklanılarak incelenen ürün ömrünü uzatılması ile ilgili ürünlerin arızalanma nedenleri, kalıcı olarak birleştirilmiş ürün parçaları, planlı eskime ve teknolojik eskime ve benzeri problem alanlarını belirlemede önemli bir temel teşkil etmektedir. Sonuçlar bakım ve onarımın, ürünün tasarım sürecinin başında göz önünde bulundurulması gerektiğini göstermektedir.

Anahtar Kelimeler: Ürün Ömrü, Sürdürülebilir Ürün Tasarımı, Mutfakta Kullanılan Elektrikli Küçük Ev Aletleri, Ürün Bakım ve Onarımı

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CHAPTER 1

INTRODUCTION

1.1 Problem Definition

Today, majority of the products in the market are designed without considering maintenance and repair. Even design of the products itself makes maintenance and repair of them harder. It is not possible to repair most of the products on the market due to their very small and/or unreachable parts (Norman, 1998). Extra features added to keep up with rapidly evolving technology makes not only use but also repair of products difficult (Verbeek & Kockelkoren, 1998). Considering these circumstances, designers should pay special attention to product maintenance and repair to prolong the lifespan of products. Furthermore, products usually fail to meet the specific preferences and requirements of users as their social and cultural dimension is not taken into account (Doğan, 2007). Whether the product will meet the requests of user or not, the longevity of it, and it's positive and negative effects on the environment are the characteristics that are mostly shaped in the product design process. Because of that reason the designing process can be seen as the most significant stage in the product lifespan.

In the last two decades, there has been a rapid change in the electrical household products sector. Products are manufactured of materials of lesser quality, discarded in shorter time and less carefully used than in the past. Until 20th century, products were viewed as investment and intended to be used as long as possible (Copper, 2005). Over time, low quality materials, planned obsolescence and disposable products became commonplace to decrease the manufacturing costs and product prices leading to sell more products (Cooper, 2005). Users discard their products although they are still in good shape. This drastic change has drawn attention of many researchers and professionals. Therefore, approaches for sustainability came up to urge designers to take responsibility on environmental and social issues (Fiksel, 2009).

Environmental problems such as limited resources and increasing waste necessitate an alternative consumption model. Reisch (2001) states that the words as "progress" and "growth", which modernity have brought up, are the foundation of today's economy. In this economy, time is seen as equal to money and people consume in a pace never seen before (Cooper, 2005). While the technological development is accelerating, product lifespan becomes shorter. As a result, world's resources have rapidly melt away leaving a constantly growing pile of waste behind. Instead of caring for and living in line with environment, technological developments are used to make people discard their products prematurely and lead them to continually buy new ones. In order to prevent depletion of world's resources, the cycle that raw materials are consistently turned into products and thrown away, should be strived to slow down and change (Cooper, 2005).

Detrimental effects of consumerism resulted from rapid disposal of products on the environment is unlikely to be overcome as long as the quantity of products discarded in industrial societies continues to increase. The rapid development of technology together with the decreasing prices have reduced the lifespan of most electronic equipment (Tanskanen, 2013). In the last ten years, the amount of e-waste, caused by USA, EU countries and the developing countries, has ascended with a considerable rate (Tanskanen, 2013). Data provided by the US Environmental Protection Agency shows that (Directive EC, 2002) each house owns approximately 34 electronic devices and electrical appliances, which causes more than 5 million tons of e-waste totally in a year. On the other hand, each citizen of an EU country precipitates 15 kg of e-waste in a year, which means 7 million tons of e-waste totally. As a result, waste electric and electronic equipment constitutes one of the fastest growing waste flow, already accounting for about 8% of municipal waste (Directive EC, 2002).

Small household appliances can be easily discarded when worn-out, broken or outdated no matter how well functioning they are instead of being repaired or upgraded because of their significantly lower price compared to other products. The main purpose of this thesis, within the scope of product longevity of small household appliances, is to observe and examine the current situation of product maintenance and repair to identify potential areas in product design. To achieve this goal, it is aimed to gather in-depth knowledge from authorized technical services and repairmen.

Consequently, to minimize the negative environmental effects of production, it is significantly necessary to develop new approaches of designing things through taking environmental, social and economic dimensions into account. A new way of design-thinking should be formulated that handle all stages of product lifespan including use, maintenance, repair and post-use.

1.2 Aim and Objectives of the Study

Considering the implications of maintenance and repair for sustainable product design, this research aims to explore the potential areas for extending product lifespan with a focus on small kitchen appliances. In order to achieve that, semi structured interviews were conducted with authorized technical services and repairmen in the small kitchen appliances sector in Ankara.

This research will explore potential areas for product longevity enabling people to effectively use resources through long lasting products to achieve sustainable consumption and production. In doing so, the research aims to provide suggestions in line with sustainable design considerations within the research context focusing on small kitchen appliances.

Based on the maintenance and repair processes of small kitchen appliances, the research includes the following purposes:

- Examine and define potential areas for extending product lifespan with a focus on product maintenance and repair for small kitchen appliances based on the findings from the authorized technical services and repairmen.
- Explore the potentials of product maintenance, repair and upgrading for small kitchen appliances.

- Assess research findings based on sustainability approaches within the research context - focusing on small kitchen appliances (e.g. mixer, blender, toaster, tea machine, coffee machine, juicer, etc.).

1.3 Research Questions

The main research question is:

- What are the potential areas that affect product longevity for sustainable product design with a particular focus on product maintenance and repair in small kitchen appliances?

The secondary research questions are:

- What are the main reasons of product breakdown for small kitchen appliances in relation to small household products? (Field Work)
- What kind of strategies can be applied within the product design process to extend the product lifespan of products for sustainability? (Literature Review)
- What are the implications of product maintenance and repair for extending product lifespan of small kitchen appliances? (Field Work and Literature Review)

1.4 Structure of Thesis

This thesis includes five chapters:

Chapter 1 constitutes a brief introduction, the problem definition, the aim and objectives of the study, and presents the research questions.

Chapter 2 includes the literature review that starts with exploring the area of sustainability, and approaches on product design for sustainability. It continues with presenting the place of maintenance and repair among the approaches on product design for sustainability. This chapter concludes with explanation of the key concepts related to maintenance and repair of products.

Chapter 3 contains the stages of the research, data collection and analysis methods. The structures of the pilot studies and the primary research are presented respectively. The stages of semi-structured interview questions, content analyses, population and sampling are explained. The results of the primary research will be explained in detail in the following chapter.

Chapter 4 starts with the primary study findings. The results of semi-structured interviews are presented. The chapter continues with various cases to understand and present the implications of the maintenance and repair processes for sustainable product design. This chapter concludes with overall findings and conclusions from the primary research.

Chapter 5 presents and summarizes the overall conclusions and findings of the study by revisiting the research questions and discusses the implications of these for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The environmental problems from global climate change, contamination and depletion of renewable and non-renewable resources to waste production have resulted from the way that products are designed, produced and consumed. It is widely acknowledged that we need to reconsider the current production and consumption patterns in order to reduce our environmental impact. Papanek addresses the problem several years ago that the way we use resources and materials is putting in danger the well-being of the future generations:

> There can be little doubt that the environment and the ecological balance of the planet are no longer sustainable. Unless we learn to preserve and conserve Earth's resources, and change our most basic patterns of consumption, manufacture and recycling, we may have no future. (Papanek, 1995, p.17)

The production of electrical and electronic products is among the most rapidly growing global manufacturing activities. This growth has caused the waste from the electric and electronic products to increase. Urbanization and increasing demand for products as this is related to rapid economic growth are the reasons of increase in both the consumption and the production of these. Waste from electrical and electronic products also damages the environmental resources (Babu, Parande, & Basha, 2007).

European Commission takes necessary precautions in order to prevent environmental problems generated by increasing electronic waste. European Commission policy analysts show interest to this issue in the recent years due to the waste caused by disposal of household appliances. Millions of electrical and electronic products are thrown away each year all over the world. The European Union (EU) also cares about this issue, as they take measures to prevent electronic waste and to encourage the re-use, recycling and other methods for recovery so as to decrease the amount of waste (Directive EC, 2002).

According to the directives of European Commission, which were published in 2002, the rate of recovery by an average weight per appliance must be at least 70 % for small domestic appliances. On the other hand, the rate of component, material and substance reuse and recycling by an average weight per appliance must be at least 50 % for small domestic appliances (Directive EC, 2002).

In the field of product design, significant efforts such as life-cycle assessment approaches and product maintenance and repair platforms are currently in effect to promote environmentally-friendly solutions. The number of examples that address social dimension of sustainability are quite a few, as design-centered approaches are mostly focused on other areas of product design such as green technologies to reduce carbon emissions and technological solutions to increase

environmental effectiveness. However, these developments without taken into account consumption patterns could not succeed to reduce electronic waste and energy consumption (Cooper, 2005). Many of the mass produced products are designed for a fairly short lifetime without much consideration on social and environmental impacts of it (Slade, 2006). Especially, in the household appliances sector, a huge increase of electronic waste can be seen due to the current production and consumption patterns (Waste Watch, 2005). That is why, the basic purpose of the extended producer responsibility is to reduce the environmental impacts of the industrial production by implementing new recycling and product lifespan principles. The studies conducted on this very field influence product design strategies through presenting new ways of thinking like cradle to cradle, design for disassembly, post-use for product repair, maintenance and upgrading, etc. (Van Rossem, Tojo, & Lidhqvist, 2006; Smith, Sonnenfeld, & Pellow, 2006). In spite of all of these examples, high-tech industry still continues producing products with short lifespan (Huang & Truong, 2008). Such a perspective not only perpetuates current consumption culture but also hinders effective use of resources (Walker, 2011).

Sustainable consumption is not only focused on the purchase phase like current economic system, but it also includes the phases of maintenance, repair and reuse (Marchand & Walker, 2007; Thang & Bhamra, 2009). Moreover, aesthetic characteristics, extensive product services for maintenance, repair and upgrade, and features added to age gracefully are regarded as significant sustainability considerations for achieving product longevity. Alternative production systems and service strategies should be developed for an innovative change in manufacture for aiming longer product lifespans. In this chapter, sustainable design approaches, and strategies like using high-quality and durable materials for manufacture, enabling maintenance and repair of products are presented.

2.2 Product Maintenance and Repair

Electrical or mechanic devices are subject to three actions when they are broken or damaged: maintenance, repair and overhaul. Maintenance is the routine preventative measure taken in order for the device to keep working flawlessly and at full function. Repairing is the act of finding the problem in the device whose functionality has been compromised, and developing a solution for restoring it back to full functionality. Overhauling is done when the device or the system needs to be renewed completely to regain function. These actions can be technical, managerial and supervisory in nature, and are shortened as MRO (European Federation of National Maintenance Societies, n.d.). There are two types of MRO operations. In the first case, the device belongs to the person who made the purchase and the MRO service is being offered by the supplier. In the second case, the device is bought from the owner by an organization that takes on the MRO operation, then sells it to anyone who wants to purchase the repaired device.

In practice, maintenance definitions have been made regarding the sectors telecommunication, real estate and engineering. It is described by the Federal Standard 1037C titled Telecommunications as Glossary of Telecommunication Terms firstly as activities such as tests, measuring, restoration, adaptation and repair that are intended to restore function of a device or to a described state so that the device operates at the intended function (European Federation of National Maintenance Societies, n.d.). Another definition states that maintenance with regard to material is all activity intended to keep material in serviceable condition, or to retain full serviceability.

Maintenance strategies in engineering include inspection, repair, overhaul and replacement. In this sort of strategy, inspection should be made upon considerations such as previous failure experience, cost of the inspection, possibility and risk of malfunction, consequences of malfunction with regard to safety, health and business operations, the risk of the inspection causing further malfunctions, the quality of the results of the inspection. Performing maintenance activities are done in many approaches depending on variables such as the type of functionality, location and business location (Bloch, 1990).

2.3 User Manuals

A user guide, or a user manual, is a document in varying complexities that instructs the reader of the specifics such as installing, executing or troubleshooting a product either hardware or software. A user manual's complexity and length depends on the task being instructed. The document could be a brief ten page introduction or in the form of a book with over 200 pages (McMurrey, n.d.). User guides are usually written by technical writers, but it is also seen that they are prepared by programmers, product or project advisors, or other technical personnel (Pearsall & Cook, 1997, p.143). The contents of a user guide include installation procedures, troubleshooting procedures, executing commands, tutorials for getting started.

The content of most user guides include instructions, which guide the reader to complete tasks related to assembly, operation or troubleshooting of the product. It provides precautionary information which warns the user from the dangers of using the product as well as gives liability information (McMurrey, n.d.). Information about the product, which provide a description of the product and its features, and technical background of the product to make the user familiar with the mechanical or digital components of the product that are essential to operating it are also provided in the user manuals (McMurrey, n.d.).

2.4 Product Longevity and Extending Lifespan of Products

Product lifetime varies depending on various factors such as design, technological changes, maintenance, repair, availability of parts, aesthetic values and fashion (Cooper, 1994; Walker, 2006). Nowadays, most of the consumer goods are considered as throwaway items (Cooper, 2005). People do not use objects for a lifetime or leave them to their children anymore. Products are seen to be disposable and discarded long before they are worn out or broken (Papanek, 1985, p.87). That is rooted in many factors like comparably lower prices and lesser quality of products. Researchers have presented various typologies to examine the factors affecting product obsolescence (Packard, 1960; Heiskanen, 1996). Packard (1960) defines three types of obsolescence namely obsolescence of function, obsolescence of quality and obsolescence of desirability. The first factor, obsolescence of function corresponds to the ineffectiveness in the functionality of a product when new models appear on the market. The second, obsolescence of quality may occur when an object wears out or is broken. The third and the last, obsolescence of desirability is the state of being that a product is no longer desired and gets outdated because of reasons such as style and fashion, and consequently discarded long before its time is over. Obsolescence of desirability, also called psychological and aesthetic obsolescence is related to the influence of user behavior and desire on the lifespan of product.

2.4.1 Production Oriented Longevity Strategies

In many product groups, there are high-quality products designed and manufactured specifically to be used for a long time (Cooper, 2005). Not only technical but also aesthetic features such as surface quality, reparability, maintenance and upgradability determine the lifespan of products.

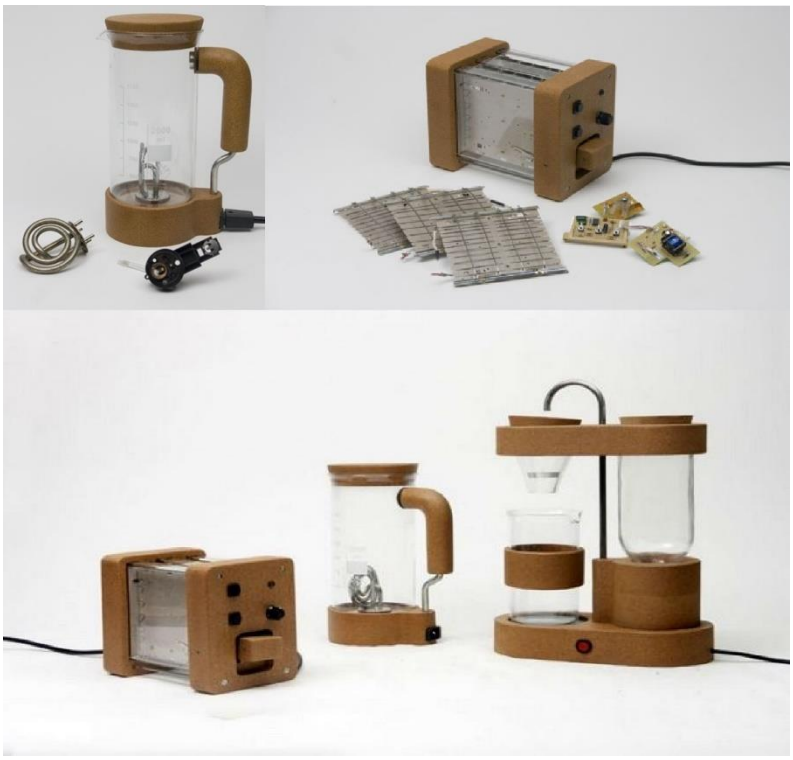


Figure 1 - Re-Done Kettle (retrieved on August 25, 2013, from http://www.re-do-studio.com/index.php/project/re-done-kettle/).

Designer Gaspard Tine-Beres has created a series of recycled appliances that deal with the problem of excessive electrical waste (see Figure 1). The coffee-machines, kettles and toasters are made out of waste electrical components and found glassware from landfills with a main structure made out of natural cork. This design does not require any mold and can be frequently upgraded, repaired or changed as required.

Figure 2 - Power Riva Piano bookshelf (retrieved on August 25, 2013, from http://www.riva1920.it/en/prodotti/bookshelves/piano-design/).

Figure 3 - Power Riva Piano bookshelf maintenance kit (retrieved on August 25, 2013, from http://www.edilportale.com/upload/prodotti/prodotti-18762-catca4b1900-16e6-43f5-8d71-89ad24ca46d0.pdf).

Piano bookshelves in Figure 2 are another example of enduring products. This product is specifically designed to be used for a long period with respect to the quality of the timber used (i.e. multi-layered wood, veneered and bordered by 100% wood panels) and the overall structure. Different parts of the bookshelf are designed in a way to allow easy replacement and upgrading of the components to facilitate assembly and disassembly, which makes it as a long-lasting product. Beyond that, to provide lifelong maintenance, the bookshelf is sold together with a maintenance kit consisting of a set of small tools including oil-based paints or natural wax to finish surfaces, which can be used when the product is scratched or damaged (see Figure 3).

Long-lasting products are easy to repair because their designs define the parts as accessible, easily removable and replaceable (Park, 2003). The materials used are of high quality enough to enable the product to age gracefully. Also the quality and durability of motor and/or circuit board, which are the parts of operating mechanisms of products, affect the robustness of products. Appearance of the outer surface of a product is also a significant feature influencing product longevity. How a product's surface changes after a long period of use directly affects a user's decision whether or not s/he is going to keep on using it (Cooper, 2005).

2.5 The Relationship between User and Product Lifespan

Post-use services provided by manufacturers like product maintenance, repair, reuse, upgrading, and product part recovery are production-oriented strategies to extend the product lifespan (Vezzoli & Manzini, 2002). Additionally, there also exist use oriented product longevity strategies. On the products designed with aim of sustainability, the main focus is mostly placed on economic feasibility and environmental problems, but user and product use perspectives of sustainability are mostly ignored (Park & Tahara, 2008; Colantonio, 2007). However, factors stemming from product use can play an important role on reducing this product's potential environmental, social and economic impacts.

If a product is not used for its intended purpose, it can not be described as a sustainable product. Even though the purpose of use is determined by users, designers may still provide solutions guiding the user behavior and reducing the potential negative effects. Changes devoted to product use, repair and maintenance for sustainable design should be supported by products.

Cooper (2004) emphasizes the role of user behavior and emotional attachment between user and product on the product lifespan. Building a personal meaning between them is one of the strategies to extend product lifespan. Personal meaning means the connection between the object and the user (Schifferstein & Zwartkruis-Pelgrim, 2008). Meanings that are attributed to products encourage users' desire to utilize such products, and contribute to extending product lifespans. In this perspective, developing design solutions tailored to local needs and preferences for product personalization is regarded as an important sustainability strategy. This may help to build a bond between user and product that enriches personal experiences (Chapman, 2005). In that way, users do not discard the products that they have an emotional attachment as quickly as the ones they do not. Even they use them carefully and get them repaired when broken (Schifferstein & Zwartkruis-Pelgrim, 2008). Maintenance and repair ensures extended use of a product. Therefore, product attachment motivates users to have a product longer. If there occurs a connection between the user and the product, it prolongs the psychological lifetime of products (Verbeek & Kockelkoren, 1998).

Life-cycle assessment (Birkeland, 2002), Cradle to Cradle (McDonough & Braungart, 2005), Eternally Yours (Verbeek & Kockelkoren, 1998), ISPDS (Doğan, 2007), post-use design thinking (Coşkun, 2010) and halfway products (Fuad-Luke, 2009), etc. appear to be possible approaches to integrate sustainable design considerations into the design process.

2.6 Sustainable Design Approaches Considering Product Maintenance and Repair

Life-cycle assessment, Cradle to Cradle, Eternally Yours, ISPDS, post-use design thinking, design explorations for sustainability, slow consumption and halfway products, etc. present various strategies that integrate sustainable design principles into the design process. There are also strategies such as open source designs (openstructures.net, etc.) and product repair and user platforms emerging. These approaches are presented in this section.

2.6.1 Life Cycle Assessment and Cradle to Cradle

Life Cycle Assessment (LCA) is a method primarily used to interpret and compare environmental impacts of products during their lifespans. Environmental performances of products throughout their design, manufacturing, distribution, use, and post-use (e.g. maintenance, repair, reuse and upgrade) phases are assessed through considering their impacts such as resource depletion and deprivation, toxic substances and pollutants (Tischner & Charter, 2001). That is to say, LCA can be an effective tool in prolonging product lifespan (Heiskanen 1996; Vezzoli & Manzini, 2008). LCA enables that every stages of a product's lifetime is given equal importance by distributing the focus on production and consumption stages to other areas from design to post-use of a product (Cooper, 2005). When a product's lifetime is over, disassembling its parts in the most effective way for reusing purposes is the main concern of the 'design for disassembly' method (Fiskel, 2009). In line with LCA, this method (Birkeland, 2002) considers the design process of products to make use of their parts and materials in the most efficient manner.

In the mini oven example (Figure 4) developed within the context of the third year industrial design education project at METU, accessibility of products parts is considered in terms of product maintenance, repair and product part replacement. As a result of this feature, technician or repairman is able to reach the broken part easily without disassembling the product. The part including controls and displays in this example can be separated from the product when it is not working or when product part replacement is needed.

Figure 4 - Koray Benli, mini oven, 2010-2011 spring term, ID 302 course, in collaboration with Profilo.

In the post-use process, how maintenance and repair are provided, whether upgrading is necessary, and how environmental effects of a product are interpreted need to be addressed considering the product lifetime as a whole. LCA thinking can be explained with the help of other approaches like 'Cradle to Cradle' proposing enclosed production techniques that do not produce waste (McDonough & Braungart, 2002). The waste is processed, re-valued and reused in such systems.

Cradle to Cradle as a design approach mainly focuses on creating an environmentally and resource-friendly industrial system contributing to the economy in the long run (McDonough & Braungart, 2002). Eco-effectiveness is one of main components of this approach. Shift into eco-effective industrial system can be discerned through eliminating unwanted toxic materials and rethinking of products. Cradle to cradle approach categorizes resources as technical and biological nutrients, and creates a cycle for each group (McDonough & Braungart, 2002). It strives for preventing waste generation by forming industrial and natural closed loops through which the waste becomes resources.

2.6.2 Eternally Yours

Eternally Yours is comprised of Dutch designers who work on the subjects of product longevity and sustainability. The group is basically focused on the lifespan of products as they are concerned that the reason behind product disposal is not they wear out or are broken, but users are bored of them. The group emphasizes that the LCA approach is insufficient, and proposes new solutions against environmental problems. Eternally Yours essentially searches for forms and materials which prolong product lifespan. Additionally, they put emphasis not

just on materials and surfaces but they also explore how the maintenance and the repair of products have an effect on product lifespan.

Products may be discarded not only when they are worn out or broken, but also when new versions appear on the market. The old ones become instantaneously outdated and they do not fit users' preferences anymore. In his book Verbeek (2011) argues that the post-use services like repair and upgrading prevent products from being discarded long before their lifespan is over. He explains Eternally Yours' solutions to this problem.

Eternally Yours claims that LCA is beneficial to manufacture environmentally-friendly products but it does not address the problem of short product lifespan (Verbeek, 2011). While asserting that issues about short product lifespan are mainly cultural as they relate to local needs, tastes and preferences, the group suggests that it is a necessity to provide solutions that encourage longevity. Today's culture is a so-called throw-away society (Cooper, 2005). Users discard products prematurely due to various reasons including poor surface quality, changing fashion and rapidly evolving technology. This habit causes products to be regarded as throw away items. Products are discarded even they still function properly. According to Eternally Yours, throw away culture is not only about developing technology, it is also a cultural issue (Verbeek, 2011). Thus, it is not enough to produce environmentally-friendly products to overcome problems, product longevity should also be taken into consideration.

Eternally Yours distinguishes four methods to extend the lifespan of products. The first is to switch from products to services. Services like repairing, maintenance, upgrading and renting may stimulate longer-time use of products (Verbeek, 2011). For the reason that they are affordable, products may be disposed when they are still repairable. Users prefer to replace them immediately instead of repairing. Such a culture may cause acceleration of consumption pace, and in turn lead to irreversible environmental consequences. Regular maintenance and repair ensure and contribute to extended use of products. Repairing a product when broken or worn out rather than just discarding directly elongates product lifespan. Furthermore, for technologically outdated products which do not have as many functions as their successor models, upgrading is an option to keep up products with the pace of technology and for product longevity. By this way, consumption speed will slow down along with the production speed, thus environmental damage and pollution will be minimized (Verbeek, 2011). The second method is eco-design which attempts to reduce environmental adverse effects of products during stages of their lifetime. Recycling, which is the third method, aims to recover and reuse parts of discarded products. The fourth and the last method is prolonging the lifespan of products. The reasons of short product lifetime, according to Eternally Yours, can be explored in three different dimensions; technical, economical and psychological (Verbeek, & Kockelkoren, 1998). Products are thrown away because they are broken, they can not be repaired and new models have arrived on the market. Eternally Yours claims that psychological lifespan is the most important one among three dimensions to affect the product lifespan. That is why, primary ways of extending psychological lifespan should be searched further. Eternally yours provides three possible solutions to this problem (Verbeek, & Kockelkoren, 1998). The first solution, "Shape 'n' Surface", aims to achieve long-lived products with the help of materials and forms. In this consideration, products not losing their value during use and even gracefully aging ones are examined. For example, while polished and shiny surfaces lose appeal with a tiny scratch, materials including wood and leather increase in attractiveness after a long time of use.

In the second possible solution namely "Sales 'n' Services" (Verbeek, & Kockelkoren, 1998), the purpose is to contribute to longevity with the help of services. Eternally Yours believes that companies today are solely focused on production and sales, but what should be done is to shift the main focus to post use services (Van Hinte, 2004). Provided that a good communication is maintained between users and companies, the lifespan of products, as being in the center of this communication, will improve in the meantime.

Lastly, under the header "Signs 'n' Scripts" (Verbeek, & Kockelkoren, 1998), tacit meanings and stories of products are questioned. Products have stories, and it is these stories that give them meaning, which in turn make them a part of users' lives. A bond is established between users and products with stories, as a result the users keep them for a long time.

Eternally Yours defends that products should be durable and long-lasting to be able to deal with environmental problems. For this particular purpose, it investigates the reasons behind short product lifespan, and offers diverse solutions while indicating services involving repairing, maintenance, upgrading and renting as one of four methods to provide product longevity.

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

The Integrated Scales of Design and Production for Sustainability (ISDPS) Approach bringing local and mass production together during design, production and post-use stages contributes to local skills and employment. This approach aims at creating products by integrating locally produced parts manufactured by small scale enterprises with the mass produced more complex ones (Walker, 2010; Doğan, & Walker, 2008). Thus, a more effective way to design products adapting to diverse local needs, fostering user experience, enabling product maintenance and repair at local scale can be provided. Design approaches dealing with local characteristics of design and production by taking into consideration both pros and cons of these regarding environmental, social and economic aspects are remarkably few.

2.6.3.1 Localization

Localization can be defined as design solutions for diverse user preferences and needs at the batch production scale, enabling post-use possibilities including repair, reuse and recovery at the local and regional levels (Walker, 2010; Doğan, 2007).

Through bringing various scales of production together, ISDPS allows product maintenance and repair at the local scale through integrating small scale producers and users into the process (Doğan, 2007). This approach gathers the most suitable characteristics of different production scales in order to achieve the best results during production, use and post-use stages. For example, offering maintenance and repair services at local workshops would enable easy and quick access of users to those services.

ISDPS approach helps users relate themselves to the product while integrating them into the process by local designs, design researches and integrating different scales of production. In today's production systems, they are alienated from many stages of a product's lifetime (Doğan & Walker, 2008). They have limited involvement in the design and production processes within the current mass production system. Similarly, they are mainly not offered any information and possibilities about what to do with products after use.

In ISDPS concept, not assembled products but parts of them are transferred from international to local networks in contrast to what is today (Doğan , 2007). The finished product is obtained by integrating these parts with the locally produced parts. The parts that are frequently breakdown or wear out can be produced locally. Thus, it will reduce the time to deal with commonly-faced problems. With the help of locally attainable parts, the design can come up with solutions and possibilities at the local scale like product lifetime, maintenance and repair, and reuse.

ISDPS creates new opportunities for designers. Designers can create products by combining off the shelf components with locally produced and tailored components (Doğan & Walker, 2008). As a result, with a rich culture incorporating local needs and tastes, products that are upgradable, repairable, long lasting, personalized and evolving can be designed and produced.

The design is isolated from many stages in mass production process. Designers are focused mostly on the use process, however all stages of a product's lifetime should be considered as a whole. Within the current system, production is disconnected from repair, upgrading and reuse services because they are mainly not available or accessible at the local level. However, increased localization presents opportunities and sustainable solutions with to overcome this. It supports reducing environmental problems with reuse facilities. Besides, by means of supporting local skills and employment opportunities, effective use of resources and economic aspects are also considered.

2.6.4 Post-Use Design Thinking

Post-use design thinking implies the integration of potential post-use possibilities into the early phases of the product design process (Coşkun, 2011). It suggests that production and consumption processes need to be addressed simultaneously through incorporating user involvement and small scale production at the local and regional levels to tailor the products to both use and post-use phases (Coşkun, 2011). Curtain with a dressmaker's pattern to enable transformation is designed by Djoke de Jong in 1993 which a product example for the post-use design thinking (see Figure 5).

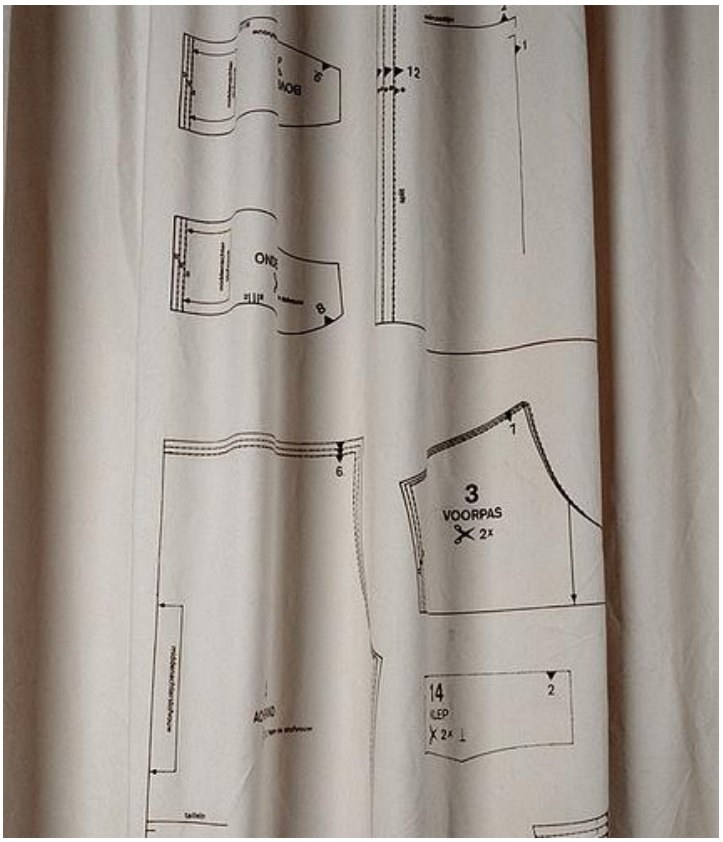


Figure 5 - Curtain with a dressmaker's pattern enabling post-use, Djoke de Jong, 1993 (reproduced from Ramakers, 2002).

In post-use design thinking approach, products transform into new ones after their initial use instead of being discarded. During this transformation, locally and regionally available materials and local knowledge and skills are made use of and also users are involved in this process through incorporating various product accessories (Coşkun, 2011). This involvement encourages users to reuse their products for longer time. This approach enables product longevity by taking into consideration consumption related strategies in the design process like maintenance, repair and re-use.

2.6.5 Design Explorations for Sustainability

Design explorations for sustainability approach means that designers explore theoretical themes and concepts through using designing as a research method (Marchand & Walker, 2007).

Figure 6 - Red dot on drinking glass (reproduced from Marchand, 2008).

Figure 7 - Cutlery pieces with red handles (retrieved on August 25, 2013, from http://www.detnk.com/node/1495).

In this study of Anne Marchand (2008), out of date and unvalued products regain their value through design explorations for sustainability. Different and outdated products are integrated around 'family of products' concept through design interventions. In the first example, permanent red dots painted on glasses make them seem like that they are of the same product family. Diverse glasses are re-contextualized as a family of products (see Figure 6). The second example is the family of objects created through a red coating applied to different cutlery pieces (see Figure 7).

These specific designs are designed within sustainable design considerations that Marchand identifies to encourage responsible consumption patterns. Design explorations approach enables post-use of products with the means of revaluing and rethinking them, thus it creates product longevity (Marchand & Walker, 2007).

Design for sustainability approach utilizes design ideas including evolving products, do-it-yourself, localization and post-use. Evolving objects are easily adaptable to different places and tastes. By supporting do-it-yourself approach through enabling use of locally produced additions, users are more actively involved in the design process. In this approach, products or parts whose initial use is over are brought into play again with small modifications. The idea of evolving products brings an alternative perspective to users' understanding of old and new (Marchand, 2008).

Human beings are meaning seekers according to Walker, and he also claims that personal meaning of the product is the term that is argued to be the fourth part of the triple bottom line of the sustainability which consists of economic, environmental and social factors, in order to understand the link between individual and sustainability (Walker, 2010). For instance, denim jeans, vintage products or an old family watch etc. do not have an end-of-life according to users because of their personal meanings. Besides products with personal meaning must embrace some other priorities in order to be long lasting, technology, fashion and aging of products are the main obstacles which long lasting products encounter in their lifespan. Concept mobile phones designed by Walker are conceptualized to overcome these challenges; they evolve with the user and his/her preferences (Figure 8). Moreover they are upgradeable according to technological improvements besides helping the development of local enterprises, and contributing to the cultural identity (Walker, 2010). Electronic and electrical products are one of the most rapidly discarded products. Rapid technological change following high rates of product obsolescence and rising problem of waste through Europe and other parts of the world caused policy makers to turn their attention to this product sector (Cooper, 2005).

Figure 8 - Evolving concept mobile phones (reproduced from Walker, 2010).

Small household appliances can be more effective and environmentally friendly if they are designed considering maintenance and repair (Hanton, 2006). The product parts should be easily accessible and visible to enable proper maintenance and repair. The other issue critical to users is the cost of these services. In today's system, maintenance and repair of a product almost equals the sales price of it (Hanton, 2006).

Figure 9 - Small kitchen appliance (reproduced from Hanton, 2006).

Magnus Hanton (2006) designed a sustainable small kitchen appliance, which is comprised of parts produced with both mass production and local batch production in the most effective manner, according to various sustainable design considerations that he identified in his study (Figure 9). In this way, local preferences and needs can be met, and local skills can be made use of which contribute to the product design process.

Hanton (2006) offers his product heating and mixing methods together. By combining these functions, it is ensured that the same parts in small kitchen appliances are used in common. As a result, repetitive product parts are eliminated and thus effective use of materials can be realized.

This product example offers a number of advantages in terms of product maintenance and repair. When all parts of a product are reachable and apparent, it is possible to replace broken and worn-out parts without any need for disassembly. Moreover, this approach encourages design possibilities for upgrading. Thus, new products can be upgraded afterwards with the parts produced with the developing technology.

2.6.6 Slow Consumption

Cooper (2005) asserts that slow consumption concept will help achieve sustainable production and consumption. The primary purpose of this concept is to slow down the consumption process by increasing durability of products and maintaining them. Product longevity secondarily means that fewer products will be purchased and subsequently fewer products will be thrown away. However, such decline in sales may result in increase in unemployment, which may be one of the unwanted consequences. Nonetheless, Cooper suggests that durable products when supported with maintenance and repair can overcome such adverse effects. On the other hand, the prerequisite to produce long lasting products is high-skilled labor and craft-based production. Besides, the workforce needed to provide maintenance, repair, refurbishment and upgrading of products will enhance employment. This model, Cooper (2005) says, can contribute to sustainable consumption patterns with the means of durable products that decrease materials and energy required for manufacture. According to Cooper, increased consumption required to maintain economic development will not be necessary any more when product longevity is succeeded.

2.6.7 Halfway Products for Personalization

Halfway products are not ready-to-use products. Users complete and adapt these products themselves through personalization (Fuad-Luke, 2009, p.95).

In accordance with their preferences, needs and creativity, users put the finishing touches on products. User involvement in the personalization process builds a bond between the user and the product (Fuad-Luke, 2009, p.95). This bond is a result of a process and a story, and it is what distinguishes that very product from the others. Natalie Schaap in “an affair with chair” offers a chair frame to the users (Figure 10). To be able to use the chair, it is first needed to be completed by the user. Such an approach creates meaning by integrating the user as the active participant into the product design process while aiming to strengthen the interaction and user experience between the user and the product.

Figure 10 - An Affair with a Chair Natalie Schaap (reproduced from Fuad-Luke, 2009).

Users get to know their products while interacting with them. They also familiarize with the parts of the product and have an idea about how to replace them through this process. This familiarity renders upgrading, maintenance and repair much easier for the user.

2.7 New Approaches

2.7.1 OpenStructures.net [Open Source Platform]

OpenStructures.net is an ongoing exploration that aims to find out what happens if people design objects according to a shared modular grid, a common open standard that stimulates the exchange of parts, components, experiences and ideas, and aspires to build things together.

OpenStructures is an open source platform which supports diverse customizable solutions that are created with parts designed according to a shared modular grid and by combining these parts in different ways on the same modular guide. It enables sharing of opportunities and restrictions freely by creating a modular system which everyone can contribute to and benefit from. On this emerging platform, an experimental design approach mostly adopted for the shared possible solutions and the effective involvement of users in the design process is provided.

This platform offers an innovative approach especially about product maintenance and repair which are among the sustainability criteria. Interchangeable parts that can be used in different products stimulates local production and integration of these parts into any product in terms

of needs later on. It is possible for the users to repair their own products because they were actively involved in design and production processes formerly.

Jess Howard has developed household appliances which users effectively produce, repair and modify. On Open structures platform, production guidelines for the products designed in accordance with this scenario are provided. By using 3D printed, the resulting products can be reproduced one-at-a-time rather than on the scale of mass production. The family of appliances consists of a toaster, a motorized grinder, a vacuum cleaner, and an electric kettle.

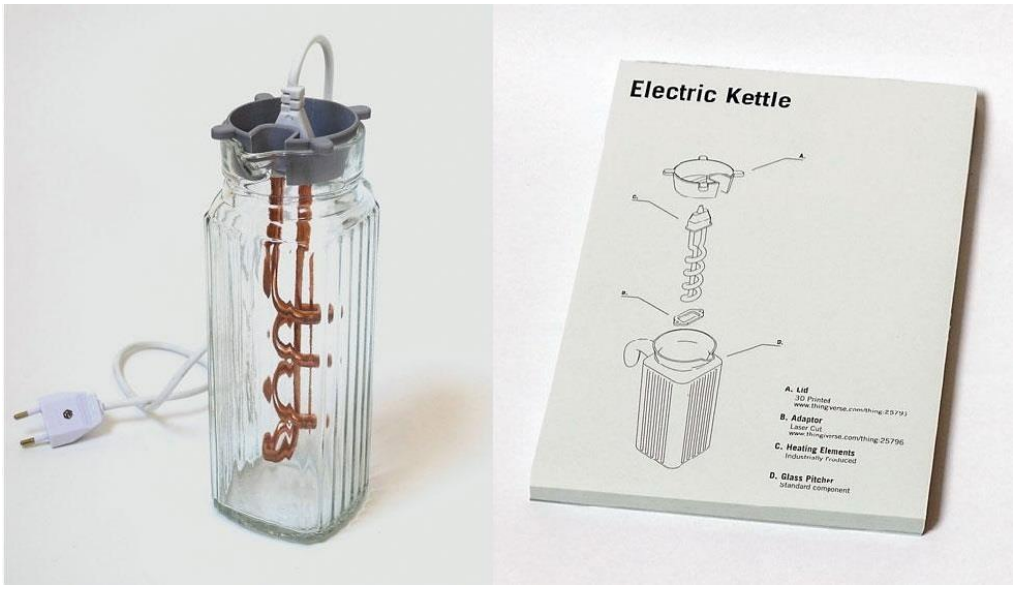


Figure 11 - Jesse Howard, Kettle, from the Transparent Tools series (retrieved on August 29, 2013, from http://www.domusweb.it/en/design/2012/11/21/process-is-toast.html).

As shown in this example (Figure 11), parts created in accordance with a modular guide are shared with everyone through open structures platform. This guide provides quite extensive information ranging from dimension, size and thickness details to joining. In the meantime, products assembly samples showing how users/designers can combine these parts in various ways are shared as well.

2.7.2 Product Repair and User Platforms

Information and techniques enabling users to repair their own products spread across the internet. On websites such as *ifixit.com, fixya.com, howstuffworks.com and familyhandyman.com*, useful information about how to fix goods is elaborately described to users.

Figure 12 - Blendtec Total Blender Teardown (retrieved on August 25, 2013, from http://www.ifixit.com/Teardown/Blendtec+Total+Blender+Teardown/1128/1).

The website *ifixit.com*, the most popular one among these information platforms, offers effective knowledge and processes about product repairing. As can be seen in Figure 12, repair process is illustrated step by step in detail. *ifixit.com* is a free platform that contains instructions on how to fix various items including household appliances, tutorial videos and information about providing specific parts while allowing users to share their own experiences.

2.8 Legal Regulations on Household Appliances and Sustainability in Turkey

In Turkey, the regulation on product lifespan and necessary after-sales services is published by Republic of Turkey Ministry of Science, Industry and Technology in 2003. In this regulation, product life cycle lengths and duration that producer or import companies required to cover the expenses of assembly, maintenance and repair after-sales services are specified. According to this, life cycle of household appliances is stated as seven years except for electric oven and microwave oven. For microwave and electric ovens this time is specified as ten years. In addition, producer and/or importers must provide required technical personnel and establish after-sales services at specified number and places for every product group indicated. An after-sales service proficiency is required for these services (T.C. Ministry of Science, Industry and

Technology, 2003). The related ministry or contracted institution like TSE examines the required qualifications for this certificate.

2.9 Conclusion

Sustainable development means environmental consciousness, social responsibility and economic feasibility (Dresner, 2002). The underlying criteria for sustainability are providing economically feasible and environmentally friendly solutions in product design and considering social aspects of product lifecycle. Sustainable development literature draws attention on limited environmental resources. In order to reduce the rate of consumption, more researches related to product longevity are needed. In this study, key factors for maintenance and repair to prolong product lifecycle are examined. Moreover, potential effects of maintenance and repair on product longevity of small household appliances, especially kitchen appliances are presented. Although there are only a few studies specializing on product maintenance and repair in sustainable design literature, in many of the studies this issue is discussed among the factors extending product lifespan. According to literature review, providing services such as maintenance, repair, refurbishment and upgrading ensures extensive use of products (Cooper, 2005). Long time use of products helps to decrease excessive demand on the market. In response to decreasing demand, the amount of products being produced will diminish accordingly. In order to achieve sustainable production and consumption, consumption of resources and production of waste should be minimized. Furthermore, product longevity is placed within the basic necessities to attain sustainable development.

In this chapter, strategies considering maintenance and repair operations to extend product lifespan are discussed. The advantages of product longevity and approaches developed to progress towards sustainable consumption and production are also explained. In conclusion, for sustainability, product lifespan should be prolonged, and strategies and approaches developed for that purpose should be further emphasized and employed. Designers and producers should consider not only production and use but also all stages of product lifetime.

CHAPTER 3

METHODOLOGY

In this chapter, the research stages, the data collection tools and the analysis techniques employed during the study are explained. The study process begins with the pilot study, continues with the primary research developed in the light of these studies, and concludes with the analysis part. The chapter includes detailed information about population and sampling, interview questions, semi-structured interviews conducted with authorized technical services and repairmen, and content analysis method used in the study.

3.1 Research Stages

The issue of maintenance and repair of products is one of the most significant factors that affects the product lifespan, and accordingly it needs to be taken into account in design practice and design education. Although the number of studies dealing with this topic increases day by day, there are a few number of products designed by taking the product maintenance and repair into consideration. It is clear that companies, though they provide post-use services, do not consider the maintenance and repair processes of the products during their design processes. The research aims to examine and define potential areas for extending the product lifespan with a focus on product maintenance and repair for small kitchen appliances based on the findings from the authorized technical services and repairmen.

The study consists of three main sections: literature review, the pilot study and the primary research. The pilot study includes semi-structured interviews with two authorized technical services. The primary research contains the analysis of semi-structured interviews which are tested and developed at the preliminary research stage, and the interviews carried out with eleven authorized technical services and four repairmen.

3.2 Data Collection Method

The semi-structured interviews are used in the study in order to collect detailed data which is analyzed with the content analysis method. The ways of incorporating these methods and their significance for the research will be explained in this section.

3.2.1 Semi-structured Interviews

Semi-structured interview is a widely-used qualitative research method through which researchers ask a series of open-ended questions that are determined beforehand (Ayres, 2008). The researcher's handling on the subject is better compared to unstructured interviews, as an interview guide is utilized in semi-structured interviews (Ayres, 2008). Furthermore, contrary to structured interviews that consists closed questions, the questions do not have pre-established answers in semi-structured interviews (Cook, 2008). The semi-structured

interviews allow participants to talk freely, thus giving the researcher the opportunity to obtain in-depth information. The reason the semi-structured interview has been chosen for this study is that it can provide the researcher with detailed information in the specified subjects.

The respondents for the semi-structured interviews related to both pilot study and primary research are authorized technical services and repairmen in the small kitchen appliances sector in Ankara. The interviews are audio-recorded for supporting the process of analysis. It also prevents data loss and helps the researcher to track Participant's responses easily during the interview. The broken-down products mentioned in the interviews are both photographed and video-recorded. Participants' permission is requested before the interview in order to record the process. While and/or after conducting the interviews, the researcher gets into and explores the storage rooms of services, talks with the Participants about the broken products in detail. The researcher experiences Participants' working environment and observes two repair processes to have a better understanding of the setting and the tools involved. Two of the Participants do not allow the researcher to see the storage room (Participant 6 and 8). These two Participants show the broken appliances to the researcher one by one. The interview sessions take nearly 60 to 90 minutes. Most of the interviews (13 out of 15) are carried out in the Participants' work places in order to observe their working environment and to discuss about the broken appliances around (see Figure 13).

Figure 13 – A photograph from an interview session.

3.3 Data Analysis Method

3.3.1 Content Analysis

Content analysis is a widely-used research method through which textual materials are reduced to more relevant, manageable data by classifying them into content categories (Weber, 1990). The content analysis method enables researchers to systematically analyze large amounts of data (Weber, 1990). Categories are groups that put together words with similar meanings and connotations (Weber, 1990). Its most important feature is that it is a systematic and repeatable method which enables the classification and analysis of the data consisting of many words into fewer categories within certain encoding rules. It allows researchers to determine and make sense out of the relationships and connections between variables and themes in the data (Julien, 2008). It is used to analyze various data such as interviews, transcripts, speeches and media such as drawings, photographs and videos. It can be used in analyzing both qualitative and quantitative data. While content analysis is carried out with a deductive perspective in quantitative studies, the inductive method is used in qualitative studies (Julien, 2008). Inductive study starts with reading the text in detail. This helps the detection of small details in the data that is not clear. While qualitative data such as interviews are analyzed, the whole set of data is meticulously examined, and codes and clusters from relevant and related data are created. Afterwards, these codes are changed into themes. Content analysis requires in-depth analysis of the data collected and allows uncovering the themes and dimensions that are not clear before.

The reason the researcher employed this analysis method is that this method provides the opportunity for systematic and detailed study of a large amount of data by making inferences. The semi-structured interview results are considered as the primary data set and analyzed through content analyses.

3.3.2 Validity and Reliability

The researcher ensures reliability through repetitive analysis and searching for counter examples and confirmatory examples while conducting a qualitative research. She/he consolidates the reliability with supportive examples given for the results. Including all the data in the determined groups and representing the groups and categories without losing their contents after determining thematic categories are necessary in terms of validity and reliability (Julien, 2008).

3.4 Pilot Study

In order to structure the primary research, a pilot study is conducted before the primary research in order for them to create feedbacks. The interview questions are revised based on this initial study. The semi-structured interview begins with the questions about home appliances in general, and then becomes more specific with the questions about small kitchen appliances. The questions are about product lifespan, product breakdown reasons, product maintenance and repair process, and problematic areas about product maintenance and repair.

3.4.1 Semi Structured Interview Questions

Before the main interviews, two semi-structured interviews are conducted in order to test the validity and suitability of the interview questions (see Appendix B). After the first interview, the questions are reviewed; some are removed and some other questions are changed. The interview questions given in the first interview are presented in Table 1.

The questions about energy consumption and efficiency are removed from the first version of the interview as they are not relevant to the subject. The questions are categorized as the main questions and sub-questions related to the main questions. The interview results are grouped and organized under three main topics. The interview questions are put into groups so that they could comprise all three topics:

1. Questions about lifespan, maintenance and repair process of small home appliances: are asked to examine and define the position of small kitchen appliances in the small household appliances category related to product lifespan and product breakdown.

2. Questions about lifespan, maintenance and repair process of small kitchen appliances: are asked to find out product breakdown reasons, details about maintenance and repair processes of small kitchen appliances.

3. Questions about the involvement of users in the process of maintenance and repair: are asked to gather information about the intervention of users in the maintenance and repair process, and the relationships between users, technicians/repairmen and producers.

Table 1 - Semi Structured Interview Questions of Pilot Study.

Semi Structured Interview Questions

1- Could you please evaluate the household appliances in terms of their product lifespan? If we were to compare the products in terms of their lifespans, which one has the longest and which one has the shortest lifespan? Could you explain the reasons by giving examples?

2- Are there any strategies that the company you work for follows in energy consumption and efficiency, and product maintenance and repair within the lifecycle of the household appliances that the company produces? If there were any, could you explain them by giving product examples?

3- Could you mention how often the household appliances produced by your company are sent to the technical services?

4- For what reasons are the household appliances sent to technical services? What are the most frequent complaints that you come across? Could you explain by giving product examples?

5- Could you talk about the maintenance and repair processes of the kitchen appliances? Could you explain by giving product examples?

6- What kind of problems do you come across during the maintenance and repair of the household appliances? Could you explain by giving product examples?

3.5 Primary Study

The primary research questions mainly focus on:

- the problematic areas affecting product longevity related to product maintenance and repair in the small kitchen appliances sector,
- the reasons of product breakdown;
- the role of product maintenance and repair for extending product lifespan of small kitchen appliances.

It is found suitable to conduct interviews with authorized technical services and repairmen who are dealing with the maintenance and repair of the products, and identify the reasons for the product breakdown in order to obtain comprehensive and in-depth answers for the results of the study.

The views and suggestions of the Participants about the problematic areas affecting product longevity and product maintenance and repair contribute to the research questions.

The semi-structured interviews are used as a data collection method throughout the research process. Broken-down products at the service are examined and the causes of this are investigated during the interviews. Participants are asked to support their answers through providing examples and these increase the reliability of the research findings.

3.5.1 Semi-Structured Interview Questions

The interview questions focus on different areas such as product breakdown reasons, frequency of delivery to the service, and maintenance and repair. The validity of the questions is tested through the pilot studies conducted at the beginning of the research. After the pilot studies, the questions are divided into three sections. The questions related to the same topic are grouped into the same categories. The sequence of the questions is changed and revised. While preparing the interview questions, the small household appliances are grouped under four different categories. This categorization is carried out considering the product groups determined by the companies. These four categories consist of small kitchen appliances, irons, personal care products and vacuum cleaners.

Each category is divided into groups in itself. For instance, the small kitchen appliances include food preparation appliances, heaters and cookers. Irons are divided into two categories as regular irons and irons with steam generators. Personal care products consist of hair care appliances, epilators, and electric shavers, etc. Vacuum cleaners consist of products such as vacuum cleaners with and without dust bags, with water filter, charged upright vacuum cleaners and wet, dry ones and similar products. It is essential to determine certain product groups in the household appliances in order to inclusively carry out the study. Basic product groups that are focused on within the scope of the project by considering the design and manufacturing processes in Turkey are presented in Table 2.

Table 2 - Four Basic Groups for Household Appliances.

1. Kitchen appliances

- Food preparation appliances: mixers, food processors, blenders, juicers, choppers, scale devices, etc.
- Heaters and cookers: tea machines, coffee machines, kettles, grills, sandwich toasters, mini ovens, bread makers, toasters, popcorn makers, yoghurt makers, etc.

2. Irons

- Regular irons, irons with steam generators

3. Personal care products

- Hair dryers, hair straighteners, shavers, epilators

4. Vacuum cleaners

- Vacuum cleaners with dust bags, without dust bags, with water filter, charged upright vacuum cleaners and wet and dry ones.

Table 3 - Semi Structured Interview Questions.

a- General questions about the product life, maintenance and repair of small household appliances:

1- Could you please evaluate the kitchen appliances and other household appliances (irons, personal care products, vacuum cleaners and others) that the company you are working for manufactures with regard to how often they are brought to the service?
2- Are there any problematic product groups in terms of maintenance and repair? What are the most common problems that you come across? Can you give examples from products?
3- Are there any strategies that your company in order to prolong product life? If there are any, can you explain by giving examples from the products?
4- Do you have any limitations as a company in terms of product maintenance and repair? Are there any methods, strategies or solutions that you prefer and find effective as the authorized technical service, but that are not employed in the company? Can you please explain by giving examples from products?
5- Where is the place of manufacture of the small kitchen appliances that your company produces? In which counties are the parts of products are produced?

b- Questions about the maintenance and repair of small kitchen appliances:

6- Could you mention how often the small kitchen appliances that your company produces are brought to the service?
7- What are the breakdown reasons of the small kitchen appliances/reasons for their being brought to the service?
   a. What are the most common complaints you come across? Could you explain by giving examples from the products?
b. Do you encounter any problems due to manufacturing defect?
8- Could you tell about the maintenance and repair process of small kitchen appliances produced by your company? Could you explain by giving examples from the products?
   a. Do you come across problems during the maintenance and repair processes? If you do, could you explainvby giving examples from the products?
   b. Which parts are the renewable/non-renewable? Can you explain by giving examples from the products together with their reasons?
   c. Are there any example products that you find effective in the maintenance and repair of the products? From which aspects do you think these solutions are effective?
   d. What can be done in the design and production processes in order to make the maintenance and repair process more effective and to expand the product life? Do you have any advice on this matter?

c-Participation of the users in the process:

9- Do you use different methods to receive feedback from consumers or users about product maintenance and repair? Can you explain by giving examples?
   a. Are there any demands and advice you receive from users for product maintenance and repair processes?
   If there are, how do you evaluate these demands and advice?
   b. Do you give advice to users about the product maintenance and repair? If you do, can you explain how these methods are applied by giving examples?
   c. Do you keep records of breakdown reasons of products? How is this information evaluated by the company you are working for?
   d. Could you share us this information for the following stages of this study? Is it possible for us to reach the users as part of this educational project with your help?
   e. Which parts in which broken or old products can be replaced by users? If there are such parts and products, could you please explain by giving examples from the products?
10- How do you make use of the products that cannot be repaired? Is there a company you work together for the recycling of the products?
11- Are there any factors we have not touched on during the interview? Is there anything you would like to add?

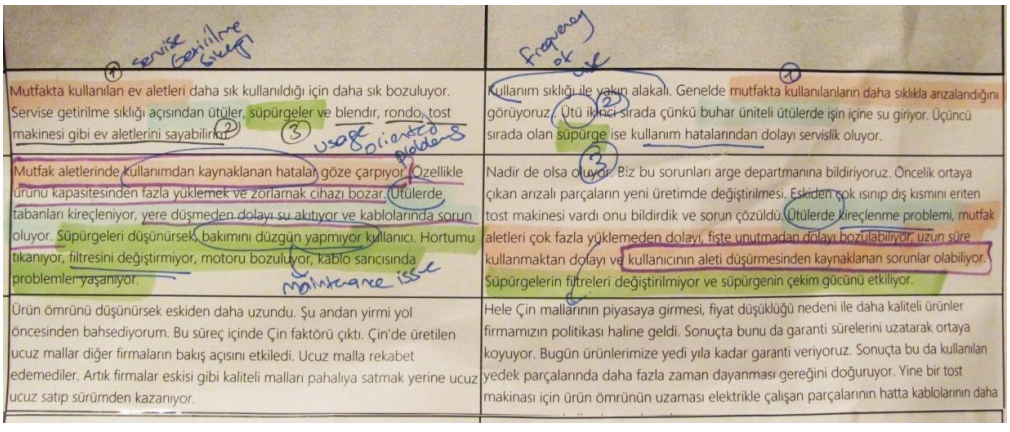
The interview questions for technical services and repairmen are presented in Table 3. The questions are prepared in Turkish as it is the Participants' native language. The original versions of the interview questions can be found in Appendix C.

3.5.2 Population and Sampling

The interviews are conducted with authorized technical services and repairmen in Ankara. The interviews are carried out with 11 authorized technical services having agreements with 30 different companies, and 4 repairmen. All of the participants are male. At the time of the research conducted, there is not an available data or research about the number of the whole population. Availability sampling based on convenient accessibility of the Participants is utilized in this thesis. The authorized technical services are reached by the researcher through companies' official websites and contact information. The researcher contacts with the repairmen with the help of or suggestions given by the authorized technical services personnel. Six of the technical services are located in the Ulus, five of them are in Kızılay, three of them are in Ayrancı, and one of them is in Yüzüncü Yıl in Ankara. All off the offices of the repairmen are in Ulus.

3.5.3 Data Analysis Process

The data collected by means of the semi-structured interviews are analyzed through the content analysis method. Verbatim transcription technique is used for the data analysis phase. Then, the transcribed data are transferred into a comprehensive matrix that was formed in order to see the whole raw data together. This matrix helps the researcher putting the data together and made it possible to see the diverse responds in terms of similarities and differences conveyed by the Participants. It also helps the researcher compare and contrast the findings for developing categories and themes.



Mutfakta kullanılan ev aletleri daha sık kullanıldığı için daha sık bozuluyor. Servise getirilme sıklığı açısından ütüler, süpürgeler ve blendır, rondo, tost makinesi gibi ev aletlerini sayabiliriz.	Kullanım sıklığı ile yakın alakalı. Genelde mutfakta kullanılanların daha sıklıkla arızalandığını görüyoruz. Ütü ikinci sırada çünkü buhar üniteli ütülerde işin içine su giriyor. Üçüncü sırada olan süpürge ise kullanım hatalarından dolayı servislik oluyor.
Mutfak aletlerinde kullanımdan kaynaklanan hatalar göze çarpıyor. Özellikle ürünü kapasitesinden fazla yüklemek ve zorlamak cihazı bozar. Ütülerde tabanları kireçleniyor, yere düşmeden dolayı su akıtıyor ve kablolarında sorun oluyor. Süpürgeleri düşünürsek, bakımını düzgün yapmıyor kullanıcı. Hortumu tıkanıyor, filtresini değiştirmiyor, motoru bozuluyor, kablo sarıcısında problemler yaşanıyor.	Nadir de olsa oluyor. Biz bu sorunları arge departmanına bildiriyoruz. Öncelik ortaya çıkan arızalı parçaların yeni üretimde değiştirilmesi. Eskiden çok ısınıp dış kısmını eriten tost makinesi vardı onu bildirdik ve sorun çözüldü. Ütülerde kireçlenme problemi, mutfak aletleri çok fazla yüklemeden dolayı, fişte unutmadan dolayı bozulabiliyor, uzun süre kullanmaktan dolayı ve kullanıcının aleti düşürmesinden kaynaklanan sorunlar olabiliyor. Süpürgelerin filtreleri değiştirilmiyor ve süpürgenin çekim gücünü etkiliyor.
Ürün ömrünü düşünürsek eskiden daha uzundu. Şu andan yirmi yol öncesinden bahsediyorum. Bu süreç içinde Çin faktörü çıktı. Çin'de üretilen ucuz mallar diğer firmaların bakış açısını etkiledi. Ucuz malla rekabet edemediler. Artık firmalar eskisi gibi kaliteli malları pahalıya satmak yerine ucuz ucuz satıp sürümden kazanıyor.	Hele Çin mallarının piyasaya girmesi, fiyat düşüklüğü nedeni ile daha kaliteli ürünler firmamızın politikası haline geldi. Sonuçta bunu da garanti sürelerini uzatarak ortaya koyuyor. Bugün ürünlerimize yedi yıla kadar garanti veriyoruz. Sonuçta bu da kullanılan yedek parçalarında daha fazla zaman dayanması gereğini doğuruyor. Yine bir tost makinası için ürün ömrünün uzaması elektrikle çalışan parçalarının hatta kablolarının daha

Figure 14 - A section of the matrix.

A small section of the matrix developed for the extensive analysis of the qualitative data is presented in the Figure 14. The names of the authorized technical services are given respectively at the top row. The data from each interview is placed in the cell where the corresponding theme is presented.

Color coding is used in order to differentiate related concepts and parts in the matrix. For example, the first line in the Figure 14 includes the answers to the question, "which household appliances are brought to the service most often?" The phrases of "Small kitchen appliances" in this line are coded and marked with pink, "vacuum cleaner" coded with green, and "iron" coded with blue in this example. The second line in the Figure 14 includes the answers to the question, "what are the breakdown reasons of small household appliances?" The same color coding is utilized in this line, for instance the data related to vacuum cleaners is coded with green. Color coding helps the researcher to see the same topics and concepts as a whole. It also makes the process of allocating the data into related categories easily.

3.5.4 Categories Developed for the Data Analysis

In order to carry out the data analysis after the qualitative data collection process, the categories below are developed as a result of the literature review and the pilot study:

- Household appliances that are brought to the service most often
- The problems observed in household appliances
- Strategies to extend product lifespan
- Factors that facilitate maintenance
- Technical service, R&D and user relationship
- Product maintenance and repair, and company limitations
- Advice on the maintenance and repair process
- Utilizing old and/or broken parts
- Repair processes and durations

Inductive approach is used while conducting the content analysis method. The categories are determined according to interview questions and inferences from the responses. The main categories are summarized above. The interview results according to the determined categories are analyzed for each Participant. The inferences made from the results are grouped under the relevant categories and the results are interpreted and presented accordingly.

3.5.5 Limitations of the Study

There are many authorized technical services belonging to various companies. The fact that the interviews were conducted only in Ankara limited the scope of the sampling. Other interviews with technical services and repairmen in different cities would have supported the content of the research in terms comparing and contrasting the results from the primary

research. That would require a more extensive study which was beyond the scope of the current research.

One of the limitations of the research about the product maintenance and repair is that it consists of interviews that focus on only technical services. If the interviews were conducted with users and professional designers, the data obtained would be helpful for the content of the research to incorporate their viewpoints. This would also support the results of the main research related to the breakdown reasons of products.

Most of the authorized technical services record the maintenance and repair processes together with details such as breakdown reasons and replaced parts. However, these records can not be shared with the third parties due to the privacy policy of the companies. If the information about the maintenance and repair processes of products in the database of technical services could be used, this would support the findings from the research.

Authorized technical services working for a specific company might avoid making negative comments about products of the company that they are working for. This hesitation could hinder receiving the credible information from the technicians about a question related to the company that they work for. Technicians might have a tendency to give biased answers to the interview questions so as not to have problems later on with the company. Although the Participants were informed that the data would be kept anonymous, they might hesitate to provide thorough detailed responds regarding the product maintenance and repair processes. The interviews were not only conducted with the authorized technical services. Consequently, the interviews conducted with the repairmen also supported the reliability of the research.

All of the interviews were conducted in Turkish as it is the Participants' mother tongue. Insights derived from the raw data was also in Turkish then translated and revised in English. In order for the results to be presented, the interview results were translated to English. The insights derived from the raw data was also in Turkish, then translated and revised in English. Therefore, the results might have been affected by the inferences that the researcher made during the translation and data analyses.

The incorporation of the content analysis method for this research was based on the researcher's abilities and inferences. The researcher derived conclusions and findings by using corresponding examples and confirmatory examples with repetitive analyses during the research.

This chapter contains the stages of the research, data collection and analysis methods. The structures of the pilot study and the primary research are presented respectively. The stages of semi-structured interview questions, content analyses, population and sampling are explained. The results of the primary research will be explained in detail in the following Chapter.

CHAPTER 4

RESEARCH

This chapter presents the conclusions and findings from and insights into the pilot study and primary research based on the interviews conducted with authorized technical services and repairmen. The outcomes of the two pilot studies and the main research are analysed together and are given in eighteen sections. The chapter concludes with overall conclusions of the primary research. This research aims to explore the potential areas for extending product lifespan with a focus on product maintenance and repair for small kitchen appliances. In order to achieve this, fifteen semi-structured interviews that are conducted with technicians and repairmen are analyzed and presented in this section (see Table 4).

The chapter starts with the comparison of the delivery frequency of small kitchen appliances and small household appliances to services. Then problematic product groups in terms maintenance and repair like vacuum cleaners, irons and small kitchen appliances are examined. The reasons behind the difference between the delivery frequencies of these products are also presented with the product breakdown reasons. Breakdown reasons of small kitchen appliances including blenders, food processors, toasters etc. are presented in detail.

The maintenance and repair process and stages of both authorized technical service and repairmen are described. This process usually includes trouble shooting, spare part supply, replacing broken part and testing phase. Some companies also make contact with the user after the delivery of the product to collect their opinions about the maintenance and repair process. Moreover, the Participants list the problems faced during the maintenance and repair.

The regular communication between companies, authorized technical services, R&D departments and the users will help to solve the manufacturing defects, the problems and breakdowns that occur during maintenance, repair or use phase. Essential points about the communication between R&D departments, authorized services and users, their meetings and trainings are presented.

Participants' advices about maintenance of the product, use of the products and the breakdown reasons are presented. They also give advices about how to use small kitchen appliances longer. Participants' responses about the users' involvement in the repair process are also analyzed, and the issues related the users' intervention in repairing small kitchen appliances are discussed. Small kitchen appliances in the market look different but they actually have similar operating system, similar product parts, hence similar repairing processes. Similarities between the operation systems and the parts of the products are explained.

Electrical waste must not be thrown away but there is not enough recycling options in our country. In the responses about what happens to the products that can not be repaired are gathered and presented. Whether the waste products or the product parts are sent to the storage, are given to the waste collectors or recycled or not, are discussed.

Table 4 - Information about Participants.

Participant 1	Authorized Technical Service
Participant 2	Authorized Technical Service
Participant 3	Authorized Technical Service
Participant 4	Authorized Technical Service
Participant 5	Authorized Technical Service
Participant 6	Authorized Technical Service
Participant 7	Authorized Technical Service
Participant 8	Repairman
Participant 9	Repairman
Participant 10	Repairman
Participant 11	Repairman
Participant 12	Authorized Technical Service
Participant 13	Authorized Technical Service
Participant 14	Authorized Technical Service
Participant 15	Authorized Technical Service

4.1 The Comparison of the Delivery Frequency of Small Kitchen Appliances and Small Household Appliances to Services

The authorized technical service personnel and repairmen are asked to compare the delivery frequency of small kitchen appliances and small household appliances to the services and to explain the differences they observe between the products (see Table 5 and Figure 15).

Table 5 – The Delivery Frequency of Small Kitchen Appliances, Vacuum Cleaners, Irons and Personal Care Products to Services.

Participants	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
Small Kitchen Appliances															
Vacuum Cleaners															
Irons															
Personal Care Products															

Figure 15 - Small kitchen appliances, vacuum cleaners, irons and personal care products delivered to the services.

Figure 16 - Epilator and connector.

Participant 14 states that small kitchen appliances take place on the top in terms of the delivery frequency to the technical services, and these are followed by irons and vacuum cleaners. According to Participant 1, the small household appliances that are most frequently brought to the service are coffee machines and kettles. Participant 5, on the other hand, states that the items that are most frequently brought to the service are irons, food processors and vacuum cleaners, respectively. It is also mentioned that personal care products comes after these three groups in terms of the delivery frequency to the technical service (see Figure 16). Participant 8 reports that the items that are most frequently brought to the service are kitchen appliances and vacuum cleaners, respectively.

Contrary to the most of the Participants, Participant 2 mentions that small kitchen appliances are brought to technical services less frequently than small household appliances that include vacuum cleaners, irons and personal care products. The firm that Participant 2 working for have less product types in kitchen appliances category. In other words the spectrum of the small kitchen appliance are less compared to other appliances in the company he works for, this may affect the frequency of small kitchen appliances being brought to the service.

Participants 3, 4, 9, 13 and 14 suggest that the delivery frequency of products to technical services is directly proportionate to use frequency of products. They argue that, since small kitchen appliances are used more when compared to other small household appliances, they are brought to technical services more often. Participant 13 lists the products that are most frequently brought to technical services as irons, vacuum cleaners, blenders, choppers and sandwich toasters, without putting them into frequency order.

Participant 15 lists the products as vacuum cleaners, small kitchen appliances and irons, again without putting them into frequency order. Participant 15 also mentions that personal care products such as hair dryers and epilators are sometimes brought to technical services. Similarly, Participant 7 also says that the delivery frequency of products to technical services is in direct proportion to the use frequency of these products. Furthermore, he claims that breakdown frequencies of products differ seasonally. He indicates that epilators are brought to the service frequently in summer while hair dryers are brought to the service mostly in winter (see Figure 17 and 18).

Figure 17 - Hair drier with broken heating element.

Figure 18 - Broken shavers kept in the technical service storage.

Participants 10, 11 and 12 state that the delivery frequencies of products to technical services are, besides use frequencies, directly related to material quality as well. They also mention that the products having materials of low quality are mostly from the Far East have high frequency in terms of delivery to services.

4.2 Problematic Product Groups in terms of Repair and Maintenance

According to the data obtained from the Participants, breakdown reasons differ according to the inner parts of the appliances in each product category. The Participants state that they deal with breakdown problems related to motors, thermostats, resistances and cable connections. They list the main problems encountered as:

- Cable winder malfunctions and suction problems in vacuum cleaners;
- Calcification in kettles, tea machines and coffee machines;
- Gear wear in choppers, blenders and food processors;
- Calcification problems in irons.

Participant 3 states that there are no malfunctions that occur recurrently. He adds that they mostly deal with problems related to malfunctions in electrical parts of products.

4.2.1 Vacuum Cleaners

According to the findings, the most frequent breakdown reasons encountered in vacuum cleaners are related to filters. Participant 1 lists the problems about filters in vacuum cleaners among the primary ones dealt with at the service. Firms have begun to use heap filters in vacuum cleaners that requires regular maintenance. He explains that users can not get used to this change, and usually forget to clean the filters of their vacuum cleaners. According to Participant 1, vacuum cleaners are brought to the service more often because of the change in the type of filters.

Participant 2 states that the most frequent malfunction at the service is the decrease in the suction capacities of vacuum cleaners. As he adds, there are complaints about the dust that vacuum cleaners emit while operating, and the malfunctions in cable winders (see Figure 19).

Figure 19 - Vacuum cleaner with broken cable winder.

Participant 12 states that users complain about the decrease in suction capacities of vacuum cleaners and this is one of the main problems arising from the fact that filters are not replaced regularly.

Participants 13 and 14 report that the maintenance of vacuum cleaners is not done accurately through cleaning their filters. Consequently, suction capacities of these vacuum cleaners decrease over time. They also state that torn hoses, motor malfunctions and stuck cable winders are the most common problems encountered in vacuum cleaners. Participant 15 claims that mostly use oriented problems lead to malfunction of vacuum cleaners. He states that the most common problem is the decrease in suction capacities. His suggestions to increase the lifespan of the product involve the cleaning of the filters after every use, replacing of dust bags without waiting for it to be filled completely, and not vacuuming liquids. He also mentions that when users vacuum trash such as paper tissues and papers, this leads to blockages and cause problems in motors.

4.2.2 Irons

Participants argue that the most commonly faced problem in irons is calcification in resistance. Besides, they state that the problems related to water leaks due to drops, and cable related problems are frequent as well. For example Participant 1 states that the most common problem they face in small household appliances is calcification in iron bases (see Figure 20 and 21).

Figure 20 - Iron base is broken-down as a result of calcification.

Figure 21 - Iron base is broken-down as a result of calcification.

Figure 22 - Disassembled bases from broken irons.

Figure 23 – Broken irons kept in the technical service storage.

4.2.3 Small Kitchen Appliances

Most of the Participants claim that small kitchen appliances are brought to technical services more often because they are used more frequently compared to other small household appliances. Breakdown reasons of small kitchen appliances are presented in detail in Section 4.4.

4.3 The Frequency of the Small Kitchen Appliances Being Brought to Technical Services

The frequency of the small kitchen appliances being brought to the technical services is shown in Table 6. The answers of authorized technical service personnel and repairmen about this topic are observed to be similar. According to the research results, the food preparation appliances (i.e. mixers, food processors, blenders, juicers, choppers, etc.) are brought to technical services more frequently than the heaters and the cookers. Most of the Participants declare that the choppers, blenders, food processors have been brought to the technical services more frequently than the other small kitchen appliances (see Table 6).

Table 6 - Answers of Participants about Small Kitchen Appliances that Breakdown Most Frequently.

Participants	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
Blender															
Kettle															
Chopper															
Toaster															
Food processor															
Mixer															
Coffee maker															
Tea maker															
Mini-oven															

Figure 24 - Broken food processors and choppers.

Participant 3 states that food preparation appliances are delivered to services most often than the other the small kitchen appliances. He also adds that especially the chopper and the blender are the ones that are brought to the service most frequently (see Figure 24). Based on the field work result, twelve out of the fifteen Participants point out blender as the kitchen appliance which is brought to services most frequently (see Figure 25).

Figure 25 - Broken blenders.

Participant 14 states that blender breaks down very often, and the mostly seen problem stems from the operating system. The power switch button should be pushed at intervals of ten seconds. Otherwise, motor can be burnt out and gears can be worn away (see Figure 26). However, the Participant 14 claims that the users usually do not abide by this rule. Besides he adds that using the blender for the hard vegetables also leads to product breakdown.

Figure 26 - Blender with eroded shaft gear.

Participant 8 asserts that the blenders and the toasters are the small kitchen appliances which are delivered to the service most frequently. According to Participant 13, the small kitchen appliances that are brought to the services more often are the choppers, blenders, toasters and the kettles. Participant 9 lists the products according to their frequency to be brought to technical service as blenders, choppers, toaster, water heaters and mixers. Participant 5 states that blender and the food processors are the small kitchen appliances that brought to the service most frequently. Similarly Participant 15 asserts that the blenders, choppers and the food processors are delivered to services most frequently.

Kettle is one of the small kitchen appliances that is brought to technical services most frequently based on the research data. Eight of the Participants considered kettles as the small kitchen appliance that is brought to technical services most frequently. Choppers are also specified to be the small kitchen appliance that is delivered to the technical services most frequently by the seven Participants. Six out of the fifteen Participants specifies toasters as the small kitchen appliance that is brought to technical services most frequently. Whereas four Participants assert food processors as the most problematic small kitchen appliance.

The mixer is found as the most problematic appliances by the three Participants (Participants 10, 11, 12). Participant 4 states that blender and the food processors breakdown very often whereas the tea and the coffee machines are brought to the service rarely, since they are not

used as commonly as the others. Participants claim that they are usually used in the offices whereas the blender and the food processor are used almost in every house.

Participant 1 mentions that the coffee machines and the water heaters are the small kitchen appliances that are brought to technical services most frequently. Only Participant 1 points out that the coffee machines are brought to services most frequently. Participants 1 and 2 state that tea machines are brought to technical services most frequently.

4.4 Breakdown Reasons of Small Kitchen Appliances

The breakdown reasons of small kitchen appliances are presented in this section. The reasons of breakdown range from issues regarding production to use oriented ones such as overworking or misusing etc. Frequent breakdown reasons of small kitchen appliances include resistance and thermostat problems in kettles and toasters, and issues related to the gears of blenders, choppers and food processors.

4.4.1 Blender

Table 7 - Breakdown Reasons and Broken Parts of Blenders.

Breakdown Reasons of Blender	**Broken or Worn out Parts of Blender**
Operating the appliance perpetually	Gears wear away and/or motor is burnt out
Blending too dense material	Gears wear away and/or motor is burnt out

Blender is the most problematic appliance which breaks down most, according to the field work. The breakdown reasons stem from both use oriented and production oriented issues (see Table 7). Participants state that gears and motor are the parts of blender that breakdown most. This product differs from other small kitchen appliances in terms of operating system. According to user manual blender should operate at 10-second intervals. Otherwise, product and the pieces may be damaged. Participant 1 states that non-stop use of the blender may damage the gear or motor. Putting dense material to blend may also lead to problems (Participants 11, 13 and 15).

Figure 27 - Broken blenders kept in the technical service storage.

All of the Participants suggest that user manual should be read, and products should be used complying with the instructions. 11 Participant out of 15 state that blenders' gears wear away and motor is burnt out, and most of the time product failures or breakdown result from these two factors. Participant 8, 10 and 15 state that unless users abide by the instructions, products fail and their lifespan shrink.

Participants state that blenders should be cleaned abiding by the instructions in user manual. Participant 8 touches upon a rule while cleaning the product. He states that product's steel foot part should be left in a position in which blades stay upwards after being cleaned. If this part dries in a position downwards, metal parts of the product may be oxidized, and this lead to failure because it gets harder to spin.

The most common breakdown reason of blenders is that gears wear away. This is confirmed by majority of the Participants and it stems from both use and production oriented problems. Participant 15 says that these pieces are made out of plastic which is mostly of low quality and wear away easily. He also claims that if the gears are made out of more durable material to

overcome this problem, another piece of the product may breakdown. He mentions the durability of the product parts should be similar. He states that appliances need to be considered as a whole. He claims that if all of the parts are produced out of durable materials, their price will rise and, consequently sales will fall.

4.4.2 Kettle, Tea Machine and Coffee Machine

Table 8 - Breakdown Reasons and Broken Parts of Kettle, Tea Machine and Coffee Machine.

Breakdown Reasons of Kettle, Tea Machine and Coffee Machine	**Broken Parts of Kettle, Tea Machine And Coffee Machine**
Water leaking into the circuit of product	Circuit board burn out and steam sensors breakdown
Operating without water inside the reservoir	Resistance and Thermostat
Calcification	Resistance
Overworking the product (Workplaces, Offices)	Resistance and Thermostat

According to research findings, kettle, tea machine and coffee machine bear similarities in terms of their breakdown reasons. Data shows that most frequently malfunctioning parts are resistance and thermostat (See Table 9). Most basic factors leading to failure are overworking the product, water leaking into the circuitry of the product and calcification.

According to the statements of authorized technical service personnel and repairmen the frequency of the product breakdown depends on the frequency of their use. How often a product is used may vary depending upon where it is used and the number of people in this place. For example, a kettle or sandwich toaster or tea machine may be used in a family of four people. They may also be used in workplaces, offices. These two places naturally differ in terms of use frequency. Participant 1 states that the company he works for produces products which are suitable for home environment and tests are carried out considering the frequency of use in this place. He notes that users usually ignore this point and use products in cafes, and consequently these products breakdown due to overworking. He states that sandwich toasters and coffee machines are especially used in cafes and offices. He takes coffee machine as an example and adds that when a coffee machine is used at home, maximum six cups of coffee is

made with it in a day. However, in a workplace this number may rise up to fifty cups. As a result, the risk of failure also rises. Participant 15 argues that when this kind of products which are suitable for home environment are used in a workplace, their lifespan may also decrease due to overusing.

One of the reasons why kettles, tea and coffee machines breakdown is that they are not cleaned considering the instructions (see Figure 28). Because they have electrical circuits inside, they should be wiped with a cloth. If they are washed in a sink or dishwasher, water leak into the circuits (Participants 1, 14 and 15).

Figure 28 - Tea machine cleaned in the dishwasher.

Coffee and tea machines and kettles should not be operated without water in their reservoir. Otherwise, thermostat or resistance may overheat, circuit board may burn out and sensors may breakdown. Participants state that this is the most frequently seen problem in kettles, coffee machines and tea machines (Participants 2, 3, 4, 5, 9, 13 and 14).

Figure 29 - Kettle with broken resistance.

When tap water is used in kettles, tea or coffee machines, it may lead to calcification in their reservoir or resistance (see Figure 29). Calcified resistance overheats in order to boil water and breaks down. Participant 3 states that kettles fail due to this overheating problem. Participant 10 says that this problem is rare in Ankara comparing to other cities as a result of low levels of lime.

Participants recommend that a kettle should be operated after its top is closed and water should be somewhere between maximum and minimum level. Participant 11 states that if a kettle is operated without closing its top, steam sensor can not sense that water is boiling and thus, it keeps boiling until water runs out. Then, resistance burns out as no water remains in reservoir. Moreover, Participants 11 and 13 assert that steam sensor breaks down when too much water is filled into the kettle exceeding the maximum level.

4.4.3 Food Processor, Chopper

Table 9 - Breakdown Reasons and Broken Parts of Food Processor, Chopper.

Breakdown Reasons of Food Processor, Chopper	**Broken Parts of Food Processor, Chopper**
Product parts should fit closely together before use	Gears wear away and motor is burnt out
Processing hard materials	Gears gradually wear away, motor is burnt out
Overloading the container	Gears gradually wear away, motor is burnt out

In the light of field work, food processors and choppers breakdown due to similar factors. Most common problem is that gears gradually wear away (see Figure 30). Operating the product without placing its pieces properly, processing hard material and putting excessive amount of material for the product to process are among the factors that also lead to failure (see Table 9).

Food processors and choppers are composed of different parts such as chopper blades and top. These parts should fit closely together before use. Participant 2 states that users need to properly fit the pieces together before they use the product. This Participant emphasizes that this is a common problem in food processors because users do not pay attention to fit these pieces together properly, and this usually results in worn away or eroded gears and burnt out motor.

Figure 30 - Broken choppers with eroded gears.

Participants state that food processors and choppers breakdown because of overworking. They add that users try to process hard materials such as carrots and dry breads without cutting them into small pieces and this may damage gears and motor. Participants 1, 3, 10 and 13 mention that when too hard material is processed with blender or food processor, plastic gears wear away. Participant 7 states that users try to process dry bread but this material is too hard to process, therefore gears and motor are damaged. Participant 9 points out that users bring blenders and food processors to service more than any other small kitchen appliance. This Participant claims that these failures stem from overloading. When choppers are overloaded, it gets harder for blades to spin. Food processors also break down due to the same problem.

4.4.4 Sandwich Toaster

Table 10 - Breakdown Reasons and Broken Parts of Sandwich Toaster.

Breakdown Reasons of Sandwich Toaster	**Broken Parts of Sandwich Toaster**
Overworking the product (e.g. working places, offices)	Resistance burns out
Operating product for a long time	Resistance, thermostat and fuse breakdown
Not maintaining the product regularly	Teflon layers wear away
Low material quality	Product parts wear away and breakdown

Authorized technical service personnel and repairmen state that resistance and thermostat are the pieces of sandwich toasters which break down most. If product is not cleaned when it is necessary and keeps operating for a long time, this kind of failures may arise (see Table 10). Furthermore, Participants also point out that products may break down if they are made out of low quality material.

How often products fail and how long they will keep functioning mainly depend on what type of material they are made out of. Participants 7 and 11 state that the most frequent problems of sandwich toasters are related to resistance which burns out, and teflon layers which wear out.

If sandwich toasters keep operating for a long time, they overheat and this may cause a problem in the resistance, thermostat or fuse. According to Participants 3 and 9, most common problem in sandwich toasters is that users plug them in for a long time or forget them in that state. Participant 10 states that when sandwich toaster is left plugged in for a long time, its fuse burns out. If they have no fuse, then the resistance burns out (see Figure 31).

According to Participant 8, users do not take care to clean sandwich toasters properly. Therefore, they break down in a short time. He states that unless sandwich toasters are cleaned, oil begins to accumulate, leaks inside and damages the cables. Teflon layers of sandwich toasters should also be cleaned regularly (see Figure 32).

Figure 31 - Sandwich toaster with broken fuse.

Figure 32 - Sandwich toaster with eroded teflon layers.

4.4.5 Toasters

Table 11 - Breakdown Reasons and Broken Parts of Toaster.

Breakdown Reasons of Toaster	Broken Parts of Toaster
Not maintaining the product regularly (crumbs may accumulate inside toasters)	Malfunctioning of moving mechanism
Operating product for a long time	Resistance, Thermostat and Fuse Breakdown

Toasters should be cleaned on regular basis depending on how often they are used. Participant 4 states that crumbs may accumulate inside toasters unless they are cleaned, and this causes failure of the product. These crumbs go inside the product and may be squeezed between the parts (see Figure 33). Thus, they prevent the inner parts from moving. He adds that problems in toasters range from burning out resistance to malfunctioning mechanism (see Table 11). Toasters are broken down if they keep operating for a long time. Product parts overheat and may have a problem in the resistance, thermostat or fuse (see Figure 34).

Figure 33 - Toaster with broken mechanism.

Figure 34 - Toaster with broken fuse.

4.4.6 Juicer

Table 12 - Breakdown Reasons and Broken Parts of Juicer.

Breakdown Reasons of Juicer	Broken Parts of Juicer
Not maintaining the product regularly (leftovers accumulates between pieces)	Motor burns out

Participants state that juicers should be maintained and cleaned every time they are used. Otherwise, waste food inside the product may go between the product parts and it gets harder for the motor to operate (see Table 12).

Figure 35 - Sieve of the juicer covered with leftover food.

Participant 14 states that motor burns out when juicers are filled over their capacity. Participants 4 and 13 say that it is crucial to keep some products clean to prevent them from breaking down. Participant 13 emphasizes that juicers are particularly vulnerable to this problem because leftover food may cause the product to fail (see Figure 35). He states that this leftover part accumulates in pieces and makes it hard to spin, and as a result motor fails due to forcing it over capacity.

4.4.7 Mixer

Table 13 - Breakdown Reasons and Broken Parts of Mixer.

Breakdown Reasons of Mixer	Broken Parts of Mixer
Mixing dense material	Motor burns out

Participants 11 and 12 state that users put dense materials, and as a result the motor of mixer burns out (see Figure 36), which is the most common problem in mixers (see Table 13). As stated by the Participants, users should not mix the dough when it is hard.

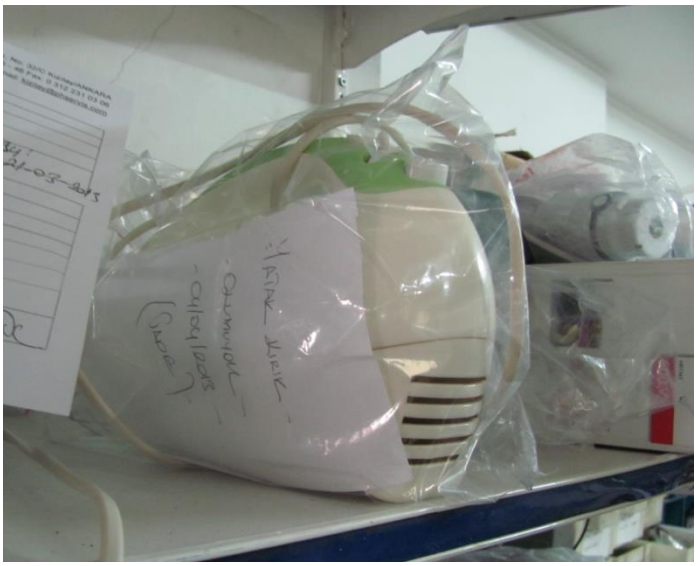


Figure 36 - Mixer with broken shaft because of mixing too dense material.

4.4.8 Mini Oven

Table 14 - Breakdown Reasons and Broken Parts of Mixer.

Breakdown Reasons of Mini Oven	Broken Parts of Mini Oven
Issues related to maintenance of the product (Cleaning is problematic)	Outer surface of the product gets older and looks worn out
Overworking	Resistance breaks down

Majority of the Participants state that users have difficulty in cleaning mini ovens and throw products away because of their old and dirty appearance (see Table 14). Participant 13 says that the most common problem in mini ovens is that outer surface of the product gets older and looks dirty (see Figure 36). Furthermore, Participant 10 claims that users have trouble cleaning mini ovens, which affects only the ease of use but also the lifespan of the product. He states that users can not clean the product and replace it with a new one. He also says that it is especially hard to clean the inner part of it. Moreover, stains on the main part close to the lid, which do not come out, disturb users. He adds another problem apart from cleaning that is resistance breakdown.

Figure 37 - Mini oven with broken on-off switch.

4.4.9 Main and Common Product Breakdown Reasons

Main and common breakdown reasons of small kitchen appliances include the following:

- Cleaning and maintenance problems
- Issues related to user manual
- Low material quality
- Voltage fluctuation

4.4.9.1 Cleaning and Maintenance Problems

Maintenance has a great impact on the lifespan of the product according to the Participants. They claim that maintaining and keeping the product clean have a positive impact on the lifespan and decrease the failure rate (see Figure 38 and 39). Participant 13 points out that products will endure, if users clean and maintain them properly after each time they use them.

Figure 38 - Cleaning of deep fryers is difficult as a result of this oil leaks into the motor.

Figure 39 - Filter of the deep fryer that is covered with oil and dirt.

4.4.9.2 Low Material Quality

Majority of Participants argue that the most common problem in blenders is that gears wear away in time as stated before. Participant 15 states that these pieces are made out of low quality

material and wear away easily. He explains that if gears are made out of more durable material to overcome this problem, motor will fail instead of the gear when the product is forced. He adds that durability and quality of the product parts should be proportionate with each other. He says that appliances should be considered as a whole.

Participant 8 clarifies this with the help of an example. According to him, especially juicers should be produced from high quality materials. He states that users use these household products as industrial products, overuse and force them till they break down (see Figure 40). Therefore, they should be made out of durable materials to prevent breakdowns.

Figure 40 - Juicer broken down because of low material quality.

4.4.9.3 Issues Related to User Manual

Participants claim that users do not read user manual beforehand, and use product without following the instructions. According to Participant 6 users start using products by trial and error, and this leads to product faults. He mentions malfunction of small kitchen appliances regarding this issue. As he states, when using food processors, users should put all pieces of the product together first. Then, they should put the food in to be processed. Some users put the food before placing the blades first. However, it should be vice versa. In this case, the product can not operate easily and gears are worn out or damaged.

4.4.9.4 Voltage Fluctuation

Participants 3, 11 and 12 state that voltage fluctuation is also a factor causing product breakdown. Participant 3 claims that there are two kinds of problems in electrical appliances. First type of faults stem from using the product without complying the instructions and second type of faults are due to the changes in the electric current.

4.5 Maintenance and Repair Processes

The maintenance and repair processes of the fifteen Participants including eleven authorized technical services from different companies and four repairmen, consist of resembling stages. Besides, the results of the research conducted show that the time spent for maintenance and repair of the products are mostly close to each other. According to Participants, users do not bring the products to the service for maintenance, instead they mainly bring the products for repair. Repair process is as follows:

- Delivery of the product to the service: The repair process starts with the delivery of the product to the service by user.
- Troubleshooting: It goes on with the troubleshooting phase that technicians/repairmen identify the breakdown reason of the product.
- Repair and product part replacement: Repair procedure continues with the provision of the spare part; and the process is completed after the part replacement with the defected part.
- Testing: If the product is found to be fully functional during the testing phase, it is delivered to the user lastly.
- Customer feedback: Majority of the authorized technical services make contact with users after the delivery of the product to collect their opinions about the maintenance and repair process, and to evaluate the customer satisfaction.

4.5.1 Troubleshooting - Detection of the Product Breakdown

Authorized technical service personnel and repairmen firstly examine the product brought by its user to the service and figure out its defect. Afterwards, they determine the repair costs and approximate repair time and share this information with the user. The costs of the guaranteed products are covered by the company. Users are informed about the costs of the products which are not covered by the guarantee, and their approval is awaited. For instance, as it is illustrated below, the coffee machine is broken and technician (Participant 3) records the defected parts, the costs of spare parts and workmanship on the paper in order to inform the user about the total cost of the product repair (Figure 41).

Figure 41 - Broken coffee machine with a record including the cost of repair process.

4.5.2 Provision of Spare Parts

Since the costs of spare parts are lower than the cost of the labor required during the repair today, the broken parts of the products are not repaired. All of the Participants state that the products are not repaired anymore; instead, their spare parts are changed after the troubleshooting phase. Therefore, the provision of spare parts can be considered as the most significant factor determining the repair time, and whether the repair will be completed or not. Participant 1 states that the repair time of the products differs according to the availability of the spare part in the service, and they deliver the product to the user in at least one, at most five days. He also adds that the spare parts which frequently breakdown such as resistors and thermostats are available in their service, so this leads to a shorter repair time of these parts. The costs of the guaranteed products which do not have spare parts are returned to the user or the product is changed with a new one or a superior model. Participant 2 also states that repair time is related to the provision of spare parts and that the process has extended since the imported parts become widespread. For example, three or four years ago, even if the spare part of the broken product was not available at the service, the product would be delivered within a week, ten days at most, because the spare parts were manufactured locally. He states that, today, however, almost all the parts of the products are imported; a spare part which is not available at the service arrives in minimum twenty days, and this situation extends the repair time. He indicates that there are cases in which the users wait for forty days for maintenance. He adds that the spare part is requested from Istanbul, and if it is not available there, it is brought from a European Country. There are certain ordering days for requesting spare parts. According to the information obtained from the Participants, the provision of spare parts is one of the most frequent problems during the maintenance and repair process. Locally manufactured spare parts are not only easy to access but are also delivered to the service in a shorter time compared to imported ones. Participant 15 states that they have difficulty in providing the spare parts of old products, and consequently, they can not carry out the repair

of some products. For instance, as it is illustrated below the broken vacuum cleaner and refrigerator can not be repaired as the needed spare parts are not available (see Figure 42).

Figure 42 - Broken vacuum cleaner can not be repaired as the needed spare part is not available.

4.5.3 Testing Stage

After the spare part is replaced with the broken one, the testing stage comes. If it is determined that the product is repaired, it is delivered to the user. Participant 1 states that the product is taken into the testing stage after the replacement of the broken part. When no problem is encountered in the testing stage, the product is delivered to its user (see Figure 43).

Figure 43 - Deep fryer in the testing stage after repairing stage.

4.5.4 Investigation of Customer Satisfaction

Some companies contact with the user after the delivery of the product to collect their opinions about the maintenance and repair process. Participant 2 states that authorized technical service personnel calls users after the maintenance and repair service, and obtains information about the process. He reports that they ask the users whether the repair of their products is carried out and how much time the process takes. Some companies provide users the opportunity to follow the maintenance and repair process. Participant 4 says that the users are able to follow all the processes from the delivery of the product to the service to the delivery of the product to the user from the internet. He states that the central service frequently informs the user about the product. Users are called in order to investigate their satisfaction one or two weeks after the delivery of the product. He adds that, in case of a negative criticism, the authorized technical service that carries out the maintenance or repair of the product are informed about the criticism, and the technicians again make contact with the user about the problem they have. Some companies pay attention to customer satisfaction concerning maintenance and repair processes. They get users' opinions about these processes through different means of communication. Repairmen who do not work for a specific company do not investigate customer satisfaction exclusively about maintenance and repair processes.

4.5.5 Maintenance and Repair Time

Although it differs according to the product, the breakdown reason and the provision of spare parts, the maintenance and repair time of products are generally close to each other according to the field work results. Five of the Participants state that the repair process is completed within a day. The number of Participants who claim that this process takes less than a week is nine. Two of the Participants say that the repair process takes more than fifteen days due to

various reasons they mention. Participant 3 indicates that, if the required spare part is available at the service, the repair can be completed within the same day, and then the product is delivered to the user. Participant 4 explains the necessary materials for the repair of the product are requested from the central service, and when the spare parts are delivered, they are replaced with the broken parts. He states that they deliver the products in three to seven days. Participant 7 states that the repair of the product can be completed within a day and delivered to the user. Participant 8, on the other hand, says that the repair time differ according to the product and breakdown. While some authorized technical services and repairmen repair a product in an hour, some may take more than fifteen days because they wait for spare parts. He mentions that there is no problem with the spare parts that are manufactured locally; however, the delivery time of the products manufactured in the Far East can be quite long. He adds that these kinds of problems are encountered especially with juicers and personal care products.

4.5.6 Maintenance and Repair Process: Differences between Authorized Technical Services and Repairmen

Some differences are observed in the maintenance and repair time of the authorized technical services and repairmen. All of the repairmen state that, contrary to authorized technical services, they do not make contact with users in order to investigate customer satisfaction after the maintenance and repair processes. Besides, they have difficulty in finding spare parts and they meet their needs either from authorized technical services or with the spare parts they take from broken products. For example, Participant 11 has difficulty in providing spare parts, since he does not work for any specific firm. He states that, in the repair process, he first detects the breakdown reason of the product. If he needs a spare part for the product that is not available, he just do not accept the product for repair. Participant 11 also mentions the same subject and states that if he can carry out the repair, he hands in the product to the user in one or two hours. Participant 10 states that they repair the broken product in a few hours, and if there is any breakdown they can not repair, they can direct the user to another service. Users prefer to bring broken products which are not under warranty to repairmen due to the lower maintenance and repair costs. The repairmen do not accept products whose spare parts they can not find because they will not be able to repair them, and advise users to take these products to product's authorized technical service.

To summarize, the process of maintenance and repair of 11 authorized technical services and 4 repairmen is described in a detailed manner in this section. This process usually includes trouble shooting, spare part supply, replacing faulty part and testing phases. Some companies question customer satisfaction after the product is delivered. According to the data, users do not bring their products to service for maintenance. All products are brought to service for repair. All Participants are of the same opinion that replacement of the spare parts is more frequent than repair work. Therefore, the most crucial part of the process is to supply spare part and the most common problem during the process is the supply of spare part. Especially repairmen who do not work with a company have difficulty in finding spare parts. They use some working parts of the products which can not be repaired as spare parts. The data derived from the Participants reveal that product is repaired and maintained in a period of 7-10 days depending on the type of products and their faults. The Authorized technical services and the repairmen may differ in terms of supplying spare part, contacting customers and deciding how products will be discarded.

4.6 The Strategies Followed by Companies for Extending the Product Lifespan

4.6.1 Maintenance

The Participants point out that maintenance is one of the main factors that prolong the lifespan of the products. Participant 1 explains that the company he works tries to make the devices to do various actions by itself with the help of the electronic systems and sensors. He notes that they do not leave any responsibility to the user, and are able to eliminate misusing errors by this way. Research and development studies aim to make the product easy to use, develop the product technologically and extend the lifespan of the product.

Participant 2 mentions that the products need to be cleaned by products and tools that are proper to their operating system and materials, and also the company he works for produces cleaning materials for maintenance of the products. He gives examples of the interior cleaning materials for washing machines and dishwashers. He adds that they can prevent the machine's plastic parts being worn-out. Participant 6 explains that his company aims to extend the lifespan of goods by developing maintenance and protection systems special for each device they sell.

According to the research data, cleaning personal care products after each use is one of the significant factors to extend their lifespan. Participant 3 states that electric razor's headpiece and hair removal tool's tweezers need to be cleaned after use, and the tools or accessories for cleaning can be found in the boxes of products.

4.6.2 Providing Maintenance and Repair in Technical Services

Authorized technical services offer free maintenance and repair for the products in warranty and a paid maintenance and repair for the damages that are not covered by the warranty. Participants consider the maintenance and repair service as a strategy to extend the lifespan of the product.

Participant 1 and 4 see the providing spare parts as a strategy to extend the products lifespan. Participant 4 indicates that the company he works for produces spare parts for seven years which is the requirement of Ministry of Science, Industry and Technology for the lifespan of the product. Participant 4 also points out that this period used to be ten years but three years shortened.

Participant 15 says that the company that he works for provides the warranty in order to extend the lifespan of the product, also emphasizes that how the maintenance will be done is written in detail in the manual.

4.6.3 Quality of the Materials

The majority of the Participants think that using high quality materials increases the lifespan of the products. Participant 5 says that the company he works for develop strategies about the repair of products in order to extend the product's lifespan such as using the highest quality material and providing high quality technical service. Local production of products is a factor that has a positive effect on the both the accessibility of spare parts, and the quality control of products. According to Participant 8, durable and high quality products were used to come from European countries, and Turkish products had low quality 15 years ago. He claims that

locally produced products have higher quality than imported ones currently, and he advises companies to produce their products and spare parts in Turkey.

Product longevity has a positive relation with the quality of the production processes and materials. Participant 14 says the company that he works for prefers to use high quality materials to increase the lifespan of the products. He also highlights that changing warranty duration from two to seven years is the proof of that firm producing high quality products.

4.6.4 The Technical Knowledge and Experience of the Technicians/Repairmen

There are various products of different companies in the market. Even they usually have similar working principles, there are differences observed in the inner parts and their placements. Participant 12 points out that maintenance and repair base on the technical knowledge and the experience. He believes that an experienced repairmen with a proper technical knowledge can easily overcome a complex problem that he faces; whereas a repairman who opens up a product for the first time might not know how to disassemble it or where to put screws in it and so on. All of the Participants agree on that the repair process requires technical knowledge and experience. The ones who lack enough information may face with a lot of problems during the disassembly and assembly of products.

4.7 The Problems Related to the Maintenance and Repair Process

The problems faced during the maintenance and repair by the Participants can be listed as:

- Producing permanently attached product parts
- Issues related to replacement parts
- Accessibility of the inner parts of products
- Manufacturing defects
- Planned obsolescence
- Technical obsolescence
- User tries to repair the product

4.7.1 Producing Permanently Attached Product Parts

Assembling some parts of a product with methods such as gluing up or attaching by press permanently, are considered by the Participants as the company constraints. This make the lifespan of a product shorter, and also increase the cost of the repair. Even the functioning parts have to be removed with the broken ones, as they are permanently joined together, thus the cost of the repair increases. Besides, the functioning parts' being thrown away with the broken ones increases the amount of waste. Since the cost of repair is almost as much as the cost of buying a new one, the consumers prefer to buy a new product. Production of the heating coils of some electric irons together with their surfaces can be considered as an example for this. In case the surface of an iron breaks down, other inner and functioning parts produced together with it should also be replaced. Participants state that this matter is used to be different formerly as the parts of an electric iron such as the heating coil, the ironing surface and the thermostat were produced separately, and all of them were easily replaceable.

The body of a blender produced by in-mould assembly, can also be considered as another example related to this issue. As the blender can not be disassembled, even if a break-down

which can be easily repaired occurs, the whole body is immediately thrown away. Similarly, Participant 11 states that it is impossible to repair the parts produced as attached to the body, since such products can not be disassembled. Participant 7 predicts that the broken products will be immediately replaced without being repaired in the near future, as they will be produced as disposable. He claims that disposable appliances can even be observed nowadays. Participant 7 has even a foresight about the authorized technical services. He predicts that the way how the technical services work will also change and the number of them will be reduced. Head service offices will be determined; one for each region, such as one in Istanbul for Marmara Region, and one in Ankara for Central Anatolia region. Such a head technical office will be able to collect and store more broken products than any usual technical service. Cargo companies will also be included in this system, in which a broken product will be directly taken from the user's home and a new one is delivered back.

Participants 2 and 12 give the example of kettle about the production and assembly process through which the parts are permanently attached together. The lower base, the resistance and the thermostat are attached together in some kettles, thus all the parts need to be thrown away in case a problem occurs in any of these parts. Moreover, the body of a kettle, which is made of plastic and steel, are not provided to the service separately. Participant 12 emphasize that the lower base and the resistance are produced attached to the body, thus the repair becomes impossible.

Participant 5 exemplifies this situation with blenders and food processors. The motors of these products are produced in way that they are permanently attached to the body, hence these parts can not be replaced. In case of a break-down, a new one is delivered to the user. In such cases that multiple parts are attached together, the working parts have to be replaced together with the broken ones. The resistance of the toaster is produced connected to the body, just like the tea machines, grills and blenders are produced with multiple attached parts.

Production with multiple attached parts causes challenges for the technical service personnel and repairmen during the repair and maintenance processes. Participant 13 says that he feels uncomfortable in case he damages any part while dissembling a product with multiple attached parts.

The fact that some parts of the products are manufactured in a way that they are permanently attached is considered as one of the problems faced during the maintenance and repair by the Participants. A functioning part which has not completed its lifespan yet has to be also replaced, as it is produced attached to the malfunctioning part. Under these circumstances, both the repair cost and the amount of waste increase. So the users do not prefer their products to be repaired. This problem is most commonly faced in the product cases of blenders, electric irons and kettles.

4.7.2 Issues Related to Replacement Parts

According to the Participants the difficulties about providing spare parts are among the main problems faced during the repair process. They mention that the repair process means the replacement, since the broken products are repaired no longer. Instead of repairing the broken products, these are replaced with the new ones. In such a system, the spare parts provide a basis for the repair process. The spare parts which are delivered to the authorized services by their companies are not produced any more after a period. This period which depends on the

firm varies between 7 to 15 years. After this period, the product is considered as out-of-date. The refrigerator shown in Figure 44 has been waiting for a spare part approximately for three months.

Figure 44 - Broken refrigerator can not be repaired as the needed spare part is not available.

Participant 1 indicates that the product has been counted as out-of-date and its broken part is no longer produced. The ones that experience the most difficulty at providing spare parts are the repairmen who are not working for any company. The repairmen state that they provide the spare parts from either the authorized services of the companies or from the reliable parts of the irreparable products. Participant 12 says that he experienced difficulties at finding spare parts because of not working for a company. He also indicates that, since these parts are mainly produced in China, they do not exist in our country. Besides as he says, the repairmen who do not work for a company supply the spare parts from the authorized services. He adds that the situation of spare parts' being no longer in production is among the constraints about maintenance and repair. He remarks that even though a product is no longer in production, some consumers continue to use these. According to Participant 12, in case these products go out of order and their spare parts are not found, they can not be repaired, thus are thrown away.

Cost of the spare parts is a factor that increases the repair cost. Participants indicate that users complain about high repair costs.

As the spare parts are mostly produced in the Far East countries, it is a problem for the authorized services to supply them. Participant 10 states that products are not repaired but their parts are replaced with the spare ones in the services. He also mentions that in the maintenance and repair process, the most commonly faced problem is not being able to find the spare parts. He adds that this problem occurs less if the spare parts are produced locally, but more frequently the parts produced in the Far East countries.

Participants 4, 6 and 8 indicate that the problem of the product can not not fixed without the spare parts, so the company replaces the product with the new one. Likewise, Participant 10 says that the repair can not be handled without the spare parts. Participants give examples of the spare parts they fail to provide. Participant 9 says that they fail to provide the extra parts of the main bodies of the products. He also adds that when there occurs any damage on the body of the product, they replace the whole product with the new one.

Participants stress that in order to repair the products efficiently, the most important factor is to provide the spare parts. The reason for that is the technical services are not doing repairs any more. The broken products are adjusted to work in order by replacing the malfunctioned part with the new one. All of the Participants mention their problems about providing spare parts. They claim that the locally produced spare parts are more accessible and qualified compared to the ones that are produced in the Far East countries.

4.7.3 Accessibility of the Inner Parts of Products

Products should be designed by taking their maintenance and repair process into consideration. The questions like how the product will be opened, how the repairmen will determine and reach the broken part, how he will insert the spare part, and how he will assemble the product at last should be thought. Participants indicate that the design process without considering the maintenance and repair processes of the product causes problems such as the assembly of the parts and the product body. They mention that they encounter difficulties while assembling the spare parts, even though for some products it seems easy to do so.

Participant 15 points out that device bodies are assembled in three different ways; screwed, snap fit, by adding that he prefers the screwed ones as the most efficient solution. He mentions that spiked ones are more fragile so with a sudden force they get broken. He states that, to dismantle the click-fit products, they need to use a force on the body and thus the body gets damaged. For the screwed ones, even if the screws are worn out after a long period, the screws can be replaced.

Participant 3 and 8 say that they have problems in the process of maintenance and repair when they disassemble the products. They criticize that there are various number and types of screws. Participant 8 says, “Formerly, when I wanted to disassemble an electric iron, I used to be able to handle it by removing a screw that is on its outer surface. But now in order to reach a piece in inner part, sometimes I need to remove forty one screws. Various kinds of screws are used; triangular, hexagonal screws and there is even one with a hole on its tip.” The characteristics of a product that Participants are looking for during the repair are that their parts should be easy to locate and easily disassembled and assembled.

Participant 8 and 9 suggest that the devices should be closed up with screws so as to make maintenance and repair procedures more efficient. They also add that there should not be any screws more than needed on the product. They indicate that they encounter problems with the products with snap fit as their body can be easily damaged while disassembling.

To summarize, the problems Participants face during the maintenance and repair due to the ways that the parts are connected are analyzed in this part. Most of the Participants state that product parts should be accessible. In addition, they argue that the parts should be easily assembled and disassembled, as this can ease the maintenance and repair process. The way that the parts and the body of the products take apart should be considered in the process of design. The number of the screws, accessibility of the product parts, and the way of assemble/disassemble can be counted as the factors affecting the maintenance and repair duration.

4.7.4 Manufacturing Defects

Participants argue that they face problems during the maintenance and repair process that result from the failures of the production process. Participant 3 states that sometimes a new spare part does not work. Besides, he complains about the plastic pieces in the products which remains because of the mold defects that can cause problems during the repair phase. He explains that before repairing they fix and clean these defective parts.

Participant 2 divides the products which can not be repaired in to two as the ones with permanently attached product parts and the ones that can not be disassembled as a result of their design and production. In addition he claims that these problems are present because local production is not common and can not be controlled.

4.7.5 Planned Obsolescence

Participants indicate that using materials of poor quality in production causes problems. They say that some brands use this kind of materials, which are produced in Far East countries. Participant 5 and 8 consider the poor quality of the products and their spare parts as one of the constraints that companies have about maintenance and repair. Similarly, Participant 10 complains about using low quality materials in production and added, “Sometimes the materials of a product are too bad that it gets broken in our hands during the repair.” He gives some examples related to this problem such that the body may crack while dissembling of the snap-fit joined products, the nails of the products may be broken while closing up, and the screw details of the malfunctioning part may break while trying to take it out. Participant 2 shows Chinese products as an example of using low quality materials. He mentions that companies mostly use the parts produced in East Asia, and especially the plastic parts that are produced from poor quality materials break while trying to connect them to the product, and the seats of screws are scattered.

4.7.6 Technical Obsolescence

Participants claim that the digital parts of the products breakdown more frequently than the mechanical parts. Participant 11 declares that the digital parts create problems both during the use and the repair procedures. He also says that these parts shorten the lifespan of the products.

Especially the digital parts of some products as kettles are getting easily broken whereas the mechanical parts are more durable and long-lasting. Those parts also create problems during the repair, since they are too complex. As the technology is getting developed further, the mechanical parts are being replaced by the digital ones. According to the Participants, this shortens the lifespan of the products and increases the frequency of product breakdown.

4.7.7 Users' Intervention in Repairing the Product

Technical knowledge and skills are required to repair most of the small kitchen appliances in the market. Trying to repair an electrical appliance without proper knowledge and experience not only increases the cost of the repair, but also can cause dangerous accidents such as electric shocks. Moreover, it makes the process of the repair longer and harder.

Figure 45- User's intervention to repair the vacuum cleaner and disassembled parts of it.

Participant 1 states that the maintenance process becomes more difficult when the users try to repair the products on their own, and can not manage to do it. He shows a vacuum cleaner as an example that the user has tried to repair and disassemble. As the user can not bring the parts of the vacuum cleaner together, it takes more time to repair that product (see Figure 45).

Participant 2 points out that it is harder to repair small kitchen appliances compared to the other household appliances like washing machines, dishwashers. However, he admits that there are customers that can open up the toasters and change the resistors. He indicates that there are delicate nails placed in the opening parts of the small kitchen appliances which users may damage the product if s/he does not have the required knowledge and experience.

Majority of the Participants assert that users can change the accessories of the small kitchen appliances. The knives of mixers, filters of the coffee machines, glass pots of tea and coffee machines can be changed or replaced easily by the users.

Participant 3 states that special screws are used in products, and users can buy appropriate screw drivers in order to disassemble the appliance. He also mentions that the company that they are working for do not sell spare parts of the product, so even if the user disassembles the product s/he can not fix it.

Participant 4 explains that they do not do repair in the service but they change the broken parts with the spare ones. He suggests that users can change these parts to repair products by themselves. He gives the example of gears of the blenders that are worn out frequently.

Participant 6 mentions that the users need the equipment to repair their electrical products like spare parts and screwdrivers. He asserts that after having the proper tools, users are able to fix their products. Likewise Participant 9 and 10 declare that some users are able to fix their products. This depends on the user's knowledge and skills, and the product type. Participant 10 says that there are users who try to open the products that are hard to open and break them. On the other hand, he also mentions that there are users who open the product that are screwed and easy to open, find out what is wrong and repair it.

Participant 15 indicates that since the users do not have enough experience and knowledge, they make mistakes while trying to repair the product. He also says that the users may place the parts which they remove into a wrong place or in a reverse position, hence these also increase the cost of the repair. He states that some of the users have tried to reconnect the broken cables with a tape without realizing the possible harmful consequences of their actions. He also advises that the users have to ask for help from technical services about the technical issues. They need to realize the risks of electric shock during the repair, and also other associated risks and accidents. For instance, a temporary solution such as tape can melt by the heat of the electricity through the cable, which may cause a fire.

For the users that do not have the skills or knowledge electrical products may be dangerous to repair and cause accidents. Participants explain that users open the products, disassemble the parts and then they are not able to bring the parts back together. They claim that repair process gets harder and the cost of the repair increases (Participant 8, 9, 10).

According to five of the Participants, users should not try to repair small kitchen appliances as the process requires technical knowledge. Participant 12 argues that in order to repair household products a person needs to be trained in this topic and he gives microwave ovens as an example. He states that repairing microwave ovens requires special technical knowledge and it is very dangerous for someone to disassemble it. However he also mentions that some users try to repair even their microwave ovens.

4.8 Constraints of the Companies Related to the Maintenance and Repair

4.8.1 Increasing the Product's Functions and Decreasing the Product's Lifespan

The users might have different approaches to the lifespan of the products, compared to the companies. The users would like to use the product in a longer term, while the companies prefer products with a shorter lifespan in order to sell more products. The products have less lifespan than the ones of 20 year before even if various options and more advanced products are offered in the market in line with the developing technology. For instance, more different options are brought into use in washing machines for washing different kinds of fabric day by day. However, Participant 1 mentions that the lifespan of a today's washing machine has shortened more than 50 percent when compared to 20 years ago. Moreover, he adds that the companies try to encourage the users to replace their products with new ones by adding brand new features to their products.

4.8.2 Being out of Warranty

An electrical product with any kind of breakdown is repaired under the warranty for at least two years unless it is caused by a user error (T.C. Ministry of Science, Industry and Technology, 2011). Participant 14 considers the breakdowns that are out of the scope of warranty because of misuse as one of the constraints of the companies about repair.

4.8.3 Planned Obsolescence

The companies might prefer to keep lifespan of the products shorter in order to have an economic advantage. In this case, companies aim to sell more products, and thus make more profit. They reduce the quality of the materials to control the lifespan of the products. Participant 7 states that the companies do not have any strategy to prolong the lifespan of the products, on the contrary, they work on reducing the lifespan of them so as to sell more. Participant 9 mentions that companies have been doing that willingly to make more profit and he says, "The lifespan of the products was used to be approximately ten years and back then there was less consumption, since the lifespan of the products was longer. The costs of products were higher but they could be used for years. Day by day their lifespan are getting shortened by reducing the quality. Nowadays the cost of the products is low and it is really easy to buy a new one. However, they breakdown and sold out in two years."

Participant 7 gives the example of a food processor about the reduced lifespan of products. He says that the food processor is 30 years old, since the materials of it is of high quality, it can be used for more years. He also points out that it is impossible for the new products to be used for such a long term such as 20 or 30 years.

Participant 10 also states that companies use materials of low quality to reduce the lifespan of products. The material selection and the production are made in such a manner that the products will not breakdown for the warranty period, which is mostly 2 years. He says that older products used to cost higher but they are able to stand longer. According to him, the users also know that the warranty covers the repair for two years and the products are more affordable and accessible; hence they do not care about the use and the maintenance of the products. Participants 13 agrees with the fact that the lifespan of the products is now shorter

and he believes the reason for this change is the cheap products outsourced to China that are getting into the market. Companies producing the high quality but high cost products can not compete with the cheap alternatives coming from Far East, and this has changed the approach of the companies. The aim of the companies is now to gain from demand by selling cheaper products of poor quality rather than the expensive products of higher quality. Participants have claimed that companies have been reducing the lifespan of the product willingly in order to increase the rate of the profit. They set the lifespan of the products by changing the quality of the materials used in production.

4.8.4 Replacement of Broken Parts Instead of Repair

According to field work results, twenty years ago the broken parts of a product used to be actually repaired, however such parts currently are replaced with a new one (Participant 3, 4, 6, 10). They also say that since the broken-down products are not really repaired, they do not face any problem related to repair process. Participant 4 states that he has been working as a repairman for many years and twenty years ago, the spare parts were coming from Europe and the prices of them were very high. At present, most of the spare parts are made of plastic, coming from the Far East and they can easily be thrown away as they are cheap.

Participant 10 reports that the repair today is way more different than twenty years and explains the reason for this change. Ha claims that replacing the broken parts costs less than the repair. Participant 6 points that some companies do not replace the parts of the personal care products as the consumers do not prefer regarding of hygiene; instead they replace the product with a new one.

4.9 Communication between Companies, Authorized Technical Services, Research and Development Departments and Users

Relevant information about the communication between authorized technical service personnel, companies, research and development departments and users have been gathered from the interviews. Participants mention the contribution this communication will provide for the maintenance and repair process. According to the research data, some companies give importance to this communication, and accomplish the mutual transfer of information with the help of various platforms and activities. Participant 1 indicates that the communication between authorized services, research and development department (R&D) and the users is considered important in the company he works for. He mentions that authorized technical services report the techniques they find efficient which are not practiced in the company. At certain times, authorized technical services are asked for their opinions and they attend trainings on pre-determined dates. He adds that when the authorized services request anything about the maintenance, repair or the product use, their companies give importance to their opinions and assess them.

Participants mention that they are in touch with the R&D department of the company and they inform the department about the problems occurred during the maintenance and the repair. Participant 1 indicates that the possible problems which can occur in use are taken into consideration in the design process of the product; the problems that can be faced during the maintenance and the repair are also evaluated in this phase. He argue that products are produced after an intense research, study and testing period. He says that the services are

experienced and trained about the maintenance and the repair of the products; as a result, they handle their jobs properly.

The companies which the authorized services work for have pre-determined rules and methods regarding the maintenance and repair of the products. Participant 7 mentions that companies do not allow authorized services to go out of these rules or methods, otherwise their contract is terminated.

Companies provide various channels and platforms through which users can contact with them. Users can declare their demands or suggestions via phone, company websites or e-mail addresses. The regular communication between authorized services, R&D departments of the companies and users help to solve the problems which occur during the production phase of products, as well as maintenance, repair or use. Some companies place particular emphasis on the communication between R&D departments and authorized services, arrange meetings and trainings.

4.10 Advices of Technical Service Personnel and Repairmen to the Companies to Make the Maintenance and Repair Process More Effective

During the interviews, Participants mention the points that needs to be paid attention to make the product maintenance and repair more effective. Handling the maintenance of the product at required times and regularly is one of the important factors that affect the lifespan of the product. According to Participant 14, the products that can be maintained easily will have a longer life and this factor should be considered in the design process. He says that the equipment related to the maintenance of the product can be sold together with the product, and suggests that this equipment needs to be considered together with the product. In addition, he states that ease of the product repair is also a significant factor that affects the product lifespan.

Participant 8 says that he prefers the products which are easy to disassemble. He adds that they face problems when opening the products closed with especially snap fits. He prefers the products that are assembled with screws because they provide convenience during the maintenance and repair process. He says that he prefers less number of screws on a product because redundant number of screws causes a waste of time.

Participants 1 and 6 indicate that the R&D departments of the companies they work for do research to make the maintenance, repair and use phases of products more effective. Participant 6 adds that a product is being tested approximately for a year before the release to the market.

Participants also explain the techniques which they find effective for maintenance and repair processes that are not practiced by the companies. Participant 15 mentions that more information should be given to the users about the product maintenance. He states that companies can remind the users about their maintenance periods, via phone or e-mail. He adds that the maintenance period may depend on the conditions and frequency of use. He gives the example of vacuum cleaner: “Some people clean their houses with vacuum cleaners twice a day, others clean them once in two weeks. That’s why the maintenance periods and lifespans of vacuum cleaners differ from each other.”

4.11 User Demands and Suggestions about Product Design, Maintenance and Repair

Users have suggestions both to the authorized technical services, repairmen and the companies about the design and use of small kitchen appliances. Some of the users explain their demands and suggestions to the technicians or repairmen face to face if they have the chance, as the others contact the companies directly via internet or call centers.

Participant 1 mentions that the users communicate with the R&D department, which consists of engineers and research groups, not with the authorized technical services about their demands and suggestions. Moreover, he indicates that customers are called and asked for their opinions, questionnaires are conducted with them; so the customer satisfaction is evaluated by these methods. He adds that customers can also share their demands via internet or call centers. He says that they usually get suggestions about the use and design of a product and gives example of the Turkish coffee machine. He explains that users want them to increase the capacity of Turkish coffee machines to make more coffee in a single use.

Participant 2 says that the users tell their requests and suggestions to the companies directly rather than telling them to authorized technical services. He points out that authorized technical service personnel calls the users after the maintenance and repair process, and get information from them about this process. They ask the users whether their product is fixed or not, and how long this process takes.

The users have to pay for the repair if their products are out of warranty or the warranty has expired. Participant 3, 13 and 15 explain that the users ask for the spare parts and repair costs to be lower. Participant 13 points out that since the users find repair costs high, they do not prefer to get their products repaired and buy a new one instead.

Some of the companies care about the customer satisfaction, and question it in various ways. Participant 4 states that the users can monitor online the whole maintenance or repair process of a product in the technical service, from its submission to the service until its delivery back to the customer. He says that the head technical service provides continuous information to the customer about the product. He mentions that the customer is called one or two weeks after the delivery to learn about their satisfaction. He adds that if there is any negative feedback from the customer, the technical service that repaired the product is informed, and they contact back with the customer about the problem faced.

Users make research on the product about its use, maintenance and repair before buying it. Participants 8, 11 state that the customers call the technical service and ask for an advice when buying a new product. He explains that they advise the customers to buy products from national brands, as the possibility to find a spare part is higher.

Technical service personnel and repairmen explain users the reasons of break-down and shows the ways of using products more effectively to prolong the product lifespan. Participants 10 and 14 say that the users get curious and ask the reasons of break-downs when they visit them to leave the broken products. They mention that if the product is broken down due to misuse, they explain the users how to use the product properly. Users contact the technical services to give recommendations and to get information about the design, use or break-down reasons of a product. On the other hand, they contact directly with the company to explain their opinions about the prices of spare parts, repair costs or the performance of a product after repair.

4.12 Advices of Authorized Technical Service Personnel and Repairmen to the Users about Maintenance and Repair

Authorized technical service personnel and repairmen give advices to the users about use, maintenance and break-down reasons of small kitchen appliances, and inform them about how to use these products longer. So as to use the products longer, their maintenance and cleaning need to be done regularly through following the instructions in user manual carefully.

4.12.1 Advices about Maintenance of the Product

Participants say that they advise the users to care for the maintenance and the cleaning of the product regularly. Participant 2 indicates that products have their own special maintenance and cleaning sets, and these sets include various materials from polish to rubber. He adds that the maintenance of a product should be done with its own kit. He says that even though they recommend the users to use these kits for cleaning, most of them do not pay attention to this issue. He points out that especially kettles and coffee-making machines should be cleaned, as tap water is mainly used, which causes calcification.

Participant 8 gives advices about cleaning the blender. He indicates that he warns the users that they should place the part with knife upwards after washing the blender so knives can get dry. Otherwise knives become moldy because of the water. Thus, as the knives rotate hardly, the gear of the blender gets worn out.

Participant 6 talks about the advices he gives to the users about the maintenance of the product. He says it is important to be careful while using the product. For instance, while using a chopper, initially the knives should be placed, and later on the food should be put in, and lastly the chopper should be operated. He adds that they advise the users to use water with lemon in kettles, tea machines and coffee machines to avoid calcification.

4.12.2 Advices about the Use of the Products

Most of the Participants recommend users to pay attention to the user manual while using the product. Participant 4 exemplifies that kettles, coffee machines and tea machines should not be activated without putting water in, in case the resistor burns and the thermostat breaks down. Participant 5 says that they explain the users how they should use the products. They advise them to pay attention to the amount and the density of the ingredients they mix with the blender, not to use dense food. This is also valid for the toasters; the users should not put thick stuff in the toaster and apply force on it.

Participants advise the users to read the user manual, and use the products properly with respect to the instructions. Participant 3 says that they recommend reading the manual and applying the instructions written here. He points out that users should pay attention to the manual of the blender, and stop the blender every ten seconds. He says that the devices are designed to process certain materials with a certain capacity. He adds that if the blender had a more powerful motor, maybe it would not breakdown but the price would be higher.

Participant 15 indicates that they advise the users to read the user manual before using the product, they should not delay the maintenance. Another issue Participant 15 emphasizes is that a product should be used in conditions appropriate to the instructions in the user manual. He especially advises that appliances should be in minimum touch with water.

4.12.3 Advices about the Reasons of Product Breakdown

Participants say that they explain the reasons of the breakdowns and the types of misuse to the users. For instance, the kettle may breakdown when the water added exceeds the maximum capacity or the choppers need to be used to chop the soft vegetables like tomatoes, not the hard ones causing a breakdown (Participant 7). It is also advised that pomegranates should not be squeezed in the juice extractors or machines, since the particles get into and breakdown all parts of the device, including the motor and the cogwheel (Participant 7).

It is suggested that the product should be turned off immediately after use since the ones which stay turned on a long time breaks down more frequently. Participant 12 gives the example of a toaster about it. He suggests that the users should not leave their product plugged for a long time. If the customer wants to make three toasts, it is better to put them into the machine together in order to shorten the time that it is plugged in.

Participants recommend the consumers to buy household appliances which has spare parts easier to find. Participant 13 suggests that either any excessive force should not be used on the products, or they should not be overworked.

4.12.4 Advices to Extend the Lifespan of the Products

Participants have some advices to the users in order to extend the lifespan of the products. They point out that the lifespan of a product depends on the way it is used. Participant 1 says: "The products can be used for long period of time if the user cleans the product elaborately, and brings it to the service whenever needed."

Participant 11 says that maintaining the product properly expands the product's lifespan. He advises that the product has to be cleaned after every use, and gives the toaster as an example: "If oil on the toaster is not cleaned, it leaks into the product and causes the circuits to burn."

In this section, the advices of technical services to the users are mentioned. The means of use, maintenance, reasons of break-down and ways to extend the lifespan of small kitchen appliances are discussed briefly. Participants mainly point out that the users should care about the maintenance and cleaning of the products, and follow the user manual properly.

4.13 Efficient Product Examples in terms of Maintenance and Repair

The most important notion about the repair process is the technical knowledge and the experience of the technicians and repairmen according to Participants. Most of the Participants imply that there is not any effective products in terms of maintenance and repair in the market. They defend that the means of operating the products, their inner parts, and thus the repair processes of them are mostly similar. Participant 13 claims that he can fix products that he has repaired before more easier and rapidly. He explains how he faces complexity while he is trying to repair a totally new product. Participants open up a new product first to discover, and this makes the repair process more effective.

4.14 Similarities among the Working Principles and the Parts of the Products

Participants provide information about the similarities of both the operating principles and inner parts of the different small kitchen appliances. They argue that these properties are mostly alike even though external forms of the products show diversity.

Participants 7, 8, 10 and 15 state that most of the products work in a similar way and have similar parts even though they belong to diverse brands and have different forms. Participant 8 says that repairing the products with mechanical parts are easier and more effective than the repairing the digital ones.

Participant 5 and 13 says that the products have the same working principles and similar inner parts even if their outer appearances are different. Thus, the ways of repairing are also similar of these products. Participant 5 claims that there is not any relation between the maintenance, repair and the appearance.

According to Participants, most of the electronic appliances in the market have similarities on their working system, thus on the processes of repair. In spite of various appearances of the products, the contents and components of them are the same. Briefly, they explain that the processes of maintenance and repair resemble for different versions of products.

4.15 Recording the Maintenance and Repair Processes

The processes of maintenance and repair are recorded in most of the authorized technical services. Most of the Participants explain that the reasons of the breakdowns are recorded, and then reported to the companies (Participants 2, 3, 4, 5, 6, 14 and 15). The aim of the recording is to document the process, which includes information such as the repair time, duration, the parts replaced. They are also used to improve the quality of products by some of the companies. Participants declare they do not have the authority of sharing this information.

Participant 3 remarks that why the products are brought to the service is recorded with the whole process and reported to the companies monthly. The companies try to rectify the problems in latter products.

Participants 7, 8, 9, 10, 11, 12 and 13 respond negatively when they are asked whether they record the reasons of the broke-downs. Neither the authorized services located in Ulus, nor the repairmen who do not work under any company record the maintenance and repair process.

4.16 The Production Place of the Small Kitchen Appliances

Most of the small kitchen appliances are produced in Far East countries. However, there are few products produced in Turkey and Europe. Twelve of the fifteen Participants say that most of the products which they repair are from China. Two Participants state that they do not have any information about the production place. Only Participant 3 declares that ninety percent of the products of his company are produced in a European country. He says that some of the choppers, coffee machines, tea machines and kettles are produced in Turkey. He adds that about 10 percent of all products comes from the Far East and their assemblages are also done in China. Participant 6 says that microwave ovens are produced in China whereas other small kitchen appliances are produced in Turkey. Participant 8 reports that 6 of the 8 companies he works with produce their products in China.

4.17 Disposal of the Irreparable Products

Participants explain what they do with the irreparable products; in other words, how they are reused or disposed. Most Participants state that they usually send these back to the company, or keep them in the storages, and they give the rest to the waste collectors.

4.17.1 Collecting the Products in the Storages

Participant 1 says that the broken and irreparable products are collected in the storages, and then their parts are given to the waste collectors (see Figure 46). Batteries, electronic cards and the other electronic parts are grouped and collected in separate boxes.

Participant 2 states that recycling is not an option for his company. As they do not want their customers to think that any part of an old product is reused for the broken ones, they do not collect the broken and irreparable products in the technical service as a policy. They give these products to the waste collectors.

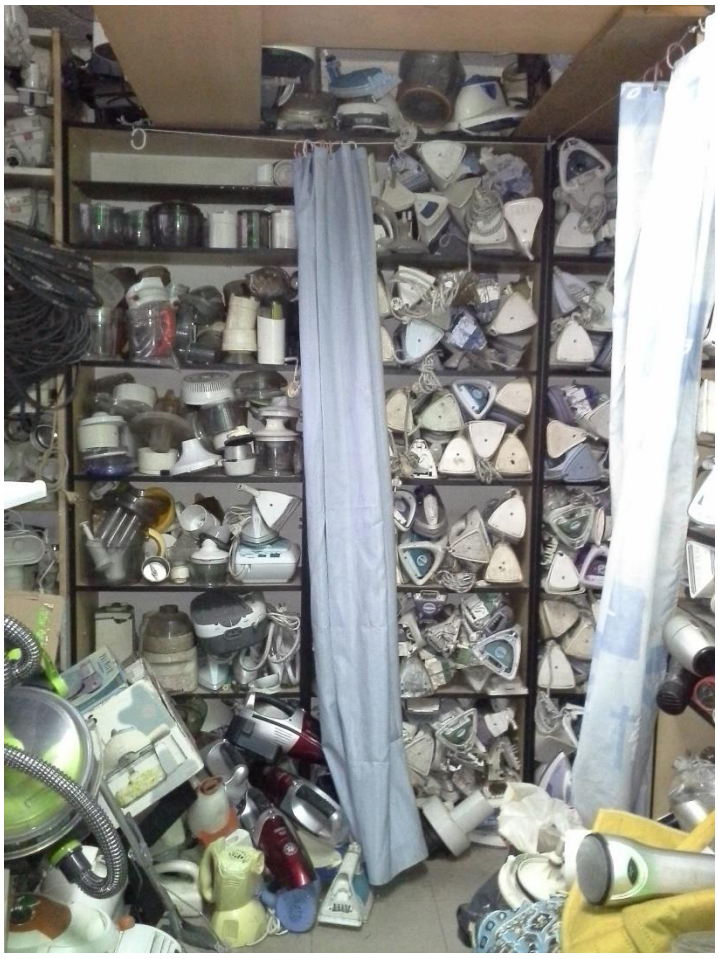


Figure 46- Broken appliances in the storage.

4.17.2 Sending the Products Back to the Companies

Participants 3 and 15 state that the companies they work for keep the irreparable but new products, and send the users new ones instead. Besides, metal and plastic parts of the irreparable, out-of-production ones are separated and given to the waste collectors.

Participant 4 says that irreparable products are collected in the central storage, which is located in Istanbul and then they are recycled. Participant 5 says that the irreparable parts are reused in three different ways. Some of these products and the parts are sent to the company. Some are kept in the storage or given to the waste collectors. Similarly, Participant 6 states that irreparable products and the broken parts are sent back to the companies.

Participant 14 says that the products which are replaced by new ones according to the warranty policy are initially sent to the authorized technical service head office, and then to the company. He points out that they do not reuse the working parts of the old products. Instead, they prefer to give these to the waste collectors.

4.17.3 Reusing the Working Parts of the Broken Products as Spare Parts

Participant 7 says that he keeps most of the irreparable products in the service and uses the working parts of these as spare parts to repair the other broken products. He states that the consumers may leave the broken products at the technical services instead of taking them back.

Figure 47- Appliances with broken parts are stored in the storage and they are grouped according their functions, labels and models.

He groups these products with respect to their functions, labels and models by using separate boxes for each (see Figure 47 and 48). So as to recall which box belongs to which product, he attaches an emptied product of this type on each box. The working parts of the products are categorized and put in those boxes to be used as spare parts.

Figure 48- Spare parts taken from the broken products are organized in the boxes.

Participant 7 gives the example of a food processor that has been used for almost thirty years and the owner wants to keep on using it. He says: “I keep these broken items because for instance the cogwheel of one and the motor of another might be broken.” As the food processor is too old, it is not possible to find any spare parts for it. However, he makes this food processor work with the help of the working parts of another one. Similarly, Participant 9 explains how they reuse the irreparable products: “If the consumers leave the broken products to us, we reuse their functioning parts as spare parts for other broken ones.”

Participant 8 says that the company he works for takes the products which are in the scope of warranty back, and replace with the new ones. The products with expired warranty are kept in the service as functioning parts are used as spare parts.

4.17.4 Waste Collectors

Waste collectors form the last step of the lifespan of the products that are not or can not be repaired. After taking out the necessary parts, Participants give the products which they do not send back to the company and do not want to keep in the storage of the service to the waste collectors. Most of the Participants say that the irreparable product parts either given to the waste collectors or thrown away (see Figure 49). Participant 2, 3 and 5 say that metal and plastic parts of the old, out-of-production and irreparable products are separated, and then given to the waste collectors.

Participant 10, 11 and 12 say that they make use of the working parts taken out of the broken products by using them for out-of-warranty products. They add that the left parts that they do not use are given to the waste collectors or thrown away.

Figure 49- Irreparable products are given to waste collectors.

To summarize, relevant information is obtained about what happens to the products that can not be or are not repaired from the field work. Participants explain that the waste products and/or the product parts are either kept in the storage or sent back to the company, and the rest of the parts are given to the waste collectors. Some of the Participants state that the working parts of the irreparable products are reused as spare parts.

4.18 Overall Results of the Research on Product and User Related Factors Affecting Product Lifespan

This section presents an overview of the results of the primary research conducted with the authorized technical services and repairmen regarding the maintenance and repair process of small kitchen appliances.

In the research, the frequency of small household appliances being brought to the services for repair and their breakdown reasons are presented. It is found that the delivery frequencies of products to technical services are affected by the quality of materials and use frequencies of products. Besides, it is realized that there exist some foremost reasons for why these products breakdown. It is found that suction problem of vacuum cleaners and calcification of iron heating coil are the problems mostly faced. As small kitchen appliances are one of the product types brought to the service at most, this issue is studied further in the research. The breakdown reasons of the products in this category are examined.

Consistency can be observed between the answers of authorized technical services and repairmen about the frequency of the small kitchen appliances being brought to the technical services. It is supported by the research data that the food preparation appliances are brought to the services more frequently than the heaters and the cookers. Most of the Participants state the blenders, food processors, choppers and mixers as the ones that are brought to the service more frequently.

According to the results of the study, blender is the most problematic appliance among small kitchen appliances. The majority of Participants argue that the most common problem in blenders is that gears wear away in time. This finding results from the fact that blender differs from other small kitchen appliances in terms of use. According to user manual blender should operate at 10-second intervals. Otherwise, product and the parts may breakdown.

Some small kitchen appliances bear similarities in terms of factors leading to failure such as kettle, tea machine and coffee machine or food processor and chopper. Most frequent problems of kettle, tea machine and coffee machine are related to thermostat and resistance. The gears of food processor and chopper gradually wear away similar to the problem exist in blender.

It is found out that technicians and repairmen do not actually repair the product. All of the Participants state that the products are not repaired; instead, their spare parts are replaced after the troubleshooting. The spare parts prices used to be higher than the labor, however this is the opposite at the present time. Most of the spare parts are made of plastic, coming from the Far East, and are so cheap that they are not considered for repair anymore. As a result of this fact the supply of spare parts is the most significant factor determining the repair time and whether the repair will be completed or not.

Some differences are observed in the maintenance and repair process of the authorized technical services and repairmen. Repairmen have difficulty in finding spare parts and they meet their needs either from technical services or they use the working parts of the broken products. There are other difficulties that Participants encounter such as issues about reaching the broken part and assembling the spare parts. Products should be designed by taking their maintenance and repair process into consideration. Participants provide their suggestions to the companies about design details. They made recommendations such as making it easy to open the product, and developing tools and materials for the product’s maintenance.

Significant results are derived about the permanently attached product parts. Combining some parts of a product by gluing up or attaching by press permanently, makes the repair process harder, increases the cost of the production, and it consequently has negative effects on the product lifespan. The working parts have to be removed with the broken ones as they are joined, thus the cost of the repair increases. Besides, throwing away the working parts' along with the broken ones increases the amount of waste.

Participants criticize users about not reading user manuals and not using the product regarding the instructions. The results revealed that small kitchen appliances breakdown mainly because users do not clean and maintain them properly, and do not follow the instructions in user manuals. These are general assumptions of the Participants. There are also other different factors affecting product breakdown as discussed earlier (e.g. quality of materials, overusing of products, technical obsolescence, planned obsolescence). The acts of users have to be considered in the design process such as not following the instructions stated in the user manuals. For instance, some users wash their kettles and tea machines in the washing machines, accordingly these products get broken. This issue of misuse possibly arises from the cleaning needs of the users. If the products were designed to respond that kind of needs, related problems would disappear.

An interesting result is derived about the digitalization of the products. Mechanical product parts are currently replacing the digital ones as the technology develops and changes rapidly. Participants advise the user to prefer the products with mechanical parts as they tend to breakdown less frequently.

Participants claim that companies have been reducing the lifespan of the product on purpose in order to increase the rate of their profit. They determine the lifespan of the products by changing the quality of the materials used in the production phase. The companies might prefer to keep lifespan of the products shorter in order to have an economic advantage. They reduce the quality of the materials to predetermine and limit the lifespan of the products. Participants complain about the quality of materials in the production.

Small kitchen appliances look different but they have similar components and their working principles are also alike. However, as the connection types of these parts are different, in case one of these parts is broken, another one can not be used instead. A spare part of the same type which belongs to the same model of same brand can only be used for part replacement.

Post-use and Disposal Problems

Relevant information is obtained about the disposal of household appliances that are not repaired or can not be repaired. These product waste are either kept in the storage or sent back to the company, and the rest of the parts are given to the waste collectors. Some repairmen utilize a sustainable way of dealing with the small household appliances that can not be repaired. An interesting result derived is that some of the Participants extract the working parts of the irreparable products, and use them as spare parts.

Small kitchen appliances are disposed or thrown away when most of the parts are still working. Participants claim that users complain about the high prices of spare parts and length of the repair process. They do not prefer to repair the product when the cost of repairing is close to the price of a new product. Users ask for spare parts, maintenance and repair costs to be cheaper and convenient.

In this chapter, the results of the interviews with the authorized technical services and the repairmen are presented in detail to show the potential areas for extending product lifespan related to the maintenance and repair of small kitchen appliances. The results are given comprehensively to provide a better understanding for each product category, and to explore the implications of the field work. In the next chapter, the conclusions drawn from these results will be presented.

CHAPTER 5

CONCLUSION

This chapter presents the conclusions from and insights into the research through revisiting the research questions based on the primary research and literature review. The presentation of conclusions and findings is followed by the concluding remarks on the implications of the study for product design process and further research.

5.1 Research Questions Revisited

What are the potential areas that affect product longevity for sustainable product design with a particular focus on product maintenance and repair in small kitchen appliances?

The maintenance and repair of product have the potentials for leading sustainable consumption and production through achieving product longevity. This study explores the potential areas for extending product lifespan with a focus on small kitchen appliances. Maintenance and repair of these products can provide valuable opportunities to address the social and environmental impacts of small kitchen appliances through prolonging their product lifespan.

Participants claim that maintaining the product regularly has a positive impact on the lifespan, which decrease the breakdown frequency. Providing services such as maintenance, repair, refurbishment and upgrading prolongs the lifespan of products (Cooper, 2005). Today, most of the products are designed without considering the maintenance and repair phase. Even the design of some products itself makes the maintenance and repair process harder. It is not possible to repair most of the products on the market due to their very small and/or unreachable parts (Norman, 1998). Product lifetime varies depending on various factors such as design, technological changes, maintenance and repair, availability of parts, aesthetic values and tastes (Walker, 2006; Cooper, 1994).

Significant results are derived about the underlying causes of breakdown of small kitchen appliances. It is observed that small kitchen appliances mainly breakdown because of the use oriented problems such as overuse, misuse, disregarding the use instructions, and avoiding or forgetting maintenance. However, there are production oriented problems as well, such as using low quality materials, planned obsolescence, permanently attached product parts, technological obsolescence and issues related to obtaining spare parts. Assembling some parts of a product with methods such as gluing up or attaching by press permanently causes the product parts that do not complete their lifespans to be thrown away.

Small household appliances can be easily discarded when worn-out, broken or outdated no matter how-well functioning they are instead of being repaired or upgraded because of their significantly lower prices compared to other products. In his book, Verbeek (2011) examines how lifespan of products can be prolonged, and he argues the post-use services like upgrading

and repair prevent the products from being discarded prematurely. Repairing a product when broken or worn out rather than discarding it directly elongates product lifespan. Furthermore, the products are disposed when they are technologically outdated. So as to prevent this situation, the products should be designed and produced through enabling upgrading and repairing.

What are the main reasons of product breakdown in the area of small kitchen appliances in relation to small household products?

Breakdown reasons of small household appliances can be classified under two groups: use-oriented reasons (e.g. over-use, disregarding the user instructions and maintenance), and design and production oriented reasons (e.g. planned obsolescence, technical obsolescence, accessibility of the inner parts of the products and permanently attached product parts).

The research results indicate that the problems related to filters as one of the most common problems encountered in vacuum cleaners. It is found out that the maintenance of vacuum cleaners is not handled accurately through cleaning their filters. The most common problem in irons appears to be the resistance calcification.

Small kitchen appliances are selected to focus on and examined in detail in this research, as it is determined that these products are brought to the services most frequently. According to the results of the field work, blender appears to be the most problematic appliance. It is found out that gears and motor are the parts of blender that breakdown most. This product differs from other small kitchen appliances in terms of its operating system. According to user manual blender should operate at 10-second intervals. Participants assert that blender needs to be used and maintained through complying with the instructions, so that it does not break down.

Kettles, tea machines and coffee machines bear similarities in terms of factors leading to failure. Most frequent problems are related to thermostat and resistance. Products are suitable for use at home only for a specific number of people. However, when they are overused, they breakdown. Tea machines and coffee machines are preferred in workplaces with a large number of people, which causes the product to fail more often. Other factors that lead to failure include leak of water into the inner parts, and calcification of resistance due to tap water.

Food processors and choppers are used in the kitchen for similar purposes. Data yielded from research demonstrate that factors leading to their breakdown also resemble each other. Users try to process hard materials, overload the bowl or container, and do not properly fit the product parts together. All these are what cause a food processor or chopper to break down. Most frequent problem encountered in these product groups is wear in gears. Most frequent problem for sandwich toasters is also related to the use patterns. If sandwich toasters keep operating for a long time, they overheat and may have a problem in the resistance, thermostat or fuse.

Apart from the faults specific to each product, there are general factors leading to breakdown in small kitchen appliances. These factors basically range from issues related to cleaning, material quality and voltage fluctuation to following the instructions in the user manual. Participants complain about the quality of materials and connection details of product parts in the production phase. Furthermore, voltage change has an adverse effect on operating mechanism of products. They also criticize users who do not read user's manual properly and comply with the instructions in it.

The quality of material is among the significant factors affecting the product lifespan. Products should be considered as a whole in terms of quality of materials used so the durability of the product parts should be proportionate. Otherwise, the product is thrown away with most of the parts of which function properly. A significant result can be derived that the part with the shortest lifespan determines the product lifespan.

Designers, R&D departments of companies, firms and even users can benefit from the information related to breakdown reasons of products. Users are able to choose their products in the light of the available preceding information. Producers and R&D departments can use this information for the purpose of product development. This research mainly is aiming towards the product designers, the information acquired can be included in the design process so as to provide suggestions for and insights into the development of products with prolonged lifespan.

What kind of strategies can be applied within the product design process to extend the lifespan of products for sustainability?

Strategies considering post-use services such as maintenance and repair to extend product lifespan are mainly discussed in the literature review chapter. The advantages of product longevity and approaches developed to progress towards sustainable consumption and production are also presented.

Extending product lifespan is crucial for sustainable development, and strategies and approaches for that purpose should be considered at the early stages of the product design and development process. Different strategies like LCA (Birkeland, 2002), Cradle to Cradle (McDonough & Braungart, 2005), Eternally Yours (Verbeek & Kockelkoren, 1998), ISPDS (Doğan, 2007), post-use design thinking (Coşkun, 2011) and half-way products (Fuad-Luke, 2009), etc. appear to be potential approaches to integrate sustainable design principles into the design process.

A product can not be used any more in case any part of it is broken, unless the repair is possible. Eternally Yours argues that services like repairing, maintenance, upgrading and renting prolong the lifespan of products (Verbeek, 2011). Small kitchen appliances are disposed or thrown away because of their low price, even if they are still repairable. Users prefer to replace them with new ones instead of repairing. In case a small part of a product is broken, the other functioning parts are also thrown away. The strategies developed for preventing this situation should also be integrated into the design process through identifying and addressing the problems related to each product.

The means of incorporating post-use phase (e.g. maintenance, repair, re-use) of a product into the design process should be considered. Life Cycle Assessment (LCA) is a method primarily used to interpret and compare environmental impacts of products during their life cycles. LCA argues that all stages of the product lifespan including their design, manufacturing, distribution, use, and post-use (e.g. maintenance, repair, reuse and upgrade) phases should be taken into consideration as a whole. Various tools considering resource depletion and deprivation, toxic substances and pollutants are used for assessing the environmental performances of product's life cycles (Tischner & Charter, 2001).

Integrated Scales of Design and Production for Sustainability (ISDPS) approach aims at creating products by integrating locally produced parts manufactured by small scale enterprises with the mass produced ones (Walker , 2010; Doğan & Walker, 2008). According to the research results, production with low-quality material shortens the product lifespan, which causes difficulties on the repair process. Based on the research findings, the provision of spare parts is one of the main problems encountered during the repair process. Participants state that locally produced products have better quality, and locally produced spare parts that are more accessible ease the repair process.

What are the implications of product maintenance and repair for extending product lifespan of small kitchen appliances? (Field Work and Literature Review)

Maintenance

Significant results are derived about the maintenance of the products. It is one of the main factors that affect the lifespan of the products. According to the research findings, Participants claim that users do not read the user manuals, and as a result, they do not know and follow the instructions about the regular product maintenance. Consequently, the products and product parts of which maintenance are not handled on a regular basis breakdown more frequently. As a suggestion from designer's viewpoint, these parts should be easily replaceable, these products should inform the users about their maintenance periods through design details. Providing maintenance kits together with the products and informing the users about product maintenance through making this more visible and accessible for them can be considered among the strategies for encouraging and incorporating this process. The parts in need of product maintenance are visible for some products, however there may be other product parts of which the users can not be aware. For instance, users may notice the need for cleaning of their kettles as the calcification of it is visible. However, this may not be the case for vacuum cleaners as their filters are not apparent for these products.

Repair

An interesting result is derived from this study about the differences observed in the lifespans of product parts. Some specific parts of products such as the gear of a blender or the resistance of a kettle are getting broken more frequently than the others. The well-functioning parts that have not completed their lifespan yet are also thrown away with the broken ones. Most products are also thrown away as only one of their parts is broken. To overcome this problem, the design of such products have to be reconsidered. These parts should be designed in a way that they enable repairing, replacement and upgrading. The re-use and recycling solutions are not enough to solve this problem, as the main problem is about the products' inner structure and design details for connecting product parts.

Some parts of the products are permanently attached in the production process. It is found out that these parts have a significant effect on the product lifespan and product part lifespan and increase the cost of the repair, because of the fact that working parts have to be removed with the broken ones as they are attached. To overcome this problems designers should involve in the manufacturing stages and these stages should be controlled.

Accessibility

The stages of the maintenance and repair processes should be taken into consideration in the design process. The results of the primary research support that Participants have problems related to the accessibility and the assembly of product parts. How the product is disassembled, how the technician or repairman determine the defect and reach the broken part, how he replaces the spare part, and how the product parts are brought together need to be considered to a greater extent in the design process. Long lasting products are easy to repair, since their design details make it possible that their parts are accessible, can be easily removed and replaced (Park, 2003).

Local Product Part Replacement

In the study, it stands out that some specific product parts are frequently broken down. The design details that enable easy product part replacement shorten and improve the repair period, it will also contribute to longer product lifespan. Especially, the production of the problematic parts by local producers will make these parts more accessible. As a suggestion from designer's viewpoint, these frequently broken down parts should be locally produced and accessible, and easy to be replaced, which should be taken into consideration in the design process. ISDPS approach allows product maintenance and repair at a local scale through bringing various scales of production together. Thus, a more effective way to design products adapting to diverse local needs, enriching user experience, enabling product maintenance and repair at local scale can be provided. Moreover, these problematic product parts should not be produced as permanently attached to the other product parts, and should be more durable in line with the lifespan of each part.

Local production and assembly are factors that have a positive effect on the both the accessibility of spare parts and the quality control of products. Participants claim that they prefer locally produced products and spare parts as they are more accessible and their material quality is higher compared to the ones that are produced in the Far East countries. Participants state that in order to repair the products effectively on time, the most important factor is to provide the spare parts. The reason for that is the technical services are not doing repairs any more. They replace the malfunctioned part with the new spare part.

Quality of Materials being Used and Planned Obsolescence

Participants complain about the quality of materials used in some of the products. The majority of the Participants argue that using high quality materials increases the lifespan of the products. In many product groups, there are high-quality products designed and manufactured specifically to be used for a long time (Cooper, 2005). However Participants state that the companies aim to produce products of low quality, since the users prefer these ones as they are affordable and accessible.

Participants argue that companies decrease the product lifespan intentionally so as to increase the rate of the profit. They predetermine the lifespan of the products by changing the quality of the materials used in product parts, particularly the ones that break more frequently. The companies might prefer to keep lifespan of the products shorter in order to have an economic advantage. In this case, they aim to sell more products to make more profit. They reduce the quality of the materials to control the lifespan of the products. However, this has severe implications for ever increasing waste, and degradation and overconsumption of renewable

and non-renewable resources. According to researcher's viewpoint this issue stems from the fact that designers are isolated from the production process. If the products were manufactured locally, designers would have more chance to effectively involve in the production processes, and the sourcing and selection of materials.

Technological Obsolescence

Although digitalization of product parts and automatic features sometimes support the idea of effective use of resources through providing different options for adjusting the temperature, self-cleaning feature and auto-shutdown, they may have negative effects on the lifespan of products. Significant result is derived that the digital parts of the products breakdown more frequently than the mechanical parts. The mechanical parts of the products are being replaced by the digital ones as the technology continues to change substantially. According to the Participants, this feature of the products shortens the lifespan of the products and increases the frequency of breakdown.

User Intervention in the Repair Process

Participants state that users try to repair their products. However, the user without the required experience and technical knowledge cause various and more complex problems instead of repairing them. They attempt to dismantle the product and fail to bring them back together. While taking apart the product, they damage the parts and connection details or bring the parts together wrongly. Thus, the repair cost increases accordingly. For the users who do not have the skills and expertise, it is dangerous to repair appliances, which can lead to serious accidents. Some of the Participants state the users can repair their own products with the spare parts provided by the service if they have the necessary tools. As a suggestion from designer's viewpoint small household appliances can be repaired by the users, if they are designed specifically for enabling this purpose. Furthermore, there are examples like open source platforms that users produce appliances by themselves. There are instructions explaining how to disassemble and repair a product step by step in certain web sites.

5.2 Implication of this Research for Product Design

This thesis presents the conclusions from and insights into a graduate research. To explore the potential areas related to product maintenance and repair of small kitchen appliances in order to prolong the product lifespan, the semi-structured interviews were conducted with authorized technical service personnel and repairmen. As a contribution to design knowledge, this research has generated and assessed research data to gain insights into the maintenance and repair processes, and breakdown reasons of small household appliances with a focus on small kitchen appliances. This thesis does not aim to make generalizations about the maintenance and repair processes of small kitchen appliances based on the conclusions and findings drawn from the primary study. Instead, it attempts to provide compressive analysis about these processes, and present potential areas for extending product lifespan of small kitchen appliances to focus on for designers, producers and even users.

One of the limitations of the research about the product maintenance and repair is that it consists of the interviews that only focus on technical services. If the interviews were conducted with users and professional designers to gain insights into their points of view, the

findings obtained would be more comparable and wide-ranging considering the main area of the research.

Most of the authorized technical services record the maintenance and repair processes together with details such as breakdown reasons and replaced parts. However, these records can not be shared with the third parties due to the privacy policy of the companies. If the information about the maintenance and repair processes of products in the database of technical services could be used and incorporated, this would have further supported the research findings and conclusions.

5.3 Implications of this Thesis for Further Research

This thesis addresses two areas of further research related to the product maintenance and repair for sustainable product design. Firstly, detailed information has been gathered about the repair and maintenance procedures, and breakdown reasons of small kitchen appliances in this study. A similar research about other household appliances and even any other product types can be explored. Especially, there may be further studies to be conducted about vacuum cleaners and electric irons which are considered as the ones delivered to services more frequently among the household appliances.

Furthermore, small kitchen appliances are considered and covered as a whole in this study. More in-depth information can be gathered with the help of more product-specific researches. Potential areas for further studies can be about problematic product groups such as blender and product parts like resistance and thermostat. Through adopting research through design approach, these products and problems can be explored more in-depth to develop design solutions and assess design considerations for sustainability.

Secondly, all the information in this study has been gathered from the perspective of authorized technical service personnel and repairmen, which present potential areas to focus on further. A similar research considering the users' perspective is worth exploring and investigating.

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APPENDIX A

A SECTION OF THE MATRIX PRESENTING THE ANALYSIS PROCESS (TURKISH)

Table A.1 - A Section of the Matrix

Raw Data	Revised Data
Constraints of Companies Related to the Maintenance and Repair Participant 1	Increasing Product Functions Decreasing Product Lifespan
Müşterimizin talebi uzun süreli kullanmak ama fabrikamız bunu biraz kısmak istiyor. Kişileri yeni bir cihaz almaya yönlendirmeye çalışıyor. Cihazları daha iyi yapıyor ama kısa ömürlü olmasını sağlıyor. Örneğin bir çamaşır makinesi eski sistemle yirmi yıl kullanılabiliyorsa şimdi on yıl ömrü var. Nedeni de örneğin çamaşır makinelerinde eskiden pamuklu ve sentetik kumaşlar vardı. Şimdi ise yünlüler, hassas çamaşırlar, çocuğu ve hastası olanlar için hijyenik yıkama için çalışmalar yapılıyor. Yeni çıkan cihazlar bu şekilde üretiliyor. İnsanlar eski cihazlarını bıraksın yeni sistemde yeni kıyafetlerini bozmadan daha iyi bir şekilde kullanabilsin.	Kullanıcılarla firmaların ürün ömrüne yönelik bakış açıları farklı olabilir. Kullanıcılar ürünlerini daha uzun süreli kullanmak isterken; firmalar daha fazla ürün satmak amacıyla ürün ömrünün kısa olmasını amaçlamaktadırlar. Teknoloji ile birlikte işlevsel açıdan kullanıcılara farklı seçenekler ve daha gelişmiş ürünler sunulsada ürünün yirmi yıl öncesine göre daha kısa ömürlü olduğunundan bahsedilmektdir. Örneğin çamaşır makinelerinde farklı tipteki kumaşların yıkanması için gün geçtikçe daha farklı seçenekler sunulmaktadır. Ancak Eskiden bir çamaşır makinesinin ömrü yirmi yıla yaklaşırken, artık bu ömrün yarıya indiğinden bahsedilmektedir (Katılımcı 1). Ayrıca ürünlere eklenen yeni özellikler sayesinde kullanıcılar ürünlerini değiştirmeye teşvik edilmektedir (Katılımcı 1).

APPENDIX B

SEMI-STRUCTURED INTERVIEW QUESTIONS OF PILOT STUDY (TURKISH)

1- Bağlı olduğunuz firmanın ürettiği ev aletlerini enerji tüketimi ve verimliliği açısından değerlendirir misiniz? Ürün örnekleri üzerinden açıklar mısınız?
2- Bağlı olduğunuz firmanın ürettiği ev aletlerini ürün ömrü açısından değerlendirir misiniz? Ürünleri kullanım ömürleri açısından kıyaslarsak ürün ömrü en uzun ve en kısa ürünler nelerdir? Nedenlerini örnek vererek açıklar mısınız?
3- Bağlı olduğunuz firmanın ürettiği elektrikli ev aletlerinin ürün yaşam döngüsünde, *enerji tüketimi ve verimliliği* / *ürün bakım ve onarımı* konularında izlediği stratejiler var mı? Varsa, ürünler üzerinden örnekler vererek açıklar mısınız?
4- Ürettiğiniz ev aletlerinin kullanım ömrünün sona ermesinin başlıca sebepleri nelerdir? Ürün ömrünün arttırılması için firmanızın izlediği stratejiler var mı? Varsa, ürünler üzerinden örnekler vererek açıklar mısınız?
5- Bağlı olduğunuz firmanın ürettiği ev aletlerinden hangilerinin ne sıklıkla servise gönderildiğinden bahsedebilir misiniz?
6- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan elektrikli ev aletlerinden hangilerinin ne sıklıkla servise gönderildiğinden bahsedebilir misiniz?
7- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan elektrikli ev aletlerinin hangi şikayetlerle servise gönderiliyor? En sık karşılaştığınız şikayetler nelerdir? Ürün örnekleri üzerinden açıklar mısınız?
8- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan elektrikli ev aletlerinin servise gönderilmesi daha çok kullanıcı hatasından mı yoksa üretim hatasından mı kaynaklanıyor?
9- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan elektrikli ev aletlerinin bakım ve onarım sürecinden bahseder misiniz? Ürün örnekleri üzerinden açıklar mısınız?
10- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan elektrikli ev aletlerinin bakım ve onarımı sırasında ne gibi sorunlarla karşılaşıyorsunuz? Ürün örnekleri üzerinden açıklar mısınız?
11- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan elektrikli ev yenilenebilen/yenilenemeyen parçaları hangileridir? Ürün örnekleri üzerinden açıklar mısınız?
12- *Enerji tüketimi ve verimliliği* / *ürün bakım ve onarımı* konularında yetkili servis olarak tercih ettiğiniz ve etkili bulduğunuz ancak firmada uygulanmayan yöntemler var mı? Sizce ürünlerin enerji tüketiminin azaltılması ve verimliliğinin arttırılması için neler yapılabilir? Ürün örnekleri üzerinden açıklar mısınız?
13- *Enerji tüketimi ve verimliliği* ve *ürün bakım ve onarımı* konularında tüketici veya kullanıcılardan geribildirim almak için farklı yöntemler kullanıyor musunuz? Örnek vererek açıklar mısınız?

14- *Enerji tüketimi ve verimliliği / ürün bakım ve onarımı* konularında kullanıcılardan size gelen istekler ve tavsiyeler var mı? Varsa örnek vererek bu yöntemlerin nasıl uygulandığını açıklar mısınız?
15- *Enerji tüketimi ve verimliliği / ürün bakım ve onarımı* konularında kullanıcı bilgisinin ne derecede olduğunu düşünüyorsunuz?
16- *Enerji tüketimi ve verimliliği / ürün bakım ve onarımı* konularında kullanıcılara tavsiyelerde bulunuyor musunuz? Varsa örnek vererek bu yöntemlerin nasıl uygulandığını açıklar mısınız?
17- *Enerji tüketimi ve verimliliği / ürün bakım ve onarımı* konularında etkili bulduğunuz ürün örnekleri var mı? Ne açılardan etkili çözümler olduğunu açıklar mısınız?
18- Elinizdeki (elektronik) atıkları nasıl değerlendiriyorsunuz?
19- Kullanıcıları ürünlerin geri dönüşümü hakkında bilgilendiriyor musunuz?
20- *Enerji tüketimi ve verimliliği / ürün bakım ve onarımı* konularında firma olarak kısıtlarınız neler? Ürün örnekleri üzerinden açıklar mısınız?
21- Görüşmemiz sırasında, *enerji tüketimi / verimliliği* ve *ürün bakım ve onarımı* konularında değinmediğimiz ve sizin eklemek isteğiniz başka etkenler var mı?

APPENDIX C

SEMI-STRUCTURED INTERVIEW QUESTIONS OF PRIMARY RESEARCH (TURKISH)

Mutfakta kullanılan küçük elektrikli ev aletleri

Gıda hazırlama aletleri (ürün bakım onarımı) : Blenderlar, Mutfak Robotları, Mikserler, Meyve Sıkıcıları, Doğrayıcılar, El Blenderları, Tartılar

Isıtıcılar ve pişiriciler (enerji tüketimi, ürün bakım onarımı) : Çay Makineleri, Türk Kahve Makineleri, Kahve Makineleri, Kettle (Su Isıtıcısı), Tost Makineleri, Griller, Ekmek Yapma Makinesi, Ekmek Kızartıcılar, Mısır Patlatma Makinesi

Ütü (enerji tüketimi ve su kullanımı, ürün bakım onarımı)

El ütüleri, Buhar jeneratörlü ütüler

Kişisel bakım ürünleri

Saç Bakımı, Epilasyon

Elektrikli süpürge (enerji tüketimi, ürün bakım onarımı)

Toz Torbasız, Toz Torbalı, Islak – Kuru, Su Filtreli, Dik Kullanımlı Şarjlı Süpürge

Mutfakta Kullanılan Küçük Elektrikli Ev Aletleri Dört Grupa ayrılmıştır:

1- Blenderlar, Mutfak Robotları, Mikserler, Doğrayıcılar, El Blenderları

2- Çay Makineleri, Türk Kahve Makineleri, Kahve Makineleri, Kettle (Su Isıtıcısı),

3- Tost Makineleri, Griller, Ekmek Kızartıcılar,

4- Meyve Sıkıcıları, Tartılar, Ekmek Yapma Makinesi, Mısır Patlatma Makinesi

Firma yetkili servisleri ve tamirciler ile yapılacak görüşme kılavuzunda yer alan sorular:

Sorular üç ana konuyu kapsayacaktır:

a- Genel, Küçük elektrikli ev aletlerinin ürün ömrü, bakım ve onarımı ile alakalı sorular

b- Mutfakta kullanılan küçük elektrikli ev aletlerinin bakım ve onarımı ile ilgili sorular

c-Kullanıcıların sürece katılımı

a- Genel, Küçük elektrikli ev aletlerinin ürün ömrü, bakım ve onarımı ile alakalı sorular:

1- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan küçük elektrikli ev aletlerini ve diğer küçük elektrikli ev aletlerini (ütü, kişisel bakım, süpürge ve diğer) servise getirilme sıklığı açısından değerlendirir misiniz?

2- Bakım onarım açısından problemli ürün grupları var mı? En çok karşılaştığınız sorunlar nelerdir? Ürün örnekleri üzerinden açıklar mısınız?

3- Ürün ömrünün uzatılması için firmanızın izlediği stratejiler var mı? Varsa, ürünler üzerinden örnekler vererek açıklar mısınız?
4- Ürün bakım ve onarımı konusunda firma olarak kısıtlarınız var mı? Ürün bakım ve onarımı konusunda yetkili servis olarak tercih ettiğiniz ve etkili bulduğunuz ancak firmada uygulanmayan yöntemler, stratejiler veya çözümler var mı? Ürün örnekleri üzerinden açıklar mısınız?
5- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan küçük elektrikli ev aletlerinin üretim yeri neresidir? Ürünlerin hangi parçalar hangi ülkede üretiliyor?

b- Mutfakta kullanılan küçük elektrikli ev aletlerinin bakım ve onarımı ile ilgili sorular:

6- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan küçük elektrikli ev aletlerinden hangilerinin ne sıklıkla servise gönderildiğinden bahseder misiniz?
7- Mutfakta kullanılan küçük elektrikli ev aletlerinin servise gönderilme/bozulma nedenleri nelerdir?
    a. En sık karşılaştığınız şikayetler nelerdir? Ürün örnekleri üzerinden açıklar mısınız?
    b. Üretim hatasından kaynaklanan sorunlar oluyor mu?
8- Bağlı olduğunuz firmanın ürettiği mutfakta kullanılan küçük elektrikli ev aletlerinin bakım ve onarım sürecinden bahseder misiniz? Ürün örnekleri üzerinden açıklar mısınız?
    a. Bakım ve onarımı sırasında sorunlarla karşılaşıyor musunuz? Eğer karşılaşıyorsanız ürün örnekleri üzerinden açıklar mısınız?
    b. Yenilenebilen/yenilenemeyen parçaları hangileridir? Ürün örnekleri üzerinden nedenleri ile açıklar mısınız?
    c. Ürün bakım ve onarımı konusunda etkili bulduğunuz ürün örnekleri var mı? Hangi açılardan etkili çözümler olduğunu açıklar mısınız?
    d. Ürün bakım ve onarım sürecini daha etkin hale getirmek için ve ürün ömrünü uzatabilmek için üretim ve tasarım sürecinde neler yapılabilir? Bu konuda tavsiyeleriniz var mı?

c-Kullanıcıların sürece katılımı:

9- Ürün bakım ve onarımı konusunda tüketici veya kullanıcılardan geribildirim almak için farklı yöntemler kullanıyor musunuz? Örnek vererek açıklar mısınız?
    a. Ürün bakım ve onarımı konusunda kullanıcılardan size gelen istekler ve tavsiyeler var mı? Varsa bu tavsiye ve istekleri nasıl değerlendiriyorsunuz?
    b. Ürün bakım ve onarımı konusunda kullanıcılara tavsiyelerde bulunuyor musunuz? Varsa örnek vererek bu yöntemlerin nasıl uygulandığını açıklar mısınız?

c. Ürünlerin bozulma nedenlerini serviste kaydediyor musunuz? Bu bilgiler bağlı olduğunuz firma tarafından nasıl değerlendiriliyor?
d. Bu çalışmanın sonraki aşamaları için bu bilgileri bizimle paylaşabilir misiniz? Eğitim projesinin bir parçası olarak kullanıcılara sizin aracılığınızla ulaşmamız mümkün olur mu?
e. Bozulan veya eskiyen parçalardan hangileri hangi ürünlerde kullanıcılar tarafından değiştirilebilir? Varsa ürün örnekleri üzerinden açıklar mısınız?

10- Bakım ve onarımı yapılamayan ürünleri nasıl değerlendiriyorsunuz? Ürünlerin geri dönüşümü konusunda birlikte çalıştığınız bir firma var mı?
11- Görüşmemiz sırasında değinmediğimiz ve sizin eklemek isteğiniz başka etkenler var mı?

APPENDIX D

CONSENT FORM (TURKISH)

Orta Doğu Teknik Üniversitesi (ODTÜ)

Mimarlık Fakültesi Endüstri Ürünleri Tasarımı Bölümü

Yüksek Lisans Tezi konusu: Mutfakta kullanılan küçük elektrikli ev aletlerinin bakım ve onarımı

Görüşme için katılımcı izin formu:

Bu araştırma ODTÜ Endüstri Ürünleri Tasarımı Bölümü yüksek lisans tez çalışması kapsamında yapılmaktadır. Araştırmanın amacı yetkili serviste çalışan teknik elemanların elektrikli ev aletlerinin kullanımına, bakım ve onarımına yönelik deneyim ve görüşlerini öğrenmektir. Görüşme sırasında elde edilen veriler yalnızca bilimsel amaçlarla, tasarım sürecinde, tez araştırmalarında, bilimsel yayınlarda ve sunuşlarda kullanılacaktır. Katılımcıların kimlik bilgileri saklı tutulacaktır. Görüşme sırasında fotoğraf makinesi, video veya ses kayıt cihazı kullanılması izninize bağlıdır. Görüşme yaklaşık bir saat 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 öğrencinin, 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.

Katılımcının adı soyadı	**İmza**	**Tarih**

Araştırmacı:

ODTÜ Endüstri Ürünleri Tasarımı Bölümü

Yüksek Lisans Öğrencisi

Nazlı Gökçe Terzioğlu

Araştırmadan Sorumlu Danışman:

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