Product optimization to increase consumer acceptance of refurbished domestic appliances

Karen Ratering Master Thesis, Delft University of Technology

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Preface

This master thesis is about making the purchase of a refurbished product more attractive to consumers. Refurbishment is one of the strategies of the circular economy and helps to reduce the negative impact on the environment of the products we design. In my personal life I am trying to be conscious about the decisions I make regarding the environment. For example with the things I eat, the products I buy and the way I travel. However as a product designer you are contributing to the consumption of products. With this project I hope to turn this around and contribute to a better environment.

I would like to thank my supervisory team from the TU, for guiding me throughout the project. Stefan, for always make me look one step further and Theresa for your enthusiasm for the topic and for always helping me when I got lost.

A big thanks to my supervisors from Bosch Ina and Phillipp, for you positivity and enthusiasm for the project.

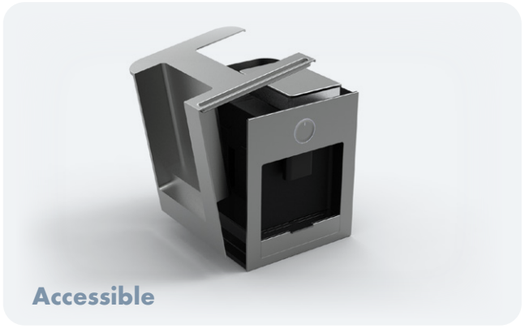
I would like to thank my colleagues at BSH, for always being willing to help me and to help me find answers to my questions. And a thank you to all the people from BlueMovement for adopting me in your team!

Thanks to my flatmates for keeping up the fun and sticking together during these strange times of having to stay at home. Thank you for always being willing to help me with my research and for joining the creative session!

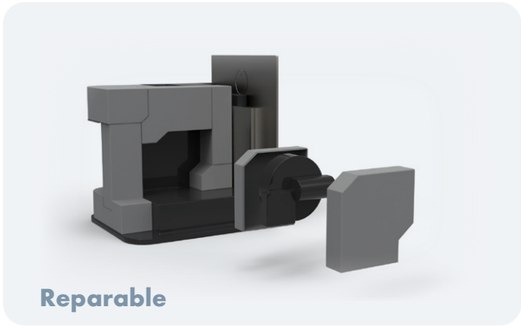
Most of all I want to thank my family for listening to me when I needed to clear my mind and supporting me when things got hard.

Enjoy reading!

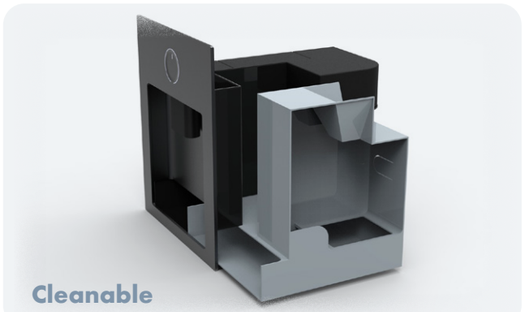
Karen



Accessible



Reparable



Cleanable

Upgradeable

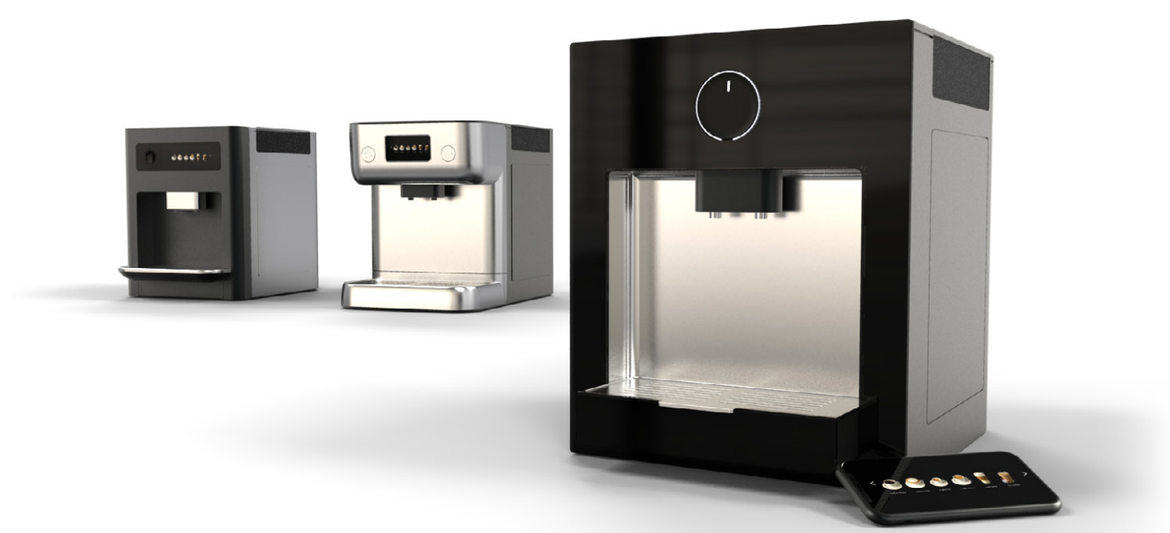


Figure 1: Design solutions

Executive Summary

The world is becoming more and more technology-driven. The consumption of electronic products leads to an increase in electronic waste (e-waste). More than half of all the e-waste that is generated in the Netherlands originates from **domestic appliances** (WEEE register, 2019) and only 9% of all the e-waste will be recycled (Renewi, personal communication, 2019). The remaining waste will be dumped into landfill sites, and the energy and resources used to make the products will get lost, therefor products need to be designed with a 'circular approach'.

The goal of the circular economy is to use products, equipment and infrastructure for a longer time, and to improve the productivity of these resources. (Ellen MacArthur Foundation). One of the strategies of extending the life time of products within the circular economy is **refurbishment**: *"A process of returning a product to good working condition by replacing or repairing major components that are faulty or close to failure, and making 'cosmetic' changes to update the appearance of a product"* (Ellen MacArthur Foundation). Right now, refurbished products are not a common consumer choice.

Therefor the question that is answered in this master thesis is: *How can the design of a household appliance be optimized to increase the consumer acceptance with regard to the refurbished product?*

The research was divided in three parts. First the motivation of the consumer was investigated by means of a literature review and a survey amongst consumers. Then the preferred aesthetics of refurbished appliances were researched through literature and doing in-dept interviews. Lastly a research was done in order to optimize this process of refurbishment. Interviews and observations where done with repairers and refurbishers.

Based on the results of the consumer research three different target groups were identified; the ecological buyer, the economical buyer and the secure buyer.

Consumer research shows that the three aspects **reparability, cleanability and timelessness** cause a more efficient refurbishment process and a greater customer acceptance of the refurbished products. These aspects are turned into a set of guidelines that will serve as proposed requirements to design for refurbishment. They must be taken into account when designing the product, choosing materials and maintaining the product.

However, only incorporating these guidelines would not be sufficient to enhance the consumer acceptance of refurbished products. Research showed that not only performance of the product plays a large role in the acceptance of the product. Awareness and trust should also be created. In addition, the experience of buying a refurbished product should be as fun and exciting as buying a new product.

It was found, that when the product still looks like new, the customer is more likely to trust the product. The concept 'looking good, feeling good' is created on this insight. The core of the concept is that part of the cover can be replaced or refinished. Therefor the machine looks new while preserving the internal components and 80% of materials used in the cover. The customers can compose their own refurbished product by starting out with a refurbished base and then choose their own new or refurbished cover to create a stronger product attachment.

All findings where combined and translated to a redesign of a fully automatic coffee machine. This was done by improving the accessibility of internal components and to create a modular structure on the inside of the coffee machine in order to make the process of repairing and cleaning more efficient.
Moreover, three different front designs were created that meet the requirements of the aesthetics that are preferred for refurbishment. Combinations of colors and materials were tested with the target groups and the result were evaluated.

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Introduction

1. Scope

During this graduation the consumer acceptance of refurbished products has been analyzed. Additionally the process of refurbishment and its stakeholders has been researched.
This research is done in order to increase the consumer acceptance of refurbished household products. After that a redesign was made of a full automatic coffee machine, in order to meet the needs of all stakeholders involving this topic. To tackle this challenge I teamed up with **Bosch Household appliances.**
For this project the double diamond approach was used. This approach will be elaborated on the next pages with an overview of all the different phases.

1.1 Assignment

RESEARCH QUESTION

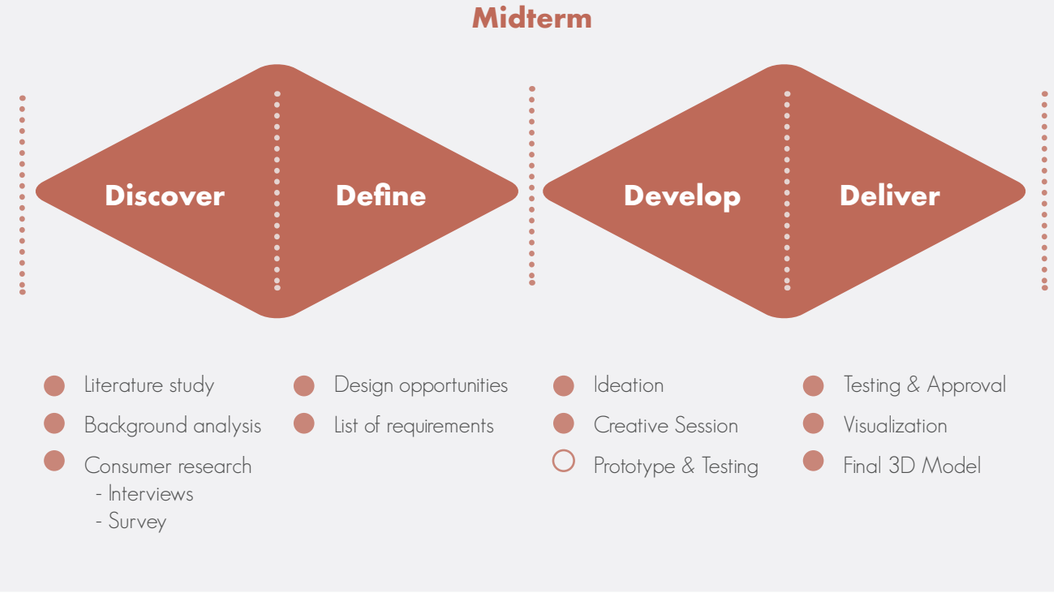
How can the design of a household appliance be optimized to increase the consumer acceptance with regard to the refurbished product?

SUB-QUESTIONS

To answer the research question it is divided in separate sub-questions. These questions will be answered during the different chapters of the report. These questions will be the guidelines for the analyses done in the first part of the project. And with the answers to the research question and sub-questions the redesign of the product will be made.

1. ***What is the relevance of refurbishment?***
2. ***How can you design for product life extension?***
3. ***Where can refurbishment be implemented?***
4. ***What is the reason people do (not) buy refurbished appliances?***
5. ***What product aesthetics is preferred for refurbished products?***
6. ***How can design increase the consumer trust of a refurbished product?***
7. ***How can a product be efficiently refurbished?***

1.2 | Approach



1.2.1 Approach and Methods

This project covers all the parts of the design cycle. The double diamond approach (Bànàthy, 1996) was chosen. It started with an in-dept research on refurbishment and its relevance which was followed by a consumer research. For this study different research methods were used. It started with a literature research revealing existing knowledge about motivations of customers concerning refurbishment. An additional quantitative research survey was done to validate this research and to discover more interesting insights. In addition qualitative research interviews were conducted in order to discover more in-dept insight into refurbishment. And experts on topics of repair, refurbishment, sustainability and design were interviewed to gain more knowledge of these topics. After that all these insights were translated into design opportunities, and various personas were developed in order to specify the target groups, and these were used to make decisions on the ideas.
In order to generate ideas a creative session was held and also other brainstorm techniques were used. Decision making methods were used such as the C-box and spider plots.
Ideas were combined and a guideline for refurbishment was created.
With these guidelines a concepts was created to make the process of refurbishment more efficient. Next to that 3 variations of an upgradeable aesthetics were created. A material and color study was done in order to evaluate the research with the consumer. A survey was held in order to test the designs with the customer.

1.2.2 The project

The figure below is a schematic representation of the steps that were taken in this project. The figure shows the structure within this double diamond approach of Bànàthy (1996).

I Discover

A background analysis was done in order to define the context, company values and the outlines of refurbishment. Next to that a more zoomed-in analysis was in order to define the motivations, need and wishes for all stakeholders involved with refurbishment.

II Define

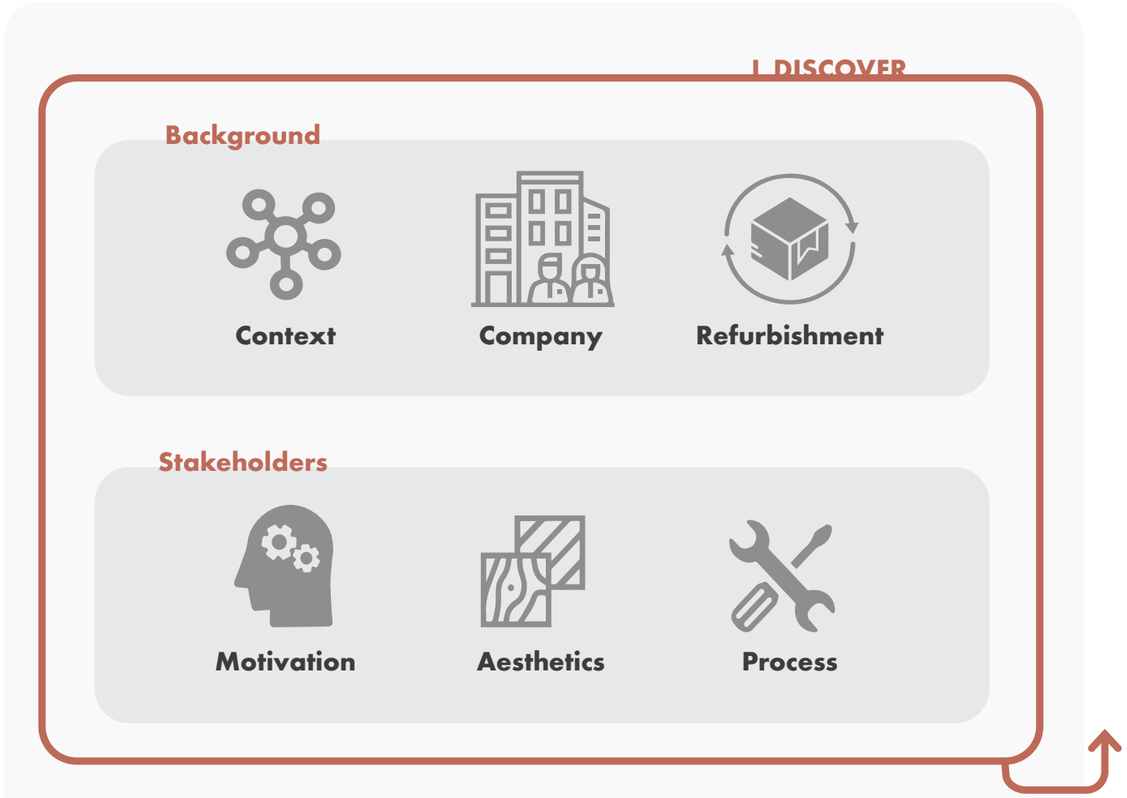
The insights that were found in the first phase of the project were translated into personas and design opportunities. They will be used as a guideline to create ideas and to make decisions based on the research.

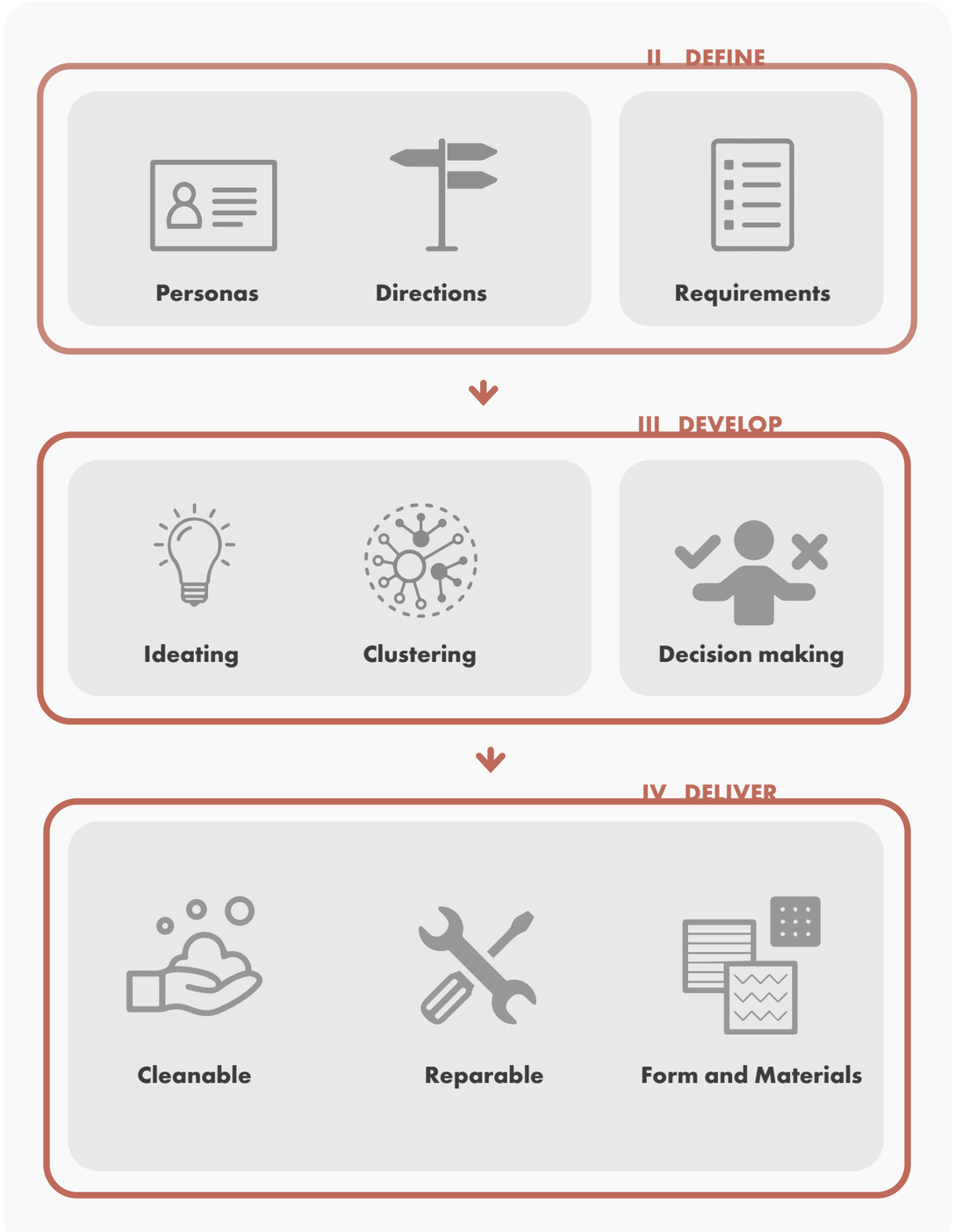
III Develop

Based on the design directions ideas were generated and clustered. Ideas were combined into promising ideas and afterwards the decisions was made based on the personas defined by the research.

IV Deliver

A concept was created based on the outcome of the previous phase. Different elements were taken into account and the full automatic coffee machine had been redesigned with regards to accessibility, cleanability and reparability. In addition to this, three different cover designs were created that connect to the insights found in the aesthetic research. Color and materials were researched with the target groups and the designs of the changeable covers were evaluated by means of a survey.





DISCOVER

2. Context

To understand more of the importance to design for refurbishment an analysis of the context was executed.
First the impact of designing in a linear way was explored and after that the circular economy was evaluated. Relevant trends were analyzed in order to identify customer needs and wishes in relation to products in a circular economy.

2.1 Waste

The reason why it is important to change the way we design our products is the fact that the current way increases the waste we are producing. Rapid innovations in products contribute to an increase in e-waste (European Environment Agency, 2017). This can cause pollution of the groundwater and loss of resources. This will be further explained in the next chapters.

2.1.1 Waste

In the Netherlands we produce 490kg waste per person every year (Milieu Centraal, n.d.). In 2017, 59% of this waste was submitted in a separated form. The rest of the waste is residual waste. As you can see in Figure 2, some product categories are already being separated quite well. Paper, cans, glass and chemical waste lead the way. However, textiles, electronic appliances and drink cartons lag behind. According to Milieu Centraal it would be possible to separate 80% of all waste.

As most of us know, the separation of waste is good for the environment.
The waste that gets separated can be recycled so that the need for new raw materials will be reduced. Recycling (e.g. the melting of metals and glass) takes less energy than processing new raw materials. For example, manufacturing with recycled aluminum cans uses 95 percent less energy than creating the same amount of aluminum with bauxite (Stanford University, n.d.).

On top of that, electronic waste contains a lot of valuable materials that are scarce and take a lot of energy to process. It is important to collect electronic waste to prevent the loss of these materials. As you can see in Figure 2, 51% of the discarded electronic products is not collected properly.

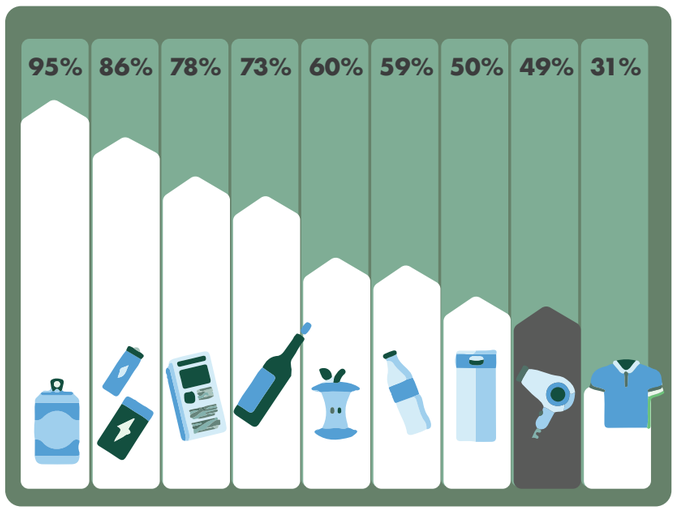


Figure 2: Amount of waste collected per category 2017 (Milieu Centraal)

2.1.2 | E-waste

The world is becoming more and more technology-driven. The consumption of products leads to an increase in electronic waste (e-waste). E-waste refers to all items of electrical and electronic equipment that have been discarded as waste without the intent of re-use (Step Initiative, 2014).
In the EU the quantity of e-waste increases by 3-5% per year (Gaidajis, G., Angelakoglou, K., & Aktsoglou, D., 2010). and only 9% of all the e-waste will be recycled (Renewi, personal communication, 2019).

This can all be very worrying for the environment since, as mentioned before, electronic products contain valuable materials. According to the United Nations (2012), electronic waste contains deposits of precious metal estimated to be between 40 and 50 times richer than ores mined from the earth.

According to Gaidajis (2010), the recycling process is often outsourced to countries where the recycling costs are lower, such as China, India, Pakistan, Vietnam, Philippines, Malaysia, Nigeria, Ghana etc. However, they are working in loose environmental frameworks, which has a negative impact on the environment and the workers on site (Feldt et al., 2014). The remaining waste will be dumped into landfill sites, and the energy and resources used to make the products will get lost.
To avoid these resources to get lost, it is important to design products in a circular way. This means that old products will be used to generate new products in a way that all materials and parts stay in a closed loop.

E-waste collection

Old household appliances are collected in stores where similar new appliances are sold. The store is obliged to take all similar appliances back with no extra charge. This can also be useful for taking back products and giving it a second lifetime instead of discarding/recycling the product.

E-waste categories

The product categories that generate the highest amount of E-waste, according to the Dutch government, are large appliances, such as fridges and washing machines (Figure 3). This figure shows the weight-based division of different categories of e-waste. (WEEE register, 2019). On top of that the WEEE register also shows a large increase (19%) in waste generated by small domestic appliances in 2018.
Both categories of household appliances take up a significant percentage of all the kilo's e-waste produced in the Netherlands. This makes household appliances an interesting category to explore when designing with a sustainable approach.. The cooperation with Bosch Home appliance is therefor very valuable.

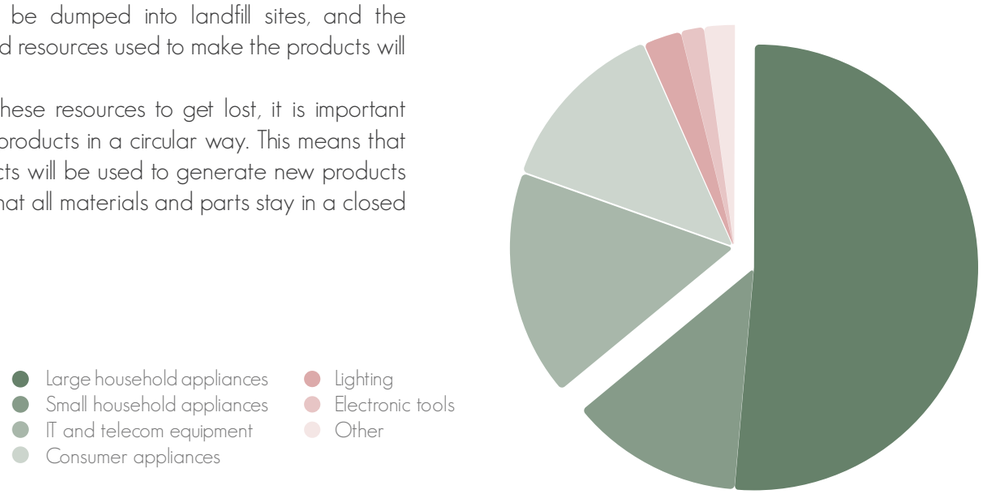


Figure 3: Mass division of E-waste in the Netherlands in 2019

2.2 | Circular Economy

To reduce all this waste that we generate and to prevent pollution and loss of resources, the circular economy was called into being. In this chapter a deeper understanding of the circular economy will be created. It will also be determined how refurbishment fits within this strategy.

2.2.1 | Definition

As described in the last chapter (2.1), a lot of materials that have been put to waste, can be used for the manufacturing of new products. By doing this the process of making products becomes 'circular' instead of linear. Materials will enter a loop of use.

A circular economy (CE) is based on the principles of designing out of waste and pollution, keeping products and materials in use, and regenerating natural systems (Ellen MacArthur Foundation, 2017). According to the Ellen MacArthur Foundation, the CE changes the 'end-of-life' concept by shifting towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.
Solutions within this circular model are: reuse, sharing, repair, refurbishment, re-manufacturing and recycling. This is how you can create a close-loop system and minimize the use of raw materials and the creation of waste, pollution and carbon emissions.

The goal of the circular economy is to use products, equipment and infrastructure for a longer time, and to improve the productivity of these resources. The waste of one process should be useful for another process. The CE strategy says that it can be as profitable as a linear approach with the same product quality (Ellen MacArthur Foundation, 2013).

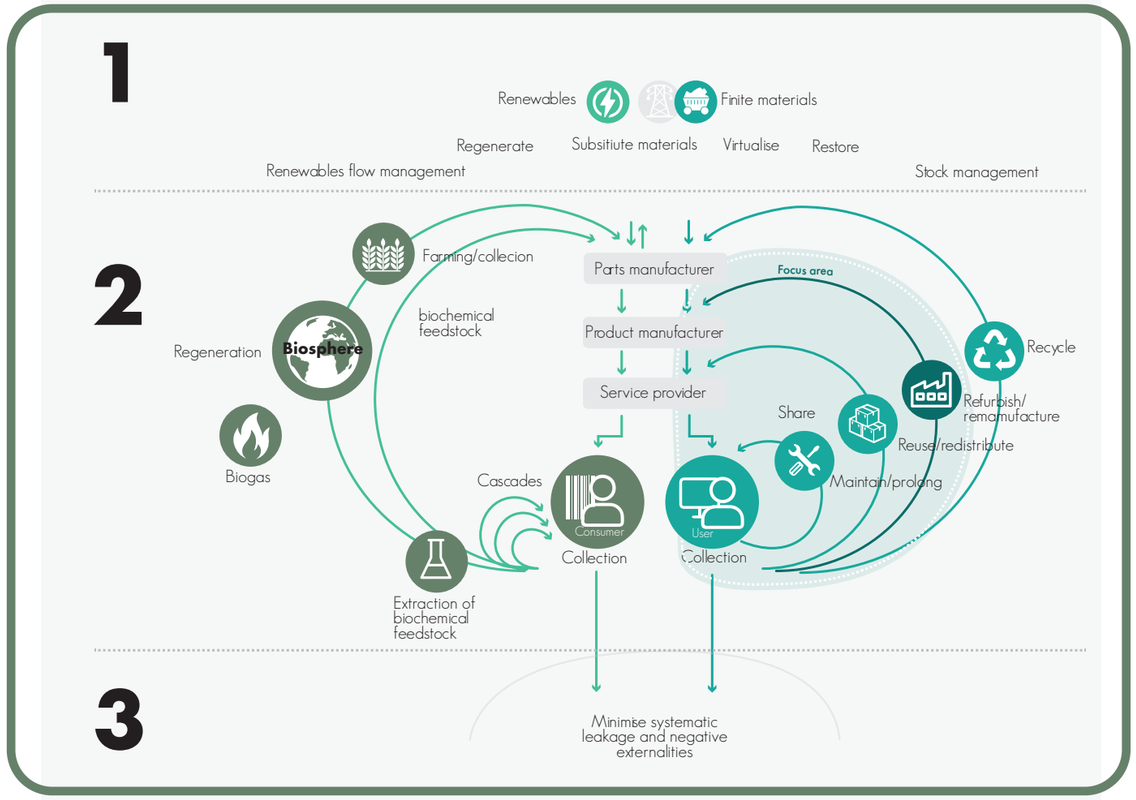


Figure 4: Outline of a Circular Economy (Ellen MacArthur Foundation, 2017)

2.2.2 | Principle

The Circular Economy is based on multiple principles. These principles are illustrated in Figure 4.

Design out of waste

The first principle of Circular Design is: Design out of waste. Technically the model states that there would be no such thing as waste. To achieve this, it should become easier to renew products. When products are designed to last for a long time, using good quality materials and optimizing the product for a cycle of disassembly and refurbishment are important. When the product is designed according to this principle, biological nutrients are non-toxic and can be composted. The technical nutrients (like polymers, alloys and other man made materials) will be reused and in such a way that quality is maintained and the energy usage is minimized.
The goal of this principle is to control finite stocks and balance renewable resources flows in order to protect and increase natural capital (YouMatter, 2020).

Following Design and Cycles from nature

As mentioned before, the circular economy model makes a distinction between technical and biological cycles where the consumption only takes place in the biological cycles.
Biologically-base materials, like food, linen or cork, will return into the system through natural processes such as anaerobic digestion and composting. (YouMatter, 2020).
The oceans and soils will act as a regenerative system that provides us with renewable sources for the economy.
On the other hand we have the technical cycles. They recover and restore products, components and materials. This is done by strategies such as reuse, repair, refurbishment, re-manufacturing or recycling. These strategies are important to increase the lifetime of products and materials. Therefore these strategies are important to use when designing a product for a circular economy.

Renewable Energies

The last principle concerns the energy that is required for the circular economy. The energy used for this cycle should be renewable and cause a decrease in the dependency on resources.

2.3 | Refurbishment

This project will focus on refurbishment. In the previous chapter (2.2) it was stated that this is one of the strategies for a circular economy, and it fits the second principle. It is the third cycle within this principle and therefore it is important to keep the other cycles in mind because it is part of a bigger loop. The product should therefore also be repairable and reusable and these strategies have to be taken into consideration throughout this project. In Figure 4 the focus of the project is illustrated. The main focus will be design for refurbishment.

The relevance of refurbishment is illustrated in Figure 5 below (Ellen MacArthur Foundation, 2020). To design for a circular economy we must keep products and material in use.
When a product is refurbished after use, the process of getting the product back into the cycle is shorter and more efficient than recycling the materials of the product (Second principle of Figure 4).

The Definition

The definition of refurbishment by the Ellen MacArthur foundation is as following:

"A process of returning a product to good working condition by replacing or repairing major components that are faulty or close to failure, and making 'cosmetic' changes to update the appearance of a product, such as cleaning, changing fabric, painting or refinishing. Any subsequent warranty is generally less than issued for a new or a remanufactured product, but the warranty is likely to cover the whole product (unlike repair). Accordingly, the performance may be less than as-new. "(Ellen MacArthur foundation, 2020)

This is the definition that will be used in the rest of the project.

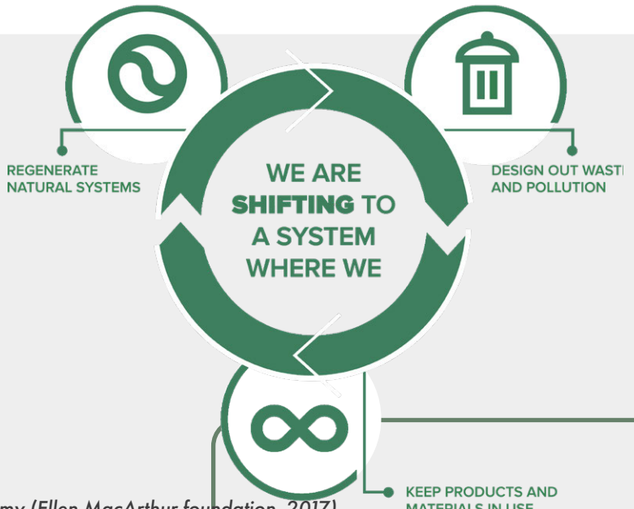


Figure 5: Circular economy (Ellen MacArthur foundation, 2017)

For this project we zoom in at this part of the circular economy. With refurbishment, products and materials are kept in use in stead of being discarded after its first use.

2.4 | Trends

Different trends were analyzed around the products in the circular economy where determined. This was done in order to discover the relevance of refurbishment and the customer needs and wishes.. The European Environment Agency did a study in 2017 on products in a circular economy were relevant trends were determined.

2.4.1 |Increasingly complex product design and functionality

'Many products (especially electronic devices) are increasingly designed to provide a wide variety of functions, and/or provide better functionality while using less material. This design trend leads to products containing an increasing number of different materials and additives, with smaller amounts of each specific material. In addition, product components are increasingly glued to or even integrated into the product body to achieve smaller form factors.' (European Environment Agency, 2017)

This trend makes products hard to repair and recycle, since these materials are hard or impossible to separate. In addition, the innovation trend is causing an increase in the sale of new technological products, since consumers are embracing these product innovations. This results in a positive effect on economic growth and stimulates the fast growth of linear product development.
This shows that it is relevant to design the innovative products with a circular approach.

2.4.2 | Building services around products

The product as a service is a trend that is becoming more and more important. For example, look at BlueMovement mentioned in the next chapter, where the use of a washing machine is sold instead of the ownership of it. By providing maintenance and repair this becomes an attractive subscription for customers. There is a growing shift from owning a product to leasing a product. Other examples are Swapfiets and GreenWheels, but also on-line services such as Netflix and Spotify.
'Using a service-based business model is a powerful way of increasing product circularity if product ownership remains with the producer. In that case, minimising the total life-cycle cost of the product is an economic incentive that can encourage the design of products for longer lifespans, reuse, repair or remanufacture. However, this may still present a higher life-cycle cost if, for example, the labour needed for repair is too expensive. (European Environment Agency, 2017)

This trend shows how relevant it is to design a product for reuse and refurbishment. In order to keep labor costs for maintenance low, the product should have a design that fits the service needs.

2.4.3 | Home delivery systems

The online retail sector is still growing, and online-markets are taking up a big part in the sale of customer appliances. The total market share of online sales (calculated for private households in the Netherlands) in products on domestic and foreign online sales channels was 9.2 percent in 2018 (Emerce, 2018). In 2019, 79 percent of people over 12, about 11.8 million people, said they had bought something online. In 2015 this was 70 percent (CBS, 2019).

Big channels such as Bol.com and Coolblue sell home appliances on their websites and advertise with free delivery and installation. Moreover, the reflection period for returning a product is around 30 days.
According to the product manager at BSH the Netherlands, this returning policy entails a couple of problems:

- If customers buy their products online, the return rate is higher than if they buy it in a store. They have not seen the product in real life and the product can be different from what they expect it to be.
- If a product is used for less than 30 days it can be returned, but not sold again as a new product. It has to be sold as a 'B-product'.
- If a product has transport damages or the investment costs are too high, the product might be discarded.

The amount of hardly used products is growing. If these products come back to the manufacturer, they need to be refurbished in order to put them back on the market.

2.4.4 | Repairing

At the moment Sire, the social-cultural advertiser in the Netherlands, is running a campaign to encourage citizens to take more care of their products and to stimulate them to repair products that are broken, instead of buying new ones.
This trend makes people more aware of the environmental value of repairing and taking care of their products. This awareness can be beneficial to the relevance of refurbished products.

Repair Cafes

An upcoming phenomenon in the Netherlands form the so-called Repair Cafes. A Repair Cafe is a meeting focused on repair, organized in the neighborhood. It was set up in Amsterdam in 2009 and currently has meetings in 35 different countries.
This trend also shows that people are becoming more aware of the value of their products.

Conclusion Context

Q1: Why is refurbishment relevant?

Refurbishment can reduce the waste we are producing, to counteract groundwater pollution and loss of resources. Refurbishment is one of the Circular Economy strategies and it contributes to recovering and restoring products, components and materials.

Key insights:

- Large household appliances and small household appliances take up a significant mass percentage in the generated e-waste in the Netherlands. Therefore these are interesting product categories to redesign for refurbishment.
- The definition of refurbishment: *A process of returning a product to good working condition by replacing or repairing major components that are faulty or close to failure, and making 'cosmetic' changes to update the appearance of a product, such as cleaning, changing fabric, painting or refinishing (Ellen MacArthur Foundation).*
- The increasing complexity of products contributes to a linear process of designing products. This trend makes it hard to repair and recycle products, since these materials are hard or impossible to separate.
- In order to keep the labor costs for maintenance low, the product within a product service system should have a design that fits the service needs.

3. Company

To answer the research question, I teamed up with Bosch Household appliances. An analysis of the company will be done to have an insight in the different layers of Bosch and BSH. A brief analysis of the product range of Bosch Home will be done and aesthetic qualities of the variety of products will be summarized.

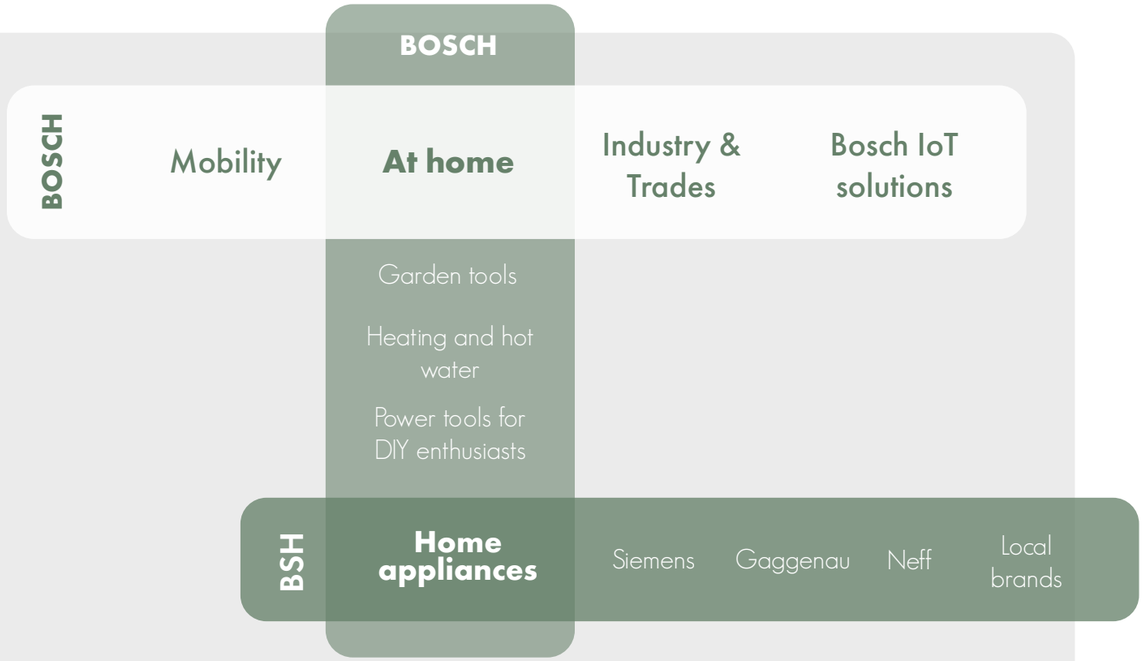


Figure 6: Structure of various Bosch divisions

3.1 | Bosch

Robert Bosch GmbH is an international technology and service company consisting of the divisions automotive technology, industrial technology, consumer products, energy and building technology. Bosch was founded as a workshop for precision mechanics and electrical engineering in Stuttgart in 1886. (Bosch, 2020)

3.1.1 | Devisions

Bosch is an International corporation active in different divisions. (Bosch, 2020)

Mobility Solutions
This is the largest division within the Bosch brand. Bosch produces multiple technologies for the automotive industry. Bosch is also active as a service for the automotive aftermarket.

Industrial Technology
The sector includes the Drive and Control Technology division and the Packaging Technology division. Bosch is active in packaging for pharmaceutical, food and candy industry.

Consumer goods
The Bosch consumer goods division takes care of different sectors such as power tools and garden tools. The Consumer Goods business sector also includes BSH Hausgeräte, which offers household appliances.

Energy and Building Technology
It has two areas of business: the global product business for security and communications, and the regional integrator business.

3.1.2 | Core values

Mission:
"*„We are Bosch*" explains what drives us, what we have in common, and what we stand for. We want to leave a lasting trace in the world – achieved by a unique outstanding team." (We are Bosch, 2020)

Motivation:
"*Invented for life*: we want our products to spark enthusiasm, improve quality of life, and help conserve natural resources." (We are Bosch, 2020)

Strategy:
"*Focusing on customers*: We understand our customers' requirements. We tailor our products to them, and we create innovative business models.
Shaping change: We shape change and seize the opportunities it brings, especially in connectivity electrification, energy efficiency automation and the emerging markets.
Striving for excellence: We measure ourselves against our strongest competitors. Our work is fast, agile and accurate. Efficient processes, lean structures and high productivity secure and increase the value of the company. "
(We are Bosch, 2020)

3.2 | B/S/H/

BSH Hausgeräte GmbH, is the largest manufacturer of home appliances in Europe and one of the leading companies in the sector worldwide. It started as a joint venture of Bosch and Siemens and was fully taken over by the bosch group in 2015 (BSH group, 2020)

3.2.1 | History

BSH Hausgeräte GmbH was founded in 1967 as a joint venture by Robert Bosch (Stuttgart) and Siemens (Munich) when the appliance market was in crisis.
In 1982 BSH took over the Neff brand and founded Neff GmbH in Munich. Between 1993 and 1998 BSH took over several brands across the globe. Within the last 50 years BSH turned into the leading home appliance manufacturer of the whole world. BSH has over 58,000 employees worldwide and has reached a turnover of 13.2 billion Euros in the last year. Worldwide BSH produces its appliances in 40 factories spread over the world. (BSH group, 2020)

3.2.2 | Brands

BSH is build of the brands Bosch and Siemens, as well as Gaggenau and Neff that operate world wide. The local brands include Thermador, Balay, Profilo, Constructa, Pitsos and Coldex.
The product portfolio contains a wide range of appliances. From cookers, ovens, hoods, dishwashers, washing machines and dryers, refrigerators and freezers to small household appliances such as vacuum cleaners, espresso machines and kitchen machines
The local BSH brands all have a strong local relationship to the consumers. On the other hand the global brands serve their own target groups practically everywhere in the world. BSH aims to become a true Hardware+ company when combining with digital services like Ecosystem Brand Home Connect and Service Brands like Kitchen Stories. (BSH group, 2020)

3.2.3 | BlueMovement

For my graduation I was placed in the BlueMovement team at Hoofddorp. BlueMovement is a startup within BSH, that leases washing machines, dryers and now also fridges. BlueMovement no longer sells the ownership of appliances but now sells its use by offering subscriptions to sustainable household appliances. Because BlueMovement remains the owner of the devices, they take care of maintenance, refurbishing and recycling of the devices with the aim to keep them in operation as long as possible.
Once a contract ends the appliance comes back to BlueMovement and gets refurbished. This appliance will be brought back into use at a new contract.

3.2.4 | Sustainability at BSH

Sustainability is a topic BSH has been exploring for some period of time. This topic has been implemented within different parts of the product journey: production, owning, using, returning and recycling. Some interesting examples useful for this project are mentioned. (Sustainability at BSH, 2019)

Own

Pappilion Project:
The Papillon project is a collaboration between BSH Home Appliances and the social enterprise Samenlevingsopbouw West-Vlaanderen in Belgium. The program aims to help families in financial difficulties with a product service system. The goal of this project is to remove outdated and thus energy-wasting home appliances that are owned by families in financial difficulties and install new energy-efficient ones on a lease-contract.

We wash:
We wash is a service concept that stimulates the efficient use of washing appliances in the laundry rooms for community washing of rented apartments or hotels. This concept has been established in Germany, Belgium, Austria and Switzerland. The goal is to lower CO2-emissions through more efficient use of washing machines.

Blue Movement:
This has already been mentioned. The goal of this project is to have ecological benefits by giving appliances a second life (refurbishment). The project also ensures a 100% recycling rate to enhance the reuse of materials. It stimulates and contributes to a circular economy through reuse and recycling and creates a sustainable supply chain channel.

Use

In addition, BSH has incorporated sustainable innovations within their products in order to save resources during the use of the products. Examples are I-Dos (to save water and detergent: automatic dosing of washing detergent and water), energy saving heating pumps for dryers, energy saving dishwashers with the use of the natural mineral zeolite, and new cooling techniques to keep food fresh three times longer in order to prevent food waste.

Return

Products are designed to be durable and easy to repair and recycle, and should contain a high proportion of recycled materials.
Pilot projects are setup to return old washing machines and other large appliances to BSH and thus gain experience with the company's own recovery of raw materials. (Sustainability at BSH, 2019)

Within BSH product service systems are being developed. Therefore it is important that the products are designed in such a way that they are optimized for these services. Refurbishment is an important part of this cycle.

3.3 |Bosch Home

3.3.1 | Categories

Bosch Home sells all sorts of household products related to kitchen and cleaning. The appliances that they have in the market can be divided in two different groups, large white goods and small domestic appliances.

Large white goods:
The portfolio of the large domestic appliances consist out of the categories: Cooking and Baking, Washing and Drying, Dish-washing and Cooling and Freezing.

Small Domestic appliances:
The portfolio of the small domestic appliances consist out of the categories: Coffee, Breakfast appliances, Food preparation, Irons, Vacuum-cleaners and Kitchen machines.

Positioning
In emerging markets the focus is on making the Bosch brand accessible to an increasing amount of households to improve peoples' lives. In developed markets Bosch strongly focuses on brand-shaping innovation topics to set itself apart from its competitors. Key to Bosch products is having a design that delivers an excellent and consistent experience, manifesting quality and simplicity in the perception of consumers (Bosch, 2020).

Sustainability
Bosch Home has a focus on sustainability and has different strategies to be more environmental friendly. It starts at the inside of the products:
About 40% of the patents that Bosch applies for are related to environmental protection and the careful use of raw materials. Bosch home appliances are among the most economical and efficient in the world. Products are efficiently packed to reduce packaging materials and CO2-emmission during transport. (Bosch, 2020)

Innovation
Bosch products are innovative in all product categories. Bosch explores ways to innovate its products by solving day to day problems: For example, the Zeolite technique has been developed to achieve perfectly dry dishes, and Vita Fresh is used in refrigerators to keep food fresh three times longer. But there are also sustainable innovations: For example, washing machines are equipped with an I-Dos system that saves detergent.
And on a durability level: The new Vario fridges are customizable. The front can easily be changed if you want to give your refrigerator a new look.

Active areas
Over the recent years Bosch has been responsible for almost half of BSH's business and is growing across all five regions. However, the Bosch business itself is still dependent on only two regions: Europe, and the Middle-east and Russia (Figure 7). Approximately three-quarters of the Bosch business is currently executed in these two regions.

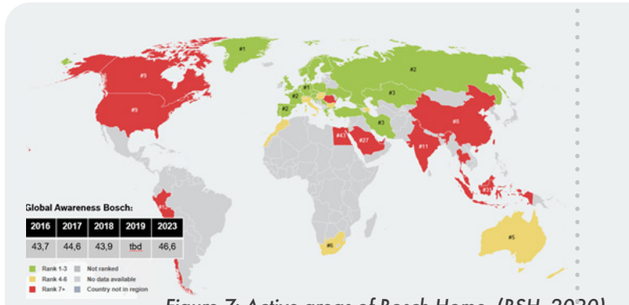


Figure 7: Active areas of Bosch Home (BSH, 2020)

3.3.2 |Aesthetics

When we take a look at the aesthetics of the products designed by Bosch a clear pattern of calm and discreet colors and forms can be seen. Figure 7 shows an overview of the various products from Bosch. Here you see that not a lot of colors are used and that all the product have a combination of metal and plastic.
Figure 9 shows an overview of different design elements that repeat in the products of Bosch. Characteristics of the products in the portfolio of Bosch:

- Combinations of plastic and light metal
- Large curvatures
- Simple and solid forms
- Color accents usually in red

These characteristics will be taken into account with the redesign of the product later this project. The design needs to fit the brand and aesthetic identity of Bosch.

Figure 8: Products from Bosch Home

Figure 9: Elements of aesthetics of the Bosch Home products

4. Refurbishment

In this chapter different examples of refurbishment will be discussed. An analysis will be done in the literature on how to design for refurbishment and how to design for product lifetime extension. Possible user scenarios will also be explored.

4.1 Examples

We have been refurbishing for a long time already. For example, old houses in the center of big cities that have been restored for the next owners, and antique furniture that is cleaned and repaired and then sold again.
Another big category where refurbishment takes place all the time is the car industry. Not only cars are sold in a renovated state, also the parts of used cars are reused for other cars.

Electronics

When you ask customers about refurbished products, the first thing that comes to their minds are refurbished electronics. A big share in this market is for Apple, which has a prominent place on a lot of different refurbishment websites in the Netherlands, such as: ReBuy.nl, Leap.nl and refurbished.nl.
These websites also sell phones and laptops of other brands. However, these brands seem to be a less popular choice.
Other electronics that are often sold as refurbished are cameras, smartwatches and game consoles.
What is notable about these products is that they all have a high value and high price, also within their product categories. The relatively fast pace of innovation of these products causes the demand for new products to increase, which may explain the large market share of refurbished products.

Home appliance

When looking for refurbished home appliance, customers cannot think of many examples. This is not yet an extensive market. However, it was discovered that well-known, successful brands that sell expensive product within their product category such as KitchenAid and Vitamix, sell refurbished products on their own websites. (Figure 11)

Service

As has been mentioned before, ownership of products is gradually changing into use of a product with a service. Once a product has been returned to the retailer, the product is 'refurbished' and distributed again to the next user. Examples are Swapfiets, BlueMovement, SplashLease and Bundles.

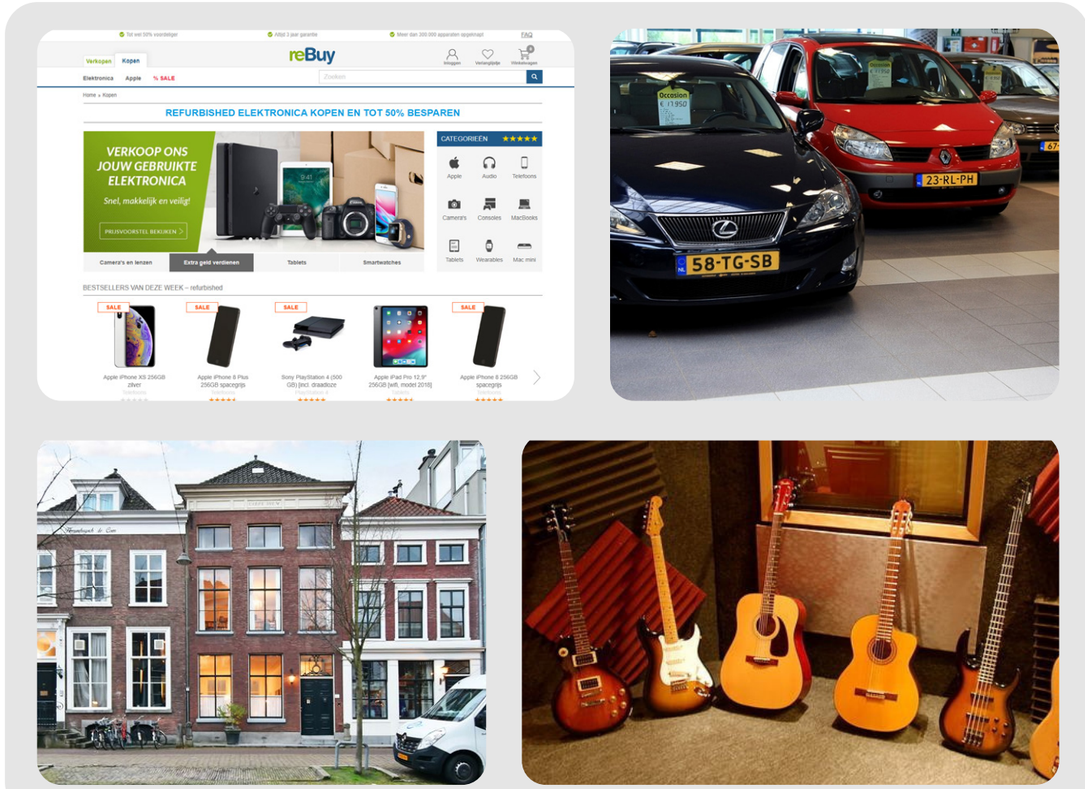


Figure 10: Examples of common refurbished products

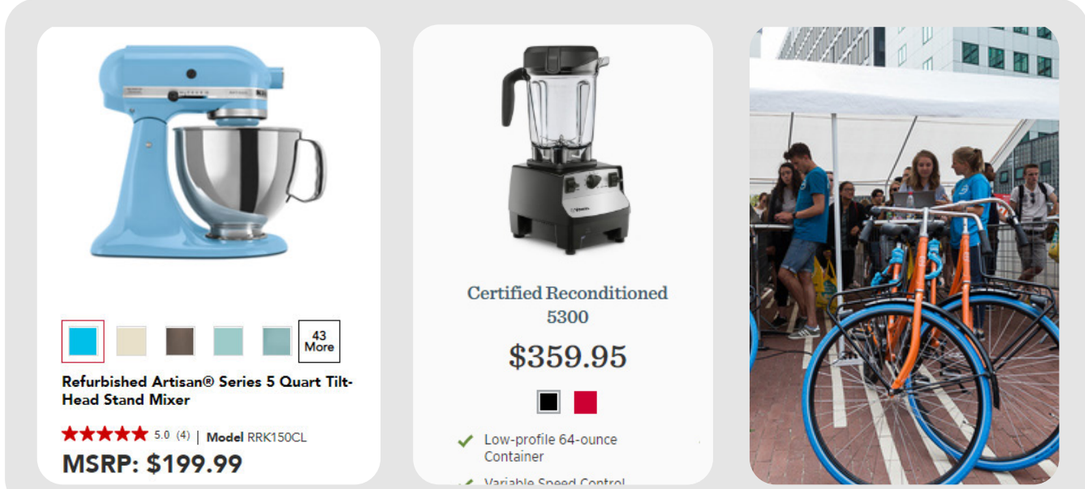


Figure 11: Examples of refurbished home appliances and refurbishment in a product service system

4.2 | Scenarios

With regard to refurbishment multiple scenarios are defined. In these scenarios refurbishment especially makes sense and it can save a lot of resources and be economically attractive for the original manufacturer.

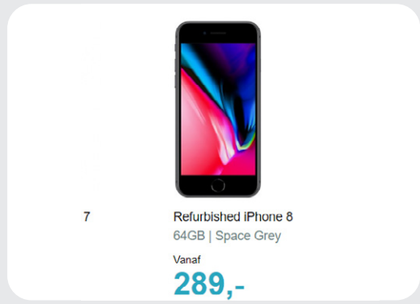
Product replacement by owner
The most common situation right now with, for example electronic devices, is that the devices are collected after use. The devices will be checked and if necessary repaired and then sold again as a refurbished model.

Products in use during a service
Another scenario is the scenario of a product service system. Ones a product is returned to the retailer, the product is ' refurbished' and distributed again to the next user.

Product replacement for repair
In this scenario a product can be resold as refurbished if a product was collected for repair. If it takes too long to repair an appliance on site (high labor cost, due to inefficiency or unavailable resources) it can be more efficient to take the product back to the repair center. The customer will be supplied with a new or refurbished model. (Possible scenario by BSH)
The repair of collected products is more efficient and saves money. The products will be resold as refurbished.

Damage during transport/return
Right now at BSH in the Netherlands, a product will be refurbished and resold as a 'B-product' only if damages occur while delivering a product, so that it cannot be sold as new (Ronald Borst, BSH).
The 'B-products' also include appliances that are used in showrooms or other demonstrations, as well as products returned within the reflection period of 30 days.

Product replacement by owner



Products in use during a service

Product replacement for repair

Damage during transport/return

4.3 | Design for refurbishment

When a product is refurbished, the life time of the product is supposed to be increased. It is important to keep this in consideration when designing a product for refurbishment. There are several strategies that can be explored to extend the life time of a product.

4.2.1 |Life time extension

For a product to maintain its value over time, Conny Bakker and Marcel den Hollander (2013) identified different design strategies for product life time extension in a circular economy. These strategies aim to prevent or postpone the perceive obsolescence of a product.
(Bakker & Hollander, 2013) (Medkova et al, 2017)

1. Design for Product Attachment and Trust:
This strategy's goal is to minimize an emotional obsolescence by creating long lasting products that people will love and trust .

2. Design for Product Durability:
Create products resistant to wear and tear. For this strategy material choice is very important and high quality components to prevent functional obsolescence.

3. Design for Standardization & Compatibility:
Designing product's parts and interfaces that are usable for other products and making products multi-functional and modular.

4. Design for Ease of maintenance and Repair:
Aim at easy maintenance to keep the product working, easy repairability and replacement of broken parts to extend the lifetime of a product.

5. Design for Upgradability & Adaptability:
Avoiding obsolescence by maintaining product life time by making it possible to upgrade the performance and value of the product, and by adapting it to the changing needs of a user.

6. Design for Dis- and Reassembly:
Avoid obsolescence and maintain the product life time by making it possible to upgrade the performance and value of the product, and by adapting it to the changing needs of a user.

These strategies will be useful for designing for refurbishment, since the estimated product life time will be longer. This strategies can also be useful for handling the variety of owners of the product. (Design for Upgradability & Adaptability)

4.3.1 |Design for Refurbishment

In a research by Flora Poppelaars (2014) done in collaboration with the Ellen MacArthur Foundation, different design strategies were explored. It also included design for refurbishment. However, this option has not yet been thoroughly explored.

Design for Refurbishment
The goal of refurbishment is to bring a product back to the market in a good working condition and with its original aesthetics. To achieve this, it is important that the design of the product allows for this process. However, there are no concrete guidelines to design for refurbishment, but there is a strong connection with designing for reuse. Also the first part of the re-manufacturing process applies to the way products are refurbished (Poppelaars, 2014). By combining these two design strategies, a clearer view occurs of designing for refurbishment.

Designing for Reuse
When designing for reuse, the product should be easily disassembled and repaired. On top of that for the user it is very important that the product has an acceptable aesthetic.

Design for Re-manufacturing
Re-manufacturing means "the rebuilding of a product to specifications of the original manufactured product using a combination of reused, repaired and new parts" (Johnson, McCarthy, 2014). Out of design for re-manufacturing a couple of strategies can be used for refurbishment. For refurbishment, the inspection, disassembly, cleaning, repairing and testing are important factors to design for.

Conclusion

Q2: How can you design for product life extension?
Different strategies for product life time extension have been determined. It is important to create trust and attachment to the product. The product should be durable and also standardized. In addition, the product should be easy to maintain and repair, to disassemble and to upgrade.

Q3: Where can refurbishment be implemented?
Four scenarios have been defined for the implementation of refurbishment: products that have been replaced by its owners for newer models, products that are in use within a product service system, products that have been replaced after repair, and products that cannot be sold as new due to transport damages or after being returned in the reflection period.

Key insights:
- Home appliances are not yet popular for refurbishment. Only well-known, successful brands, which sell expensive products within their product category such as KitchenAid and Vitamix, are already selling refurbished products on their own websites.
- It is important to keep the strategies for life time extension into consideration since refurbishment will increase the time a product will be in use.
- When designing for reuse, the product should be easy to disassemble and repair by the refurbisher. It is also very important for the user that the product has acceptable aesthetics.

5. Product

It is important that the consumer acceptance of refurbished products is increased in order to make it a more common user choice. With regard to the product level in relation to refurbishment, there are several things that need to be analyzed. First the motivation of the user was investigated by means of a literature review and a survey. Then the preferred aesthetics of refurbished appliances were researched.

Motivation

When designing a product for refurbishment, the first thing that needs to be established is: Why do people (not) buy refurbished products? What are their concerns, or what are the perceived benefits of refurbished products? A literature review and a quantitative research helped explore these questions.

Aesthetics

In addition, the aesthetics of a product are very important. What should the product look like? What product aesthetics are preferred when the product is going to have a second life? When does a product look more reliable? These questions were answered by means of consumer interviews and a literature review.

Repair

Not only the customer is involved with the refurbished product. Also the repairer or the refurbisher plays an important role. Refurbishment is only profitable if the refurbishment process is time-efficient and thus cost-efficient. For this reason, research was done among repairers and refurbishers at BSH to discover insights.

5.1 | Motivation

5.1.1 |Literature review

There are different reasons that buying refurbished products is not yet the common choice for the consumer:

Barriers

According to a study by TU Delft (van Weelden, E., Mugge, R., & Bakker, C., 2016; Mugge et al, 2017) there are several reasons why consumers prefer buying a new product. When consumers are gathering information about a new product there are some barriers preventing the choice of a refurbished product.

- People are unaware of the environmental benefits of refurbished products.
- When buying a refurbished product, the consumer misses the thrill of newness.
- The perception of refurbished products is not correct. Consumers regard refurbished products as second-hand products and do not know that the product has been renewed.
- The option of buying refurbished products is not well known among consumers, and they do not know where to buy them.
- 'Habitual purchase behavior and a preference for convenience lead to a situation in which many consumers do not take refurbished products into consideration if they are not offered by established retail channels'.(van Weelden et al, 2016)

Moreover, other research (Abby, 2014 ; Baxter, 2016) showed that consumers may find refurbished product unhygienic. Some consumers associate refurbished products with dirty and contaminated objects.

Risks

When comparing a refurbished product to a new one, consumers perceive different risks (van Weelden et al, 2016 ; Mugge et al, 2017):

- performance risks
- financial risks
- time risks
- obsolescence risks

Consumers are afraid that the refurbished product does not function as expected or that the product will become obsolete, and that they will lose money and time to replace it. In addition, they are unaware of the environmental benefits of buying refurbished products.

Benefits

However, consumers do not only experience barriers and risks when buying refurbished products, they are also aware of benefits (van Weelden et al, 2016).
It is an important benefit that the product is sold at a lower price. This makes expensive brands available for a larger group. Consumers also associate environmental benefits with refurbished products. Sometimes consumers consider it a benefit that a refurbished product does not have the undesirable innovative features of its successor. The refurbished product may also have unique features compared to a new one. The final reason mentioned is that refurbished products offer a better performance than second-hand products, and offer greater warranty.

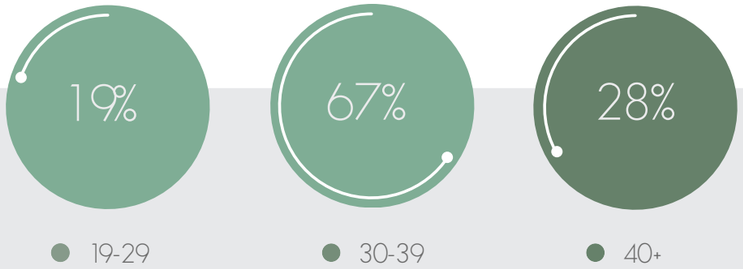
Product categories

The study by TU Delft (Mugge et al, 2017) categorizes eight different product groups within refurbishment. One group consists of hygienic products, products that are used to prepare food or products that contact the skin. This group applies to the product portfolio of Bosch Home. When designing for refurbishment in these categories the following recommendations were done: *Companies need to minimize the hygienic concerns by enhancing ease of cleaning and by communicating the efforts put into cleaning and disinfection during refurbishment (Mugge et al, 2017).*

5.1.2 | Survey

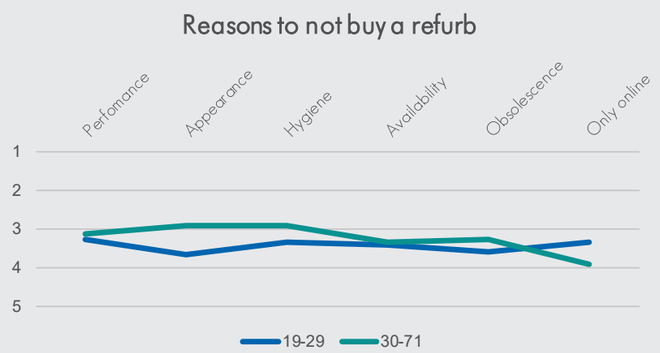
In order to attain more insight into the motivation of consumers and to validate the literature review, an additional survey was conducted. The survey was filled in by 60 participants aged 19 to 71. The full survey can be found in Appendix A.

The goal of the survey was to find out why customers do (not) buy refurbished products. And what aspects they would value most highly for their product. In addition, the preferred product categories were explored.



Age

TTo the question 'Do you own any refurbished products?', most people in the age category between 30-39 years answered with yes. The most frequently mentioned reason for buying a refurbished product was the price difference. People who mentioned sustainability as a reason for their refurbished purchase were all aged 30+.



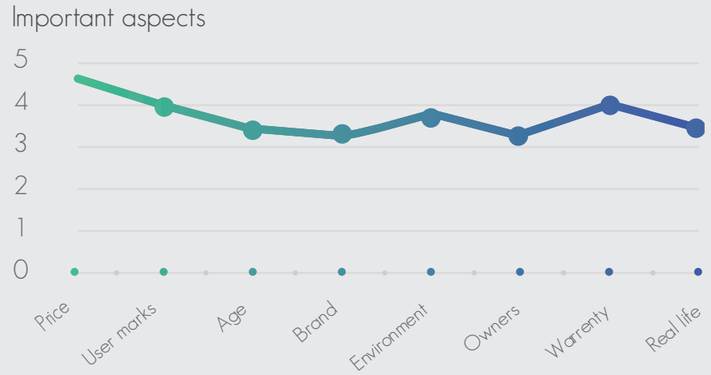
Why not?

When ranking different product aspects as the most important reason to not buy a refurbished product, a variation within age groups was detected. The older age group is more concerned about the appearance of the refurbished product than the 19-29 year olds. However, for both age groups the performance of a refurbished product is a major concern.

Products

This visualization gives an overview of what products users prefer to buy refurbished. Participants were asked to rate the likeliness to buy the product refurbished on a scale of 1 to 7.

People often choose large appliances such as fridges and washing machines, or products that do not have close contact with food, such as an iron and a vacuum cleaner.



Values

It may not come as a surprise that the main driver for consumers to go for a refurbished product is the price difference. Other important aspects for users are the warranty and sustainability.

“I never really come across the option of buying refurbished.”

”When the price difference Is not that much I prefer to buy it new.”

“For some reason I think the quality is not equal to that of a ‘new’ product.”

”I usually find the cost benefit too low.”

“ Never thought of it. Not obviously offered to create need. ”

“I bought something refurbished because it is cheaper and better for the environment.”

“I would buy a fridge or washing machine. New they are quite expensive so the price difference would be most significant.”

“I would buy smaller household products. These are often cheaper, making it easier to replace a bad buy.”

‘I’ll go for products where the hygiene of the previous owner is not relevant.”

5.1.3 |Discussion

The questionnaire contained open questions where participants could give their opinions. These opinions led to interesting insights into the way the participants were thinking. And these answers correspond with the findings in the literature review.

Choosing for refurbishment

Almost everyone who purchased a refurbished product, gave the price difference as an argument. They even state that if there is no significant price difference between a new and a refurbished product they would choose the new product.
This may be related to the risks concerning refurbished products (Van Weelden et al, 2016).
However, this may also be related to the barrier of missing the thrill of newness. Buying something new gives the customer a happy feeling.

Another important reason why people do not go for refurbishment is that they are not aware of this option. If you want to buy something refurbished you have to actively search for it; refurbished products are not yet a common option on the regular retail channels. This became clear also in the literature review (Van Weelden et al, 2016).

Environment

As mentioned before, the main driver for refurbishment is the price difference between the refurbished and the new product. However, 28% of the people who bought refurbished products mentioned the environmental benefit in addition to the discount. The people who took the environment into their considerations were all older than 30 years.

Product categories

As can be seen in the overview of the products consumers prefer to buy expensive products refurbished. This is because the price difference is bigger. However, there is also a group that likes to buy these products new. Their argument is that they expect these products to last for a long time and want to invest money in them.
Small domestic appliances are preferred less, because of hygienic reasons. However, consumers do buy refurbished kitchen machines and coffee machines.

Conclusion

Q4: What is the reason people do (not) buy refurbished appliances?

The main reason why people buy refurbished appliances is the price difference in comparison with new products. The environmental benefits, the unique features of the older model and the warranty are also drivers for customers.
People do not buy refurbished products because they are not aware of the concept or the option to buy refurbished products. They are also afraid that the appliance does not perform well enough, that the product becomes obsolete quickly and that the product is unhygienic. Missing the thrill of buying a new product is the final reason.

Key insights:

- 28% of the people who bought refurbished products mentioned the environmental benefit in addition to the discount. The people who took the environment into their considerations were all older than 30 years.
- Companies need to minimize hygienic concerns by enhancing ease of cleaning and by communicating the efforts put into cleaning and disinfection during refurbishment.
- The older age group is more concerned about the appearance of the refurbished product than the 19-29 year olds.
- If the price difference between a new and a refurbished product is not significant they would go for the new one.

5.2| Aesthetics

The aesthetics of a product are very important. What should the product look like? What product aesthetics are preferred if the product is used in a second life? When does a product look more reliable? These questions were answered in customer interviews and by doing a literature study.

5.2.1 | Literature review

When designing for refurbishment it is important that the aesthetics of the products should match the needs of the customer. If the product gets refurbished, its lifetime is extended, and therefore the aesthetics of the product should be resistant to time.
Moreover, since the products will be used for a second lifetime the new customer should trust the product as if it were new (Bakker et al., 2016).

The consumer survey revealed that sustainability is a driver for people to choose refurbished products.
A study was done (Zafarmand, Sugiyama and Watanabe, 2003) on how aesthetic attributes can promote product sustainability. This study on aesthetics focuses on lifetime extension and is therefore of importance to refurbishment aesthetics as a whole.
First of all this study investigates the role of aesthetics in product unsustainability. Table 12a shows the different aesthetic elements of unsustainable products. According to this study, when designing for a longer lifetime and sustainability the product should preferably not contain:
• Irrelative form & function
• Hidden construction and material used in the object
• Sharp shape
• High contrast and vivid color
• Highly polished and shiny surface

A highly polished and shiny surface is attractive in a new product, but it will get obsolescent quickly when the product wears.
These aspects are translated to strategies to design for sustainability: (Zafarmand et al,. 2003)

1. Aesthetic durability: Extending the product life is very important for sustainable product design. First should the effects of repair, environment en use not have an unpleasant affect on the aesthetic of a product. Secondly the product should not get unattractive and boring during use.
2. Aesthetic upgrade-ability and modularity: Design for aesthetic upgradabillity, can slow down aesthetic obsoleses.
3. Simplicity and minimalism: The simple forms give the sense of elegance and minimizing the number of separate components and variety in materials makes the product repair and refurbishing easier.
4. Logicality and functionality: Integrating logical and functional forms into the design influences on the aesthetic longevity and perfection.
5. Natural forms and materials: In nature forms are perfectly drawn from function and seem to stay beautiful over time. Also natural materials are recyclable and harmless.
6. Local aesthetic and cultural identity:
7. Individuality and diversity

Shapes and styles

According to a study carried out on the value of timeless design styles for the consumer acceptance of refurbished products (Wallner, T. S., Magnier, L., & Mugge, R., 2020) there are different design styles preferred for refurbishment.
Two design styles were researched: the neo-retro style and the simplistic design style. Both styles turned out to improve the consideration for refurbished products.
The neo-retro style evokes a positive association with the better quality of products of the past.
Simplistic products are associated with durability and high quality brands.

Philosophy	Context	Elements
• *Confrontation with nature* • *Global standardisation* • *Ignored local cultural identity*	• *Obsolescence* • *Market-led design* • *Short life fashion and style, innovative, and distinctive*	• *Irrelative form & function* • *Hidden construction and material used in the object* • *Sharp shape* • *High contrast and vivid colour* • *Highly polished and shiny surface*

12 a. *Different levels of aesthetic characteristics of unsustainable products (Zafarmand, 2003)*

12 b. *Aesthetic attributes promoting product sustainability and related aspects of product sustainability (Zafarmand, 2003)*

Figure 12: Table on Aesthetics for sustainability (Zafarmand, 2003)

5.2.2 | Interviews

In-dept interviews were held with six consumers to discover more about the preferred aesthetics of refurbished home appliances. Three participants were of the age group 50+ (2 female, 1 male) and three were of the age group 23-28 (2 male, 1 female).

Setup

During the interview, three sets of product variations within a product category were shown to the participant. Variations on blenders, coffee machines and fridges were printed out and questions about the machines were asked (Appendix B).
The pictures were used as a guideline to open the discussion on what kind of materials, forms and colors consumers prefer for new and refurbished products. The goal of my research was to find out if the choices differ for new and refurbished products, and what aesthetic aspects are most important when designing for refurbishment.

Results

On the right page some quotes from participants are shown. Different insights could be drawn from these interviews.

- The way a product looks when it is refurbished (user marks) is considered more relevant than the functional quality.
- If a product does not look used, the product is trusted more.
- Consumers usually do not choose a different product if they buy a refurbished product. They will choose the product that they think is the most beautiful/suitable. They only choose a more sturdy product if they have experience with the breaking down of a similar product.
- Robust products with few loose parts look most reliable.
- Metal and glass are considered most reliable.
- Some participants regard white plastic as unsustainable and cheap.
- If a product has few options (simplicity) the product is expected to work for a longer time.
- Natural materials such as cork look eco-friendly, although they are not expected to be long-lasting.

Figure 13: In-Dept interview was done to discover the preferred aesthetics

Conclusion

Q5: What product aesthetics is preferred for refurbished products?

A simple design with few options is preferred. It gives consumers the feeling that the product will last longer. Most consumers find it essential that the refurbished product keeps looking good. However, consumers usually do not choose a different product if they buy a refurbished product. They will choose the product that they think is the most beautiful/suitable. (However, this also depends on the product.)

Q6: How can design increase the customer trust of a refurbished product?

A robust product with few loose parts is considered most reliable. Metal and glass have a durable appearance. A product that does not look used is trusted more. Some participants regard white plastic as unsustainable and cheap.

Key insights:

- Simple products are associated with durability and high quality brands. They also give a sense of elegance. Minimizing the number of separate components and different materials makes product repair and refurbishing easier.
- Design for aesthetic upgradability can slow down aesthetic obsolescence.
- Sharp shapes, high contrasts, vivid colors, and highly polished and shiny surfaces are not considered properties of a sustainable design.

"When a product looks simple with little options I think it is most likely to last longer."

"When a product has little user marks, I am most likely to think that the product still works well."

"A robust product with little loose parts looks most trustworthy."

A selection of quotes from the consumer interviews

5.3| Process

One of the main motivations of consumers to purchase a refurbished product is the price difference with a new version. To keep this price difference significant, it is important that the refurbishment process should take place efficiently in order to keep the costs low. Consumers also indicate that they find it essential that the refurbished product is totally clean. A research was done to find insights in order to optimize this process of refurbishment (repairing and cleaning).

Refurbishment at BlueMovement

An interview with a colleague who is occupied with optimizing the refurbishment process at BlueMovement gave a good view of how the process takes place.
He discovered some problems concerning the cleaning of appliances, which can be tackled. These will be mentioned in the next paragraph.

Refurbishment projects at BSH

At BSH Germany and Belgium there are several projects that are exploring the options for refurbishment.
Projects are carried out within BSH or by a third party refurbisher. It was interesting to discover that third party refurbishers are not keen on refurbishing fridges and ovens because it is hard to clean them. This provides room for improvement in the design of the product.

On tour with the repairman

I got the opportunity to spend a day with a field service repairer at BSH. My aim was to find problems that occur during the repair of the product. However, for a lot of the visits there were no spare parts available. These had to be ordered and the repairer had to make an appointment for another day. This might show the inefficiency of not having the spare components within easy reach. For profitable refurbishment, quick repair is needed, since man-hours account for a lot of costs.

Interesting insights

- There is no defined structure within the process.
- Not more work will be done than worth 70% of the selling price.
- It is expensive to store spare parts for the lifetime of the product.
- Different factories have different suppliers. This results in different components in the same sort of product. So it is difficult to obtain spare parts.

Cleaning:

- There are parts that cannot go into the dishwasher due to electric components.
- Holes and slots are places where dirt can get stuck, which takes time to clean.
- Where different materials are joined together dirt can get stuck, and moisture cannot escape after cleaning.
- Uneven surfaces are hard to clean.
- Automatic cleaning programs are used to clean the product from the inside.
- Some refurbishment centers are equipped with product showers.
- Cleaning of ovens and fridges is challenging, therefore refurbishers do not want to deal with these products.

Replacement

- Parts are taken of old appliances.
- Some parts are hard to reach and therefore the reparation takes up more time.
- A lack of available components may occur.

Figure 14: Examples of products in the refurbishing process

6. Coffee Machine

Research showed that one of the main drivers of consumers to go for refurbishment is the price difference. It is therefore important to zoom in on products that are in a high price range. The consumer research revealed that espresso machines comprise one of the product groups that consumers are most likely to buy refurbished. This combination makes it a good product to decide to optimize for refurbishment.

6.1 | Models

Existing full automatic coffee makers were analyzed, and an overview of the machines of Siemens will be shown below. All the machines are more or less similar with regard to functionality, but expensive models have more coffee variations and a more elaborate interface. In addition, the aesthetics are more luxurious.

As Bosch has no full automatic coffee machines in the portfolio at the moment, the machines of Siemens will be examined here. These models are representative of the quality that Bosch would have in their portfolio. The prices range between € 499,00 and € 2.249,00 (CoolBlue). For this project we zoom in on the products starting from € 900, and their specifications. These products would have the highest price difference and would therefore be more profitable. Some specifications of these models are:

- Integrated milk foamer
- Touch screen with preprogrammed drinks
- Remotely controlled with tablet or smartphone
- Automatic milk tube cleaning
- Ceramic coffee grinders
- Two bean containers to switch between types

Figure 15: Various high end full automatic coffee machines of Siemens

6.2 | Inside the machine

One of the main motivations of consumers to purchase a refurbished product is the price difference with a new version. To keep this price difference significant, the refurbishment process should be efficient in order to keep the costs low. Moreover, consumers indicate that they find it very important that the refurbished product is totally clean. To optimize the automatic coffee maker for repair and cleaning it is essential to understand the functions and the crucial parts.

9.2.1 Operation

To understand more about the operation of the fully automatic coffee machine, experts were consulted. The scheme on the right (Figure 16) illustrates a simplified flow of the coffee in the coffee machine. The processes are regulated by sensors, a control panel and interface, and a motor. The product can be divided into a 'wet' part and a 'dry' part. The dry part consists of all the electronics and the motor. The wet part consists of all the parts that come into contact with the coffee or the water.

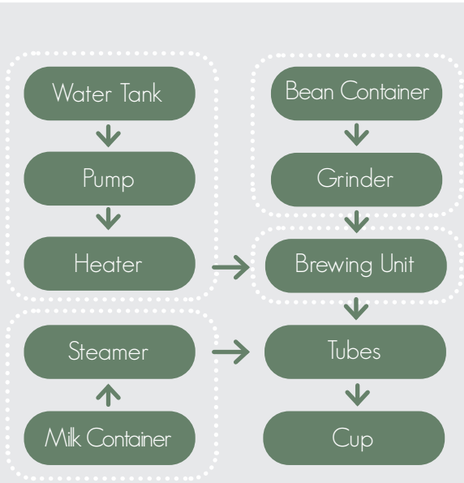


Figure 16: Simplified flow of a coffee maker

Modules

The components of the inside of the coffee machine can be categorized in 4 separate modules:

- *The brewing module:* The brewing module consists of the parts that come into contact with the coffee beans. The coffee beans are stored in an external container. The grinder is positioned at the bottom of this container. Once the beans in the container are ground, gravity leads the ground coffee into the brewing unit. A motor makes sure that the coffee will be pressed and be ready for the water to be pressed through it.
- *The water module:* The water from the water tank will be led through the heater by the pressure from the pump. The water will be heated up and pressed through the ground and pressed coffee. The coffee extraction will go through tubes to the cup placed outside the coffee machine.
- *The engines and gearbox:* The gears and the engines make sure that the brewing unit is able to move and press the ground coffee. It also allows the coffee grinder to spin and grind the coffee beans.
- The electronics: The electronics and the interface control the process of the coffee machine. The interface allows the customer to select preferences, and the electronics translate this into the movement of the elements. Sensors control the process of coffee making.

The innovations on the inside of the coffee machine are not very significant. The main things that evolve in time are the user interface with the variety of coffee specialties and the aesthetics of the machine.

6.2.2 Crucial components

A visit to the repair and refurbishment center of BSH at Tiel provided me with more insight into the repair and maintenance of the product. A mechanic at the repair center informed me about the crucial components. Components most likely to break down are the brewing unit and the coffee grinder.

The brewing unit must be maintained carefully and cleaned regularly. However, not all users take good care of this module. Since this is a moving unit, the parts become worn out after a certain number of rotations. The brewing unit is easy to replace by the repairer, but also by the user him/herself. It is possible for the user to take out the unit for cleaning and therefore it is also possible to replace it.

The grinder is a component that can break down. After a number of cups of coffee, the blades of the grinder can get blunt or clogged with coffee and therefore need to be replaced. In the cheaper and simpler models the grinder is easy to reach. However, in the more expensive machines it can take some time to get to the grinder to replace it.

Pumps and motor and heater are components that can cause problems in the machine, but not as often as the brewing unit and the grinder. These are parts that can be replaced. As the picture on the right shows, all components are visible and free behind the cover and therefore easily accessible. However, this is not the case with all machines.

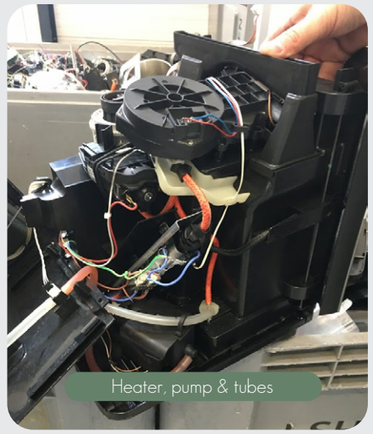
Interfaces can easily be replaced by detaching them with one clickable electrical component. Updates can also be done on the machine by the repairer. A service cable is plugged in at the back of the screen and the electronics can then be updated.

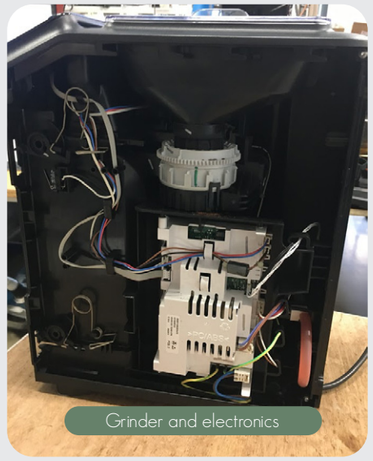
The electric components and tubes are least likely to break down. Sometimes there can be a leak, but this is usually not caused by the tubes.

The repairer explains that machines are most likely to malfunction if they are used very intensively or if they have not been used for a long time.


Brewing unit


Interface connection


Heater, pump & tubes


Grinder and electronics


Brewing unit cavity


Lime stains caused by water tank


Coffee ground from grinder


Irremovable stains on aluminum

6.2.3 Cleaning

The parts that become dirty are the parts of the machine that come into contact with the coffee or with water. Water can leave lime stains on the plastic parts and acids can leave stains on the aluminum parts.
To get a coffee machine completely clean again, it is important that the user maintains the product during use. When the brewing cavity is not cleaned properly during use, stains can get into the aluminum. The newer brewing unit cavities are made of black plastic, which is easier to clean since dirt cannot easily get stuck, and plastic can be easily wiped off.
The brewing unit should be rinsed every two weeks to keep the machine clean.
The drip tray collects all the ground coffee and the water used to rinse the tubes of the coffee dispenser. This drip tray can get stained and coffee rests can get stuck in the cavity of the drip tray. It is hard to reach these parts and to get them clean again.


Coffee rests in drip tray cavity

6.3 | Outside

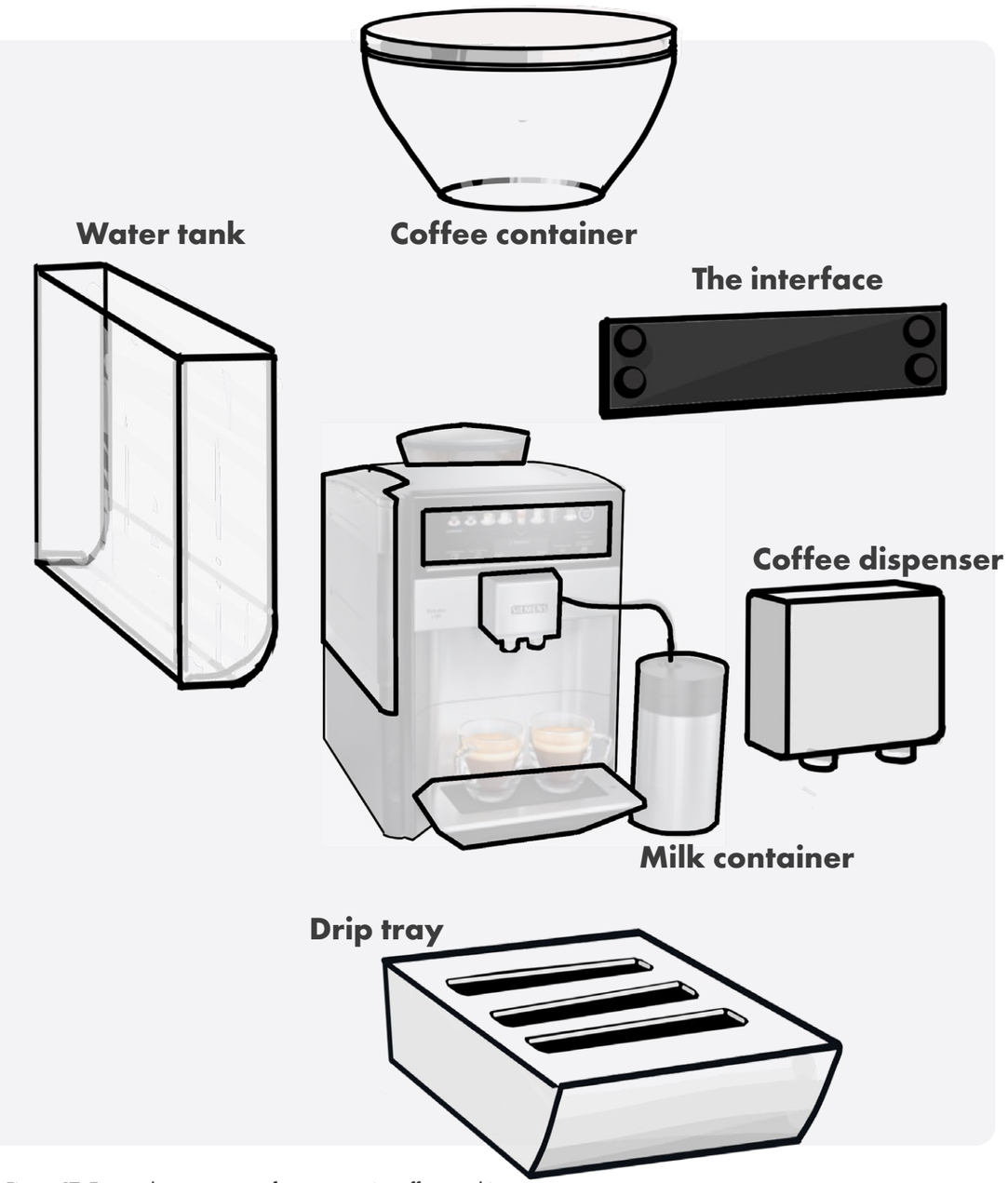


Figure 17: External components of an automatic coffee machine

The parts that interact with the customer will now be identified (Figure 17). These parts are important for the customer acceptance of the refurbished product. These are the visible parts on which the customer bases his/her judgment. Research shows that the customer judges the quality of the product by looking at the product and interacting with the product.
It is therefore important that all components are clean and functional, and show no or hardly any user marks.

Water tank
The water tank should be easily detached and it should fit under the tabs. Newer machines contain water purifiers. If hard water is used in the machine, lime can build up around the water tank. It is essential that the water tank is descaled in order to increase customer acceptance.

Coffee container
The coffee bean container should be easy accessible for the user. It is important that when the customer receives the refurbished product, no coffee rests are left in the machine.

Drip tray
The drip tray needs to be taken out by the user. It should therefore be easily accessible, and it should be easy to clean the coffee rests, preferably in a dishwasher. During the refurbishment process the drip tray should also be completely cleaned..

The interface
The interface is located at the front of the machine. As the display is innovated regularly, it should be upgradeable to keep in touch with current technologies. Another possibility is to make the interface as basic as possible, and make use of an external screen such as a smartphone or tablet.
The interface can also be used to show errors, or indicate maintenance in case the product keeps count of the number of uses.

Coffee dispenser
The coffee dispenser should be adjustable in height to prevent spatters. Adjusting should still go smoothly after the product has been refurbished. Moreover, the nozzle could get clogged, and therefore maintenance by the customer is required.

Milk
The milk container could be either an integrated part or a separate accessory in which the tube can be inserted. Milk rests should be removed and the tubes should be checked for clogged milk. The automatic cleaning system will be activated after each use of the part will reduce the chance of dirt.

Other interactive aspects that should be paid attention to are:
- Sound
- Smell

DEFINE

7. Results

After completing the analysis it is important to take a look back into the research question: How can the design of a household appliance be optimized to increase the consumer acceptance with regard to the refurbished product?

In this chapter we will take a closer look at the motivations of the consumer and at how we use these insights to increase their acceptance and to verify some conclusions.

7.1| Motivation

During the analysis the motivation of consumers to buy a refurbished product were analyzed. In this chapter the main motivations will be defined and translated into a time-line of buying a refurbished product. The main reason for consumers to buy a refurbished product is the price difference and the main reason for not buying a refurbished product is the risk of a faulty performance.

7.1.1 Summary

The main motivations for consumers to purchase a refurbished product are:

1. Price difference: Consumers can have a high quality product for a lower price.
2. Sustainable benefit: Consumers save resources when they buy a refurbished product instead of a new one.
3. Desired features: The refurbished product has unique features compared to a new one. It is also possible that the consumer prefers the absence of undesired features.
4. Safety: Refurbished products have a higher performance than second-hand products, and they have a warranty.

And the main reasons for consumers to not buy a refurbished product are:

5. Performance risks: Consumers are afraid that refurbished products will have a faulty performance and are more likely to break down soon.
6. Hygiene risks: Consumers are worried about hygiene risks because of the previous owner.
7. Unawareness: Consumers are unaware of the concept of refurbishment and its benefits.
8. Obsolescence risks: Consumers are afraid that the refurbished product gets obsolete quickly.
9. Thrill of newness: Consumers miss the feeling they have when they are buying a new product.

7.1.2 Time-line

On the next pages a timeline of the stages in which these concerns occur will be shown. This timeline is based on the literature (Van Weelden et al., 2016) and insights gained from the consumer research. The concerns are translated into opportunities for the redesign of the product. These will be used for defining design directions.

The existing motivations to buy refurbished products should be enhanced and the concerns around refurbishment should be taken away.

The timeline starts with the moment of looking for a new product and at this stage the awareness about refurbishment should be enhanced. However, this is a more marketing / business related topic, and it is recommended to research this on a different project. However, a good design and a satisfied customer can also add to positive marketing.

7.2| Performance

In order to verify earlier discovered insights and assumptions, an additional research was done. A survey was conducted to discover on what aspects consumers base their judgment for the performance of the refurbished product. The most important aspects were then verified.

7.2.1 Survey

One of the main reasons why consumers do not go for refurbishment was the performance risk, although refurbishment provides a warranty and the product is tested before being sold.
To take away these concerns it is important to know on what aspects consumers judge the performance of the product. During the research on aesthetics and refurbishment it was found that they base the performance of the product on its appearance.
An additional research was done in order to confirm this insight and to find out what aspects of the appearance are most important.

In addition, it was tested which of the various aspects that were discovered were considered most important by the users. It was also tested whether consumers find it important to be able to repair their own products, since one of the strategies within the circular economy and refurbishment is design for repair.

The consumer survey was held under 100 respondents varying in age from 18 to 78 years old. 55% of the respondents were female. An overview of the survey is shown in Appendix C.

Results

The results confirm that consumers base their judgment on the appearance of the product (Figure 18). More specifically the amount of scratches and dents in the product are used as indications of its performance. The age of the product is also a very important factor when assessing the performance. However, this is a factor that cannot be changed. Timeless design and the absence of user marks can influence the perception of the age of the product.
Moreover, it was found that consumers find it most important that the product is completely clean and has no traces of the previous owner. It was interesting to see that they value the way the product looks over the way the product functions (Figure 19).

Figure 18: Qualities users base the performance of a refurbished product on

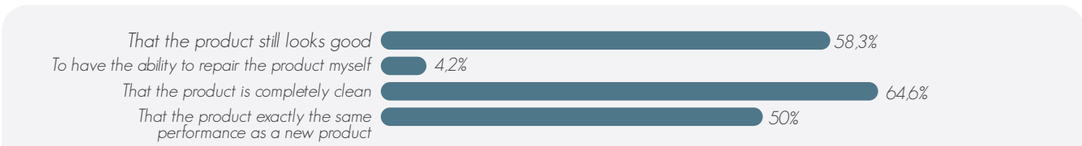


Figure 19: Preferred aspects for a refurbished product

Time line:

Concerns

Before needing an appliance

- Refurbished product are **not obviously promoted**
- The **perception** of refurbished products is **not correct.** Consumers think that refurbished products are the same as secondhand products and do not know that the product has been renewed.
- People are **unaware of the environmental benefits** of buying refurbished product.

Looking for an appliance

- When the consumers buy a refurbished product, they miss **the thrill of newness**
- The **option** of buying a refurbished product is **not well known** under the consumers, and they **do not now where to buy them**.
- **Habitual purchase behavio**r and a search for convenience lead to many consumers to not take refurbished products into consideration if they are not offered by their usual retail channels. (van Weelden et al., 2016)

Choosing an appliance

- The consumer is **afraid** that the refurbished product **does not function** as expected or that the product gets **obsolete** and he will **lose money and time** to replace it.
- Benefits of refurbished products are not always very obvious. Benefits of refurbishment are:
  - Price difference
  - Environmental benefits
  - Absence of undesirable features
  - Unique features
  - Better performance that 2nd hand

After buying a refurbished appliance

- Reduced product attachment because consumer have the feeling that it is a secondhand product.
- The performance of a refurbished product is poorer than the performance a new product.
- Performance of the product is based on the amount of user marks on the product

Opportunities

Before needing an appliance

Refurbishment should be promoted and environmental awareness should be created

Information about refurbishment should be available:
- about the concept
- about the process
- about the environmental benefits

Looking for an appliance

Customers should have the feeling that they are buying a 'new' product

The refurbished options should be available next to the regular products

Refurbishment should be a well-known / day to day option

Choosing an appliance

More trust in the performance of a refurbished product should be created

Concerns about the hygiene of a refurbished product should be taken away

Benefits of some unique features of refurbished products should be enhanced

Benefits of price difference should be enhanced

After buying a refurbished appliance

Customers should be satisfied with the refurbished product and expectations should be met

Customers should be proud of their refurbished products

Warranty and service should be provided to increase trust

Product should be completely clean and have as little user marks as possible.

8. Directions

The insights gained from the research phase were analyzed and clustered in six different design directions.

These directions can be divided in two separate groups that will be explored in parallel.

During the analysis, the motivation of consumers to buy a refurbished product was analyzed and afterwards distributed over four time periods to discover design opportunities. The opportunities discovered in this analysis and synthesis were combined and clustered into separate design directions. These directions can be split into Pillars and Emotions. The pillars should be a base for all the products designed for refurbishment, and the combination with the emotions will create a stronger customer acceptance for refurbished products.

Pillars:
Design for reparabilty, design for hygiene and design for timelessness should be applied to all redesign of refurbished products. These aspects serve as the basis of the redesign and involve a more technical approach of redesigning for refurbishment.
One guideline will be formed out of these design directions.
The pillars can be divided into two parts: process efficiency and customer interaction. One of the main motivations of consumers is the price difference of the refurbished product. To maintain this price difference it is important that refurbishing is a quick process to save labor costs of the refurbisher.

Moreover, it is necessary that the product does not get outdated and obsolete. Since refurbishment extends the life time of the product it should also be attractive for the customer for a longer period of time.

Emotional:
In addition, there are the emotional directions, which should be combined with the pillars to make a solid design. These can be integrated separately and involve different approaches of gaining customer acceptance of refurbished products.

Design for awareness: Sustainability was discovered to be a reason to go for refurbished products. However, a large group is unaware of the environmental benefits of refurbished products. It can therefore target a large group that is interested in sustainable products.

Design for fun: One of the discovered barriers is that customers miss the 'thrill of newness' when buying a refurbished product, or that they assume that it is the same as second hand. The aim of this design direction is to give customers the feeling that they are buying something new.

Design for trust: One of the product lifetime extension strategies is to design for trust. The interviews showed that consumers would prefer to buy durable designs refurbished. Specific materials and simple forms can create a feeling of trust in the customers.

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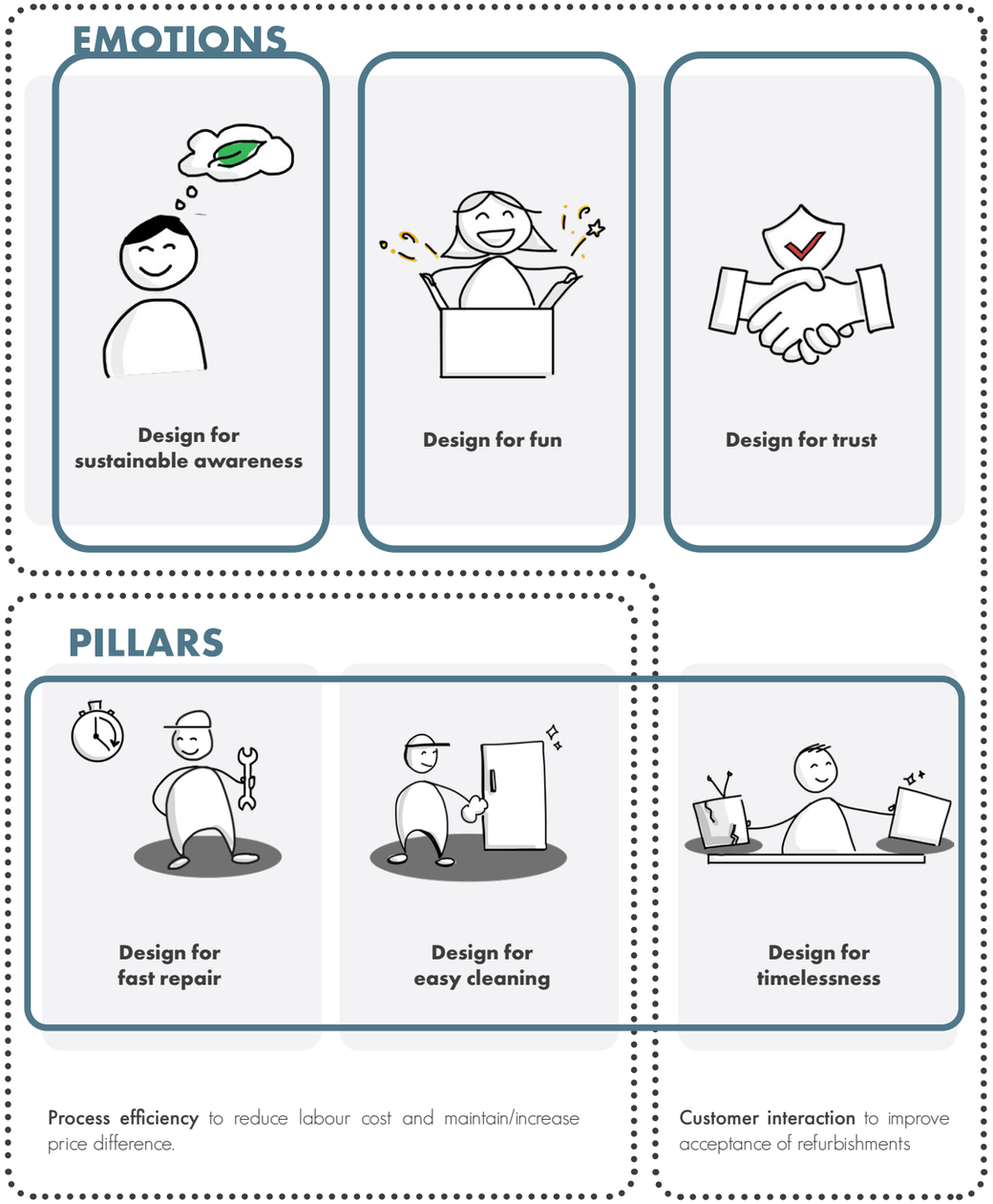


Design for fast repair

To get the used product to an acceptable state the product needs to be maintained and sometimes repaired. If it takes a long time to repair a product, labor costs will be high and thus refurbished products will not be very profitable.

Moreover, the parts that are needed are not always at hand, and may be expensive to order, because they differ per model. In addition, the opportunity to do a full checkup of the appliance can reduce possible faults.

Design for easy cleaning

One of the main concerns of users is the hygiene risk of refurbished products. Therefore the product must be completely clean before it can be sold again. To make this easier, the product design must be optimized to reduce the chance of getting dirty. If even surfaces and parts of the appliance can be placed in the dishwasher the cleaning process will be faster and more thorough.

Design for timelessness

If a product is used for a second time, the lifetime of the product will be increased. Therefore it is more likely to get outdated. Previously researched strategies for lifetime extension should be used to withstand obsolescence. Moreover, users are less likely to trust products if they look used. Therefore it is important that materials do not easily show signs of wear and tear.

Design for fun

One of the discovered barriers is that customers miss the 'thrill of newness' when buying a refurbished product. They may also assume that it is the same as a second hand product. The aim of this design direction is to give customers the feeling that they are buying something new. Moreover, the literature states that a good product attachment contributes to higher product value.

Design for sustainable awareness

Sustainability was discovered to be a reason to go for refurbished products. However, a large group is unaware of the environmental benefits of refurbished products.

It is important that consumers should be made aware of this fact. This can change the way refurbished products are perceived.

Design for trust

One of the product lifetime extension strategies is to design for trust. The interviews showed that consumers would prefer to buy durable designs refurbished. Specific materials and simple forms can create a feeling of trust in the customers.

9. Who for?

After the research phase three personas were identified. The results gained from the consumer survey were used to characterize these personas. The personas will be used as an inspiration for the ideation but also as a means to make a selection of suitable Ideas and concepts. The concepts will be tested later with consumer groups based on the personas.

9.1 | Personas

By combining the insights discovered through the research, three personas can be defined. They are from different age categories. These personas have their own separate reasons to go for a refurbished product. It was discovered that they all value different emotions, and on these emotions the design opportunities are based. These preferences will be combined and used to make decisions in the rest of the project. Appendix D shows the statistics and quotes that the personas have been based on.

1. The economical buyer.
The research that was done on the motivations of consumers showed that the consumers between 19 and 29 years old would buy refurbished product because of the price difference with the new product. They mentioned that they would like to have a specific brand, although this was not always the affordable option. Persona 1 is based on these buyers. The participants in the research within this age group were mostly students who do not own their apartment, but live in a rental apartment. They are less likely to invest in household products.

2. The ecological buyer.
The research that was done on the motivations of consumers showed that half of the consumers between 30 and 39 years old would buy a refurbished because of environmental reasons. The older age group highly values hygiene. It was also found that they value the appearance of a refurbished product more.

3. The security buyer.
The research that was done on the motivations of consumers showed that the consumers aged 40 years and older value brand and environment significantly higher than the younger age groups. Moreover, they rank the aspect of warranty higher than average. When they buy a refurbished product, they are concerned about its performance and hygiene.

THE €CO LOVER

Sanne de Vries

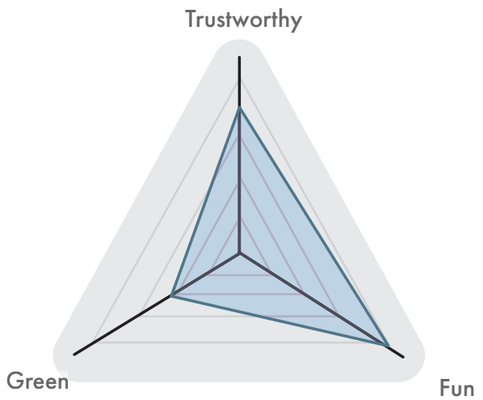
Age: 28
Work: Starter in Marketing
Family: Lives together with partner
Location: City centre of the Hague

Sanne has a rented kitchen. She does not want to invest too much in products that may not fit in her next home.

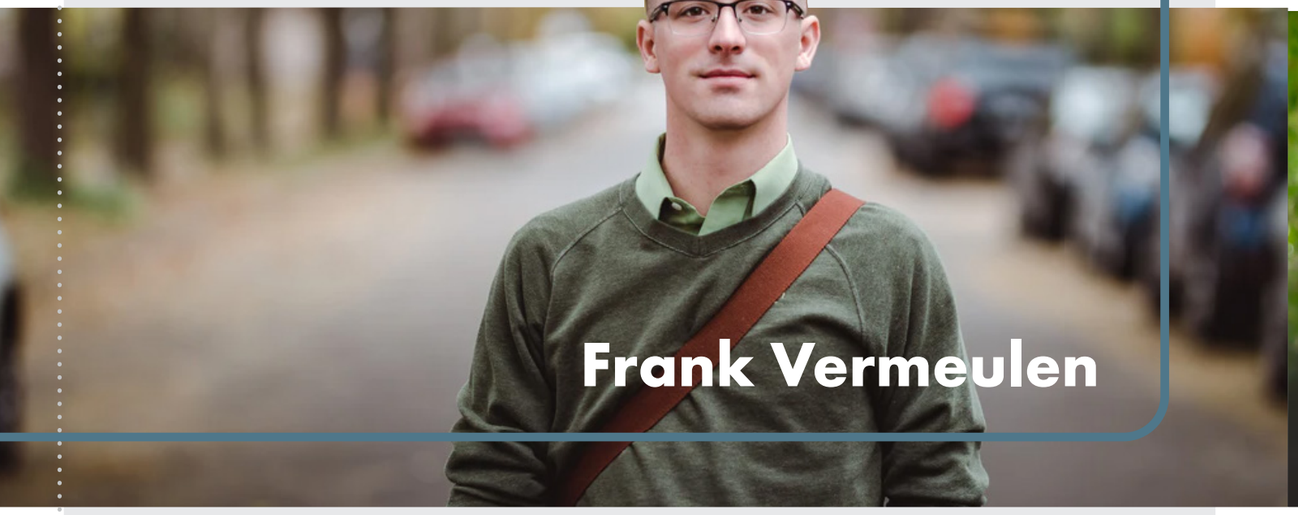
About Sanne
Likes to have good working household products but does not have the money to invest in expensive products.

"I would buy refurbished because it can be as good as new but cheaper"

Values



THE ECO LOVER



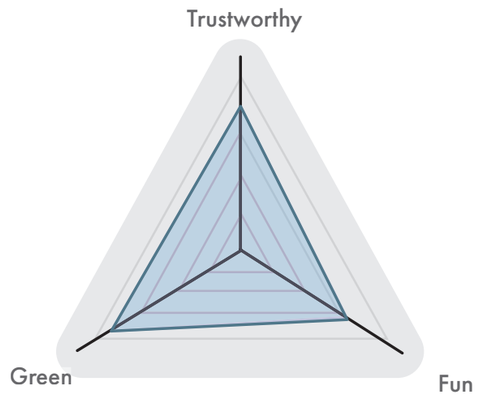
Frank Vermeulen

Age: 35
Work: Accountant
Family: Lives together with partner son of 4 and their cat
Location: Terraced house in Noord-Braband

About Frank
Frank and his family are environmentally conscious. They are vegetarians and love to cook. When he goes on holiday, he prefers to go by train. However he would not like to pay significantly more money to act sustainable.

"I would buy refurbished products because they are more sustainable and have a good value for price"

Values



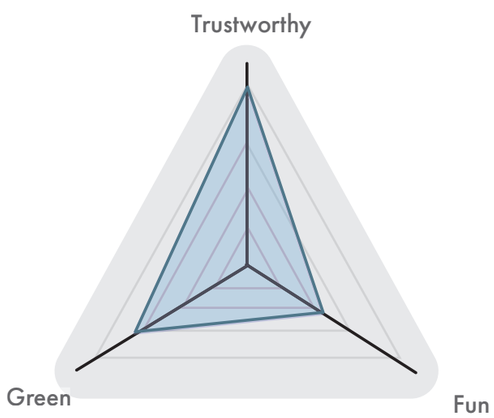
Monique Veldman

Age: 52
Work: Doctor
Family: Lives together with husband and 2 children
Location: Detached house in Zeist

About Monique
Monique likes to have well-functioning products. Monique prefers refurbished products over second hand products because of the warranty and the reliability.
A lower price combined with warranty and a reliable good product.

"Lower price, paired with warranty and a really still good product"

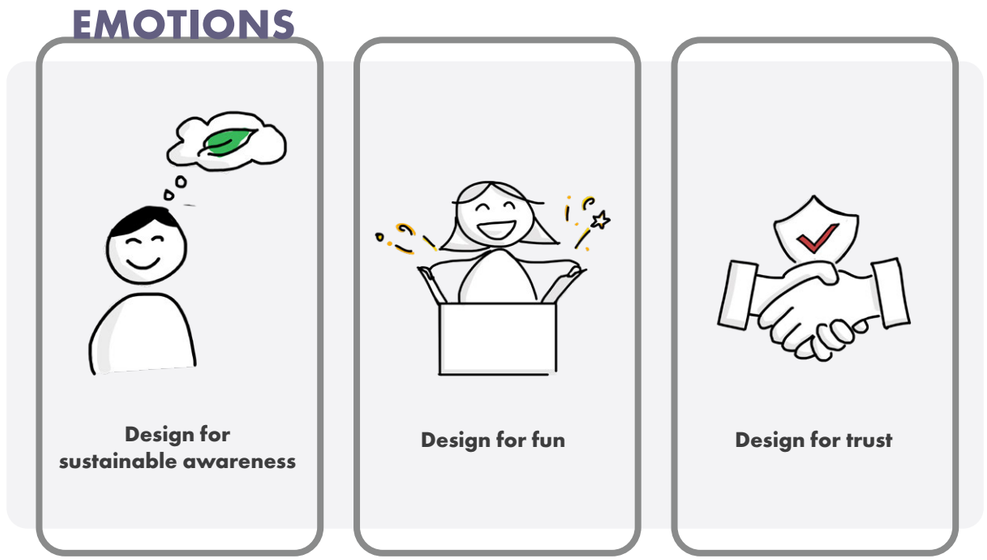
Values

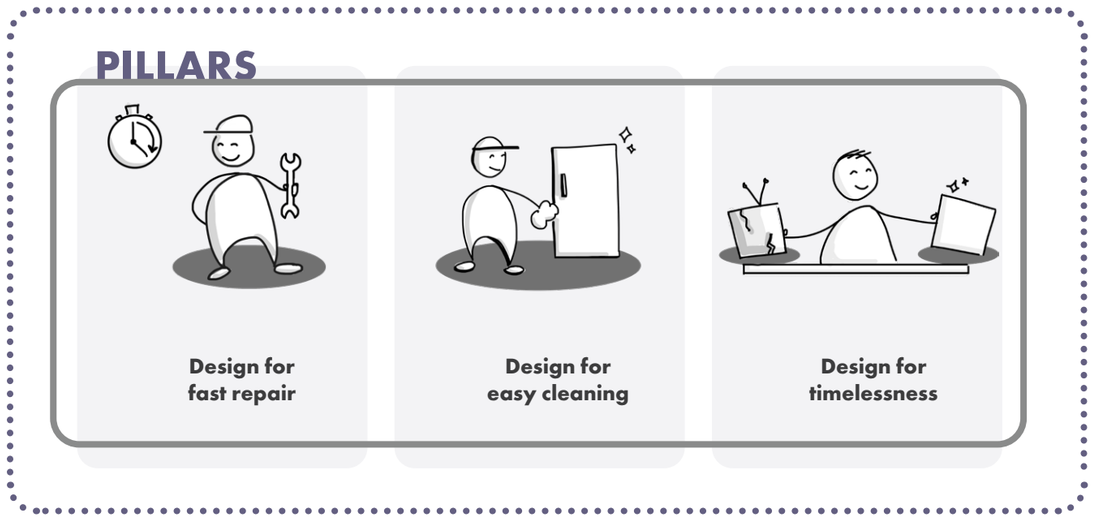


DEVELOP

10. Pillars

Design for reparabilty, design for hygiene and design for timelessness should be applied to all redesign of refurbished products. These aspects provide the basis for redesign and involve a more technical approach of redesigning for refurbishment.
One guideline will be formed out of these design directions.





10.1 | The guidelines

The results gained from the analysis of the process and the aesthetic research led to design directions that serve as a basis for design for refurbishment. These design directions are translated into guidelines to which the design of a product for a circular economy should adhere.

These pillars result in a guideline to which products designed for refurbishment should adhere. These aspects cause the refurbishment process to develop more efficiently and the consumer acceptance of the products to increase.
These guidelines have a strong influence on the product architecture and the product aesthetics, although they would not change the function of the product. They have to be taken into account when building up the product, choosing materials and maintaining the product. They will serve as requirements to design for the circular economy.

The guidelines for repair and cleaning have been developed to make the process of refurbishment more efficient. They influence the work of refurbishers.

On the other hand, the guidelines for timelessness affect the attitude of the user. The user should be satisfied with the aesthetics and the function of the product all through the lifetime of the product.

A more in-dept explanation of the guidelines will be shown in the next chapters. The guidelines will serve as a basis for the redesign of the product, in combination with the results from the emotional ideation. Together they will form the concept.

Repair

1.Easy access components
2.Easy product inspection
3. Component availability
4. Defined repair/checkup structure

Cleaning

1. Washing machine proof
2. All parts reachable
3. Even surfaces
4. No overlapping materials
5. Self Cleaning

Timelessness

1. Upgradeable and adaptable
2. Create attachment and trust
3. Simple design styles
4. Timeless Materials

10.2 | Repair

1.Easy access components

The crucial components should be determined to see which parts of the product are more likely to need repair. If these components are made easily accessible, the repair of the product can be done more efficiently..

2.Easy product inspection

If the refurbisher can make use of a system that can detect faults or run tests when the product is refurbished, an overview of possible failures is directly available.

3. Quick replacement

Components should be easy to replace in order to keep maintenance cost low. It should not take up a long period of time to remove and install components

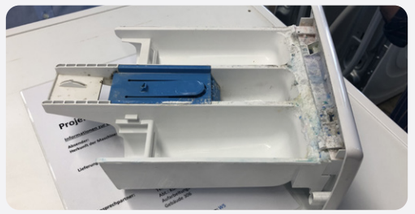
3. Component availability

Storing product parts for a long time can be very expensive. However, ordering parts from other locations may lengthen the reparation time. This can be solved by using parts that fit all different types of machines.

4. Defined repair/checkup structure

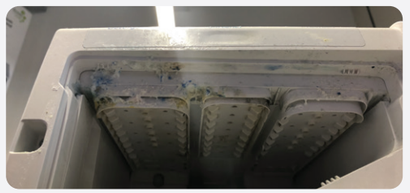
After a talk with refurbishers of BlueMovement it became apparent that there is no clear structure in checking and repairing the product. Setting up a defined repair/ checkup structure should be a solution for refurbishment centers..

10.3 | Cleaning



1. Dishwasher proof

All the loose parts that get dirty should be able to get wet. The ability to detach electronic components allows parts to be put in the dishwasher.

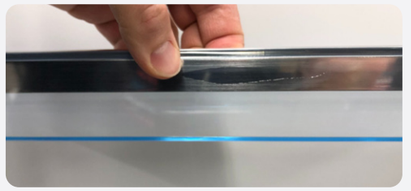


2. All parts accessible

All parts that get visibly dirty should be accessible and easy to clean. If this is not possible, specific tools should be designed.

3. Even surfaces

Even surfaces and simple design styles can improve the cleanability of the product. Dirt can be removed easily.



4. No overlapping materials

It was found in my research that when two materials are overlapping, soap and moisture can get stuck between these parts when cleaning the product. By reducing the number of materials this problem can be solved.

5. Self Cleaning

It is recommended that all products should be equipped with a self-cleaning program. This enables the user and the refurbisher to clean the product.
The self-cleaning facility is usually already integrated in many Bosch products.

10.4 | Timelessness

1. Upgradeability and adaptebility

Obsolescence is avoided and product life time is maintained by making it possible to upgrade the performance and value of the product, and by adapting it to the changing needs of the user.
This is especially useful for user interfaces that can be upgraded according to new technological innovations.

2. Creating attachment and trust

One of the strategies to extend the lifetime of a product would be to create attachment and trust. This strategy is aimed at minimizing emotional obsolescence by creating long lasting products that will be loved and trusted.

3. Simple design styles

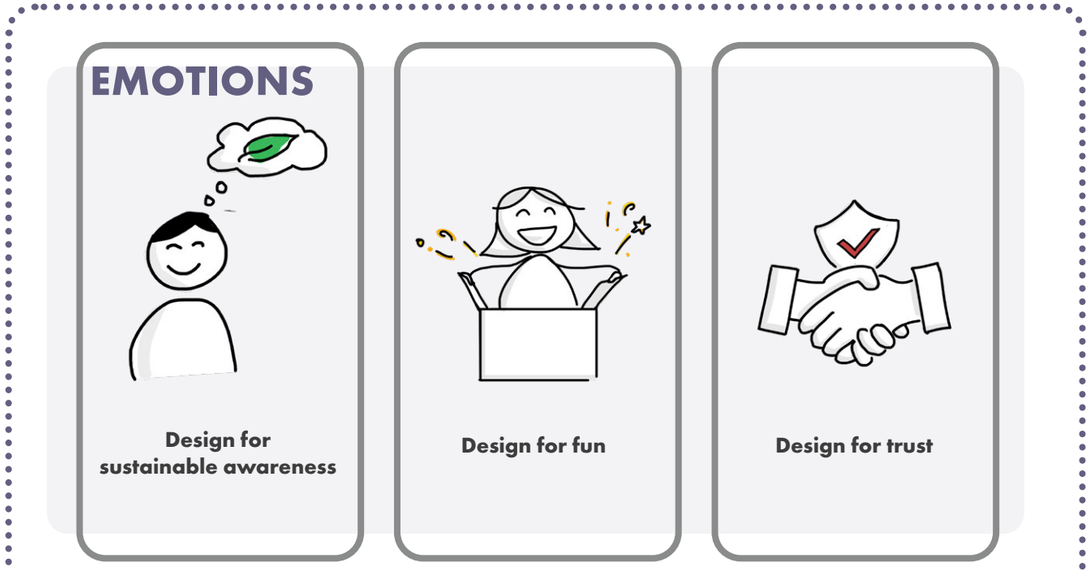
The literature about sustainable aesthetics revealed that simple forms provide a sense of elegance. Moreover, minimizing the number of separate components and the number of materials makes product repair and refurbishing easier.
Research also showed that customers are more likely to trust simple aesthetics. Neo-retro aesthetics and simple aesthetics turned out to have a positive effect on the considerations for refurbished products.
They evoke a positive association with the better quality of products of the past and the durability of high quality brands.

4. Timeless Materials

When designing for timelessness it is important to look at the aging of product materials. Not only the materials' vulnerability to damage, stains and scratches should be looked at, but also the way materials age. The way consumers perceive these materials should also be examined. They are more likely to trust materials such as glass and metal used for products with a second life.

11. Emotion

The brainstorming for ideas was done with the emotional design directions in mind. These ideas in combination with the application of the defined guidelines for refurbishment will result in the final concept. This combination will lead to answering the research question: How can the design of a household appliance be optimized to increase the consumer acceptance with regard to the refurbished product?



11.1 | Ideas

The brainstorming for ideas was done with the emotional design directions in mind. The ideas were generated by using various methods: Brain Writing, How-to's and a creative group brainstorming session. All the sub-ideas have been evaluated with the C-box method and the most promising ideas have been combined and elaborated. These ideas will be evaluated.

The ideas from the brainstorming session have been evaluated and combined and five promising ideas have been elaborated. A more elaborate explanation of the ideas can be found in Appendix F. Appendix E gives an overview of the brainstorming and the creative session.

The ideas were evaluated on six different characteristics. The first three are the three emotional design directions. In the research it was discovered that these directions will enhance customer acceptance of refurbished products.
The ideas will also be evaluated on feasibility, innovation and attachment. Attachment is one of the strategies to enhance the product lifetime.

User groups

As explained in Chapter 8 the different personas each have their own preferences within the emotional directions. In the figure below the different preferences of the target groups are displayed. Their preferences were combined in order to choose an idea that will appeal to all three customer groups.
The five most promising ideas were evaluated to see what idea would best represent the combination of preferences of the user groups.
Ideas were combined and developed into a concept that fits the needs and wishes of all the user groups.

11.2 | Choosing

The brainstorming results can be found in Appendix E and F. Ideas have been generated using various design methods. All ideas have been evaluated using a C-box method, and the most valuable ideas have been combined into five promising ideas. A more elaborate description of these ideas can be found in Appendix F. In this chapter the final idea will be chosen and explained.

11.2.1 | Decision factors

When combining the preferred emotions of all the user groups, all three emotions turn out to be valuable (Figure 20). However, the emotion of trust is of significant importance to all the user groups. This has also been discovered in the research. It revealed that the performance risk was the main motivation not to buy a refurbished product. Therefore this emotion had a larger influence on choosing the idea. The ideas were also evaluated on feasibility, innovation and attachment.

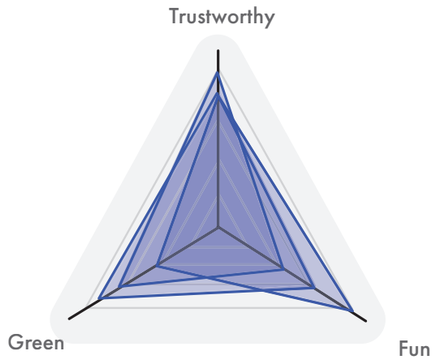


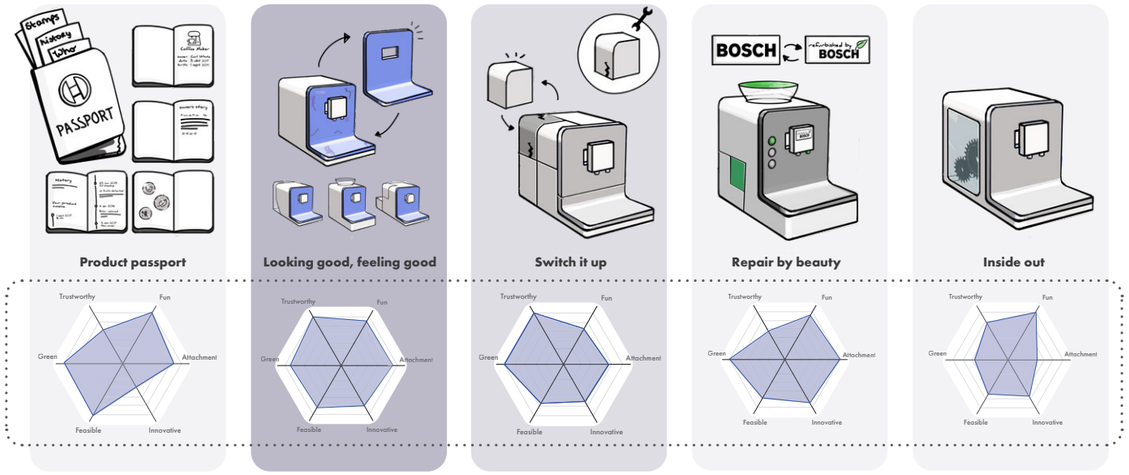
Figure 20: Combined emotional preferences

Evaluation

After the evaluation the idea 'looking good, feeling good' was ranked as most compatible with all user groups. Changing the cover of the machine makes the machine less prone to user marks, and therefore trust is created. This has been determined in the user research.

Moreover, the idea 'looking good, feeling good' scores best on feasibility and attachment. Since the customer can choose his/her own cover, the machine becomes personal so that attachment is created. This is especially valuable within a product service system.

To meet the requirement of designing for quick repair and cleaning, a modular system was chosen for the inside. The process of refurbishment will be more efficient and the valued price difference will be maintained.



11.2.1 | The ideas

The idea 'looking good, feeling good' was chosen to be elaborated into a concept

Looking good, feeling good

In my research it was found that if the product still looks new, the customer is more likely to trust the product. The idea 'Looking good, feeling good' has been created on the basis of this insight (Figure 20) The principle is that part of the cover can be replaced or refinished. The customers can compose their own refurbished product by starting out with a refurbished basis and then choose their own new or refurbished cover.

The form of the machine cover stays the same over time and therefore it allows the product to be updated easily in the course of the years. The refurbished coffee machine will not show many user marks and the customer is more likely to trust the performance of the product. All the covers would be compatible for all types of coffeemakers. So a new cover design in 2027 should fit a machine produced in 2021 for example.

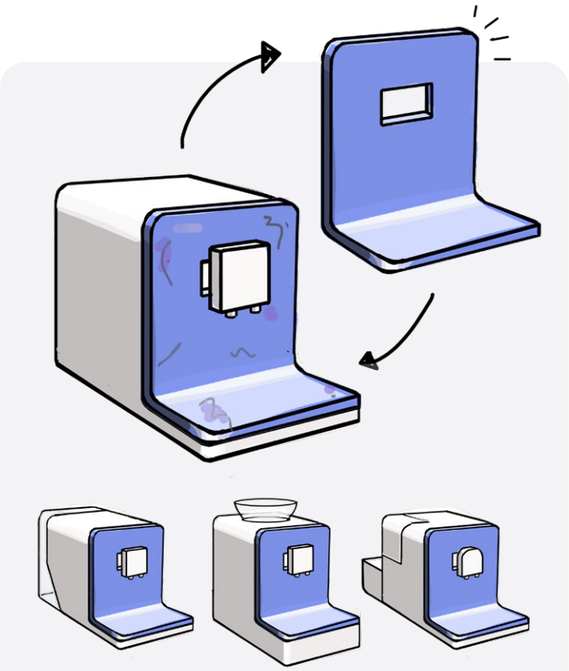


Figure 21: The idea: Looking good, feeling good

Switch it up

To increase the trust and the lifetime of the product the 'switch it up' was created. Different parts of the product will be stored in various modules. If one of the modules stops working it can easily be replaced or upgraded with a new or repaired module. The old module can later be repaired or sent to a third party. This concept also makes it possible to upgrade a product when new innovations within a module are created. As a result the lifetime of the product will be increased. It also makes the process of refurbishment more efficient, and therefore the price difference can be maintained.

When combining these two ideas, the inside of the machine as well as the outside would be optimized for refurbishment. With both ideas the lifetime of the product would be extended and the trust of the customer would be enhanced.

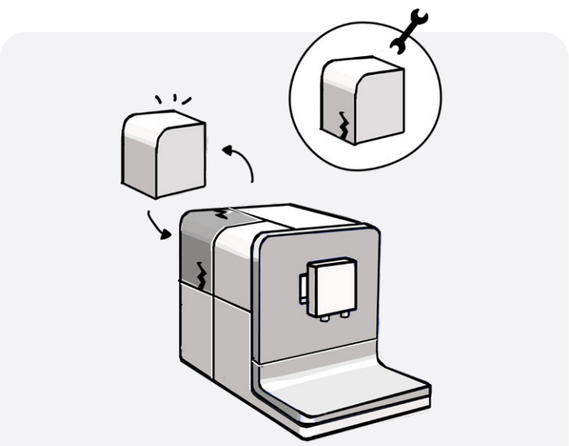


Figure 22: The idea: Switch it up

11.3 | Combining

The results of the design directions were combined. The pillars will serve as a guideline and requirement to elaborate the emotional directions. The ideas are separated into two different parts: process efficiency and consumer acceptance.

11.3.1 Design directions

Pillars
When we look at the requirements of designing for refurbishment, the three pillars, reparability, cleanability and timelessness are essential in every product design. These aspects cause a more efficient refurbishment process and a greater customer acceptance of the products. The three aspect reparability, cleanability and timelessness are turned into a set of guidelines.
These guidelines have a large influence on the product architecture and the product aesthetics, although they would not change the function of the product. They have to be taken into account when building up the product, choosing materials and maintaining the product. They will serve as proposed requirements to design for the refurbishment.

Emotions
In my research it was found that only incorporating these guidelines would not be sufficient to enhance the consumer acceptance of refurbished products. Research showed that not only performance plays a large role in the acceptance of the product. Awareness and trust should also be created. In addition, the experience of buying a refurbished product should be fun and not feel like buying a second-hand product.
If a modular system is used inside the coffee maker it can be repaired and cleaned more easily.

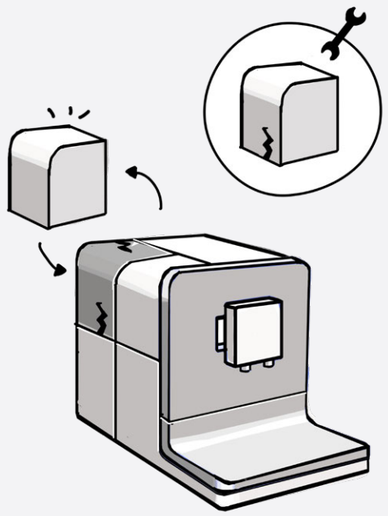
1.3.2 The focus

The combination of the results of the design directions can be divided into two parts: Process efficiency and consumer acceptance.

Process efficiency
Process efficiency contains all the modifications that should be done in order to optimize the process of refurbishment. This is essential to maintain profits on refurbished products, and keep the prices for consumers low. Process efficiency will also make refurbishment more attractive for companies.

Customers acceptance
Consumer acceptance contains all the modifications that influence the user perception of refurbishment. This part focuses on the outside of the product and the customer attachment to the product. Since the research question is based on customer acceptance, this will be the focus of the concept.

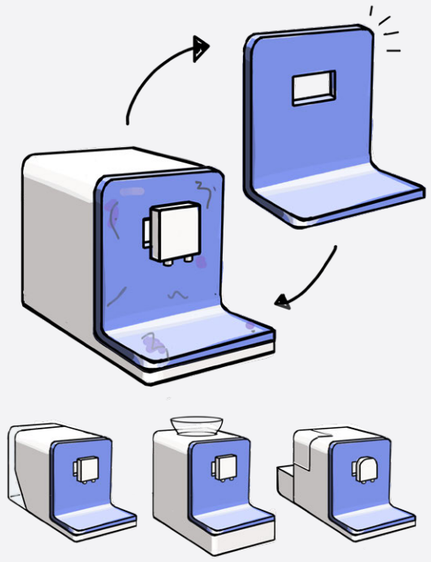
Process efficiency



Repair
1. Easy access components
2. Easy product inspection
3. Quick replacement
4. Component availability
5. Defined repair/checkup structure

Cleaning
1. Washing machine proof
2. All parts reachable
3. Even surfaces
4. No overlapping materials
5. Self Cleaning

Customer acceptance



Timelessness
1. Upgradeable and adaptable
2. Create attachment and trust
3. Simple design styles
4. Timeless Materials

IV

DELIVER

12. The concept

In this chapter the application of the results of the ideas is discussed. The concepts are linked to the design directions and a story board is made in order to explain the steps of the concept.

12.1 |The principle

The principle is that part of the cover can be replaced or refinished. The customers can compose their own refurbished product by starting out with a refurbished base and then choose their own new or refurbished cover. All the covers would be compatible for all types of coffeemakers. So a new cover design could fit an older model as well.
The customer can create its own coffee machine by starting out with a refurbished base and then choose their own cover on it. Because the cover looks like new, the customer is more likely to trust the machine. Old covers can have a surface treatment (brushed, sanded, painted), recycled or they can be reused when they are scratch free.

Product service
When looking back at the different scenarios around refurbishment, this idea could have high value for product services. When letting the customer choose the aesthetic of their machine, attachment will be created and thus a more personal experience.

Design for Trust

The concept is base on the insight: when a product still looks good the customers is most likely to think that the product still works. Therefor the trust is enhanced. Part of the cover of the coffee-machine can be replaced to give the product a polished look.

Design for Fun

Because the concept gives the opportunity to compose your own product you give the user a personal shopping experience. Because of this personalization more attachment to the product will grow. A feeling of having an new product is created instead of having the feeling that they are using somebody else's product.

Design for sustainable awareness

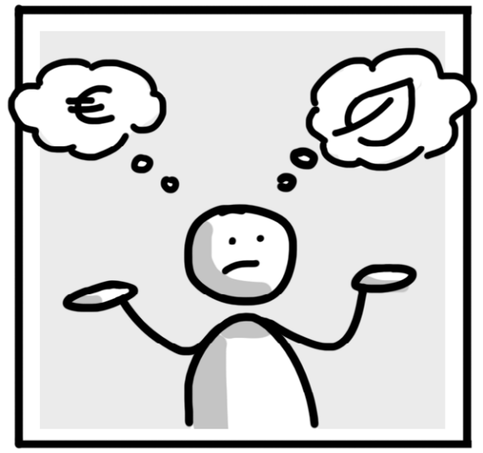
When providing more information about the environmental benefit of buying a refurbished product, awareness will be created. When giving the consumer the option of choosing for a refurbished model or a new model, the benefits of price and sustainability should be addressed.
Thus customers who where not yet aware of these benefits will be informed and they can make a product decision based on these aspects.

Design for timelessness

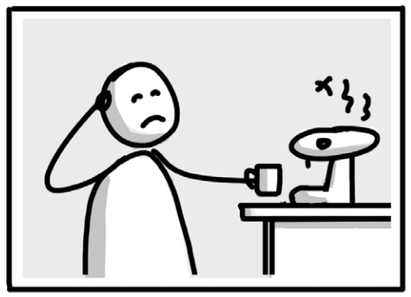
Since part of the covers can be replaced and the shape is meant to stay the same for all future models, the aesthetic can be updated. Therefor the coffee-machine can withstand trends in colors and materials, but more important wear and tear of materials can be undone.

Story board

On the next page a story board of concept is shown. The storyboard is based on the scenario of refurbishment within a product service system. It explains the concept out of the view of customer, Jamie, who is looking for a new coffee machine.



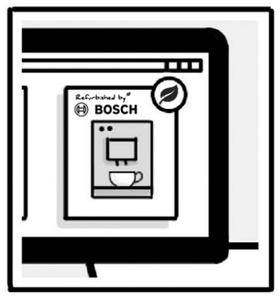
12.2 |Storyboard



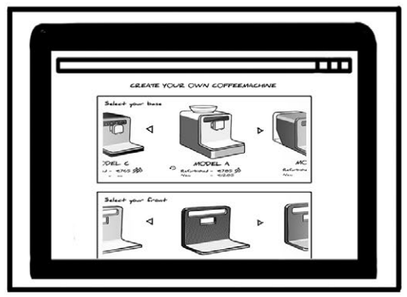
Jamies coffee machine has stopped working. Unfortunately his machine can not be fixed and it needs to be replaced

Jamie wants the new coffee machine to be affordable, without having a big environmental impact

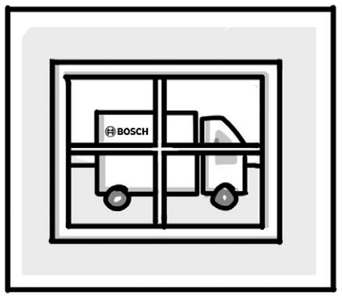
On the website of the retailer Jamie gets informed about the option and the benefits of leasing a refurbished coffee machine.



He chooses the refurbished model over a new model, because it is cheaper and better for the environment.



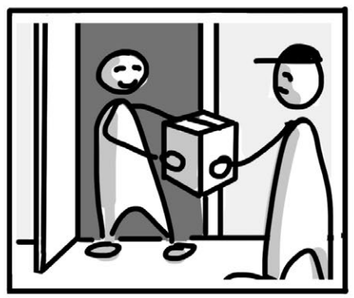
Jamie composes its own coffee machine. He can select a refurbished model with his preferred specifications and pick a cover design that he likes and that fits his interior.



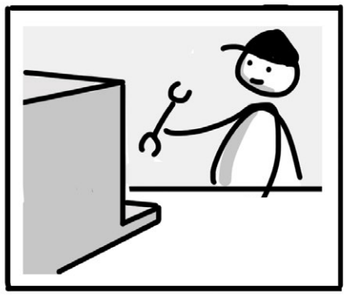
The lease starts and the coffee machine gets delivered to Jamies home

The coffee machine looks just like new because the most visible part of the machine has been renewed.

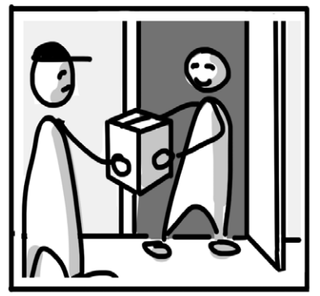
When a component or unit is damaged or isn't working properly, the interface shows the action that Jamie needs to do in order to solve the problem.



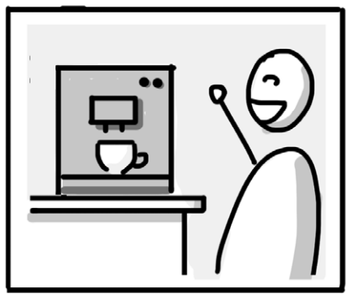
During the leasing period, the repair of the machine is covered. The machine gets picked up at Jamies home and delivered to the repair shop.



Because the accessibility of components and the ease of repairing, the machine will be fixed quickly and the repair costs of BSH will stay low.

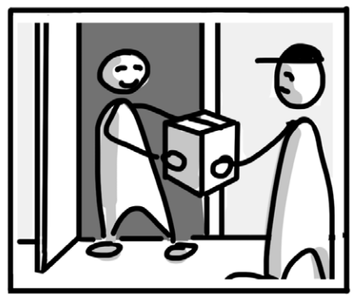


The repaired coffee machine will be returned to Jamies home.



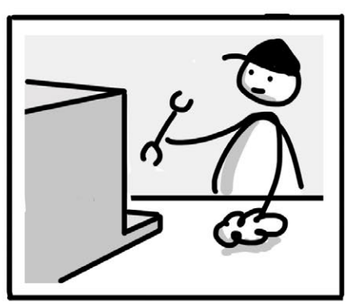
Jamie can use his machine again.

End of contract

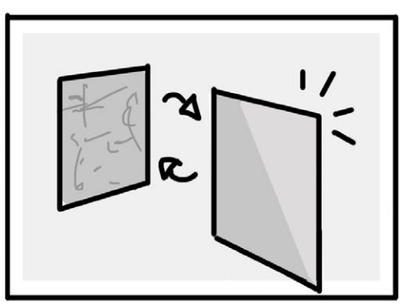


When the leasing contract ends, the coffee machine gets returned to the retailer

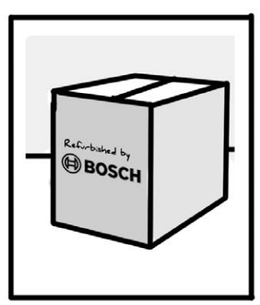
Refurbishment



The used full automatic coffee machine will get cleaned thoroughly and checked. Components that are faulty or close to failure will be replaced.



The used and worn out front will be replaced with a design that is selected by its next user.



The refurbished machine gets send to its next user.

13. Architecture

This chapter focuses on the architecture of the internal components of the full automatic coffee machine. A redesign was made in order to increase the accessibility, cleanability and reparability of the coffee machine.

13.1 | Accessibility

In order to make the process of refurbishment more efficient, it is necessary to have the crucial components easily accessible. This is needed to save time during the reparation of broken components in order to keep the costs low. To find out how to increase the accessibility of the components inside the machine, an interview was conducted with a repairer of full automatic coffee machines at the repair and refurbishment center at BSH.

Cover

After the observation and interview at the repair center, it became clear that the cover of the coffee machine is an important part in the efficiency of repairing.
Right now most machine covers consist out of a lot of separate components (Figure 23). These cover parts are usually hard to remove since they contain screws and tight snap-fits. These snap-fits are sometimes designed in such a way that they can break easily when taken apart.
During the interview it was mentioned that certain models of the full automatic coffee machine where designed more efficiently for the repairer. In this model the cover consists only out of two parts that where screwed to the base. This design of the cover was seen as very pleasant for repair, and therefore it was taken as a guide for the redesign of the coffee machine.
There is an additional advantage when making the cover out of two parts. The top of the machine will be supported by the sides of the cover, therefore there is no need for a support structure inside the machine. This will save space and the components inside the machine are better accessible, because no structure is blocking these components like before (Figure 23)

Figure 24 shows the redesign of the cover of the full automatic coffee machine. The cover consists out of two parts, the back-right and the top-left. The cover can be installed with only two actions. The back-right part of the cover can be slid onto the base of the coffee machine. When this part is installed, the top-left part can positioned on top of it.

Positioning of components

Three iterations were done (Appendix G) to find out what the ideal positions of the brewing unit is in order to make all the other components best accessible. Moreover the cleanability of the machine was taken into account when positioning the components. More on that in Chapter 14.3.

The top-left part of the cover contains the cavity of the water tanks. When removing this part of the cover, the internal components are revealed. The internal components such as the pump, heater and motor are placed in the middle of the machine and all positioned next to each other. This prevents parts from blocking the accessibility of other parts.

Figure 23: Left: seprate parts of the cover. Right: Internal structure older model

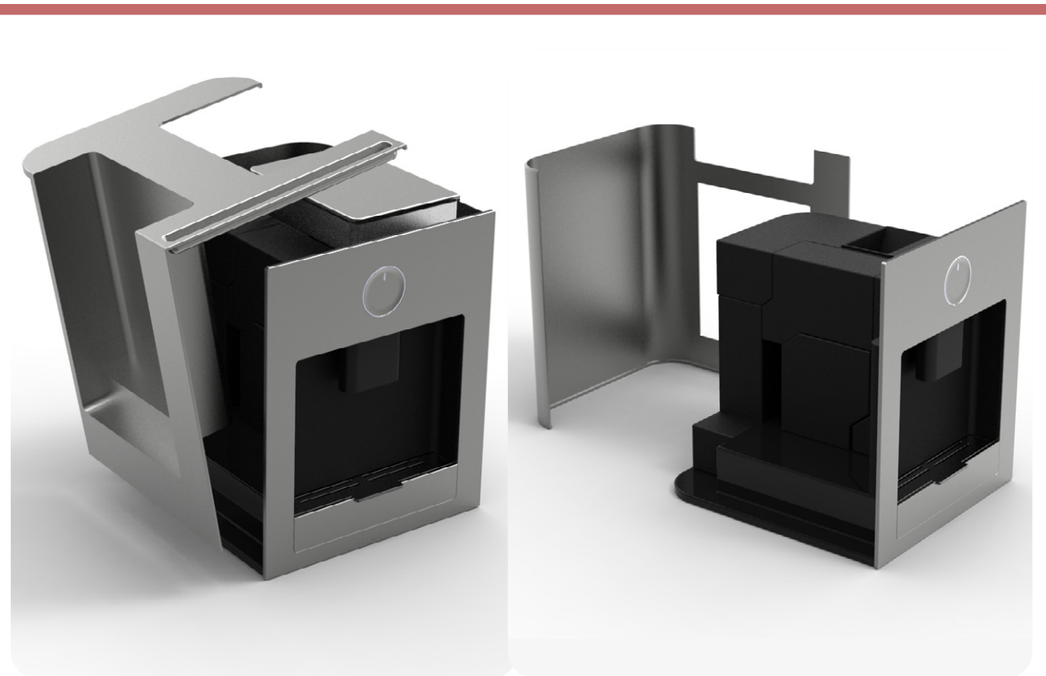


Figure 24: Quickly removeble cover parts

13.2 | Reparability

One of the main drivers for consumers to choose for a refurbished product is the price difference compared to a new product. To extend this benefit, it is important to keep labor costs low. Components should be easy to replace in order to keep maintenance cost low. This chapter presents a modular concept that should increase the ease of repair.

Accessible

One of the points that was identified with the guidelines was accessibility. The placement of crucial parts should be in such a way that the repairer can easily access these parts to repair or replace them.

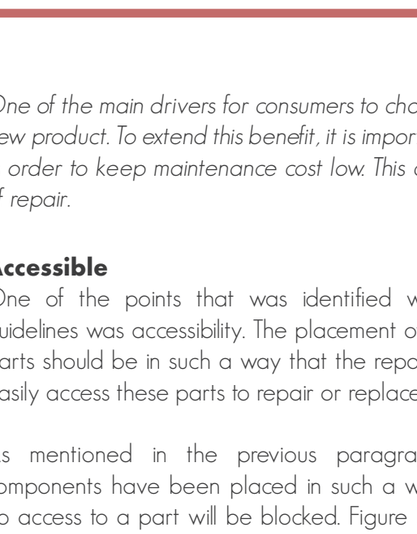
As mentioned in the previous paragraph the components have been placed in such a way that no access to a part will be blocked. Figure 25 give sa schematic overview of the placement of the components. Comparing the new design to the old product will show that the redesigned interior gives the repairer a better overview of all the components. All the modules can be easily reached in order to replace any failing module.

Modular

A conceptual view of the design of the coffee machine was illustrated where modules were used to build up the coffee machine. These modules would fit into each other like a puzzle and the separate modules will contain all components that are needed for their subassembly. Figure 26 shows an example of how module fits inside the machine.

Crucial components were determined in Chapter 6.3. Separate modules are be created for the:

- Motor and gears
- Electrical panel
- Pump
- Coffee grinder
- Heat element



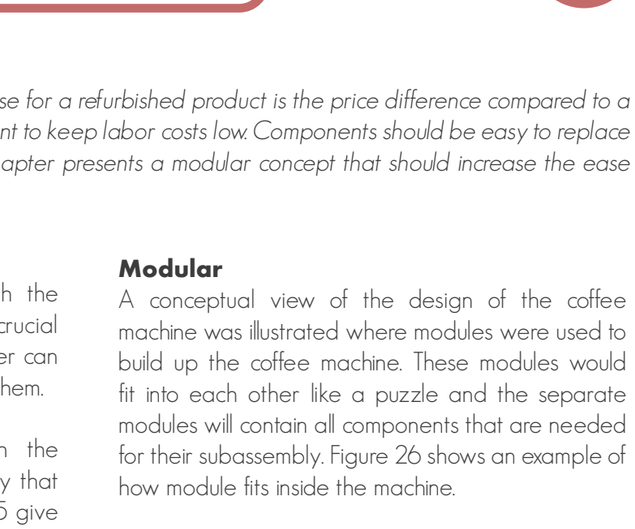


Figure 25: Old and new interior of the full automatic coffee machine

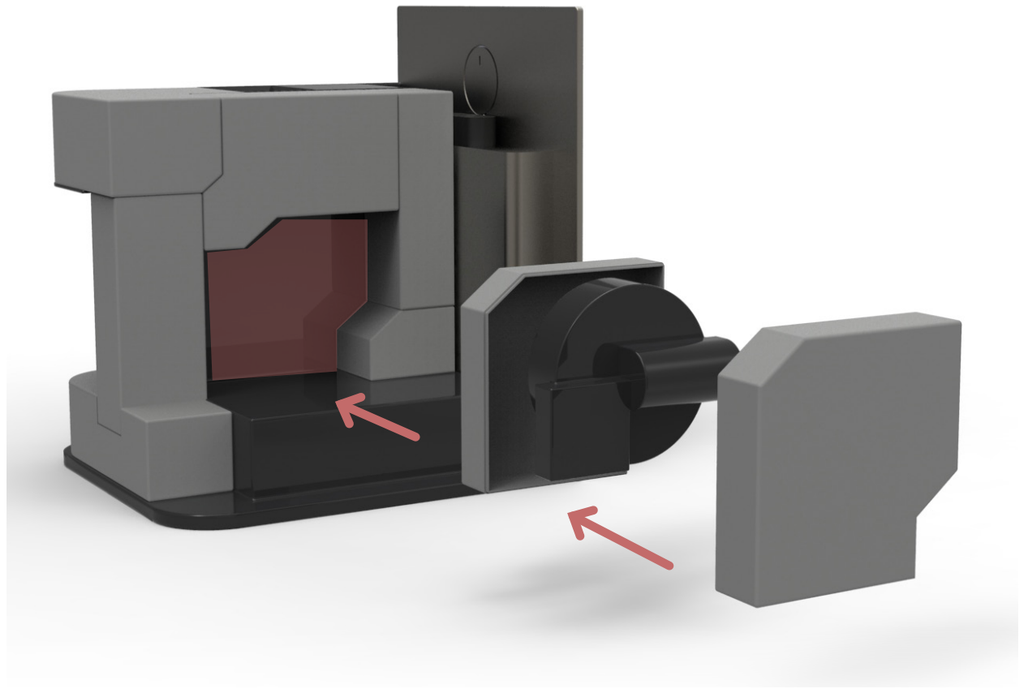


Figure 26: Conceptual representation of a modular interior: Inside the motor module, that fits in the machine

One of the options could be that all the assemblies are connect via each other to the electrical panel. This will make the need for external wiring and tubing irrelevant. The repair would become very easy as you would just need to replace one module, without any more actions needed.

Predicted maintenance

Since all the parts are divided into modules, it could be recommended to put sensors into these modules to detects failures or expected failures. The interface on the coffee machine can show the repairer which of the modules needs replacement. Therefore repair becomes very easy and it can even be done by the user itself.

When a module breaks down, it can be quickly replaced by a new one. The old module can then be repaired and used for another coffee machine. This increase the efficiency of repair and can make a leasing model more profitable.

Recommendation

The solution of building the internal components of the coffee machine in a modular way has been created on a conceptual level. It is recommended to explore this opportunity better by experts in this area. The modules should not increase the material use of the product, since that would make the environmental impact of the product higher. The recycling and repair of modules should be explored.

13.3 | Cleanability

In the consumer survey that was held in the analysis phase, it became clear that it was most important that the refurbished appliance was completely clean. This chapter explains the solution to optimize the process of cleaning the appliance.

Division

The coffee machine can be divided into two parts. The 'wet' part and the 'dry' part. The dry part is the side where all the electronic components are placed. This part is closed off and not prone to dirt. This part is usually not visible to the customer.

The wet part contains all the open parts where liquids run through. This excludes the pump, tubes and the heater since that are closed off components. The wet part is highlighted in Figure 28. It exists out of the cavity where the brewing unit is placed and the drip tray. This cavity can get very dirty and coffee residues can be stuck. This part is visible by the customer during daily use and gets in contact with the coffee they will be drinking therefor it must be completely clean.

During the research that was done with the refurbishment experts and repairers, it became clear that this cavity that contains the brewing unit and the drip tray can be hard to clean. This is because some areas are hard to reach, materials get stained and there are uneven surfaces where dirt can get stuck behind.

Right know the wet area is attached to the whole machine and therefore using water to clean can be tricky. When the water would reach to the electronic components, a short circuit can be caused and the machine can break down. So a solution can be to separate these parts.

Covers

When trying to refurbish a coffee machine myself, I discovered that a lot of coffee residue was accumulated at the back of the covers of the machine (Figure 27). It took a lot of time to clean all the covers by hand, since the dirt was hard to remove, due to the little holes and cavities that were not easy to reach. The covers had to be cleaned by hand, because the material of the covers (ABS) could not go into the dishwasher There is a chance that due to the high temperature of the water and the detergent, the covers can be deformed or be damaged.

Some parts of the cover were discolored by the coffee. The light gray turned slightly brown and this was not cleanable. It can be advised to have the colors of the cover in a slightly darker tone, in order to have no visible discoloring.

Figure 27: Dirt behind housing

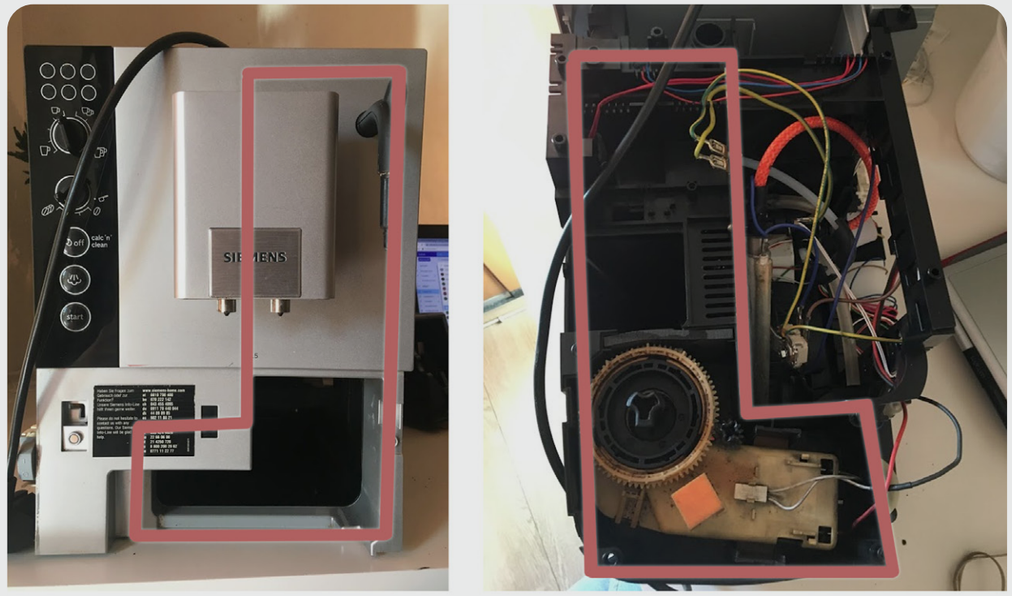


Figure 28: Wet parts coffee machine that need cleaning

The solution

In order to make it easier to clean the 'wet' part of the inside of the machine, it was chosen to separate this part from the rest of the machine.

The structure of the inside of the machine is split into two parts (Figure 30). The base structure is where all of the electric modules are attached to. In this base structure a cavity is created where another structure can be slid in. This second structure will be called the liquid cavity and a simplified version is illustrated in gray in Figure 30. The liquid cavity contains:

- The funnel for the ground coffee
- The cavity for the brewing unit
- The cavity for the drip tray

The liquid cavity can be slid into the base structure and it will lock itself in place with a snap fit. The drip tray and the brewing unit will fit into this structure.
Once the machine is going to be refurbished or cleaned, the liquid cavity can get detached from the base structure. Now this part, that is most likely to get dirty, can be easily cleaned. Since in contains no electronic components, the structure can be rinsed with water or even be put inside a dishwasher.

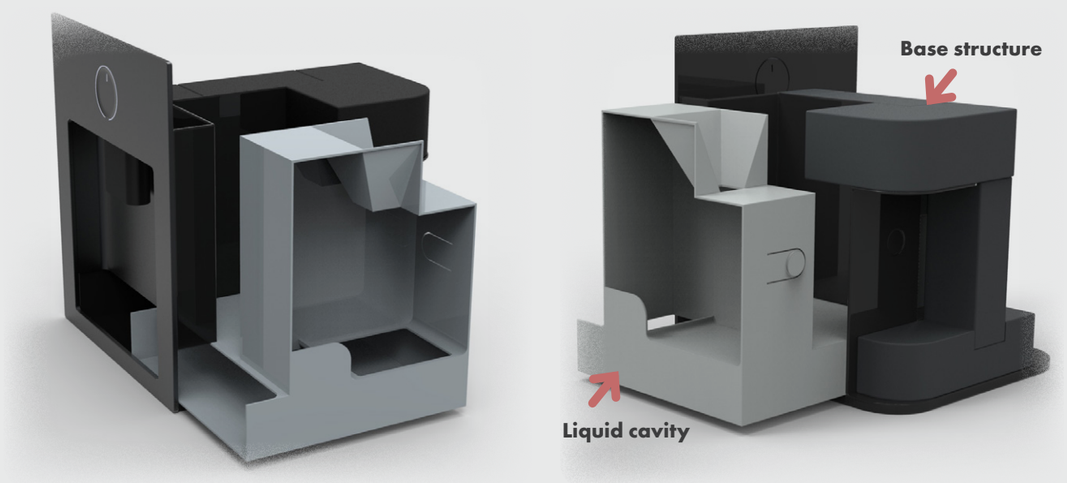


Figure 30: Removable structure for cleaning

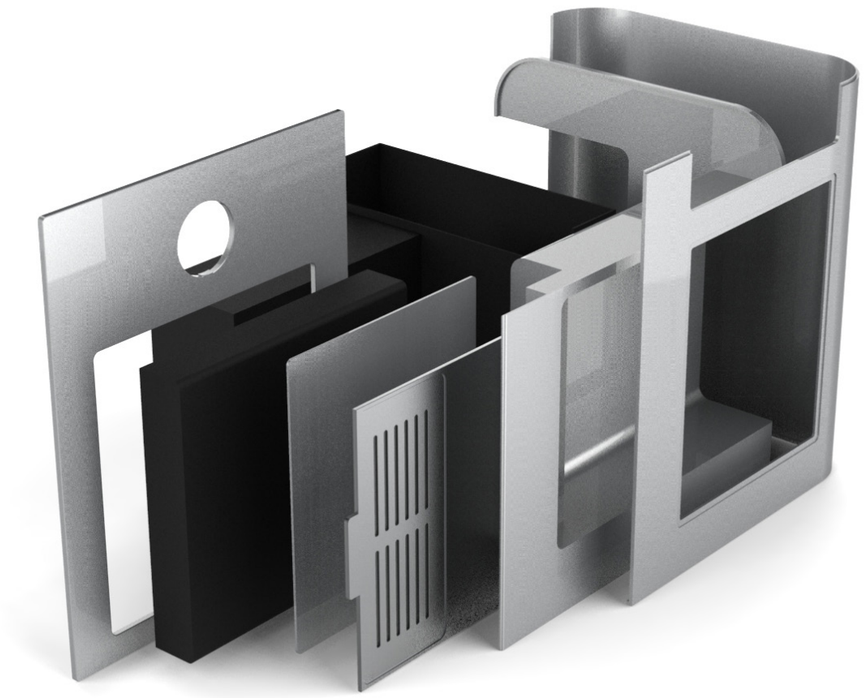


Figure 31: Parts that can get cleaned in the dishwasher

Dishwasher proof

One of the guidelines that was a result of the design directions was that the parts that need cleaning should be able to be put into the dishwasher. Like mentioned in the previous paragraph, part of the structure can be taken off in order to be put into the dishwasher. Next to that, all parts of the housing can easily be dismantled. In the picture above all the separate parts that need cleaning are displayed.

Materials

If the parts of the full automatic coffee machine will be cleaned in a dishwasher, it is important that the materials of these components are resistant to this.

For the internal plastic parts that need cleaning, plastics such as polypropylene (PP) can be used. PP is used as a material for cutlery racks in the dishwasher and has excellent resistance of heat, dissolvers and acid and base. This is important since these parts come into contact with the coffee as well. Moreover, polypropylene can easily be recycled. (Rogers, 2014) For the cover, it is recommended to use metal since the customer research on aesthetics showed that products that use these materials are trusted more. A metal that works excellent with liquids and is cleanable and hygienic is austenitic stainless steel. (Azo materials, 2005).

On the other hand, special dishwasher(programs) could be designed for the cleaning of product parts. Using lower temperatures and less intensive chemicals to clean the different parts of the coffee machine offers more options in variation of materials. However this means that the user is not able to clean its appliance at home.

14. Aesthetics

The customer research showed that the aesthetics of the product play an important roll into the acceptance of refurbished products. Customer research was done in order to find out what kind of aesthetics are preferred for refurbished products. This chapter explores the redesign and the changeable front cover.

Literature Research

The aesthetics of the product should fit the design for lifetime extension. These aesthetics are based on the literature of lifetime extension, design for sustainability and design for refurbishment:

- Simplistic products are being associated with durability and high quality brands. Also they give the sense of elegance and minimizing the number of separate components and different materials eases the product repair and refurbishing.
- The neo-retro style evokes a positive association with the better quality of products of the past.
- Design for aesthetic upgradabillity, can slow down aesthetic obsolescences.
- Sharp shape, high contrast and vivid color and highly polished and shiny surfaces are not considered properties of a sustainable design.

User research

On top of the literature research user research was done to discover the preferred aesthetics for refurbishment.

Some insights from customers:

- "When a product looks simple with little options I think it is most likely to last longer."
- "A robust product with little loose parts looks most trustworthy"
- "Metal and glass look like materials that last long. "
- For some participants white plastic is seen as unsustainable and cheap.

Exploration

In addition to the extensive literature and customer research, an analysis was done on second change products that are sold online. This was done in order to discover what kind of materials are more likely to show user marks, see Figure 32.

- Shiny metals show scratches very easily
- Matte plastics are less likely to look used than shiny plastics
- Screens of user interfaces quite often show scratches

Based on these findings and the analysis of the brand aesthetics of Bosch, the memetic collage was made.

This collage will be used to explore the new design of the coffee machine. See appendix H

Figure 32: Second chance product CoolBlue: Materials that wear

14.1 | Cover Designs

Three different cover designs were created to match the preferences that were found in the research on preferred aesthetic for refurbishment. In Chapter 15.1 the various designs will be used to validate the insight that were discover by the research done on aesthetics.

Neo-retro

The first cover design is in the style of neo-retro (Figure 33). Neo-retro is a design style that combines and reinterpret styles from various design styles from the past (Celhay, Magnier, & Schoormans, 2020) . Research showed that products that are designed in this way are preferred for refurbishment. This is because is evokes a positive association with the better quality of products of the past (Wallner et al., 2020). The design has been kept simple with little options, in order to give a sense of durability.

The neo-retro cover consist out of two parts, the upper part with a screen and buttons and a part that covers the drip tray. The upper part has a cutout for the coffee dispenser, two buttons and a touch screen. The interface of the touch screen can be updated over time. The bottom part of the cover fits over the drip tray and slides out of the machine when the customer needs to empty the tray. It can be removed to clean by the customer.

Figure 33: Neo-retro cover design

Simplistic

The second cover design was designed with a simplistic approach (Figure 34). Simplistic products are being associated with durability and high quality brands (Wallner et al., 2020). Next to that the model was designed to look robust to evoke a feeling of trust. Even though the model looks simple, sharp shapes were avoided in order to meet the strategies of designing for sustainable aesthetics (Zafarmand, 2003).

The cover consist out of one part that has a cutout for the coffee dispenser and a cutout for a screen module. The screen module contains a screen and two buttons and a turning wheel.

The drip-tray is elevated in order for is to look less bulky. In order to accomplish this another part needs to be added to the changeable cover. This part is attache to the drip tray and can slide out in order to empty the tray. The drip tray cover is changeable a as well since coffee cups easily leave marks on this part.

Figure 34: Simplistic cover design

Minimal
For the last design the interface of the coffee machine was taken out of the product. This was done in order to increase the timelessness of the model. When you look at the evolution of the full automatic coffee machines, the component that has changed the most over time is the interface of the machine. Since technologies have not stopped evolving, it was decided to make the interface of the machine remote. You can connect your smartphone, tablet or other future mobile device to your machine via Blue-tooth or NFC technology and use it to control the machine. The light behind the cover responds to your actions that you do on your device. You can make presets and one physical button can be used to quickly make your favorite drink, or scroll through your presets.

The design of the cover has taken simplicity one step further than the previous simplistic model. The cover consists out of one flat sheet with a cutout for the button and for the cavity to put the coffee cups. In order to make it more sleek and compact and to save space on the counter top, the drip tray is made retractable. When you slide out the drip tray, the coffee machine turns on (Figure 35).

On top of the machine a slot is made to hold your mobile device, however you can also choose to operate the machine from a distance.

Figure 35: Minimal cover design turned off

Figure 36: Minimal cover design with extracted drip tray

14.2 | Replaceable cover

As mentioned before, the core of the concept is that part of the cover can be replaced or refinished when the product gets refurbished. The customers can compose their own refurbished product and the aesthetic can be updated. Therefor the coffee-machine can withstand trends in colors and materials, but more important wear and tear of machine can be reduced.

Design for aesthetic updatability
The replaceable covers for the three different designs are shown in the image to the right. According to the designer of coffee machines at BSH, internal components and functionalities of a full automatic coffee machine do not innovate much over time, however the trends in aesthetics do change. Every time the machine gets refurbished the aesthetics can be updated to the trends of the moment. However in order to increase the usage time of a cover, the colors and material of the cover should be kept resistant to trends and ware and tare. The next chapter focuses on the color and materials of the designs.

It could be an option to explore if the cover could be sold as a separate part. Customers can change their own cover design of the coffee machine in order to be able to change the look of their machine. This can increase the life time of the coffee machine. However it needs to be researched it customers would be interested in changing their cover by themselves.

Reuse of cover
The cover needs to be made from recyclable materials. When a cover is obsolete it can be recycled and used for another cover. Besides, it is advised to look into the refinishing of the used covers. Metal covers could for example be repolished, repainted or sandblasted to give the cover a new life. Parts and materials will stay into the cycle of use.

Material Loss
The replaceable parts take up less than 20% of the total material used for the housing of the machine. Therefor 80% of the housing and all of the internal components will be reused. The total material loss will be much less than when you would buy a new coffee machine.

Figure 37: Designs with their changeable cover

14.3| Colors and materials

A survey was conducted in order to find out what colors and materials for the fully automatic coffee machine are preferred and to validate the aesthetic research that was done in the first part of the project. Consumers were ask to rate different models on timelessness, reliability, durable, eco-friendliness and quality. (See Appendix I) These characteristics were identified as important when designing for refurbishment. The research was done with 12 participant aging 20 to 72.

Materials

Various material and color combinations on the coffee machines were presented to the consumers. The materials that were evaluated where:

- Glass
- Aluminum
- Bamboo
- Cork
- Plastic

The materials that were ranked as most **timeless** were shiny aluminum, cast iron and black glass. Also sanded aluminum was seen as a timeless material. On the other hand coffee machines that were made of plastic or contain natural materials like bamboo, wood or cork were rated very trendy. Especially using a natural material for the whole front cover was evaluated the least timeless.

Figure 38: Cast Iron

Cast iron and brushed aluminum were seen as most **reliable** materials. Next to those sanded aluminum, glass and shiny aluminum were also seen as reliable. The materials that were least reliable were bamboo and plastic.

Figure 39: Shiny aluminum

The participants found it hard to rate the products on **durability** and **eco-friendliness** because they would base this on other specifications of the coffee machine, that are not related the looks of the product. This was interesting to know, since this indicates that aesthetic do not have much influence on the perception of these aspects. However glass and metals were rated to be more durable than the other materials.
Bamboo, glass and cast iron were rated the most eco-friendly out of all the materials and plastic as the most polluting.

Figure 40:Brushed Aluminum

Lastly the perceived **quality** was measured. Black glass give most hight quality look of all the materials that were researched. Closely after that the different kinds of aluminum and cast iron were rated as high quality. Plastic was perceived as the most cheap material.

Figure 41:Black glass

Colors

A variation with a coffee machine with a bright red color was presented. This machines was seen as very trendy and does not score high on durability. Darker machines score higher on quality than whites.

Figure 42: White Plastic

Recommendations
All in all black glass was rated best at most of these aspects. After that cast iron and aluminum score high. The natural materials only score high on eco-friendliness however on the other qualities they fall behind.
I would recommend to use glass on flat surfaces like the simplistic design and make use of aluminum or cast iron on the covers that have curved surfaces. Even though customer have a preference for shiny aluminum I would recommend to use sanded aluminum since this would show less user marks. I would recommend to not use natural materials such as wood or cork, since they are not perceived timeless and of good quality It is also not recommended to use bright colors. Dark colors are seen as more high quality.

It is recommended to extend this research with more participant to have a more reliable conclusion.

14.4 | Logo

One of the design opportunities was to create sustainable awareness. In order to achieve this with the design of the appliance, is was chosen to change the logo once a machine gets refurbished. The regular Bosch logo will be changed in to a 'refurbished by Bosch' logo.
By adding a leaf to the logo, it illustrates that a refurbished model is a more sustainable option than a new model.
Next the that the logo says 'refurbished by' Bosch. This can be an indication of quality, since Bosch is an established brand. Trust towards the refurbished product will be created by the customer.

Figure 43: Bosch logo for refurbishment

15. Evaluate

The designs have been evaluated by the target groups in order to validate design choices and to identify aspects that need more attention. Next to that recommendations were done for the next steps that are needed in order to implement the concepts.

15.1 | Design

In order to find out which design was preferred by the consumer, part of the survey from last chapter (14.3) was dedicated to evaluate the design of the coffee machines. Consumers were ask to rate different models on timelessness, reliability, durable, eco-friendliness and quality (Appendix I). These characteristics were identified as important when designing for refurbishment. Next to that people were asked if they had a preference for one of the models. The research was done with 12 participant aging 20 to 72.

Results

It was interesting to see that there was no obviously preferred design (Figure 44). However patterns could be identified within the previously defined target groups.

General

In general the neo-retro design and the simplistic design with integrated screen were evaluated as most timeless. These two models were rated quite equally on the aspects of timelessness, reliability, durable, eco-friendliness and quality. It was found out that females were more likely to prefer the neo-retro model than males.

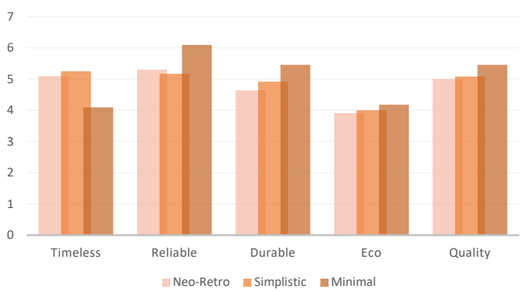


Figure 44: Overview ranking per aspect

The minimal design is evaluated to be relatively trendy in comparison to the other models. However the design is seen as most reliable and durable. It also score the most high quality. This verifies the insight that was found in the in-dept interviews. The less options a product has, the more the product was trusted to last long.
Even though the design was not rated as timeless, the majority of the participants had a preference for the model. Especially the group of participant that are aged less than 30.

The answers to the survey showed an interesting difference in preference within the target groups that were defined in Chapter 9.

Economical buyers

The younger target group, the economical buyers, had a strong preference for the minimalistic coffee machine. They mentioned that the machine looked sleek and robust. Some of them mentioned that they did not like the screens on the neo-retro and the simplistic designs because they were distracting.
One of the participants even choose the minimalistic model because it was trendy.

Ecological buyer

Due to time limitations, this group is not represented in this study. It is recommended to do further research in order to find out the preferences of this target group, in order to have a more reliable conclusion.

Secure buyer

Lastly the more older target group, the sure buyer, had a preference for the designs with the integrated screen. Both the neo-retro design and the simplistic design were picked as favorites. The neo-retro design was slightly preferred and perceived to be easy cleanable and the curvy and elegant shapes were appreciated. The simplistic design was seen as integrated and practical.

Discussion

When we take a overview of all the results of the form evaluation, the older target group preferred the designs that have an integrated screen. This can be explained by the fact that the older target group did not grow up with technology and find it inconvenient to connect their devices to their products.

The minimal design was preferred by the younger target groups even though the design was rated as trendy. The trendiness of the model was also mentioned as one of factor of preferring this model. The relevance of timelessness for this specific design should be tested. Since the design of the cover is made of one sheet and it is able to be updated over time. Curvatures and materials can change over time in order to withstand aesthetic aging.

It can be recommended to use multiple cover design since this research shows that taking out the user interface of the machine does not appeal to all the target groups.

It is recommended to extend this research with more participant to have a more reliable conclusion.

Figure 45: f.l.t.r Neo-retro, simplistic and minimalistic front cover designs

15.2 | Recommendations

An initial evaluation is done on the design of the cover of the redesign of the full automatic coffee machine. Further evaluation on the design of the internal components and structure of the redesign is recommended. More recommendations were done for the continuation of this project.

Evaluate with refurbishers
The first recommendation is to evaluate the redesign of the interior components that needs to increase accessibility, cleanability and reparability with the stakeholders. Prototypes should be made in order to test the design of the quickly removable housing, the cleanable internal cavity, and the modular components. Tests with refurbishers should validate if these concepts make the process of refurbishment more efficient.

Validate acceptance
The redesign of the coffee machine was designed based on the research that was done on the process of refurbishment, the motivations concerning refurbishment and ideal aesthetic for refurbishment. The final designs are validated on the intended aspect. However additional research is needed in order to find out if these design do contribute to the acceptance of refurbished household appliances.

Explore modular interior
The solution of building the internal components of the coffee machine in a modular way has been kept very conceptual. It is recommended to explore this opportunity better. The modules should not contribute to the material use of the product, since that would make the environmental impact of the product higher. The recycling and repair of modules should be explored.

Explore possibility of home refurbishment
The solutions that were presented were meant for refurbishment done by the companies. However the modular interior and changeable cover front can also open doors to have refurbishment brought to the consumers home. Since the repair of components has become easier, customers become able to repair their own product. There can be looked into the possibility of guidance to DIY repair.
Next to that it can be explored if providing customers with the option to replace the covers of their coffee machine leads to an increase of the use time of the. I would recommend to research if the environmental impact does not increase when consumer have to option to change the appearance of their coffee machine.

Focus on marketing
What I found out during the research phase of the project is that there was a lack of knowledge about refurbished products. People were not aware about the existence of the concept or had a wrong interpretation of refurbishment. Also a big group of the participant were not aware of the sustainable benefits of refurbishment.
It would recommend to look into the marketing of refurbished products. Look more into the strategic side of implementing refurbishment. By informing the consumers about the benefits of the concept more acceptance can be created. This can help to attract more potential customers, that are not well informed about refurbishment and its benefits.

Other products
Lastly, these guidelines were meant to be useful for different kind of household appliances. The application of the guidelines in combination with the exchangeable front concept should be tested on different domestic appliances. It should be explored if these guidelines are sufficient or that they need to be specified for different kind of products.

15.3 | Reflection

After working on this project for six months it is time to look back and reflect of all the things that I learned and achieved over this period of time. I look back at a time full of ups and down and challenges I overcome on a project level as well as a personal level. I feel like I have learned a lot on the topic of sustainability and customer research.

When I first started the project and explained the people around me what my topic of my graduation was I got ask a lot on how I was going to solve this problem. I had no answer to that question at the start since this project was one of the first projects where I had no idea what the outcome would be. I let myself guide with the insights I found during the consumer research. This was sometimes hard, since I had no straight path to follow, however it made the project exciting and surprising.

Consumer research
During this project I found out about the value of consumer research. I am used to always keep the user central when designing a product, however my interests were more towards the conceptualization and embodiment of a concept. Quickly after starting this project it became clear that this topic needed a lot more research than anticipated. I became curious about what drives consumers to make certain choices and I kept being surprised by the results. It was a good experience to see how participants are always willing to help you out and provide you with their feedback. I think this is a topic where I improved myself a lot, since I am always hesitant to ask people for their valuable time.

Keeping the focus
The beginning of a project can be very fuzzy and this is something that can make me insecure. Since I am used to do a lot of group work during my bachelor and master, I found it very hard to lead such a big project by myself. I discovered that I work more relax when I confirmation of the things I am doing from a project group.
I noticed that I found it hard to keep everyone up to date with the developments of the project and to balance between the various tips and opinions I received from everyone involved with the project.
I am naturally someone who keeps her thoughts to herself, but during this project I learned that talking to someone on what is on your mind can bring back the focus.

While doing my graduation project I noticed that I struggle to express my thoughts into words. This is with writing a report as well as with presenting my ideas to someone else. I feel like this is something I have always had, however since your doing this project all by yourself it becomes more clear. I tried solving this by making my ideas visual with images and drawings. And by asking people help to check my texts and listen to their feedback. However this is still a point that needs more attention and that I will need to work on.

Unforeseeable circumstances
During my graduation I learned to handle quite some unforeseeable circumstances that were causing delay into working on the project, like breaking my finger, getting ill and the situation concerning Covid-19. I feel proud that I was able to not get distracted by these situations and that I was able to carry out the project.
At the start of the graduation project I said that I would like to make a prototype of the model in order to test it with the stakeholders. However due to the situation concerning Covid-19 it was decided to only make a computer model. This gave the freedom to go deeper into the customer research.

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V

APPENDIX

Contents

A. Survey 1

The overview of the survey that was done to find out the motivation of customers of refurbished products

Refurbished products

For my graduation of the master Integrated Product Design at the TU Delft I will do a project on the consumer acceptance of refurbished products.

What is refurbishment?
Refurbishment is the distribution of products, that have been previously returned to a manufacturer or vendor for various reasons. Refurbished products are tested for functionality and defects before they are sold to the public. They are repaired by the original manufacturer and resold with a warranty.

Wat is refurbishment?
(Refurbishment is de distributie van producten die eerder om verschillende redenen aan een fabrikant of verkoper zijn geretourneerd. Opgeknapte producten worden getest op functionaliteit en defecten voordat ze aan het publiek worden verkocht. Ze worden gerepareerd door de oorspronkelijke fabrikant en weer verkocht met garantie.)
*Vereist

1. What is your age? (Hoe oud bent u?) *

_____

2. Number of people in your household. (Het aantal mensen in uw huishouden) *

_____

3. Did you ever purchase a refurbished product? (Heeft u ooit een refurbished product aangeschaft?) *

Markeer slechts één ovaal.

- ◯ Yes *Ga naar vraag 4*
- ◯ No *Ga naar vraag 8*

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4. What kind of refurbished product(s) did you buy? (Wat voor een refurbished product heb je aangeschaft?) *

5. Why did you buy the product in a refurbished state? (Waarom heb je het product als refurbished gekocht?) *

6. Are you satisfied with the state of the product you received? (Ben je tevreden met de staat van het product) *

7. Would you recommend refurbished products to others? (Zou je refurbished producten aanraden aan anderen?) *

Ga naar vraag 11

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8. Why did you never buy a refurbished product? (Waarom heb je nooit een refurbished product gekocht?) *

9. Would you consider buying a refurbished product? (Zou je overwegen een refurbished product te kopen?)

Markeer slechts één ovaal.

- Yes *Ga naar vraag 11*
- No
- Maybe

10. Please rank the reasons to NOT buy a refurbished product from most important (1) to least important (6) (Rangschik de redenen GEEN refurbished product te kopen van belangrijkste (1) naar minst belangrijke (6))

Markeer slechts één ovaal per rij.

	1	2	3	4	5	6
Perfomance (Werking)						
Appearance (Uiterlijk)						
Hygiene						
Availability (Beschikbaarheid)						
Obsolescence (Veroudering)						
Only online (Alleen online)						

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11. How important do you find these different factors when buying a refurbished product (Hoe belangrijk vindt u deze verschillende factoren bij het kopen van een refurbished product) *

Markeer slechts één ovaal per rij.

	not important	less important	no opinion	slightly important	very important
price difference (prijsverschil)					
no visible user marks (geen zichtbare gebruikssporen)					
age of the product (leeftijd van het product)					
brand (merk)					
environmental benefit (milieu voordelen)					
low number of previous owners (weinig voorgaande gebruikers)					
warranty (garantie)					
Possibility to see the product in real life (mogelijkheid om het product in het echt te zien)					

12. What kind of products are you most likely to buy refurbished? (Welke producten zou je het meest waarschijnlijk refurbished aanschaffen?)

Markeer slechts één ovaal per rij.

	1 Extremely unlikely	2	3	4 Neutral	5	6	7 Extremely likely
Fridge (Koelkast)							
Washing machine (Wasmachine)							
Toaster (Broodrooster)							
Kettle (waterkoker)							
Blender							
Kitchen Robot (Keukenmachine)							
Hand blender (Staafmixer)							
Espresso Machine							
Oven							
Iron (strijkijzer)							
Dryer (droger)							
Vacuum Cleaner (stofzuiger)							

13. What products were you most likely to buy refurbished? Explain why. (Welke producten zou u het meest waarschijnlijk refurbished kopen? Leg uit waarom.) *

14. What product were you least likely to buy refurbished? Explain why. (Welke producten zou u het minst waarschijnlijk refurbished kopen? Leg uit waarom.) *

Thank you!

What product would you rather buy

B.Interview

The overview of the appliances reviewed in the interviews for preferred aesthetics. The interview were conducted with 6 participant age variated from 23 to 72.

C. Survey 2

The overview of a quick survey that was done in order to verify insights and to validate initial solutions. The survey was filled in by 96 participants of which 54 % was female.

Refurbishment

Ik doe een onderzoek naar de gebruikservaring met betrekking tot refurbished producten en ik ben benieuwd naar uw mening. Wilt u deze korte enquête invullen? Het gaat specifiek over het huishoudelijke apparaat de volautomatische koffiemachine zoals in de afbeelding hieronder.

Refurbishment is het weer op de markt brengen van gebruikte producten, die om verschillende redenen door de gebruiker zijn geretourneerd. Opgeknapte producten worden getest op functionaliteit en defecten voordat ze aan het publiek worden verkocht. Ze worden gerepareerd en opgefrisd door de fabrikant en voor een lagere prijs weer verkocht met garantie.

1. Stelt u zichzelf voor dat u een refurbished volautomatische koffiemachine gaat aanschaffen. Waarop zou u de kwaliteit van het product baseren?

Vink alle toepasselijke opties aan.

- [ ] Ik haal het product uit elkaar om de binnenkant te bekijken
- [ ] Het aantal gebruikssporen (zoals krassen of deuken)
- [ ] Het aantal gebruikssporen (zoals vlekjes en koffieresten)
- [ ] De vormgeving (verouderd of modern)
- [ ] De leeftijd van het product
- [ ] Het merk
- [ ] De oorspronkelijke prijs

Anders: [ ] _____

2. Wat vindt u het meest belangrijk als u een refurbished product gaat aanschaffen?

Vink alle toepasselijke opties aan.

- [ ] Dat het product er nog goed uitziet
- [ ] Dat het product zelf te repareren is
- [ ] Dat het product helemaal schoon is
- [ ] Dat het product van precies dezelfde kwaliteit is als een nieuw product

Anders: [ ] _____

Bedankt!

Nog een paar korte vragen om een beter beeld te krijgen over de resultaten

3. Heeft u in het verleden een refurbished product aangeschaft?

Markeer slechts één ovaal.

- ◯ Ja
- ◯ Nee

4. Zou u overwegen een refurbished product aan te schaffen?

Markeer slechts één ovaal.

- ◯ Ja
- ◯ Nee
- ◯ Misschien
- ◯ Anders: _____

5. Wat is uw leeftijd?

_____

6. Wat is uw geslacht?

Markeer slechts één ovaal.

- ◯ Vrouw
- ◯ Man
- ◯ Anders
- ◯ Anders: _____

Bedankt!

D. Persona

This appendix shows the motivations, insights and statistics from the consumer motivation surveys were used in order to the identify the 3 different personas.

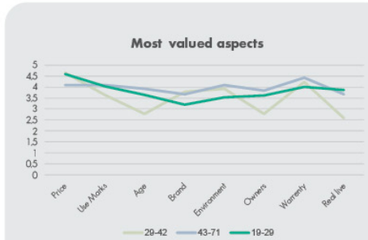
Why not?

"For some reason I think the quality is not equal to that of a 'new' product"

"I am not well aware of the options"

"Price difference was not worth the risk of defects"

"Refurbished products are not in my system yet"



I bought refurbished because they said it was as good as new but cheaper"

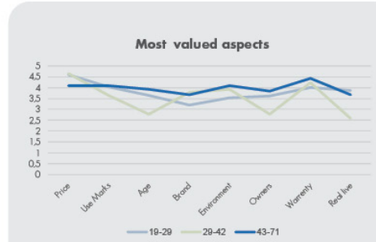
100% bought a refurbished product for the price difference

Why not?

"Never thought of it. Not obviously offered to create need."

"I would only go for products where the hygiene of the previous owner is not relevant"

"Actually it did not happen and I never thought of it."



"To save money and still have some warranty"

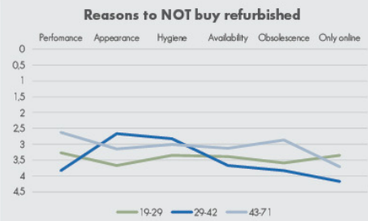
"Lower price, paired with warranty and a really still good product"

"cheaper than new + sustainable"

50%
for sustainability

"I am not well aware of the options"

"Refurbished products are not in my system yet"



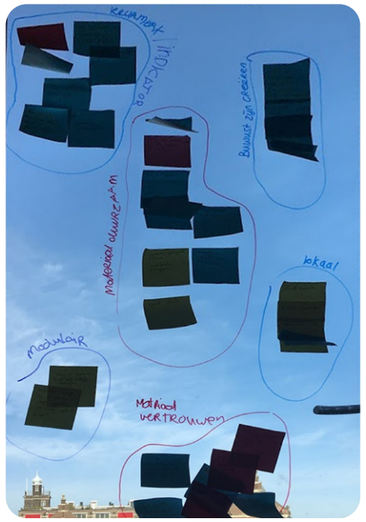
"I would not buy products that might have traces of previous unhygienic elements "

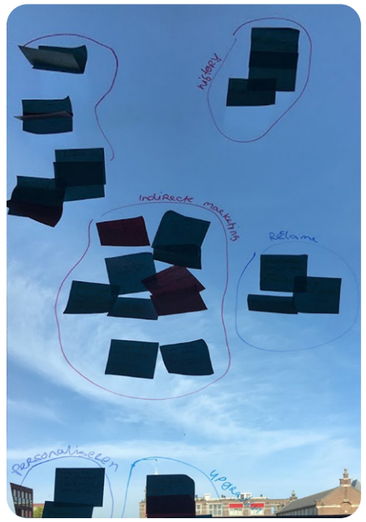
Appearance is a highly valuable factor.

E. Creative session

This appendix shows the schedule that was used during the creative session and clusters that were identified . The creative session was hold with 4 participants 2 male and 2 female.
.

Time	Task	Details	Result
2 min	Energizer	Play the object game.	Get all the participants into a creative mood
10 min	Define how tos	5 minute brainstorm on how tos, within the defined emotional directions 5 minutes selecting how tos	8 how tos of the 3 different emotions
5 min	Shredding the known	Write down ideas that already have popped up	Ideas
20 min	Brainstorm the how-tos	2 rounds of passing around the sheets of How-tos 2 minuter per sheet	Ideas
10	Clustering	Place post-its on the wall, explain you ideas an past it next to similar ideas. Create clusters around these ideas.	Clusters
15 min	Break		
20 min	Combining ideas	Participant take post its and combine them into an idea	filtered ideas
10	Presenting	Participants present the idea that they came up with	



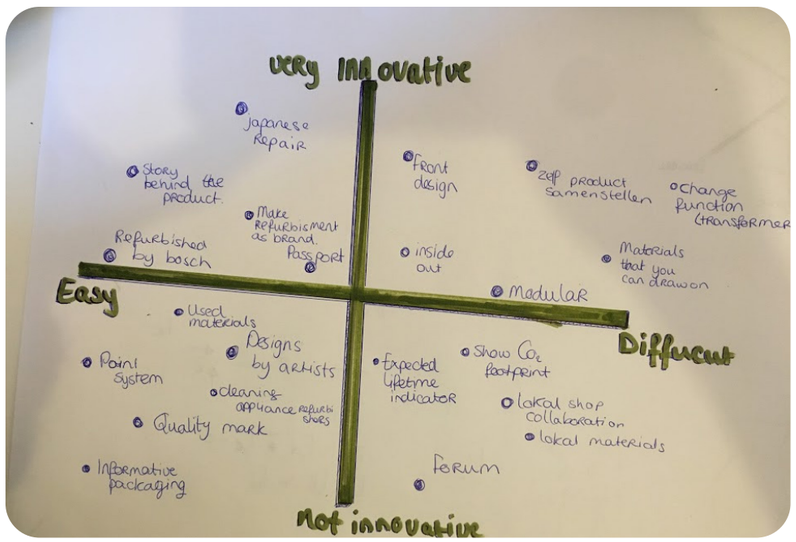


Clusters

- Indicator / quality mark
- Create awareness
- Sustainable materials
- Trustworthy materials
- Modular
- Locally produced
- Indirect marketing
- Show history
- Advertisement
- Personalization
- Upgradeable

E. Promising Ideas

The results from the brainstorm and the creative session have been clustered an evaluated. The 5 most promising ideas have been worked out and are presented in this appendix. The ideas have been evaluated with the needs of the personas.



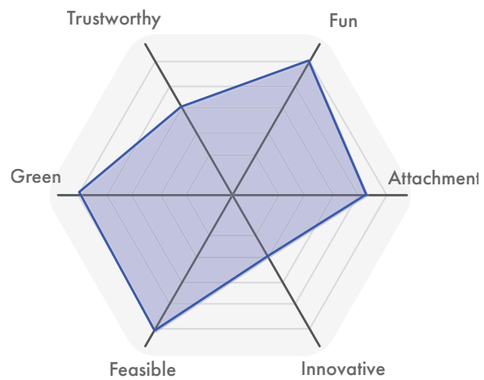
THE PRODUCT PASSPORT

The idea

To create awareness and raise trust by the customer, the product passport was created. This passport shows the history of the product in a playful way. The first page shows the personal details of the product. When the product has had an owner before, they can leave a message about their experience with the product. In the history page all the work on the machine will be shown and an explanation of refurbishment. On top of that stamps can be collected for sustainability goals and maintenance goals etc.
This product also can create awareness by the customers that buy it as a new product, because it lets them know about the possibility of a second lifetime.

Concerns

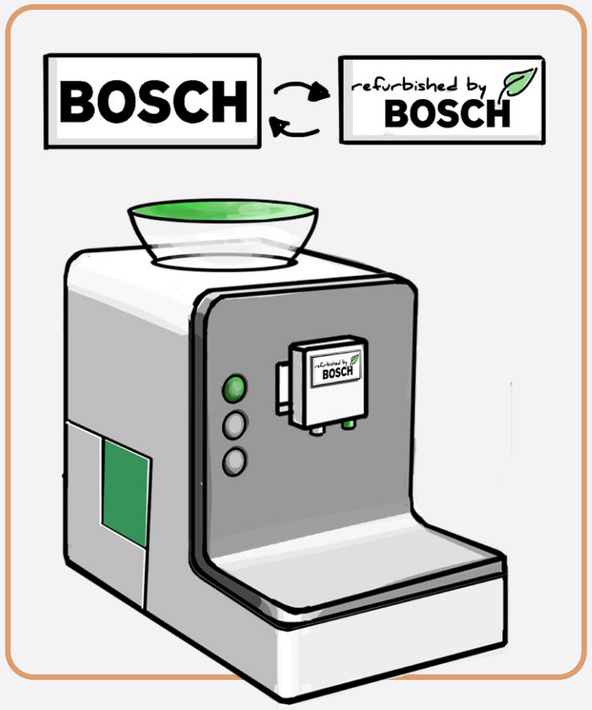
When a product has had many customers before, the user is less likely to trust the product. Therefor the product passport can work in a negative way.



Evaluation

The product passport would be a fun feature to the product range of Bosch, and it make customers aware of the sustainable advantage of refurbishment. It will raise trust when people know the history of a product. However it can also backfire when the product has had many previous owners.

BEAUTY BY REPAIR

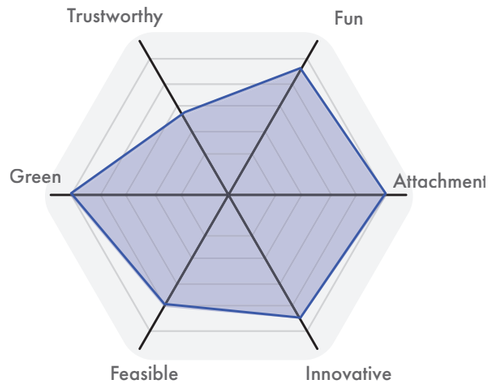


The idea

The idea 'beauty by repair' has its inspiration by the Japanese repairing technique Kintsugi. In stead of making the product look as good as new, the flaws will be highlighted and the history of the product will be embraced. When translating this to the product, it means that the parts that needed to be replaced would be replaced with parts that are visually different to show the history of the product. This will make every refurbished product unique. On top of that you would have to store less parts since these can be used on more machines

Concerns

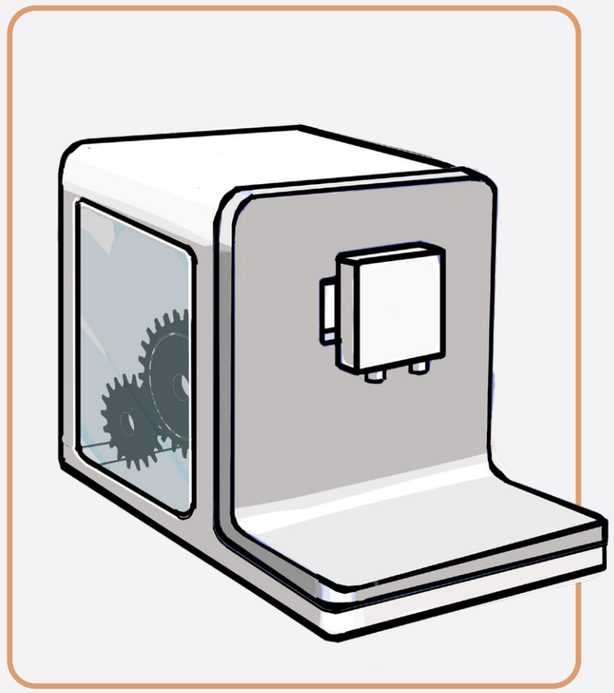
When a product has a lot of visible repairs, customers could get insecure about the quality of the product.



Evaluation

The product does not score high on trust, however this product creates a high environmental awareness and it makes the product unique. This uniques can create a good product attachment.

INSIDE OUT

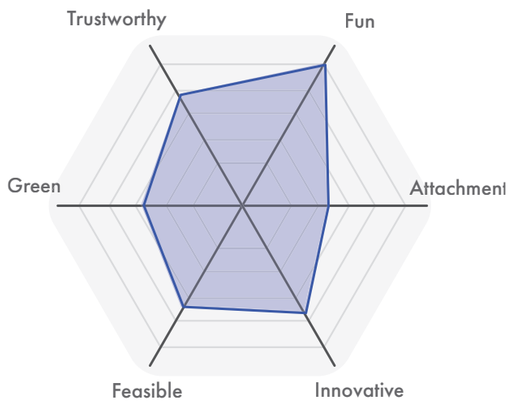


The idea

An insight on refurbishment was that the customers do not really trust the product because they do not know what happens behind the cover. During the interviews, customers preferred coffeemakers where the process is visible, since they can control the product functionality. To show the inside of the product, the customer can have the feeling of security that noting on the inside is broken.

Concerns

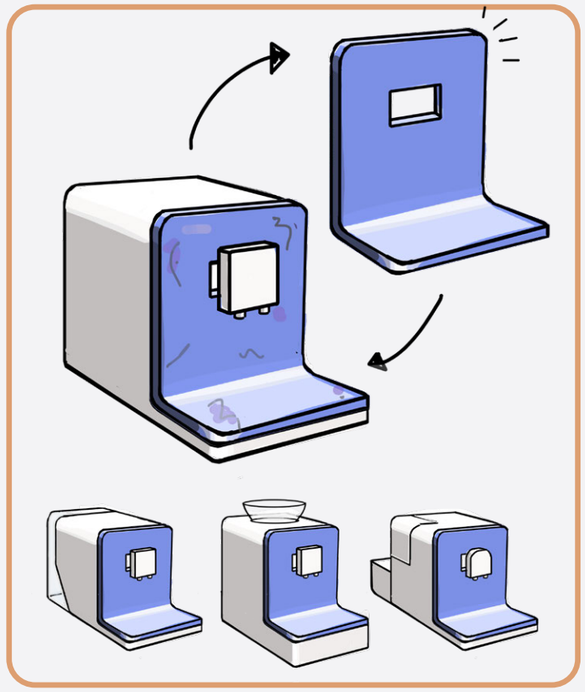
For product like for example the coffee maker, the inside looks very complex. This can cause a reverse reaction. Also the screen can get dirty with the rests of the coffee, and the product will become obsolete quickly.
Another group that was interviewed preferred products that look simple. This concept can make the product look complex.



Evaluation

This concept does not touch the aspect of sustainability, but it has an fun touch to it. The trust of the product can work in two ways. Customers could trust the product better because they see the inside of it, however it also shows the complexity of the product.

LOOKING GOOD, FEELING GOOD



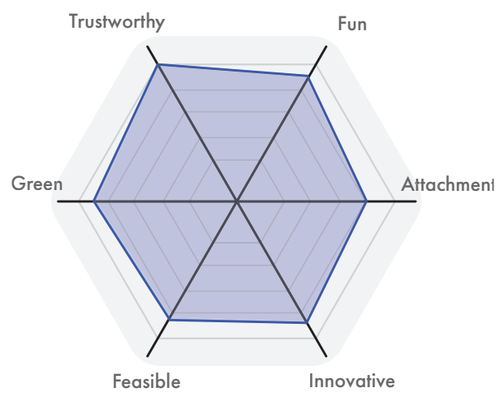
The idea

It was found, that when the product still looks like new, the customer is more likely to trust the product. This idea is created on this insight.
The principle is that part of the cover can be replaced or refinished. The customers can compose their own refurbished product by starting out with a refurbished base and then choose their own new or refurbished cover.

this idea was inspired by the pots of IKEA. All the lids fit all the different sizes of pots. This would be the same for the coffee maker. All the covers would be compatible for all types of coffeemakers. So a new cover design in 2027 could fit a machine out of 2021 for example.

Concerns

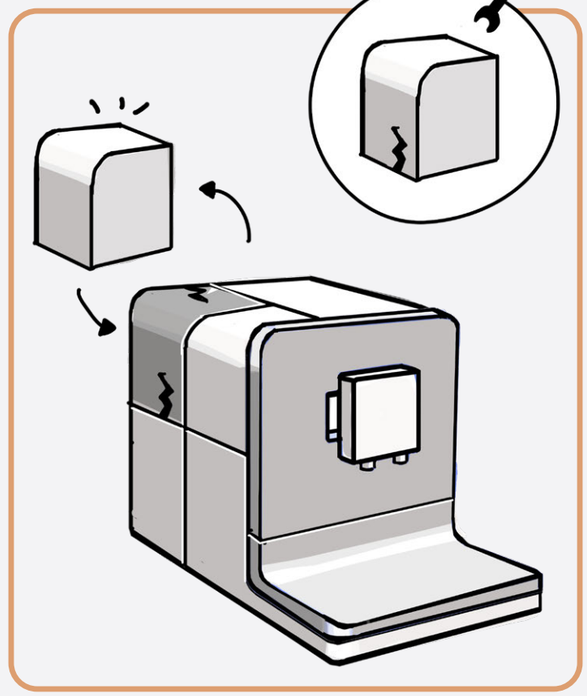
All the bases of coffee makers should be designed this way, so it would be a long term investment.



Evaluation

This concept creates trust by the owner because it can look like new again. The options to compose your own product would be a fun customer interaction to create attachment.

SWITCH IT UP

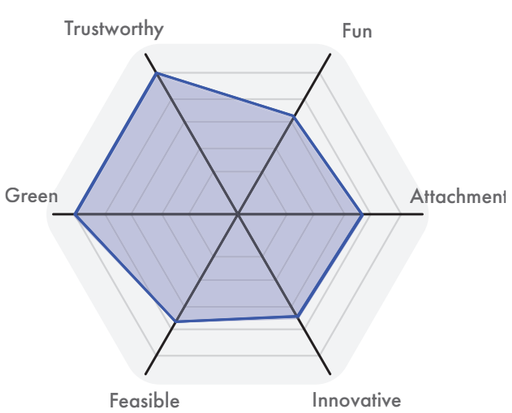


The idea

To increase the trust and the lifetime of the product the 'switch it up' was created. Different parts of the product will be stored in various modules. When one of the modules stops working it can be easily replaced or upgraded with a new of repaired module. The old module can later be repaired or send to a third party. This concept also gives the possibility to be upgraded when new innovations within a module are created.

Concerns

This concept does not allow much variation in the product designs. These block should stay the same for a long lime. It also a challenge to store every component inside a module.



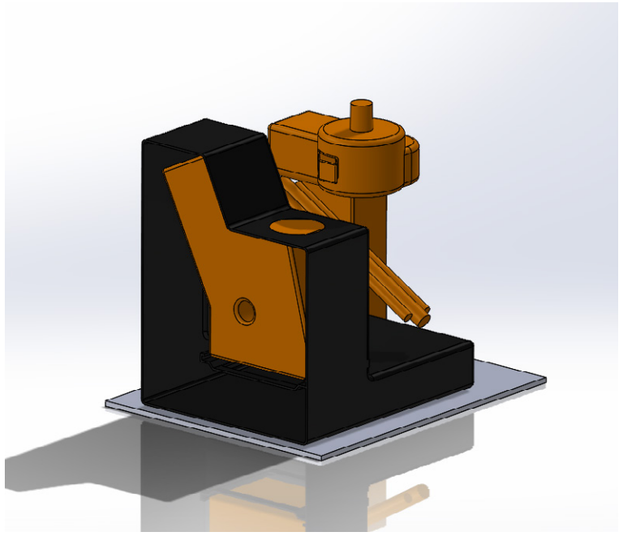
Evaluation

This idea increases the product lifetime because it can easily be repaired. Therefor it will be more sustainable. However it is hard to realize and this will have a big influence on the aesthetics of the product.

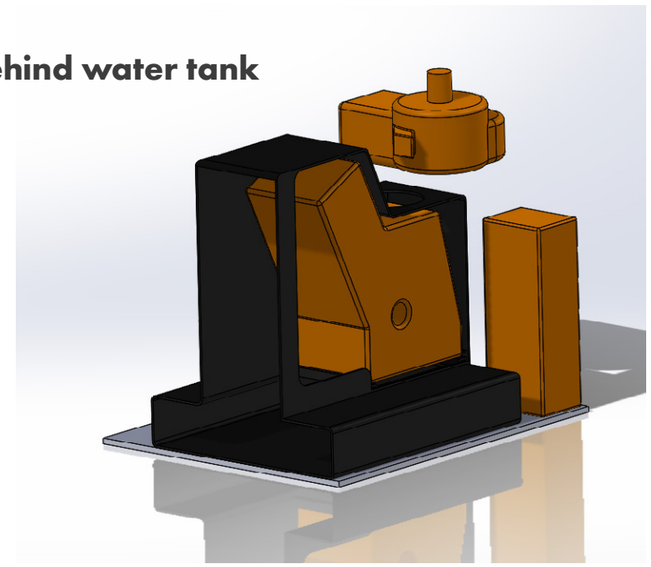
G. Architecture

3 iterations were done in order to find out what the ideal positions of the brewing unit is in order to make all the other components best accessible. This appendix shows the iterration.

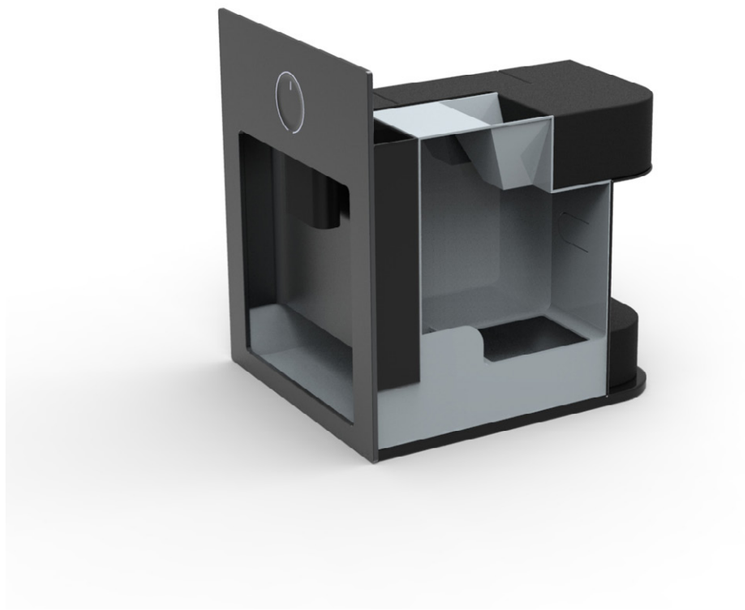
Front access



Side access behind water tank



Side access



H. Aesthetic collage

Based on the studies of preferred aesthetics for refubishement and the analysis of the brand aesthetics of Bosch, the memetic collage was made.
This collage will be used to explore the new design of the coffee machine.

I. Survey 3

On this page you see fully automatic coffee machines in different variations of colors and materials. Please rate only the aesthetics, (colors, forms and materials) of all the coffee machines. You can rate it by ranking the aspects (timelessness, reliability, durability, eco-friendliness and quality) on a scale of 1-7. Please check one box per aspect.

Do you have a preference for a color and material combination? Which one? And why?

Matt Black Iron

Trendy — Time Less
Fragile — Reliable
Disposable — Durable
Poluting — Eco-Friendly
Cheap — High Quality

Red painted metal

Trendy — Time Less
Fragile — Reliable
Disposable — Durable
Poluting — Eco-Friendly
Cheap — High Quality

Polished Aluminium

Trendy — Time Less
Fragile — Reliable
Disposable — Durable
Poluting — Eco-Friendly
Cheap — High Quality

On this page you see fully automatic coffee machines in different variations of colors and materials. Please rate only the aesthetics, (colors, forms and materials) of all the coffee machines. You can rate it by ranking the aspects (timelessness, reliability, durability, eco-friendliness and quality) on a scale of 1-7. Please check one box per aspect.

Do you have a preference for a color and material combination? Which one? And why?

Brushed Aluminium

White plastic

Dark Aluminium,
Cork top

Trendy — Time Less

Fragile — Reliable

Disposable — Durable

Poluting — Eco-Friendly

Cheap — High Quality

External interface on
your mobile device

Retractable drip tray,
to save counter space

On this page you see fully automatic coffee machines in different variations of colors and materials. Please rate only the aesthetics, (colors, forms and materials) of all the coffee machines. You can rate it by ranking the aspects (timelessness, reliability, durability, eco-friendliness and quality) on a scale of 1-7. Please check one box per aspect.

Do you have a preference for a color and material combination? Which one? And why?

Rough aluminium

Bamboo front

Black Glass

Trendy — Time Less

Fragile — Reliable

Disposable — Durable

Poluting — Eco-Friendly

Cheap — High Quality

Please do the same, but now only comparing the forms of the various models that you were presented in the previous pages. You can rate it by ranking the aspects (timelessness, reliability, durability, eco-friendliness and quality) on a scale of 1-7. Please check one box per aspect.

Do you have a preference for a model? Which one? And why?

Trendy	Time Less	Trendy	Time Less	Trendy	Time Less
Fragile	Reliable	Fragile	Reliable	Fragile	Reliable
Disposable	Durable	Disposable	Durable	Disposable	Durable
Poluting	Eco-Friendly	Poluting	Eco-Friendly	Poluting	Eco-Friendly
Cheap	High Quality	Cheap	High Quality	Cheap	High Quality

J. Project Brief