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Development of a differentiated high-end juice extractor for household use

Master of Science Thesis in the Master Degree Program, Industrial Design Engineering

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Acknowledgements

This report is the documentation of a Master Thesis project, from the beginning of the project to the final outcome. The Master Thesis is the final examination of the Industrial Design Engineering education at Chalmers University of Technology. The project has been carried out in collaboration with Electrolux at their premises with the goal to develop a new product concept for a juicer.

We would like to thank everyone who contributed to this project with their engagement and time. The possibility to carry it out in house at Electrolux has been extremely valuable. Especially because of the proximity to all knowledgeable colleagues. A great thanks to Monica Maria Rojas Restrepo, Mari Törmälä, Jérôme Esteve, Henrik Holm and Tommy Franzén for their support and helpfulness throughout the project.

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Julia Davidsson and Elisabeth Malm

Stockholm, 2012

Abstract

This Master Thesis was carried out at the department of Product and Production Development at Chalmers University of Technology by Julia Davidsson and Elisabeth Malm. The project was executed in collaboration with Electrolux and carried out at their office in Stockholm.

The project was initiated to generate a product concept for a new juice extractor. A juice extractor is a kitchen appliance that can extract the juice from many different kinds of hard or soft fruits and vegetables. The most common type on the European market is the centrifugal juicer. It grinds the fruit and spins it in a mesh basket at around 13000 rpm, which allows the juice to be extracted through centrifugal forces. Electrolux has identified a customer opportunity for a juicer that is differentiated and belongs to the market segment of high-end products. The aim of the project was therefore to make use of this customer opportunity.

The end result is a combination product of a centrifugal juicer and a blender. The two techniques complement each other because some fruits and vegetables are better suited for juicing while others are better blended. The blender function can also be used for adding other ingredients than fruit; for example ice, yoghurt and ice cream. This way, the usage range for the product has been extended significantly. The idea arose after visiting juice bars that used both juicers and blenders to create more luxurious fruit beverages.

During the first phase of the project, a thorough research was carried out. Competitor products were tested, existing users were interviewed, a focus group was performed and several juice bars were visited. The collected data was analyzed and sorted in order to be used as a base for the continued work. After a few weeks of idea generation, the concept was selected by means of an evaluation matrix and expertise from Electrolux. The concept was developed further in terms of functionality, visual expression, handling, safety, materials and manufacturing. Finally, the product concept was evaluated through non-empirical methods as well as customer acceptance tests to make sure that it attracts our intended target group. The project has been supported by contact persons from research and development, industrial design and marketing.

Key words: *Industrial Design Engineering, Product development project, Juicer, Juice Extractor, Blender, Food Processor, Kitchen Appliance, Electrolux*

1. Contents

1. Introduction

This chapter introduces the Master Thesis project behind this report. It describes the background, aim and delimitations of the project, as well as the process and the time planning that has been followed. The reader is also given a guidance on how to read the report.

1.1 Background

The purpose of this project was to develop a concept for a juice extracting machine for the company Electrolux. This section describes the company, and the background for the project.

1.1.1 The company

Electrolux is an international company that offers appliances for both household and professional use. These products include refrigerators, dishwashers, washing machines, vacuum cleaners, cookers and air-conditioners. Electrolux has around 52000 employees across the world and sell products in 150 different markets. (Electrolux, 2011)

1.1.2 Project background

Several of Electrolux' competitors provide products for extracting juice from fruit and vegetables. Electrolux themselves do not have a corresponding product on the market yet, but are interested in introducing one. The existing competitor products use different techniques for extracting juice, which all have their advantages and disadvantages. Products using the same technique also vary a lot in performance, for example regarding how much juice they extract from the same amount of ingredients. Many of the products existing today also have other flaws regarding usability, cleanability, size, noisiness etc.

According to Electrolux, the demand for luxury products is growing and consumers are ready to pay more and more for certain products that they consider important. Electrolux has seen a customer opportunity to create a juice extractor that falls into this high-end category of products. Hence, they have defined the user to belong to one of their predefined target groups that are appealed by high-end products. The existing products on the European market are relatively alike when it comes to both technical principals and their aesthetics. Even though some of the machines are relatively pricey, none of them have a distinct high-end identity. The new product does not necessarily have to fall into this category, placing a product here in terms of looks puts demands on improved functions. Depending on the nature of the chosen concept, another suitable market segment could be chosen.

Important aspects for the juicer concept identified by Electrolux are juicing performance, compactness, innovation level, easy to use and to clean, safety and differentiated/stunning design. The product could also provide other functions than just juicing, but not if it is compromising the performance of the machine as a juicer.

1.2 Aim

The aim of the project is to make use of Electrolux' identified customer opportunity for a differentiated juice extractor that belongs to the market segment of high-end products. The ambition is to find a new approach to the traditional juicer and to come up with a product that is innovative and creates an added value in terms of design, handling or technology.

1.3 Goals

The goal for the project is to create a product concept for a kitchen appliance that extracts juice. The appearance and the technical principals of the final concept shall be presented with CATIA V5 3-D model and sketches. A non-aesthetical, functional prototype will be built to secure the main functions of the product.

The final product shall:

- Be differentiated from its competitors.
- Add a benefit for the user compared to competitor products.
- Have the prerequisites to extract as much juice as a top-performing juice centrifuge (an extraction rate of around 65% of the initial weight).
- Be easy to understand and handle.
- Fit with the visual expression of Electrolux' products within the same market segment.
- Present a suggestion for materials- and manufacturing selection.
- Have the prerequisites to fulfill the relevant requirements from standards regarding hygiene and safety.

1.4 Delimitations

- The project focuses on the European market. After project completion, comments could be collected from international marketing departments.
- The prototype does not have to evaluate all functions.
- The part functions will not be optimized, but a suggestion for a working solution will be offered when considered necessary to strengthen the credibility of the product.
- The manufacturing of the product will not be determined in detail but taken into consideration. The aim is that it should be possible to further develop the product for production without making major changes to the product design.
- Cost calculations are not part of the project scope. Since the product is assumed to belong to a high price segment the end price is not the most critical factor for the success of the product.
- The project only considers the product, and does not include marketing or launch plans.

1.5 Project process

The following section explains the structure of the project and how to read this report.

1.5.1 Support functions

The project has been supported with expertise from different areas. For questions that have arisen throughout the project, different contact persons have been available for help and advice. More formal meetings have also been set up every month to report the progress to a steering group.

The main supervisor and the initiator of the project has been Mathias Belin, Global Technical Area Manager for Small Appliances at Electrolux. He has been involved in all major decisions. The support functions have been: Monica Maria Rojas Restrepo for technical aspects and general knowledge about food processing appliances, Henrik Holm for construction issues, Mari Törmälä for marketing aspects, Tommy Franzén for questions regarding safety and Jérôme Esteves for design questions.

The steering group has consisted of: Mathias Belin, Monica Rojas and Mari Törmälä as well as Simon Bradford and Pia Ringholm from the Industrial Design Department.

1.5.2 Process Plan

For making a rough lay out of the project from beginning to end, a process-plan (fig. 1.1) was created. The purpose was to get an overview of all the steps that shall be included along the way and to communicate the process to Electrolux. The process has been divided into five major blocks; Research and Analysis, Concept Development, Further development, Visualization and Fine-tuning and finally Evaluation. Between the blocks there have been decision points and checkpoints where certain deliverables were to be finished.

1.5.3 Time plan

Based on the process plan, a Gantt-schedule was made. A Gantt schedule is more detailed than the process plan and has clear time frames for each working task. At the end of each of the four blocks, a meeting with the steering group was set up. The steering group could provide expertise and give input to the major decisions that had to be taken.

1.6 Report outline

This report does not have to be read from cover to cover. It is structured in a way that allows the reader to proceed to the desired part.

After the introduction chapter, which includes background information on the project, there is a theory chapter. This part describes theory that is important for understanding different parts of the product or project. It can be used as a support to go back to when reading the rest of the report. The theory described has been collected throughout the project, but is not unique for this specific thesis. In case the user is already familiar with the subjects, it can be disregarded. The third chapter presents the different methods used throughout the project.

The following four chapters describe the execution and the results of the project. They include the decisions made and the methods used. Section 4.2 presents the results from the research performed, sorted after content. To get a better flow through the report, this structure has been chosen in favour of presenting the exact results from each and every method.

For a deeper understanding of the project, there are references to the theory and methods chapters as well as appendixes. Concluding the report there is a discussion including recommendations for further development and a conclusion.

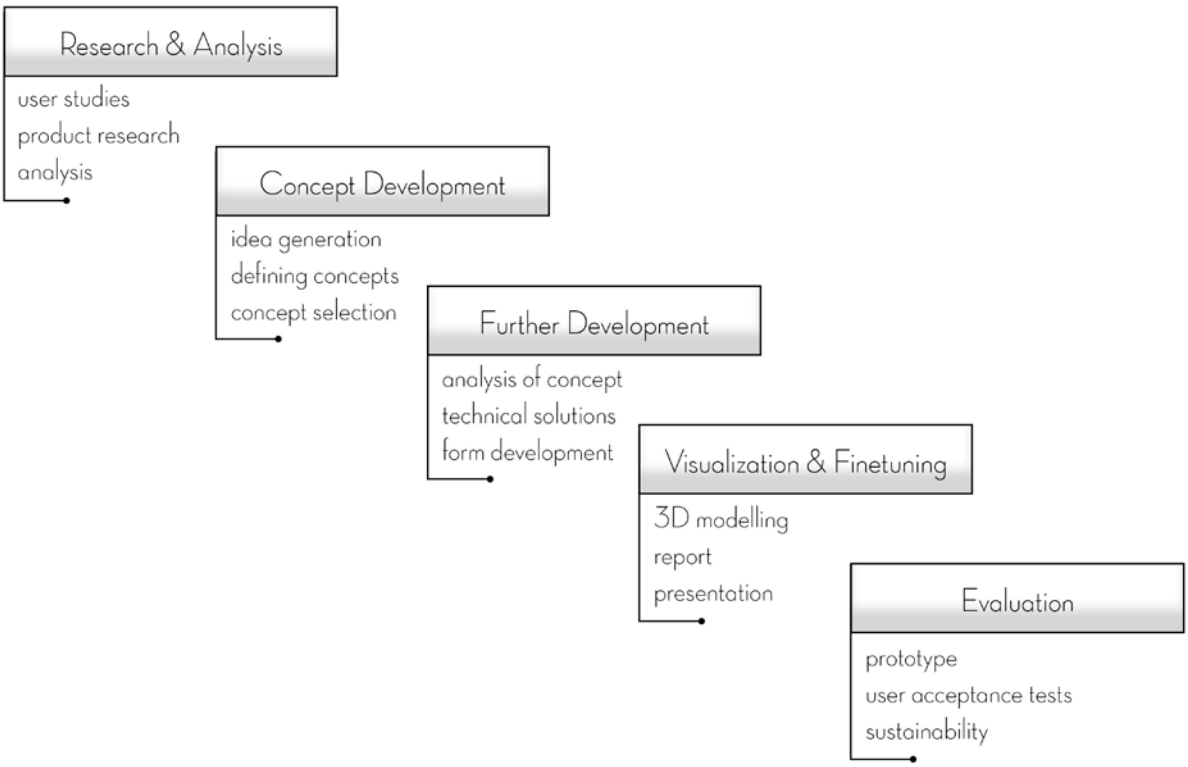


Figure 1.1 Process plan

2. Theory

This chapter contains theory that is considered relevant to fully understand the product or decisions taken throughout the project. The theory can be used as a support to go back to whenever necessary. For the reader that is already familiar with the subjects presented here, it can be disregarded. It does not present any facts that are unique for this specific project.

2.1 Nutritional facts about processing fruit

Fruit and vegetables are sources of important nutrients, such as C-vitamins and folic acid, which is a kind of B-vitamin. They also contain minerals such as potassium and magnesium, as well as food fibers. Some fruits also carry carotene, which is converted to A-vitamins in the body, or flavonoids, which work as antioxidants. Antioxidants are substances that take care of free radicals inside the body. Free radicals are harmful molecules that might lead to infections, cancer etcetera. (National Food Administration, 2011)

The digestion of juice occurs, thanks to it being liquid, in the stomach. This simplifies the absorption of nutrition to the bloodstream. Juice should be consumed directly in order not to lose its nutrients since some vitamins are damaged by air and light. Therefore only the amount of fresh juice that is needed right away should be made. (Hawkins, 2000) When food is processed or cooked, the nutrient content is changed in different ways. Vitamins are sensitive against temperature, time, oxygen, light, pH etcetera. Metals such as iron or copper can act as catalysts if used during food preparation. The most sensitive of all vitamins is the C-vitamin; it is easily destroyed during processing and storage. Apart from the conditions mentioned above, C-vitamins are also unstable when it comes to enzymes and salt or sugar concentration. However, it is stable in acid condition, which for example the A-vitamin is not. When fruit and vegetables are processed, or for example peeled, minerals might also be lost. (Bergström, 1994)

A chemical process that causes large losses when processing fruit and vegetables is called enzymatic browning. The enzyme that triggers this process is polyphenoloxidase, a group of chemical substances that is present in fruit and vegetables. There are several subgroups to this enzyme, where flavonoids (the antioxidants mentioned before) are one of them. The browning process starts after cutting or mechanically treating the food in a way that breaks the cells. The enzymatic browning can be avoided in different ways, for example by inactivating the enzyme by heat or by removing oxygen or other factors that can cause the oxidation. Another way is to add some acid to the fruit juice, for example lemon juice. The activity of the enzyme is pH-dependent and lowering the pH value to 4.0 will decrease the browning of the fruit. Industrially, fruit juice can be preserved by ultra-filtration through a membrane that removes the enzymes. (Wageningen University, 2011)

2.2 Juice extracting machines

A juicer is a machine that creates clear juices without pulp (Andersson, 2009). There are several different juicers on the market today with different techniques for extracting juice (Hawkins, 2000). The most common machines, the centrifugal juicer and the slow

speed juicer, are presented below. During Internet research, many blogs and other types of internet sources with authors that are very dedicated about juice and concerned about their health were found. One article (Kohler, 1998) argues that choosing a juicer is like choosing an outfit; at some occasions a tuxedo is more appropriate but at other times you want to wear a bathing suit. Therefore it is important to consider what the primary usage of the juicer will be. According to Kohler a centrifugal juicer is better at juicing fruit and vegetables, while a slow speed juicer can be used for leafy greens such as wheat grass. Centrifugal juicers are less expensive and more common than slow speed juicers in Europe (Törmälä, 2011). During testing, it was observed that both types of juicers can handle fruit that is not peeled or where the seeds have not been removed. However, citrus fruit need to be peeled, because their peel tastes too bitter.

Smoothies are, unlike fruit juices, made with a blender. A blender mixes the ingredients instead of pressing the juice out of them, which creates an end product with a very different character. (Andersson, 2009) The blender is described in detail further down in this section.

2.2.1 Centrifugal juicer

One kind of juicer that exists on the market today is the centrifugal juicer (fig. 2.1). It first grinds the fruit into small pieces. These pieces are spun very fast in a basket made of fine mesh, causing the juice to be pressed out by centrifugal forces. (Hawkins, 2000)

A centrifugal juicer normally consists of six parts; a body (1), a centrifugal basket with a grinding plate (2), a juice collector with a spout (3), a scrap container (4), a lid (5) and a pusher (6) (fig. 2.2). Many machines come with a small brush to clean the centrifugal basket (fig. 2.3). Normally, the machines come with a jug to collect the juice.

The fruit is fed through a feeding chute. Many machines have feeding chutes that are large enough to fit whole apples. The chute leads all the way down to the grinding plate at the bottom of the centrifugal basket, which is spinning. With help from the user, who needs to push the fruit against the grinding plate with the pusher, the fruit gets ground. When the fruit is ground it is small enough to slip through the small gap between the chute and the grinding plate and out to the centrifugal basket. Here, the fruit is thrown onto the mesh walls of the centrifugal basket. The juice is extracted by centrifugal force while the scrap stays inside. Further, the juice runs into the juice collector and through the pipe out to a glass or jug that has been put there before hand. The scrap on the other hand is thrown further via the lid to the scrap container. This movement is due to the conical shape of the centrifugal basket.

Figure 2.1 A centrifugal juicer

Inside the body, there is an electrical engine. Many machines have an engine with a wattage of around 300-700 watt (Bogyo, 2010), but the project group has also seen machines with more powerful engines. The engine spins the basket at a high speed. The speed also varies between different models, but as an example there is a machine with a 700 watt engine that spins the basket at around 13000 rpm

Figure 2.2 The pieces of a centrifugal juicer, numbered 1-6 from left to right.

(Alrp Agentur, 2011). Some machines allow the user to switch between two different speeds and there are machines that have a step less velocity regulation. Softer fruits are better juiced at a low speed while harder fruits shall be juiced on a higher speed. During some tests it could be observed that grapes were sometimes thrown to the scrap container before all juice had been extracted due to a too high speed.

All parts can be removed from the body for cleaning or storage. When assembling the machine, the juice collector is first fitted onto the body before the sieve is put inside the juice collector. The scrap container is hung onto the body before the lid is put on top to cover all the other parts. Finally, there are usually one or two large handles to secure that the lid stays in place. All parts except for the body are in contact with food and need to be rinsed or cleaned. The centrifugal basket needs to be cleaned with a brush (figure 2.3) because small pieces of pulp tend to stick in the fine mesh.

Figure 2.3 A brush to clean the filter

Magimix LeDuo XXL

Many centrifugal juicers are similar to the one described above, but there are some exceptions. Some juicers do not have a separate scrap container, but collect all the scrap inside the centrifugal basket instead.

Figure 2.4 Magimix LeDuoXXL

Figure 2.5 The centrifugal basket from Magimix LeDuo XXL

The machines that have a scrap container still need to be cleaned regularly to avoid the mesh from clogging (Hawkins, 2000). One example of a machine that collects the scrap in the centrifugal basket is the Magimix LeDuo XXL (fig. 2.4). In order to get a nice even layer of scrap inside the centrifugal basket, the basket is straight instead of conical (fig. 2.5). It also has an upper edge to keep the scrap inside and make sure it is not thrown out of the basket onto the lid. This edge makes the filter more difficult to clean, and therefore it comes with a spatula that facilitates removal of the scrap from the basket. LeDuo XXL also comes with an accessory called a couler. This can be put inside the machine to make more smoothie-like drinks. It is put on top of the centrifugal basket and held still by the lid. When the basket rotates the couler pushes the fruit against the sieve, which makes more pulp go through. It also helps to homogenize the juice to create a result more similar to the outcome of a slow speed juicer, explained below.

2.2.2 Slow speed juicer

The slow speed juicer (fig. 2.6) extracts juice by slowly chewing the fibers and pressing them against a sieve. They decompose the cell structure, why the end product gets very clear and contains lots of fibers, enzymes and vitamins. With special accessories, these types of machines can also be used for processing children's food, sorbets etc. (Andersson, 2009) They consist of 7 parts (fig. 2.7); a body (1), a sieve basket (2), a scraper (3), a screw (4), a juice collector with two outlets (5), a lid and a pusher (6). Traditionally, the slow speed juicers used to have a design where the screw was positioned horizontally. Now these juicers also come in a vertical design. Slow speed juicers are also called auger juicers. (Discount Juicers, 2011)

The fruit is fed through the feeding chute that leads down to the top of the screw. Due to the shape of the screw, the fruit is seized and starts to follow the movement of the screw. The screw constantly presses the fruit against the sieve basket as is turns, causing the juice to run through the sieve and the scrap to keep following the screw until all juice has been extracted. At this point, the scrap has followed the threading of the screw to the bottom of the sieve. There is a hole in the sieve that is connected to one of the outlets of the juice collector. Due to the constant pressure from new scrap, the scrap is pushed out through the pipe as long as new fruit is fed. The juice runs through the sieve, to the juice collector and out through the outlet.

The machine has a small feeding chute, so the fruit needs to be cut in pieces before it is fed into the machine. The screw would have to be dimensioned extremely large if it was to seize and masticate whole apples. The motors of these machines are different from the ones used in the centrifugal juicers. The electrical engine in the Hurom Slow Juicer has a wattage of 150 W and rotates at 80 rpm. (Roland Products, Inc., 2010)

The machine is assembled by putting the juice collector onto the body and securing it by twisting it a few degrees. The scraper, the sieve basket and finally the screw are put inside the collector, and the lid is put on top and twisted into place. Two containers, for example normal drinking glasses, must be put under the two outlets. One for the juice and one for the scrap.

Figure 2.6 A slow speed juicer

Figure 2.7 The parts of a slow speed juicer, numbered 1-6 from left to right

When starting the machine, the screw and the scraper start to move in opposite directions through a built-in cogwheel in the juice collector. The sieve is not rotating. After usage, all parts accept for the body need to be rinsed or cleaned. The whole juice container can be removed with the other parts inside and carried to the sink.

2.3 Blenders

A blender (fig. 2.8) is a machine that cuts and mixes the ingredients added instead of pressing out the juice. Therefore it can be used to make other types of drinks than clear fruit juice, for example smoothies. (Andersson, 2009) A main function for blenders is also their ability to crush ice (Sennebogen, 2011).

A blender consists of the following parts (fig. 2.9): A body (1), a blade (2), a jug (3) and a lid (4). The jug has a removable base and a seal ring to prevent leakage. The jug is put on top of the body and filled with the desired ingredients before lid is closed and the machine is turned on. The lid is normally just pressed into the jug and kept in place through rubber seals. The machine can therefore be operated without the lid, but there is a large risk of splashing. Often, there is a small opening in the lid so that ingredients can be added during usage. This opening has a removable cover to avoid splashing. When the machine is turned on the blades start to spin and the circular movement creates a vortex in the fluid. This vortex creates a vacuum in the middle of the jar, which causes the ingredients to be sucked towards the knives. Because there is no space below the knives the ingredients are then pushed out to the sides again, and this circular movement is repeated inside the jug until the blender is turned off. (Sennebogen, 2011) To clean the machine, the jug and the lid need to be rinsed or washed and the base of the jug can be removed for the user to better reach the knives. Since the machine does not sort out any pulp or seeds, the added fruit needs to be peeled and seeds have to be removed beforehand.

The knives are normally made from stainless steel and consist of four blades arranged in different angles to increase the contact with the food. The jugs are often tapered to lead down the ingredients to the knives and

Figure 2.8 A blender

Figure 2.9 The parts of a blender, numbered 1-4 from left to right

make the blending more effective (fig. 2.10). The body contains an electrical engine with an effect of between 450 watts and 750 watts. The rotation of the engine is transmitted to the blades through a claw clutch in the body. These claws cause the base of the jug, and hence the knives, to rotate. (Sennebogen, 2011)

Figure 2.10 A blender jug with knives

2.4 Safety aspects

Several aspects were relevant to consider in the final product concept regarding safety. These aspects were identified with help from Tommy Franzén (2011), safety expert at Electrolux, when the functions had been set.

- There has to be a feeding chute of at least 180 mm. The user must not be able to reach the grinding plate.
- The machine must come with a pusher, to avoid that the user does not try to push the fruit towards the grinding plate with any other device.
- The machine must be stable enough to stand on a plane with an inclination of 10° without falling.
- The lid must be secured in place so that it cannot spin open when the machine is turned on.
- The user shall not be able to touch any rotating parts during usage, for example the blender knives. To control this, there is a standard probe (fig. 2.11) to simulate a finger and a hand. The standard probe is put into the container and the finger must not be able to reach the knives.

Figure 2.11 A standard probe to ensure safety for the user

- There must be a drainage for possible liquids in case of leakage. Otherwise, there is a risk that the user is subject to shocks.

- The machine must be able to secure that the lid is in place, probably through a hidden power switch.

- The machine must be able to secure that the jug is in place so that the knives cannot be disassembled and run without the jug.

(Franzén, 2011)

2.4.1 Existing solutions for safety locks

Within the food processing industry, three different ways of securing that an appliance is correctly assembled before it can be turned on have been identified.

The first way is through a switch (for an example of a switch, see fig. 2.15) in the machine body that is pushed by a part on the lid (fig. 2.12). The lid is put on top of the jug and screwed into place. This is a rather simple solution, but it requires contact between the machine body and the lid. This solution has been seen in many food processors, in particular older machines.

Figure 2.12 The first type of safety lock

The second solution is similar to the first one, but instead of letting the lid directly hit a switch in the machine body, the jug is involved as well (fig. 2.13). The jug has a plastic part that follows the outside of the shape, that contains a rod. When the lid is screwed into place, the rod is pushed downwards and hits a switch in the machine body. The advantage with this solution is that the machine body can be shaped more freely. The jug can stand on top of the engine without any requirements that the lid must be able to touch the machine body. This type of security lock seems to be quite modern and is often used in newer food processors.

Figure 2.13 The second type of safety lock

The third solution (fig. 2.14) requires two large arms that are attached to the machine body and secure the jug in place. As the jug is secured, the arms push a switch on the machine body. The advantage of this solution is that the lid does not have to be screwed into place, but can be laid on top of the jug. This security lock has only been seen on centrifugal juicers, but within this product range it is a very common solution.

Figure 2.14 The third type of safety lock

Figure 2.15 A safety switch of a blender

2.5 Materials and Manufacturing

This section includes materials and manufacturing methods that are useful to be familiar with to understand the final product concept.

2.5.1 ABS plastic

ABS stands for Acrylonitrile-butadiene-styrene and is a plastic built up by three monomers. ABS is a common plastic for kitchen appliances and is also used in amongst others: vacuum cleaners, pipes, luggage shells, automotive parts, computer mice, lego and telephone cases. ABS is tough, resilient and easily molded. It is naturally opaque but can nowadays also be transparent to some extent. It can easily be colored in vivid colors. (Ashby and Johnson, 2010)

Some grades of ABS can be recycled. Acrylonitrile, which is one of the monomers in ABS, is very harmful but once polymerized with styrene it becomes harmless. (Ashby and Johnson, 2010)

2.5.2 SAN plastic

SAN stands for Styrene-Acrylonitrile and is a plastic material built up by the monomers Styrene and Acrylonitrile (Saechtling, 1995). SAN has good thermal and mechanical properties, such as maintaining good strength and stiffness over time. It is also well resistant against oil and fat. SAN is naturally transparent and uncolored and it takes color very well. SAN is commonly used for household appliances, in particular transparent bowls. Other usage areas are fridge details, toothbrushes, cups and trays. SAN is suitable for injection molding and extruding (Klason and Kubàt, 1995). SAN products are dishwasher-safe (GoPolymers, 2011).

2.5.3 Brushed steel

Steel is an iron-based alloy that contains carbon and other elements. Most steels contains less than 2% carbon. (Brennert, 1993) A brushed steel has been given a surface finish that is scratched by intention. The scratches are made in a unidirectional way, which changes the appearance of the surface from isotropic to anisotropic. Anisotropic means that there is a difference in physical properties depending on direction. The anisotropy affects the way that other objects are reflected in the surface and creates a characteristic appearance. Other metals that are often used for this surface treatment are aluminum and zinc. The surface has been treated with an abrasive material to obtain that rough appearance. (WiseGEEK, 2011) Abrasive particles can be used to remove material in different ways. The abrasives can be bond together in a rigid tool, in this case the process is called grinding. Other ways are to suspend the abrasives in a liquid (called ultrasound machining) or direct them with a jet stream (called abrasive jet machining), either through air or a liquid. Steels and cast irons are normally treated with grinding. (Allen et al, 1994)

2.5.4 Injection molding

Injection molding is a common method for producing plastic pieces. Both thermosets, thermoplastics and elastomers can be injection molded. The most common equipment to use for injection molding is a reciprocating screw in which granulates of plastics are fed, heated and mixed. The screw pushes out the soft dough of plastic into the mould where it solidifies under pressure. When solid, the part is ejected from the mould. It is possible to mould both simple and complex shapes, but there must be draft angles so that the part can be ejected from the mould. (Ashby and Johnsson, 2010) A schematic image of injection molding is shown in fig. 2.16.

The parts produced by injection molding are precise and have a good quality surface finish. Texture or decorative labels can be molded onto the surface. There is no need for after treatment except for removing the spure that led the plastic into the mold. (Ashby and Johnsson, 2010)

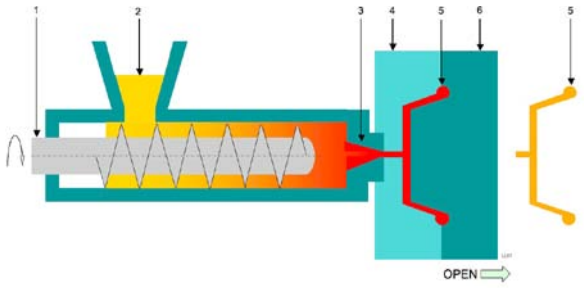


Figure 2.16 The principle of injection molding (Van Lieshout, 2007)

2.5.5 Die casting

Die casting is a method for forming small metal components with a complex shape. The process of die casting metal is very similar to injection molding polymers. Molten metal is injected into a metal die under high pressure through a spure or a system of spures. The part is kept in the die until it is cooled down to the solid state; then the die is opened and the part ejected.

Complex bulk shapes can be molded with die casting. Hollow shapes have to be molded in sections and then joined. Aluminum, zinc and magnesium waste can all be recycled and the process itself is not particularly harmful. (Ashby and Johnson 2010)

2.6 IEC Test-standard

The IEC standard called *Electrically operated food preparation appliances – Measuring methods* describes amongst others how to test the performance of centrifugal juice extractors. For the tests; apples, carrots, grapes and tomatoes are used. It is specified whether they shall be cut, and in that case into what size. The standard also specifies how much fruit shall be used for each batch. The procedure includes measuring the time it takes, the amount of juice that is extracted and how much pulp the juice contains. (International Electrotechnical Commission, 1995)

3. Methods

In this chapter, the methods used throughout the project are explained. Their respective advantages and disadvantages are mentioned and in some cases, suggestions on how to use them are provided. The implementation of the methods, and the result they generated for this project, is explained in the next coming chapter.

3.1 Planning methods

In this section, the main method used for planning and structuring the project is described.

3.1.1 Gantt-chart

The Gantt-chart is a traditional way of creating a time plan (Bergman and Klevsjö, 1995). It consists of a horizontal time line, where each task that shall be performed throughout the project is visualized through a horizontal bar. The bars are drawn from its starting date to its finishing date, creating bars of different lengths. (Ulrich and Eppinger, 1995) Normally, the times estimated in the beginning of the project are nothing but "good guesses" and the chart is of course not more precise than the input from which the chart is created. Therefore its preciseness shall not be overestimated. (Maylor, 2010)

3.2 Data collection methods

The following section describes empirical data gathering methods that have been used throughout the research phase. Data gathering within product development involves different kinds of contact with customers and familiarization with the usage environment of a product (Ulrich and Eppinger, 1995).

3.2.1 Analysis of competitors

Research for understanding and becoming familiar with competitor products is important in order to know how to position a new product. Apart from that, the research can also provide ideas for the new product or the production of it. (Ulrich and Eppinger, 1995)

3.2.2 Interviews

An interview is a discussion between one single interviewee and one or two development members. Interviews can be of different character; structured, free or somewhere in between. Completely structured interviews can be beneficial when confirming data in a later stage of the development. When identifying customer needs in an initial state of the development, structured interviews do not provide enough information about the usage environment. They are also ineffective in revealing unanticipated needs. (Ulrich and Eppinger, 1995)

When conducting a semi-structured interview, it is important to go along with the flow of the interview rather than following a pre-defined interview guide too strictly. Another tip is to bring visual stimuli, for example a selection of competitor products or early concepts. It is also important to avoid focusing too much on technology or product features and instead try to understand the underlying needs. When conducting a large amount of interviews, a high percentage of customer needs will most probably be detected. However, this relation stagnates. Already after five

interviews around 75% of the needs are found. Sound recording is an effective way of documenting interviews, even though it is time consuming to transcribe. (Ulrich and Eppinger, 1995)

3.2.3 Focus groups

A focus group is a discussion within a group led by a moderator (Ulrich and Eppinger, 1995). The group is gathered to discuss a certain issue, regarding for example a product. The discussion is normally kept quite open to make sure that the subjects that are most important to the participants are addressed. The moderator usually has a set of prompts to stimulate the discussion if it fades out. Another important task for the moderator is to make sure that everybody's voice is heard. (Jordan, 1998)

Videotape recordings are often used for documenting focus groups. The benefit is that they are useful for communication within the company. The ability to re-watch them facilitates finding latent needs. Photographs are easier to access and display, but their disadvantage is that they cannot provide dynamic information compared to video recordings. (Ulrich and Eppinger, 1995)

3.2.4 Generative techniques

Generative techniques are used to get a deeper understanding of the user and the context around the product. This depth is hard to reach through interviews or observation. With generative techniques, knowledge about what people know, feel and dream can be obtained. This knowledge can seldom be described with only words and is called tacit knowledge. Fig. 3.1 shows this relation. In some cases also latent knowledge can be obtained, which is knowledge that people did not even know they possessed. (Stappers, Van der Lugt, Hekkert and Sleeswijk Visser, 2007)

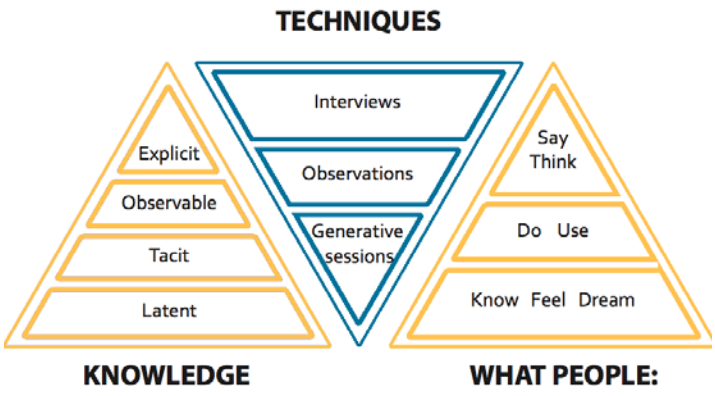


Figure 3.1 The model for generative techniques

Generative techniques are based on the principle that the participant creates an artifact such as a drawing, collage, map, storyboard or model and then tells stories about and around what they created. The creative process makes the user aware of their experiences and how they feel about a situation, context or product experience. The stories about the artifacts and the discussions that follow are often of a rich character and can contain valuable insights. The artifacts themselves should be seen as expression of experiences and not design concepts. (Stappers, Van der Lugt, Hekkert and Sleeswijk Visser, 2007)

Sensitizing

Prior to a generative session a sensitizing process of the participants may take place. The sensitizing material can exist of small exercises and assignments related to the topic of the session for the participant to complete beforehand. Giving the user the chance to start reflecting prior to the session enhances the quality of the outcome. (Stappers, Van der Lugt, Hekkert and Sleeswijk Visser, 2007)

The sensitizing topic is often broader than the one of the following session. It is also preferred to ask the participants to work with the sensitizing material over a period of days and do for example one task a day. This slowly enhances their awareness of their experiences. The sensitizing material can be shared and discussed among the participants, collected and analyzed prior to the session or just collected for the researcher to use on their own. (Stappers, Van der Lugt, Hekkert and Sleeswijk Visser, 2007)

The Generative group session

A generative group session often contains four to six participants. For collage making, materials needed are a big poster sheet and a set of images and words. Often a set of 100-120 pictures along with a set of 100-120 words are suitable to use. Diverse pictures from different contexts which a balance between literal and ambiguous as well as positive and negative should be used. The time given to make the collages is often between 15 and 20 minutes. The participants shall present the collages for each other. To encourage an open discussion in the end can be rewarding. (Stappers, Van der Lugt, Hekkert and Sleeswijk Visser, 2007)

3.2.5 Observations

Observing a customer using a product can provide numerous new insights about the product as well as the customer needs. In an observation, the observer can take different approaches. He or she can either be completely passive or participate and use the product side by side with the observed person. (Ulrich and Eppinger, 1995)

3.2.6 Self Observations

Another observation method is self observations where a few users fill in a diary about their behavior over a period of time. The benefit of this method is that relatively accurate data can be collected compared to retrospective interviews. However, information about underlying reasons for a type of behavior cannot be seen. There is also a risk that the process of filling in the diary affects the behavior pattern being studied. (Karlsson, 2007)

3.2.7 Interpreters

When developing new products, it is important to think about the profound reasons to why consumers buy a product. Changing these reasons drastically can be a source of innovation. An example is the game console "Wii" created by the company Nintendo. The game console has turned video games into an active, very physical entertainment. This change has expanded the customer group to include many people that did not use to be the typical video game players before. According to Verganti, these changes are difficult to achieve if a very user-centered approach is taken, because a too strong focus is put on the existing target group. The product will be highly adjusted for those people, but it might not attract new customers. (Verganti, 2009)

Verganti suggests collaboration with what he calls interpreters. Interpreters are people that are interested in the same target group and the same life context as the product developer. They can for example be artists, researchers or other firms that develop products. The interpreters can help figuring out and reinventing the profound reasons to why a product is bought. (Verganti, 2009)

3.3 Analysis methods

This section describes methods to analyze the data found through the methods in the previous section.

3.3.1 KJ-analysis

The KJ-analysis method is used as a way of structuring large amounts of verbal data and to find connections between different data. This data can for example be ideas, opinions or customer requirements. First, the data is written on individual post-its so that they can be moved around easily. The pieces of paper are put on the wall. The different data is grouped with other data that is similar in some way. The groups that build up are given names. (Bergman and Klevsjö, 1995)

3.3.2 Persona

A persona is a representation of the target group with the purpose to put a face on the typical user. It is a specific and concrete description so that it is easier to remember and more engaging. Using a persona as a method in product development is a way of keeping the user in mind and work in a more user focused way. It helps creating a common language for communication and serves as a support for decision making. (Adlin and Pruitt, 2010)

3.3.3 Hierarchical Task Analysis

A Hierarchical task analysis, HTA, is a method to break down the execution of a task to a series of steps. Each task is divided into subtasks, which creates a hierarchical structure. This gives a clear overview over the difficulty and required effort of a task. (Jordan, 1998)

3.3.4 Function Analysis

The purpose of a function analysis is to find the functional core of a product. In this analysis method a wide definition of the word function is used; it includes all requirements and properties of the product. The first step in the process is to identify the main function; the reason for the product's existence. Functions that are crucial for the main function are called part functions. If one of them is absent the main function is failing. Functions that are supporting the functionality of the product, but that are not crucial for the main function are called support functions. Included in the support functions are for example safety regulations and norms. (Österlin, 2003)

When describing the functions, the foundation for further design work is built. It is therefore of high importance to choose the formulation of the functions carefully. Preferred is to describe every function with a verb and a noun and to choose comprehensive words. For example the main function for a pen can be described as: make mark. (Österlin, 2003)

3.4 Idea generation methods

The methods in this section are meant to stimulate creative thinking and help the product developer to find new approaches and ideas to a problem.

3.4.1 Brainstorming

Brainstorming is a well known method to generate a large number of ideas. The ideas emerging should be short and snappy and crazy ideas should be encouraged. Eventually most of the ideas from a brainstorm session are discarded, but perhaps some novel ideas are worth to develop further. (Cross, 2000)

Brainstorming is preferably conducted in a group of four to eight people. It is of high importance that the group is non-hierarchical even though one person is needed to facilitate the session. Preferred is also that the group is cross functional and that it contains participants with different expertise. Some basic rules to be followed in a brainstorming session are:

- No criticism is allowed during the session
- A large quantity of ideas is wanted
- Seemingly crazy ideas are welcome
- Keep all ideas short and snappy
- Try to combine and improve the ideas of others (Cross, 2000)

3.4.2 Brain writing

Brain writing is a method that is similar to brainstorming, with the difference that the group members work on their own to start with. This way, the ideas are less likely to become too similar. After some minutes of idea generation, the ideas can be passed on to another group member for further development. Another approach is to look at each other's ideas for inspiration. (Österlin, 2003)

3.4.3 Synectics

The method synectics is based on analogical thinking and the ability to see parallels and connections between different contexts and topics. Synectics works, like brainstorming, best in a group setting. The method can be divided into the following four analogies; direct, personal, symbolic and fantasy. *Direct analogies* for example suggest trying to find existing biological or analogue solutions to a similar problem. In *personal analogies* the participants imagine how they would perform a task if they would be the product being developed. This type of analogy can also be extended into imagining how to solve the problem if the participant would be for example an animal or have a specific profession. *Symbolic analogies* are used as more abstract or poetic metaphors to relate aspects of one solution to aspects of another. The last one is *fantasy analogies*, where the participant imagines how things would be solved in a magical way. (Cross, 2000)

3.4.4 Osborne's idea spurring

Osborne's idea spurs are a set of words to help giving new approaches to a problem. The words are simply applied to existing ideas one word at a time.

The words are:

- Enlarge
- Combine
- Reduce size
- Other applications
- Exchange
- Replace
- Modify
- Do the opposite
- Process (Österlin, 2003)

3.4.5 Random entry

Unrelated random stimuli can be effective in encouraging new ideas. Random input can be chosen from various sources such as newspapers, dictionaries and piles of photographs. The random object or word should be related to the problem being solved. (Cross, 2000) An alternative is to combine two words or objects and use this combination as a suggestion for a solution. (Österlin, 2003)

3.5 Evaluation methods

The methods in this section help to evaluate and compare developed concepts with each other. They can be used as a guidance when selecting which concept to develop further. The section also includes a method for cognitive evaluation in order to find improvement possibilities.

3.5.1 Comparison chart

A comparison chart is a tool to evaluate the relative importance of requirements for a product. The requirements are compared two by two, and the times that a demand has won over another is summed up. This number gives an indication for how important the demand is in comparison. (Johannesson, Persson and Pettersson, 2004)

3.5.2 Matrix evaluation

For evaluating product concepts by means of a matrix, the ideas to be evaluated are written along one side of the matrix. Along the other side, a number of important requirements are listed. The concepts are given points according to how well they fulfill each requirement. A simple scale of 1-5 where 3 means acceptable is appropriate. The scores of the different concepts can be summed up to create a total score. (Österlin, 2003)

3.5.3 Cognitive Walkthrough and Physical Human Error Analysis

Cognitive walkthrough (CW) is a non-empirical method used to evaluate the usability of a product by trying to follow the user's cognitive process. One or a few evaluators perform the analysis. The evaluators go through the task flow, for example the last stages of an HTA (see section 3.3.3), and try to answer the following four questions at every task; *Will the user try to achieve the right result?*, *Will the user notice that there is a possible path to the right result?, Will the user associate the right action with the right result?* and *If the right action is performed, will the user notice that this action brought her closer to the completion of the task?*. These questions help the evaluator to understand and investigate if the user understands the intended usage and gets enough feedback. If the answer to any of the questions is *no,* the evaluator will think about the underlying problems. These will be taken into consideration in further development of the product. (Jordan, 1998)

A Physical Human Error Analysis (PHEA) is a method to identify possible usage faults that can occur during the interaction with the product. This method works very well as a compliment to the CW described above. The evaluator answers the following questions for every task performed; *Which actions may the user do wrong at the right timing?, Which actions may the user do right at wrong timing?, What happens if the user performs an incomplete action or exclude an action?* and *What happens if the user performs the tasks in wrong order?*. The evaluator must try to imagine every possible usage situation so that as many faults as possible can be identified at this stage. (Jordan, 1998)

4. Research and Analysis

This chapter describes the research and analysis phase of the project. Both the implementation, analysis and results of the data collection is presented. The results are presented sorted by content instead of method, to make the overall outcome more comprehensive and interesting. Explanations for the different methods used are found in the previous chapter.

4.1 Collection of data

In this section, the implementation of the different data gathering methods is described.

4.1.1 Electrolux visual brand identity

To communicate the desired visual identity of their high-end small domestic appliances, Electrolux uses a range of concept products. The products should be considered as a guide for the identity of this specific product range. They were also used within this project, as a help to know where to aim with the concept. In the later phase of the project, continuous reviews have been given by Jérôme Esteve, the contact person from industrial design within small domestic appliances.

4.1.2 Competitor research

To get an understanding for the market and the existing actors and products, competitor research has been carried out. Some of the information has been provided through the marketing department. This information has been studied but also questioned and verified. Alongside, own Internet research has been conducted. Competitor research was one of the first actions taken in the project but it has also been performed continuously throughout the development process. Retailers of home electronic equipment have been visited in order to speak to the staff and to get an understanding for how products are sold and displayed. Competitor products are found in appendix 1.

4.1.3 Testing competitors

Together with a test engineer from Electrolux, a number of juicers have been tested according to the IEC-standard (see section 2.6 for an explanation about the standard) for juicers. Among the juicers there were both centrifugal juicers and slow speed juicers. Parameters tested were the overall product experience and efficiency. Compiling the test results and drawing conclusions from the tests was done by the test engineer. By participating in the testing process, valuable hands-on experience of the products was obtained early in the project. Testing of a more experimental character has occurred later in the process to test specific ideas or to further explore juicing.

4.1.4 Interviews

In order to find out more about the user and the usage situation, interviews were performed. The interviewees were possessors of a juicer, an electrical citrus press or an espresso machine. They were chosen to match the target group as well as possible. One aspect was to find out if, and in that case why, these users take their time to make an espresso or a glass of juice in the morning. Interesting with espresso machines is that they are generally luxury products with a high status and tend to be kept on the counter rather than in a cabinet. Since the task was to develop a more luxurious juicer, it was considered beneficial to study users of espresso machines. The overall idea was that talking to different kinds of users would give us a broader input than only talking to juicer-users. It was difficult to verify that the interviewees were part

of the target group since it is based on values rather than demographic facts. Due to difficulties of finding participants, most interviewees were IT consultants.

Five semi-structured interviews that took between 15 and 25 minutes were performed. They took place somewhere chosen by the interviewees, normally their work place. The first questions were basic questions concerning their product, its brand and its functions. The middle part of the interview was about thoughts and opinions. In order to get deeper into the interviewees feelings, a paper with twelve different pictures was used. The participants were asked to choose three pictures that could be associated with the feeling of using their product. The concluding part of the interview contained questions about the usage and handling of the product, as well as the reasons to why they bought the product in the first place. The interviews were performed together so that one person could ask the questions while the other one took notes and filled in with follow-up-questions whenever necessary. All interviews were recorded and transcribed so that nothing was forgotten or interpreted too early. For the full interview guides, see appendix 2.

The data collected from the interviews was structured by means of a KJ analysis. The important parts from the interviews were cut out from printouts of the transcripts. These pieces of paper were grouped together depending on their content and glued onto a large poster. Headlines, descriptive arrows and notes were drawn directly on the poster.

4.1.5 Self observations

To collect more information than the one obtained in the interviews, two users were asked to perform self-observations. The two users each had a juicer, a weeks consumption of fruit and a diary delivered to their homes. The diary was for them to record their experiences and thoughts throughout the usage.

Figure 4.1 Diary for the self observers

The reason for this complementing method was difficulties finding juicer-users, as well as the benefit of collecting the insights from people that are reflecting while using the product. The users have a fresh mind and have not yet accepted or adapted to a process. After a week of using the product, an interview was performed. The diary was used as a mediating object.

4.1.6 Focus group

A focus group with five participants from Electrolux was performed (fig. 4.2). Some days before the focus group, a workbook (fig. 4.3) was distributed for the participants to fill in prior to the session. The purpose of the workbook was for the participants to start thinking about their morning habits in advance. (This is called sensitizing, and explained in detail in section 3.2.4)

Figure 4.2 Focus group

Figure 4.3 Workbook from focus group

The first part of the focus group was to go through the workbook (see appendix 3) and let everybody explain what he or she had written. The purpose was to find out about their morning habits and their values for example regarding time and health to see if people would consider taking time to make juice in the morning. The second part was a generative session to get deeper into user needs and wishes. The participants were asked to produce and present individual collages on what they consider luxury in their everyday life and what they do when they want to have a luxurious experience. The presentations were followed by a group discussion led by the moderator concerning similarities and differences in their collages (see appendix 5). Some predefined questions had been prepared to get as much out of the discussion as possible. For the full focus group schedule see appendix 4.

The last part of the focus group was a more traditional group discussion regarding juice in general and the opinions and wishes on the juicer as a product. An existing centrifugal juicer from a competitor was brought as a mediating object. The participants were asked what they think about the design of the product and what they would like a juicer to look like if they would buy one. The discussion also concerned requirements on a product in order for it to stay on the counter instead of being placed in a cabinet after each usage. The focus group was filmed in its entirety. Afterwards the important parts were written down and structured into a KJ analysis, just like the data from the interviews.

4.1.7 Interpreter Study

In order to get a broader view of the potential usage of the product, an interpreter study was performed. First, a brainstorming session was held to find possible areas to look for useful interpreters. Two specific areas were chosen; juice bars and hotel breakfasts. The desired outcome was to find aspects that could be incorporated into the new juicer concept in different ways. Inspiration from the experience of drinking juice in a juice bar could for example help enhancing the luxurious feeling of making juice at home.

Figure 4.5 Juice from Juiceverket

Three juice bars in Stockholm were visited. The ambiance, menu and guests were observed and a short interview with the manager was held. The questions mainly regarded the guests and their preferences, for the full interview guide see appendix 6. The first of the juice bars was *Juiceverket* (fig. 4.5) near Odenplan, the second one was *Naked Juice Bar* in Cityterminalen and the third one was *Squeezed Up Juice Bar* in Gallerian. The three places were quite different in expression

Figure 4.4 Images from three different juice bars: Juiceverket, Squeezed up and Naked Juice bar

(fig. 4.4) and image towards their customers even though similarities in their values and business ideas were found. In all three bars the juice was in focus, for example they only have a few seats.

Five luxury hotels were contacted, and a small semi-structured interview was performed with the breakfast responsible of each hotel. The aim was to be able to share their insights on what people consider luxurious and appreciate in the morning. Therefore, the questions concerned the preferences of their customers, their habits, their views on healthy food etcetera.

4.2 Results – Research & Analysis

In this section the results from the brand identity analysis, testing of competitors, interviews, focus group and interpreter studies are presented. The results from the different methods have been merged and sorted by content. Some of the insights found were new while other confirmed previous hypotheses.

4.2.1 Visual identity of Electrolux high-end Small Appliances

The impression from the concept range was put together in an image board (fig. 4.6) to communicate the desired visual impression. Some words that can be used to clarify that description are elegant, human and simple with a twist. The purpose of the images was to communicate form elements, materials and colors rather than a life style.

Electrolux requests a product that is not too extreme in its appearance. Since it shall belong to their high-end market segment it needs to be able to have long life time. Preferred is to stick to a few materials and only make material changes where it is functionally motivated.

Figure 4.6 Image board
(Image sources from left to right: Electrolux, 2011; IKEA, 2011; All modern, 2011; All4Women 2011; Desperate Designers, 2011; OpenBuildings, 2011; Prokök, 2011; Well chosen, 2011)

4.2.2 Results from testing of the competitors

The main parameters when testing the competitors was the overall experience and the efficiency. Even though many machines looked similar, large differences in efficiency were observed, especially among centrifugal juicers. Depending on the texture of the fruit different products gave different results. Centrifugal juicers with a separate scrap container and a conical basket tend to throw out ground fruit that has not been centrifuged long enough. These types of machines get very messy inside. Not all scrap is properly transported to the scrap container but ends up on other parts of the machine. In fig. 4.7 there is a picture of a lid and a scrap container after juicing circa 200 g of carrot. The lid is very messy, while the scrap container is almost empty.

Centrifugal juicers with a straight basket and no separate scrap container were more efficient in extracting juice. This is due to the fact that the ground fruit never leaves the basket but gets centrifuged until all juice is extracted. Those types of machines were also less messy than the juicers with a separate scrap container. The reason is that the scrap does not leave the basket and get thrown around in the machine.

Regarding the overall experience of the products, all machines have many parts to clean. It was concluded that it is not only the number of parts to clean but also the size and shape of them that determines the effort of cleaning.

In most of the centrifugal juicers the feeding chutes are dimensioned to fit a whole apple. That is very convenient and eases the handling a lot. Slow speed juicers do not have an equally large feeding chute. Due to the juicing principle, the fruit needs to be cut into smaller pieces, which adds an extra task to the juice preparation. The slow speed juicers are heavy and not so easy to move around as the centrifugal juicers.

Figure 4.7 A lid and a scrap container from a centrifugal juicer after juicing 200 g of carrot

There is a difference in the juice produced with the two types of products. The juice made in a slow speed juicer is more homogenous, thicker and has more pulp, while the juice from a centrifugal juicier is more clear and contains less pulp.

4.2.3 Personas

In order to facilitate the communication of whom the interviewees and their reasons to make juice, three personas were put together. The personas are

Peter is 33 years old and lives together with his family in Stockholm. He has fairly young kids and bought his centrifugal juicer to create a healthy habit for him and his family by making fresh juice. An expectation he has is that it can boost his kids with vitamin to be more resistant against germs spreading in the kindergarten. He tries to make juice 3-4 times a week and he always has the same routine, he makes the juice, does the dishes and drinks the juice together with his family. He believes that he would not eat as much fruit if he would not have a juicer. (Image source: Kitchen, 2011)

descriptions of the real life people and their habits. However, their names and personal references were disconnected from the descriptions. The personas are presented in grey boxes on this spread.

4.2.4 Habits and Attitudes

One of the main findings from the interviews was that all users of a juice machine or juice press had made a decision to drink more juice and thereafter purchased a juicer. The decision was strongly based on health matters, either regarding themselves or their children. Therefore they had adapted to a process of making their own juice and accepted the time it consumes. Most of the users want to make juice more often than they do, and they make juice more seldom than they expected when buying the product. The users also expressed that they experience stress while using the product because of the time consumed.

Every one of the participants in the focus group, who did not own a juicer, could imagine making their own juice and thought it was worth some inconvenience. With the insights from the interviews, the assumption can be made that they might not use the machine as often as they believe now. A sense of pride in making your own juice could be sensed both among the interviewees and the focus group participants. One participant would like to offer her friends juice at festive occasions and another participant had the idea of bringing a bottle marked with *my own juice* to work in the morning.

An interesting finding was that the interviewed espresso machine users were willing to spend some time on pottering with their espresso machines to get the perfect coffee. However, they would not accept spending that much time on preparing a glass of juice. One user said that juice, unlike espresso, can be bought at the supermarket. Hence making fresh juice

Johan is 44 years old and lives with his family in an apartment in Stockholm. He makes orange juice for his family almost every morning. He uses a citrus press and buys his oranges almost on a daily basis in the close by grocery store. The start of his habit was that he realized that the premium juice he normally buys is not as fresh as they claim. Another reason is that he wants his children to know how real oranges taste, so they won't get their taste references mixed up with artificial tastes. (Image source: Nemenz, 2011)

competes with something that is much easier. Other reasons can be the tradition behind making coffee, that it is considered a way of relaxing and that the users highly appreciate the ability of affecting the result of the coffee.

4.2.5 Morning habits

The first part of the focus group session was dedicated to discuss morning habits. It was found that the participants had fairly different morning habits. Some participants had to be quiet in the mornings,

Karin is 29 years old and she lives in a single household in Stockholm. She is very aware about her health and takes good care of her body. The reason that she bought her juicer was that she had read a book about the positive effects of freshly made juice. A few times a week, she makes juice in the evenings after working out. She would like to make juice more often or even in the mornings but thinks that it takes too much time to clean up. Karin thinks drinking juice is tastier and much easier than eating a lot of fruit. (Image source: Moore, 2011)

why a potential juice machine would have to be quiet not to wake other family members. The balance between efficiency, calmness and health varied among the participants. This was due to personal preferences but also strongly dependent on the participant's living and commuting situation. Some users preferred to bike or exercise in the morning and get ready at work. One aspect that was common among all participants was that their morning routine and breakfast should be both healthy and efficient. The interviewed hotel breakfast managers confirmed that it is important for their customers to have a healthy breakfast. None of the hotels are providing fresh made juice for breakfast, but some of them used to have it before. It was very appreciated by the customers, but messy and complicated to provide.

4.2.6 Juice and usage

The juicer-users are very satisfied with the taste of the juice. They often add multiple kinds of fruits when making their juice, something that was also seen when visiting juice bars. The juice bars use only fresh fruit and no sugar is added to their juices and smoothies. In addition to juice all of them serve healthy shots that can be drunk separately or as an add-ons in the juice. The shots consist of different types of herbs or other healthy natural substances. The juice is fairly expensive and costs around 40-50 SEK for a glass.

The juice bars mostly use a centrifugal juicer for any clear juices. As a complement, in case they want to add any soft fruit or ice, they use a blender. Using the combination of the two techniques gives the juice a luxurious texture. When ice is blended in the juice, it becomes very well chilled. In addition, a few aspects that add to a luxurious feeling of the juice were found. One example is juice with a nice color served and presented in a pleasant way. The bar and cocktail expression of the juice bars enhance the feeling of indulging yourself.

The interviewed citrus press- and juicer- users clean their machines by hand. If it stays all day in the dishwasher, the pulp might dry up and make it very difficult to clean. Another aspect is that the product might be used more often than the dishwasher. The biggest problems when it comes to cleaning the parts are that there are many parts, but also that the parts are big, which makes them difficult to handle. Removing the pulp is considered disturbing because it gets stuck in the strainer or tends to end up on the floor. Since the pulp is wet one has to decide whether to throw it straight into the trash and cause the trash to get wet or to throw it into the zinc and take care of it a second time when it has dried. Some participants from the focus group thought that it would feel more worth to take the time to clean the machine if one would make juice for more people at once. The users also addressed the issue of getting spare parts if something breaks or wears out, for example the little dish brush.

4.2.7 Products

The interviewees found it very important to have full control over their products; to be sure that they are clean and to have the possibility to make adjustments and affect the outcome. The only user of a slow-speed juicer made the conclusion that since the pulp was dry and tasteless, the machine is effective and the juice has a high quality. Another aspect of control could be to vary the texture of the juice by adjusting the amount of pulp.

Regarding the design and quality, the interviewees and participants in the focus group consider the overall feeling of the product very important. It should feel genuine, stable and not too plastic. Products shall be both aesthetic and functional and contribute to a nice experience. Durability is important when it comes to both mechanics and materials, for example it has to sustain being used and cleaned in the way that is intended. Aesthetic requirements for kitchen products were that they should be simple, discreet and not take too much space. Common for the participants in the focus group was that they find properties and durance of a product more important than the brand.

Both the interviewees and the focus group participants were asked about the demand on a product in order to stay on the counter top at all times. Primarily there has to be room for the product and it has to be used a few times a week or at least on the weekends. Secondarily it has to have a pleasing appearance. However it seems to be a matter of personal preference on whether to keep products on the counter or not. One focus group participant explained that he has a large counter because he wants a large counter, not because he wants it cluttered with different kitchen products. Other users also expressed a wish to be able to store a juicer in a cabinet, or at least to be able to push it under a cabinet. One user addressed the problem of using for example coffee makers that stand under a cabinet, where it is very difficult to fill them with

water. The espresso machine users said that they don't have a choice to put away the espresso machines, they are too large and heavy.

4.2.8 Everyday Luxury

Among the focus group participants, luxury is considered to be a balance between health and good food, wine or sweets. Being healthy during the week allows you to eat or do whatever you like on the weekend. Colorful food feels luxurious, as well as being able to try new and different kinds of food and being able to always have fresh fruit and vegetables at home. The participants choose groceries that are good for their own health. Locally produced food is not considered very important, but during the right season in Sweden, local fruit is for example preferred. Luxury is also to be able to make use of what you have at home, for example fruit from your garden.

Products with the right perception of quality can enhance the sense of luxury for an everyday activity. For example, taking a run can feel a lot more luxurious with comfortable, nice running shoes. Products can also be something that you indulge yourself with. Apart from the product-related luxury, luxury can according to the participants be time to take care of yourself. Getting physical exercise is important but also a luxury. Everyday luxury is considered very important and it does not necessarily have to be big things. The conclusion was drawn that variation is necessary to keep up a feeling of luxury, but on the other hand it feels luxurious to be able to do things every day if it regards your health.

Variation in combination with a big selection was addressed by the hotel breakfast responsible as one of the key aspects for enhancing the feeling of luxury. A small-scale feeling, in contrast to industrially cooked or prepared food is also considered as luxurious. One hotel for example buys their marmalade from mansions close by, while another hotel produces marmalade and muesli on their own.

4.3 Function and Task Analysis

4.3.1 Hierarchical Task Analysis

A Hierarchical Task Analysis was performed to analyze the usage of the product as it is today. The main task with the machine is to make juice, and the steps below include everything from preparing the fruit until cleaning and storing the machine. For the HTA, see appendix 7.

4.3.2 Function analysis

A function analysis (fig. 4.8) was performed to clarify the functions of today's product as well as to work as a transformation tool into the future product. The main function of the product is to *make juice*. After that the partial functions and support functions are stated. The function analysis also worked as the foundation for the basic function list, see appendix 8.

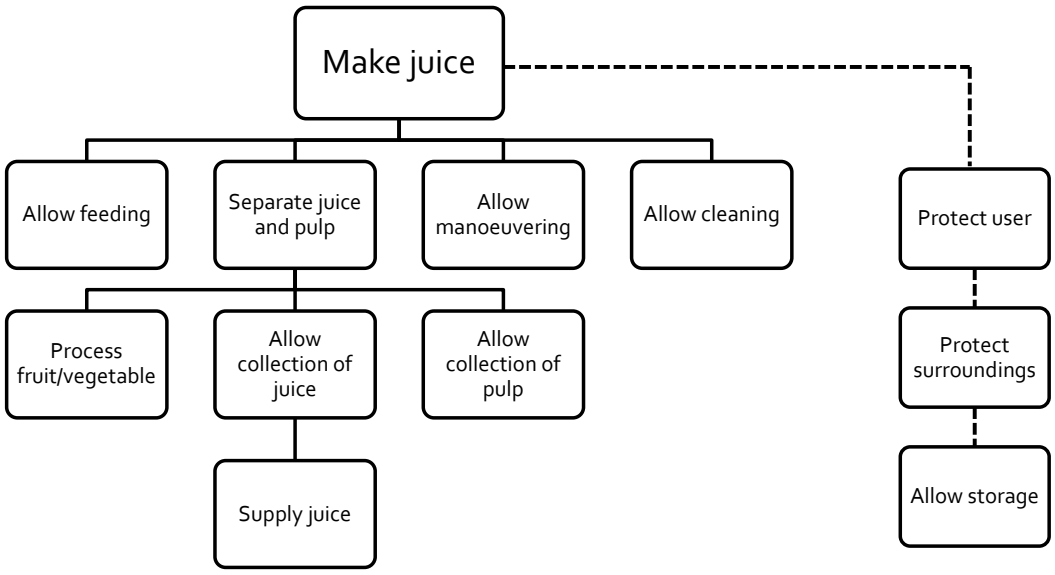


Figure 4.8 Function analysis

4.4 Conclusion from Research

As a summary of the Research phase, a map was created (fig. 4.9). The list to the left is a first draft of a function list. It explains what functions the product has to be able to handle. The functions are divided into different sections depending on their nature. Further to the right there are balloons in different shades of grey. The most opaque balloons represent ideas and areas to look into. The more to the right and the more transparent the balloon is, the more fuzzy is its content. The ones that are the furthest to the right are about transferring different feelings. Dashed lines mean that there is a decision to be made, and that there might be different possible directions. For example, the machine could either show the user that the scrap is dry as a sign of its effectiveness or hide the scrap so that the user doesn't have to see it or deal with it before it needs to be emptied.

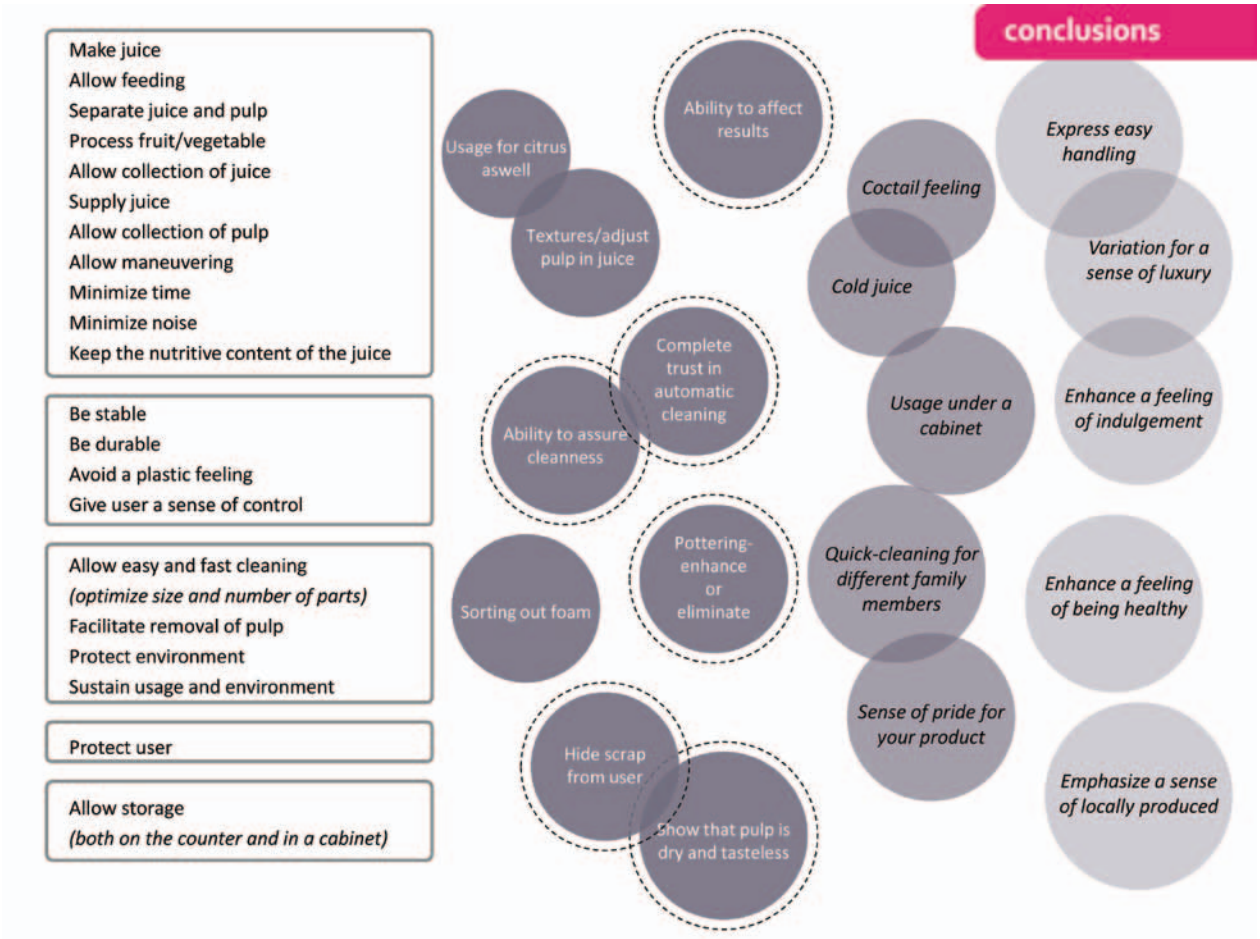


Figure 4.9 Mapping of the conclusion from research

5. Concept development

Based on the research performed in the first part of the project, ideas were generated. From the ideas, different concepts were put together. The concepts were evaluated and compared and in the end one single concept was chosen to develop further. This chapter describes the process and the outcome of the concept development.

5.1 Idea generation

To generate ideas for the product concept, idea generation sessions were held. A creative workshop was also executed to collect ideas from the outside.

5.1.1 Idea generation sessions

After all research had been conducted and the research phase had been concluded, it was time to start the idea generation phase. The idea generation phase included brainstorming (see section 3.4.1) for ideas on different levels; ideas were searched both on a very general level and on a more detailed level. The goal when working on a detailed level was to find partial solutions for specific problems. These problems were found in the map of the results from the research phase (see section 4.4). When working on a general level, random entry methods (see section 3.4.5) were used to get a broader range of ideas. The inputs consisted of words or images. Synectics (see section 3.4.3) was also used, with analogies such as *How would I make juice if I were a penguin?*. When working on a detailed level random inputs were too difficult to work with and therefore this method was discarded early.

During these early idea generations, the ideas were put aside before being fully worked out. When many ideas had been collected, they were all looked through again. For an example of sketches, see fig. 5.2. The ideas with potential were thought through more thoroughly and if necessary, some research was made on the topic. When one group member had developed an idea further it was passed on to the other group member. In this way, both group members could contribute to, and get involved in, all ideas.

5.1.2 Creative Workshop

During the idea generation phase, a creative workshop (fig. 5.1) was held in order to collect new ideas and get inspiration from people that had not been involved in the project before. It was done at home during evening time with participants known privately. Having it at home made the participants more relaxed and less pressured. The participant group consisted of four people between the age of 25 and 30, two women

Figure 5.1 Creative Workshop

and two men. Four people were considered enough to get a variety of ideas but not too many to make each individual heard. All of the participants were engineers with a practice of working with products and expressing ideas through sketching; which was considered useful for this purpose. The workshop session started with a brief presentation of the project and the current juicer products on the market. To facilitate understanding, two existing competitor products were showed and explained more thoroughly. The participants were given the opportunity to try the products to stimulate new ideas and thoughts.

The first idea generation method was done in group to get the participants started and to make them feel comfortable before starting with individual sketching or writing. Two questions were asked; *How can food or fruit be processed into smaller pieces*? and *How can something firm be separated from a fluid, such as pulp from juice?*. The participants were to come with suggestions that were written on post-its and put on a wall. The purpose of the exercise was both to collect new ideas, but also to get the participants to start thinking outside the box and to provide an idea bank as a support for the next steps of the workshop. After the group task, an individual idea generation session was held, including the method brain writing (see section 3.4.2). The participants were to choose two ideas to give forward to the person sitting on their right hand side. The method was repeated until all participants had worked with all of the sketches. During the session, the participants were encouraged to think about Osborne's idea spurs (see section 3.4.4) to stimulate creative thinking.

Quite many ideas were brought up during these few hours, and the results were pleasing. Most ideas that came up were not entirely new, but in some cases a useful reference to another product or subject was provided. This gave us new input on research subjects or new viewpoints on how to develop an idea further. The ideas from the workshop were put together with the previous ideas to be evaluated together.

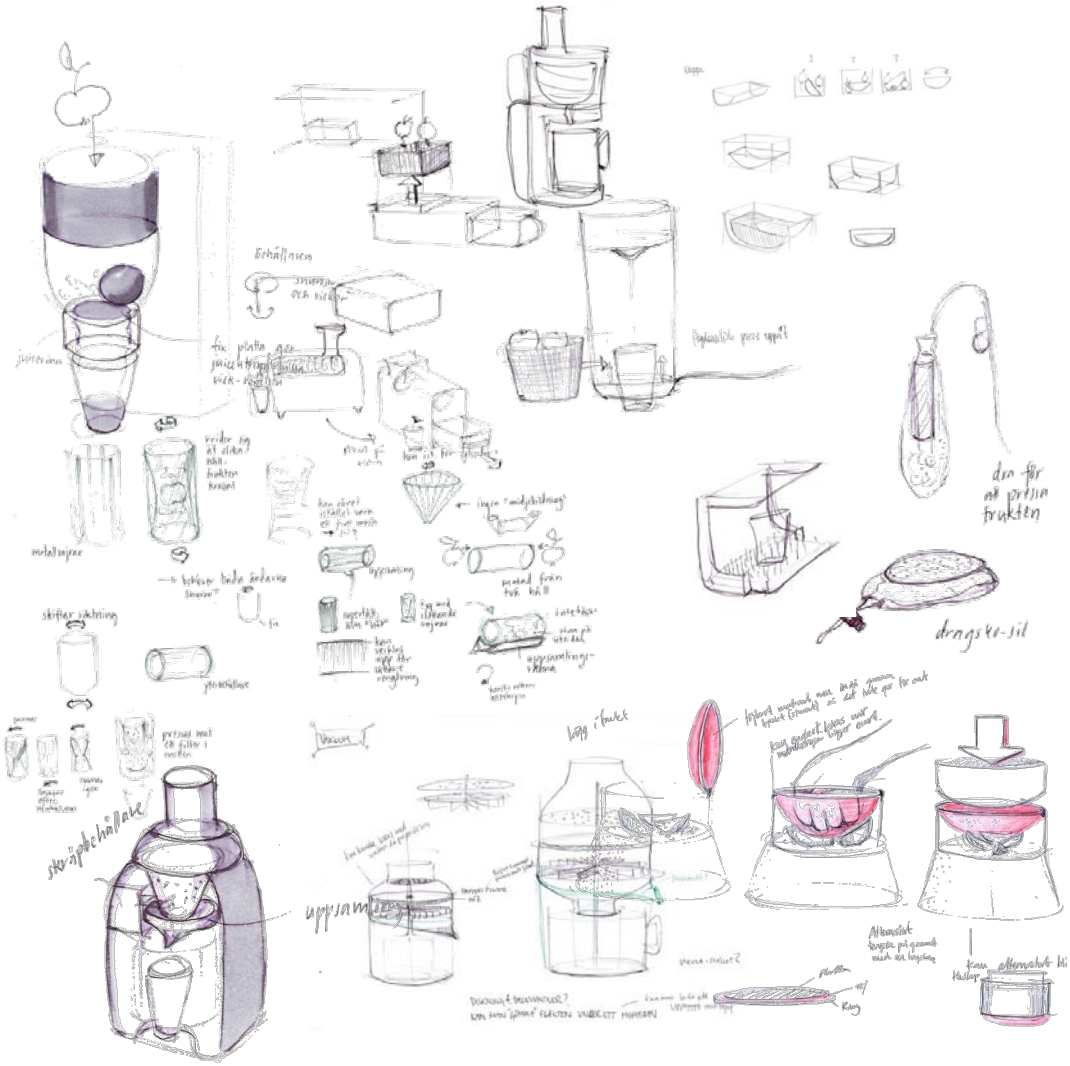
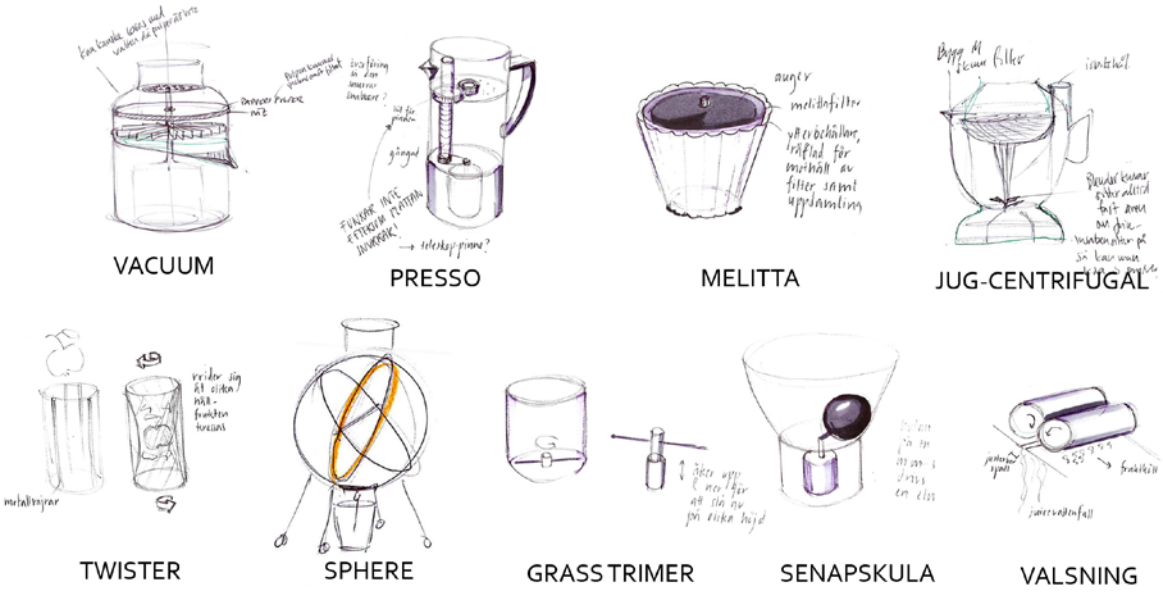


Figure 5.2 Mixed sketches from the idea generation

5.2 Evaluation of ideas

After working through the ideas from all idea generating sessions and the creative workshop, ten new principles had crystallized and several interesting partial solutions were found. For support with evaluating the ideas, both contact persons at Electrolux and supervisors at Chalmers were consulted. Another tool used for the evaluation was a graded evaluation matrix. To get an internal ranking of the requirements, a comparison chart was used. This ranking was later transformed into an index of importance between one and four. All ten concepts were graded how well they fulfilled the requirement with a grade between zero and four, where zero was insufficient fulfillment of the requirement and four was excellent fulfillment of the requirement. This method was used to get an indication on how beneficial the concepts were rather than a final determination of which concept to further develop.

In the evaluation matrix (fig. 5.3) two existing solutions were also included. The primary reason for this was to assure that the concepts had potential to be at least as good and efficient as existing solutions. Many concepts fell during the matrix evaluation because they did not provide enough benefit to be worth the development efforts. These concepts are shown on this page, but not explained further.



	Effective juice extraction	Fast juice extraction	Can handle whole fruits	Continous feeding	Effortless feeding	Nicely supplied juice	Little mess	Facilitate removal of pulp	Easy cleaning	Allow maneuvering	Minimize noise	Keep nutrients	Juice quality (color/homogenity)	Stability	Durability	Control for user	Number of parts	Compactness	Storage	Safety	Adjust pulp	Citrus usage	Possibility for cold juice	Usage range	Differentiation	Low development effort
Vacuum	2	3	3	3	2	3	3	2	1	2	2	2	2	3	2	2	2	1	2		1	1	1	1	3	1
Presso	3	2	2	0	3	2	21	2	3	2	3	2	3	3	3	3	3	3	3		1	3	1	1	3	2
Melitta	2	3	3	3	2	3	3	3	3	3	2	2	1	3	2	2	2	2	1		0	1	1	0	1	2
Jug-centrifugal	3	3	3	2	2	1	21	2	2	2	1	2	2	3	2	2	2	2	1		2	0	2	3	2	2
Twister	1	1	3	2	3	2	21	2	3	2	3	3	2	2	2	2	2	3	2		0	0	0	0	3	0
Grind in sieve	2	2	2	2	3	3	3	2																		
Sphere	2	2	2	3	3	3	2	1	1	3	2	2	2	2	2	1	2	1	2		0	0	1	1	3	01
Grass trimmer	1	1	2	3	3	2	2	1	1	3	2	2	2	3	1	1	2	1	1		1	1	1	1	3	0
Senapskula	2	2	1	2	3	2	2	1	2	2	2	3	2	2	3	2	2	1	2		2	0	1	1	3	0
Valsning	3	2	1	3	2	3	2	2	2	2	2	3	3	3	2	2	2	1	1		1	0	1	1	2	1
Magimix	3	3	2	3	1	3	2	2	1	2	1	2	2	2	2	1	2	1	1		2	1	0	2	1	
Philips	2	3	3	3	2	3	21	1	1	3	2	2	2	3	2	2	1	1	1		0	0	0	1	1	

Figure 5.3 Evaluation of ideas

5.3 Concepts

After the evaluation of the ideas, three new concepts were put together to present to the steering group at Electrolux. The two most important existing principles of extracting juice, centrifugal juicers and slow speed juicers, were also presented. Even though main focus had been put on finding new solutions some ideas on how to improve existing solutions had emerged. By presenting these techniques, Electrolux was given the opportunity to proceed in this direction if it was considered more beneficial. Below a description of the concepts follows.

5.3.1 The Slow speed juicer

The Slow speed juicer (fig. 5.4) is as earlier described (see section 2.2.2) a juicer that crushes the fruit and at the same time presses it against a sieve. The pulp produced by the slow juicer is very dry and well packed, which simplifies cleaning and makes it possible to throw the pulp directly into the trash. It can also be seen as a proof for effective juice extraction. However, there is always a bit of pulp left in the machine which tends to make the sink messy when cleaning. Another withdraw with this concept is the limited size of the feeding chute which implies that the fruit always need to be cut in pieces before juicing. Other advantages of the method is the possibility to juice leafy greens such as wheat grass or salads and that much of the nutrients of fruit is kept in the juice since no cutting or shredding is done (see section 2.1 for more information on nutrients in juice). The juice produced in these types of machines has a very homogenous texture.

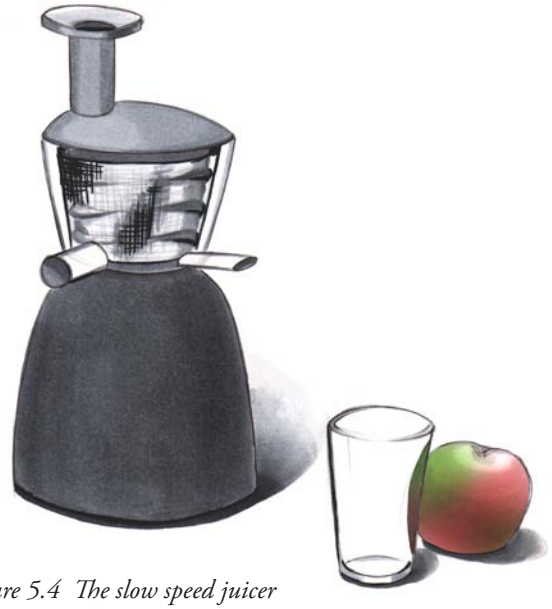


Figure 5.4 The slow speed juicer

5.3.2 The Centrifuge

The Centrifuge (fig. 5.5) is as described in section 2.2.1 a machine that first grinds the fruit with a rotating grinding plate and then spins the pieces in a mesh basket at a very high speed to extract juice by centrifugal force. The feeding chute can be made so wide that whole fruits, for example apples, can be fed. That is a large advantage because the user does not have to prepare the fruit before usage. Another advantage is that the machine works fast. One negative aspect is that it is difficult to clean, because there are many and large parts and the sieve often requires lots of scrubbing. Another disadvantage is that it is difficult to keep down the size of the machine.

Figure 5.5 The centrifuge

5.3.3 The Presso

In the Presso concept (fig. 5.6), all fruit is put in a jug that is closed with a lid. When the machine is started, a plate starts to spin in the bottom of the machine. This plate has the function of both a sieve and a grinder. As the plate spins it is also moved upwards, causing the pulp to follow with the plate and the juice to stay in the bottom. The plate will then push against the lid and cause the fruit to be both ground and pressed. Different mechanical solutions on how to move the plate have been considered but not yet decided. It could for example be moved with a spring or a threaded stick in the middle of the jug. As the plate has moved all the way up to the lid, the lid and the plate can be removed together. Advantages with the concept are first of all

that it is simple and compact. Since all fruit it is fed from the beginning it does not need to have a feeding chute that takes up space. Besides, it does not require the user to exert force with a pusher but produces this force by itself. The pulp will be collected in one place and easy to remove. When the juice pours down and the pulp moves upwards, there might also be a cool visual effect. Disadvantages are the limited capacity due to the fact that it cannot be filled continuously, as well as the risk of the kitchen getting messy when removing the lid and the plate. The jug must be dimensioned for whole un-juiced fruit that cannot be closely packed. Therefore it can never be filled completely with juice. The shape of the jug will affect the amount of fruit that can be added. If the compromise is made that the fruit must be cut beforehand, the machine can be made in a slimmer shape.

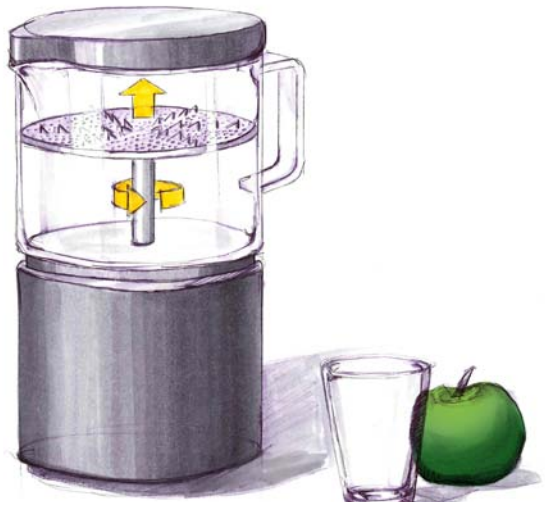


Figure 5.6 The presso

5.3.4 The Vacuum

The vacuum concept (fig. 5.7) is a new principle on how to make juice, inspired by the principle of a wet and dry vacuum cleaner. The principle is to suck the juice through a sieve which will lead to hard packed pulp that is collected in one place of the machine. The machine consists of a fan that builds up a low pressure in a connected container. On the rotation axis of the fan there is also a shredding plate that moves with the same rotation as the fan. The fruit is fed from above and pushed towards the shredding plate. The shredding plate shreds and lets the fruit pieces through the plate. Underneath the shredding plate on a few centimeters distance there is a sieve. A pipe connects the low pressure container with the area underneath the sieve. Therefore the juice is sucked through the sieve and into the container. From the container the juice pours out in a glass. It is important that the fan is positioned higher than the connecting pipe to avoid that the juice pours into the fan. If the parts are correctly positioned, the juice falls down through gravity.

The benefits with the concept are as mentioned before that the pulp can be packed really hard and in one place, like a cake. There is a possibility of making the machine more compact because many components are flat. This is also something that may ease the cleaning. However there are many uncertainties about the concept. Questions about the functionality, the volume and the effectiveness in making juice still need to be investigated further. A clear drawback is that the solution might be noisy.

Figure 5.7 The vacuum

5.3.5 The BlenderJug

The BlenderJug extracts juice with the same principle as the centrifugal juicer (see section 2.2.1) but it is combined with the function of a blender. The machine has a jug that contains both a set of blender knives and a centrifugal basket on top of an axis. The basket turns with the same speed as the blender knives. On top of the jug and the basket there is a lid with a feeding chute the allows the fruit to be fed in the same way as in a centrifuge. A pusher is provided to give sufficient pressure for the fruit against the shredding plate. The machine has no separate scrap container since all scrap is collected inside the centrifuge basket. (This works in same way as a Magimix LeDuo XXL, see section 2.2.1.)

The benefit with the concept is that it provides an extended usage range. Fruits not suitable for juicing can be blended and ice can be added to chill the beverage. This need was identified when visiting juice bars during the interpreter study (see section 4.2.6). Another benefit is that the juice pours directly into the jug so there is one part less to clean. However there is a risk that the jug feels big and that it might be hard to serve juice directly from the jug without demounting the lid with the feeding chute.

Figure 5.8 The BlenderJug

5.4 Partial Concepts

Alongside with the five main concepts a few partial ideas were presented in the steering group meeting. Those ideas were not considered unique for one concept but could be implemented in some or all of them. They were divided into four areas that arose during the user studies. Below follows a description of them.

Cold juice:

- Ice jug (fig. 5.9) - A jug that has an outer shape or other parts that are filled with phase change material. The jug can be placed in the freezer before usage and then act as a cooling coil.

- Small Ice cube box (fig. 5.10) - A box for making very small ice cubes. The small container holds a few trays and has a built in channel system, which enables the user to fill water in only one place and let the water flow into the trays. The box is put in the freezer and the water freezes. The trays can be pulled out and placed in the spout of the juicer. The warm juice will release the ice cubes that will flow into the glass and chill the juice.

Figure 5.9 Jug for cold juice

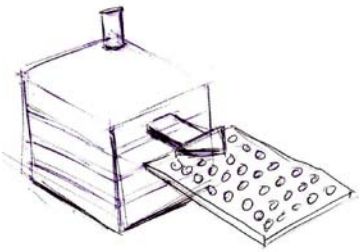


Figure 5.10 Ice cube box

Usage for citrus as well:

For both a centrifugal juicer and a slow speed juicer ideas on how to integrate a citrus press were created.

- For a centrifugal juicer, the pusher has a citrus press hidden inside (fig. 5.11). The top of the pusher can be unscrewed, turned around and screwed back in place with the citrus press pointing upwards. In the bottom of the pusher there is a connection to the basket so that the rotational movement is transferred to the pusher. This way the citrus fruit can be squeezed on top of the pusher. On the sides of the pusher there are channels were the juice can flow down into the machine and mix with the rest of the juice.

- For a slow speed juicer, a similar accessory can be provided (fig. 5.12). It is a citrus press that can be mounted on top of the turning screw.

Figure 5.12 Citrus press for a slow speed juicer

Figure 5.11 Citrus press for centrifugal juicers

Usage under a cabinet:

- Telescopic (fig. 5.13) - The feeding chute is telescopic so that it can be folded together when storing the machine.

- Elastic (fig. 5.14) -There is no feeding chute but a bigger opening towards the grinding plate. There you put the fruit and then close a lid. The lid is elastic and pressure towards the grinding plate can be provided with your hands or a matching pusher.

- Turning plate (fig. 5.15) - The feeding chute is eliminated by having a turning plate. The machine is fed in a hole at one side of the plate. The plate turns 180 degrees where there is a hole in the lower part where the fruit falls down in the machine. The machine is not open directly over the grinding plate so the user can not get hurt.

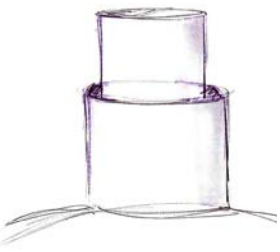


Figure 5.13 Telescopic feeding chute

Figure 5.14 No feeding chute

Figure 5.15 Turning plate

Adjust the texture in the pulp:

- Elastic filter (fig. 5.16) - The elastic filter is stretched to a preferred degree and then mounted in the machine. Different degrees of stretching gives different amount of pulp in the juice. This type of filter can also be easier to clean.

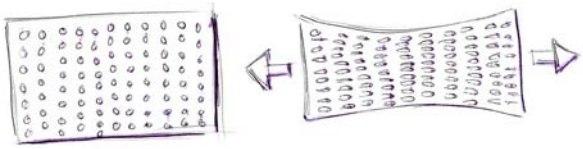


Figure 5.16 Elastic filter

5.5 Concept selection

One of the concepts was to be chosen for further development. The definitive concept selection was made during a meeting together with the steering group at Electrolux.

The BlenderJug was considered to be the most innovative and differentiated concept compared to existing products. The extended usage range with the possibility to make both juice and other types of fruit drinks, such as smoothies, was considered to be in line with the brand values and to have a stronger market potential than the other concepts. With this concept a feature not directly expressed by the user but something seen in the interpreter studies (see section 4.2.6) was integrated, which led to a higher level of differentiation. The BlenderJug is built around existing techniques which is an advantage regarding development and may also give the users a certain amount of comfort and recognition. For these reasons this concept was chosen for further development. Fig. 5.17 shows a position matrix of the BlenderJug compared to the other concepts.

The Presso concept was considered to be a simple and clean juicer that would feel new and fresh and in the meantime fairly basic. This concept was aiming to simplify the usage and to create a product optimized for everyday use. The concept was considered to have a high developing potential but compared to the BlenderJug it only offered functions already excising on the market.

The Vacuum concept was the least concrete one since the vacuum technique was applied in a completely new area. The concept offered a new technique without major changes for the user. The steering group appreciated the opportunity to build a story around the vacuum technique and the history it has within Electrolux. Overall, the concept generated more positive response than expected. It was however considered too far from existing technical solutions without providing enough added value for the user.

During the discussion the two existing solutions where early discarded as options for further development. They were considered to be less interesting and promising and provide too little opportunity for differentiation. Many of the partial solutions were best suited for optimizing the existing juice extractors, therefore they were discarded at this point. Since the new product concept can blend ice, the ideas for chilling the beverage are no longer needed.

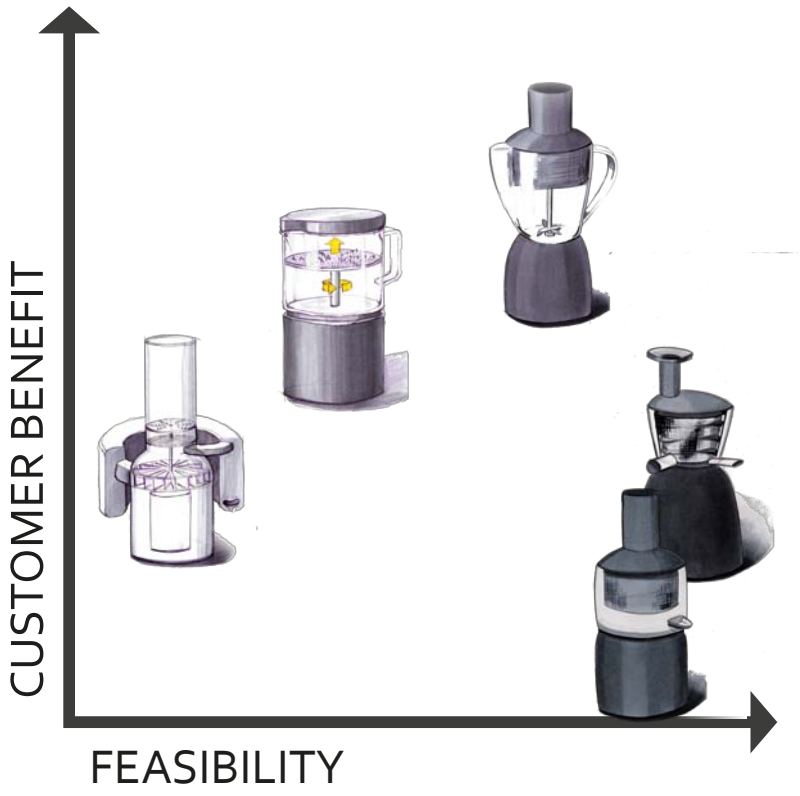


Figure 5.17 Position matrix of the part concepts

6. Further development

This chapter describes how the chosen concept was evaluated further in terms of product architecture, technical solutions and form development. Since the concept was different in functionality from today's juice extractors, the user aspects had to be analyzed first to identify areas that needed to be considered.

6.1 User aspects

Some aspects have changed for the user because of the new functionality of the product. These needed to be investigated.

6.1.1 Target group

The target group for the product was in the project scoop defined as one of Electrolux's predefined target groups. They are mainly based on values and habits. This group was narrowed down and further defined when starting to develop the concept further. In order to make the information more accessible and applicable to this product a board of both pictures and words was created (fig. 6.1). Fictive pictures of metaphors, interior of the target groups homes and people belonging to the group were used. Due to confidentiality reasons, the board cannot be shown in its entirety. Some characteristics of the target group are: Feel confident, Good income, Personal style is important, Want functional products.

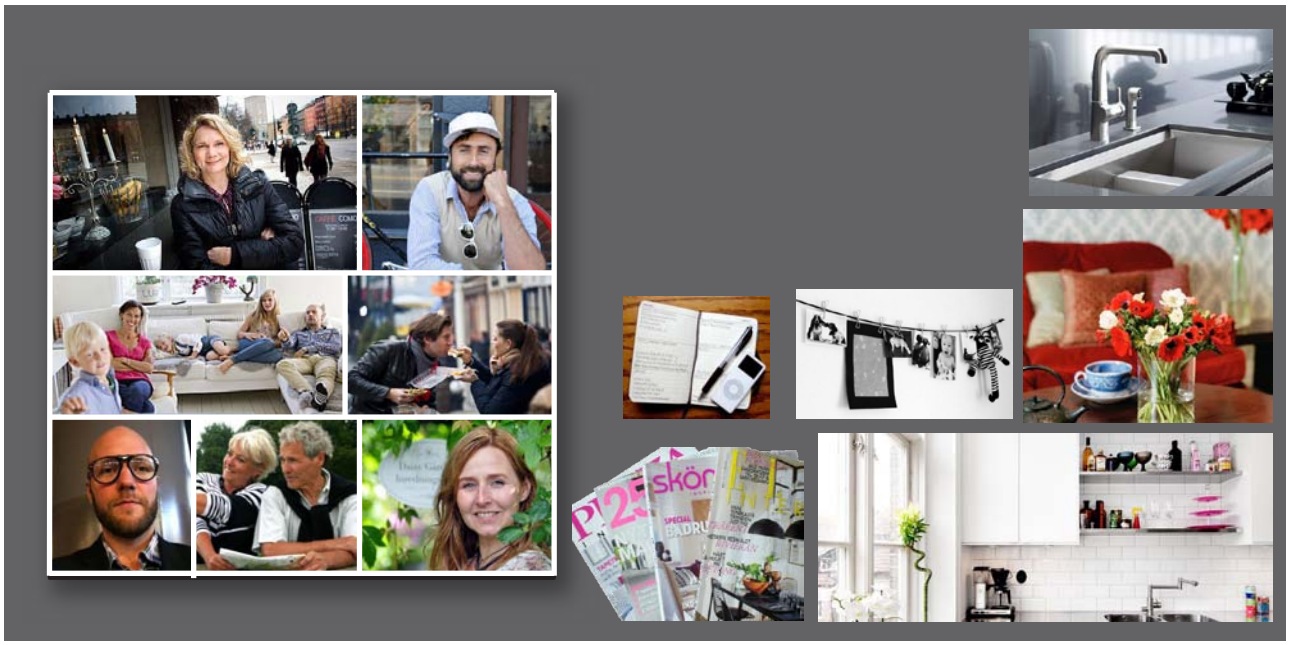


Figure 6.1 The target group.
(Image sources from left to right: Hoelstad, 2010; Lum, 2010; Declutter Home-Maxupdates, 2011; Huett Nilsson, 2011; BeingAKB, 2011; Irmaos de assis, 2011; Kjellberg, 2011; Skoog, 2003; Wass, 2011; Red Roof In, 2011; Thelin and Clarholm, 2010; Bolin, 2011; Hemnet, 2011)

6.1.2 Usage situations

The BlenderJug concept gives the opportunity to use the product in a larger variety of situations than a regular centrifugal juicer. A matrix of the most likely usage situations and ways of using the product was made. From that, combinations to cover the most important aspects were concluded in three story boards (fig. 6.2). The handling of the product is very similar in the different usage situations. The main difference in usage depends on whether chosen ingredients are most suitable to juice or blend.

Fresh Morning Juice

The Afternoon Snack

Party Fruit Drinks

Figure 6.2 Possible usage situations for the Blender jug concept
(Image sources from left to right: Dahl, 2011; Foodcollection RF, 2011; Moment, 2011; Cole, 2011; Frisk, 2010; Jupiterimages, 2011; Ki and Sungmi, 2011, Scarbinsky, 2011; Alvhem, 2011; JUNKII'S)

6.1.3 Hierarchical Task Analysis

The hierarchical task analysis made in the beginning of the project (section 4.3.1) was updated to the new concept. It was updated once more even later in the process. The most prominent change in the tasks is that there are two tasks involving feeding the machine in different ways. The assembling of the machine also differs from previously studied juicers. The part of the HTA affecting the assembly is shown in fig. 6.3.

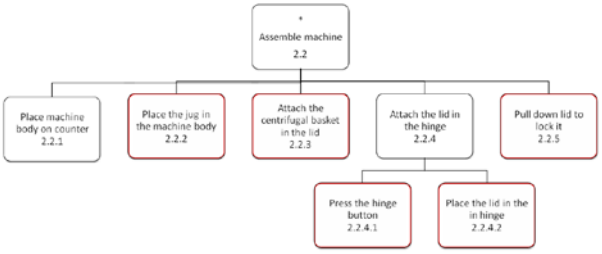


Figure 6.3 The part of the HTA that represents the assembly

6.2 Functions and requirements

Due to the extended function of the BlenderJug concept the function tree (4.3.2) needed a rework and some aspects had to be added and worked out in more detail (For the first part of the function tree, see fig. 6.4. The whole function tree is found in appendix 8). A requirements specification for the product was worked out along with the function tree. For the full list see appendix 9.

A second round of benchmarking was performed to verify that there is no identical product on the market. No product of the same principle was found, but there are several combination-products that can both blend and juice. These normally have one base with two different insets, one for blending and one for juicing. That means that if one wants to do both, the juice still has to be poured into the BlenderJug afterwards, causing all parts to become dirty. These discoveries confirmed the hypothesis that there could be a market potential for a combination product that is simple to use and to clean.

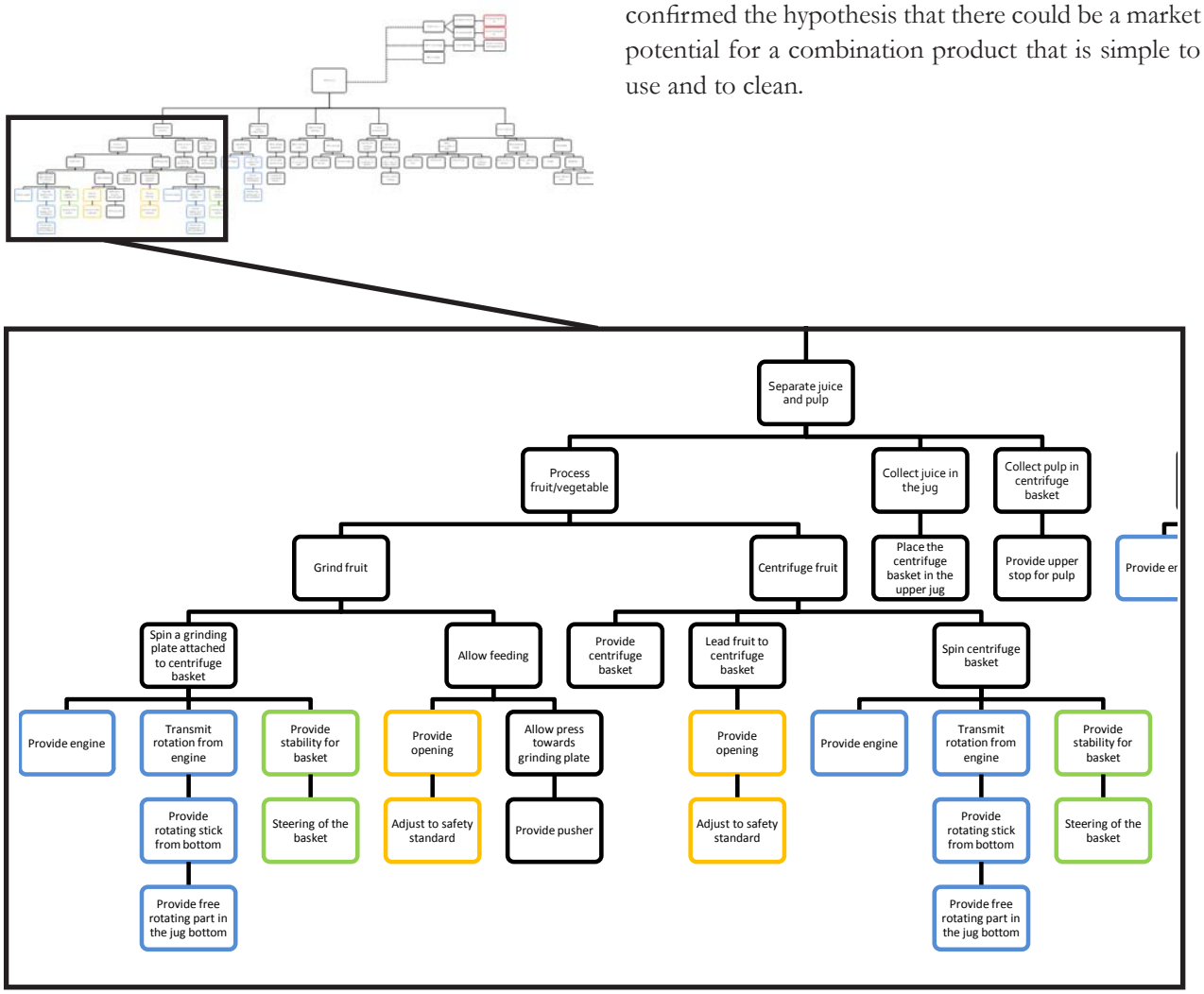


Figure 6.4 The first part of the function tree

6.3 Capacity

Unlike many other centrifugal juicers, the BlenderJug does not have a separate scrap container but collects all the scrap in the centrifugal basket. Therefore, the capacity is highly dependent on the size of the basket. More specific, the surface area of the mesh decides how long it takes before the basket clogs. To investigate this relation, a couple of tests on the Magimix LeDuo XXL (see section 2.2.1) were performed (fig. 6.5). The discovery was that the Magimix can juice nine apples with a good extraction rate (the juice weighs 66% of the initial weight of the fruit). Afterwards, the extracted juice per apple gets significantly less. After twelve apples the layer of pulp is so thick that it starts to creep over the upper edge, and the pulp gets spread out in the whole machine. To see what happens if the surface area is smaller, a piece of tape was put to cover a part of the existing basket. The extraction rate of the first three apples was high (68%), but for the next three apples it went down to 56%. The assumption is that this decrease depends on the smaller surface area. However, the test was not completely authentic because the basket was only simulated to be smaller. The juice could not be extracted through the taped surface, but the pulp still spread out over it. This caused a pulp layer that was thinner than it should be.

The BlenderJug collects the juice directly in a jug, unlike Magimix LeDuo XXL. Therefore the capacity is also dependent on the size of the jug. A reasonable size for the jug was judged to be at least four glasses of juice (of 200 ml), to be sufficient for a regular family. Since there must be space for blending ingredients as well, a volume of 1,2 liters was selected. This size is similar to many blenders today. Based on this value, the current size of the Magimix LeDuo XXL basket would fit the demands of the product.

The surface area of a cylinder is

$$2\pi r(r+h)$$

where r is the radius and h the height of the cylinder. (Råde and Westergren, 1995)

For aesthetical reasons, making a basket with a smaller diameter than the one from Magimix LeDuo XXL was considered. The basket was measured to have a diameter of 160 mm, and a height of the mesh part of 50 mm. To keep the same surface area, the basket with a diameter of 140 mm would have a height of 78,6 mm. Reduction of the diameter also reduces the centrifugal force, therefore the basket would have to spin quicker to keep the same capacity. Reducing the radius 1 cm would increase the speed from 1500 rpm to 1900 rpm. With the results from the calculations it was regarded as possible to make a basket with a smaller radius if that would be preferred.

The centrifugal force depends on the mass of the rotating object (m), the angular velocity (ω) and the radius (r).

$$F_{centrifugal} = m\omega^2 r_{\perp}$$

The angular velocity is described by $\omega = 2\pi f$ (Taylor, 2005)

Figure 6.5 Capacity tests of Magimix LeDuo XXL

6.4 Product architecture

The many functional requirements on the product has had a large impact on the product architecture. Feeding and blending in the same container puts many, sometimes more or less contradictive, demands on the design of the jug. The upper diameter is decided by the size of the basket while the lower diameter is constrained to a certain dimension to optimize the flow to the blender knives. The volume of the jug was decided by the capacity, explained in section 6.3.

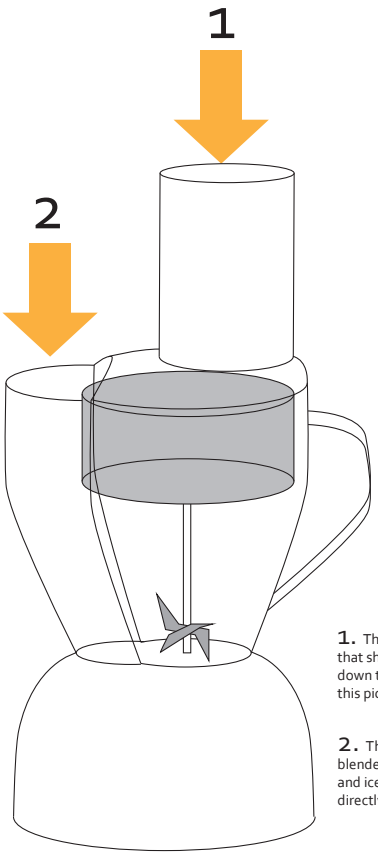
It was decided quite early that the jug would be placed next to the engine instead on top of it, like in today's centrifuges. The main reason regarded height issues, since the fact that the juice is collected in the jug adds around ten to 15 centimeters to a normal centrifuge. A too high product does not fit under a cabinet and causes problems regarding stability. This decision was later on strengthened as it was realized that a coupling is needed which adds further to the height.

6.5 Interaction with the different functions

The fact that the product has two separate functions makes it necessary to have two different inlets for the fruit that should be processed by the different functions. The fruit that shall be juiced has to be fed into the centrifugal basket whereas the fruit, or other ingredients, that should be blended has to be fed in the machine without passing the juice basket. It is crucial that this is well communicated and that the inlets are distinguished from each other. Important is to minimize errors, to minimize interaction places, to minimize mess and to keep down the height of the machine so that the user will reach the feeding chute.

6.5.1 Early solutions

The feeding of the blender function has been the most difficult decision regarding the product architecture. One track was considered and evaluated for a long time before it was discarded in favor for another idea. The initial idea was to have an inlet for the blending ingredients directly on the jug that led past the juicing basket to the blender knives (fig. 6.6). The advantages would be that it could be fed continuously during usage, unlike solutions where the whole lid and the basket had to be removed or where all the blending ingredients had to be fed before closing the machine.



1. The feeding chute for the fruits that should be juiced. The fruit falls down to the basket which is grey in this picture.

2. This is the feeding hole for the blender. It is important that the fruits and ice pass by the basket and fall directly down to the blender knifes.

Figure 6.6 The initial idea for the Blender jug concept

The initial idea implied several challenges. The major problem was how to serve the juice. The user could either pour the juice from the jug with the basket and the lid still assembled or remove the lid and the basket prior to serving. It was assumed that the target group would feel limited if both ways were not possible. In existing juicers on the market, the juice is poured directly into a drinking glass or a jug, which is more convenient for the user than having to pour it from the jug. Removing the lid and the basket prior to serving would be one extra task for the user to perform before receiving the juice. Besides, there might be a lack of space to put the dirty lid and basket. If the user on the other hand prefers to clean the machine before drinking the juice he or she might prefer to remove the lid and the basket before pouring. The same goes for a user that wants to put the jug on the table. When serving the juice with the basket and lid still assembled there has to be enough space for the juice to run beside the basket. The jug will get heavy which increases the demands on the ergonomics. An estimation based on parts from existing food processing appliances was that the full jug would weigh around 2,4 kg, given that it was made from plastic. As a comparison, a regular glass blender jug weighs around 1,5 - 2 kg when empty. Since the jug needs to

be transparent and a glass jug would weigh at least one kilogram more, a prerequisite for this concept was a plastic jug.

It was difficult to add the inlet for the blending ingredients to the jug without making it look very large or unaesthetic. Two main directions were considered, to have the inlet in the front combined with the spout, or to have it in the back combined with the handle. There were also thoughts on inlets on the side of the jug, but this asymmetry was even more difficult to build in aesthetically. Placing the inlet next to the handle was considered more logical, because all interaction occurs on the same side of the product. However, there was a large disadvantage in Ergonomics as a consequence of the large distance between the handle and the centre of gravity. Another difficulty with the initial idea was to prevent splashing from the inlet of the jug during usage. There would also be a risk that something could get stuck in the inlet, and perhaps the machine would have to come with a second pusher. Because the jug needs to be high enough to cover the basket, it needs to be over dimensioned in relation to the volume of juice it can carry. This means that the jug, after the basket has been removed, only will be half full.

6.5.2 Evaluation through mock-ups

To evaluate handling, ergonomics, size and aesthetics, six mock-ups (fig. 6.8) were built. The materials used were kapa-board, carton and foam plastic. Plastic handles were disassembled from existing products and attached to the models. The mock-ups differed in proportions, placement of handle and position of inlet. Two of them were built for the basket that exists in the Magimix LeDuo XXL today (see section 2.2.1), and three of them were dimensioned for a basket with a decreased diameter and increased height (explained in section 6.3). To evaluate the mock-ups, two test persons were invited (fig. 6.7). Appropriate weights were added to the mock-ups to make the test as realistic as possible. The jugs were covered with plastic bags and filled with water to analyze the feeling of pouring.

Figure 6.7 Handling tests

Figure 6.8 Different mock-ups to evaluate the form of the jug

None of the models felt like a good alternative, and they were all heavier and more bulky than desired. They were relatively difficult to pour from, even though an insecurity factor in the tests was the instability of the mock-ups. The materials were weak and the added weights sometimes moved around during pouring. In general, the lower jugs were preferred because of the ability to assure that they were empty. The solutions with a combined feeding inlet and spout were disliked because of the lack of logic in the interaction. Feeding in one end and pouring from the other enhances the feeling of the fruit being processed. The mock-ups were also presented to, and discussed with, the steering group.

6.5.3 Final decision for interaction with the different functions

During the steering group meeting the question was raised whether the blender function needed to be fed continuously or if it could be done in another way. The ideal usage would be that the juice function is fed like a regular juicer and the blender function can be fed like a blender, meaning lifting the lid to add the blending ingredients.

Ideas of making the product more similar to a coffee machine were discussed. The thought was that the jug could be pulled out from the machine while the basket and the lid would stay in place. Like a coffee filter, the basket would hold the scrap in place until the user chose to empty and clean it. These thoughts had been considered previously in the process but discarded due to difficulties to solve some technical problems. Unlike a coffee can, the jug needs to connect to a claw clutch in the bottom, and cannot be slid into place from the side. Another problem was how to make the basket connect to the axis so that it can rotate. If the jug is removed but the basket still assembled, juice might drip into the claw clutch and make it messy.

Not being able to feed the blending ingredients continuously was considered an acceptable disadvantage. The important aspect is that feeding the blender should be effortless and possible to do after the product has been assembled.

The solution found was to attach the lid to the machine body with a hinge (fig. 6.9). The lid would be large enough to cover the whole basket. To feed blending ingredients, the lid can simply be folded up. The basket is attached to the lid with a snap fit and follows to the folded-up position. The whole cross section of the jug is open for feeding the blender, so there is no risk for clogging. Eliminating the separate inlet on the jug solves the problem of splashing during usage. To serve the juice, the lid is folded up and the jug is lifted upwards and removed from the claw clutch. When the lid is folded-up there is no risk of dripping into the claw. Hence the machine can be left open until the user chooses to clean it. Since the lid and the basket are disconnected from the jug, the jug does no longer have to be large enough to contain the basket. This will make the pouring a lot more ergonomic and the whole volume of the jug can be used for fruit drinks, which gives a more aesthetic appearance.

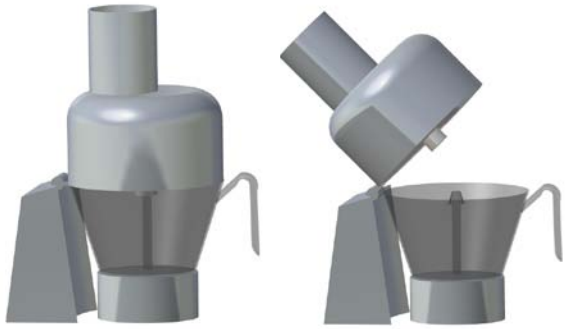


Figure 6.9 Principle of the selected interaction with the different functions

6.6 Clutch and gearing

For the initial BlenderJug concept, the idea was that the blender knives were attached directly onto the shaft that connects to the basket. The two functions would consequently run at the same time. However, there are some advantages with being able to switch on and off the different functions. First of all, the fruit drink becomes fluffier and filled with air when blending it. This might lead to oxidation of the fruit juice, and a texture that might not always be desired. Another aspect is the noise level if two functions run at the same time, as well as the higher demands on the motor.

The first idea was to make a cone clutch (fig. 6.10). This would be able to couple in and out during usage, so that the blending function could be switched on and off while the centrifuge is turning. The concept has two separate claw clutches that attach to the axis that runs the basket and the knives, respectively. The clutches are always coupled in, but the claw that

connects to the knives is controlled by the cone clutch that is hidden inside the machine. The negative aspects with this solution are the complexity in development and low durability due to the fact that it couples in and out during usage. Since the centrifugal basket still always runs when the blender is switched on, the noise level and the demands on the motor are not solved. Besides, it was not considered a necessity that the blending function can switch on and off during juicing. Quite opposite, it is more logical to do the two things one at a time.

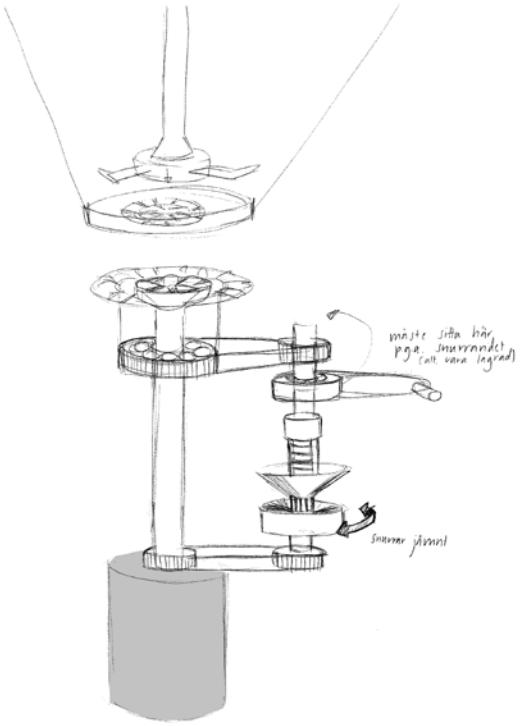


Figure 6.10 Idea for a cone clutch

Therefore a clutch that can not be switched on and off during usage was chosen. It leads to a more durable solution and makes the mechanics easier to solve. The drawback for the handling is that making the fruit drink takes a little longer, but since it is only a matter of seconds this was not considered as a large problem. The chosen solution is based on the principle that there are two separate claw clutches for the axis and the knives, as in the previous concept. However, both claws are always turning at the same time, but only one is in contact with its matching claw in the jug. Claw clutches cannot couple in and out during a high speed without damaging the claws, so in between the two different functions there is a zero position where the motor is stopped. There were different solutions on how the claws could be coupled in and out. One suggestion was that the position of the jug would decide which function is activated. This would be an intuitive and interactive way of switching between the functions, and the solution would be mechanical and quite simple. However, the final concept

Gearing

Gears can have different purposes, one is to increase or decrease rotational speed. The relation between the circumferences of the wheels decides how fast the driven wheel is spinning. In order for two wheels to cover the same distance, a smaller wheel needs to spin faster. Since the circumference of a circle is proportional to its radius, the gear ratio can be described as the relation between the radiuses. If the radius of a cog wheel is half of the radius of the transmitting cog wheel, it spins twice as fast. The ratio is expressed as 2:1 (two to one). In the same way, the gear ratio can be calculated as the ratio between the number of teeth. (Brain, 2012)

Clutches

A coupling is a part that connects two shafts and allows power transmission between them. A clutch provides, unlike a coupling, a non-permanent connection. (Rao, 2008)

In a cone clutch, the transmission occurs between two parts that have friction surfaces in a conical shape. The cones are pushed together through a spring pressure, so that their whole surfaces are in contact. To release the clutch, a cone has to be pulled back via a lever that pushes against the spring force. Cone clutches can transmit more torque than a disc clutch (a clutch where the transmission surfaces are flat) because of the higher normal force due to its shape. (Purohit and Sharma, 2005)

A claw clutch transmits power through surfaces that are shaped in a way that they can interlock mechanically. Compared to other types of clutches they are relatively small, light in weight and simple to construct. (Purohit and Sharma, 2005)

requires interaction from the user in the way that the lid is opened and closed. To have another turning movement was considered to be too confusing. The chosen idea was to control the clutches through a slide control on the machine body. The final solution for the clutch is presented in detail in section 7.2.4.

The basket and the knives need to spin at different speeds, and therefore a gearing function will be needed in the engine.

6.7 Selection of components

Some components needed to be selected to fulfill the part functions of the BlenderJug concept.

6.7.1 Bearings

There are several parts in the concept that need to rotate but still take up load. Hence, the usage of bearings has been necessary. Inside the clutch there are sliding bearings. The speed of the components will be quite high, which makes this a suitable selection. Since the parts are inside the machine body they will not be subjected to water, acids or other substances that might affect the lubrication. From other gears and cog wheel solutions that have been seen, sliding bearings seem to be a common and relatively cheap solution.

Between the lid and the basket there is a rolling bearing. The weight of the basket will be quite high when it is filled with scrap. When the lid is not closed, the weight of the basket cannot rest on the axis and hence the bearing will be subject to a load. The basket is geared down to spin significantly slower than the engine shaft, which also makes a rolling bearing more suitable.

Bearings

A bearing is a part that supports a rotating shaft and takes up a load. Because of the rotation, the surfaces on the bearing and the shaft are subject to friction and heat is produced. Lubricants are substances that are added to reduce friction, take away heat and minimize the wear on the parts. (Purohit and Sharma, 2005)

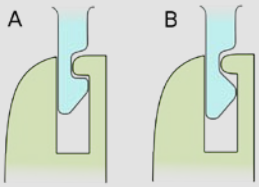
There are different types of bearings, depending on their construction and what type of load they can take up. One way of classifying bearings is dependent on the contact between the bearing and the shaft. There are sliding contact bearings and rolling contact bearings. When selecting bearings, different aspects need to be taken into consideration. For example, rolling contact bearings can take up more load than sliding contact bearings. Both types of bearings have a speed limit. When it comes to sliding bearings, it mostly depends on the lubrication, since a higher speed causes more heat. For rolling bearings, the limit depends more on the dimensions. (Purohit and Sharma, 2005)

6.7.2 Snap fits

There are two snap fits in this product. One is to secure the lid in place when the machine is running. This is designed as a regular permanent snap fit of cantilever type. However, the groove is movable to release the snap fit. More specific, it is controlled by a button on the handle. That way, the user does not have to pull the lid open with force. When closed, the lid is secured in place and there is no risk that it might open during

Snap fits

A snap fit is a simple joining method that doesn't require any additional fastener. The method can be used to join two parts of different materials. The parts can be made of two different polymers, or for example a metal and a polymer. A snap fit consists of a hook and a groove, so that the hook can deflect and snap into the groove. Snap fits can be either permanent or multiple. Permanent snap fits are often used in disposable products, to simplify assembly and minimize costs. An example of a multiple snap fit is the cap of a pen, that can be opened and closed many times. Both of these snap fit types can be designed in a number of different ways, and these different designs can be ordered into families. A basic type of snap fit, where the beam is snapped axially into the slot, is called a cantilever beam. (Tres, 1995) (Image source: Cqui, 2008)



usage. Inside the handle, a spring is pushed together when the lid is closed. To divide the load, there are two small snap fits instead of one large, but this does not affect the usage at all.

The other snap fit is used to join the basket with the lid. On the basket there are three small spheres that are snapped into spherically shaped grooves in a pipe on the lid. Because of the round shape of the balls, this is a multiple snap fit. The snap fit should be dimensioned to carry the weight of the basket, which is around 900 g when filled with scrap. On the other hand the user must be able to pull it out without using too much force. As long as the machine is running, the basket rests on the shaft and the snap fit is not subject to any high loads.

6.8 Form development

The form development process of the chosen concept and the challenges met are described in this section.

6.8.1 Competitors

When the BlenderJug concept was chosen, the most relevant competitors for Electrolux within this product and price range were identified with help from Jérôme Esteve. They are: Kitchen Aid, Breville, Philips (Robust Collection) and Magimix. In figure 6.12 a few product examples from each brand are shown. Similar collections of products were made from other brands that were considered to have a strong brand identity. The intention was to get inspiration on how to create a clearly differentiated expression. However, the most useful usage of them turned out to be communicating form within the group.

6.8.2 Development

In the first stage of the form development, ideas were generated rather freely with inspiration from the image board but without taking too much consideration to technical aspects. This turned out to be very difficult, so the form development was put on hold until the product architecture was set completely. In the meantime, the logic of the usage was further discovered before setting the overall shape.

When the product architecture was determined, a simple CAD-model was created to make a quick evaluation. This model was printed in both 3-D and 2-D view to create an underlay to sketch on. This way, many different variations could be tried quickly and sketching errors in proportions were avoided. These sketches were still on an un-detailed level and many of them were quite exaggerated in their expression. Five main tracks, with some sub tracks, of the overall shape were created (see figure 6.13).

Those tracks were discussed and evaluated together with Electrolux. Among them were ideas on having one solid body, make the product look neater by dividing the body into different parts, enclose the jug in the machine, emphasize the hinge or put all focus on the jug and lid.

Figure 6.12 The main competitors

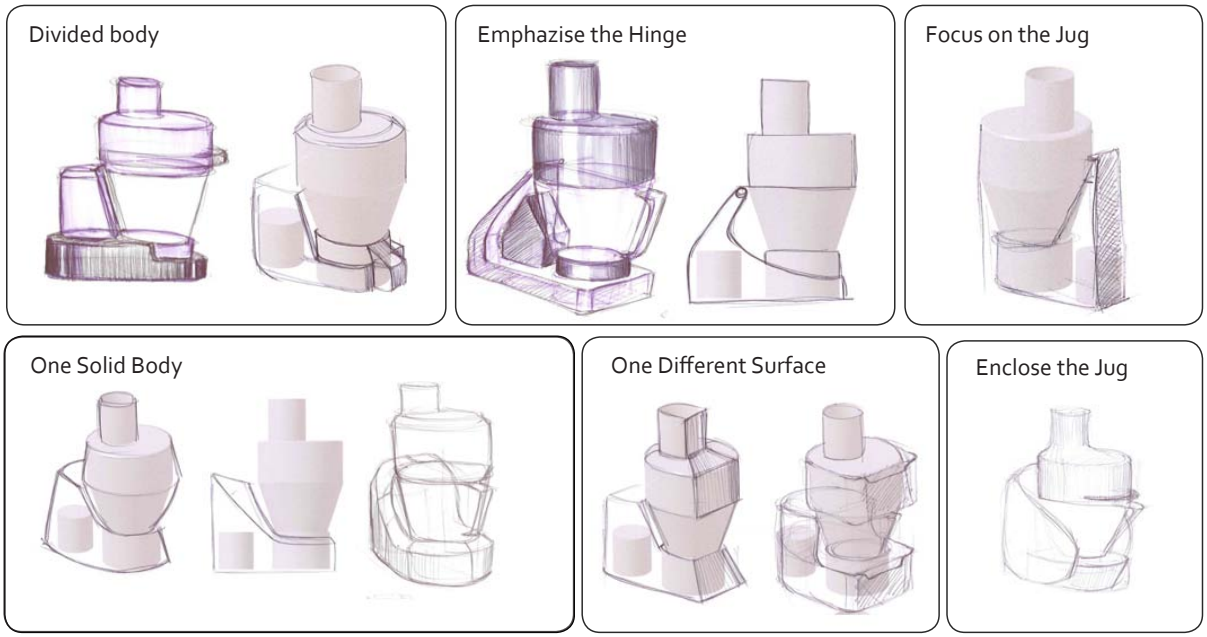


Figure 6.13 Different form tracks worked out for the BlenderJug concept

The conclusions were to make a product with a simple shaped body that also looks stable in the bottom, and not trying to cover the jug. One thought was that the lid and the body should be visually connected since much of the functionality is included in the lid. However it was decided not to visually emphasize that it belongs to the body because it might look unmovable.

Another approach discussed was to create a design that eliminates people's worries about the product. Worries wished to avoid were: Unstable, loud, take up too much space, difficult to get clean.

6.8.3 Challenges

After the free sketching phase most of the form giving process took place in CAD, complemented with hand sketching. Several models have been produced to test different alternatives of the body shape. Problems faced during the form development phase were mainly due to the complex nature of the concept. Several functional requirements had to be fulfilled without making the product look complex and difficult to use. One example was the predetermined shape of the jug. In the top it must have the same diameter as the basket, but in the bottom it has to be tight enough that a blending vortex will be created. This conical shape of the jug caused problems when trying to create a look of one compact unit, and to make the body follow the shape of the jug (fig. 6.14). One solution was to extend the sides to cover part of the jug. However, the extensions became very thin and wing-like (6.15) which made them look more decorative than functional. The base of the machine body where the jug is standing was desired to have the same dimension as the lid, to enhance a feeling of stability. The large difference in dimension between the base and the jug made it difficult to create the feeling of a tight fit (fig. 6.16).

Figure 6.14 Difficulty to create a tight fit between the body and the jug

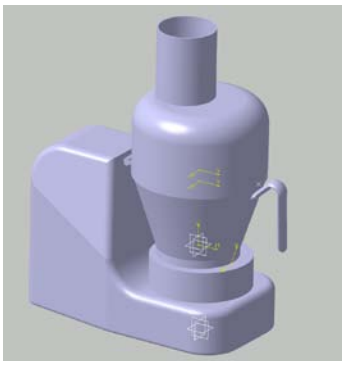
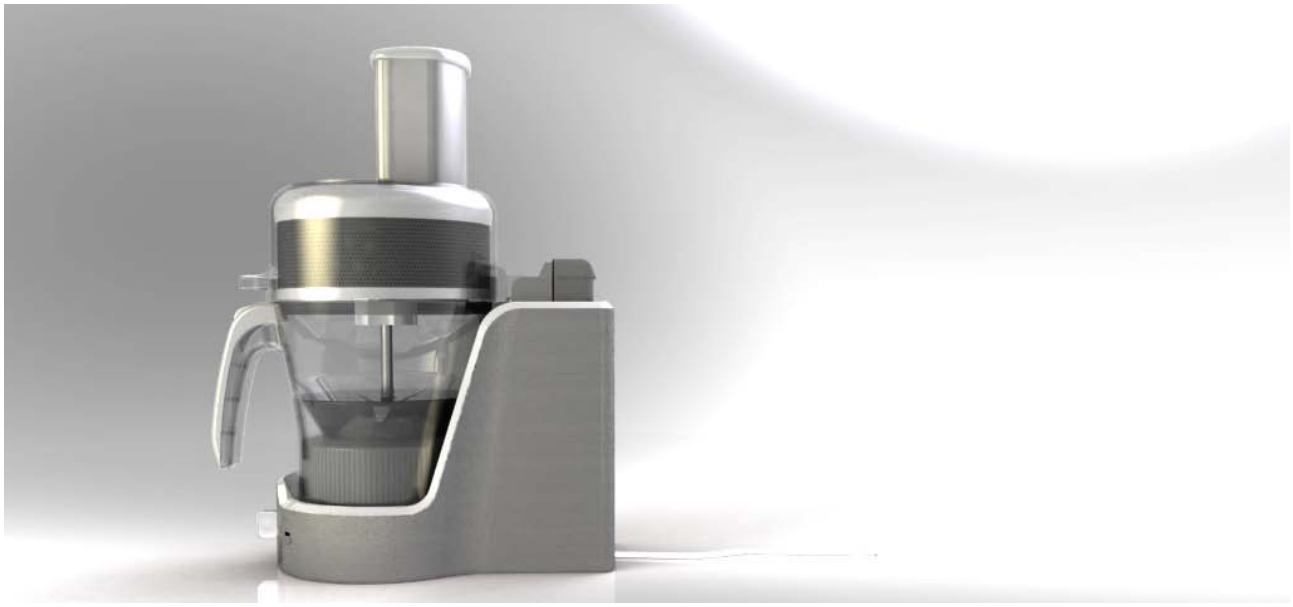


Figure 6.15 The wing like shape of the sides

Figure 6.16 The large difference in dimension between the jug and the bottom

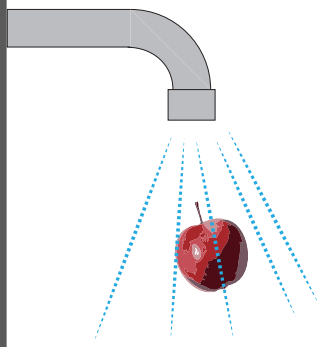
7. Final results

The new product, called the JuiceMixer, is a machine that can both juice and blend fruits and vegetables and hence create a wide range of luxurious fruit drinks. Some fruits, like apples and carrots, are well suited for juicing and give in a clear juice without any seeds or pulp. Softer fruits however, like bananas or kiwi, are better suited for blending. Therefore, the two techniques complement each other. The blender function can also be used for adding other ingredients for example ice, yoghurt and ice cream. The name is chosen to reflect the functions of the product and to be easy to comprehend.

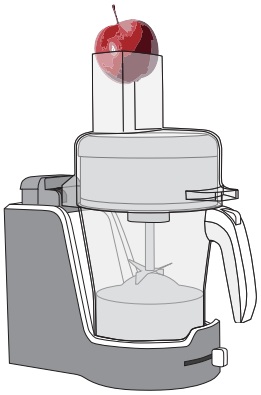



Electrolux

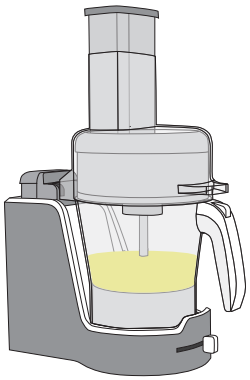
7.1 Usage



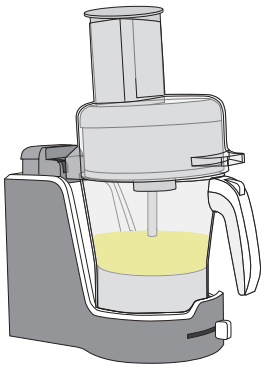
Wash fruit



Feed fruit to juice in the feeding chute and turn the control to the right

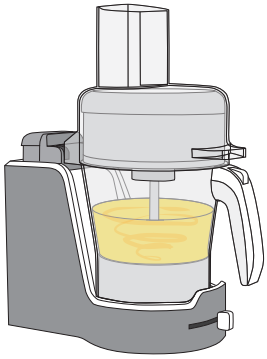


Press with pusher

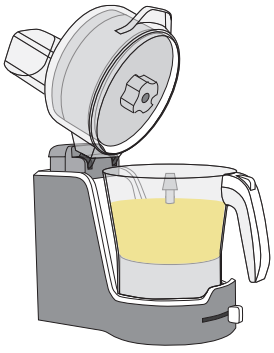


Release the lid with the button on the handle

Add ingredients to blend

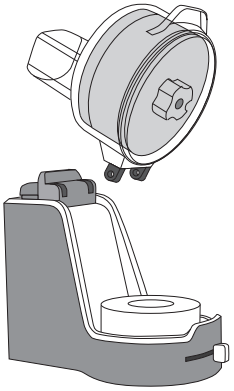


Close the lid and turn the slide control to the left



Open the lid and remove the jug

Serve the drink



Remove the lid and basket by pressing the button

7.1.1 Assembly

The machine is assembled in a few steps (fig 7.1). First, the jug is placed into the machine body with the spout pointing into the machine and the handle in the opposite direction. The base of the machine and the base of the jug have a form fit that only allows the jug to be placed in the right way. The body has a small chamfer to simplify the placement.

Figure 7.1 Exploded view of the product

The basket is pushed into the lid and secured in place with a snap fit. To disassemble it, there is a grip on the bottom surface of the basket that allows you to pull it outwards again (fig. 7.2).

The lid is placed into a hinge at the back of the body. To be able to place it, a button needs to be pressed. As the lid is secured in the hinge, the lid can be folded down. The lid is secured closed with a snap fit that connects to the handle of the jug. To open the lid again, the button on the handle is pressed.

7.1.2 Cleaning and storage

Three parts of the machine are in direct contact with food and need to be cleaned after usage; the jug, the lid and the basket. To release the lid, the button on the back of the product is pressed. When the lid is removed or folded down, the jug can be removed. The basket is disattached from the lid by simply pulling it out. To simplify removing the pulp from the basket, the JuiceMixer comes with a spatula (fig. 7.3). The

Figure 7.3 A spatula to facilitate removal of pulp

pulp will be quite dry which minimizes the mess and makes it possible to throw it directly into the trash instead of letting it dry up in the sink first. For a more thorough cleaning of the blender knives, the bottom part can be released by twisting and pulling.

The machine can be stored according to personal preference. The back side of the JuiceMixer has been made flat so that it can easily be pushed against a wall for storage. On the backside of the machine there is also a hole acting as a handle if moving the machine into a cupboard is preferred. The materials chosen are made dishwasher safe, however there are uncertainties whether bearings, snap fits etc. can sustain being washed in a dishwasher. The bottom of the blender jug must be washed by hand.

Figure 7.2 The lid is attached to the basket

7.1.3 Interface and Semantics

For switching on the JuiceMixer and using the two different functions, there is a slide control in the front of the product (fig. 7.5). Turning it to the right activates the juicing function, and turning it to the left turns on the blending function. In between, there is a zero position where the machine is turned off. The two functions only have one speed, and the control has to be slid to the extreme positions. If it is not slid all the way, it is pushed back to the zero position through the force of a spring. There are two icons (fig. 7.4) to illustrate the different functions. For both icons, the jug and the lid is illustrated. The part that is rotating for the respective functions is filled while the rest is outlined. That way, the user can either recognize the look of the basket and the knives, or recognize whether the action is performed in the top or the bottom of the jug. At the zero position there is a zero so that the user understands that the machine is turned off here.

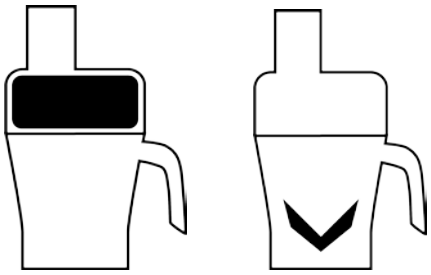


Figure 7.4 Icons for representing juicing and blending

The lid is secured by a snap fit in the jug during usage. To release it, there is a button (fig. 7.6) on the handle of the jug. The button is placed close to its function and its position on the handle triggers the user to push it. When the button is pressed, the lid pops open a few centimeters to simplify the opening of the lid for the user. That way, the feedback from button is very obvious. Because the button does not have to be continuously pressed while opening, both hands can be used to open the lid. Placing it on the jug rather than the machine body enhances the feeling that it controls a mechanical rather than electrical function.

To release the hinge that is holding the lid there is a button (fig. 7.7) in the back of the product. This button has a large surface for different reasons. Since it is in the back of the product it is important that it is easily visible. Making it large enhances the feeling that it has a mechanical function rather than an electrical. It is also ergonomically easier to press it, since the whole palm of the hand can be used. It is placed right next to the hinge for practical as well as semantic reasons.

Figure 7.5 The slide control

Figure 7.6 Button to release the snap fit that holds the lid

Figure 7.7 Button to release the hinge

It is more likely that the user will connect it with the hinge when it is positioned very close. The button also has the same color as the part where the hinge is connected. This part has another color than the rest of the machine body and is separated with a split line. The form has been determined by the function, which enhances the feeling that it has a specific purpose. The purpose is to hold the hinges and provide a stop so that the lid cannot be rotated too far and press down the button that releases it self. To communicate and facilitate the possibility to fold up the lid, a small handle is provided in the front of the lid.

The handle of the jug has a white upper part, which makes it stand out from the rest of the jug. This, together with its archetypical form for a handle, immediately expresses that this is the most important part of the jug for the user. The basket also has white edges to communicate interaction. On the bottom surface of the basket there is a little grip facilitating the removal of the basket from the lid.

Having the lid transparent enhances the lightness of the product and allows the user to see the functional parts which contributes to the understanding of the product as well as giving the user a sense of control.

Figure 7.8 The centrifuge basket

7.2 Technical principle

The fruit is processed into juice by grinding the fruit and then separating the juice from the pulp by centrifugal force. This occurs in the basket attached in the lid. The blending of juice and other ingredients occurs in the bottom of the jug where a set of knifes is placed. Those functions as well as other functions will be described further in this section.

7.2.1 Juice function

For juicing, the JuiceMixer has a basket where the side walls are made of mesh and the bottom is a grinding plate. This basket is attached to the lid. The juice is produced when fruit is fed into the feeding chute and,

Figure 7.9 The connection between the axis and the basket

with the pusher, pushed towards the grinding plate. The fruit gets ground and fruit pulp is centrifuged in the rotating basket so that the juice pours out through the mesh due to centrifugal forces. The lid collects the juice and lets it run down into the jug. The feeding chute has a diameter big enough to fit a whole apple and the fruit does not need to be peeled beforehand.

The basket (fig. 7.8) is spun by an axis that goes all the way through the jug. The axis gets its rotational movement from the engine through a claw clutch, this is further described in section 7.2.4.. The movement is transferred from the axis to the basket through a conical clutch (fig. 7.9). The clutch has small teeth to enhance the transferring. The reason that the clutch

Figure 7.10 The blender knives

is conical is both to increase the transferring surface but also to allow the basket to couple in. The conical shape is needed since the lid and the basket hit the axis slightly angled when folding them down. The basket is placed inside the lid with a snap fit. This snap fit has a bearing that allows the basket to spin while the lid is still. For a more thorough explanation on centrifugal juicing, see section 2.2.1.

7.2.2 Blending function

For blending, the JuiceMixer has knives in the bottom of the jug (fig. 7.10). They are mounted around the axis driving the basket but can rotate freely around it. The rotational movement from the engine is transferred to the blender knives via another claw clutch (see section 7.2.4). A vortex is required to mix the ingredients well and to suck them down to the knifes. In order to achieve this vortex and to lead down the fruit to the knifes, the radius of the jug around the knifes need to be rather small. That gives the jug a slightly conical shape since it has to match the size of the basket in the top.

7.2.3 Opening and closing the lid

The lid of the jug, which is also the holder for the centrifugal basket, can be opened and closed by folding it up and down. At the back of the body, there is a hinge that holds the lid in place and on the back of the lid there are loops fitting into the hinge. The lid has to be removable due to cleaning matters. The lid is released with a button next to the hinge. As the button is pushed down, the two metal rods inside the hinge are pushed towards the center of the product (fig. 7.12). When the button is released, the rods are pushed back out through the force of a spring. In the front of the machine, the lid is secured in its closed position through a snap fit (fig. 7.11) connected to the top of the handle. To release the snap fit, a button on the handle is pushed.

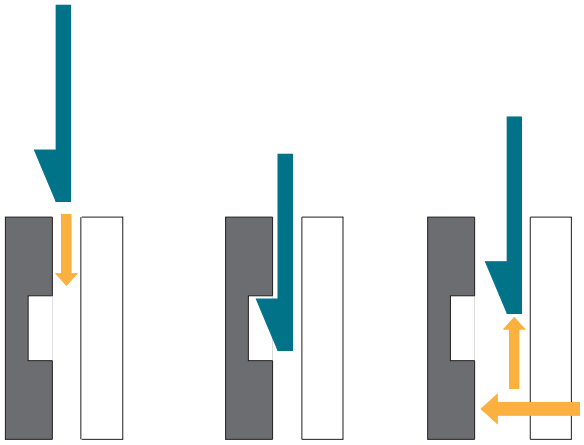


Figure 7.11 The function of the snap fit that holds the lid

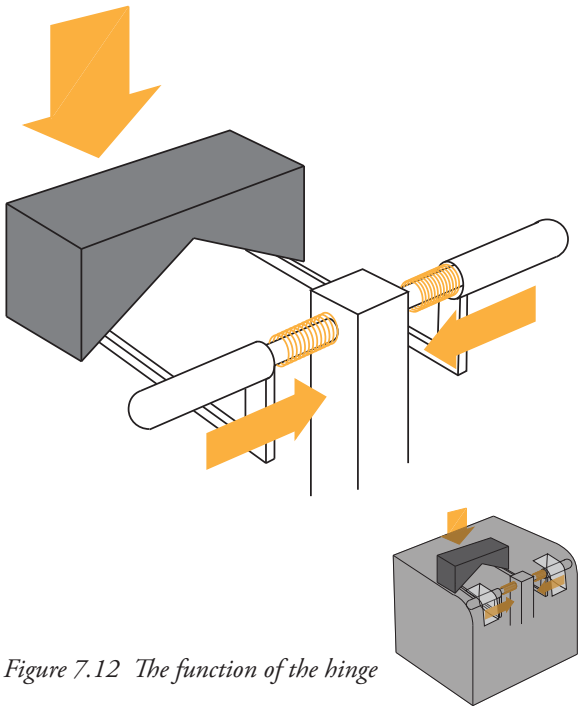


Figure 7.12 The function of the hinge

7.2.4 Clutch and gearing

The two different functions are controlled through two separate claw clutches (fig. 7.13). One clutch connects to the blender knives while the other clutch connects to the axis that turns the centrifuge basket. Both clutches are always spinning. The clutches can be steered through a slide control (fig. 7.16). Pushing the control to the right will cause one of the clutches to go up, while the other clutch will go up when the

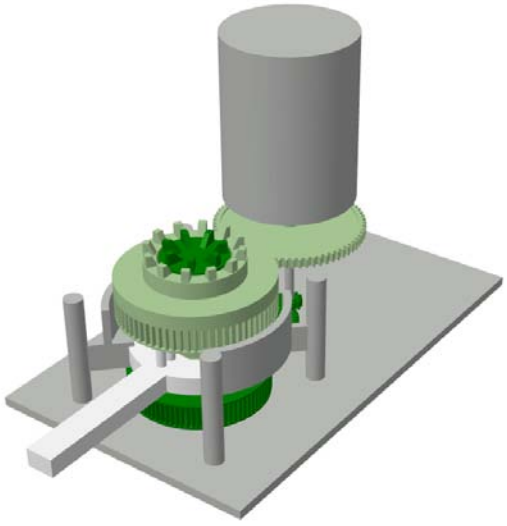


Figure 7.13 3-D view of the clutch

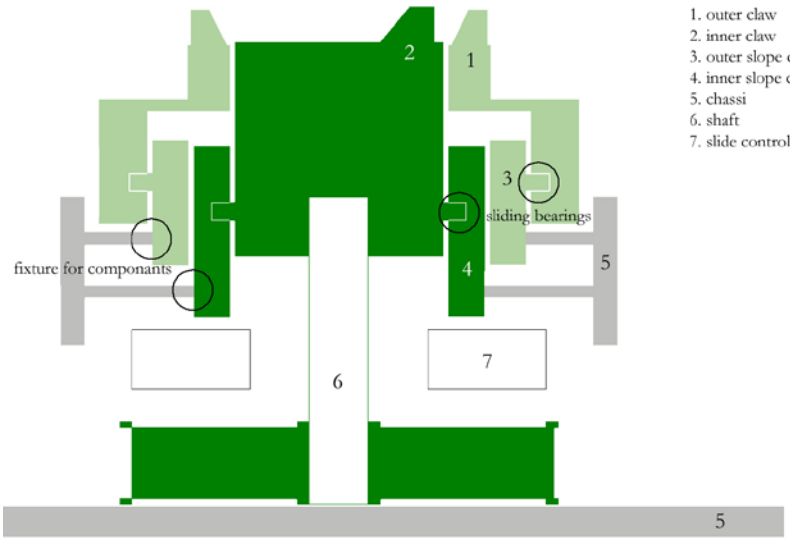


Figure 7.14 Section of the clutch

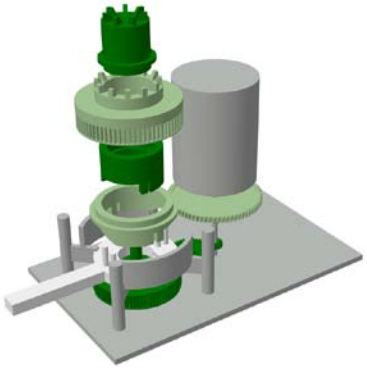


Figure 7.15 Exploded 3-D view of the clutch

control is pushed to the left. The movement is due to a component that has a slope where the control is attached. A movement sideways for the control causes a movement up- or downwards for the component, that is fastened in the chassis. Between the component and the claw there is a sliding bearing, which allows the component to be still while the claw is spinning. At the same time, the claw follows the component up and down. Apart from the mechanical movement, there are switches in both extreme positions, so that the engine is only turned on when the switches are hit. Hence, the motor automatically turns off when the slide control is in its middle position. Therefore the clutches never have to couple in during operation. Fig. 7.14 and 7.15 show the parts of the clutch.

so that they are allowed to spin even though they have a high degree of surface contact to other parts due to steering reasons.

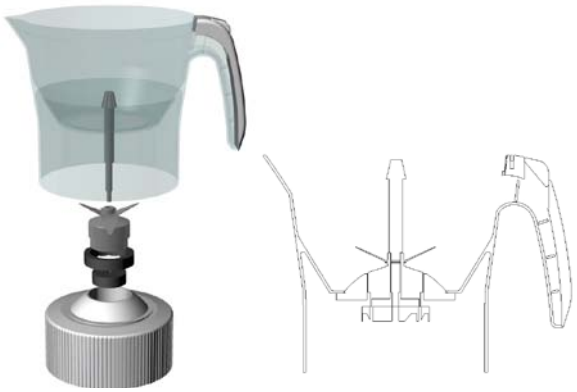


Figure 7.17 The parts of the jug

The jug (fig. 7.17) contains two parts in the bottom that can rotate freely; one for the axis and one for the knives. They each have a claw that is spun by the claws from the motor. The claws are attached to the jug bottom with left-handed screws so that they cannot open during usage. The different parts are lubricated

The blender knives need to spin significantly faster than the rotational basket. Therefore the basket is geared down to a lower speed with a series of cog wheels. The gear ratio is 1:7, which means that the size and the number of cogs of the last wheel is seven times the first wheel. Hence, the basket spins seven times slower than the blender knives.

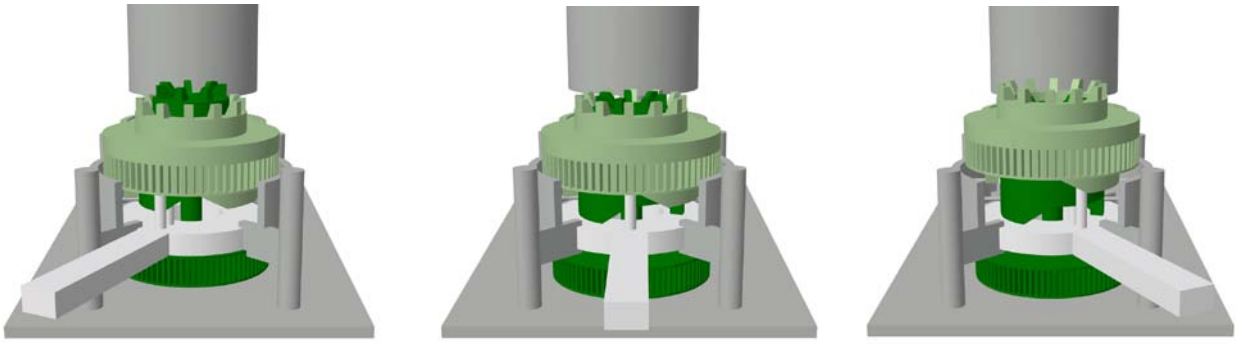


Figure 7.16 The function of the clutch. Pushing the control to the right will cause one of the clutches to go up, while the other clutch will go up when the control is pushed to the left.

7.2.5 Rotational speed

The basket spins at approximately 1500 rpm, while the blender knives spin around seven times faster, at 10500 rpm. These speeds are estimated from products that are on the market today.

7.3 Product identity and expression

The JuiceMixer has a simple but yet expressive shape that makes it fit with Electrolux' design language. In the front of the base there is a rounded surface that is very typical for Electrolux' newer products. This is also where to logotype is positioned to enhance the recognition for Electrolux' brand. For images to better understand this section, see the beginning of the chapter.

The cross section of the back part is square while the cross section of the front part is circular. The transformation between the two shapes is made with a relatively large rounding. This rounding has a tilt backwards, with almost the same slope as the side. The slight difference in slope creates a tension that makes the product look more dynamic. It removes the wing-like look (see section 6.8.3), which gives a harmonic transformation from the top surface to the sloped sides.

The diameter of the round bottom part is the same as the lid, to increase the feeling of stability. The jug is slightly lowered into the machine body. To enhance this, the inner surface of the hole has been given a small chamfer. That way the user can feel secure that the jug is standing steady. Chamfering the surface also makes it look smaller which minimizes the visual difference between the jug diameter and the bottom plate. The part of the machine body that faces the jug follows the shape of the jug and do not leave much of an air gap. Making the jug fit well with the machine enhances the feeling of the product being one well-worked unit. The fact that the inner part of the machine body is made of another material than the outer part enhances this feeling even further. As the jug is put in place the machine body gets complete and less naked. To get a more aesthetic overall impression and to create a better fit between the jug and the machine body, the jug has been given a rather straight shape. Because of the functional demands on the upper and lower diameter, the jug has been given an inner shape that departs from the outer shape close to the blender knives. That way the more aesthetical outer shape can be kept without interfering with the functional demands.

The lower half of the handle is made from the same part as the jug and is hence in transparent plastic. The other half is made of an opaque plastic. That way the handle looks more dynamic and less solid which prevents it to take too much attention. The lower part of the handle is given a cut that creates a tension.

The outer metal shell goes all the way down to the table while the inner part has small feet to create a nice stable base. In the bottom, the shell has a small rounding to create a smooth meeting with the table and to throw a small shadow.

The outer material is made of brushed steel (see section 2.5.3), which is associated with high-end products. The inner part of the body is made of glossy white plastic, which also looks exclusive. It has a distinct chamfer to create a nice framing of the product and provide a well-worked transit from the metal to the plastic. The chamfer follows the product all the way around and flattens out over the Electrolux surface mentioned before to make it more distinct and create a tension. The jug and the lid are made transparent so that the user can see what happens and understand the product better. Making parts see-through gives the product a lighter impression but having all of them completely transparent was considered to make the product look too technical. Therefore the sides of the lid are frosted from the inside to preserve the glossy finish but make the view into the basket slightly blurry.

7.4 Materials and manufacturing

The outer metal shell of the body is made of brushed steel (explained in section 2.5.3) and will be die-cast (section 2.5.5) in order to achieve a good quality of the multi curved surface. Die-cast steel is considered to be a high-end material choice and more modern than brushed aluminum, which has been used in kitchen appliances for some time. Steel is also resistant and easy to clean. The inner part of the body will be produced in white shiny ABS plastic (see section 2.5.1 for more information about ABS plastic). ABS plastic is good for achieving a high glossy surface that

can sustain usage in a good way. A shiny surface was desired to enhance the luxury feeling and to create a strong contrast to the steel. The upper metal edge will be covered with the plastic chamfer following the edge around the outer shape of the body.

The jug will be injection molded (for explanation on injection molding see section 2.5.4) in plastic. Four molds will be used to be able to produce the details and the shape of the jug. The plastic used will be a type of SAN derivate (see section 2.5.2 for more information about SAN plastic). SAN is a clear plastic with a good durability. Compared to a glass jug, a plastic jug can be made lightweight and given a complex form. In the earlier phases of the project, glass was considered an alternative since it in Europe generally is considered as a more premium material (Törmälä, 2011). The JuiceMixer is a new kind of product and not directly associated with a blender, which often has glass jugs. Therefore the choice of material will hopefully not decrease the premium feeling, but rather contribute to the modern feeling and the level of novelty of the product.

The lid will be produced in the same plastics as the jug. The part of the lid that is covering the basket will be frosted from the inside, by a texture in the mold. On the lid, the loops that will connect to the hinge are mounted in the plastic extension on the back. The holders as well as the rods in the hinge are made in metal. Using the same material for both of the parts that slide against each other is a way to resist wearing of the moving parts. The holder for the hinge will be in plastic and so are the holes where the loops fit. That area is not as sensitive for wearing and by having it in plastic turning the lid around the hinge goes smoother.

Blender blades are normally produced in stainless steel and the axis as well as the mesh on the basket will also be in stainless steel. The product consists of several other functional parts for which the manufacturing and material are not determined.

7.5 Safety

For this type of products certain safety standards need to be followed. For further explanation of the safety requirements that were considered relevant for this project, see section 2.4. Below there is a table illustrating if and how the standards are fulfilled.

The JuiceMixer would provide one safety switch in the back that would be hit when the lid is folded down. The JuiceMixer also has the possibility to add another switch in the bottom to secure that the jug is in place. Since the product cannot run with the lid open, there is no risk of touching any rotating parts. Therefore any tests with the standard probe are unnecessary. The lid is secured in place with a snap fit so it cannot be spun open during usage. The machine body has holes in the bottom to allow leaking fluids to run out instead of into the electrical parts of the product. Since the product has small feet to stand on there is space for the fluids to run out to the sides. The visual test for stability is found in appendix 10.

Provide a feeding chute of at least 180 mm	✓	
Provide a pusher	✓	
Offer stability	✓	Tested visualy
Hold the lid	✓	Snapfit
No ability to touch rotating parts during usage	✓	
Provide drainage	✓	Holes
Make sure that the lid is in place	✓	Safety switch
Make sure that the knifes are in place	✓	Safety switch

✓ = Fulfilled ✓ = Possible to fulfill ✗ = Not fulfill able in this concept

8. Evaluation of results

In the end of the project, the final product concept was evaluated with respect to functionality, appearance, handling and sustainability. This was done by means of a prototype, user acceptance tests, a cognitive walkthrough, a physical human error analysis and the eco strategy wheel. The implementation and the results of the evaluations are presented here.

Figure 8.1 The prototype

8.1 Prototype

A functional prototype (fig. 8.1) was built to test the basic function of the JuiceMixer; to juice and to blend in the same container. The parts (fig. 8.2) were, when possible, taken from existing blenders and juicers. The jug was built from polycarbonate plastic and adjusted to fit with the parts taken from existing products. The axis was turned and milled and attached to an existing bottom from a blender jug. The blender knives and the basket were mounted on the same shaft, and could not be run independently of each other.

The prototype was run via an adjustable power regulator so that the voltage could be increased slowly. A measurement with a tachometer was made on the motor to see what rotational speed corresponds to a certain voltage. 40 volts were measured to correspond to 1500 rpm, 42,5 volt to 1800 rpm and 46 volts to

Figure 8.2 Parts of the prototype

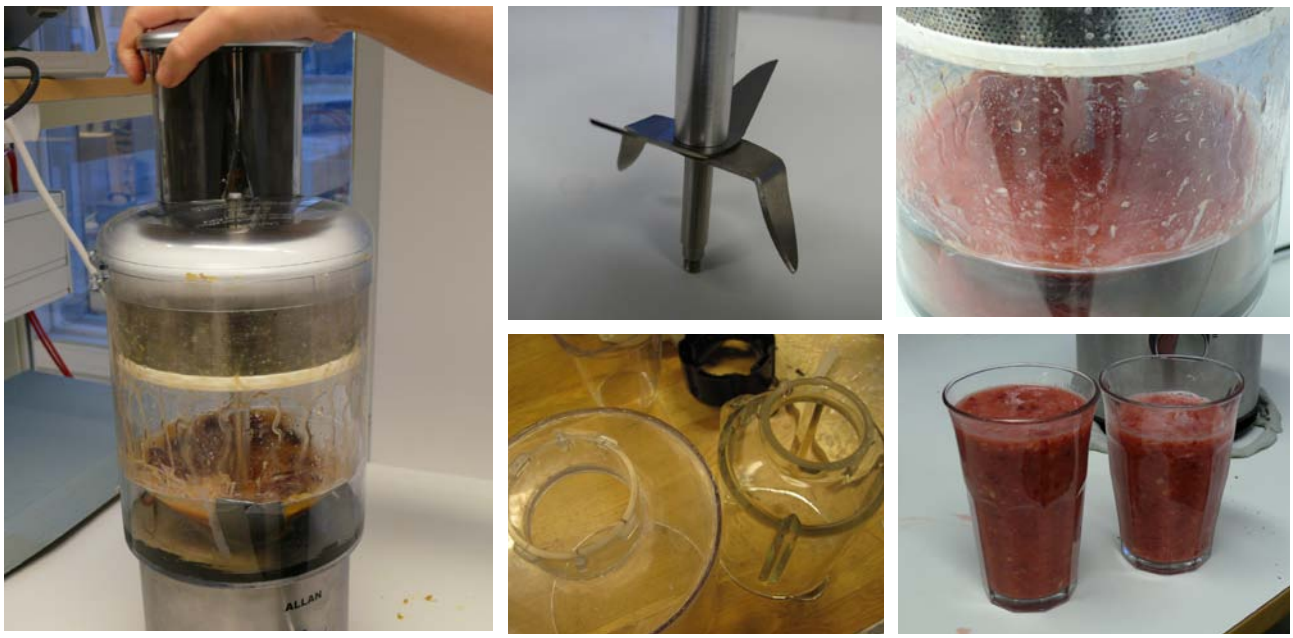


Figure 8.3 Images from building and testing the prototype

2000 rpm. Due to limits on the measuring device, this measurement could only be done on the motor itself without the basket and the shaft. Therefore they might not be completely accurate. In the final test the machine was operated at around 100 volt. At that high voltage, the machine was vibrating heavily, and there was a risk of breaking the prototype. Pictures from building and testing the prototype are found in fig. 8.3.

The test performed intended to simulate a normal usage situation; to make a smoothie of apple, banana and frozen berries. The juicing went well, but the machine was not strong enough to grind the apple. It had to be pre-ground in a food processor and added to the basket. The blending worked fine as well, a vortex emerged and the fruit was cut into pieces. The pieces were not as small as desired, but this was probably due to the fact that the blender went on a lower speed than it should.

The vibrations and the instability of the prototype were most probably due to flaws in the prototype. In the prototype, the proportions were not exact and the axis was made taller than in the real product. Therefore, the demands on preciseness of the axis were even higher. The way the axis was built, this precision was not achievable. The axis was attached on top of the knives instead of going through the jug base and being steered. Another reason for stronger vibrations in the prototype was that the basket did not have a proper steering from the top. In the final product, there is a rolling bearing that will allow the jug to spin smoothly while it is prevented from moving vertically. In the JuiceMixer, the lid is attached to the machine body and not only to the jug, which will make the product more stable and prevent vibrations. There will still be high demands on the precision of the axis, but with the proper steering and right manufacturing, it is considered achievable.

The fact that the prototype did not manage to grind the fruit is not considered to be a critical problem. The machine was running on a low voltage and due to the vibrations there was no possibility to test the grinding at a higher voltage. There is a possibility that the grinding would have worked with the engine of the prototype. The project has not included selection of motor, and it will most probably be possible to select a motor that can handle the demands of the product.

8.2 User acceptance test

As an evaluation of the JuiceMixer, interviews with four previous juicer-users were performed. The interviews lasted around 30 minutes and were divided into three parts; Handling, Usage and Expression. The interview guide is found in appendix 11.

First, the function of juicing and blending in the same machine was explained. All interviewees were very positive to the idea and the concept of getting two machines in one. They experienced making regular juice to effortful in the long run, but thought they

Figure 8.4 Interviewees at the user acceptance test placing products on a scale

would be more willing to continue using this machine. One interviewee thought that his current juicer was too bulky, but that including two functions would justify the bulkiness. The interviewees were to guess how the machine is used by looking at a computer rendering of the product. The users did first not mention the fact that the machine needs to be fed two different ways because of the two functions. When they were given the direct question on how to get the fruit into the blender, they understood that they had to lift the lid. Two of the users also understood the function of the hinge. One person was convinced that the knives had to be removed from the jug, because it would be too dangerous otherwise. Another user was disturbed by the aesthetics of the axis in the jug when serving.

The participants thought that they would use the machine once a week respectively two to three times a week. Among these usages, weekend mornings were the most common situation, followed by snack or indulging yourself and parties. The most popular drink to make would be smoothies with yoghurt, and cocktails with ice. Two of the users would store the machine on the counter while the other two users would put it away because they don't want to have any machines visible at all.

To get an indication on how the expression of the JuiceMixer was perceived, the interviewees were asked to describe the look of the product with three words. The most prominent words were: modern, cleanliness, stylish, functional, non bulky and explicit. The interviewees (fig. 8.4) were given seven products in a price range of 3000-5000 SEK (fig. 8.5) to place on a scale from exclusive to cheap. One of the products was the JuiceMixer. Most of the interviewees put the Breville juicer and the Kitchen Aid blender that are die-cast as the most exclusive products. The JuiceMixer was mostly placed slightly above the middle, with the motivation that it looks robust and genuine. The perception of the products varied quite a lot, and the quality of the pictures might have affected the results. The next task was to place the products on a scale from human to technical. Most of the interviewees perceived the products with softer shapes and one single control, for example the Magimix duo or the Philips Robust, as more human. On the other end of the scale they placed the Breville juicer and the Kitchen Aid blender, because of their die-cast parts and details. The JuiceMixer was, except by one participant, placed somewhere around middle at the scale. Motivations were that it was a product where

Figure 8.5 The products used in the user acceptance tests, from the left Hurom, The Mix Juicer, Philips Robust, Magimix, Breville, Kitchen aid, Smoothie maker

you understood the function and it felt familiar due to similarities to other products and functions. The transparency of the product also contributed to this impression. One participant expressed the JuiceMixer as the most human since it was transparent and the functions were well communicated.

Lastly the participants were asked how well they thought the new product fitted with the image board (the image board is found in section 4.2.1). The general answer was that it fitted well but looked slightly less exclusive. Most of them saw the image board more as a description of a lifestyle and not a collection of form elements, as intended. They thought that the product was not exclusive enough to fit into the house on the image board.

8.3 Cognitive Walkthrough- Physical Human Error Analysis

A Cognitive Walkthrough (CW) and a Physical Human Error Analysis (PHEA) were conducted in order to detect difficult tasks or risks for mistakes with the product. A summary of the most prominent issues found during the evaluation will follow below. For the full evaluation see appendix 12.

One of the main issues with the understanding of the product is, as also seen in the user acceptance tests, the two different ways of feeding. Users might not understand that they will have to lift the lid to feed the blender, so they might feed the blender-ingredients into the feeding chute of the juicing function. If they turn on the blending function there will not be any consequences, but if they turn on the juice function the ingredients supposed to be blended get juiced instead. Another issue with feeding by opening the lid is that the user might open the lid before all the juice is extracted from the pulp in the basket. The consequence will be less juice in the jug and wet pulp, which is more difficult to clean.

The assembly of the product seems rather self-explaining except for the placement of the basket. The basket needs to be snapped into the lid before placing the lid in the hinge and closing it. The user might try to place the basket directly on the axis in the jug (where it will be placed when the machine is closed) and try to close the lid. The user might also not assemble the basket at all. One reason for not assembling it could be that the user does not understand its purpose. Another reason could be that the user would like to use only the blender and believes that the basket does not have a function.

For the first case the user will immediately notice that there is no possibility of closing the lid. For the second case the JuiceMixer, in its current layout, will be possible to operate but the axis will not have any steering from the top. There are uncertainties whether this will deform the axis and therefore this type of usage might have to be prevented by for example a safety switch.

The third area where possible misunderstanding can occur is around the attachment and release of the lid. There might be a risk that the user does not understand that the hinge-button needs to be pressed to release the hinge both for attachment and detachment of the lid. Another risk is that the button is pressed during usage by mistake. This should not cause any problems since the machine stops as soon as the lid is removed.

Some of the insights gained are possible to improve during further development. However, this is a product that the user will have at home and hence learn how to use. Therefore, the product does not have to be as self explaining as a product targeting many first time users.

8.4 Sustainability

To critically evaluate the new product from a sustainability point of view, the eco strategy wheel was used as a framework. The Eco strategy wheel is according to SVID (Swedish Industrial Design Foundation) a tool used to stimulate ideas on how to reduce the environmental impact of a product. The wheel consists of eight main areas. For each area new solutions to reduce the environmental impact of the product are sought through brainstorming. In this project the eco strategy wheel has been used as a tool to reflect over what has been done and what could be done to decrease the environmental effect. Because of the scope of the project, the main focus has been put on making improvements in phase one of the eco strategy wheel, which is to optimize the function.

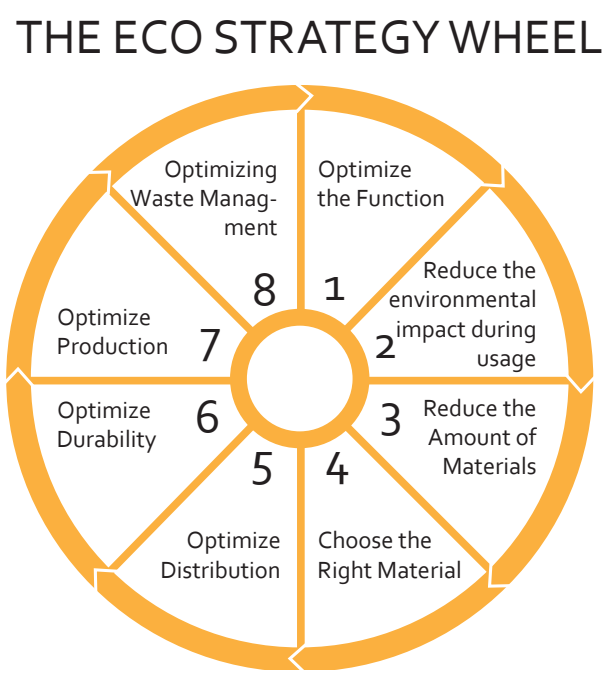


Figure 8.6 The eco strategy wheel

1. The main function is still the same as of a regular juicer, but with the added function of a blender the users will hopefully use the product longer and more frequently than a regular juicer. The two functions offer a clear extension of usage range since you can use it both as a blender and a juicer. Hopefully the new types of fruit drinks are, in themselves, a reason to use the product more. A lot of effort has been spent on optimizing the product for effortless usage so that the users will continue using it even after the thrill of a new product has passed. Most probably this optimization has to continue to reach a sufficient level of effortless usage. For example, the cleaning could be further improved. A downside of having two functions is the increased number of parts and hence a larger risk of something breaking. This can hopefully be avoided by choosing the right materials and ensure a high durability.

2. Regarding the second phase of the wheel, the energy consumption was improved from the initial idea. In the initial idea, the product was constructed in a way that both functions would always run at the same time. The discovery was made that there would be advantages both for the product and for the user if there was a possibility to switch between the functions. In the final product concept, the product will not waste energy by running any unnecessary functions. The jug and the lid are transparent, so the user has a good overview of what is happening inside the product. This way, the risk of running the functions for longer than needed is minimized. A negative aspect with the energy consumption of the JuiceMixer is that the basket will require a higher speed from the motor than necessary. Instead of letting the speed be controlled by the motor, the basket is geared down mechanically. An improvement point for the future would be to let the engine run at one speed when juicing and another speed when blending. Providing the possibility for the user to adjust the speed could also be an improvement point, so that the user would not have to run the product at a higher speed than necessary. Only the main functions, juicing and blending, are done electrically. The other functions, like releasing the hinge and opening the lid are done mechanically or by the user. This also minimizes the energy consumption of the product.

3. The third phase of the eco strategy wheel is about reducing the amount of materials. By using a straight centrifugal basket, the scrap container could be eliminated completely. Since all scrap is collected inside the basket, the product has one part less than many juicers. The JuiceMixer also collects the juice directly in the jug, and therefore it does not have both a juice collector and a separate jug. The stainless steel shell of the product has been added as an extra material that is not needed for the main function of the product. However, it increases the durability and enhances the feeling of a high-end product which hopefully leads to a longer usage of the product.

4. The materials have been chosen with respect to high durability and good aesthetics in first hand, and recyclability in second hand. Increasing the feeling of quality will extend the life time of the product. Neither of the plastics suggested seem to be the most suitable for recycling. In further development, a plastic that is easier to recycle could be found. However, it is important that it does not compromise the quality and the appearance of the product too much, since that might decrease the usage and life time of it.

5. When reasoning on the transport of the juicer versus juice that can be bought in stores one can think that transporting one machine once

is better than transporting one bottle of juice a week. However, most of the fruits people uses for making juice are imported from far away. A positive effect can be achieved if the purchase of a machine encourages people to use leftover fruits from their gardens instead of buying juice. It is also important that spare parts are well distributed so that broken parts can be replaced.

6. The project has focused on developing a high-end product that has a long life time and that is perceived as a quality product. The durability has been an important factor in the decision making. For example, the clutch was decided not to couple in and out during usage to minimize the wear and extend its life time. The parts of the product shall be easy to replace for a layman. That way, the product does not have to be disposed earlier than desired.

7. The production has only been considered to a small extent within the scope of the project. The suggested manufacturing methods have been selected for their suitability for the chosen materials. How to minimize energy consumption etcetera during production has not been possible to affect within this project.

8. Regarding waste management it is important that the parts can be disassembled easily. All plastics should be marked, so the user knows what they are and how they can be recycled.

9. Discussion

In this chapter, the project is discussed. The discussion includes the final outcome and the goal fulfillment as well as the process and the methods used. At the end of the discussion there are recommendations for further development.

9.1 Project outcome

We feel confident that we have fulfilled the goals for this project. The concept developed is clearly differentiated from its competitors. The combination of a juicing function and a blending function in one product has not been seen anywhere else. The new combination of functions allows the user to prepare drinks with different textures in the same machine, which makes the JuiceMixer innovative and gives the user a significant benefit through the extended usage of their product. Using a well-known juicing-technique gives us the courage to say that the product will have a top juicing-performance. The product has been designed with respect to semantics and the usage and the handling has been evaluated both through user acceptance tests and non empirical evaluation methods. The evaluation showed some possible areas of improvement, but overall the usage and handling are well communicated. This is due to the well visible functions and similarity with acquainted products. During the user acceptance tests it was also verified that the product fits well with the visual expression that we were aiming for and associate with Electrolux high-end products. Materials and manufacturing methods have been suggested, and the prerequisites for fulfilling relevant safety standards have been investigated and verified.

Based on the problems with existing juicers, the assumption by the ones involved in the project was that a product with a clearly improved handling would be most beneficial for the user. Most existing juicers have many parts and are difficult to clean. During the concept selection a few concepts targeting the handling were presented. However those were discarded in favor for a concept offering a larger amount of differentiation and innovation compared to the rest, even though it did not have fewer parts or improved cleanability. We believe that the new concept is more beneficial than a regular juicer with improved handling. For Electrolux it provides a possibility of clear differentiation, and the user will have a machine with a wider usage range that can create luxurious healthy drinks with many types of fruits and vegetables.

9.2 Process

The chosen concept differs in functionality from the product we set out to develop. For this reason it would have been interesting to have the possibility to take a few steps back in the process before starting to develop the concept further. If we could have started over with a new deep going idea generation phase with a more precise target, the concept could have reached an even higher level of innovation. As the concept had been selected, it was already defined that it can juice and blend in the same jug. If the starting point would have been to find a product that can create fruit beverages with different textures and ice, the results may have been different.

Throughout the project we have often worked together, instead of dividing the tasks. We have deliberately tried not to develop thoughts too far without updating each other. We think that has worked very well and helped us to avoid situations were discussions about "mine or your" concept could occur. It has been very beneficial for us to be situated at Electrolux's office in Stockholm. We have had close contact to many persons that have been able to answer questions and provide input. This would have been much more difficult to communicate on distance. Another positive aspect is the closeness to products and labs. We have been able to test and use almost all products we have been in contact with in the project. It has also been a great source of knowledge and inspiration to quickly be able to check how different issues are solved in other products. Without this possibility, our technical solutions would probably not have had the same depth.

9.3 Use of methods

The focus group performed was useful but time consuming. It was surprisingly difficult to find participants, even in house. During the focus group, we focused strongly on every day luxury and morning habits. This was based on the assumption that most users would make juice in the mornings. However, with the new product concept we think it is as likely that it is used anytime of the day. The focus on luxury fitted very well with the JuiceMixer, but if we would have chosen to go with for example the Presso concept it would have been less interesting. Much effort was spent in finding the right focus for the focus group. We had deliberately chosen to have a wide focus to open up for the possibility to find unexpected insights. We think we maybe set the focus for the session a bit too wide. We received a lot of information about people's values around everyday luxury but this knowledge was by some means superficial. It would probably have been beneficial to make a secondary focus group when the product concept had been selected, focusing on the usage of the new type of product. However, there was not sufficient time.

We found it difficult to find participants for the interviews as well. In the end, most participants were consultants from the same firm and belonging to the same age span. This might have biased our results. Especially the insights that they liked manual coffee machines in order to have full control or that they wanted to make juice every morning for their children. This might be the point of view of a person who is well educated and interested in living the right way. All user related research had to be performed with Swedish users due to our location and the project scope. Since the product targets the European market, it would have been beneficial to talk to non-Swedes as well.

Building mock-ups was probably one of the most important steps for us to come to our final results. It did not turn out the way we expected, since we decided to discard all of them. We think however that if we wouldn't have built them, we might not have realized that our track was not the best option until much later. For the first evaluation matrix, we used very many requirements. That was very time consuming, and in the end many concepts scored similar. It would probably have been more beneficial to select only a few very important demands.

The sustainability evaluation was done late in the project and is hence a reflection over how sustainable the product is in its current design. It has not been a main focus during the project to make a more sustainable solution or to change the behavior of the user. However many choices are still open for the concept. The construction could be optimized for disassembly, other materials could be selected and energy consumption could possibly be optimized.

9.4 Lessons learnt

When we decided to look more into solutions where the jug could easily be removed with the lid and the basket still in the machine (see section 6.5.3), we realized that we had already been onto this track. Unfortunately we had discarded it for reasons that we later discovered were solvable. We thought that the initial track would be simpler and more intuitive. This is something we have learned from and towards the end of the project we have been very strict with documenting and motivating decisions taken. Sometimes we have started to work on a detailed level of solutions too quickly, which may have been a contributing factor to discarding those concepts. In general, it has been very hard to early determine which solutions are feasible or not. We hope that finding the balance between keeping good ideas which may look unsolvable versus discarding completely unrealistic ideas will be easier the more experience we gain. Sometimes we have been so eager to solve technical problems that we forgot to put the most logical usage in focus. Therefore we got stuck a few times and had to take a step back and continue from there.

Similar problems have occurred in the form development. In this project, we have been very eager to make a thorough form development. We started out early and our intent was very good, but our way of working with the form was too ambitious at some points. Because of the multiple functions, there were many functional requirements to consider. We experienced that we got stuck and had troubles finding a desired visual appearance. Our contact person from industrial design encouraged us to think simpler and to use the ideal usage as a starting point. In the end we worked out the full product architecture before starting to work with the form. This input was very helpful and in the end we are very pleased with the visual expression.

9.5 Further development

Below follow descriptions of some points that need be further investigated and developed in order to ensure the functionality and handling of the JuiceMixer.

- The demands on the performance of the blender could be further investigated, both through market and user investigations and technical research. If the product shall be intended as a substitute for a blender, the speed of the knives might have to be controllable. Another point to investigate is whether it is technically possible to achieve the same performance with this type of jug.

- A risk with the JuiceMixer is that the jug could get over filled and start to leak without the user noticing. In a blender, the user puts all the ingredients into the jug beforehand. In a juicer, the juice runs into a separate glass. Possible ways of increasing the feedback could be investigated.

- The seal of the jug bottom needs to be further developed. In between the axis and the knives there needs to be a seal to prevent the beverage to leak. This could be challenging because the two parts have a relative rotation.

- Whether a gear is the best way to slow down the basket can be investigated. Now that the engine is turned off as the functions are switched, the difference in speed could possibly be controlled electronically instead. This might reduce the energy consumption. To reduce energy consumption further, the JuiceMixer could provide the possibility to adjust the speed so that the user would not have to run it faster than necessary.

- Regarding handling, some improvement points have been found. The assembly of the basket into the lid could be clarified, unless the product could be constructed in a way that different ways to assemble the basket were possible. The possibility to operate the JuiceMixer without the basket could be prevented by a safety switch, to avoid deforming the axis. Other improvement points regarded feeding the blending ingredients and pressing the button to release the hinge. These aspects could be improved further, but since the user will have the product at home and learn how to use it, they are not critical for the success of the product.

9.6 Recommendations

Some possibilities to improve the JuiceMixer even further have been identified. A list with these recommendations follows.

- To ease the cleaning of the basket, one part of the basket could be made removable so that the rinsing water and pulp easier could be poured out from the basket. In general, the parts could still be optimized for cleaning.

- Give clear instructions on where spare parts can be bought, for example an extra spatula. Make sure that spare parts are well distributed.

- A guide or recipe book that clearly explains which fruits are best blended respectively juiced would be useful. It can also include recipes of drinks that can be made.

- To optimize storage a retractable chord can be added and the lid could be optimized so that it can be turned around and the feeding pipe can be hidden inside the jug.

- Through further materials investigation, possibly plastics with the same properties but better recycling possibilities could be found. The plastics should be marked so the user knows what they are and how they can be recycled.

10. Conclusion

The outcome of this project is a product concept for a juicer, developed in collaboration with Electrolux. It is clearly differentiated from its competitors and it provides a clear benefit for the user; an extended usage range. Apart from the juicing function, the product also has a set of blender knives. The two technologies complement each other because some fruits are better suited for juicing while others are better to blend. Besides, the blender function can also be used for adding other ingredients than fruit; for example ice, yoghurt and ice cream. The idea arose after visiting juice bars that used juicers and blenders sequentially to create more luxurious fruit beverages.

The product carries the Electrolux design language for the intended market segment. The product has been designed with respect to semantics and its usage and handling has been verified through user acceptance tests and non empirical evaluation methods. The technical solution for the product is based on existing techniques. The main functionality has been evaluated and verified with a functional prototype and suggestions on how to solve other technical aspects have been given. During the evaluation phase, some minor issues were identified regarding vibrations in the product and possible areas of misunderstanding the handling. Recommendations on how to manage these aspects have been given. The prerequisites for fulfilling relevant standards have been investigated and verified.

Electrolux' response on the product concept has been very positive, both from a marketing and development point of view. The concept has been considered very innovative but yet feasible and well thought through.

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Appendix

Appendix 1- Competitor products

Appendix 2- Interview guides

INTERVJUGUIDE

- Vad har du för produkt? (Vilken typ, märke)
- Hur länge har du haft produkten?
- Vad gör du med maskinen?
  - Varierar det mycket? (Inspiration)
- Var förvarar du maskinen?
  - Hur fungerar det?

- Vad ger det för känsla för dig att använda produkten? (papper med bilder)
  - Hur önskar du att du skulle känna när du använder produkten?
  - (Lyxigt, jobbigt, hälsosamt, onödigt, tråkigt, fräschhet)
- Är det värt tiden och arbetet för att få en kaffe/ett glas juice?
  - Varför/varför inte?

- Varför köpte du den?
  - Uppfyller den det du hoppades när du köpte den?
- Hur ofta använder du produkten?
  - Använder du den mer eller mindre än du trodde när du köpte produkten?
- När använder du oftast produkten?
  - Varför?
- Hur nöjd blir du med resultatet?

- Hur fungerar hanteringen av produkten?
- Hur diskar du den? (Maskin, inte maskin? Varför?)
  - Hur lång tid tar det?
- Förstår du produkten?
- Använder du alla funktioner?
- Finns det något annat du har tänkt på som vi inte har frågat om?

INTERVJUGUIDE - espresso

- Vad har du för produkt? (Vilken typ, märke)
- Hur länge har du haft produkten?
- Vad gör du med maskinen? (espresso/latte/kaffe americano)
  - Alltid samma? (Inspiration)
- Var förvarar du maskinen?
  - Hur fungerar det?
- Är maskinen automatisk/manuell?
  - Varför valde du en sån?

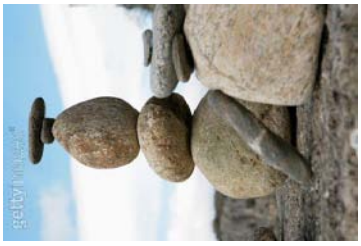
- Vad ger det för känsla för dig att använda produkten? (papper med bilder)
  - Hur önskar du att du skulle känna när du använder produkten?
  - (Lyxigt, jobbigt, hälsosamt, onödigt, tråkigt, fräschhet)
- Är det värt tiden och arbetet för att få en kaffe?
  - Varför/varför inte?

- Varför köpte du den?
  - Uppfyller den det du hoppades när du köpte den? (Blir du nöjd med kaffet?)
- Hur ofta använder du produkten?
  - Använder du den mer eller mindre än du trodde när du köpte produkten?
- När använder du oftast produkten?
  - Varför?

- Hur fungerar hanteringen av produkten?
- Hur diskar du den? (Maskin, inte maskin? Varför?)
  - Hur lång tid tar det?
- Förstår du produkten?
- Använder du alla funktioner?
- Finns det något annat du har tänkt på som vi inte har frågat om?

- Skulle du kunna tänka dig att köpa en juicemaskin? Vad skulle krävas av den för att du skulle vilja ha den? Skulle den få stå framme?
- Har du några andra idéer för den perfekta juicemaskinen och hur vi kan få den att ”bli mer som/få samma status som en espressomaskin”?

Pictures used as mediating objects during the interviews



INTERVJUGUIDE- Juicedagbok

- Hur kändes det att göra juice varje dag?
  - Skulle du kunna tänka dig att fortsätta med det?
- När gjorde du juice?
- Är det värt tiden och arbetet för att få ett glas juice?
  - Varför/varför inte?
- Hur nöjd blir du med resultatet?
  - Tyckte du det blev mycket skum?

- Hur känner du dig när du använder produkten/ vad får du för känsla av att använda produkten/hur känns det att använda produkten?
  - Hur önskar du att du skulle känna när du använder produkten?
  - (Lyxigt, jobbigt, hälsosamt, onödigt, tråkigt, fräschhet)

- Hur fungerar hanteringen av produkten?
- Hur diskar du den? (Maskin, inte maskin? Varför?)
  - Hur lång tid tar det?
- Var förvarar du maskinen
- Tycker du att du hade kontroll över maskinen
- Ljudnivå
- Sugproppsfötter?

- Skulle du kunna tänka dig att köpa produkten?
- Varför/varför inte?
- Snygg/prestanda/Hälso/lyx/slös?
- Hur skulle du vilja att den såg ut om den skulle vara i ditt kök?
- Skulle du köpa den av en hälsoaspekt?

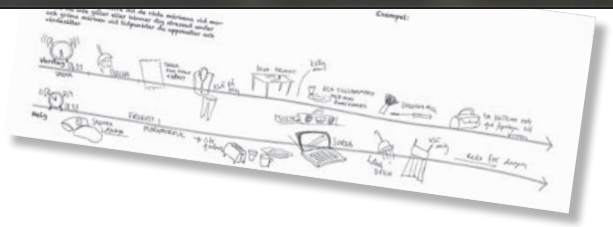
- Hur jobbigt var det/ var det värt det?
- Finns det något annat du har tänkt på som vi inte har frågat om?

MORGONVANOR

Rita eller skriv in dina mogonvanor på tidsaxlarna nedan, både för vardag och helg.

När du är färdig klstra dit röda klistermärkena vid moment du inte gillar eller känner dig stressad under och gröna klistermärken vid moment du uppskattar och värdesätter.

Exempel:



Vardag

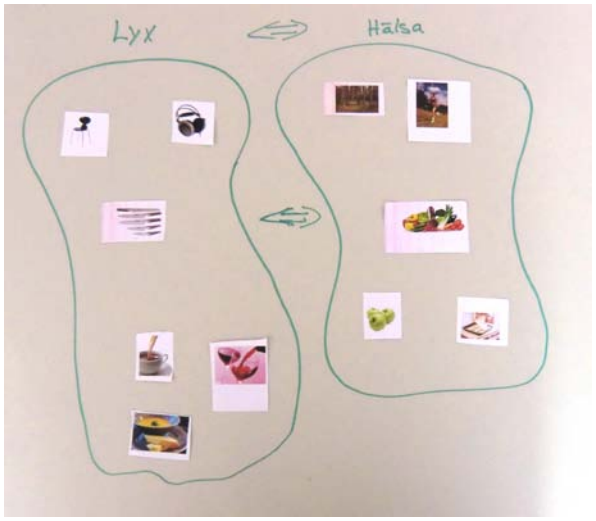
Helg

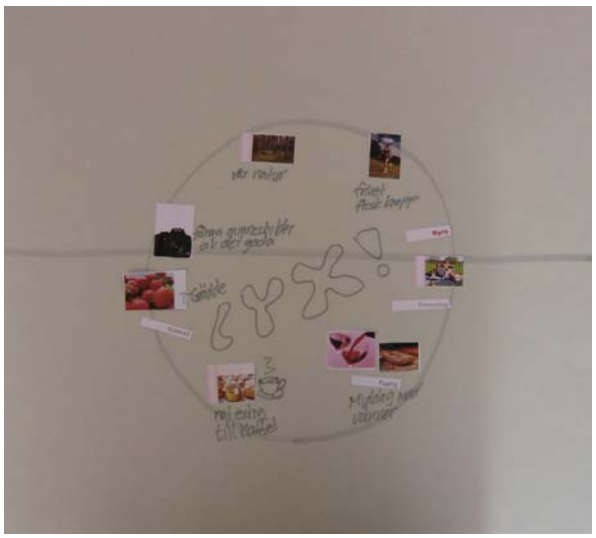
Appendix 4- Plan focus group

Moment	Beskrivning	Material	Tid
Introduktion	- Vilka är vi? Vad gör vi? - Lite om projektet. Vi vill inte berätta så mkt än. - Syftet med fokusgruppen. (Komma åt värderingar och prioriteringar. Ni är experter, finns inget rätt/fel) - Schema. (Workbooks, Collage, Produktspecifikt) - OK att vi filmar?	- Fika - Ev. Namnskyltar - Filmkamera - Tidtagare	10 min (09.45)
Uppvärmning	- Vi börjar med en liten lek för att komma igång. Vi säger ett påstående och om det stämmer på er ska ni resa er upp och byta plats med någon. - Jag åkte hit med tunnelbana i morse. - Jag är född i Stockholm. - Jag har druckit mer än en kopp kaffe idag. (- Jag hann inte borsta tänderna i morse.) - Jag tycker att det här är lite töntigt.		5 min (09.55)
Workbook	- Ni har alla fått den här boken. Det var för att ni skulle börja fundera lite över era vanor. Vi skulle vilja höra vad ni har skrivit, vi börjar med dig. Om ni andra undrar saker är det ok att fråga. - Proba: (varför är det viktigt) - Hur mycket varierar morgonvanorna? - Hur viktigt är det att det ni äter till frukost är nyttigt? - Äter ni lokalproducerat/ekologiskt? Varför? - Vad skulle kunna få dig att ändra dina frukostvanor? - Tid för frukost? Vad skulle kunna få dig att lägga mer tid på din frukost?	- Distribuera workbooken (+ klistermärken)	15 min (10.10)
Collage	- Skriv ut frågorna på White boarden. - Behöver inte vara självförklarande. **- Vad upplever du som lyxigt i din vardag och vad gör du för att lyxa till det för dig själv?**	- Lim, tejp, saxar, pennor, pappersark, bilder, ord - Musik - Snacks	15 min (10.25)
Berätta om collage	- Varje person får berätta och förklara om sina collage. (2-3 min per person) - Proba och fråga under tiden.		15 min (10.40)
Diskussion om collage	- Hur viktigt är lyx i vardagen? - Vad är det som ger den där lyxkänslan? - Själv eller tillsammans? - Är produkter en viktig del för lyxkänslan? (förbrukningsvaror eller fasta produkter) - Tycker du att den här produkten ser lyxig ut? (fråga om en specifik produkt i collagen?) Varför? - När/i vilka situationer kan du tänka dig att lyxa till det? - Vad unnar man sig? (tid/pengar/ohälsa) - Är lyx förknippat med positiva känslor eller dåligt		10 min (10.50)
	samvete? (Hur kan man ändra det?) - Vad för mat är lyxig? - Lyx vs. Hälsa?		

Juice	- Nu har vi diskuterat det här med lyx. Det som vi arbetar med och vill göra lyxigare och mer användarvänligt är en juicemaskin. Än så länge är vi bara i researchstadiet över brukaren och kontexten för en sån här maskin, och det är därför ni är här. - Dricker du juice? Varför? Varför inte? När? - Skulle ni kunna tänka er att göra juice själva? - Vad skulle kunna få dig att göra det? - Har ni någon form av juicepress? Har du funderat på att köpa en juicemaskin? - Vad har du för produkter på din köksbänk? Vad skulle krävas av en juicepress för att få stå framme?	- Juicemaskin	15 min (11.05)
Avrundning	- Tack så jättemycket för hjäpen. Hoppas det har känts roligt också.		5 min (11.10)

Appendix 5- Collages





Appendix 6- Interpreter interview guide

ATT OBSERVERA PÅ JUICEKAFÉ

- Vad har de för drycker/mat? Vad har de för juicer?
- Vad verkar vara mest populärt?
- Har stället en nyttig/hälsosam image? Är stället ”hippt”?
- Vem är där?
- Är juicen direkt-pressad eller klar?
- Består juicen mest av en eller flera ingredienser?
- Är juicen kryddad?
- Äter folk något till eller dricker de juicen som den är?
- Vad är det för utseende/färg på juicen?
- Smuttar folk på juicen eller dricker/shottar de den snabbt?
- Finns det sittplatser eller står man i baren? Takeaway?

FRÅGOR TILL JUICEBARTENDER

- Vad dricker kunderna mest?
- Väljer folk juice över andra drycker? Varför?
- Varför kommer folk?
- Vilka kommer hit?
- Vilka vill ni attrahera? Vem anser ni vara er målgrupp?
- Vilka tider är det mest folk?

- Hur länge har ni funnits?
- Varför öppnade caféet?

- Vi håller på med ett projekt för Chalmers där vi ska utvecka ett koncept för en juice press för hemmabruk. Vad tror du att folk vill ha för maskin hemma? Vad är viktigt för en hemma-juicepress?
- Vad har ni för juicepress? Varför?
- Använder ni samma juicepress för alla typer av frukter och grönsaker?
- Hur tycker du att hanteringen av juicepressen fungerar?
- Hur rengör ni juicepressen? Fungerar det bra eller dåligt?

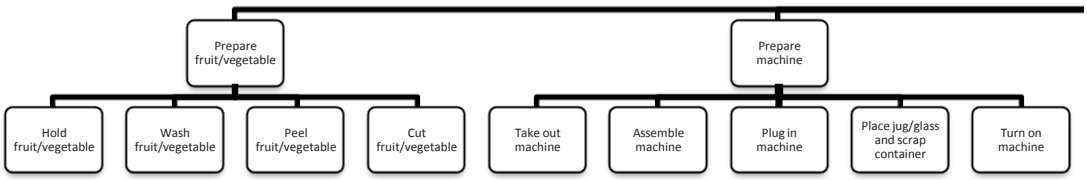
FRÅGOR TILL HOTELLFRUKOSTPERSONAL

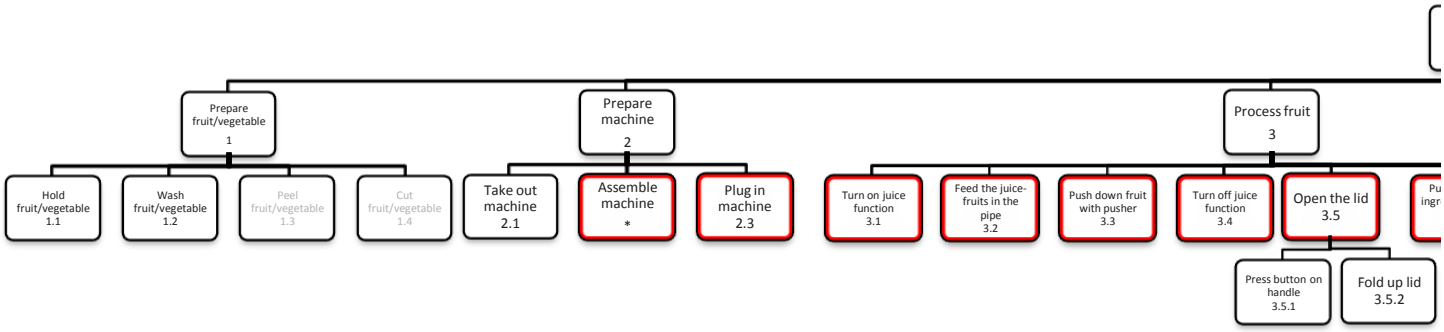
- Har du någon känsla för vad folk tycker är lyxigt på er frukost?
- Har ni något på frukosten som ni anser vara ”det lilla extra”?
- Vad har ni för olika juicer? Har ni färskpressad juice?
- Verkar folk bry sig om hur nyttigt det de äter och dricker är?
- Har ni moment där folk själva får göra det de ska äta eller dricka alt. se när någon tilla gar det de vill ha? Är det i så fall populärt? Varför/Varför inte?

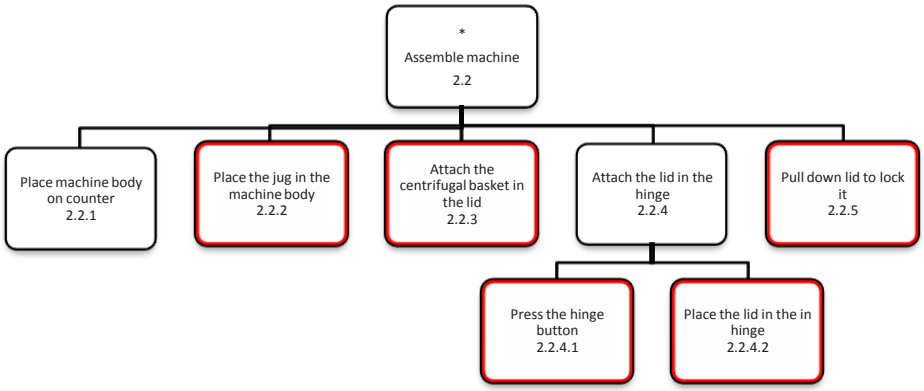
  Finns det något annat du tänker på som man skulle uppskatta att ha hemma, som gör att man kan ta hem den där lite hotell-lyxiga känslan?

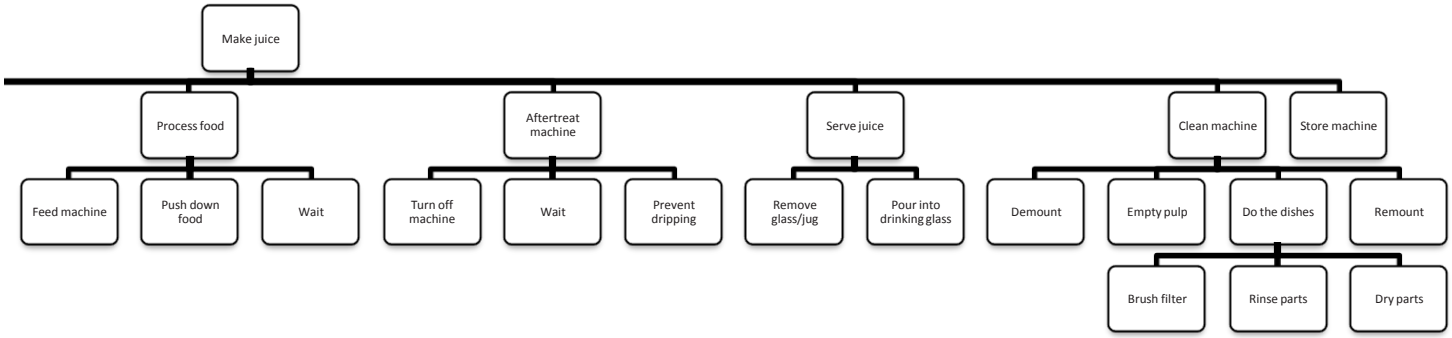
Appendix 7- HTA

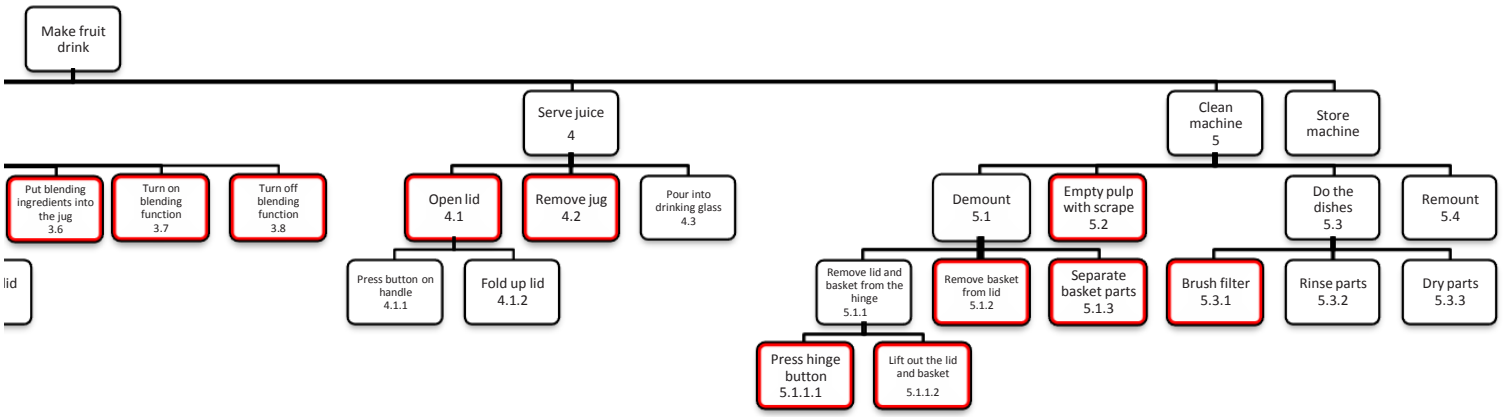
On top the HTA for a regular juicer done during the research. Below is the HTA for the final concept. This is also the foundation for the CW & PHEA done durning evaluation.





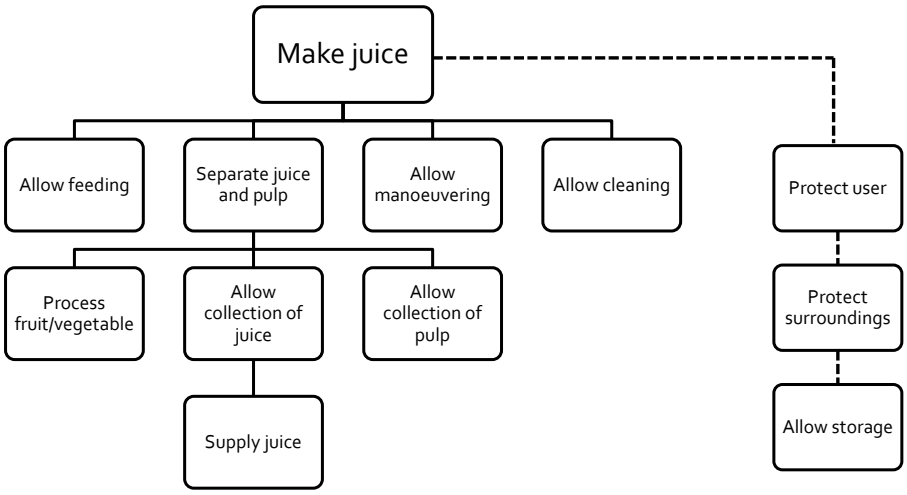


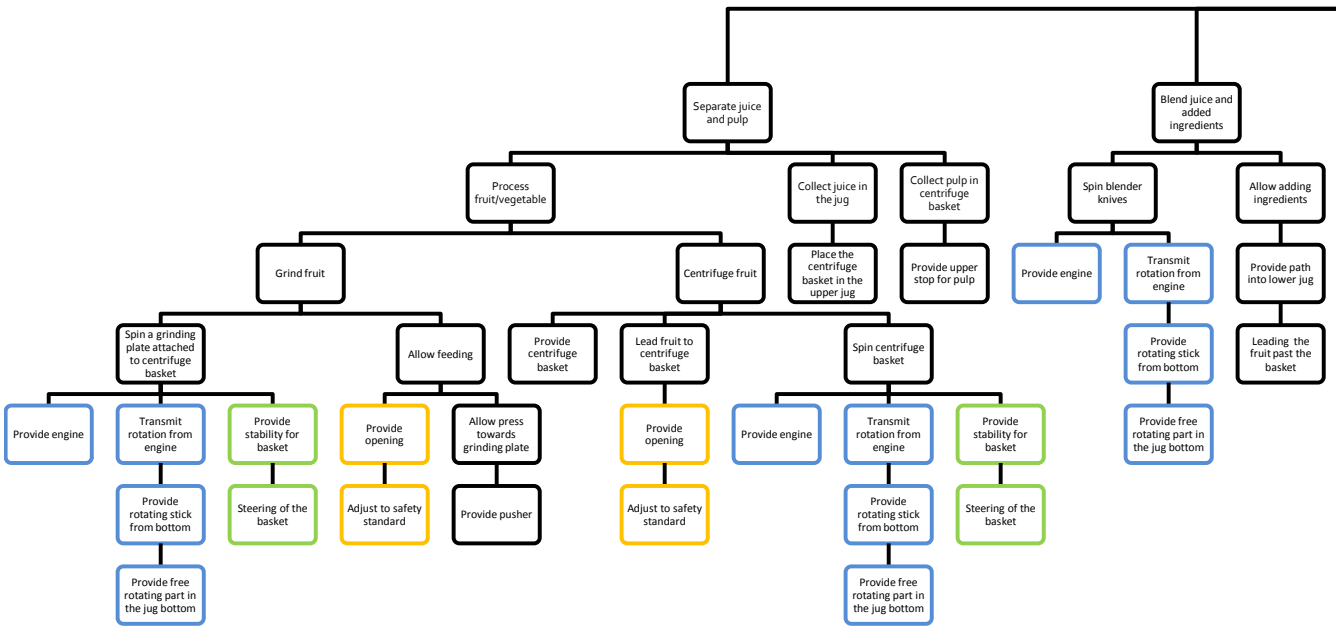

Make juice
Process food
Feed machine
Push down food
Wait
Aftertreat machine
Turn off machine
Wait
Prevent dripping
Serve juice
Remove glass/jug
Pour into drinking glass
Clean machine
Demount
Empty pulp
Do the dishes
Brush filter
Rinse parts
Dry parts
Remount
Store machine

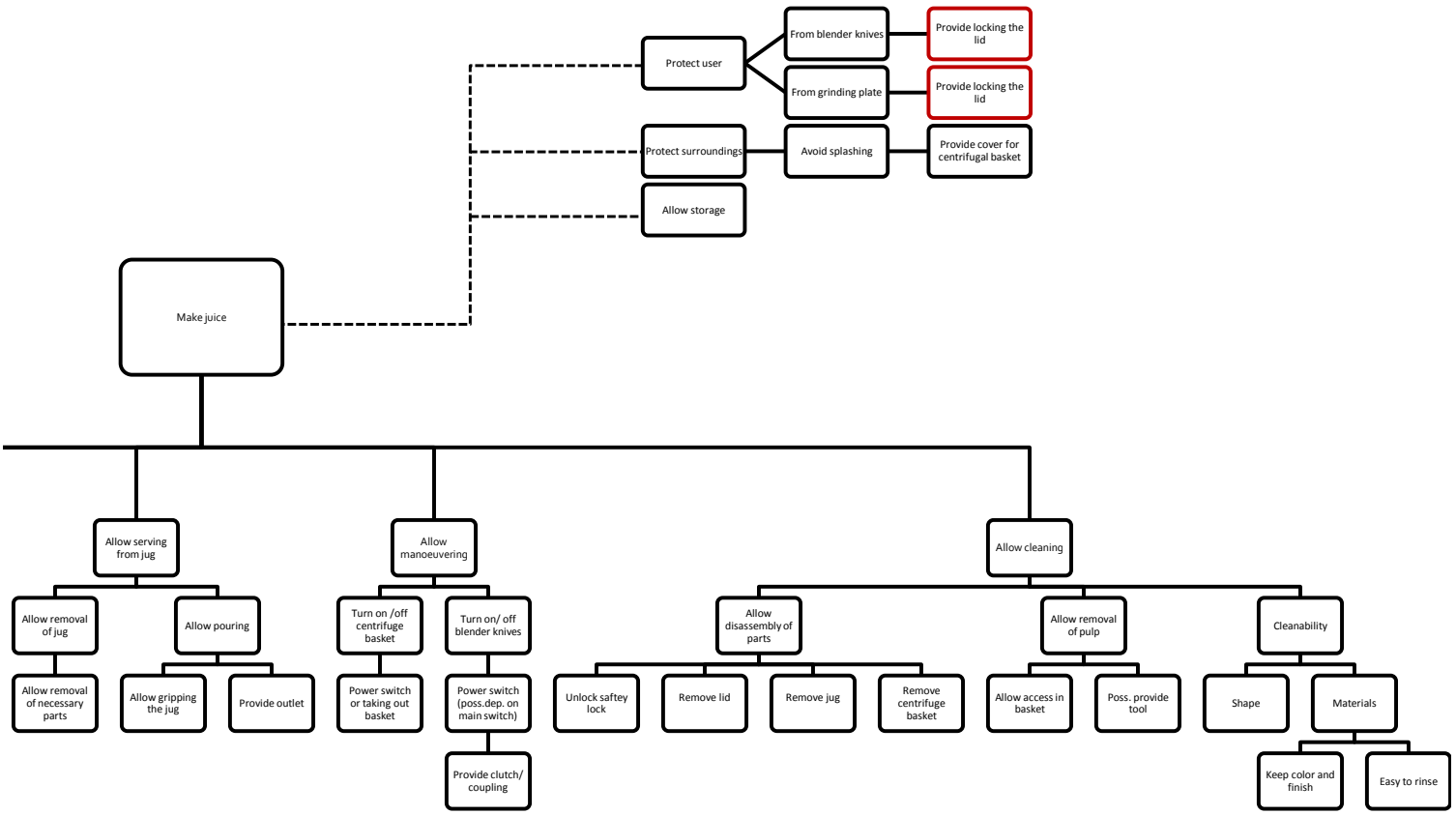

Make fruit drink
Put blending ingredients into the jug 3.6
Turn on blending function 3.7
Turn off blending function 3.8
Serve juice 4
Open lid 4.1
Press button on handle 4.1.1
Fold up lid 4.1.2
Remove jug 4.2
Pour into drinking glass 4.3
Clean machine 5
Demount 5.1
Remove lid and basket from the hinge 5.1.1
Press hinge button 5.1.1.1
Lift out the lid and basket 5.1.1.2
Remove basket from lid 5.1.2
Empty pulp with scrape 5.2
Separate basket parts 5.1.3
Store machine
Do the dishes 5.3
Brush filter 5.3.1
Rinse parts 5.3.2
Dry parts 5.3.3
Remount 5.4

Appendix 8- Function Analysis

To the upper left is the function analysis for a regular juicer done during the research. In the bottom is the function list for the chosen concept Blenderjug. To the right in that tree-structure is the supportfunctions placed.






Make juice
Protect user
From blender knives
Provide locking the lid
From grinding plate
Provide locking the lid
Protect surroundings
Avoid splashing
Provide cover for centrifugal basket
Allow storage
Allow serving from jug
Allow removal of jug
Allow removal of necessary parts
Allow pouring
Allow gripping the jug
Provide outlet
Allow manoeuvering
Turn on /off centrifuge basket
Power switch or taking out basket
Turn on/ off blender knives
Power switch (poss.dep. on main switch)
Provide clutch/ coupling
Allow cleaning
Allow disassembly of parts
Unlock saftey lock
Remove lid
Remove jug
Remove centrifuge basket
Allow removal of pulp
Allow access in basket
Poss. provide tool
Cleanability
Shape
Materials
Keep color and finish
Easy to rinse

Appendix 9- Requirements specification

Functions

Requirement	Explanation	Limits/Measurement	Measuring
Grind fruit	Through a rotating grinding plate attached to centrifuge basket.	With1500 rpm or higher	
Centrifuge fruit	Through a rotating centrifuge basket.	With 1500 rpm	
Separate juice and pulp	The basket is made of mesh material.		
Allow feeding to grinding plate	Through an opening.	Shall fit whole fruits of diameter 70mm	Check
Allow applying pressure on grinding plate	With a feeder.		Check
Collect pulp	In the centrifugal basket.	Shall be able to collect pulp from up to 9 apples.	Capacity testing
Provide upper stop	In the centrifugal basket, so that the pulp stays.	Of at least 1 cm.	Check
Collect juice	.	Collect at least 1200 ml.	Check
Allow feeding to blender	Without passing through the centrifugal basket.	Shall fit ingredients of size3cm diameter	Check
Blend ingredients	Through rotating knives in the bottom of the jug.	With 10500 rpm	
Blend ice	Optimize the shape of the knives and the jug		
Allow serving from jug	Provide a spout and optimize proportion of jug.		Handling testing

Allow gripping the jug	Provide a handle.		
Allow switching on and off centrifuge	Provide a switch.		
Allow usage without centrifuge basket	If only blender function is desired.		
Allow disconnecting blender knives	During usage, with a coupling or separate motors.		
Provide ability to take off the lid/edge of centrifugal basket	For easier removal of pulp and rinsing the centrifugal basket.		
Allow removal of pulp	Possibly provide a tool for removing the pulp.		

Handling

Requirement	Explanation	Limits/Measurement	Measuring
Fit in a cupboard		Cannot be bigger than 60cm high when storing	
Allow fast assembly			Handling
Communicate assembly	Through good semantics		User testing
Give clear feedback	When assembling and using; visual, tactile or audio		User testing
Allow fast cleaning			
Sustain dishwashing	Regarding materials etcetera of most parts.		
Minimize weight of jug	For easier serving.		
Maximize user control over jug	Optimize placement of the handle and weight distribution of jug.		User test

Allow fast disassembly of lid, jug and basket			
Avoid pulling of the motor when turning on			
Allow visibility of what happens inside the jug			

Safety

Requirement	Explanation	Limits/Measurement	Measuring
Provide feeding chute	To maximize the distance between user and grinding plate.	Of at least 180 mm.	
Provide feeder	To avoid that the user tries to apply force with something else.	Fit the feeding chute	
Offer stability	Avoid that the machine falls over	It must be able to stand on an inclined plane of 10^{o} without falling.	
Hold lid	Make sure that lid does not spin up when machine is turned on.		
Prevent injuries	Make sure that the user cannot get hands or fingers hurt.	The standard finger should not be able to touch any spinning parts during usage.	Standard finger probe
Allow drainage	In case fluids leak onto the body, to avoid giving the user electroshocks.		
Secure assembly of lid	Through a hidden power switch		
Secure assembly of knives	The knives cannot be turned without the jug, hidden power switch.		

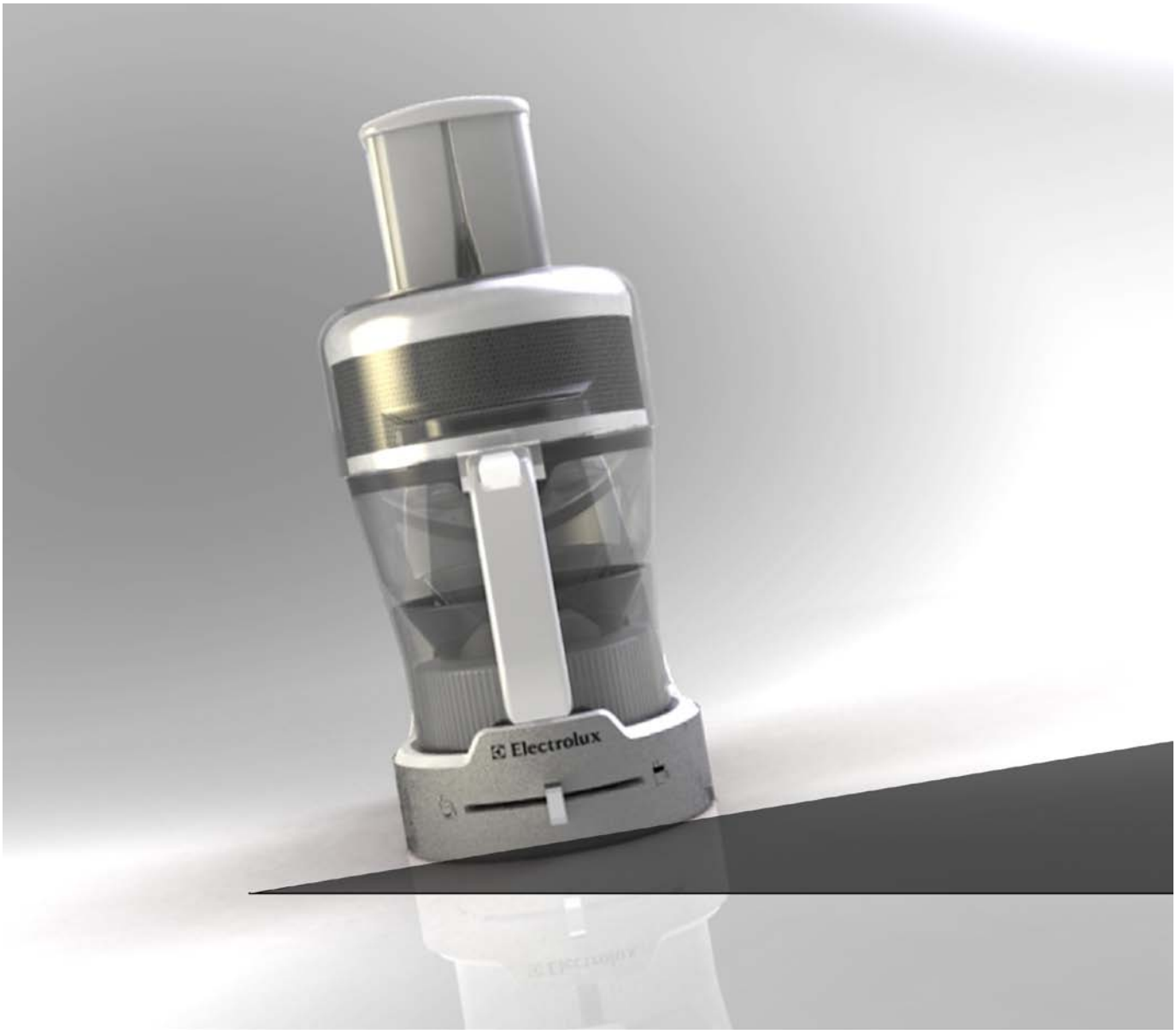
Expression

Requirement	Explanation	Limits/Measurement	Measuring
Have the Electrolux design language	Fit together with the concept products from the range and have some Electrolux design cues.		

Quality and Material

Requirement	Explanation	Limits/Measurement	Measuring
Maximize performance	It shall be able to extract as much juice as a Magimix.	The juice that is extracted should weigh at least 65% of the initial weight of an apple.	
Minimize wear of the jug	The material shall not get too much scratches.		
Facilitate cleaning of surfaces	Material choice.		

Appendix 10- Visual stability evaluation



Appendix 11- User acceptance test plan

- Introduction
- What do they think about the idea?

Handling

- Show renderings and ask if the understand how it works
- Explain how it works, ask for feedback

Usage

How often would you use the machine (make a mark on the scale)

Every day — Once a month

When do you believe you would use the machine? (Answer in percent, 100% totally)

Weekday morning _____ %

Weekend morning _____ %

Party _____ %

Snack _____ %

Indulge yourself _____ %
(When ever in the day)

Which kind of drink would you make then?

_____

Where would you store the machine, given that your kitchen is not super small?

Expression

- Describe with three words your impression of the product.
- In relation to each other place these product on the scale: exclusive – cheap, Technical - Human
- How well, on a scale from 1-10, do you believe the new concept fit with this image board.

Appendix 12- CW & PHEA charts

CW and PHEA Task nr 2.2.2 in HTA: Place the jug in the machine body				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**

CW and PHEA Task nr 2.2.3 in HTA: Attach the centrifugal basket in the lid				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	No	Might be more more logical to attach the basket on the axis.	The lid will not close if not also the upper snapfit is conical. The basket might be instable while closing lid.	If the is basket placed on axis, it is not covered by the lid.
2. Will the user notice that there is a possible path to the right result?	Yes/No	It is difficult to see that it should be snapped into the lid.	The user will put it directly on the axis or not assemble it in the machine at all.	
3. Will the user associate the right action with the right result?	Yes/No	Understand that the basket shall be covered by the lid but maybe not that it should be snapped into the lid	Will put the basket directly on the axis or not assemble at all.	
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes	Nice snap! That gives sufficient feedback.		
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Don't put in the basket at all	Forget it/don't fully understand its place/Only want to blend and belive they don't need the basket	Not possible to juice, might throw whole apples into the blender. If only blending: no problem.	Fruit falls through unprocessed.	Open, take out fruit, insert the basket
Put it directly on the axis	You don't understand that you shall put it inside the basket. Don't know that there is a snapfit and maybe think the basket would fall out	Cannot close the lid (risk of breaking something?)	The lid does not close.	Take out the basket and put it into the lid

CW and PHEA Task nr 2.2.4.1 in HTA: Press the hinge button				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes/No	Depending on if the user see the button or not. The user will not look for a button	The lid cannot be attached	Good if you can see that the hinges are "folded out" and you understand that they are so big that the lid cannot be snapped in.
2. Will the user notice that there is a possible path to the right result?	Yes/No	Depending on visability of the button and how close it is to the hinge. Might not understand that it controls the hinge.	The lid cannot be attached	
3. Will the user associate the right action with the right result?	Yes	If the button is designed in a good way		The button shall look mechanical.
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes	The user sees that the holes look like the hinge holders on the lid and that the hinges are hidden.		Mechanical solution makes sure that the button cannot be pushed when the lid is vertical
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Try to attach the lid without pressing the button	Think it shall snap in. Don't see the hinges (lid might be in the way)	Cannot attach the lid	Immediate	Not necessary
Push the button during usage	Don't understand what it's for. By (e.g. Chlidren)	Will vibrate. Not good. The lock might break and it will continue running	Don't see what happens to the hinges. Feel that the button is mechanical.	Release the button. Might have to correct the placement of the lid

CW and PHEA Task nr 2.2.4.2 in HTA: Place the lid in the hinge				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes	The user understands that the hinge holders on the lid shold go towards the machine, where they will fit in the machine.		Good with something on the lid that marks that it is the front of the lid
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Don't fit the hinge holders on the lid in the holes on the body	Don't understand or see that it is possible	The machine will not start	Immediate	

CW and PHEA Task nr 2.2.5 in HTA: Pull down the lid to lock it				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Try to start it without closing the lid	Don't understan that the lid needs to be closed	Machine won't start	Immediate	Close the lid
Lid is folded down but not propperly snapped into the jug	Pused down with to little force (even though very little force is needed)	Won't start	Immediate	Close the lid
Fold down lid without placing jug	Don't know that jug needs to be there	Won't have enough space to place jug	Immediate	Lift the lid to place the jug

CW and PHEA Task nr 2.3 in HTA: Plug in Machine				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**

CW and PHEA Task nr 3.1 in HTA: Turn on the juice-function				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Pull the switch in the wrong direction	Don't understand the symbols/words.	Start blending instead of juiceing	Immediate	Pull the switch in the other direction
Pull switch before everything is assebmled	Misstake/ belive one are finsihed with the assembling	Won't start	Immediate	
Don't pull the switch all the way	Believe there is a stepless start	Won't start	Immediate	Pull more
Pull back the switch before the micoswitch started the machine	Believe it was a wrong action and that the machine won't start.	Won't start		

CW and PHEA Task nr 3.2 in HTA: Feed the juice-fruits in the pipe				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Feed before starting machine and stuff the pipe full.	Belive that is the right way to feed it.	Might get to heavy to press down fruit with pusher.	Immediate, will hear it and feel it.	Stop machine and remove the fruits.
Put fruit directly in basket before assembly	Don't understand the overall function of the machine.	Difficult to attach basket, no grinding and no juice.	Difficult to attach basket and very bad efficiency.	Remove fruits and put them in feeding pipe.
Feed without pushing	Don't belive it necessary	Slow or no grinding	Slow process	Start use pusher

CW and PHEA Task nr 3.3 in HTA: Push down fruit with pusher				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Don't use the pusher	Don't belive it is neccesary	Slow or no grinding	Slow juiceing	Use the pusher to push
Push with hand or other tool	Lost the pusher or beeing lazy	Don't reach fruit, can get dangerous.	No sucess	
Push with hand or other tool	Something got stuck	No grinding	No juiceing	Turn off and remove alternatively use the pusher

CW and PHEA Task nr 3.4 in HTA: Turn off Juice-function				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes/no	Maybe turning off the machine by opening the lid and belive that is the switch.		The zero-state for the switch must be very visible
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Pull switch too far- directly to blending	Misstake or don't get enough feedback at zero-state	The machine start to blend	Immediate	

CW and PHEA Task nr 3.5 in HTA: Open the lid				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes/No	The user might not understand that you need to open the machine to feed the blender. He/she might believe that there is another way of feeding, either in the juicer-feeding-pipe or through another feeding hole.	Puts the ingredients in the juice feeder	
2. Will the user notice that there is a possible path to the right result?	Yes	There is a visible hinge and a handle		
3. Will the user associate the right action with the right result?	Yes/No	The usage is intuitve if you regard the machine as a blender, but since the juicing function has a specific feeding pipe one might expect the same for the blending function.	Feeds the wrong pipe or gets annoyed for not understanding where to feed.	
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			There is a risk that the user doesn't think this is the right/only way of feeding even if he/she sees that it is a possible way.
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Feeding through juicer-feeding-pipe	Believes this is the pipe to use for both functions/Doesn't pay attention	The fruits that were supposed to get blended get juiced. If ice or frozen fruit, they might hurt the basket.	Fruit does not reach jug. Might take a little while to realize.	Disassembly
Opening before all juice has been extracted.	Believes it is finished.	Wet pulp with potential dripping, less juice.	Maybe dripping, otherwise difficult.	Start the machine again.

CW and PHEA Task nr 3.5.2och 4.1.2 in HTA: Fold up lid				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Trying to pull the lid upwards instead of around the hinge	Doesn't understand that there is a hinge	The lid doesn't open (the hinge is strong enough not to break)	Immediate	Not necessary
Doesn't fold the lid all the way up	Think that the lid will stay there and, e.g. because of built-in block in the hinge	Lid falls back on the jug, risk of hurting the machine or squeezing fingers	Immediate	Fold the lid back up

CW and PHEA Task nr 3.5.1 in HTA: Press button on handle to open lid				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes/No	The user might not understand that the snap-fit needs to be released (depending on how clear the "snap" was when assembling)	User tries to open without sucess	
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes	Immidate feedback, since it opens with a click		
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes	The lid opens a little bit		
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Pulling on the lid without pressing the button	Don't understand that it needs to be released	The lid doesn't open, risk of breaking the snapfit	Immediate	Not necessary (unless the snapfit breaks, then tere is no correction)
Happen to press the button during usage	By accident/for fun/belive that it is the turn-off button	The machine stops	Immediate feedback, but risk of not understanding why the machine stopped	Close the lid

CW and PHEA Task nr 3.6 Put blending-ingredients into the jug				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes/No	The blender blades could be covered with juice, and the user might not know/think about that there are blades in the bottom of the jug.		
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Colliding with the rotating axis.	Not careful.	Risk of scratching hands. The fruit bumps on the axis and might cause splashing. Large pieces of fruit don't fit.	Immediate.	Not possible.

CW and PHEA Task nr 3.7 Turn on blending function				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Turning on the juicing function instead of the blending function.	Mistake or doesn't understand the symbols/words.	The centrifuge basket starts to spin.	There are not vortixes. Difficult to detect if not observant.	Switch function.
Turning on the blending function when wanting to make juice.	Mistake or doesn't understand the symbols/words.	The blenderknives start to spin.	The centrifuge basket doesn't spin. The blender knives start to spin. Might not detect immediatly.	Switch function.
Not pulling the lever all the way.	Doesn't get enough feedback	The lever jumps back to the zero-state	Immediate	Not necessary.
Turning on blender function before closing the machine.	Believes one can feed when the blender knifes are running.	The machine doesn't start.	Immediate.	Not necessary.

CW and PHEA Task nr 3.8 Turn off blending function				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
See turn off juicefunction 3.4				

CW and PHEA Task nr 4.1 Open the lid to remove jug				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Trying to pull out the jug without opening the lid first.	Doesn't understand that one must open the lid.	Not possible to pull out the jug, the machine body will probably slide on the counter. Risk of breaking the machine?	Immediate	Not necessary.
Opening the lid while running.	Opens the lid to turn off the machine instead of using the switch.	Machine stops.	Immediate	Not necessary.

CW and PHEA Task nr 4.2 Remove jug				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Pulling instead of lifting the jug.	Thinks it's the right way to take out the jug (unless it is clear that the jug is built in).	Machine will start to slide on the counter.	Immediate.	Not necessary (perhaps push the machine back again).
Lifting the jug when the lid is closed and locked.	Thinks it is possible.	Heavy to lift but risk of cracking the snapfit.	Will be heavy to lift, hopefully the user understands that it is the wrong way to do it.	Not necessary. (unless snapfit breaks, then there is no recovery)

CW and PHEA Task nr 5.1.1 Remove lid and basket form the hinge				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes/(No)	The user might believe that the lid can be whiped off rather than washed and might therfore only remove the basket.	The lid is dirty and will eventually start to smell.	
2. Will the user notice that there is a possible path to the right result?	Yes	There is a big button.		
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Forgetting the basket and the lid in the machine.	The user forgot.	The parts will start to smell.	Eventually, through smell or because he/she sees it.	Take out the parts and clean them.
Removing only the basket and letting the lid stay in the hinge.	Believe that the lid is fixed.	Nothing at first, but the parts will start to smell. The user might get annoyed for not being able to clean the machine properly.	Difficult.	Take off the lid and clean it.
Trying to remove the hinge with the lid still snapped into the snapfit in the front.	Thinks it is possible and easier.	Unclear, maybe the jug will lift or the snapfit will break.	If something breaks or it is not possible to lift the lid.	Not possible if the snapfit breaks.

CW and PHEA Task nr 5.1.1.1 Press the hinge button				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes	There is a big and visible button.		
3. Will the user associate the right action with the right result?	Yes			Probably the button is just next to the hinge.
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes/No	If not holding the lid at the sametime one wil not get feedback that it is loose.		
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Pressing the button without holding the lid.	Doesn't belive it is neccecary, or by mistake.	Lid can fall down, maybe break.	Through the sound when the lid falls.	Pick the lid back up. If it breaks, there is no correction.
Not pressing the button all the way.	The user does not use enough force or doesn't get enough feedback to understand that the button isn't all the way down.	Can't remove lid or lid gets skewed and stuck.	Probably.	Push down the button again and try to correct the placement of the lid.

CW and PHEA Task nr 5.1.2 remove basket from lid				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes	A grip there is!		
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Trying to screw the basket out of the lid.	Think it is attached by screwing.	It will start to spin but it will not be disattached.	Immediatly.	Not necessary.
Not removing it and trying to clean with the basket still in the lid.	Doesn't dare to pull, thinks it is fixed. Or doesn't succeed with removing the basket.	Very difficult (impossible) to clean.	Difficult.	Take out the basket and wash the parts.
Pushing through the feeder to remove the basket.	Thinks it's the right way to do it.	Will work if the user reaches all the way down.	None.	Not necessary.

CW and PHEA Task nr 5.1.1.2. Lift out the lid and basket to remove from hinge				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	Yes			
2. Will the user notice that there is a possible path to the right result?	Yes			
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**
Trying to pull sidewards.	Doesn't understand the hinge.	Can't remove the lid.	Immediate.	Not necessary.

CW and PHEA Task nr 5.2 Empty pulp with scrape				
	Yes/No	**Why?**	**Problem**	**Notes**
1. Will the user try to achieve the right result?	No	Will not intuitively look for a scrape to clean with.	Difficult to empty the basket.	Make a good scrape!
2. Will the user notice that there is a possible path to the right result?	Yes/No	Yes if you know that there is a scrape, but no if you don't.		
3. Will the user associate the right action with the right result?	Yes			
4. If the right action is performed, will the user notice that this action brought her closer to the completion of the task?	Yes			
Which actions may the user do wrong at right timing? Which actions may the user do right at wrong timing? What happens if the user performs an incomplete action or exclude an action? What happens if the user perform the tasks in the wrong order?				
Wrong /mistake	**Reason**	**Consequences**	**Detection**	**Correction**