

Development of portable unit for the coffee industry

Utveckling av bärbar enhet till kaffeindustrin

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Bachelor of Science in Innovation and Design Engineering

Thesis work 22.5 credits

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2018-06-18

Abstract

The project is executed along with the course "Degree of Bachelor of Science in innovation and design engineering". The course takes part at the faculty of Health, Science and Technology at Karlstad University. The employer is in the coffee industry with a focus on the professional market. The company wishes to complete its product range with a new unit for the coffee industry. The technology behind the aid has already been developed by the company, of which the bachelor thesis concerns the design and construction of the product. By agreement with the company, the product's function will not be exposed in the report.

The work follows the design process from start to finish including a project plan, pre-study, product specification, concept generation, configuration and prototype development. A large part of the work relates to the pre-study that has been conducted. The study is divided into two branches, one of which aims to chart the process of product development. The second purpose of the study is to answer how the product can be designed to reflect the company brand, current trends, human ergonomics and the cognitive understanding of the user. The pre-study does also aim to chart which stakeholders should be considered when developing the product. The process has been adapted to the fact that the product's function cannot be exposed to people who are not in direct contact with the project. As the product is new in the product range it does also lack precursor and known users. Due to these facts the company itself has had a very high influence in the decision making of the product's final design. Therefore, trend and user analyses have been performed to broaden the understanding of the need that will be posed by the actual user.

The final concept is a suggestion of how an exclusive variant of the unit may look. Potential end users of the product are almost everyone in the coffee industry, where the spectrum extends from waiters to the more skilled technician at a vending company which means that the unit will be used from once a year to each day. Thus, the design of the product is held simple to ease the cognitive understanding of the product regardless of user. The main materials in the product are aluminium and wood. The size of the device is selected to be ergonomically easy to handle and grip. The dimensioning is also motivated by the thought of giving a solid and stable expression. Complementary to the product a box has been developed to easy transportation of the product.

The development of this type of product requires an understanding that the product does not work alone but acts in a context. In addition to its function, it acts as a service both for operator and customer by generating a certain type off experience. Today's coffee and barista industry offer more than just receiving a cup of coffee, where identity and trends are important in addition to the taste of the cup itself.

Sammanfattning

Projektet görs i samband med kursen "Examensarbete för högskoleingenjörsexamen i innovationsteknik och design". Kursen ges vid fakulteten för hälsa, natur- och teknikvetenskap på Karlstads universitet. Uppdragsgivaren för arbetet befinner sig inom kaffebranschen med fokus på den professionella marknaden. Företaget önskar komplettera sitt sortiment med ett nytt verktyg till kaffeindustrin. Tekniken bakom produkten finns redan framtagen av företaget och examensarbetet avser formgivning och konstruktion av enheten. På grund av överenskommelse med företaget kommer verktygets funktion inte att exponeras i rapporten.

Arbetet följer designprocessen från början till slut innehållandes en projektplan, förstudie, produktspecificering, konceptgenerering, konfiguration samt prototypframtagning. En stor del av arbetet avser den förstudie som gjorts. Studien riktar in sig i två grenar där en av dessa avser att kartlägga utformningen av produktutvecklingsprocessen. Det andra syftet med studien är att svara på hur produkten kan utformas för att spegla företagets varumärke, trender, människans ergonomi samt den kognitiva förståelsen hos användaren. Förstudien svarar även på vilka intressenter som ska has i åtanke vid utveckling av verktyget.

Processen har behövt anpassas utefter det faktum att verktygets funktion inte får avslöjas för dem som inte står i direkt kontakt till projektet. Då produkten är ny inom företagets produktsortiment saknar den företrädare samt kända användare. På grund av dessa faktorer har företaget haft ett stort inflytande vid utformningen av produktens slutgiltiga koncept. Därmed har de genomförda trend- och användaranalyserna varit av hög relevans för att öka förståelsen för de behov som den faktiska slutanvändaren kan komma att kunna ställa på verktyget.

Det slutgiltiga konceptet är ett förslag på hur en exklusiv variant av produkten kan se ut. Potentiella slutanvändare är nästan alla inom kaffebranschen, där spektret sträcker sig från servitörer till den mer skickliga tekniken. Det innebär att enheten kommer att användas från en gång om året till varje dag. Således hålls utformningen av produkten enkel för att underlätta produktens kognitiva förståelse oberoende av användaren. De huvudsakliga materialen i produkten är aluminium och trä. Storleken på verktyget är anpassad för att vara ergonomiskt tillfredställande att handskas med samt greppa. Dimensioneringen är även motiverad av tanken att på att ge ett stabilt uttryck. För att enkelt kunna transportera verktyget har en verktygslåda utformats.

Vid utveckling av den här typen av verktyg krävs en förståelse för att produkten inte verkar själv utan levererar i ett sammanhang. Utöver sin funktion fungerar verktyget som en tjänst både för operatör och kund genom att generera en upplevelse. Inom dagens café- och baristabransch erbjuds mer än bara en kopp kaffe, där identitet och trender är av hög relevans utöver att få en god kopp kaffe serverad.

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All tables, photos, figures and illustrations are designed, photographed or drawn by the lead investigator of the project unless otherwise stated in the figure- or the table description.

1 Introduction

This bachelor thesis is executed along with the course Degree of Bachelor of Science in innovation and design engineering. The thesis is performed at Karlstad University during the spring term 2018. The course takes part at the faculty of Health, Science and Technology and includes 22.5 credit points. The report describes the process of product development of a device for the coffee industry.

The project has been done in cooperation with a company whose name will not be exposed in the report. Hereafter the company will be referred to as "Company X". The supervisor of the project is Lennart Wihk and the examiner is Leo de Vin.

1.1 Background

The employer is in the coffee industry with a focus on the professional market. Company X is completing their product range with a new t for the coffee industry. The technology behind the aid has already been developed by the company, of which the bachelor thesis concerns the design and construction of the product. In addition to the technology to be integrated into the product, two components are given. Apart from these factors, full freedom is given in the design of the product.

Today operators are needed to help staff in the coffee industry to control and adjust variables that affect the quality and taste of brewed coffee. To simplify the procedure, decrease setup time and control variables connected to quality of coffee, there is a need for a simple tool that the everyday user can control. It is of importance that the unit is stating a professional expression regardless of user. Thus, the product must be simple enough for the unprofessional user to use without greater knowledge of the technology in the product. This means the product must express credibility even when simplified.

1.2 Problem

How should the unit be designed to be attractive from a design perspective, promote human ergonomics and be easy to transport, while representing the company's brand?

1.3 Purpose

The purpose of the thesis is to pursue an independent project and develop the design of the product in respect of aesthetics and ergonomics. This by scientific methods learned during the education. For this project this means that the thesis will be implemented by methods from the process of product development. In this thesis this includes a pre-study, a product specification, concept generating, concept selection, configuration and prototype development.

1.4 Objective

The objectives of the project are as follows:

- Create a digital prototype in CAD.
- Design a concept that represents and can be identified with the company brand.
- Design the device in respect to human ergonomics.
- Base the final design on current trends.

The project will be presented by an academic report, exhibition and presentation.

1.5 Limitations

Since a suggested manufacturing method is given by the employer, manufacturing will only be investigated in general to gain basic knowledge of the subject.

2. Methodology

Based on the methodology described by Johannesson et al. (2013) the project follows the stages of project planning, a pre-study, a product specification, concept generating, concept selection, configuration and prototype development which all take part in the process of product development. Figure 1 provides an overview of the product development process inspired by the Double Diamond, that was followed for this project (Design Council, 2015).

A project diary has been used to document the process.

The process of product design is normally not linear. The concept, construction, and concept modelling phases preferably go through an iterative loop where the project specification is the key focus. Concepts are generated to thereafter be checked against the underlying specification. The first out of the two main loops in the process involve modelling and analysing. The loop is run until that moment when all the criteria in the specification are met. When the concept model has been accepted the second iterative loop takes part to result in a concept that is further developed and detailed. When the basis has been set the concept should contain as much information that a correct prototype can be made (Johannesson et al. 2013).

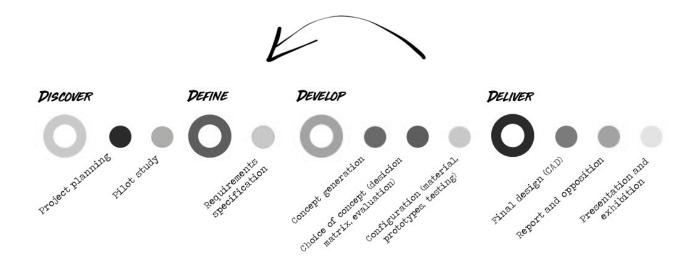


Figure 1 Summarized overview of the phases in the process

2.1 Project planning

The project plan has been developed based on the course syllabus and "Handbok för mindre project" by Eriksson and Lilliesköld (2004). When the project plan is accepted by the employer before implementing the method phase the advantage of knowing that the project is going in the right direction is given (Eriksson & Lilliesköld, 2004).

A short background has been written to give basis for the project followed by measurable objectives, both for the project and final concept. Information regarding involved stakeholders in the project is given under the title organisation. A project model has been generated to chart estimated time for each phase. Since the model only specified end dates a Gantt chart has

been developed as a support to the model to give an overview of the phases. To identify which phases should enter the project a Work Breakdown Structure (WBS) has been used.

A risk analysis for the project has been conducted followed by recommended adjustments to prevent the risks from occurring. In the analysis probability for the risks to occur and the consequence of the risks were measured from 1-5 (low to high).

2.2 Pre-study

The purpose of a pre-study is to facilitate future work. The study should be uncritical and investigate different solutions and conditions as a basis for the project. This by obtaining background information about market, design and technique. Identifying necessary information will help to avoid reconstruction and development of a product that is based on incorrect assumptions (Johannesson et al. 2013). To collect relevant information the study has been limited to two main areas: design (trends and aesthetics) and ergonomics (physical, emotional and cognitive). The study for the areas involved a literature study, a stakeholder analysis and user and trend analyses.

2.2.1 Literature study

Information about methodology has been collected to pursue the project. The literature study mainly regarded ergonomics, however cognitive ergonomics go close together with design and expression. Therefore, it is difficult to categorize the study into two terms (design and ergonomics) since information regarding the subjects can be related to in both categories. The information has been collected by literature and articles found at Karlstad university library, Karlstad university library's search tool "OneSearch" and Google scholar.

2.2.2 Stakeholder analysis

The product specification intends to consider all stakeholders involved in the project. The opinions of those considered are formulated as requirements and preferences and are included in the specification (Johannesson et al. 2013). The analysis charts the actors affected by the project. According to Jansson and Ljung (2004) the development of a stakeholder analysis follows three steps:

- Identifying stakeholders related to the project
- Understanding the stakeholder's relation to the project
- Analysing the most important stakeholders in detail

2.2.3 User and trend analysis

The analyses have been conducted by interviews.

User analysis

Interviews have been performed with potential users of the product. The aim was to cover all requirements and preferences for the product by learning the needs of the actual end user. The interviewees were asked about pros and cons of attributes that could be included in the product as well as their personal experience of the industry. The interviews have been performed by e-mail.

Those who have been interviewed for the user analysis are as follows:

- Key Account Manager at Löfbergs NO.
- Technician and installer at Johmeal.

Trend analysis

To guide the design process in a direction that is based on the market a trend analysis has been executed (Österlin 2016). In choosing interviewees these have been chosen with the view of interviewing people with various experiences in the interior industry to gather a wide range of knowledge in the field. The questions were asked to chart current and future trends. Those who have been interviewed for the trend analysis are as follows:

- High school teacher at Karlstad-Hammarö gymnasieförvaltning. Works as a teacher in design for the technology program. The interview has been performed by telephone.
- Decorator at ByBon interiör and runs the instagram account "sict.interior". The
 contact was made via her instagram account. The interview has been performed by
 email.

The information from the trend analysis have been summarized in a visual model.

2.3 Product specification

A product specification is a dynamic document that is developed to get a deeper understanding of the assignment. This is achieved by collecting the required information in addition to the statement of work. According to Johannesson et al. (2013) the specification should include a concrete problem formulation and ensured that all stakeholders, phases and aspects involved in the project have been considered. The specification is expected to lead to a more competitive product with higher quality (Johannesson et al. 2013). Rodgers and Milton (2011) state that the absence of a product specification can cause problems in the remaining process of product development. They consider that the specification ensures that the solution for the product's design is based on a correct understanding of the problem to be solved (Rodgers & Milton, 2011).

2.3.1 Function analysis and criterion matrix

The function analysis was made to ease the development of the product specification and generate more qualitative solutions for the formulated problem. The moments have been performed by the method described by Johannesson et al. (2013) in "*Produktutveckling – effektiva metoder för konstruktion och design*".

A function analysis is a summary of the information gained in a previous phase. Landqvist (1994) states that information can consider one owns research, interviews, experiments etc. as well as research made by others. By using a function analysis, the focus is on the functions rather than developing solutions for one big problem. This leads to thoughts about new and better solutions, since more solutions can be discovered when analysing each function (Landqvist, 1994).

The functions have been categorized into criteriums in form of requirements and preferences. If a criterium were to be a preference it was also weighted by its importance from 1-5 (low

to high). Secondly the criteriums were decided to be either functional or limitational. Thereafter the criteriums have been sorted into an Olsson criterium matrix. The use of checklists such as the matrix are to reassure that all stakeholders, life cycles and phases have been taken into consideration. If a cell has not added up with a relevant criterium it has been left out (Johannesson et al. 2013).

2.3.2 Failure mode and effects analysis

A Failure mode and effects analysis, FMEA, has been performed to identify possible failures that can occur. Johannesson explains that by subjective assessments the probability of a failure to occur, the ability to detect the failure and the consequences of the failure have been identified. The use of the analysis is an iterative process where the analysis is followed up each time changes are made to a design or construction. To utilize the analysis to its fullest, an important moment is to prioritize structural changes that need to be made to increase product safety. One advantage with the analysis is that you can prioritize efforts early and avoid serious difficulties. However, it should be borne in mind that the method is based on subjective assessments and does not consider linked errors (Johannesson et al. 2013). A FMEA does as well require relatively extensive work. The implementation of the analysis has been done using scales where three factors (severity, occurrence and detection) have been estimated to thereafter be multiplied with each other. The product of the factors equals in a risk priority number, RPN. The RPN is a number between 1-100 that is used to compare the risks (Johannesson et al. 2013; Scipioni et al. 2002). The risks are set although a complete concept is not available, so that the recommended actions can be considered when designing the product and developing concepts. The end date is set so that adjustments can be corrected before the configuration phase is completed, this so that a new FMEA can be performed when the final concept is set. Then the risks are once more evaluated. In "Produktutveckling – Effektiva metoder för konstruktion och design" (Johannesson et al. 2013) the use of the scales is described in greater detail:

- Occurrence rating
 - 1 = small failure probability
 - 4= certain failure probability
 - 10 = high failure probability
- Severity rating
 - 1 = negligible effect on the function
 - 4-6 = relatively serious failures, deterioration of function
 - 10 = serious failures, affects personal safety and/or conflicts with legal requirements
- Detection rating (probability of *not* detecting the error)
 - 1 = the failure is almost certain to be discovered
 - 4-6 = the failure might be discovered
 - 10 = the failure is very difficult to notice, it is almost certain that it is not detected

2.3.3 Visual theme and mood board

To ease the moment of creating ideas inspiration tools have been used. The purpose of using such tools is to guide the project in the right direction, according to Österlin (2016). One such tool are mood boards which are photo collages that have the purpose of representing the target group and its values. Another tool are visual themes. These also work as photo collages but are to represent the details and colour themes that are strived for in the project (Österlin 2016). To create identity to a company brand, several questions can be asked in the process of product development: What is the main shape? What colouring is used? Are there any characteristic details? (Wikström, 2002). These questions have acted as a basis for the development of the visual theme that is to represent Company X.

The information gathered by the literature study, interviews and trend analysis together with the Company X's expression have been summarized in two sets. The first set of the two was specifically designed to map the company's values, colour codes and recurring details. The second set was made to compile the trend analysis. The pictures that have been used have been gathered from the employer's website, pexels.com, vadarettshakerkok.se and skandinaviskashakerkok.se. Pexels is a site that shares free photos that can be used without having to ask for permission. Remaining images have been authorized to be used by the source.

2.4 Generating concepts

Johannesson et al. state a 5-step method when generating concepts:

- 1. Formulating the problem in a more abstract, neutral form
- 2. Developing a function analysis that divides the product function into sub-functions
- 3. Searching solutions for the sub-functions
- 4. Combining the sub-solutions to complete solution alternatives
- 5. Sorting for potential acceptable candidates in the complete solution alternatives

By combining the method described by Johannesson as well as methods from "Idéagenten 2.0: en handbok i idea management" by Michanek, J., & Breiler, A. (2007) the concept generating method has been performed.

2.4.1 Abstracting the problem and dividing it into subfunctions

The moment started with abstracting the problem formulation. As described by Johannesson et al. (2013) the method is carried out using two tables. In the first one, the main function of the product has been broadened into sub-functions. In the second table, the functional criteriums have been broadened and summarized. The next step is to class the functions into transforming, supporting and semantic functions in what Johannesson et al. call a function analysis (Johannesson et al. 2013). When the function analysis was developed, it was found that a minority of the functions were transforming. Thus, the moment of sorting the functions has been left out.

2.4.2 Generating ideas

The concept generation phase is in line with the requirements set out in the requirements specification (Rodgers & Milton, 2011). Rodgers and Milton state that an ideation session has achieved its purpose when contributing to inspiration that builds on the pre-study done at an earlier stage, with the outcome of new ideas and insights. According to Johannesson et al. (2013) it is of higher probability to not miss any possible solutions when generating as many ideas as possible. Using creative methods supported by a systematic process will lead to several solutions for the problem (Johannesson et al., 2013).

After generating subfunctions, solution-concepts have been developed for each function. For each of the subfunctions a separate idea generating method has been used, depending on how appropriate a method has been in relationship to the needs of each function. The sessions have been performed both in group exercises and individually by the lead investigator.

Although the phase is intended to generate "out of the box" ideas where rules and laws do not apply, there is an important structure behind the work to make it as focused as possible. It is a result-oriented process and to control the work towards the desired result, certain rules are required (Michanek & Breiler, 2007). Michanek and Breiler suggest principles for both what to avoid and what to strive for. The process is intended to strive for ideas in terms of quantity rather than quality. When generating ideas, the participants need to let go of their inhibitions while visualizing and document their ideas at the same time as it is encouraged to express ideas verbally. What should be considered is that criticism is not allowed in this stage. If you participate in the project as a governing body, it is important that everyone is aware that the whole group is participating on the same level. There is no such thing as an expert on this stage of the phase. Again, it is of importance to not be sceptical of unrealistic ideas, as these are valuable and what can be considered "unwise" can later be regards a solution (Michanek & Breiler, 2007).

Brainstorming has been used during the individual session executed by the lead investigator. Rodgers and Milton (2011) define the method as an effective method that rapidly generates innovative design concepts. The session is considered to be most efficient when performed in groups but can be applied in individual sessions as well (Rodgers & Milton, 2011). Despite this fact the method has been used in the session since it was considered appropriate. Without valuing the result, the aim is to generate as many ideas as possible. Critical thinking is not allowed and the ideas are welcome to be unusual. It is as well allowed to combine or complement ideas (Johannesson et al. 2013).

The first group session was performed by two students that as well executed their bachelor thesis at Company X. The second group consisted three persons from the same education as the report is being conducted in respect to. The lead investigator participated in both sessions. Initially, the mood boards and visual themes from the product specification phase have been presented for the groups. This was to inspire the participants and to provide information about the company's brand and expression. To promote creativity, it was of importance to get the participants in a happy state of mind. As shown in the study by Alice Isen that Norman refers to in his book, people tend to increase their ability in creative thinking when being happy (Norman 2004). As suggested by Isen, according to Norman, this can be done by creating a

comfortable environment, which can include offering small treats such as confectionery. The result of the study showed that those who had been offered the treats were more likely to think outside the box. It was therefore important to encourage participants during the session by creating a happy environment. As in the study coffee and confectionery was offered. Since both groups were familiar with the concept of generating ideas no major introduction about the methodology was given.

The method of "6-3-5" have been used in the first group session, where the number six stands for the number of people participating in the session, the three for the number of ideas that should be generated while the number five stands for the number of minutes that the three ideas should be generated in. Since this session only contained three attendings the method was modified to "3-3-5". The group was given a problem formulation that reflected the purpose of the session for each sub function. After contributing with three ideas, the paper with the sketches was passed to the next participant until it had been sent around a full lap (Johannesson et al. 2013).

During the second group session the method "Stafettpinnen" has been used. The method is described as simple by Michanek and Breiler (2007) that state that the method builds on the continuation of each other's ideas. The participants send their ideas between themselves and are challenged to develop each other's contributions or bring new ideas inspired by what appears in front of them. As in the previous group, a questionnaire was represented for each sub function. Each set lasted three minutes. When a full turn was completed the session ended and the ideas were presented to the group (Michanek & Breiler, 2007).

2.4.3 Combining and sorting solution alternatives

The following session was performed by the lead investigator of the project.

The ideas that did not meet the requirements in the product specification have been directly excluded. Subsequently, a ranking method modified from the cluster method that Michanek and Breiler (2007) describes in their book has been used to sort the remaining result. The ideas from each session have been sorted and grouped into categories, clusters, depending on their similarity. Thereafter they were weighted with either the grade one, three or five. The grade five represented the highest relevant solutions. All ideas with the grade one have been sorted out. Remaining ideas have again been sorted into clusters to then be combined into full solution concepts. According to Rodgers and Milton (2011) the process of selecting concepts is a narrowing and iterative process that does not have to generate a definitive solution immediately. In the project several iterations have been run until full concepts have been defined.

2.5 Concept selection

2.5.1 Sorting full solution concepts

Initially, the full solution concepts have been modified and updated. Further investigations have been made to find solutions that are possible to implement in consideration of manufacturing and surface treatments of different materials. According to Rodgers and Milton (2011) further research and modification of ideas can be necessary to fully satisfy the product

specification. When cleared, the full solution concepts have been sorted against the product specification and its requirements. Only those solutions that met all requirements have been passed.

To sort the outcome once more, screening occurred using the method of "three dots" (Michanek and Breiler, 2007). The process is simple and is based on voting. The ideas that are found to be the best on basis of three criteriums were chosen: a quick realizable idea, an innovative idea and an idea with great market potential. The method was conducted by the lead investigator and resulted in three final concepts. In addition to the concepts a wildcard was chosen. The wildcard was chosen to challenge the work and the employer's visions.

2.5.2 Visual tools

When generating ideas visualisation is a valuable tool to use. Österlin (2016) stated there are several advantages depending on which method is used. When visualising via sketches and pictures you can quickly communicate with others and simplify what is harder to understand by diffuse thoughts or advanced drawings. The sketching tool helps concretize loose ideas and make adjustments in contemporary time as the sketching takes place. This way changes can be made early in the process (Österlin, 2016). The writer states that mock-ups are even better than sketches when visualising, but he does also point out that sketches are easier to achieve.

Roam (2009) considers that one purpose of using the sketch as a communicative tool is to convey information quickly and easily. A major advantage of using the analogue method is that sketches are easy to correct; In case of new ideas or errors, these can be implemented or corrected as soon as they appear. The author also advocates the method as it is inviting the viewer through its expression of spontaneity as well as roughness comparatively with a "correct" digital image (Roam, 2009). Like Roam, Eissen and Steur (2015) mean that the sketching tool is useful when communication ideas and concepts. To determine the detail level of the sketch, they give the suggestion of reflecting on what phase in the design process that the sketch appears in and for whom the material will be presented (Eissen & Steur, 2015).

The top four concepts have been summarized via sketches. To further evaluate possible solutions a very simple mock-up has been used. The mock-up only involved the already known components and measurements and was used as an aid to visualize which concepts were possible to perform.

2.5.3 Final concept

The three highest valued solutions and the wildcard have been presented to the employer. The concepts were presented by sketches with complementary mood boards to convey a vision and feeling. The wildcard was only developed to a small extent since the intention was to offer another idea only if the employer so wished.

By evaluation among those concerned at Company X a definitive concept has been chosen to be continued with. When all the information had been converted into a final and definitive idea it was again cleared against the product specification. The product was again evaluated in the FMEA. Finally, the now modified concept was once more presented to Company X and approved to be continued with.

2.6 Configuration and prototype development

The focus for the phase is to provide information that supports a product with its correct use and function. The concept must meet all criteria in the product specification and present a working product. The phase is intended to gather the information needed to make this possible (Johannesson et al. 2013).

2.6.1 Sketches and physical prototype

The chosen concept has been described in detail and developed with exact measurements and layout. The appearance was ruled by the gathered information in the pre-study. Measurements and form were as well ruled by the already given measurements from Company X.

A simple prototype have been developed to test the final product against a smaller group of people. This was done to ensure that the product is perceived as intended in respect to ergonomics. The output from the testing was corrected in the prototype before facing the next moment.

2.6.2 3D model in CAD

The final concept has been compiled in a 3D model. The model has been constructed in the CAD-program PTC Creo and was made to be able to present the product in the most accurate way. After construction the prototype has been rendered in the program to have an correct visual concept to present. Final adjustments have been made in Photoshop.

3. Result

3.1 Project planning

The project plan is a dynamic document that has been updated continuously. To view the entire project plan, see Appendix A.

There are four concept objectives for the project:

- Design the product in a way that reflects and represents the company's brand.
- Design the product in respect to human ergonomics.
- Base the design on current trends.
- The project is estimated to take 600 hours and will be completed in June 2018.

The project model specifies the dates that apply for milestones, tollgates and end dates for the phases of the project. The model decides for how the process will be executed and how long each phase should be. The use of a WBS (see Appendix B) helps identifying the phases that will be included in the project.

The Gantt chart (see Appendix C) gives a good perspective over the respective phases time range. In the chart, it is borne in mind that lack of time can occur, leaving two weeks open for project implementation. New requirements are obtained by the employers halfway into the process, where these two weeks are used to compensate for the extra time since the time plan for the phases no longer is held.

The three biggest risks from the risk analysis can be seen in Table 1 together with the suggested action and risk factor.

Table 1 The three biggest risks from the risk analysis

Risk analysis	P	C	R	Suggested actions
Unable to create data due to confidentiality	3	5	15	Start report writing directly and regularly check written material with supervisor and employer
Time constrains (phases)	3	4	12	Fulfil project phases strictly
Final report is not completed on time	3	4	12	Start report writing directly and document continuously during the project

```
P = Probability (1-5) C = Consequence (1-5) R = Risk factor (PxC)
```

One risk, which can be seen in Table 2, from the risk analysis occurred. The risk has been addressed by the suggested action and have not lead to any major problems during the project.

^{1 =} low risk 5 = high risk

Table 2 The risks from the risk analysis that occur

Risk analysis	P	C	R	Suggested actions
Project ends before end date due to complications such as bankruptcy etc.	1	5	5	Continue as planned, if the company leaves itself completely mainly report the result to supervisor and examiner

3.2 Pre-study

3.2.1 Literature study

The pre-study has provided information on the implementation of the project and its methods, as reported in the methodology chapter. The remaining part of the literature study has focused on the design of the product as shown below.

Physical ergonomics

Our hand can be seen as a complex gripping tool especially suitable for work that demands precision. When designing a handheld tool these should be adjusted in respect of the human physical qualities and dimensions. As an underlying basis anthropometric data can be used which describes the human measurements, proportions, and reach. Reflecting on whom the user will be is of importance. In addition of measurements the sex of the user is as well of relevance. Mainly tools have been designed with the man as a norm, despite the development of female users that has become more of a normality. (Bohgard et al. 2015)

Bohgard et al. states that size, form, weight and body position should be considered when designing a handheld tool. Factors that should be examined are:

- Transmission of force and moment
- Comfort. The main principle says that the force from the hand should be distributed over as wide a surface as possible
- Control of the tool
- Minimize the risk of injury
- Form to indicate grip and force requirement

When considering weight aspects, usually you want the weight to be as low as possible to apply little load to the user. When considering weight aspects Bohgard et al. remind having in mind that the distribution of the weight is of equal importance. For example, the centre of gravity in the tool should in most cases as close to the wrist as possible. Regarding body position there are three focus areas: the back, the upper arm and the wrist. The main principle is to avoid bent and twisted positions as well as positioning leader in extreme positions. The wrist position is directly depending on the design of the tool. Thereby gripping areas should be designed so that the wrist position can be held as natural as possible (Bohgard et al. 2015).

Österlin (2016) means that the designer can never be thought of as the user, even if the designer can represent a part of the target group. Therefore, it is important to verify your design by facts based on user interviews, anthropometric data, mock-ups, prototypes etc. A

great design takes account to these aspects and adjust eventual errors that have occurred before product launch (Österlin, 2016)

Semiotics

The use of semiotics gives a basis for why certain decisions are made when designing, rather than creating based on one owns opinions, says Westholm (2002). The writer defines semiotics as study of signs. This does not mean that semiotics gestalt an object but in fact a relation. A sign in this meaning is a unit of expression and content. The term is divided in three branches: semantics, syntax and pragmatics. Pragmatics answer the question "In what context is the sign used?" and how the pragmatics of an object, sign, can differ depending on the context. The answer can relate to culture, time, surrounding etc. The syntax can be described as a relation between the sign itself in relation to other signs. Semantics stand for what the sign is communicating. There are four semantics functions developed by Rune Monö, says Westholm: to encourage, to express, to describe and to identify. The writer gives an example that a product can by its design encourage the user to see how the product feels. Attributes can describe the function and the design can express qualities such as "sporty" etc. Identification can be created using logotypes or a recurring design for a special brand (Westholm, 2002).

Wikström (2002) does as well mention the four semantic functions when discussing semiotics and states that they can be used as a model to control how well a product's message is communicated. How the product is presented should be connected to the company's business concept and the market. It is of relevance for a company to be consistent in their design related expression. This is to create a wholeness and unity that later will be identified by users, consumers etc. as the company's brand. When creating a new product that lacks precursor it is of extra importance that the product is given a simplicity that is natural for the viewer (Wikström, 2002).

Design language

According to Österlin (2016) the general impression is given by single shapes and lines and is strongly connected do how the viewer reads the object. Details are obvious at first sight, but when noticed details can both lead to confusion as well as creating a unity. Similar details form consistency and recognition. A messy design with a lot of different details with different forms on the other hand creates an impression of separation in the design (Österlin, 2016).

3.2.2 Stakeholder analysis

The identified stakeholders can be seen in Table 3. The employer and end user are the most influential stakeholders. Therefore, the two are mainly considered when deciding on the design and development of the product.

Table 3 Identified stakeholders

Stakeholders	Key stakeholder	Influence
Manufacturer	Yes	Large
Employer	Yes	Very large
Buyer	Yes	Large
Repairer	No	-
End user	Yes	Very large

3.2.3 User and trend analysis

The presented result is a summarize of the performed interviews. To view the entire material, see Appendix D. The summarize from the trend analysis can be seen in a visual model in Figure 2.

User analysis

By agreements with Company X, the interviewed in the user analysis have been informed by the unit's function.

From the two interviews several trends in the coffee industry are shown: new technology, technical elements and communication with the user via a screen or internet. Another trend is given by the fact that there is a new status in the barista industry, where the barista has a new role in the market as a coffee specialist. Customers are more insightful and discerning, which means that the so-called coffee expert needs to be more involved, which for example means being able to measure the degree of grinding. It requires fact-based knowledge that helps to increase the quality of the cup.

The interviewed state that potential end users of the product are almost everyone in the coffee industry, where the spectrum extends from waiters to the more skilled technician at a vending company. It is considered that the product will be used from once a year to each day depending on the user. The interviewees believe that it is important that the product is easy to carry and is stable. They prefer charging by battery, alternatively powerbank. They do also request a clear display/application as a complement to the product.

Trend analysis

In the interview with the high school teacher, it appears that environmental thinking, reused materials and heavy, restful colours influence today's trends. In terms of material metals and worn steel are considered as recurring trends. More specifically in kitchen trends, factors such as minimalism, honesty, simplicity and function are mentioned. Technical features are becoming increasingly relevant in kitchen furnishings. On the question of what is considered timeless solid wood is given as an example. Another timeless feature that is mentions is simplicity, clean lines, perfection of form, harmonies in every line in an object.

The other interviewee does also state that environmental thinking, recycled material and sustainability are relevant. Examples of natural materials like stone, wood and linen are mentioned when the question of today's trends emerges. In future trends, it is indicated that

the red colour scale will have more space, just like the graphic style. Light wood and the feeling of nature are considered as distinctive trends in kitchen interior. To express quality, it is stated that the most important thing to consider is the choice of materials. Wood and natural materials are considered as exclusive materials. To be timeless it is said to use bright colours.



Figure 2 Visual model - summarize of the outcome from the trend analysis

3.3 Product specification

The specification is updated several times during the project. The requirements from the employer are changed through the process where a material, material costs and a manufacturing method are given halfway into the project. These are deposited later when the client chooses to go in another direction.

3.3.1 Function analysis and criterion matrix

The function analysis is used as a complement to the product specification. Those functions that are not already included in the specification are added to the appropriate cell in the Olsson criterion matrix. The main function that is included in the function analysis will not be presented due to agreements with Company X.

The result ends in a complete product specification with 12 requirements and 14 desirable functions. The requirements can be seen below in Table 4. The whole analysis can be seen in Appendix E.

Table 4 The requirements from the product specification

Customer needs	Weight
Measurements component A	R
Measurements component B	R
Measurement distance component A to B	R
Should be safe to use	R
Represent the company's brand	R
Rechargeable	R
Comfortable to use physically	R
Easy to manage cognitively	R
Lightweight, should be easy to transport	R
Exclude light when used	R
Inform process	R
Be stabile when used	R

3.3.2 Failure mode and effects analysis

The FMEA results in 10 risks, see Appendix F. When updating the analysis for the chosen concept this fallouts in a lower RPN for all risks.

3.3.3 Visual theme and mood board

The two sets both contain a visual theme and a mood board. Figure 3 shows set A which represents Company X and its image. The set is to represent thought of what technology, quality and interesting shapes could be represented by. Orange is a recurring colour. The other set, B, is illustrated in Figure 4. Throughout the pictures, they are to reflect the trends that have emerged during the pre-study. Repeated for the set is wooden and metallic materials, calm and restful tones, brass details and kitchen interior. To see the sets in full scale, see Appendix G.



Figure 3 Visual theme and mood board, set A



Figure 4 Visual theme and mood board, set B

3.4 Generating concepts

3.4.1 Abstracting the problem and dividing it into sub functions

The broadening of the functional criteriums resulted in 9 subfunctions. The summary of the functions derives from Table 5 and reads: "A safe, qualitative and trendy product that represents the company. It should be easy to use and inform the process. During and after being used it should be clean".

Table 5 Broadening and abstraction of the functional criteriums

Crit.	Cell	Specification	Reformulated
nr.			
9	3.1	Design should be up to date	Design should be up to date
11	3.3	Represent the company's brand	Represent the company
12	4.1	Easy to clean	Clean when used
15	4.1	Express quality	Express quality
19	4.3	Comfortable to manage	Be ergonomic
		physically	
20	4.3	Inform process	Inform process
21	4.3	Easy to pack and unpack	Easy to set aside
22	4.3	Easy to manage cognitively	Simple to understand
23	4.3	Use should not lead to littering	Clean after used

3.4.2 Generating ideas

To facilitate the process, the sub-functions that are similar or can be combined are grouped. The features that do not require an entire idea generation session are left and resumed in the configuration phase, which leaves remaining sub functions:

- Express quality, design should be up to date and represent the company
- Be ergonomic and be easy to set aside
- Inform process and be simple to understand
- Clean during and after being used

These are generated about in the individual session performed by the lead investigator of the project. Those features that are considered to not get enough or good enough generated solutions are brought to the group sessions. These are the following:

- Be ergonomic and be easy to set aside
- Express quality and design should be up to date

3.4.3 Combining and sorting solution alternatives

Those solutions that do not match the requirements in the requirements specification are directly sorted out. Remaining ideas are combined into 12 full concepts.

3.5 Concept selection

3.5.1 Sorting full solution concepts

The top four concepts were named and are as follows:

- Concept nr 1 "The chamfer"
- Concept nr 2 "Hollow"
- Concept nr 9 "Stereo"
- Concept nr 10 "Wildcard"

To view sketches of the concepts, see Appendix H.

3.5.2 Visual tools

The mock-up in Figure 5 shows how long the link between two major components of the product need to be. To get the link as short as possible but still being able to open the hatch, a solution in concept nr 1 is found. The answer is chamfering one side of the product so that the hatch can be tilted as much as needed despite a shorter link. This modification means that more room is available for the hatch to open. The prototype also shows that concept number 9 needs to be modified to allow the hatch to open as desired. The found solution is to place the hatch in another position on the product, alternatively, creating space by using the solution given in concept 1.



Figure 5 Mock-up

3.5.3 Final concept

By discussion with the employer, the decision is made to continue with concept number 10. The concept is chosen since the choice of material together with the shape of the product is considered to express quality and exclusivity. The main materials in the product are aluminium (the chassis of the product) and wood (the unit's hatch). Since the company itself wants to choose the sort of wood to be used as well as how the mechanism for the hatch should be designed, the choice of these has been excluded.

The metal is to reflect a modern technical product. The purpose of the wooden material is to provide a sense of quality, reliability and create a connection to the nature. It is decided to design a box of the same sort of wood to the unit. The inside of the box will have a soft material for non-scratching the product.

3.6 Configuration and prototype development

3.6.1 Sketches and physical prototype

New sketches of the final concept are developed where several changes are made, see Figure 6. The hatch is moved from being centrally positioned to the end of the product to optimize the space for component placement. The design also gets a squarer shape than before, again to optimize the space in the product. Complementing the product, a tooling box is developed to ease transportation.

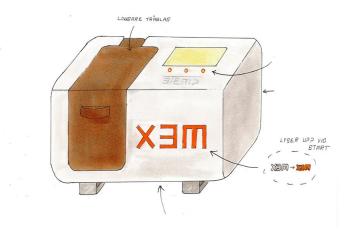


Figure 6 Sketch of the final concept

The dimensions are modified so that given components can fit in the device. They are also modified with ergonomics in mind: the product should be easy to grip, transport and give the expression of stability. To see which dimensions are suitable a prototype is used. In the first step the prototype only exemplifies the concepts outer shape so that the dimensions can be tested against a group of three persons. The size is considered appropriate of all individuals in the group and is therefore no further adjusted. The final dimensions of the unit are 100 mm (H) x 150 mm (W) x 110 mm (D).

The prototype is thereafter developed with its final detailing but due to sensitive material the remaining elements are not tested against any group. The prototype is instead used to ensure that the concept is well functioning, see Figure 7.

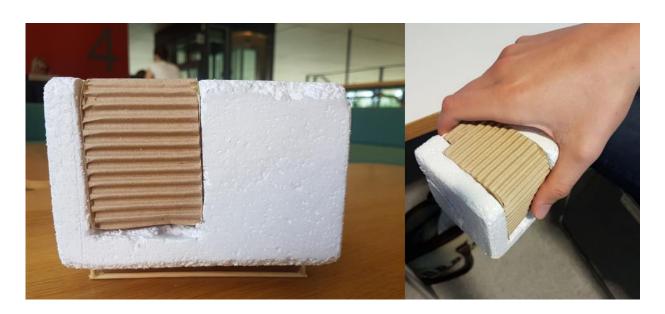


Figure 7 Prototype of the final concept

Symbols and effects are added to increase the product's cognitive ergonomics. These are as follows:

- The device's name will light up when the product is started to indicate when the product is running or not. The logo will light up in orange which is a common colour used within Company X's products. This to create identity between the product and the company brand.
- Below the display, touch buttons are added. These are icons that are to indicate different functions of the product. These will as well light up in orange when the product is running.
- Complimenting the product, a card with explanations of the icon's functions will follow
- The product logo is added to create identification with the company brand.

3.6.2 3D model in CAD

The model in Figure 8 shows the final concept. The model is developed with space for all of the technical components, however, they are not placed in the model since the employer has its own solution for the components exact placement. The model shows the product's chassis with the chosen materials, icons and logos. The device name is not displayed. In Figure 9 the tool box is shown. The model only shows the layout of the product and does not take in consideration which components are to be placed inside. Figure 10 illustrates the whole concept together with the following card that is to explain the icons on the product.



Figure 8 Rendering of the CAD model of the unit



Figure 9 Rendering of the CAD model of the tool box



Figure 10 Rendering of the final concept

4 Discussion

The purpose of the thesis has been to answer the problem formulation of how the unit should be designed to be attractive from a design perspective and promote human ergonomics while representing the company's brand. This while being easy to transport. In the development of the product great freedom has been given in terms of ergonomic aspects, design and construction. An important part of the product's exterior has been to reflect professionalism and quality. At the same time the product should be easy to handle, both cognitively and physically. In addition to these aspects an aim has been to develop a 3D-model.

Through the process the requirements from the employer have changed which has been of high relevance to the design of the process. Initially, the focus of the pre-study was on design and ergonomics. This was changed halfway into the process when the employer presented new requirements on material, cost and manufacturing method. An intensive study about the subjects had to be performed. With the new time press, no deep diving could be made within the subjects. A part of the outcome in the initial pre-study was eliminated since it no longer was relevant to the new requirement specification. Thus, a time-consuming detour is taken in the process. The new requirements also lead to that a new function analysis had to be made. As the new requirements were obtained when the idea generating phase already had begun, the time plan for the phases could no longer be kept. The new requirements also narrowed the process in question of creative space as well as outcome in number of concepts.

The product specification is developed thoroughly at the start of the project which gives the advantage of understanding the product's needs early in the process. As Johannesson et al. (2013) state, the major advantage of a project specification is that it can result in a shorter development time since you can make past and fewer adjustments. What becomes problematic is to meet all stakeholder's need and requirements, since the products is completely new in Company X's range and no specific users are known. This leads to the employer addressing some concerns that need to be considered at an early stage in the process. Therefore, the stakeholder analysis is of great help to chart which stakeholders and needs must be thought of. Thus, a central issue for the work becomes the cognitive understanding of the product. The device needs to be adapted to be managed independently of users at the same time as the product must express professionalism. As it appears from the interview with the technician/installer at Jobmeal in the user analysis, customers are more discerning when it comes to today's coffee. Due to that fact, this requires that the operator using the product needs to have a certain type of expertise. Therefore, it is important that the design reflects the relevance of the product's function in the process of coffee brewing. One thought that emerged during the individual idea generating session was to mimic other technical units that the customer can connect to technology and quality. As Norman means, emotions play a significant role when considering design. More than being aesthetically pleasing, design can awaken memories and create visions (Norman 2004). The combination of this thought, the trend and user analysis as well as a careful choice of material resulted in the four final concepts. The presentation of the concepts has benefited from the use of visual tools. Since such freedom is given in the project the prototype has worked as a very helpful tool when developing concepts and has facilitated to quickly see what solutions are possible

for components placement and dimensioning. As shown in the pre-study there is a great advantage of using sketches since it allows for implementing new ideas and adjustments directly (Roam 2009).

As the product is new to the market, a competitor analysis has not been possible to perform. Thus, the trend analysis was important for having a basis to base the design on. The visual themes and mood boards have been of great benefit to embrace Company X's own image. As Wikström (2002) says, a product's design should be connected to the company's business concept and the market. Having said that, in addition to the trend analysis, the design of concepts has been based on detailing that Company X uses today. Wikström also states that a product that lacks precursors must be kept simple in its design, which has been considered in the detail work of the definitive concept.

In this work, the sessions of idea generating did not reach the desired outcome. The sessions resulted in very similar ideas that the individual moment (implemented by the lead investigator) resulted in. One reason for this is that the areas to be generated around had to be kept very general as the function of the product could not be revealed. An option was to implement the moment only with people from Company X. However, this could result in a narrower width of the outcome. According to a study performed by Stieglitz and Hassannia (2016) the result points to that external users create a higher number of valuable ideas in total. With this knowledge, an attempt was made to implement the moment with people independent of the project with very abstract problem formulations. In a new attempt it would be more efficient to introduce the areas in relation to a product with a similar function. This to increase the understanding of the participants and direct the result towards the desired outcome.

One challenge in the project has been to measure how well the products design and ergonomics are fulfilled. Despite a pre-study of design and trends, the result is an interpretation since design is not something definite and perceived to be similar for all viewers. To avoid subjective assumptions in the design of the product, it has been crucial to perform the user analysis with possible users and to present several concepts for the employer. As confirmed by Rodgers and Milton (2011), it is important to engage stakeholders to circumvent a subjective assessment of which solution is the most appropriate. To strengthen the design of the product further, it would be beneficial for the product to be tested against a larger number of people to optimize the result. Although the concept was evaluated by a group of people, it would be interesting to test it against a group that has no relation to the project, since it could have given a new angle of approach when it comes to use and function. Users who are familiar with the technology behind the product have a reduced tendency to generate radical ideas, which may result in fewer ground-breaking solutions being presented (Magnusson, 2009).

As a major part of the pre-study focused on trends and design, a decision was made to present a so-called wildcard to take advantage of the information developed despite the new requirements. The concept did not meet the new material and cost requirements but was included to offer the employer something they may not be aware of that they want. The fact that the wildcard was chosen as a final choice depends (among other things) on the fact that

the client believes there is a space to sell a so-called "luxury model" in a smaller edition. With the chosen concept, the relevance of the pre-study and the issue of the work increases, as these can once again be considered to a greater extent. However, in the configuration phase there is no time left to develop the concept in detail for manufacturing. Therefore, manufacturing should be considered in further if developing the concept.

As mentioned earlier, the time pressure put on the project is mainly due to the dual work which emerged with new requirements. The process of product development is iterative and the loops that the process has demanded have generated better solutions for the final concept. The process has been adapted to the products need and the requirements from the employer. It would be of interest to have additional time for further tests against possible users, development of the design for manufacturing and to obtain an approximate production cost. Despite the exclusion of these matters, the process has not been damaged as these are factors that can be considered at a later stage, which both project executive and employer have established.

5 Conclusions

The objectives for the project have been met, which is evaluated by the supervisor and employer, and the employer wishes to bring the concept into the next step in the process. The product's design is based on the pre-study, the company's image and evaluations made using a prototype. Material and form are based on the trend and user analyses that have been performed. In addition to the analyses, the size of the unit is supported by the pre-study made to benefit ergonomic aspects.

To strengthen the operator's credibility, the design must express the product's technical role and professionalism. The product has a central and technical role to enhance the quality of a brewed cup of coffee and it is of importance that the customer can see this. The products design reflects these aspects and is a suggestion of how an exclusive variant of the product may look. The product is designed to reflect the pre-study. The size of the device is selected to be ergonomically easy to handle and grip. The dimensioning is also motivated by the thought of giving a solid and stable expression. Given components are placed in consideration that all areas should be easy to access for cleaning. The surface is held smooth for the same reason. The main materials of the product are aluminium and wood. The resulting tooling box is designed to be ergonomically sound. The leather handle will make it comfortable to carry the box and the size allows the product to be easily transported.

The process of this type of product requires an understanding that the product does not work in isolation but acts in a context. In addition to its function, it acts as a service both for operator and customer by generating an experience. Today's coffee and barista industry offer more than just receiving a cup of coffee, where identity and trends are important in addition to the taste of the cup itself.

The product does not have a specific user group since it will be used by people with varied experiences in the coffee industry. Depending on user, the usage frequency will differ from being used once a year to each day. The cognitive attributes of the product are held simple due to these facts so that the unit will be easy to handle regardless of user.

If further developing the product following should be investigated:

- Component placement of the technology in the product
- Selection of type of wood to the unit's hatch
- Development of the opening mechanism to the hatch
- Cost of materials and manufacturing
- Further development of the tool box for the unit

Acknowledgments

I would like to express my sincere thanks to my employer for the opportunity to perform this project. The work has given new moments of learning and the opportunity to develop the knowledge given during my education.

A big thank you to my supervisor Lennart Wihk for offering your knowledge and encouragement. Suitable for the report, I would also like to thank for the coffee at our tutorial meetings!

Not least, I would like to give thanks to those who interviewed. Your contribution has brought great value to my work.

References

Articles

Magnusson, P. (2009). Exploring the Contributions of Involving Ordinary Users in Ideation of Technology-Based Services. *The Journal of product innovation management*, 26(5), 578-593. https://doi.org/10.1111/j.1540-5885.2009.00684.x

Scipioni, A., Saccarola, G., Centazzo A., & Arena, F. (2002). FMEA methodology design, implementation and integration with HACCP system in a food company. *Food control*, 13(8), 495-501. https://doi.org/10.1016/S0956-7135(02)00029-4

Books

Bohgard, M., Karlsson, S., Lovén, E., Mikaelsson, L., Mårtensson, L., Osvalder, A., & ... Ulfvengren, P. (2015). *Arbete och teknik på människans villkor*. Stockholm: Prevent.

Eissen, K & Steur, R. Sketching - The Basics. The Netherlands: BIS Publishers, 2015.

Eriksson, M. Lilliesköld, J. (2004). Handbok för mindre projekt. Stockholm: Liber AB.

Jansson, T. Ljung, L. (2004) *Projektledningsmetodik*. Lund: Studentlitteratur AB.

Johannesson, H., Persson, J. & Pettersson, D. (2013). *Produktutveckling – effektiva metoder för konstruktion och design*. Stockholm: Liber AB.

Landqvist, J., 1994. Vilda idéer och djuplodande analys. Stockholm: Carlsson bokförlag.

Michanek, J., & Breiler, A. (2007). *Idéagenten 2.0: en handbok i idea management*. Jönköping: Bookhouse Publishing.

Norman, D.A. (2004). *Emotional design: why we love (or hate) everyday things.* New York: Basic Books.

Roam, Dan. *The Back of the Napkin: Solving Problems and Selling Ideas with Pictures*. London: Marshall Cavendish, 2009.

Rodgers, P., & Milton, A. (2011). *Product design*. London: Laurence King Publishing

Österlin, K. (2016). Design i fokus: varför ser saker ut som de gör? Stockholm: Liber AB.

Conference proceeding papers

Stieglitz, S., & Hassannia, S. (2016). *Idea Generation by Employees and External Participants in Innovation Competitions*. Paper presented at the 2016 49th Hawaii International Conference on System Sciences (HICSS) System Sciences (HICSS), 2014 47th Hawaii International Conference on System Sciences (HICSS), 2016 49th Hawaii International Conference. Koloa, HI, USA, January 5-8.

Electronic sources

Design Council (2015). *The Design Process: What is the Double Diamond?*https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond [2018-06-12]

Reports

Westholm, A. (2002) Produktsemiotik idag: Vad är det? Hur används det? Varför är det viktigt? Var kan man läsa mer? : En bred genomlysning av ämnet produktsemiotik. Institutionen för industridesign, Konstfack.

Appendix A – Project plan 2.1

Project plan

This project is executed along with the course Degree of Bachelor of Science in innovation and design engineering, MSGC12. The project takes part at the faculty of Health, Science and Technology at Karlstad University during the spring term 2018 and includes 22.5 credit points. The supervisor of the project is Lennart Wihk and the examiner is Leo de Vin.

The project is done in relationship with a company that will not be mentioned in the report due to valuable material.

1. Background

Today operators are needed to help staff in the café- and barista industry to control and adjust variables that affect the outcome and quality of technical devices. To simplify the procedure, decrease setup time and control various variables connected to quality of provisions there is a need for simple aid that the everyday user can be able to control. To exchange the user from operator to e.g. a barista it is of importance that the aid is stating a professional expression. This to maintain the importance and relevance of having the right settings when creating quality. Thus, the product must be simple enough for the unprofessional user to without greater knowledge of the technology be able to make the right adjustments. This means the product must express credibility even when simplified.

The project plan is based on the course syllabus and "Handbok för mindre project" (Eriksson & Lilliesköld, 2004).

2. Objectives

2.1Problem

How should the product be designed to be considered attractive from a design perspective, promote human ergonomics and be easy to carry while representing the company's brand?

2.2Project objectives

The objective for the project is to develop the product concept in respect of aesthetics and ergonomics. This by scientific methods learned during the education. For this project this means that the thesis will be implemented by methods from the process of product development described by Eriksson and Lilliesköld (2004). The process includes a pre-study, a requirements specification, concept generating, concept selection, configuration and prototype development.

To answer the problem human ergonomics will be investigated and a study regarding product semiotics will be performed. Also a few simple prototypes will be tested and voted against the problem formulation. At the final presentation a Computer-Aided design (CAD) will be presented.

2.3 Concept objectives

The objectives for the concept are as follows:

- Design the product in a way that represents the company brand.
- Design the product in respect to human ergonomics.

- Base the design on current trends.
- The project is estimated to take 600 hours and will be completed in June 2018.

3. Organisation

Project executive

Maria Grahn Karlstad mariagrahn@live.se

Supervisor

Lennart Wihk Karlstad University Faculty of Health, Science and Technology 21 E 214

Examiner

Leo de Vin Karlstad University Faculty of Health, Science and Technology 21F 277

4. Project model

Project phase	Milestone	Tollgate	End date	Responsible
Project planning	Project plan done		09/02/2018	Maria Grahn
		Project plan approved		Supervisor Examiner Employer
Pre-study		Methodology approved	19/03/2018	Supervisor Examiner
Requirements specification	Requirements specification done		20/03/2018	Maria Grahn
		Requirements specification approved		Employer
Concept generation	Selection of at minimum 3 concepts done		01/04/2018	
Concept selection	Choice of final concept done		08/04/2018	Maria Grahn
		Concept selection approved		Employer

Configuration	Configuration material specified		17/04/2018	Maria Grahn
Prototyping and testing	Testing done		26/04/2018	Maria Grahn
Final construction	Final construction updated and finished		13/05/2018	Maria Grahn
		Final construction approved		Employer
Documentation	Report draft done		25/05/2018	Maria Grahn
		Report approved for opposition		Supervisor Examiner
Presentation and exhibition	Presentation and exhibition material done		31/05/2018 + 01/06/2018	Maria Grahn
Opposition			07/06/2018 + 08/06/2018	Maria Grahn
Report adjustments	Report done		18/06/2018	
		Report approved		Supervisor Examiner Employer

5. Comments to time plan

The project model only specifies end dates for each phase; for an overview of the phases extent a Gantt chart has been made and can be seen in appendix 2. A Work Breakdown Structure (WBS) was developed to present the phases of the project, se appendix 3.

Since de process of product development is an iterative process the project plan will work as a dynamic document and might be updated several times during the project.

6. Risk assessment

Risk analysis	P	C	R	Suggested action
Time constrains (phases)	3	4	12	Fulfil project phases strictly
Employer is absent	2	3	6	Ask for a contact person at the company
Lack of information	2	3	6	Ask for help by employer and supervisor, search for information at the university library
Lost documentation	2	5	10	Back up regularly
Project becomes too extensive	2	3	6	Set clear delimitations
Final report is not completed on time	3	4	12	Start report writing directly and document continuously during the project
Unable to create data due to confidentiality	3	5	15	Start report writing directly and regularly check written material with supervisor and employer
Unable to reach project- and/or concept objectives	2	5	10	Regularly check the objectives and set clear delimitations
The project is not approved/does not reach coarse objectives	2	5	10	Continuous follow-up with supervisor and employer
Illness/absence	2	3	6	Put a lot of work into the work from start to have a buffer
Project ends before end date due to complications such as bankruptcy etc.	1	5	5	Continue as planned, if the company leaves itself completely mainly report the result to supervisor and examiner

P = Probability (1-5) C = Consequence (1-5) R=Risk factor (PxC)

1 = low risk 5 = high risk

7. Document managements

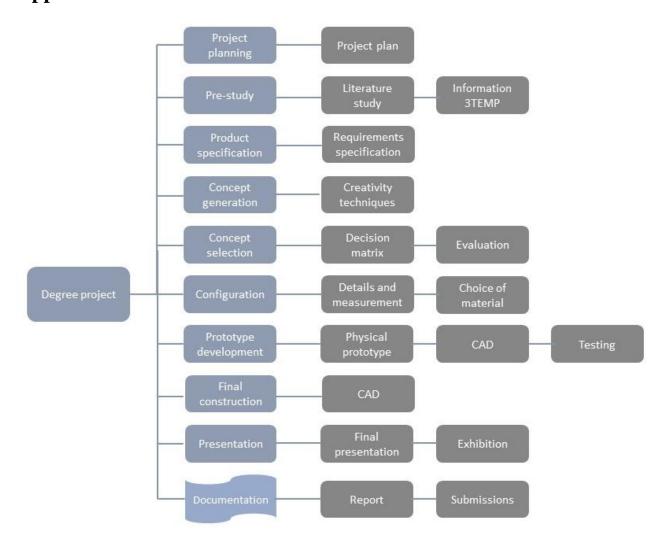
The documentation complies with academic report methodology and reference management according to the Harvard method.

All documents will be named after project phase and with a version number; 1.1.1.2 etc. In case of major changes, the version number will be updated to the next single, 2.0, 3.0 etc. A project diary will be filled in daily to avoid losing valuable information.

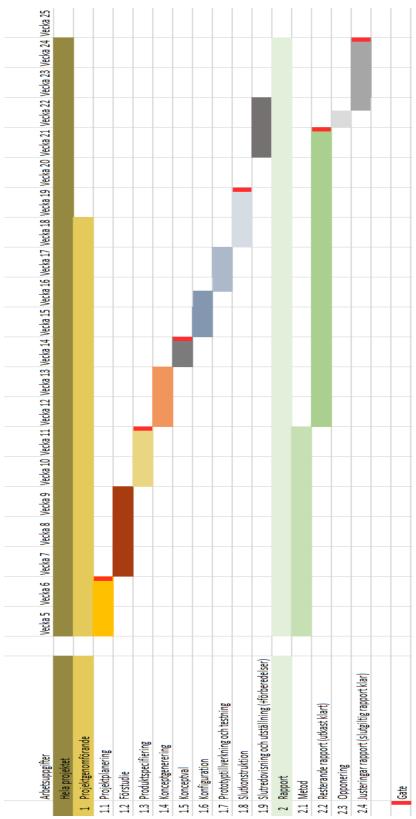
The documents will be written on a personal computer and will also be downloaded to a USB to increase accessibility regardless of workplace. The double documentation will also minimize the risk of losing material. Report material will also be uploaded on the platform It's Learning sporadically through the project.

Communication with supervisor and examiner is mainly via email and telephone, but also via It's Learning. Communication with the employer will mainly occur via email and telephone.

Appendix B - WBS



Appendix C – Gantt chart



Appendix D – Interviews user and trend analysis

Interviews trend analysis

Interview with high school teacher at Karlstad-Hammarö gymnasieförvaltning

Vad har du för erfarenheter inom design- och inredningsbranschen?

Privat så har jag ett stort intresse. Just nu inreder jag ett stort hus som vi ska flytta till t.ex. Det är ett hus från 1850-talet där jag vill behålla det traditionella i huset men samtidigt sätta dit en tvist. Professionellt har jag jobbat som lärare i design i teknikprogrammet här i Karlstad i 18 år. Jag har en utbildning inom industridesign från HDK.

Ser du någon trend som utmärker sig dagsläget? Någon trend i material?

Något som jag anser är återkommande idag är återanvända material, miljötänk. Även s.k. "fejk" material, t.ex. att man imiterar marmor. Just nu är det aktuellt med mycket färg. Gärna lugna, tunga, kraftiga, vilsamma färger. Färger som mossfärgat, mörkgrå/blå, plommon. Mättade smutsade färger ser man mer och mer av idag. Återkommande material nu senast på möbelmässan var metall - mässing och koppar är fortfarande stort. Även slitet stål.

Finns det någon utmärkande trend inom köksinredning?

I kök så anser jag att man är ute efter en ärlig design. Funktionalism blir alltmer trendigt, kolla upp shakerkök t.ex. Det ska vara ordning och reda, minimalistiskt. Enkelhet, ärlighet och funktion. Det är även inne med tekniskt funktionella finesser. Något som jag sett är kökslådor med LED-lampor inuti för att ta ett exempel.

Vilka faktorer anser du uttrycker kvalité respektive exklusivitet?

Det är svårt att svara på, att skapa kvalité kräver kunskap och medvetenhet. Man bör ha koll på trender, men trender kan även vara väldigt ytliga.

Vad är tidlöst?

Rent spontant tänker jag på den lilla svarta. Det gäller i och för sig kläder, men den står för något som är korrekt i alla sammanhang. Annars skulle jag säga massivt trä. Ett annat exempel är kalksten från Kinnekulle som är ett klassigt, gediget svenskt material. Känslan i kvaliteten på ett material är också viktigt, behandling av ytor. Återigen enkelhet, less is more. Jag tänker på rena linjer, något som är formfulländat, att det finns harmonier i varenda linjeföring. Som när man ser på en vacker sko med en fin form, ett hus med vacker taklutning kombinerat med rätt höjd mellan fönstren. Harmonier helt enkelt.

Interview with decorator at ByBon interiör

Ser du någon trend som utmärker sig dagsläget? Någon trend i material?

Den största trenden är nog fortsatt miljötänk och hållbarhet, det kan vara material som är återvunnet eller svanenmärkta möbler. Naturmaterial som sten, trä och lin är väldigt trendigt. Rosa är nog den färg som man ser mest nu, på allt ifrån textilier, möbler och väggfärg. Sammet är materialet som hägrar.

Ser du någon antydning på kommande trender?

Den röda färgskalan kommer man se mer av. Popkonsten är på väg tillbaka och den grafiska stilen kommer nog utmärka sig mer och mer.

Finns det någon utmärkande trend inom köksinredning?

Ljust trä kommer man se mer och mer, känslan som för tankarna till naturen.

Vilka faktorer anser du uttrycker kvalité respektive exklusivitet?

Materialval är viktigast. Linne och sammet är både lyxigt och håller bra kvalité. Trä är gediget och kan bli snyggare med åren. Även här är det oftast naturliga material som utmärker sig och känns mest exklusivt.

Vad är tidlöst?

Ljusa färger är alltid tidlöst. Vill man ha ett tidlöst hem så ska man nog undvika trenderna, ta in nåt mindre bara.

Interviews user analysis

Interview with Key Account Manager at Löfbergs NO

Vad har du för erfarenheter inom kaffe-branschen?

Jeg jobbet for løfbergs i Norge fra 2000 til 2010. Deretter sluttet jeg og jobbet i 4 år med salg av kaffemaskiner før jeg igjen startet opp i løfbergs i Norge. I hele perioden har jeg primært jobbet med kunder innenfor Out of Home og KBS (kiosk og bensinstasjon).

Finns det någon uppenbar trend som du ser bland de produkter som används inom baristaoch cafébranschen? Inom t.ex. material, teknik?

Jeg mener det er tydelig trend blant maskin leverandørene at ny teknologi stadig mer blir integrert i helautoamtiske kaffe/espresso maskiner. Dette blir blant annet brukt til fjernovervåkning av de tekniske elementene, tracking av salg, kommunikasjon med brukeren via skjermer og internett, justering av kverner automatisk med mer. Når det gjelder baristaen har jo dem de siste årene fått en helt nye rolle som kaffespesialist noe som også viser seg i at statusen i yrket har hevet seg mange nivåer. Jeg opplever også et stadig økende fokus på design, funksjonalitet i både produkt og emballasje og ikke minst et mye større fokus på miljøvennlige løsninger i alle deler av verdikjeden. Samt at den generelle diskusjonen i bransjen nå er mer faktabasert som en følge at vi har fått bedre utstyr som for eksempel refraktometer og ikke minst mer og bedre opplæring.

Ser du någon överlägsen, uppenbar användare av dem som kan tänkas använda produkten?

Usikker på om jeg tolker spørsmålet ditt riktig men det er klart alle som har ansvar for kalibrering av maskiner/kverner kan ha stor nytte og glede av dette produktet. Faktabasert kunnskap knyttet til riktig malingsgrad vil jo heve kvaliteten på den ferdige koppen betraktelig og det er veldig bra.

Hur ofta anser du att det skulle finnas behov av att använda produkten? Används den i olika mängd beroende på användargrupp?

En serviceteknikker i et vendig selskap vil nok ha behov for dette daglig. Om jeg tar

utgangspunkt i meg selv vil jeg ha nytte av det i forbindelse årlige kvalitetskontroller hos kundene våre som for eksempel Circle K med flere. I tillegg vil jeg har glede av det når det skal settes nye resepter på maskiner og utstyr. Så konkret tror jeg dette kommer til å bli brukt ulikt avhengig av hvordan rolle den enkelte har og type selskap man jobber i.

Om du skulle använda dig av produkten, hade du helst sett att produkten ... (ange gärna motivering till dina val)

...laddas via powerbank, batterier, vägguttag eller USB-C?

Jeg skulle foretrekke powerbank alternativt vanlige batterier. Dette mener jeg er den mest fleksible løsningen.

...styrs via platta, display på produkten eller app i telefonen?

En App i telefonen tror jeg vil være det beste men det handler jo selvsagt mye om hvordan bruker grensesnittet blir, men display på produktet kan også være en god løsning da dette ikke krever at du er avhengig av internett tilgang på mobilen. Og selv om det stort sett er dekning de fleste steder kan det fortsatt by på utfordringer.

...är stationär eller går att paketeras ned och eventuellt ställas undan?

At produktet er mobilt er et veldig stort pluss så og gjøre dette stasjonært tror jeg er en dårlig løsning.

Interview with Technician and installer at Johneal

Vad har du för erfarenheter inom kaffe-branschen?

Jag jobbar på ett Vendingföretag (Jobmeal) i 18 år.

Ansvarig för alla installationer av kaffeautomater och kaffesmaker.

Finns det någon uppenbar trend som du ser bland de produkter som används inom baristaoch cafébranschen? Inom t.ex. material, teknik?

Kanske ingen uppenbar trend men kunderna blir mer kunniga och kräsna. Som installatör och så kallad kaffeexpert så måste man ligga steget före. Så alla hjälpmedel är välkomna.

Ser du någon överlägsen, uppenbar användare av dem som kan tänkas använda produkten?

Vendingföretag, restauranger, kafferosterier och kanske även privatpersoner.

Hur ofta anser du att det skulle finnas behov av att använda produkten? Används den i olika mängd beroende på användargrupp?

Jag som Tekniker/Installatör skulle använda produkten varje dag. Även restauranger bör använda den dagligen.

Om du skulle använda dig av produkten, hade du helst sett att produkten ... (ange gärna motivering till dina val)

- ...laddas via powerbank, batterier, vägguttag eller USB-C? ...styrs via platta, display på produkten eller app i telefonen?
- ...är stationär eller går att paketeras ned och eventuellt ställas undan?

Den ska vara smidig att ta med gärna stöttålig också. Gärna batteristyrning med tydlig display.

Appendix E – Product specification 2.2

Life cycle		Asp	ects	
phase	Process	Environment	Human	Economy
Construction	1.1	1.2	1.3	1.4
Manufacturing	2.1	2.2	2.3	2.4
Distribution	3.1	3.2	3.3	3.4
Usage	4.1	4.2	4.3	4.4
Elimination	5.1	5.2	5.3	5.4

Criterium number	Cell	Criterium	R/P	F/L
1.	1.1	Measurements disc	R	L
2.	1.1	Measurements lamp	R	L
3.	1.1	Measurement distance disc and lamp	R	L
4.	1.2	Material should not be in contact with water	P5	L
5.	1.2	Material that eventually is in contact with water should have good corrosion resistance	P5	L
6.	1.3	Should be safe to use	R	L
7.	3.1	Avoid special components	P4	L
8.	3.1	Design should be up to date	P5	F
9.	3.3	Represent the company's brand	R	F
10.	4.1	Easy to clean	P4	F
11.	4.1	Be managed by display/tablet	P5	L
12.	4.1	Rechargeable	R	L
13.	4.1	Express quality	P4	F
14.	4.1	Ease installation	Р3	L
15.	4.1	Exclude light when used	R	L
16.	4.1	Be stabile when used	R	L
17.	4.3	Comfortable to manage physically	R	F
18.	4.3	Inform process	R	F

19.	4.3	Easy to pack and unpack	P5	F
20.	4.3	Aesthetically pleasing box	P4	F
21.	4-3	Ergonomic box	P4	F
22.	4.3	Easy to manage cognitively	R	F
23.	4.3	Use should not lead to littering	P3	F
24.	4.3	Lightweight, should be easy to transport	R	L
25.	5.1	Specific components should be easy to replace	P4	L
26.	5.2	Recyclable material	P3	L

R = Requirement F = Function P = Preference (1-5) L = Limitation

When ranked

Customer needs	Weight
Measurements component A	R
Measurements component B	R
Measurement distance component A to B	R
Should be safe to use	R
Represent the company's brand	R
Rechargeable	R
Comfortable to use physically	R
Easy to manage cognitively	R
Lightweight, should be easy to transport	R
Exclude light when used	R
Inform process	R
Be stabile when used	R
Material should not be in contact with water	5
Material that eventually is in contact with water should have good corrosion resistance	5
Design should be up to date	5
Express quality	5
Be managed by display/tablet	5
Easy to pack and unpack	5
Avoid special components	4
Specific components should be easy to replace	4
Aesthetically pleasing box	4

Ergonomic box	4
Easy to clean	4
Use should not lead to littering	3
Recyclable material	3
Ease installation	3

Appendix F – FMEA 1.2

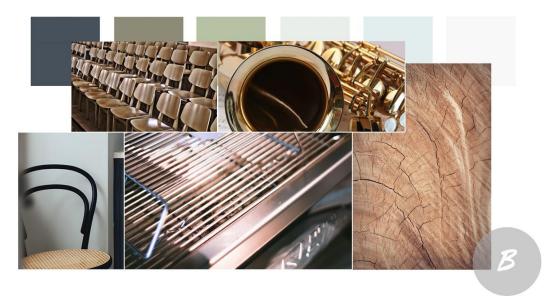
FMEA - Failure mode and effects analysis

Pro	ject: Bach	Project: Bachelor thesis	1.2	Dat	e: 201	Date: 2018-05-03	03							
					CURRENT STATE	r STATE						AFTER REC. ACTION	ACTION	
QI	NAME	FUNCTION	POTENTIAL FAILURES	S	0	Q	RPN	RECOMMENDED ACTIONS	RESP.	END DATE	S	0	O	RPN
1	Door	Keep dark	Light is let in	9	4	1	24	Verify measurements	MG	v. 17	9	1	1	9
2	Door	Keep dark	Shakes when closed	9	10	1	09	Construct stable device	MG	v. 17	9	4	1	24
3	Plate	Place content	Leaves rests of coffee	9	4	4	96	Material should be easy to clean, plane surfaces	MG	v. 17	9	4	1	24
4	Plate	Place content	Is not placed in required distance	4	4	1	16	Verify measurements	MG	v. 17	4	1	1	4
2	Charger	Charge unit	Discharged unit, lack of equipment	9	4	4	96	Charger should have space in packaging	MG	v. 17	9	1	4	24
9	Display	Give information	Is not understandable	4	4	4	64	Simple and understanable feature names	MG	v. 17	4	1	1	4
7	Display	Give information	Is used incorrectly	4	4	4	64	Clear instructions	MG	v. 17	4	1	1	4
8	Display	Give information	The surface is schratched	1	1	4	4	Protcetion around display/soft material in box	MG	v. 17	1	1	4	4
6	Unit	Measure variables	Corrodes	1	4	9	24	Korrisionsfritt material där kontakt med vatten finns	MG	v. 17	1	4	1	4
10	Unit	Measure variables	Is hard to transport	4	1	2	20	Light weight, ergonomic transport box	MG	v. 17	4	1	1	4
_									_					



Appendix G-Mood boards and visual themes







Appendix H – Top four concepts



Figure 1 Concept nr 9 "Stereo"

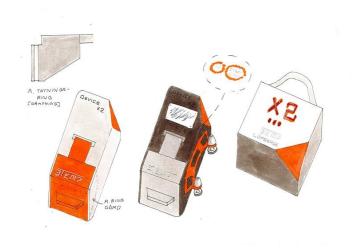


Figure 2 Concept nr 1 "The chamfer"

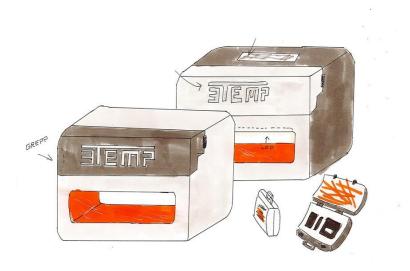


Figure 3 Concept nr 2 "Hollow"

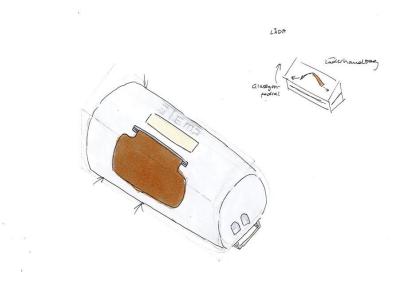


Figure 4 Concept nr 10 "Wildcard"