CHALMERS
UNIVERSITY OF TECHNOLOGY

Product Development of small Kitchen Appliances

Implementing the Scandinavian design language into a unit product series

Bachelor Thesis in Design and Product Development

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Bachelor's thesis 2019

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Cover: Visualization of final concept series

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Abstract

The culinary interest in Scandinavia has been increasing during the last couple of years. People spend large amounts of money in high-quality kitchens, and at the same time there are possibilities to various different design choices. It follows that there is an arising customer need for kitchen appliances that complement and raise the kitchen architecture as a whole. Thereby, the purpose of this thesis is to investigate how a unit series of small kitchen appliances could be designed to interact with the architecture of the Scandinavian kitchen. Also, one main focus is to find a mutual design language that could be implemented in all products within the series. The thesis will be presented with a concept proposal of two products, with three main functions, that are visualized one by one as well as together as a series. However, a limitation has been to not present specific mechanical details.

To collect information regarding the users perspective, the project started with a general survey where the most used appliances where determined. The result from the survey could tell that coffee machine, water boiler and immersion blender were among the most used. Also, the coffee machine and water boiler happens to be the kitchen appliances that extensively were left visible at the worktop, why a good design becomes even more important. Another interesting aspect was that only a few persons left their immersion blender visible, with the argument that it was too ugly designed. Furthermore, interviews with potential users and a kitchen architect from the Scandinavian company Ballingslöv were carried out. The interviews indicated that material choices were an important aspect to enable the series to complement and interact with the kitchen architecture. In order for the products to stay durable, long-lived trends were identified in dialogue with the kitchen architect. Later on, the information was summarized into a function analysis as well as a requirement specification, which then were used as a basis for further product development.

The final concept series, BOHUS, is a series of two products with three main functions. BOHUS consists of a coffee brewer with integrated water boiler and a wireless immersion blender with charging storage box. The product materials, dark stainless steel and white pigmented oak, are chosen carefully to complement the modern Scandinavian kitchen. The series is designed to promote the user to leave the products visible, even when the products are not in use.

Keywords: Scandinavian Design, Kitchen Appliances, Product Development, Product Identification

Preface

This Bachelor Thesis is the result of a six month effort in order to develop a uniform series of small kitchen appliances coherent with the Scandinavian Design traditions. The work is carried out by us, two Design and Product Development (180 credits) students from Chalmers University of Technology. The Thesis is a collaboration between Chalmers and the technology consultant company ESSIQ AB.

Furthermore, we would like to thank our supervisor Olof Wranne, Head of the program for Design and Product Development. Thank you for leading us back on track the times we doubted and our visions got to big.

We would also like to give a special thank to our supervisor Erik Westerlund, Consultant Manager at ESSIQ, who made us feel very welcomed at ESSIQ from day one. Furthermore, there are three persons from ESSIQ who has done our six months a little bit funnier - Kasper Thörneby, Sara Thyrén and Nils Kjellman, thank you for keeping us company at the desks beside. We would also like to thank everyone at ESSIQ HQ for nice lunch discussions, good training sessions and of course participating in our surveys and observations during the Thesis work.

Another thank will go to the company on the other side of the parking lot. We would like to thank Elon Friggahuset Frölunda for always welcoming us with a smile when we needed technical specifications about products.

Lastly, there is another person we would like to send a thank - Annika Vilhelmsson, Kitchen Architect at Ballingslöv AB. Annika gave us great insight within kitchen design. In a very professional way she gladly shared her thoughts of kitchen trends, colour and material settings as well as the architecture of Scandinavian kitchens. Her words have been very useful for us!

Sandra Sköld and Frida Thorsson, Gothenburg, June 2019

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List of Abbreviations

Alias Alias Autodesk Studio
CAD Computer Aided Design
CSR Corporate Social Responsibility
LED Light-emitting diode, a light source that gives light when current is added.
RPM Revolutions Per Minute

1
Introduction

The following chapter describes the topic of the thesis, as well as its structure, boundaries and assumed results.

1.1 Background

The thesis origins in an identified customer need for a uniform series of small kitchen appliances. In cooperation with the consultant company ESSIQ, a series of three electric powered appliances will be developed. All of those will have a mutual design language or feature, which identifies the series. There is a small number of actors who have developed uniform kitchen series before, for instance, OBH Nordica and SMEG. Those have a distinctive design, which can be hard to unify with the remaining home interior. It is not unusual that kitchen appliances are bought for a large amount of money and ends up in hidden storages, instead of being a part of the home interior. This project aims for making it easy for customers to identify and buy matching kitchen appliances. The products in the focus of this project will be appliances that people use on a daily basis.

1.2 Aim

The aim of the thesis is to investigate what is required to develop a new, uniform collection of small kitchen appliances. Furthermore, the thesis will investigate a unified design language for all of the appliances. The products should also be designed to complement the remaining kitchen interior. In order to achieve the aim, a user study will be performed as well as an analysis of the main competitors and trends within the branch.

1.3 Objective

The objective of the thesis is to create a small series of products, with three different main functions that will suit the interior of the Scandinavian home. The project will result in a visualized concept series in the form of 3D models. Furthermore, a proposal for materials and colours will be presented.

1.4 Delimitation

The main customer segment is Scandinavian design and culinary enthusiasts in the age between 30 and 40, who are willing to pay for the products. The project is delimited to the creating of two products. However, those products are not limited to two main functions. Any mechanical details or specifications regarding electrical certifications will not be included as well as specific manufacturing costs.

1.5 Research Questions

In order to reach the aim, a few questions will be investigated.

- How can a product series be designed to express unity?
- How should the products be designed to match the modern Scandinavian kitchen?
- Can the product be multifunctional and integrated with each other?
- Which small appliances do people use on a daily basis and leave visible even when they are not using them?

2
Frame of Reference

In this chapter, knowledge about the relevant products and the overall kitchen environment is presented. Scandinavian design traditions will be mentioned as well as a short section about product identity. Furthermore, a section about ergonomic aspects follows. Lastly, appropriate materials and manufacturing methods will be presented together with a section about certification marks and durability aspects.

2.1 The Scandinavian Kitchen

The interest for food and cooking has steadily increased among Swedes during the last decade and Scandinavian people are generally very proud of their kitchens. Food and Friends describes a movement from ”fairly interested” in cooking to ”highly interested” and what distinguish in the study is the high interested among young individuals in the age group 15-24 years. Almost half of the respondents in the age 15-24 years describe themselves as ”highly interested” in culinary according to the study. The older respondents do also show a high interest in cooking, although not as high as the younger generation (Food and Friends, 2018).

Another study made by Houzz illuminates how the average Swede would prefer to have their kitchen designed. It turned out that modern and Scandinavian is the main styles, while white and grey are the top colours chosen. Moreover, the study states that two-thirds of the Swedish housing owners spend on average 100 000 SEK when investing in a new kitchen and the main motive is other than style and sense also easiness to clean and perdurability (Houzz, 2017).

2.2 Scandinavian Design Traditions

Scandinavian design is described as a minimal and simplistic design philosophy. But what also characterizes the typical Scandinavian design is functionality, which often ends up in a fine balance between aesthetics and functionality (Nikel, 2018). When it comes to colour, variations of black, white and grey are often seen as staples. Light pastel tones like icy blue and dusty pink could also be seen, but the underlying principles are often light, airy and neutral (Nikel, 2018).

The Scandinavian design has an apparent focus on clean lines with elements of natural material like wood and concrete. Even if the typical Scandinavian design is connected with lightness and clean lines, there is no need for it to feel cold and leave a sense of loneliness. Instead, the colours tend to have a warm tone and the Scandinavian design are often symbolized with the concept of the Danish word "Hygge", which could be trans-

lated into "a quality of coziness that makes a person feel content and comfortable". It is also often used as an adjective meaning cozy or comfortable (Merriam Webster, n.d.). Another popular Swedish word which is often used when talking about Scandinavian style is "Lagom". The word could roughly be translated to "everything in moderation" (Gråbæk, 2015).

For those who have grown up in Scandinavia, understated luxury and focus on sustainability is yesterday's news. Long lasting design is rooted in the culture and it is conventional to be surrounded by a comfortable, artistic, and high-quality interior, both in public spaces and at home. To sum up, Scandinavia has a very strong and honest design tradition (Gråbæk, 2015).

2.3 Product Identity

Product identity is about recognizing the products and understand its main purpose. The identifications are mainly for functions and usage. The design of the product is about understanding what kind of product it is (Surowiecki, 2007).

During interaction with the product, the user should easily identify the functions and recognize the main function. By a quick look, the user should understand what kind of product the design indicates and also understand how the functions operate. Understanding how the user will identify the functions are important since usability and customer behavior is crucial for the usage and procurement of the products as well as customer satisfaction (Surowiecki, 2007). If the functions are hard to understand, the surrounding details will become more important. Details give clues for the user to of how to interact with the product. This could be done by giving the product a special surface shape or dimensions or making details in different colours. These details, shapes and colours could also help the user identifying a cohesive series of products (Monö & Knight, 1997).

2.4 Product Functions

In order to design good products, knowledge about the different functions of existing products must be clarified. The following products operation functions are described: coffee machine, water boiler, and an immersion blender.

2.4.1 Coffee Machine

The primary functions of a coffee machine are to produce coffee. In order to produce coffee, water needs to be heated. A traditional coffee machine has one heating element placed below the coffee pot, which will heathen both the water and also the brewed coffee in the jug. There are also coffee machines with multiple heating elements. The second heating element is, in that case, placed closer to the water, which means that the water from the reservoir does not have to be transported through the coffee pots heating element. But if the product contains two heating elements the price and the size will increase.

Inside the water pipe, there is a one-way valve, which only lets water be transported one way. The valve closes if the water starts moving the other way. After the water has been heated to approximately 90 to 96 degrees, it is transported to the filter container where the coffee grounds are placed. The water goes through the grounds and ends up like coffee in the pot (Hammack, 2010).

Another solution that could be seen more often today is the manual pour-over method for making coffee, see figure 2.1. It involves pouring hot water over a filter filled with grounded coffee beans. Thereafter, the coffee jug fills up directly and are ready to serve. The user is recommended to pouring the hot water in two operations. Firstly, a small amount of hot water pours into the filter in order to drain the grounds, which takes about 30 seconds. During the second step, the user ads more hot water by pouring it slowly in a circular motion for approximately 50 seconds, which makes the coffee staying submerged (Wilfa, 2012). However, the process takes about five minutes in total, which are approximately the same time as brewing coffee with an ordinary coffee machine. The method is a very easy way to brew high-quality coffee. The perfect water temperature for pour-over coffee should be around 93 degrees (Coffee Brewing Methods, n.d.). Furthermore, the manual brewing process allows cold brewing, which certainly is highly valued among coffee enthusiasts (Taylor, 2018).

Figure 2.1: The method for pour-over drip coffee. Pixel (2016) Published by permission.

2.4.2 Water Boiler

The primary function of a water boiler is to produce warm water. Inside a water boiler, there is also a heating element, a metal coil. When the machine is turned on electricity starts to flow through the coil and its electrical resistance can then turn the electrical energy into heat as it flows through. When water is surrounding the coil and heat is generated, the water temperature will start to increase until it is at its boiling point.

Most water boilers switch off due to a thermostat when the water has reached its boiling point, (Origin Energy, 2018). This means that the water boiler operates the same way as the coffee machine only using another kind of heating element.

2.4.3 Immersion Blender

The primary function of an immersion blender is to blend ingredients, for making soups, sauce, pastes and other liquids. The immersion blender differs from other kitchen blending appliances since the blender is mainly used by being inserted into a container of liquid and not by pouring down liquid into the blender. The user also has more control of the movement and can also use the immersion blender in hot pots, which can be useful when making larger amounts of for example soup and sauce. An immersion blender often consists of multiple parts. For example, an upper body which produces the working force and also a lower body, that often can be exchanged. This enables more functions, such as chopping ingredients, whipping creams or blending soups. The upper body part contains the motor which provides a high RPM, depending on the density of the ingredients, that enables the blender to function (Mathur, n.d.). The motor has to fit inside the external body, therefore the radius of the handle has a critical measurement. The diameter can vary from 60 to 71 millimeters, but the average diameter is 65 millimeters (Media Markt, 2019).

2.5 Ergonomics

Ergonomic is often associated with comfy office chairs, computer mice or working tools. Roughly, the word could be translated to "the science of work" and focuses on human activity. Therefore, it could even be used in the term of human factors (Ericson, M Hägg, & Odenrick, 2010). The term signifies physical environment as well as psychological factors.

One of the most critical parts of the human body for being able to work is the hands and wrists. The hands are exposed for injuring due to the easiness to overloading. The hands make humans able to work both with precision and gross motor skill. It is therefore of high importance to design tools that support the natural hand positions. There are several possible motions of the hand, including flexing, extension, deviation and twisting motions, see figure 2.2. All of these positions may injure the hand if it is too extreme (Ericson et al., 2010),

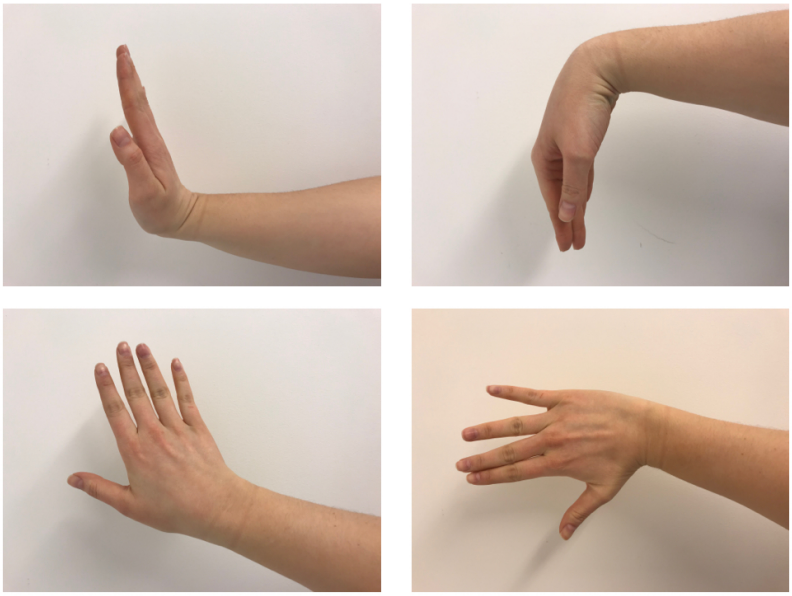

Figure 2.2: Hands in extension, flexion and different deviation positions. Author's own copyright.

When taking a transversal full-grip, see figure 2.3, the contact area of the fingers and the palm of the hand should be more than the cylinder's half range. Furthermore, the fingers should not enfold the cylinder (Tuvesson, 2017). The anthropometrical measurement for the hands' length, see figure 2.4, is 193 mm for men and 179 mm for women (Ericson et al., 2010), which is measurements that can be used in order to design good hand tools. Considering these measurements as the range, it gives a diameter of 59 mm.

When designing hand tools or handles the position of the hand should, if optimally, be as close to its resting position as possible. When the hand is positioned naturally, it ensures good conditions for both strength and precision. Another aspect that should be taken in mind is whether the working hand are going to be bare or not, for instance wooden handles are excellent for bare hands but not as good when wearing gloves (Berlin & Adams, 2017).

Figure 2.3: Hand in transversal full-grip position. Author's own copyright.

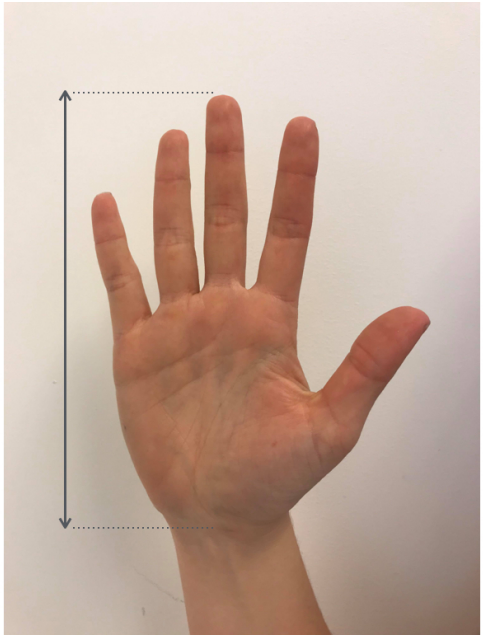

Figure 2.4: The length of the hand illustrated. Author's own copyright.

2.6 Materials

In this section, materials that have been considered for the concept series are presented in more detail.

2.6.1 Stainless Steel

Stainless steel is an alloy, mainly of iron but also chromium, nickel and often approximately five other elements. Stainless steel is often divided into five sub-groups: austenitic, duplex, ferritic, martensitic, and precipitation hardened with various properties. What

is in common for all types is that they are resistant to corrosion and that they remain ductile to even very low temperature. With the good properties of the stainless steel, it follows that it is a material often used in a wide range of products, for instance, kitchen appliances but also within the automotive industry and for making strong working tools. However, a limitation of stainless steel is that it has a relatively high-cost (Granta Design, 2019b).

2.6.2 ABS Plastics

One of the most common materials when producing kitchen appliances is Acrylonitrile-butadiene-styrene, often called ABS. The ABS plastic is characterized by high resistance to chemicals, heat and other impacts. It is a thermoplastic, which means it is easy to shape and mold (Plastics International, 2018). ABS plastics are compounded by acrylonitrile, 1,3-butadiene and styrene, which all are suspected to be both cancer causing and harmful for water organisms. Despite those properties, ABS plastics are classified as harmless since the monomers are tightly bounded (Naturskyddsföreningen, 2019). According to Naturskyddföreningen, many plastics including ABS, are hard to recycle with a valuable outcome. Some of the recycling problems mentioned is, for instance, the toxic chemicals but also that plastics products often are hard to disassemble (Dahl, Gunnarsson, Hedfors, Klar, & Prevodnik, 2014).

2.6.3 Wood

A natural material that could be seen on a regular basis in the kitchen context is wood. Wood is a material that has been used for thousands of years and has very good structural and decorative properties. It is also a material that often is associated with Scandinavian design traditions. It comes in a various of forms, densities and appearances and could, therefore, be suitable for a wide range of products. Since it is a natural material, it follows that is renewable and could also be found to a relatively low price. Mostly wood material is easily machined, both carved and joined which makes it an excellent material for complex forms. However, a limitation in wood is that it could not guarantee a specific appearance or uniformity of properties since it is a natural material (Granta Design, 2019c).

2.7 Manufacturing

Appropriate manufacturing methods for kitchen appliances are presented in this chapter. All of the products, the coffee machine, the water boiler and the immersion blender are all structured by an external body. This body part is often made of plastic manufactured with injection molding. Some of the internal details are made from compression molding and also extrusion.

2.7.1 Injection Molding

Injection molding is a good method for creating meticulous plastic details in large amounts. The surface structure depends on the tools, costs and the wanted result, the customer could want a more fine surface which is more expensive or be settled with a medium or ruff one. Creating tools for injection molding is expensive. If the details are complex the price could get even higher. Which is one of the main reasons why injection molding is mostly used for large series sizes (Plastportalen, n.d.).

The materials used for injection molding are mostly thermoplastics. The plastics are molten inside a cylinder where the molten material stays warm until it is injected into the mold, see figure 2.5. Inside the mold, the temperature decreases and the material solidifies. The mold is often made by two separate parts, mold halves. Which can be opened in order to release the finished detail and also closed for manufacturing more details. When the mold halves are closed they can withstand the high pressure and temperature from the injector during the injection phase. This manufacturing method is often automatic and can produce many details during a short amount o time (Plastportalen, n.d.).

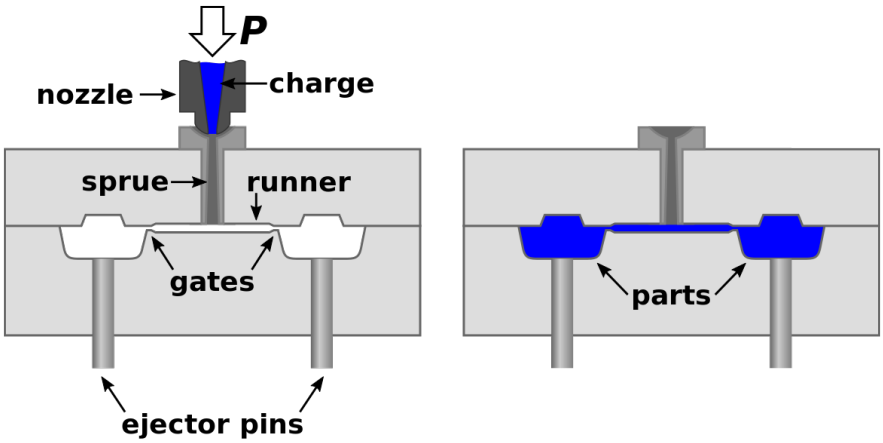

Figure 2.5: The process for compression molding. Wikimedia (n.d.-c) Published by permission of Ariel Cornejo.

2.7.2 Casting

The casting process is an old process. There are many different types of molds for casting. Sand is used in one of the oldest known molds. Today there are new technologies that allow metal casting, which is very essential for the industry (The Metalcasting, n.d.-a). Parts of the internal component for the product can be created with a casting method.

When using a metal casting method it is important to choose the right alloys, since the alloys give the material the needed characteristics. It is also important to think about the tool costs, the size of the product and tolerances. When casting metal there are multiple different methods to choose between. There are both hot and cold forming processes. For a visual description of how the process follows, see figure 2.6.

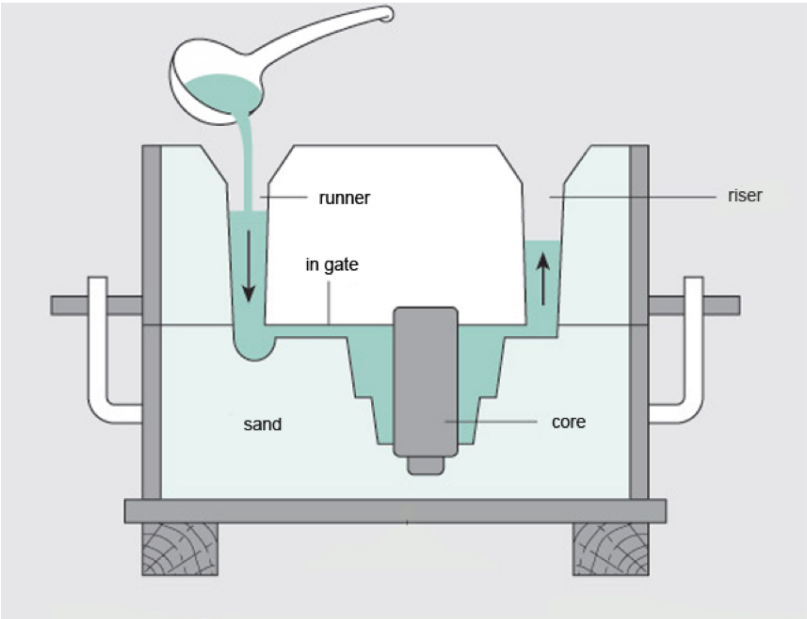

Figure 2.6: The process for casting. Wikimedia (n.d.-a) Published by permission.

Sand Casting
Sand casting is a hot forming process which is mostly used for the production of fever quantities, this is also one of the least expensive methods. One of the disadvantages is the result of the surface, the surface of the product sometimes needs to be treated after the casting process which increases the cost.

Die Casting
With die casting, good tolerances can be achieved and there is not any requirement of treatment to the details after the casting process. But one of the disadvantages is that the tool cost is very expensive and there need to be high quantities of the products in order for the process to pay off. There are also difficulties to calculate the minimum of the mechanical properties.

Permanent Mold Casting
Permanent mold casting is a less expensive method that investment cast and the dimensional tolerances are better compared to the sand casting method. The casting has a tight pressure and is dense, but no ferrous metals can be used with this method. Another disadvantage is that the tools cost more compared to sand casting and is not a proper method to use if the detail needs more than three cores during the casting.

2.7.3 Extrusion

Extrusion is a good method for creating long metal parts, for example, tubes that are both solids and hollow and also with a rectangular cross-section. Both a coffee machine and a water boiler contains these kinds of parts internally. The material used for the extrusion method is metal. The metal is squeezed in a die by the force from a hydraulic or a mechanical press tool, see figure 2.7. The method is also very cost effective since there is not any requirement of second treatment for the products, and the surfaces can also be done with good tolerances depending on the material chosen. The surface finish varies between 3µm (Steel) to -0,8µm (Aluminium and Magnesium) (The Metalcasting, n.d.-b).

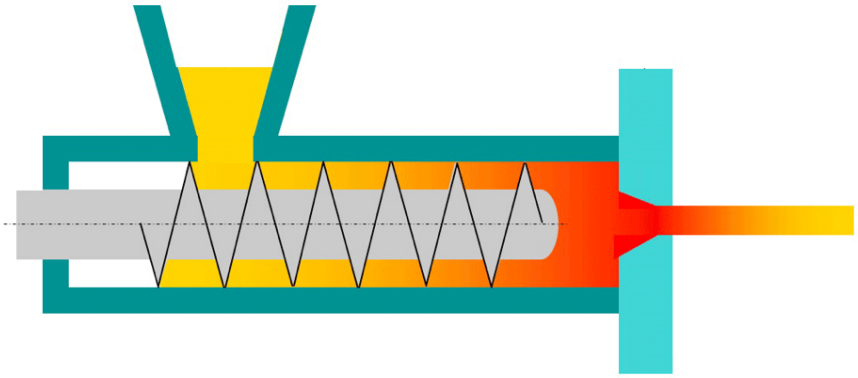

Figure 2.7: The process for extrusion. Wikimedia (n.d.-b) Published by permission.

Extrusion can be done with both hot extrusion and cold extrusion. During hot extrusion, the temperature of the metal can be up to 75% of its melting point. Together with high pressure, the metal is extruded. Lubricant is very important in order to reduce the created friction. Cold extrusion processes similar to hot extrusion but instead of the high-temperature metal the metal is in room temperature. The method is useful since the result of the metal withstands the stresses created from the extrusion (The Metalcasting, n.d.-b).

2.7.4 Deep Drawing

Another popular manufacturing method when producing components of steel is deep drawing. Deep drawing enables good forming properties and is also resistance to aging. It is a process that uses dies in order to form blank sheets of metals into shape around a punch. Deep drawing has its advantages in low cost, weight saving and a high level of flexibility when it comes to design and shapes (Satyendra, 2013).

2.8 Certification Marks

A certification mark is a trademark that is used in order to show certain standards. There are several kinds of marks regulated at the market. A certification mark supports fair competition by holding the companies to the same regulations.

One of the most used in Europe is the CE marking. The letters 'CE' signifies that products have been designed to meet good safety, health, and environmental protection requirements. The CE mark can be found at almost any product sold in EU, both electrical and non-electrical (European Commission, n.d.).

Another certification mark that could be of interest is the approved symbol from the European Coffee Brewing Centre. The symbol indicates that the machine brews high-quality coffee, why several tests are included before a coffee brewer get certified (Norsk kaffeinformasjon, 2018).

2.9 Design for Durability

In order to make the product design durable, the product needs to be both physically and aesthetically durable. Therefore the quality of the product needs to be good enough to withstand damage and wear for many years. One example is the Moccamaster, a coffee machine that is known for its quality has been produced in the same factory for over 45 years and is known for the strict and elaborate quality controls. Due to the quality, the brand extended its classic 5-year warranty to 10-years (Moccamaster, n.d.). If the product design should last for a long time it should age gracefully. Design for aging gracefully implies developing a product which is simple to maintain, possible to repair and easy to clean. The products need to have good fatigue strength since it will be used repeatedly, the product should not break just because it is being well used. Materials are also something that should be considered, the material will age as long as the product is in usage, so the material choice is very important. Scratches and damages will also be visible as the years pass (Faduli, 2015).

The products will also be durable if the owner keeps them and use them for a longer time. This means that the product needs to be both aesthetically and emotional durable, the user should not trash the product just because the relationship passed away. The product needs to have a timeless design which will imply a sustainable design (University of Brighton, 2012).

3
Methods

In this chapter, the methodology used during the project is described in chronological order. The design process created by the authors presented in figure 3.1 has been a useful tool for organizing the project. However, to keep in mind is that there have been several iterations between the steps in order to further develop the ideas.

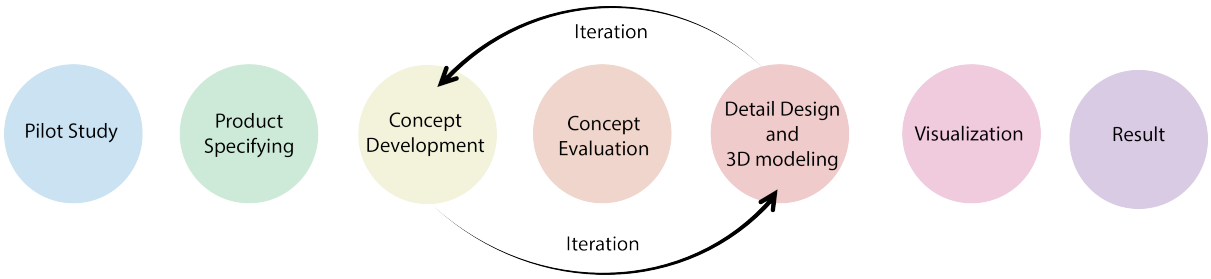

Figure 3.1: The Design process. Author's own copyright.

3.1 Methods for User Study

When identifying the user needs regarding small kitchen appliances, several methods have been used. The methodology for the pilot study is described in this section.

3.1.1 Survey

Surveys are often used to reach a lot of people in a short time and are therefore an efficient way to collect useful information (Johannesson, Persson, & Pettersson, 2013). The information from surveys tends to be more quantitative than qualitative. Therefore, its of high importance to combine surveys with another kind of collecting information.

3.1.2 Interviews

There are various types of collecting information through interviews. In this project, the semi-structured form has been used, which is a combination of a structured and an unstructured interview. When an interview is structured it is planned by the interviewing person while an unstructured is controlled by the interviewee (Johannesson et al., 2013).

A semi-structured interview opens up for further questions, which is a possibility to find new, unexplored areas to deep into. In comparison with surveys, there's a chance to get a more qualitative outcome through those kinds of interviews (Johannesson et al., 2013).

3.1.3 Observations

A common tool during the research phase is to use observations in order to see how people interact with specific products in different situations (Johannesson et al., 2013). There are several ways to observe, an observation can either be performed by an observer or with different technical tools, such as video cameras (Karlsson, 2012). The observation can either be structured or unstructured, it can be open or hidden (Johannesson et al., 2013). During an open observation, the observer knows about being observed but not always the purpose of the observation. When the observation is hidden, the observed person does not know about the observation (Johannesson et al., 2013). In this project, the observations have been open and structured.

3.1.4 Persona

The persona method is a method for analyzing possible users. The persona is a fictive character, which represents the target group for the project. A persona describes the persons' behavior, properties, aims, wishes and feelings and could be seen as a living role model for the project (Johannesson et al., 2013).

3.2 Methods for Product Specifying

When the users opinions has been collected, there is time for specifying the actual product. This is done by three methods, a function analysis which ends up in a requirement documentation as well as a benchmark. All of those methods are described in this section.

3.2.1 Function Analysis

A function analysis is done to organize and clarify the functions of a product. Each function is sorted by required, desirable or unnecessary and classified as either primary function or supporting function (Johannesson et al., 2013). Later on, the function analysis is translated into a requirement documentation.

3.2.2 User Requirements

The user requirement is a sequence of the function analysis and clarifies the actual requirements of the product. It is a tool for setting frames that later on could be used as a basis for further product development (Johannesson et al., 2013).

3.2.3 Benchmark

In order to understand the market and the competitors a benchmark will be performed. The method that will be used is five key questions, interview and a survey will be (KSF) 5 key question:

1. Who are our competitors?
2. What are their strengths and weaknesses?
3. What are their strategic objectives and thrust?
4. What are their strategies?
5. What are their response pattern?

3.2.4 Moodboard

A moodboard is mainly used by designers in order to create a feeling of a place, a product or to receive other associations. When creating a moodboard it is common to use pictures but it can also include materials, keywords and texture samples. A moodboard should be seen as a source for inspiration rather than a locked specification (Johannesson et al., 2013).

3.3 Methods for Concept Development

When investigating different entries to concept ideas, a various of appropriate methods are used. This section will present and describe the methods used for this project.

3.3.1 Brainstorming

Brainstorming is a method created by Alex Osborn whose purpose is to ease the idea generation. It encourages users to come up with all sorts of ideas and thoughts. The ideas could be complete solutions or be a beginning to a new idea generation. The method can inspire a group of users to develop imaginable and creative solutions (Mindtools, 2018).

3.3.2 Six Thinking Hats

The thinking hats method were originally created by Edward de Bono and represents different ways to think. It was developed with the fact that a group tends to solve problems with different approach depending on their personalities (Österlin, 2016, p.67). The Six Thinking hats are described as:

White hat - Objective, neutral facts
Yellow hat - Positive mind and opportunities
Green hat - Crazy, creative thoughts
Black hat - Critical thinking about risks and weaknesses
Blue hat - Thoughts about the working process

3.4 Methods for Concept Evaluation

This section aims to analyze the developed concept from the earlier phase including different evaluating methods. The methods that were used was the PMI analysis and the PUGH Matrix.

3.4.1 PMI Analysis

The PMI method was created by Edward De Bono. The model is a developed tool for the decision-making process and is supposed to reveal the plus, minus and interesting aspects of the product concepts. (Österlin, 2016).

3.4.2 PUGH Matrix

The PUGH matrix or the PUGH Concept Selection is an evaluating method. The PUGH matrix is divided into different criteria that are important for the product. These criteria are later rated for each concept, in order to see which of the concepts has the best-performed criteria. Among the different concept, a comparison item is placed. The other products are later rated in their criteria choice based on the comparison object as a reference (Österlin, 2016).

3.5 Methods for Detail Design and Visualization

During the design process, multiple methods were used to construct the details of the design and the visualization.

3.5.1 Sketching

The sketching method is usually used in order to get a quick understanding of what the design of the product should resemble. The sketches can be done both digitally and traditionally (Johannesson et al., 2013).

3.5.2 Computer Aided Design (CAD) and Visualization

To create 3D models, different programs can be used. CAD are quick tools which give a good view of the concepts in three dimensions. It also gives an understanding of what the final products physical appearance will resemble and enabled easy adjustments for example measurements. The surfaces of the 3D model are done in Autodesk Alias Autostudio 2017. Alias is a tool for sketching, surface making and concept modeling for designing different 3D products (Autodesk, n.d.). The surfaces are normally later converted to Catia V5 in order to make them solid. Catia V5 is a tool developed by Dassault systems, the program is one of the world's leading tool for designing products to the everyday-life, used by several industries (Dassault Systems, n.d.). Furthermore, renderings and visualizations can be done in Catia and Photoshop.

4
Results

In this chapter, results from the user studies are presented and analyzed. Furthermore, a benchmark, moodboard and form studies are presented. Lastly, the results are compiled into a function analysis as well as a requirement specification.

4.1 Persona

During the project, a persona was created and used as a baseline for defining the properties of the products. This persona is called Nils, he is a potential user and buyer of the products. In order to understand the target group Nils was given a certain character and a family.

Nils is 33 years old, living in an apartment in central Gothenburg with four rooms. He lives along with his wife and three years old son. For work, Nils is a graphic designer for an advertising agency. He has an interest in design and loves Swedish design classics products. Nils also has a big culinary interest. He loves spending time in the kitchen area and appreciates when he got a lot of space to cook at. He is also not afraid of experimenting with his culinary skills together with his son and cooking new dishes with new ingredients. Nils has a lot of different kitchen appliances and is tired of not finding the products hidden in storage. Nils's favorite tool is the immersion blender, which he uses on a daily basis mixing smoothies, mashed potatoes and soups.

When it comes to coffee, Nils prefers high-quality and rather spend some extra minutes in the morning to get a good tasting cup than having a fast, tasteless cup of coffee. Even though he is a coffee consumer with high expectations, he does not drink more than 2-3 cups a day. Nils certainly is a coffee enthusiast, but sometimes he likes to vary with tea as well.

4.2 User Studies

In the following section, the result of the methods is presented in order to identify the user and the needs of the user.

4.2.1 Survey

An online survey was used to collect information regarding people's use of small kitchen appliances in their everyday. Information about which products people uses on a daily basis were collected as well as which kind of products they leave visible even when they were not using them. Furthermore, the respondents had the chance to write a short comment on which products they would like to have integrated with each other. The survey was created in order to establish the final choice of designed products.

The survey, see appendix A.1 resulted in 269 participants. The age 18-29 was the largest group with the age group 30-39 as runner up. At the moment, the target group are set to the age 30-40. However, the age group with people from 18-29 will be the new target group in the next ten years, why it is relevant to collect information from that group as well.

The participants were mainly workers (62,1%), students (36,1%), and the rest of the participants were either on parental leave, retired or unemployed. The result of the survey indicated that the four most used kitchen appliances were coffee machine (63,2%), water boiler (50,2%), toaster (42,8%) and immersion blender (35,7%), see figure 4.1. The participants also got to answer which appliances they left visible in the kitchen area. The result showed that most people leave their coffee machine visible, and half of the participants leave their water boiler in a visible area. A third of all the people leave their toaster visible but only 1,5% lets their immersion blender stay in the visible area.

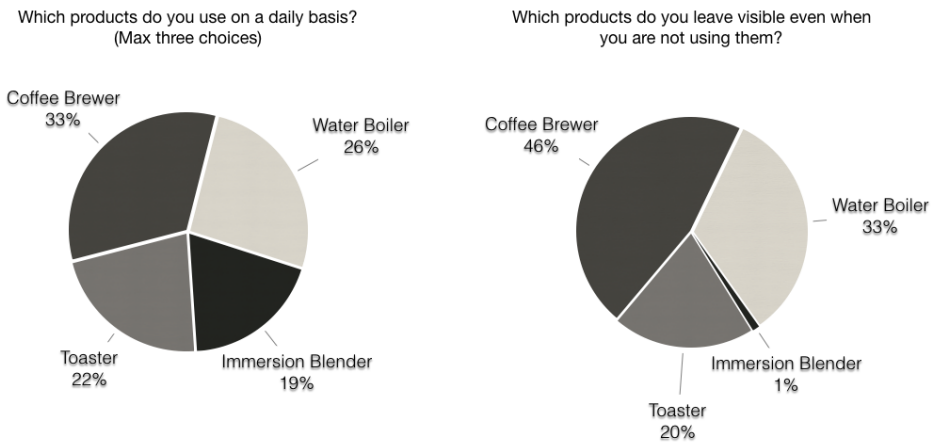

Figure 4.1: Results from survey. Author's own copyright.

The survey participants were asked how they felt about integrated kitchen appliances. A third of them were not up for appliances integrated with each other, but the rest of them seemed positive to the idea. If the participants wanted integrated products, a question about which product they wanted to be integrated followed. A total of 138 people answered this question, 48 (34,5%) of them wanted the coffee machine and the water boiler integrated. One argument for integrating the products is that they would be suitable together and the outcome of the product, a cup of tea and a cup of coffee is often something people drink during the same time.

Some people thought that it would be better to integrate as many products as possible, while others discussed that too many products equal more difficulties when it comes to the application of the product.

4.2.2 Interviews

Firstly, user interviews were performed with persons within or slightly outside the target age interval. The interviews gave an insight into the user perspective and there was also a chance to observe the users behaviour through the mediating photos of various kitchen appliance design. Also, an interview with a kitchen architect working for a well-known kitchen brand was performed in order to get an understanding of longevity trends and the Scandinavian kitchen design. The interviews were hold in the respondents native language, Swedish, in order to open up the possibility for well-developed answers. The guides for the interviews are found in appendix A.2.

Potential users
Peoples' interest in cuisine tends to increase, which also set new expectations on the products. A common opinion among the potential users is that there are too many products to store in the kitchen. There is also restricted space at the worktop, *"I live in 52 square metre and have about 2 meters of worktop, it takes a lot of working space to leave the products in front"* (User 1, personal communication, 18th of February 2019).

In general, the respondents have a positive attitude to a cohesive designed series of appliances. A unified design language also opens up for leaving the products visible at the worktop. One of the respondents says *"The main reason why I take the appliances away is because they are simply ugly. If they were designed in a nice aesthetic way, I would probably leave them visible at the worktop"* (User 2, personal communication, 18th of February 2019). That predicts that there is enough work space and that the products are used on a regular basis. When asking which appliances that are used the most, the result from the survey is confirmed. Coffee machine, water boiler, immersion blender and toaster is undoubtedly the most used products. One of the interviewees also pointed out an interesting aspect *"If I had a nicely designed appliance, I would probably be more inclined to keep it visible and that also means that I would use the product more"* (User 3, personal communication, 21th of February 2019). So if the products are designed to leave visible it would probably also be used more, which certainly is an important aspect to keep in mind when designing the products.

Furthermore, the interviewees tend to have a positive attitude to integrated appliances as well. One respondent says *"Integrated products take less space. I would like to have similar functions integrated into one appliance, for instance, immersion blender and an electric hand mixer."* (User 3, personal communication, 21th of February 2019). The user observes the importance of similar functions when integrating a product. Another user also points out that the product should not be too large. *"The product should not be too clumsy and large, if a toaster and coffee machine would be integrated it would definitely be too big."* (User 4, personal communication, 18th of February 2019).

Lastly, the interviewees are asked about how a perfect kitchen appliance should be designed in order to promote that they should leave it visible in their kitchen. All respondents mention factors like high quality, nice aesthetic design, easy to clean but also that the design should match their kitchen interior.

Kitchen Architect, Ballingslöv
Scandinavian Design is often associated to clean lines, light colours and natural materials like wood and stone. In order to achieve trustworthy insights from the kitchen branch, the kitchen architect Annika, from the Swedish brand Ballingslöv was interviewed about longevity trends regarding materials and colour as well as the customers' requirements for storing of electrical kitchen appliances.

Trends within kitchen design change over time, but Annika express that many trends also have been long-lasting. *"In the kitchen, we use to say that the colour white is long-lived. White is a colour that always works."* (Kitchen Architect, personal communication, 1th of March). When Annika is requested to describe Scandinavian Design she confirms the associations to light colours and natural materials, see figure 4.2. *"Scandinavian Design*

is at the moment white, light grey, beige, greige and blonde woods. A couple of years ago it was more common with darker woods like walnut, but nowadays people seem to prefer white oiled ash or matte, white pigmented oak as our latest series 'Wood'." (Kitchen Architect, personal communication, 1th of March).

Figure 4.2: Annika showing the latest series of Ballingslöv's kitchen, 'Wood'. Author's own copyright.

Furthermore, Annika tells about materials often used in the kitchen and that there are many innovative materials coming up. *"Dekton is the latest generation of composite material, it contains both glass and clay and can stand high temperatures, which is common in a kitchen. Then we have something called Corien, which is a material that is so strong it enables welding. It comes in a variety of colours."* (Kitchen Architect, personal communication, 1th of March 2019). Annika also thinks that culinary interested people have high expectations for their kitchen, both regarding function and quality. *"If you are interested in cooking you may use your immersion blender quite often, but you would probably not leave it visible because that is not very functional."* (Kitchen Architect, personal communication, 1th of March 2019).

One main issue when planning a new kitchen for a customer is to find out how much things they use to leave at the worktop in order to set the right requirements. Annika tells one interesting aspect *"People use to say that they do not have things in front, but when I come to visit them for measurements, there is not even a place for putting my mobile phone."* (Kitchen Architect, personal communication, 1th of March 2019). That aspect

supports the fact that people request for space efficient or even integrated appliances. However, what people like to place at the countertop varies. People who are interested in design tend to be more attentive in their choice of products that are left visible. *"One thing that could be seen in many homes of today is the manual drip coffee. The drip jug is a trendy detail that also could be seen if you take a tour at Hemnet, where apartments for sale could be found, often styled."* (Kitchen Architect, personal communication, 1th of March 2019).

Moreover, the persona Nils is presented for Annika in order to find a matching kitchen for the intended target group. Annika thinks the right kitchen for Nils would be a trendy, but still the classical kitchen. Ballingslöv's series Bistro in the colour warm grey with wooden details are mentioned as an exemplifying kitchen. *"I think that Nils would prefer a user-friendly kitchen with a deeper worktop. He will absolutely have a steam oven. He will choose the composite stone as the worktop, and he definitely has a wine cooler."* (Kitchen Architect, personal communication, 1th of March 2019).

Figure 4.3: Bistro in warm grey with wooden details. Author's own copyright.

4.2.3 Product Choice

The product chosen for the project is a Coffee machine, water boiler and an immersion blender. The products choice was based on the result of the interview with the architect. The architect mentioned that the coffee machine is something people often want to have

visible in the kitchen area. According to the survey, 34,5% wanted a product where the coffee machine and the water boiler were integrated and purchased as one product, see appendix A.1. Both the immersion blender and the toaster were something that many of the survey participants used every day. The difference between these products was that the toaster was left visible in the kitchen area and the immersion blender was stored in boxes. Choosing the immersion blender makes it a challenge to design it with a mission to make the users leave it visible.

4.2.4 Observations

During the observations, see appendix A.3, A.4 and A.5, different users were analyzed in order to get more understanding for how the users interact with the products. Three different products were used during the observation, a water boiler a coffee machine and an immersion blender. The largest number of users were observed with the immersion blender since that product can be managed in many different ways compared to the other products.

Water Boiler
Structured observations were done to examine how the users boiled water when they were instructed to make tea water. The water boiler used for the observation was from Wilfa named *Wilfa WK5,* see figure 4.4. The model can contain 1 liter of water and has a power of 1500 W. Three different buttons were visible on the water boiler which is illustrated in figure 4.4 and 4.5.

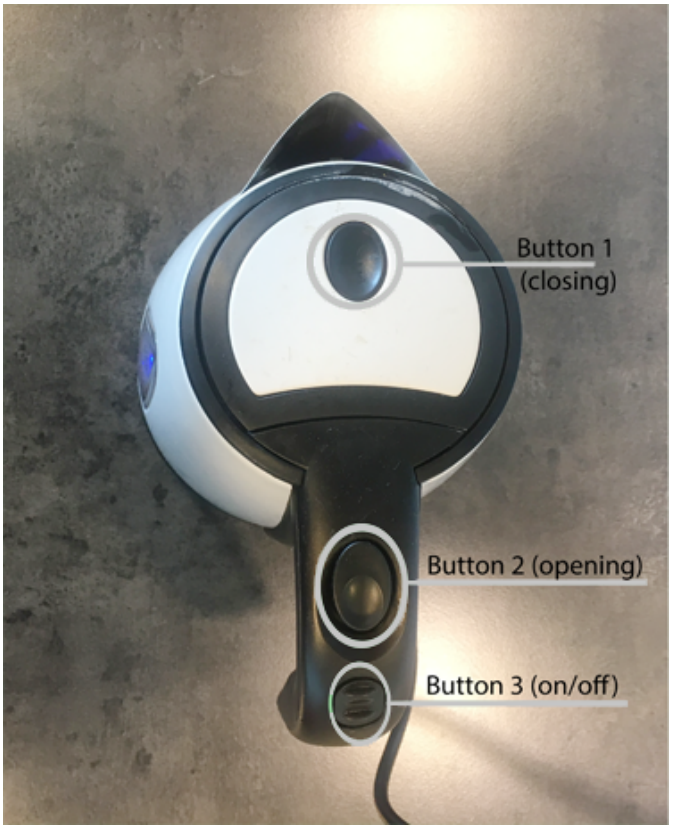

Figure 4.4: Wilfa water boiler WK5 - Top view. Author's own copyright.

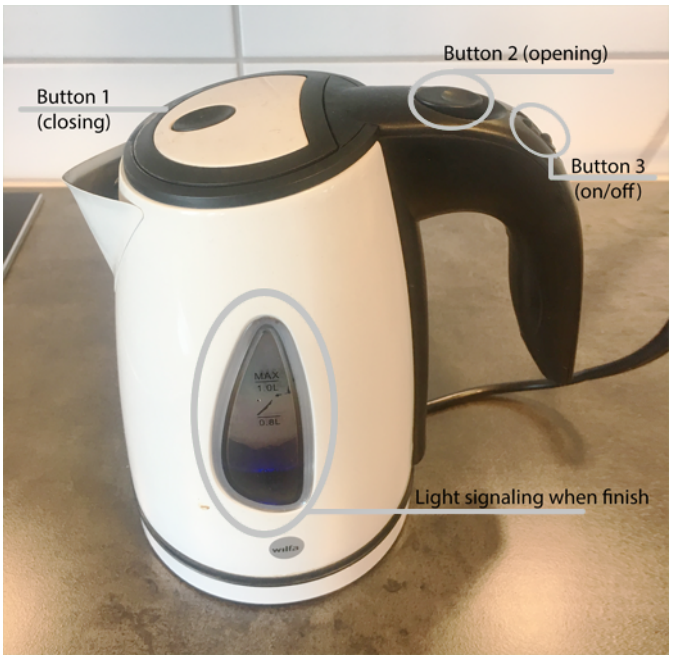

Figure 4.5: Wilfa water boiler WK5 - Side view. Author's own copyright.

During the observation, the users were asked how many buttons they saw and if they understood the main function for each button. Button one does not have a clear function but is believed to be used in order to close the lid, since it is made in other material that what the rest of the lid is made in, which does not get warm during use. Button two is for opening the lid and button three is for the on and off function. To indicate that the product is on light is also visible in the glass area where the user also can see the amount of water.

The observation was done with eight different users, see appendix A.4, both people who have experienced the product before and inexperienced users. Only one of the users understood what button one was for. One of them also tried to open the lid though button one, believing there was a storage space beneath it. The rest of the participants questioned if button one even had a function. All of the participants who wanted to boil water for one cup, boiled too much and was left with twice as much water as they wanted. One participant did not understand button two, that has the lid opening function. This participant filled the jug through the pipe not knowing it could be opened. The rest of the participants understood both the on and off function and the lid opening function.

Coffee Machine
Structured observations were done to examine how the users made coffee. The coffee machine used for the observation was a *Moccamaster KBGC982AO*. The model can contain 1 liter of water and has a power of 1520W, there is also two visible buttons on the machine. Button one is for the on and off function and button two an independent control for the heating plate, which is illustrated in figure 4.6.

Figure 4.6: Moccamaster coffee brewer KBGC982AO. Author's own copyright.

During the observation, the users were asked if they knew what the function of the two different buttons was. Later the users were examined when they added water to the machine, what sort of container they used to transfer the water and also how they gripped of the coffee pot.

The observation was done with five different users, see appendix A.3, both experienced coffee brewers and people who have only brewed coffee a few times before. When the users transferred the water only two of them use the coffee pot, the rest of them used a separate carafe. The ones that used the coffee pot were aware of cleaning it first so that the coffee machine would not get damaged. When the users were asked about the buttons all of them did understand the on and off button but only two of them understood that the second button was for the heating plate. One of the users thought that the second button was some sort of timer, another user also had a hard time understanding if there was anything that indicated that the brewing process was finished. The coffee brewer from Moccamaster has no indication for when the coffee is finished. The user knows it is finished when the coffee stop dropping from the filter.

Immersion Blender
Structured observations were done with the immersion blender, two things were examined during the process, firstly the user's grip of the blender and also the movement from the user. The immersion blender used for the observation was from Electrolux named *Electrolux ESTM1456 PerfectBlend Immersion Blender*. The measurements are illustrated in figure 4.7.

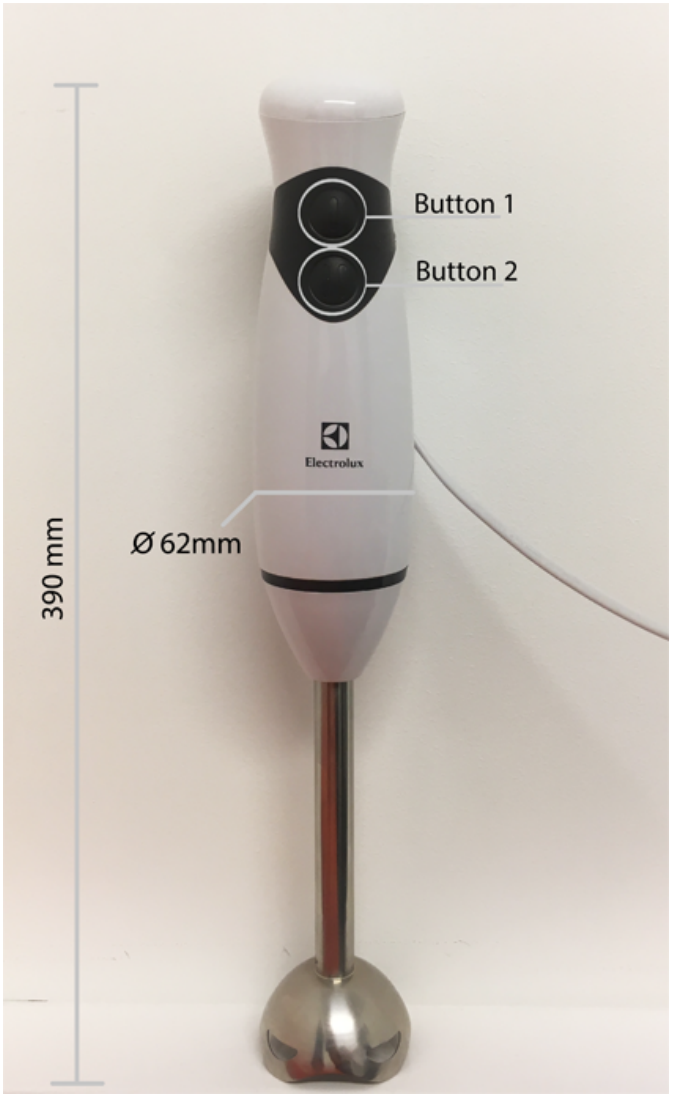

Figure 4.7: Electrolux Immersion Blender ESTM1456 Perfect Blend. Author's own copyright.

During the observations the users got to mix water in one big bowl, with the instruction to make soup, they also got to blend a smoothie in a smaller bowl. During the observation, both the grip and the understanding of the buttons was examined.

The observation was done with twelve different users see appendix A.5. The grip varied a lot between the users, only one of the observed was left-handed. However, he still used the right hand to blend. Two of the inexperienced users used both hands during the blending process, saying the machine was too powerful to handle and heavy to lift with one hand. Three of the twelve pressed the start button with their index and middle finger

the rest of the users pressed with their thumb. Most of the users tilted their blender when using the bigger bowl, mostly because there was more space for a tilted movement. Other speculations that the users had in mind was the grip surface was good since the details were made in rubber which prevented the blender from slipping out of the hand. The white area is made of plastic and was too big to grip which forces the users to place their hand on the grip surface. The result from the observation of the immersion blender shows that it is important that people can use the blender in more than one grip. Designing the blender symmetrical enables multiple grips opportunities. Some of the participants also thought that the blender was clumsy and weighed too much.

4.3 Disassembly of Immersion Blender

An immersion blender from the brand Electrolux, model ESTM3200 was disassembled to get information of including components and measurements of the engine, see figure 4.8.

Figure 4.8: Disassembly of Electrolux Immersion Blender ESTM2300. Author's own copyright.

The measurements of the engine are visualized in figure 4.9. The diameter of the engine package was 44.7 mm, which gives a minimum handle diameter of approximately 50 mm where the engine will be placed. As seen in section 2.5, an appropriate grip diameter through an ergonomically view is slightly smaller than 59 mm. This leaves an acceptable diameter between 50-59 mm. In length, the engine in the Electrolux immersion blender could be measured to 117.8 mm from top to the end of the rotating component, see figure 4.9.

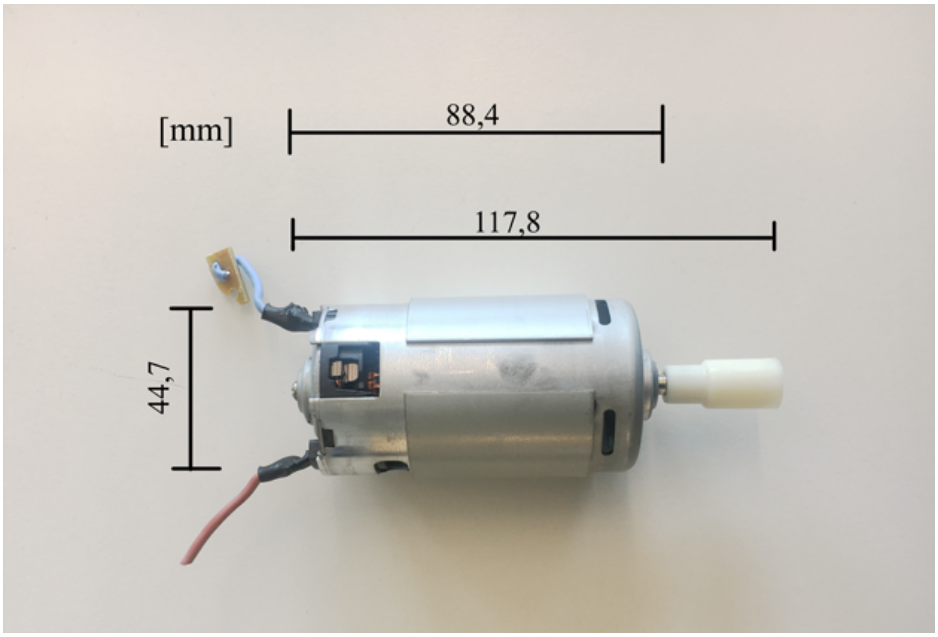

Figure 4.9: Engine measurements of Electrolux Immersion Blender ESTM2300. Author's own copyright.

4.4 Benchmark

In order to investigate existing products within small kitchen appliances, a benchmark was done. After a visit at Elgiganten Backaplan, the three major competitors was founded out. In dialogue with one of Elgiganten's store assistants, Smeg, KitchenAid and OBH Nordica was selected for further analysis. Those brands were confirmed as the top three most popular brands when purchasing a full series of appliances. Furthermore, an extended description of the brands and their series are given inspired by the five key questions presented below.

1. Who are our competitors?
2. What are their strengths and weaknesses?
3. What are their strategic objectives and thrust?
4. What are their strategies?
5. What are their response pattern?

4.4.1 Smeg

Smeg is an Italian manufacturer of home appliance, based in Guastalla in the north of Italy. The company has subsidiaries worldwide and a large sales network. Since the early 1950's Smeg has offered solutions to the demands of contemporary living, often in collaboration with many famous architects. The company dictates that maximum emphasis is placed on product quality, technology and design. Smeg appliances are designed to take the center stage in what the company believes is the heart of the home, the kitchen (Smeg, 2019a).

One of Smegs' most popular design lines is the 50's Retro Style range, see figure 4.10, which keywords are technology, aesthetics, functionality and style. The vivid coloured

products are inspired by Pop Art and rounded retro lines (Smeg, 2019b). The series could easily be identified due to the rounded aesthetic lines and the colour scale in pastel tones. The company itself describes the series as cult objects due to the products of individual personalities. The 50's Retro series includes kettles, toasters, blenders, coffee machines, stand mixers and more (Smeg, 2019b).

Figure 4.10: Smeg 50's Retro series in different color range. Published by permission of SMEG.

Smeg has its strengths in both design and technology. Their products are also designed for interacting with the architecture, which is strengthened by collaboration with well known Italian architects like Matteo Bazzicalupo (Smeg, 2019a). But what is their strength could also be their weakness. The distinctive 50's Retro design may not match the modern Scandinavian kitchen. Another development area could be the size of the products, which at the moment are designed to be quite inefficient regarding storing. The products are also priced above average within small kitchen appliances (Elgiganten, 2019), which on the other hand could be a sign for good quality.

The strategic objectives taken in mind is innovative design combined with high quality, where the technology is one of the key factors. Smeg promises high performance in the kitchen as well as qualitative design solutions that last for a long time (Smeg, 2019a).

4.4.2 KitchenAid

KitchenAid brand was created in 1919 and is known for the products professional performance. The products are developed together with professionals chefs and guarantee high-quality (KitchenAid, 2019a). KitchenAid is in the first place in multiple websites for best in test. At Test.se KitchenAid is recommended for competing against other brands with their high-quality product and also for constantly improving and staying on top in the business (Test.se, 2019).

The design of the KitchenAid appliances represents beautiful crafts, sustainability and sophisticated material. The parts of the products are combined with harmony and the quality catches the eyes through the details. The products are inspired by the icon of the kitchen appliance and the appearance is often seemed as ageless together with its bold design (KitchenAid, 2019a).

The Pro Line series includes several kitchen appliances, see figure 4.11. The series exists in seven different colours containing, three types of black, two types of silver, white and a candy apple red. The series is styled professionally and ergonomically in order to make use as pleasurable as possible (KitchenAid, 2019b).

Figure 4.11: KitchenAid Pro Line series Published by permission of KitchenAid.

The strengths of KitchenAid is certainly the high quality and the ability to encourage the user to explore their culinary passion. Another strength is their collaboration together with professional chefs, which gives trustworthiness among the customer (KitchenAid, 2019a). One weakness of the KitchenAid brand is the pricing of the products, to achieve high-quality a high price often follows. The series exists in seven colours but only the candy apple red is a strong accent color. However, the black, white and silver coloured appliances are appreciated to be more likely to compete with the developed series.

During the benchmark, a design language was spotted in the KitchenAid series. A recurring curve was noticed in many of the products, the curve was drawn in order to visualize the resemblance, see figure 4.12. The design language is distinctive and representative for the brand, therefore customers and users can easily identify the products and connect them to the brand and other products.

Figure 4.12: Form studies of KitchenAid Pro Line series. Published by permission of KitchenAid.

4.4.3 OBH Nordica

OBH Nordica is a Nordic company selling home appliances. One of their cohesive series, called Chilli, includes a various of products, for instance, a toaster, water boiler, blender and coffee machine, see figure 4.13. The series was launched in 2005 and includes seven products at that time. It was created since the trends in the Scandinavian kitchen

included products with materials such as brushed stainless steel or product made in plastic, mainly coloured in black or white. Therefore, OBH Nordica created the chili colored series with a hint of metallic, to give the kitchen a new accent colour (OBH Nordica, 2019a).

Figure 4.13: The Chilli series Published by permission of OBH Nordica.

OBH Nordica performed studies to spot the interior design trends within the kitchen. The result of the study showed that kitchens in Scandinavia are often bright and light with a minimalistic design. The study also showed that people pay most on the home interior for the kitchen compared to other home interior products (OBH Nordica, 2019b). Adding the signature Chili red color to the product for the kitchen gives the interior an expressive design. The products with the colour have been very popular since 2005 and are still being sold today. The series has gotten additional products during time with inputs and desires from previous users (OBH Nordica, 2019a). The strengths of the company are that they are still selling product form a series being created almost 15 years ago (OBH Nordica, 2019a). Another strength is the product of choice, OBH Nordica works with the most basic appliances, that most people possess in their kitchen. However, by choosing an accent colour like chili red, OBH Nordica also creates limitations and reduce the target group. The expressive colour may not suit the light colour range of a Scandinavian home today. That strengthens by several home stylists, who confirms that red is a colour that is hard to match with the remaining home interior (Broman, 2015).

The vision of OBH Nordica is “Designing for a good life”, the mission for the company is “By creating innovational and outstanding design be the first choice for the Nordic consumers of home appliances making everyday life easier” (OBH Nordica, 2019c). Their strategies are that they listen to customers and develop the products to fulfill their needs. A strategy to make customers buy more products (OBH Nordica, 2019c).

OBH Nordica has grown a lot since 2002, the year the company was created. The brand has also gotten stronger and the brand awareness grew from 7% to 97% in less than seven years (Thomas Ek, 2019). To compete with their product the company keep them innovative and introduces smart solutions. Currently, they are in a leading position in the Scandinavia and continue to offer intriguing designs.

4.5 Moodboard

Since the main focus of this project is to define a cohesive design language within the products, two kinds of moodboards were created in order to visualize the design environment and lines. The first one, see figure 4.14, focus on the mood and environmental factors while the second one, see figure 4.15, focus on the actual design language and features. The five keywords taken in mind was Scandinavian, Native, Eternal, Responsible and Noble.

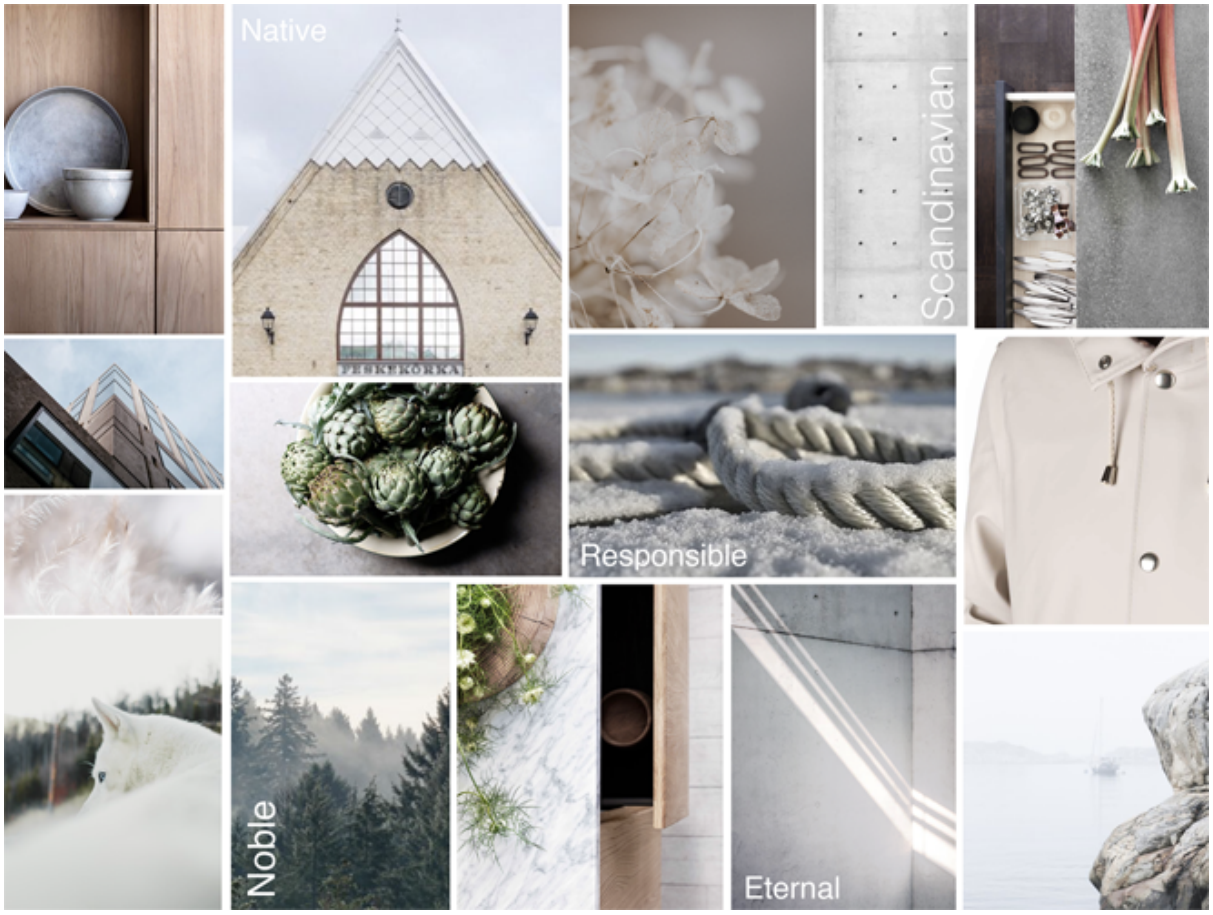

Figure 4.14: Moodboard for identifying the environment. Author's own copyright.

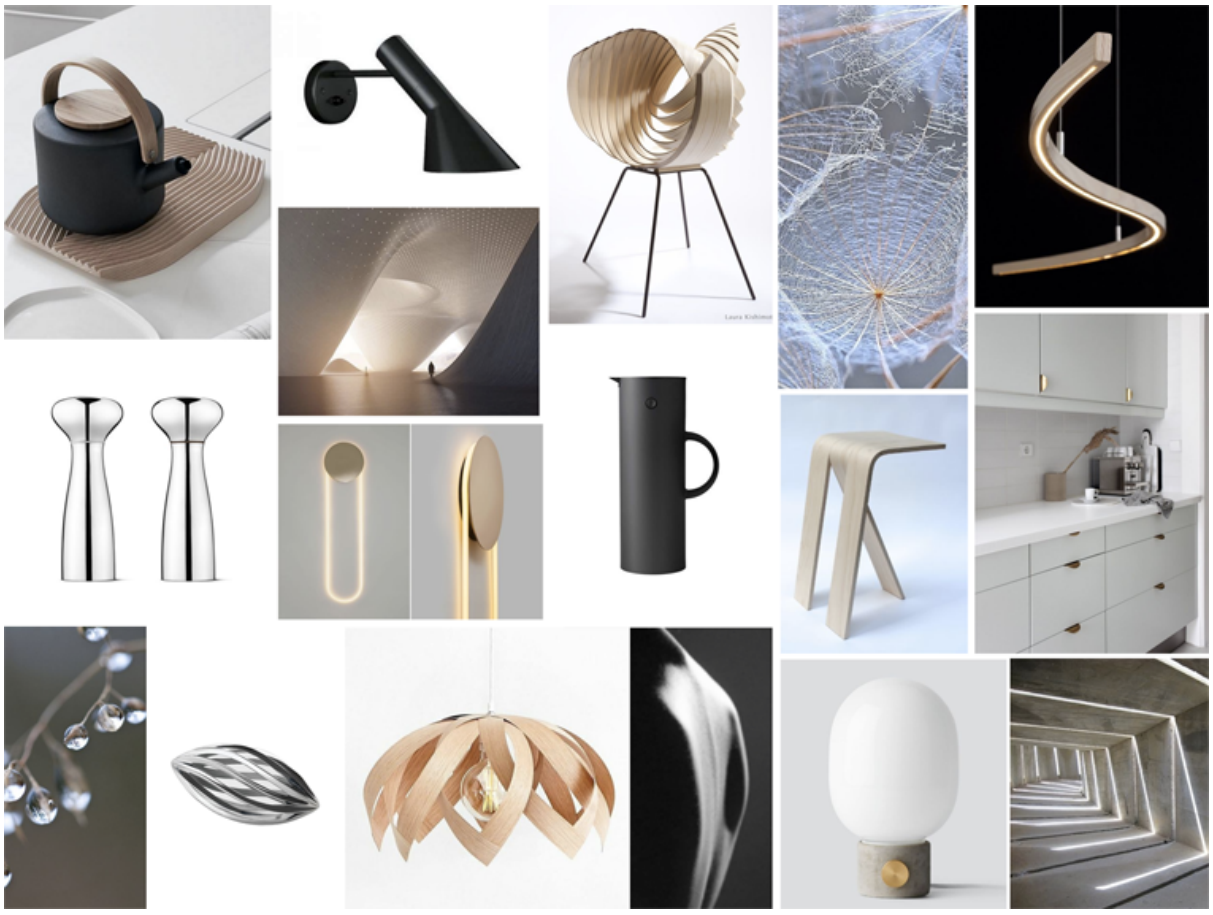

Figure 4.15: Inspiration for identifying the Scandinavian Design languge. Author's own copyright.

4.6 Form Studies

A step in the process for identifying the Scandinavian design language and lines was to analyze existing design classics and products with a typical Scandinavian approach. Those products were taken from the moodboard and analyzed by drawing lines for direction and form, see figure 4.16. Some of the directions were clearly coming back to many of the products. The lines were clean and simple and the details were carefully selected. Any extraordinary curlicues could not be seen in these products.

Figure 4.16: Form studies for identifying the Scandinavian Design languge. Author's own copyright.

4.7 Function Analysis

In order to meet the user requirements a function analysis was performed. The analysis reveals the importance of the different functions which are determined in the classification. The Main Functions (MF) are functions mandatory to fulfill. The Part Functions (PF) are implemented in order to accomplish the main function. The Supportive Functions (SF) are functions that ease the usage of the product and gives it extra value. In the function analysis priorities was also described as Necessity (N), Desirable (D), Unnecessary (U) and Interesting (I) depending on how important the functions are or if they are just interesting. Finally, a commenting column was also presented in the analysis for comments to have in mind during the development of the product.

Following are three different function analysis for both coffee machine, see figure 4.17, water boiler, see figure 4.18 and immersion blender, see figure 4.19.

Functions	Classification	Priority	Comment
Produce Coffee	MF	N	
Keep coffee warm	SF	D	
Permit on/off function	SF	N	
Provide energy	SF	N	
Indicate water level	SF	D	
Permit cleaning	SF	I	Is self cleaning an alternative?
Promote Usage	SF	D	
Express quality	SF	D	
Enable matching with kitchen	SF	D	
Appeal target group	SF	D	
Enable integration	SF	I	Is it possible to integrate with other products?
Heat up water	PF	N	
Mix ingredients	PF	N	
Give feedback	PF	D	
Hold filter	PF	N	
Store water	PF	N	
Gather coffee	PF	N	
Enable production	PF	N	
Enable assemble	PF	N	

Figure 4.17: Function Analysis for coffee machine. Author's own copyright.

Functions	Classification	Priority	Comment
Produce warm water	MF	N	
Keep water warm	SF	D	
Permit on/off function	SF	N	
Provide energy	SF	N	
Indicate water level	SF	D	
Permit cleaning	SF	I	Is self cleaning an alternative?
Promote Usage	SF	D	
Express quality	SF	D	
Enable matching with kitchen interior	SF	D	
Appeal target group	SF	D	
Enable integration	SF	I	Is it possible to integrate with other products?
Give feedback	PF	D	
Store water	PF	N	
Enable production	PF	N	
Enable assemble	PF	N	

Figure 4.18: Function Analysis for water boiler. Author's own copyright.

Functions	Classification	Priority	Comment
Blend ingredients	MF	N	
Protect components	PF	N	To lengthen the life cycle and protect parts from wear and tear
Change blending leg	PF	N	
Enable charging	PF	N	
Enable production	PF	N	
Provide blade guard	PF	N	
Enable cleaning	PF	D	
Permit on/off function	PF	N	
Supply a stand support	PF	I	Prevent the product form ending up in a storage box
Provide a good grip	SF	D	
Enable desemble	SF	D	
Appeal target group	SF	D	
Promote usage	SF	D	
Provide reverse function	SF	D	

Figure 4.19: Function Analysis for immersion blender. Author's own copyright.

4.8 List of Requirements

In the function analysis, see figure 4.17, it could be seen that a coffee machine also had the functions of a water boiler, which opens up for the possibility to integrate the two products into one unit. Thereby, a compiled list of the requirement was created as a complement to the function analysis for coffee machine and water boiler, see figure 4.20.

Moreover, a list of requirements for the immersion blender was created, see figure 4.21, based on the function analysis.

Chalmers University of Technology		**Document type**	List of Requirements	Water boiler & Coffee machine
		Project	Development of an uniform small Kitchen Appliances	
	Criterias for functions			Requirement/Desirable
1.	**Technical functions**			
	1.1	Produce warm water		**R**
	1.2	Produce coffee		**R**
	1.3	Indicate coffee refill		**D**
	1.4	Indicate on and off function		**D**
	1.5	Contain induction cooktop		**D**
2.	**Development and Assembly**			
	2. 1	Optimize packaging and transportation		**D**
	2.2	Easy to mount		**D**
	2.3	Enable change of components		**D**
3.	**Usability and esthetics**			
	3.1	Promote usability		**D**
	3.2	Fit in the kitchen area		**R**
	3.3	Express clean design		**D**
	3. 4	Minimize weight		**D**
	3. 5	Express stability		**D**
	3. 6	Express simplicity		**D**
	3. 7	Express eternity		**D**
	3. 8	Suit the Scandinavian kitchen		**R**
	3. 9	Indicate coffee pitcher		**R**
	3. 10	Be space efficient		**R**
	3. 11	Express a cohesive design language		**R**
4.	**Quality and Sustainability**			
	4.1	Withstand damages		**D**
	4.2	Express high quality		**R**
	4. 3	Enable longevity		**D**
	4. 4	Pure materials		**D**
5.	**Safety and Maintenance**			
	5.1	Permit easy cleaning		**D**
	5. 2	Express safe use		**D**
	5. 3	Permit auto shutdown		**R**
	5.4	Signal when finish		**R**
6.	**Elimination**			
	6.1	Enable desemble		**D**
	6.2	Promote recycling		**D**

Figure 4.20: List of Requirements for water- and coffee machine. Author's own copyright.

Chalmers University of Technology		**Document type**	List of Requirements	Immersion Blender
		Project	Development of an uniform small Kitchen Appliances	
	Criterias for functions			Requirement/Desirable
1.	**Technical functions**			
	1.1	Blend ingredients		**R**
	1.2	Enable wireless charging		**D**
	1.3	Permit on/off function		**R**
	1.4	Provide reverse function		**D**
	1.5	Permit a button for usage		**R**
2.	**Development and Assembly**			
	2. 1	Optimize packaging and transportation		**D**
	2.2	Enable changing of blending leg		**R**
	2.3	Supply a standing/hanging support		**R**
3.	**Usability and esthetics**			
	3.1	Provide blade guard		**R**
	3.2	Provide a good grip		**R**
	3.3	Promote usability		**R**
	3. 4	Fit in the kitchen area		**R**
	3. 5	Express clean design		**D**
	3. 6	Minimize weight		**D**
	3. 7	Express stability		**D**
	3. 8	Express simplicity		**D**
	3. 9	Express eternity		**D**
	3. 10	Suit the Scandinavian kitchen		**R**
	3.11	Be place effective		**D**
	3.12	Express a cohesive design language		**R**
4.	**Quality and Sustainability**			
	4.1	Withstand damages		**D**
	4.2	Express high quality		**R**
	4. 3	Enable longevity		**D**
	4. 4	Pure materials		**D**
5.	**Safety and Maintenance**			
	5.1	Permit easy cleaning		**D**
	5. 2	Express safe use		**D**
	5.3	Enable battery saving mode		**R**
6.	**Elimination**			
	6.1	Enable desemble		**D**
	6.2	Promote recycling		**D**

Figure 4.21: List of Requirements for immersion blender. Author's own copyright.

5

Concept Development

On the basis of the identified requirements in combination with information from the user studies, the concept development started. Furthermore, this chapter presents methods that have been used to evaluate the concept series.

5.1 Idea Generation

Various of ideas came out from the brainstorming session. The concepts were iterated and evaluated throughout the process, in order to reach a higher level and a better outcome. Some of the ideas were also an outcome from the Six Thinking Hats methods.

In figure 5.1 different solutions of coffee machines and water boilers are presented. Some of the ideas visualizes integrated solutions, while others just describe the design of the actual can. A lot of inspiration was taken from existing product solutions, combined with new ideas.

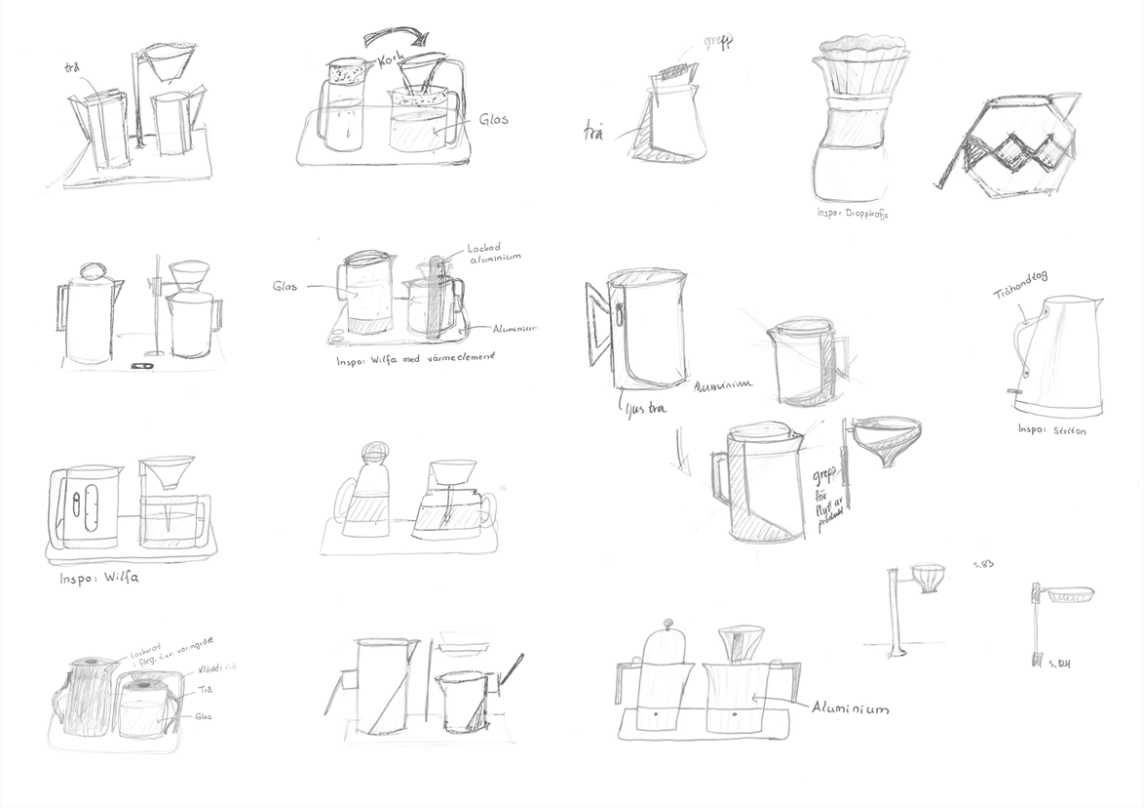

Figure 5.1: A various outcome from idea generation for coffee machine and water boiler. Author's own copyright.

In figure 5.2 ideas for immersion blenders are presented. A variety of ideas for attaching the blenders to a stand are visualized in the sketches. Most of the ideas include details in wood or other natural materials. Regarding the blade guard, a design with holes is needed to keep away from the undesired vacuum when mixing. Another aspect that was taken in mind was the potential for an ergonomic grip when mixing. Whether the immersion blender should be wireless or not mainly depends on the design of the stand, but that was certainly a factor to pursue.

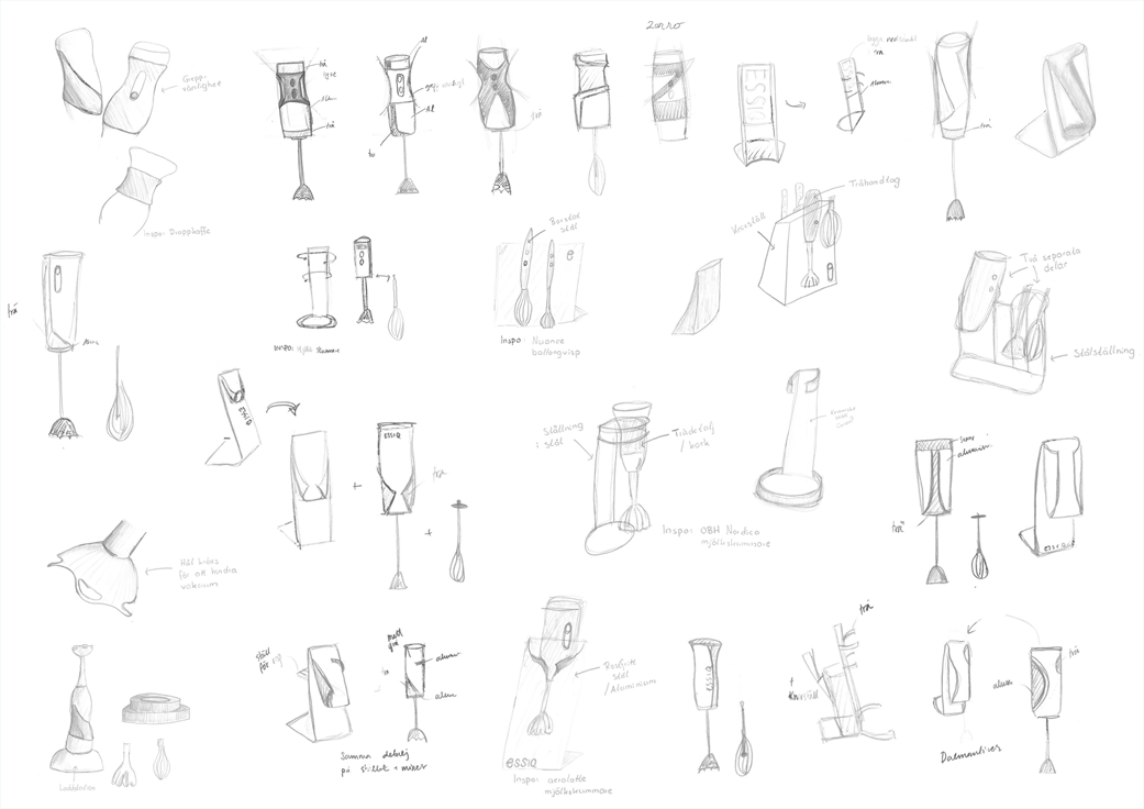

Figure 5.2: A various outcome from idea generation for immersion blender and stand. Author's own copyright.

5.2 Concept Series

Three different concepts series were created, based on the idea generation. The concepts and its inspiration are described in more detail below.

5.2.1 Concept Series 1

The first concept, is based on straight lines that could be seen in some of the Scandinavian designed products. The form and angle of the Louis Poulsen AJ lamp, seen in figure 5.3, was an inspiration for the design of the handle for the immersion blender. Furthermore, the lines from the Stelton EM77 Classic jug, see figure 5.4, were an inspiration for the coffee machine and water boiler. The angle in the immersion blender was also transmitted into the pour spout. The immersion blender stand is formed as a wrap, wrapping the mixer in place, see figure 5.5. The blender operates the same way as the traditional, see section 2.4.3.

Figure 5.3: Louis Poulsen AJ lamp. Bright123 (n.d.) Published by permission of Bright123.

Figure 5.4: Stelton EM77 Classic jug. RoyalDesign (n.d.) Published by permission of RoyalDesign.

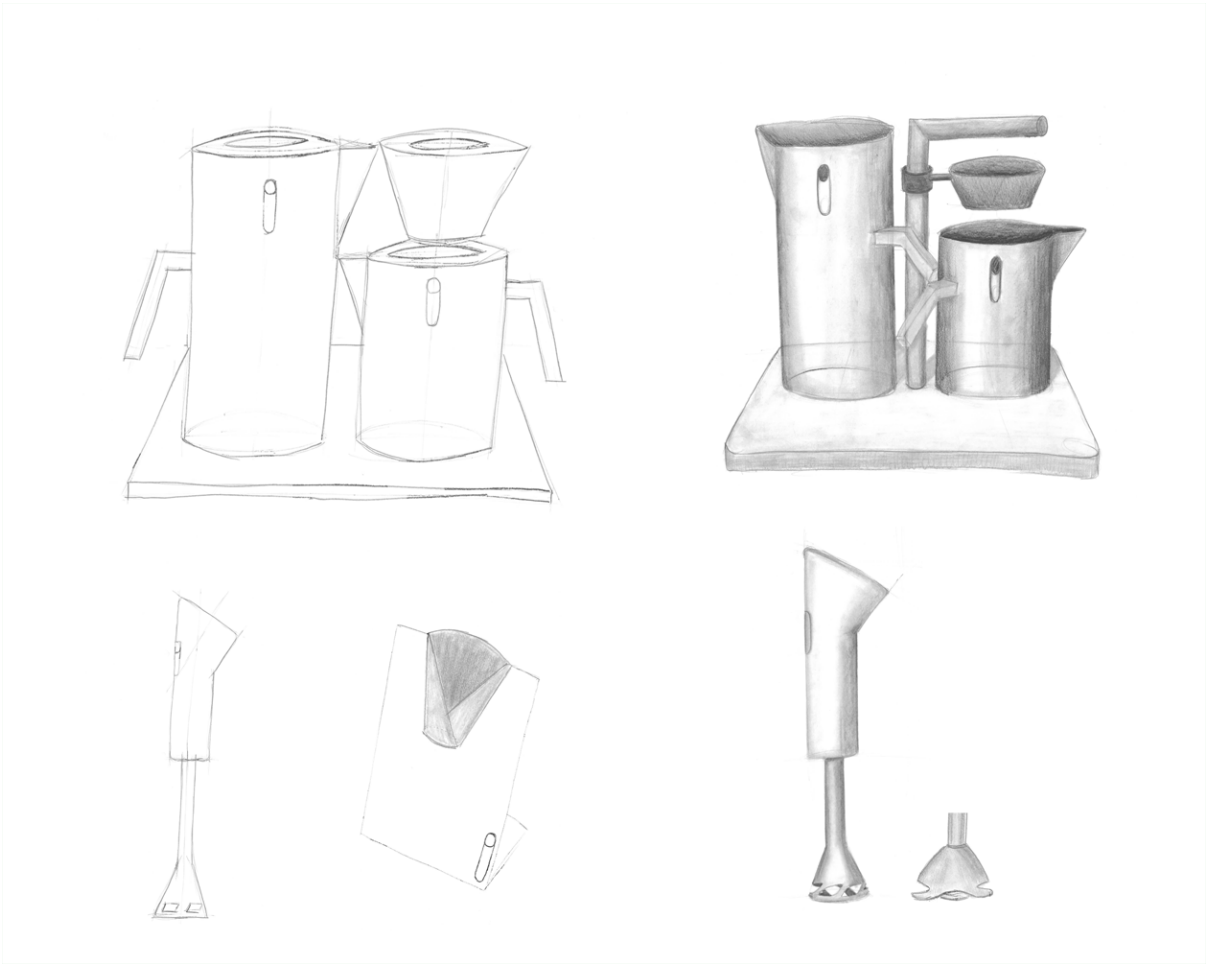

Figure 5.5: Sketches of Concept Series 1. Author's own copyright.

The water boiler works separately and can be used for boiling water both for tea and coffee. To make coffee, the water is manually poured into the filter holder. The amount of coffee and the total brewing time can be controlled by a flow control, which is placed at the bottom of the filter holder. Adding the manually pouring process will result in a slightly longer brewing time. But as mentioned in section 4.2.2, there are trends that indicate increased use of manual drip coffeemakers, so the users value the taste more than the brewing time. Wilfa, a Norwegian company, created a similar solution for the water boiler and coffee brewer called, *Wilfa Svart Manuel*, where the user pours the water into the filter holder by themselves.

5.2.2 Concept Series 2

Concept series two, see figure 5.6, is a variation of concept one, including the same straight lines that could be seen in many of the Scandinavian products. In contrast to the first concept, these have a more narrow pour stout and the angle at the top of the immersion blender is smaller. The stand-in concept series two has a simple design with a small edge keeping the immersion blender in place.

The technology used in the water boiler and coffee machine transports the boiling water through two different pipes. That technology enables separated transportation ways and thereby no risk for mixing the tea water with coffee.

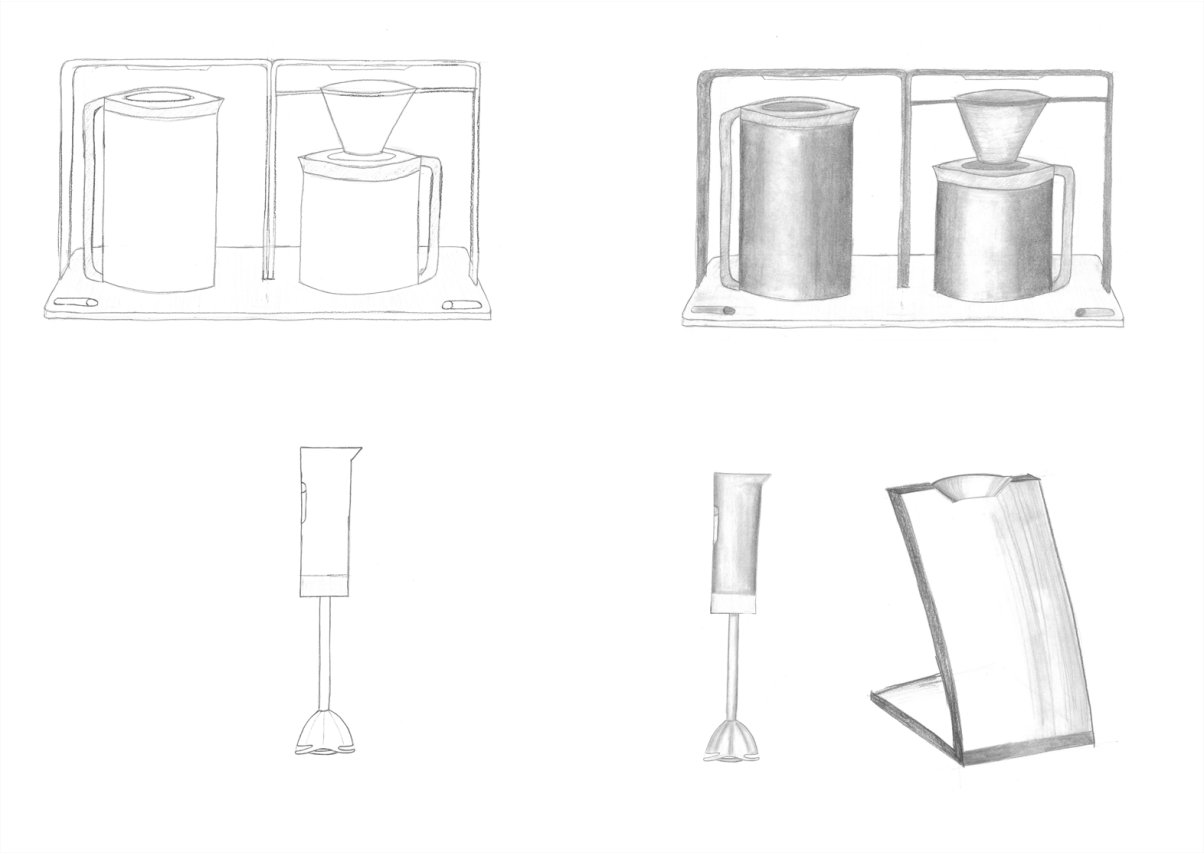

Figure 5.6: Sketches of Concept Series 2. Author's own copyright.

5.2.3 Concept Series 3

Concept series three, see figure 5.7, has a design with curvy lines. The on/off buttons are placed and integrated into the surface on the kettles. The immersion blender supplies a good ergonomic grip for the hand. The storage for the immersion blender is formed as a cylinder, in which the components of the immersion blender will be placed. The cylindrical storage box could be used as a charging station, which enables the immersion blender to be wireless.

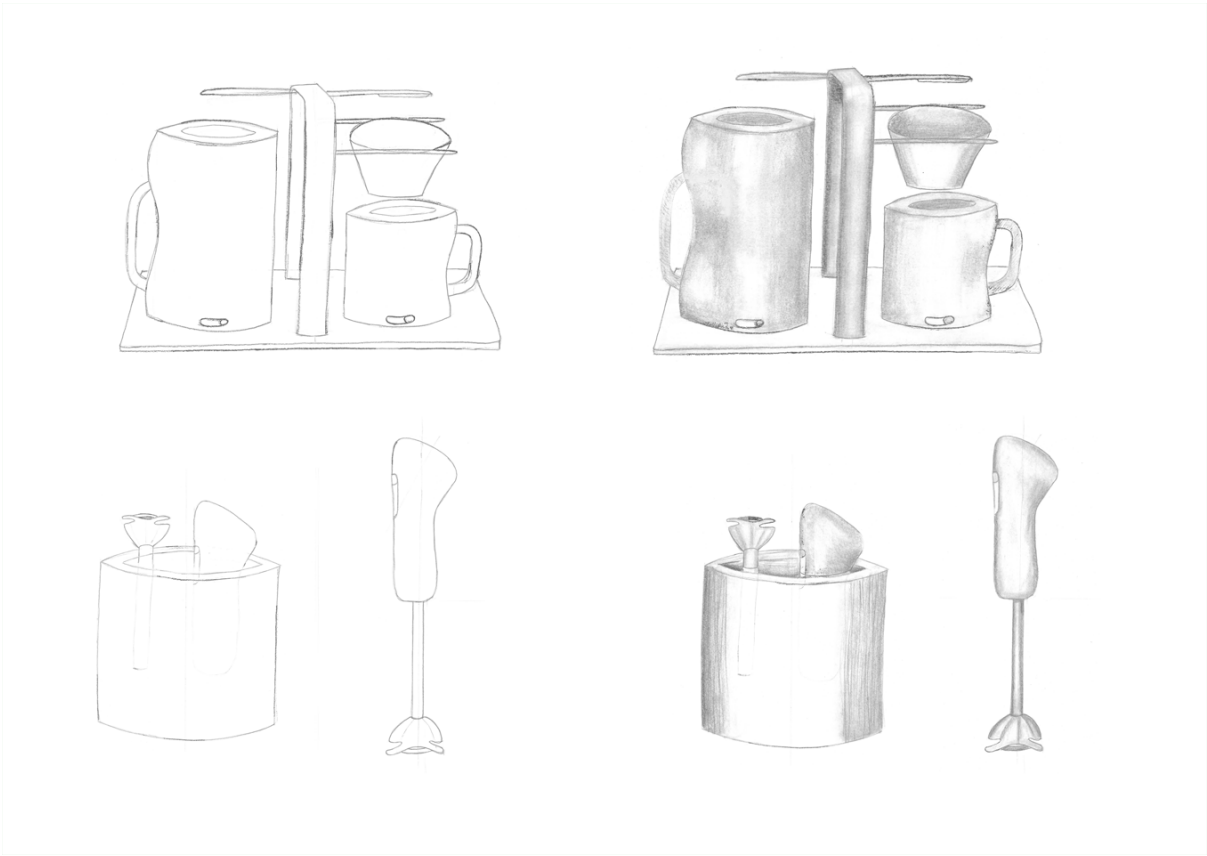

Figure 5.7: Sketches of Concept Series 3. Author's own copyright.

5.3 PMI Analysis

When evaluating the concept series, the method for PMI analysis was used. The PMI identifies plus (+), minus (-), and interesting (?) aspects with the different concept series.

Concept series 1

Plus (+)
+ The specific angle could be identified in all of the products, which strengthen the vision of a uniform product series.
+ The handle in the water boiler and coffee machine are placed in an angle that promotes a good grip.
+ The design with the clean lines are inspired by design classics, which opens up for the series to complement the modern Scandinavian kitchen.

Minus (-)
- The coffee maker and water boiler are not very self instructive.
- The coffee maker and water boiler do not have any obvious on/off button.

Interesting (?)
? The manual brewing process, which provides coffee of higher quality.

Concept series 2

Plus (+)
+ Self instructive design with on/off buttons.
+ The handle enables a different kind of grips.
+ The coffee maker is fully automatic, which could be nice to have for a stressful person.

Minus (-)
- The kettles has a narrow pouring section, which makes spillage easier.

Interesting (?)
? Could take up space in a vertical direction due to its water pipes.
? A handle that opens up for a various of grips could eventually cause un-ergonomic grips.

Concept series 3

Plus (+)
+ The coffee machine and water boiler do not need two separated pipes for water transportation, which saves materials.
+ The immersion blender stand could be used as a charging station, which enables the immersion blender to be wireless.

Minus (-)
- The curvy lines may not match the trendy kitchen of today.
- The curves make these appliances harder to manufacture.
- Many loose components, which increase the risk of damages.

Interesting (?)
?- The storage box enables charging opportunities.

5.4 PUGH Matrix

Another evaluation method that has been used is a PUGH Matrix. Firstly, two reference objects were set up as comparison objects. Two tables were created where weighting from 1 to 5 and points was awarded with a base on the requirement document. The first table shows the PUGH matrix for the coffee machine and water boiler, see figure 5.8, which has Moccamaster as a reference object. The second table shows the PUGH for the immersion blender, see figure 5.9, where an immersion blender from Electrolux was set as a reference object.

Chalmers University of Technology		Document type	List of Requirements and PUGH Matrix	Water boiler & Coffee machine	Note: *The reference object, MoccaMaster, is one of the most similar technical solutions that could be find on the market, even though it can not make both tea water and coffee. The design and material choices of the reference object may not be directly comparable with the concepts'.*				
		Project	Development of an uniform series of small Kitchen Appliances						
	Criterias for functions			Requirement /Desirable	Weighting (1-5)	Reference Object 	**Concept 1** 	**Concept 2** 	**Concept 3** 
1.	**Technical functions**								
	1.1	Produce warm water		**R**	**5**	0	0	0	0
	1.2	Produce coffee		**R**	**5**	0	0	0	0
	1.3	Indicate coffee refill		**D**	**4**	0	0	0	0
	1.4	Indicate on and off function		**D**	**4**	0	-1	1	-1
	1.5	Contain induction cooktop		**D**	**2**	0	1	1	1
2.	**Development and Assembly**								
	2. 1	Optimize packaging and transportation		**D**	**2**	0	1	1	1
	2.2	Easy to mount		**D**	**3**	0	0	0	0
	2.3	Enable change of components		**D**	**3**	0	1	0	1
3.	**Usability and esthetics**								
	3.1	Promote usability		**D**	**4**	0	1	1	1
	3.2	Fit in the kitchen area		**R**	**5**	0	1	1	1
	3.3	Express clean design		**D**	**4**	0	1	1	0
	3. 4	Minimize weight		**D**	**3**	0	1	0	1
	3. 5	Express stability		**D**	**3**	0	0	1	-1
	3. 6	Express simplicity		**D**	**3**	0	1	1	0
	3. 7	Express eternity		**D**	**4**	0	1	0	0
	3. 8	Suit the Scandinavian kitchen		**R**	**5**	0	1	1	1
	3. 9	Indicate coffee pitcher		**R**	**5**	0	0	0	0
	3. 10	Be space efficient		**R**	**5**	0	1	1	1
	3. 11	Express a cohesive design language		**R**	**5**	0	1	1	1
4.	**Quality and Sustainability**								
	4.1	Withstand damages		**D**	**4**	0	0	0	0
	4.2	Express high quality		**R**	**5**	0	0	0	0
	4. 3	Enable longevity		**D**	**4**	0	1	1	1
	4. 4	Pure materials		**D**	**4**	0	1	1	1
5.	**Safety and Maintenance**								
	5.1	Permit easy cleaning		**D**	**4**	0	1	0	0
	5. 2	Express safe use		**D**	**4**	0	0	0	0
	5. 3	Permit auto shutdown		**R**	**5**	0	0	0	0
	5.4	Signal when finish		**R**	**5**	0	-1	-1	-1
6.	**Elimination**								
	6.1	Enable desemble		**D**	**3**	0	1	0	1
	6.2	Promote recycling		**D**	**3**	0	1	1	1
Total poäng:							54	48	36

Figure 5.8: PUGH Matrix - Water- and coffee machine. Author's own copyright.

Chalmers University of Technology		**Document type**	List of Requirements	Immersion Blender	Note: *The reference object, Electrolux, is one of the most similar technical solutions that could be find on the market. The design and material choices of the reference object may not be directly comparable with the concepts'.*				
		Project	Development of an uniform small Kitchen Appliances						
	Criterias for functions			Requirement /Desirable	Weighting (1-5)	Reference Object 	Concept 1 	Concept 2 	Concept 3 
1.	**Technical functions**								
	1.1		Blend ingredients	**R**	**5**	0	0	0	0
	1.2		Enable wireless charging	**D**	**4**	0	1	1	1
	1.3		Permit on/off function	**R**	**5**	0	0	0	0
	1.4		Provide reverse function	**D**	**2**	0	1	1	1
	1.5		Permit a button for usage	**R**	**5**	0	0	0	0
2.	**Development and Assembly**								
	2. 1		Optimize packaging and transportation	**D**	**2**	0	0	0	1
	2.2		Enable changing of blending leg	**R**	**5**	0	0	0	0
	2.3		Supply a standing/hanging support	**R**	**5**	0	1	1	1
3.	**Usability and esthetics**								
	3.1		Provide blade guard	**R**	**5**	0	0	0	0
	3.2		Provide a good grip	**R**	**5**	0	1	1	1
	3.3		Promote usability	**R**	**5**	0	1	1	1
	3. 4		Fit in the kitchen area	**R**	**5**	0	1	1	1
	3. 5		Express clean design	**D**	**4**	0	1	1	0
	3. 6		Minimize weight	**D**	**2**	0	0	0	0
	3. 7		Express stability	**D**	**3**	0	1	0	0
	3. 8		Express simplicity	**D**	**3**	0	1	1	0
	3. 9		Express eternity	**D**	**3**	0	1	1	1
	3. 10		Suit the Scandinavian kitchen	**R**	**5**	0	1	1	1
	3.11		Be place effective	**D**	**5**	0	1	1	1
	3.12		Express a cohesive design language	**R**	**5**	0	1	1	1
4.	**Quality and Sustainability**								
	4.1		Withstand damages	**D**	**4**	0	0	0	1
	4.2		Express high quality	**R**	**5**	0	1	1	1
	4. 3		Enable longevity	**D**	**4**	0	1	1	1
	4. 4		Pure materials	**D**	**4**	0	1	1	1
5.	**Safety and Maintenance**								
	5.1		Permit easy cleaning	**D**	**4**	0	1	1	-1
	5. 2		Express safe use	**D**	**5**	0	0	0	0
	5.3		Enable battery saving mode	**R**	**3**	0	1	1	1
6.	**Elimination**								
	6.1		Enable desemble	**D**	**3**	0	1	1	1
	6.2		Promote recycling	**D**	**3**	0	1	1	1
Total poäng:							**80**	**77**	**68**

Figure 5.9: PUGH Matrix - Immersion Blender. Author's own copyright.

5.5 Further Development

The concept series one had the most positive aspects in comparison with concept series two and three. However, concept series two and three included some positive aspects that could be adopted into series one as well. Thereby, the main design and technology from concept series one were taken into further development, with inspiration from series two and three.

5.5.1 Result from PUGH

The result from the PUGH matrix shows that concept series one is the winning concept. The strengths from the other concepts were the placing of the on and off button in the coffee brewer. Things that have to be changed with the concept series one is the signal when the product has finished. Things that should be kept is the shape of the blender, which is one of the factors that makes the concept series feeling uniform.

5.5.2 Prototypes

Prototypes were created to ease the deciding of measurements, see figure 5.11. The prototypes were carved in foam and painted in darker colors to resemble the materials. The prototypes were later used as a base in the CAD surface modeling in Alias. Furthermore, three different handles from the original concepts were tested during observations with ten different users. Nine out of ten liked the angled handle the most, which also provides a natural hand position, see section 2.5. The person who did not like the handle with the angle told that it felt more heavy to lift the jug rather than by using a straight handle. One of the users who liked the angle mentioned: *"It felt more comfortable to hold when pouring the coffee from the jug"* Since most of the participants liked the angled handle it was chosen and further developed with 3D modeling in Alias and Catia.

Figure 5.10: Prototypes of handles. Author's own copyright.

Figure 5.11: Prototypes of final concept. Author's own copyright.

6
Final Concept

The final concept series BOHUS is a series of two products, with three main functions. When the coffee maker and the water boiler were analyzed, the similarity between the main functions were discovered which led to an integrated solution. The immersion blender are designed to promote the user to leave the product at the kitchen worktop.

6.1 The Final Concept - BOHUS

The modern Scandinavian kitchen of today requires new, modern kitchen appliances, which complements the architecture. The developed concept series, named BOHUS, takes this aspect into reality.BOHUS is a series of two products, with three main functions. The series includes a manual coffee maker, which also is able to produce hot water.

BOHUS coffee brewer is a solution where the user pours freshly boiled water from the water boiler over the coffee in the filter, see figure 6.1. The water boiler activates through the button in the right corner of the plate. One of the most important factors for brewing high-quality coffee is clean water. Using clean water should not be a problem in Scandinavia because the Nordic countries have one of the best water cleaning systems in the world. Unfortunately, there are not many coffee machines that promote this. A regular coffee brewer has a coffee jug, which is used for both filling up with water and carry the brewed coffee. The majority of the users do not dish the jug between the usage, which leaves dirt in the jug that later on transports into the water pipes and is hard to get rid off (Coffee Brewing Methods, n.d.). By using a manual solution, the product eliminates the risks of dirt inside of the pipes, which makes the products more easy to maintain. Another strength with the manual coffee brewer is the store efficiency. Instead of having two products for boiling water and brewing water, BOHUS coffee brewer utilizes the fact that the two products have similar functions and thereby integrates the two main functions into one unit product.

Figure 6.1: BOHUS coffee brewer with integrated water boiler. Author's own copyright.

The second product in the concept series is an immersion blender, see figure 6.2. When designing the immersion blender it was of high importance that it could be identified together with the integrated coffee maker and water boiler in the series. Therefore, the angle of the pouring section in the jugs was included in the design for the handle of the immersion blender. The button in the front of the blender is a manual button that turns on the product when pressing it, which also can be seen in the plate for the coffee brewer. Adapting specific forms or angles in different products in a series is a design strategy that could be seen in for instance KitchenAid's 50's Retro series, see section 4.4.2. The immersion blender includes a recharge station, which also could be used as a storage box. The recharge station is designed with the same materials as the other products within the series in order to make the products feel unit.

Figure 6.2: BOHUS immersion blender with charging station. Author's own copyright.

6.2 The Product Series in the Scandinavian Kitchen

The concept series is designed to complement the modern Scandinavian kitchen of today. Materials like light wood and stainless steel were recurrent when observing modern kitchens. Regarding colour, white was the most common but variants of grey could also be seen.

The series BOHUS has taken all those aspects into reality, why the main colour is dark grey, but there is also features in white oak. The series is inspired by the west coast environment, where the climate could be strenuous. BOHUS is a series who get the feel of stability, cleanness and eternity. The wooden details are inspired by the piers of the west coast as well as the rich and beautiful forests that could be seen in the country of Sweden, see section 4.5. The series reflects the five keywords - Responsible, Native, Eternal, Noble and Scandinavian.

The product series fits the urban home chef who has high expectations in both functionality and aesthetics. A passionate home chef has desire large working space which makes the space efficiency of the products even more important. The user would not wish for any frills when it comes to his or her kitchen appliances, it should exude high quality without any insignificant details. Furthermore, a passionate home chef tends to cook a lot of food, which also means that the appliances are used quite often. That is also an aspect that has been taken in mind while designing the concept series. The BOHUS series could be left at the kitchen worktop without bothering, since it is designed to complementing the kitchen architecture as a whole, see figure 6.3 and 6.5.

Figure 6.3: BOHUS series visualized in Ballingslöv kitchen BISTRO, coloured peppargrå. Author's own copyright.

Figure 6.4: BOHUS series visualized in a classical kitchen from Ballingslöv. Author's own copyright.

Figure 6.5: BOHUS series visualized in Ballingslöv BISTRO kitchen, coloured in ostron-beige. Author's own copyright.

6.3 Technical Components and Details

The technical components for the kitchen appliances are not detailed designed. However, the kitchen appliances are designed in order to fit the measurements for external components such as engine and battery in the immersion blender, see section 4.3, and heating components in the water boiler.

BOHUS immersion blender will work in the same way as an ordinary immersion blender. The main difference is that it is wireless and could be charged in a charging station, see figure 6.6 and figure 6.7 for a closeup. This also means that the immersion blender involves a rechargeable lithium battery, unlike the disassembled immersion blender in section 4.3.

Figure 6.6: Immersion blender placed in charging station. Author's own copyright.

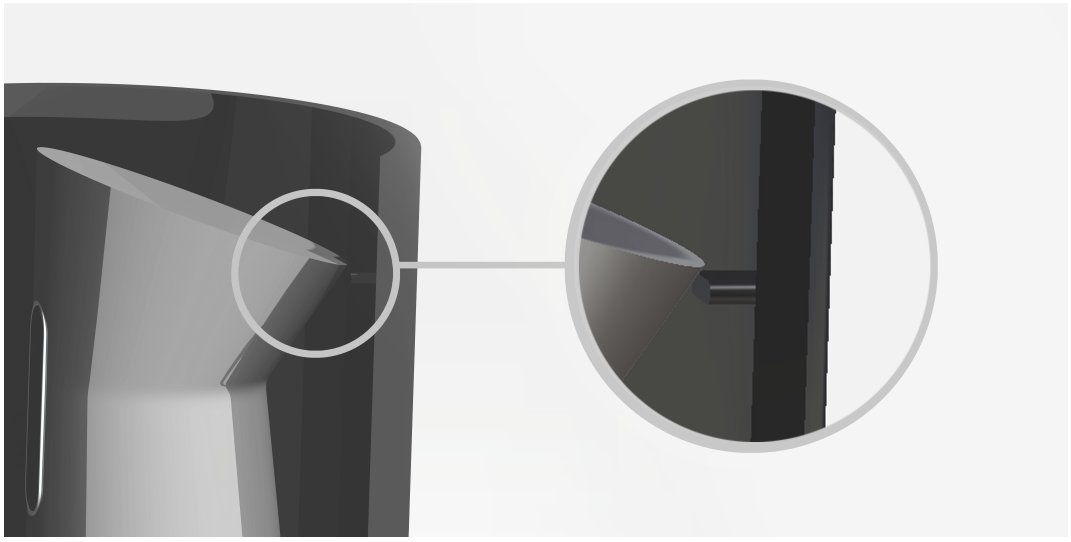

Figure 6.7: Closeup of charging outlet for immersion blender. Author's own copyright.

The integrated solution for the coffee brewer and water boiler does not have as many technical components as a regular coffee brewer, due to its manual processing. Instead, the BOHUS water boiler will use the same technique and be plugged into the power base as a regular water boiler. The bottom plate is turned on by sliding the round button in the corner of the plate, see figure 6.8.

Figure 6.8: Plugg in to powerbase for Water Boiler. Author's own copyright.

The plate for the coffee brewer will indicate when the product is on with a LED light. The light surrounds the shape of the water boiler and signals when the product is turned on, see figure 6.9. The light intensifies while the water is getting warmer and when the process is finished the light will turn off to indicate that the water is ready for brewing, see figure 6.10.

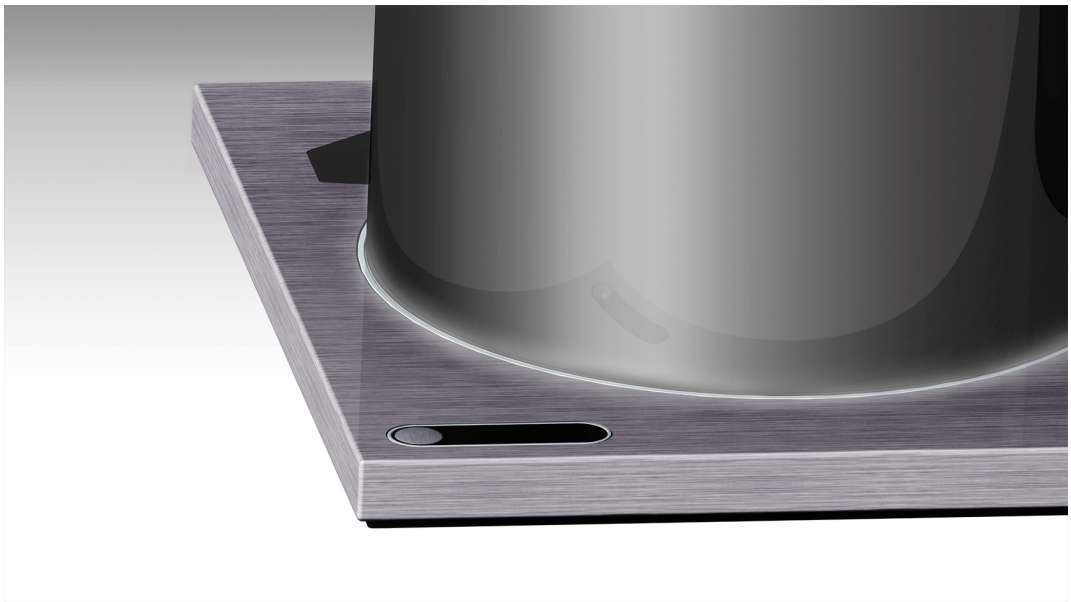

Figure 6.9: Plate for the coffee brewer with LED light glowing. Author's own copyright.

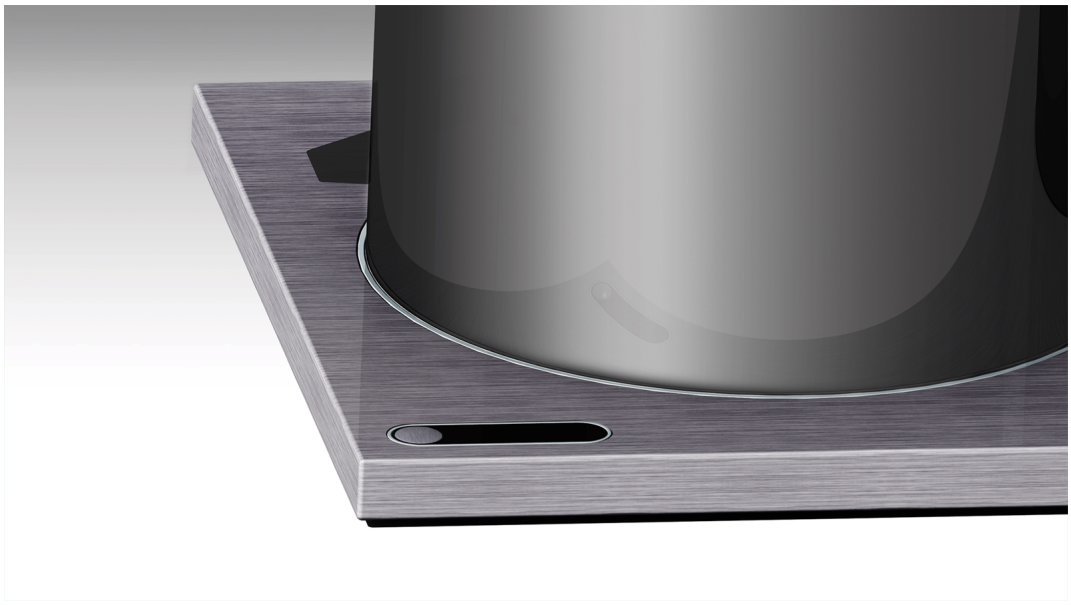

Figure 6.10: Plate for the coffee brewer while not in use. Author's own copyright.

Furthermore, the water boiler has a measure indicator at the inside of the jug, which facilitates for the user to use the right amount of water.

6.4 Measurements

The basic measurements are presented in figure 6.11. The plate will determent how much of the kitchen worktop space that will be consumed by the coffee brewer. The measurements for the width and the depth of the plate are 350 mm and 200 mm and the highest point in the coffee brewer is the filter which has a height of 258 mm.
The immersion blender has a total height of 298 mm, which makes the BOHUS immersion blender more space efficient compared to the blender used during the observation which was 390 mm, see section 4.2.4.

Figure 6.11: Measurement of the final concept. Author's own copyright.

6.5 Material Choice

The main material in the products is stainless steel, which has good resistance to corrosion and oxidation. In this case, the stainless steel will be chosen to a dark grey colour, see figure 6.12. Stainless steel does also enable a wide choice of mechanical properties. Furthermore, this is a material that can be found for both refrigerators and other kitchen appliances.

Figure 6.12: The grey colour setting, NCS code S 8500-B. Author's own copyright.

The handles will be in wood, a white pigmented oak has been chosen for these products, see figure 6.13. It has its strength in both the easy weight, cheapness and that it is a renewable material. Oak is in general easy to work with and can be both carved and joined. Furthermore, wood is a material that often is associated with Scandinavian design. When it comes to aging, wood is often very nicely aging and could be even more good looking after a couple of years, which promotes the concept for 'Design for Graceful Aging'.

Figure 6.13: White pigmented oak for the handles. Author's own copyright.

Moreover, some of the parts of a smaller scale will be produced in plastic, for instance, the covering cap for both the water- and coffee jug. The colour of those components are set to the same NCS code as the stainless steel, see figure 6.12.

6.6 Manufacturing Methods

Appropriate manufacturing methods for the product series will be deep drawing and eventually metal casting when it comes to components in stainless steel. The plastics parts will preferably be manufactured with injection molding. The wood handles would be of the highest quality by milling and turning. For further reading about the manufacturing methods, see section 2.7 in the frame of reference.

7
Sustainability Analysis

Responsible business and CSR, which includes aspects of human rights, has come to be a common term within most industries today. Customers as well as consumers requests for a more ethical view of product development, which carries an increasing demand of concerned companies. In this chapter, approaches for sustainable products development will be presented.

7.1 Material Impact and Recycling

One important aspect when promoting sustainable product development is the material impact. The products in the BOHUS series will be produced in stainless steel, a material that has a CO2 footprint of 6,9-7,61 kg/kg when the material is produced primary (Granta Design, 2019b). Stainless steel has a higher CO2 footprint than PP plastics, however, steel has a recycle fraction of approximately 37% which could be compared to the recycle fraction of PP plastics at 5% (Granta Design, 2019a).

However, some smaller parts will preferably be produced in PP plastics, for instance, the covering part for the water boiler and coffee machine. The handles and cover are produced in oak, which is a natural material with a CO2 footprint of 0,574-0,633 kg/kg in primary production (Granta Design, 2019c).

A prerequisite for recycling the materials is that the products are easy to disassemble, which have been taken in mind while designing the products. For instance, the wooden handles are easy to remove from the jugs in stainless steel. However, the electrical components complicate the recycling process and are also a reason for the user to not disassemble the products on their own. What could be done, is to inform and promote the user to leave the products to the household waste recycling center.

7.2 Technical Lifetime

A long product lifetime leads to fewer products consumption, which certainly is an important sustainability factor. The technical lifetime of the products within the BOHUS series is estimated to approximately ten years. The critical factor, which sets the limits for the lifetime, is the chargeable lithium battery in the immersion blender. However, there is extensive development going on within the area and the exact lifetime is hard to estimate. Another factor that is important to take in mind is how people would use their kitchen appliances in the future. It could not even be guaranteed that people will use the same appliances as today. A fast developing innovation is induction, which in the future could phase out the traditional heating technique in the water boilers of today.

The manual solution for brewing coffee could be questioned. It is certainly a trend at the moment, but it is not sure that it will be as trendy in ten years. However, the fact that the manual brewing process actually produces coffee of higher quality will probably attract most coffee enthusiasts, even in ten years.

7.3 Aesthetical Lifetime

The aesthetical lifetime of a product is even harder to estimate than the technical limitations since it is depending on trends and changes in peoples opinions. The changes within the kitchen industry could, however, as in most other business, be analyzed through trend analysis. During the interview with the kitchen architect at Ballingslöv, natural colour like white, grey and black were mentioned as safe cards. That was an aspect that was taken in mind when choosing the colours for the BOHUS series, which mainly is coloured in dark grey. Furthermore, natural colour choices have an advantage in matching almost every Scandinavian kitchen. That means that the customer does not necessarily need to buy a new coffee brewer when moving into a new kitchen with the argument that the old coffee brewer does not match the new kitchen interior.

7.4 Ethical Issues

An ethical issue when designing new products is that it in some way probably will increase the consumption behavior, which already is a major world problem. An aspect that speaks against that fact, is the timeless design and natural colour choices but also that the main functions, brewing coffee and boiling water, are integrated into one unit product, why the customer can buy only one product instead of two. Another ethical issue that can appear is that the customer buys all products within the series without actually being in need of all of them. The project is all about creating a cohesive series that is supposed to be purchased together, which of course has a bad influence if the customer decides to trash an already working product. Furthermore, it is important to have a good dialogue with potential suppliers to guarantee that human rights are taken in mind from the suppliers' point of view.

8

Discussion and Conclusion

In this chapter, the process and methods used during the thesis work will be discussed. Furthermore, how well the developed products actually meet the set requirements are discussed as well as recommendations for further development in the future.

8.1 Process and Methods

The thesis was divided into several phases in order to simplify the structure and set the framework for the study. Initially, considerable weeks of time were dedicated to CAD However, through dialogue with one of the supervisors the researching phase was extended to meet the capability for answering the research questions.

Regarding the methods used during the project, all methods have been of high importance for the result of the study. All methods were thoroughly chosen to enable answering all of the research questions with confidence. There are several other methods that were discussed in the early stages, for instance, KJ Analysis could have been useful in order to organize the information from the user studies. However, with limited project time, the KJ Analysis was of lower priority.

The survey, interviews and observations were useful methods for collecting insight information from a users perspective. All of the user study methods highlighted a different kind of aspects, both predicted and non-predicted, which later was taken into the product development. The number of participants answering the survey was surprisingly high, 269 answers could be compiled. The participants represented a varying age, mainly within the age range of 18-35, both men and women, which also makes the result from the study trustworthy. Furthermore, the interview with Annika, the Kitchen Architect from the Scandinavian kitchen brand Ballingslöv, granted very usable information about Scandinavian design language and trends within the industry.

Although this project did not have the aim for designing all technical details, it was useful to have a general insight in which technical components that should fit into the products. Hence, a disassembly of an immersion blender was performed during the pre-studies to measure for example the engine and circuit card. An improvement of the result could be to perform a comparable disassemble of both a water boiler and a coffee machine, which would result in an extended view of measurements and relevant components. However, the project group determined to not include such a disassemble within the frames for this thesis in a matter of both time, funding and sustainability. Instead, research from the internet and physical stores was the source for detail information regarding water boilers during this project.

8.2 Meet of Requirements

In this section, the concept series in relation to the set requirements are further discussed. The section is divided into a technical part as well as an aesthetic part where the design language is being discussed.

8.2.1 Technical Functions

Both product concepts compared to the requirement specification shows that all technical functions are fulfilled. The water- and coffee boiler can produce both hot water and coffee, it also permits the auto shutdown function after five minutes. Moreover, it signals when the water has reached a temperature of 95 degrees Celsius, which is the ideal temperature for high-quality coffee. The manual product solution does also enable that the two main functions, produce hot water and coffee, could be integrated into one product without affecting the price and including components.

The immersion blender has the ability to blend most ingredients. Moreover, it is a wireless solution that charges in its charging station. That means that the user needs to charge the immersion blender at a regular basis, which could disrupt. However, the fact that there is no wire interrupting the actual operating is seen as such a benefit that the charging scenario is estimated to not be that annoying.

8.2.2 Design Language and Product Identification

The two products are designed with the Scandinavian design philosophy in mind. One important aspect of the development was that the products should match and complement the modern kitchen of today. Thereby, the information from the Kitchen Architect was analyzed carefully in order to fit the expectations of the passionate home chef. Materials have been selected through a critical process, where the main focus was to bring the feel of the modern kitchen into the product series. The pure materials express high quality, which was desirable when compiling the requirement specification.

Furthermore, the products within the BOHUS series were designed with the same design language and the choice of materials was unit for all products. Also, the design of the button is included in both of the products to strengthen the product identification further.

8.3 Further Development

The series BOHUS is presented on a concept level, which indicates that further development is needed before the products could reach a market. One important thing that should be investigated on a deeper level before reaching the customer is the electrical aspect to eliminate risks for injuries. An outgrowth of that investigation could, for instance, include analysis of the potential for certification with CE marking as well as comparing to established ISO standards.

Furthermore, the presented manufacturing methods are not definitive and should with advantage be tested before taking a final decision. That could lead to modifications either within the design or a choice of an alternative manufacturing method to keep the

material standards high. Depending on which technical components, for instance, engine and battery, that will be chosen from the supplier the products could be in need of small modifications. However, those modifications are estimated to not affect the overall design of the series.

Another aspect that could be investigated is the possibility to extend the series with a wider range of kitchen appliances. To start with the survey, see section 4.2.1, tells that a toaster could be an appropriate entrance to extend the series. However, the overall user studies are evidence for an increasing demand of well-designed series of kitchen appliances that reflects the expectations of a passionate home chef, whether it is in the shape of a toaster or anything else.

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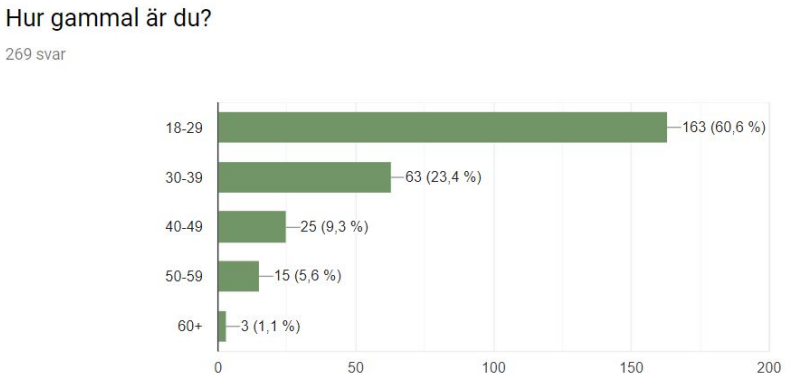
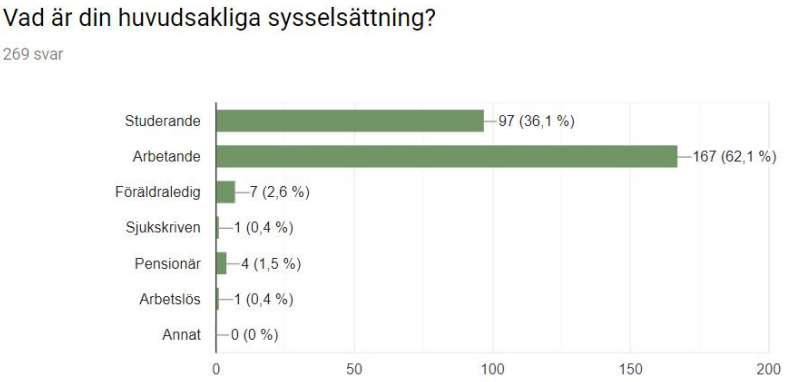
A

Appendix

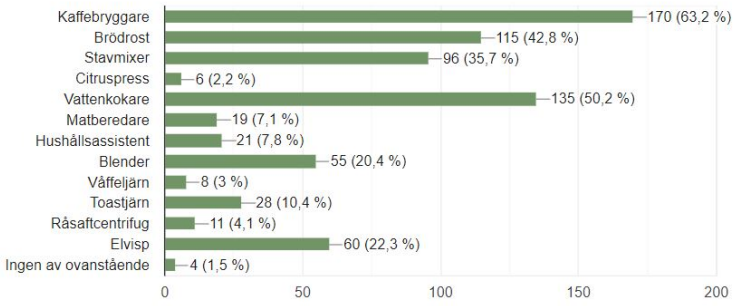
A.1 Survey Result





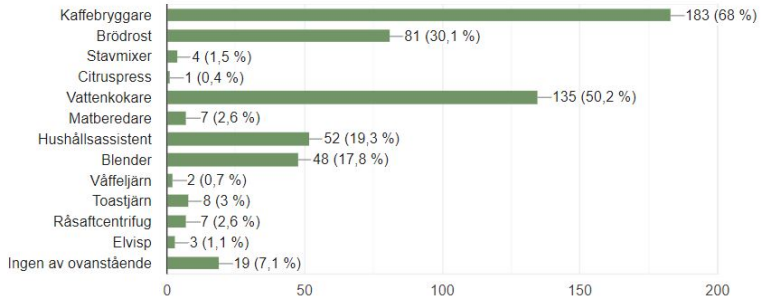
Vilka elektriska köksredskap använder du oftast? Max tre val.

269 svar



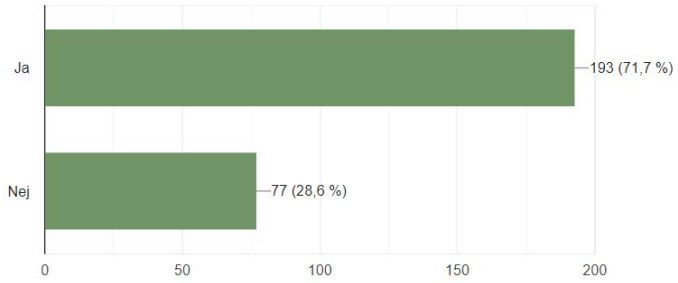
Vilka elektriska köksredskap lämnar du synliga även när du inte använder dem?

269 svar



Skulle du kunna tänka dig att ha flera köksredskap integrerade i varandra?

269 svar



Om du svarade ja, vilka redskap skulle du vilja ha integrerade i varandra?

138 svar

Kaffebryggare och vattenkokare
Vattenkokare och kaffebryggare
Vattenkokare och kaffebryggare
vet ej
Alla
alla
Stavmixer + elvisp
Typ något som både hackar/vispar/blandar. En matberedare med vispfunktion?
Kaffekokare o vattenkokare
matberedare och stavmixer, som har bättre kavlite än det som finns idag.
Mixer, matberedare, visp och liknande
elvisp, stavmixer och spirualiser

A.2 Interview Guide Lines

- Hur gammal är du?
- Vilken är din favoritprodukt och varför? Finns det någon produkt du lagt mer energi (research etc.) och pengar på än andra?
- Vilka elektriska köksredskap använder du oftast i ditt kök? (Max tre val)
- Vilka elektriska köksredskap låter du vanligen stå framme även när du inte använder dem?
  - Varför? Varför inte?
- Skulle du kunna tänka sig att ha framme produkterna om de hade ett gemensamt designspråk?
- Tycker du att det är viktigt att dina elektriska köksredskap har en gemensam design? Isåfall, vilka?
- Tänker du på att dina köksprodukter ska komplettera den övriga köksinteriören?
- Skulle du kunna tänka dig att ha flera köksredskap integrerade i varandra? Isåfall, vilka?
- Slutligen, hur ska en perfekt (favorit-)produkt vara designad? Vad krävs för att du ska lämna den framme?

A.3 Coffee Machine Observation

User	Product knowledge	Boiling coffee	Grip	Adding water	Interesting
Test 1	User knows the product and uses it everyday	Fills water with a separate pot.			User understands both buttons, the on/off funktion and the other for the hotplate.
Test 2	User knows how the product works but is not used to boil coffee.	Fills water with a separate pot.			User has no idea about the second button. Only recognize the on/off one.
Test 3	User has used the product a couple times before.	Fills water with a separate pot.			User has no idea about the second button. Only recognize the on/off one. User also looks for something that indicated that the coffee machine is finished.
Test 4	User knows the product and uses a similar one everyday	User fills the coffee pot with water but cleans it first to ensure that the machine doesn't damage.			User is left handed but grabs the coffee pot depending with any hand on the position of it. User understand the on/off button and believes that the other one is some sort of timer.
Test 5	User knows the product and uses it everyday	User fills the coffee pot with water.			User recognize button one and guesses that the second button is for the heating plate, but do not know what the symbols stand for.

A.4 Water Boiler Observation

User	Product knowlegde	Boiling water	Grip	Water usage	Interesting
Test 1	Owns the same model.	Wants to boil water for one cup		Fills to minimum, 0,4l. Uses only half of the water ends u pouring out 0,2l.	Stops the boiling process before boiling point.
Test 2	User is not used to boil water with a water boiler	Wants to boil 3 cups of water.		Fills to 0,6l. Uses only half of the water ends up with a perfect amount of water.	User does not understand the opening lid and fills the kettle with water through the pipe. User only sees the on off button but understands the opening function of button two after finished boiling
Test 3	Is used to boil water but not with the same model.	wants to boil 2 cups of water.		Fills to 0,8l. Ends up pouring out 0,3l.	Understands what button two and three is for, do not think button number one has any function, since it is not intuitive .
Test 4	Is used to boil water but not with the same model.	wants to boil 2 cups of water.		Fills to 0,8l. Ends up pouring out 0,4l. Poured extra water into the boiler to ensure that it would be enough water for two cups.	User sees two buttons but asks about button number one, later tries to open it with a knife.
Test 5	Is used to boil water but not with the same model.	Wants to boil one cup of water.		Fills to 0,6l. User likes to pour extra water into boiler since some of the water evaporates. After the user was left with 0,4l of water to pour out.	User sees three buttons, understands the on/off button. but is uncertain about the others.
Test 6	Is used to boil water but not with the same model.	Wants to boil three small cups of water.		Fills to 0,7l. The user was left with 0,15l afterwards. The user also fills up the water boiler with water after usage in case of turning on the machine by accident. Which means that the user pour out extra water if there is to much in it for the next use.	User finds it hard to see if the product is on and tried to press the timer a few times. User also sees two buttons, not button number one. But later the user consider the first button to be used when the lid is supposed to be shut. Since the buttons material is the only material that doesn't get warm during use.
Test 7	Is used to boil water but not with the same model.	User only fills to minium and wants to boil water for one person.		Fills to 0,4 l and user is left with 0,2l by the end of the process.	User sees two buttons first but hesitate when the question was asked, and changes to seeing three buttons. But button number one is probably something made for aesthetic appearance.
Test 8	Is used to boil water with the model has used it many times.	User wants to boil water for one cup.		Fills to 0,4 l and user is left with 0,2l by the end of the process.	User only sees two buttons button number one is not a button only exists the aesthetic appearance. It was hard to see when the water was finished. User think that the on/off button should be placed at the bottom of the product, to simplify for the user to know when the product is finished.

A.5 Immersion Blender Observation

User	Mixing Soup	Grip	Mixing Smoothie	Grip	Interesting
Test 1	Uses both a straight grip and an angled. Uses button 1, pressed with thumb.		Uses a straight grip. Uses button 1, pressed with thumb		Likes the tapered grip. Do not like the thicker diameter, it is harder to grip
Test 2	Uses both hands in the beginning, later one hand in an angled grip. Uses button 1, pressed with thumb.		Uses a straight grip, with a pointy thumb. Uses button 1, pressed with thumb.		Uses both hands in order to get a steady grip.
Test 3	Uses both hands in an angled circular movement. Uses button 1, pressed with thumb.		Uses a straight grip. Uses button 1, pressed with thumb.		Uses both hands in order to get a steady grip.
Test 4	Uses both a straight grip and an angled. Uses both buttons with both the middle and the index finger.		Uses both a straight grip and an angled. Uses both buttons with both the middle and the index finger.		Angles the blender to get more air into the blending process. Uses both the middle and the index finger to start the blender
Test 5	Uses a Straight grip. Do not Angle the blender. Uses button 1, presses with thumb.		Uses a Straight grip. Do not Angle the blender. Uses button 2, presses with thumb.		
Test 6	Uses a special angle with a deviation positioned hand. Uses button 1, presses with thumb.		Uses a straight grip, with a pointy thumb. Uses button 1, pressed with thumb.		Asks for a button to make the blender work on its own. User is left handed, but likes blending with the right hand.

Test 7	Uses a straight grip in circular movements. Uses button 2, presses with middle finger		Firstly uses both hands, but later moves on to one hand. Uses button 2, presses with index finger.		
Test 8	Uses both a straight grip and an angled. Uses both buttons with both the middle and the index finger.	 	Uses both a straight grip and an angled. Uses both buttons with both the middle and the index finger.		Angles the blender to get a swirl to the ingredients.
Test 9	Uses only a straight grip. A bit angled in the end of the process. Uses button 1, presses with thumb	 	Uses only a straight grip. A bit angled in the end of the process. Uses button 1, presses with thumb		Angles the blender to get a swirl to the ingredients.
Test 10	Uses only a straight grip. Uses button 1, presses with thumb		Uses only a straight grip. Uses button 1, presses with thumb		You want to place the hand on the black rubber part since the white material is slippery.
Test 11	Uses both a straight grip and an angled. Pressed with a pointy thumb.	 			The blender is very heavy, and feels clumsy to use
Test 12	Uses a straight grip and presses with index finger, tilts the blende and uses and angled grip presses with thumb.	 			Changes grip depending on the angl. Thinks that the blender will slip out of the hand if it doesn't decrease the diameter.