



JÖNKÖPING UNIVERSITY

industriDESIGN

Screen for the modern workplace

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MASTERTHESIS 2016
Master in Product Development with a specialization
INDUSTRIAL DESIGN



JÖNKÖPING UNIVERSITY

Avskärma den moderna arbetsplatsen

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This degree project is performed at the School of Engineering in Jönköping in the subject field Industrial Design. The project is a result of the master program Industrial Design. The writers are responsible of the result, conclusions and reflections.

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Extent: 30 points (D-level)

Date: 15/06/2016

Filing number:

Abstract

The goal of this project is to solve the need for screening at modern workplaces. The problem occurs in offices where many employees work at the same table. The employees sit and work close to each other which creates a bad work atmosphere according to sound level.

The solution is a screen placed on the table between the employees. To improve the atmosphere both acoustic absorption and visual screening is required. Other requirements are that the screen have to fit the company's style, have to be possible to produce, stand stable, have a high level of design. To have a high level of design means that it should look good, all details and parts should be well thought thru and the functions should work very well.

The idea comes from the furniture company Ragnars, which is a company producing premium office furniture, located in Forserum. They need a product like this thou they sell tables to offices which have the described problem. To be able to offer a solution for their costumers would gain the business.

The report explains the way how the screen has been developed from idea to final prototype. The development process goes thru many steps and methods. The methods used are applying design thinking, ergonomic studies, acoustic science and different types of testing. The process is iterative. An iterative process is when the work path goes in a spiral instead of a straight line. When iterating, new ideas generates and gets refined over and over again, better result will then be achieved.

The result is a screen made of felt that stands on the table. The screen has the possibility to quickly be moved and stored at a hanger or a shelf at the wall. The dimensions of the screen are optimized according to the standard size of workplaces and human anthropometry. The shapes and colors of the screen are chose to fit the company's assortment and at the same time modern architecture and modern trends. The screen provides sound absorption due the thickness and internal material.

Quick and easy usage of the screen were a main part of the design. This have been developed and tested thru prototypes and the result fulfills the need. Another main focus was to make the design as simple and clean as possible. During the whole process the components and shapes have ben simplified as much as possible.

The report explains all features of the product and how all decisions have been made. The process can be followed in a chronologic and easy way.

Sammanfattning

Målet med projektet var att lösa problemet med avskärmning på moderna arbetsplatser. Problemet uppstår på kontor där flera anställda arbetar vid samma bord. De anställda sitter nära varandra vilket skapar en dålig arbetsmiljö med avseende på ljudnivå och koncentrationsförmåga.

Lösningen på problemet är en avskärmare placerad på bordet mellan de anställda. För att förbättra miljön krävs både ljudabsorption samt insynsskydd. Andra krav på produkten är att den måste passa in i företagets sortiment, var möjlig att tillverka, stå stabilt och ha en designhöjd. Att ha en designhöjd betyder att den ska se bra ut, alla detaljer ska vara väl genomtänkta och alla funktioner ska fungera optimalt.

Idén över skärmen kommer från möbelföretaget Ragnars. Ragnars är ett företag i Forserum som tillverkar och säljer premiumkontorsmöbler. De behöver en produkt som den här eftersom de säljer bord till kunder som har det beskrivna problemet. Att kunna erbjuda en helhetslösning för kunderna hade gynnat företaget.

Rapporten tar upp och förklarar vägen över hur avskärmaren har utvecklats från ide till färdig produkt. Processen sträcker sig över flera steg och metoder. De använda metoderna erbjuder design tänkande, ergonomi studier, akustikvetenskap och olika typer av testning. Processen har följt en iterativ process där arbetet går i loopar istället för i ett rakt spår. Vid iterationerna utvecklas och förfinas idéer vilket leder till att ett bättre och mer genomarbetat resultat nås.

Resultatet är en avskärmare tillverkad av filt som står på bordet. Skärmen kan snabbt och enkelt flyttas och förvaras hängande eller stående på en vägg. Dimensionerna på skärmen är avpassade efter standardmått på arbetsplatser och antropometriska mått på människor. Formerna och färgerna är valda för att matcha företagets sortiment och värderingar samt att passa in i de moderna trenderna inom möbelbranschen och modern arkitektur. Skärmen kan absorbera ljud tack vare tjockleken och det absorberande materialet.

Snabb och enkel användning har varit ledord under hela utvecklingsarbetet vilket har verifierats med prototyper och tester, detta har gjort att resultatet lever upp till förväntningarna. Ett annat ledord har varit att förenkla designen. Detta har gjorts genom att alla former och delar har skalats av och förenklats så långt det gått.

Rapporten förklarar alla delar och designelement av produkten och hur alla beslut har tagits. Processen kan genom rapporten följas på ett kronologiskt och enkelt vis.

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1 Introduction

1.1 The company

The project is made in corporation with the furniture company, Ragnars. Ragnars design, produce and sell office furniture. The company was founded in the 1950s, today they have 40 employees and is located in Forserum, just outside Jönköping, Sweden, with a turnover of 9 million euros. [1]

Ragnars produce workstations, work towers, cabinets, seating etc. The products are organized in a system with numbers from 1-5. The product gets a number which indicates which class it is in, 1 is the lowest and 5 the highest. A product with a 1 is cheap and it does what you expect and no more. If the product has a 5 the price is higher, the material is exclusive selected and there are integrated functions that gives the product a higher value. There is also some product with a 6 which means that everything on the product is absolutely of the highest class. Ragnars don't have nothing under a 3. This system is an internal system which were described by the contact person.

Function and quality in the products is important for Ragnars. They are always trying to find the real need in a product to make the solution to last long. For the solutions to last long it's important that the design is timeless and the material is durable. The material is also chosen with minimal environmental impact and has to be recyclable. [1]

1.2 Background

The project has its root in the changes of modern workplaces. The modern workspace is tending to move away from traditional big desks in a private office. The modern way of working is to use big tables in open rooms where the employees have to share the space. [2] The tables get crowded and noisy which cause the problem the project is aiming to solve. See Figure 1. To make people to work and feel better while working, there is a need for screening between the workers. The table screen should absorb sound to make the sound environment better. The screen works also as a small wall where the worker won't be disturbed by glances or moving people. The problem is important because everyone want to feel focused and not to be disturbed when working. The modern way of working in groups does also requires whole groups to be screened of.

There are already products on the market that solves this problem, which means that the focus of the project will be to apply the company's form language and to make the product to work better. The company doesn't have the product in their assortment yet but they have a need for it thou they sell workplaces like the one described above. With this product they have the possibility to sell total solutions which will increase the competitiveness of the company.



Figure 1. The problem, bad work atmosphere.

1.3 Statement

There has been a great change in the offices during the last ten years. More colors and innovative furniture are used and the work area is more open. The raised used of technology and computer makes it possible to have flexible and shared workplaces. This is the modern way of working. But this change has not always created the benefit wanted. Often productivity, communication and user satisfaction have been reduced. [2]

The scenario of near-constant distraction at work have become the normal though and expectation for most people today. We also drown in information which we should process faster and come to conclusions. All of us want to feel effective and to be focused at work. This is something we try to tell ourselves all the time. No matter how much we try we will not be more focused. Controlled attention is hard work and our brain get tired, like the rest of our body when working. When the brain is tired a physiological mechanism sets in. This mechanism makes us easily distracted to save the remaining energy for “emergency” tasks. [3]

There are two types of attention, controlled and stimulus-driven. The controlled is what we choose to focus on and the stimulus is something that attracts our attention. A part of the brain called prefrontal cortex steer the attention. Even if we are focused on a task we can be disturbed by something happen around us (stimulus). This is an embedded function in our evolution to stay alive. But today the stimulus may be a phone ringing or a colleague passing by. To screen of the view and sound around the worker would reduce the stimulus and gain more focus on the task. This would increase the productivity and wellbeing for the employees. [3]

Every employee gets disturbed every three minutes in average and it takes 23 minutes to return to a task after being interrupted. [3]

1.4 Objectives

The goal of the project is to design a table screen which have a good functionality and fit the company's existing products. The product should mainly consist of felt material and have a high finish to be able to be sold with the company's most exclusive tables. For the user the screen has to be very easy to use and to be good looking so they want to use it. It has also to have functions or solutions that make this screen better than other screens.

The research question is:

- How to solve the need for screening at a modern workplace according to Ragnars design language?

To reach the goal the research question is divided into smaller questions, the associated question is:

- Which function will be included?
- How will it look?
- How will it work?
- What is Ragnars design language?
- How can it absorb sound?
- How will it be produced?
- What are the future trends and needs?
- How can it provide a greater value for the company and the users?

To solve the questions and reach the goal in an appropriate way the task will be approached in a scientific way with methods that are developed and proven before.

1.5 Delimitations

The project includes knowledge of sound and acoustics, where only basic knowledge in the specific field of absorption will be covered. There will be no work made on a big dividing screen wall even thou it is a similar product which could have been designed in the same manner. It's not possible to produce a prototype in the exact same material and colors as the final product will have. Therefore, the most similar materials are used for testing and prototypes.

1.6 Disposition

The report starts with theoretical background where existing knowledge and other important facts are explained. For example, design knowledge and anthropometrics are described. Then takes the method parts over where all used methods are presented. The methods are written in logical order but when they are used they will be used many times and in different stages. The meaning of this section is to describe and explain all methods used. In the part, approach and implementation the whole process is presented. All thoughts and decisions will be taken up. When reading the section an understanding of how the product have grown will be clear. The section is written in a way that reflects to myself. This is because to ease the reading and to understand that the thoughts are mine as the designer. All features and functions of the product will be presented in the result

part. This part is only talking about the final result, no thoughts and decisions are explained here. The report ends with a chapter of conclusions and discussion where different approaches and methods are compared. Different result might have been achieved by using different methods. The last part of the report consists of attachments where pictures and chars that didn't fit in the report are placed.

2 Theoretical Background

The work preceded in the report are built upon facts and the existing facts are described here. The most important part for the work is to understand how sound and noise works. The acoustics have a great part of the theoretical background. The used method and anthropometrics measurements will also be described. The anthropometrics are going to be used to set the dimensions at the product.

2.1 Requirements

The requirements given by the company are the following:

- Design a table screen with acoustic properties.
- Use felt as the main material.
- Fit to the company's 5 series.
- Fit the company's existing products.

Requirements set by the university:

- Deadline of the project 31 May 2016.
- Exhibit the product at the exam fair 3 June 2016
- Research approach to the project.

2.2 Design

Everything we have around us has been designed. Someone have chosen the shape, color and material. The quality and function of the design has a great impact on our life. Therefor is design and the designers' ability to create effective, attractive, useful and ergonomic products important to all of us. [4]

2.2.1 Design science

Design science is the meeting between research and design. It is a new field of studies, thou it is both art and science it has before been seen as a non-scientific field. A research field should contain creating knowledge through research and spread the knowledge by education. Design does both of this. [5]

Design science is focusing on how products are created and how they fit on to our lives. The product has to fit physical, psychological, economical and virtual in our environment. To achieve this, the design science combines data and findings from many different scientific disciplines. [5]

Good design improves our lives and bad design ruins our life. To make good design the critical and most important part is to bring all the different field of studies together. This is the aim of design science. To gather all design research and make it accessible for everyone interested. To read how other designer have approached a problem will speed up the own process and gain knowledge. [5]

To answer question like: does the design fit users of all ages, sizes, gender and with varying capabilities? How does the ethnicity, education and believes of different people affect the design? Does it fit the human body, is it comfortable and easy to use? What materials should be used and how to produce it? Is the design understandable for the users to interact? [5]

This is questions that designers have to answer in every project. To find the answers different methods and different research areas will be used. When answers have been found they can be shared. When sharing the findings other designer can use them and gain time also they can keep develop the answers or the methods. This is how other research areas work and it will raise the level of design science. The science in design need a unified approach in objectives and aim, not in method and tools. [5]

2.2.2 Design thinking

“Our job is to give the client, on time and on cost, not what he wants, but what he never dreamed he wanted; and when he gets it, he recognizes it as something he wanted all the time.” – Denys Lasdun, architect.

Design thinking is about to see beyond the obvious solution and find something exiting and stimulating. The design brief should not be seen as a specification but as a starting point from where the exploratory design process can start. The exploration aims to discover something new. [4]

A design thinking mindset is solution oriented and focusing on a preferred future, instead of focus on the problem. Thru intuition and imagination possible solutions will be explored. The solution aims to benefit the user, design thinking can be seen as a way where the designer match people’s need to a product. [6]

The risk of engaging customer to the process minimizes when using design thinking. Customer will not see the future possibilities but reflects only to the existing. Design thinkers will implement the costumer insights thru real-world experiment. [6]

The Bootcamp Bootleg method is a method used by using design thinking. [7]

2.2.3 Research through design

Design and research is similar in many ways, its iterative, evaluating, grow knowledges and leads to products or applications. The difference between the two activities is the techniques and what counts as evidence. For many years’ research have been seen as an important part in design. But design has the same importance in research. For example, is research containing of generative and evaluating thinking which requires creative thinking, where design methods will be used. Also that design creates knew thoughts and new knowledge which moves the science and research forward. [8]

2.2.4 Semantic

Semantic is the study of signs and the meaning of them. A sign is not an object, it is a relation between the shape, what it says and how it gets interpreted. For a product to be used the most important part is for the product to be understood. This means that a product can't be designed to be used, it has to be designed to be understandable. How a product gets understood depends on how the users interpret the symbolic meanings of shapes, dimensions, material, surface, color, graphics and texture. The stronger symbolic meaning a product have the stronger character it has. With a higher characteristic the product gets a deeper meaning and becomes more useful. [9]

2.2.5 Appearance

Appearance and aesthetics is a matter of how we perceive things with our senses. When talking about products it's about what we see and feel. In this counts shape, dimension, structure and composition. [9]

To make a product attractive it need to stand out from the surrounding. This doesn't mean they should have bright colors or weird shapes. When a product is not in use it should remain background, it should distinguish itself through good design. There are some rules to achieve attractive and good design. [10]

Newness: New things are more attractive than old.

Right place: A product should be where it is supposed to be used.

Simplicity: Simplicity is appealing and understandable but it must fascinate.

Unity: All parts, transitions and shapes should seem to fit together.

Regularity: Arrange parts, volumes and products in logical orders.

Symmetry: Symmetry is easier to understand than asymmetry.

Balance: Composition of objects should be in balance, then they are easy to look at.

2.2.6 Shapes

Different parts shape the product and all parts are volumes. The aim is to try to vary the shapes and the orientation of these. One way is to use three volumes and establish them as, dominant, subdominant and subordinate forms. The dominant volume is the biggest and most interesting. The subdominant is applied to complement and lift the dominant. These two volumes can create great shapes but when adding the subordinate, the shape became more three dimensional and even more interesting. The subordinate form should have the smallest volume. To make the total shape harmonic and in balance the axis of the three volumes should not be parallel. The axis should point in all three dimensions. The axis is the imaginary line through the center of the dominant direction of the shape. [11]

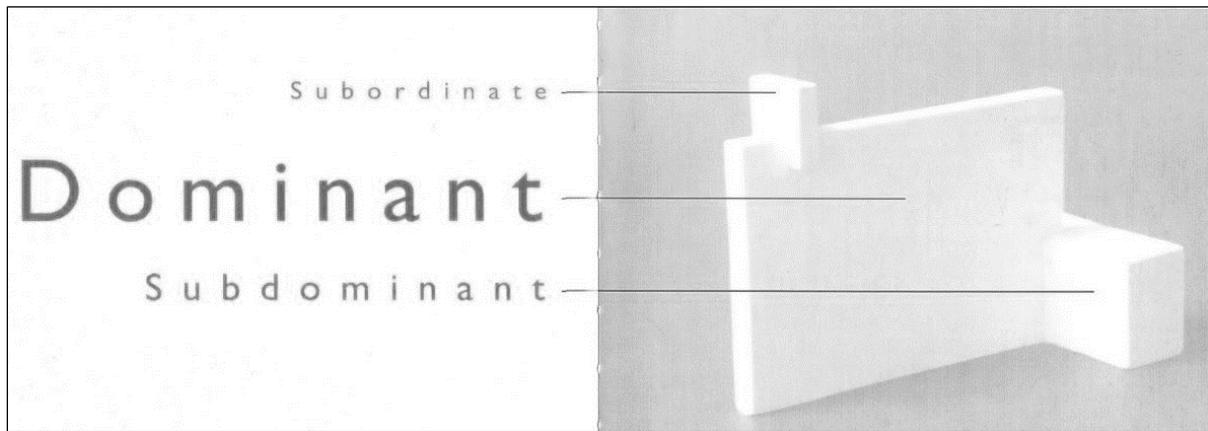


Figure 2. Placement of volumes, [11].

2.3 Bootcamp Bootleg

Bootcamp Bootleg [7] is a methodology based on design thinking 2.2.2. It is organized like a toolbox with different methods to help the designer in the design process. It consists of a document with a number of design methods to use to achieve different targets during the development of a product. The methods will guide the designer during all stages in the development process. The stages according to Bootcamp Bootleg are empathize, define, ideate, prototype and test. [7] See Figure 3. All stages and the meaning of them, will be described below.

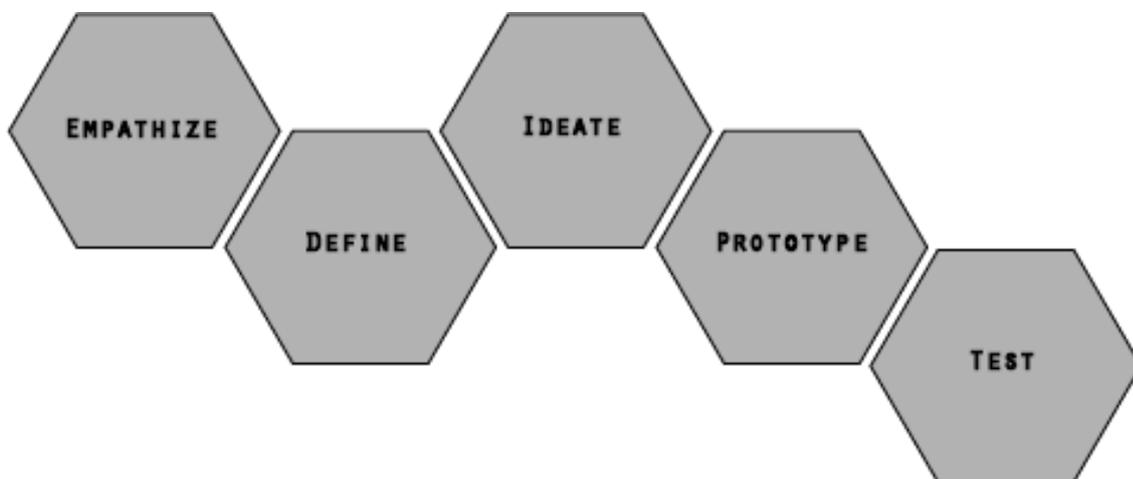


Figure 3. The stages in Bootcamp Bootleg.

2.3.1 Empathize

The goal of this stage is to study the users, to build empathy for them and to understand their needs and demands. The design is made to solve clients' problem, not the designers, that's why one has to understand other peoples' problem. To help the designer to find out the problems, demands and needs of the user, this stage is divided in to three parts: observe, engage and immerse. [7]

Step one is to observe the users in their real life, this is to see how they perform the specific task and to see where and how the problems occur. It's central to try to detect intangible meanings for the user in the interaction with a product or the environment. It's from these observations the best and most thoughtful solution grows from. [7]

Engage with the users is step two and gives information to the designer which the user may not think of when doing a task. The user might say a task is done in a certain way but when doing it, it's done totally different. The designers' role is to find out how the task really is performed or how the product really is used. In this stage it is easy for the designer to see if the users spent time and/or energy because of bad product design, which can be improved. Interviews is another important part in this stage. The interviews are made to find emotions and feelings of the user while using a product or performing a task.

At last it's of great importance to have personal experience in the area where you are designing. The designer has to try the specific tasks and products oneself to immerse in the design area and to gain a greater understanding of the context. [7]

2.3.2 Define

All findings and results from the empathizing phase will be gathered in the define stage and formulate a problem statement. [7] This is to set the frame for the project. Guidelines for the project will be set up and the focus of the work will be correct. The statement and guidelines have to be built upon facts and deep understanding of the user and design area.

When the project is defined it's easy to start work because all is set and decided. When a decision has to be made later in the project, the answers might be found in the statements, created in this phase.

2.3.3 Ideate

The aim is to go wild and try to find as many solutions as possible to the problem. Here is quantity is better than quality. From the large amount of concepts and ideas there is always some that will work, or can be combine with another to make it work. The idea is to drop of the obvious solution and think deeper to design a more innovative and better product. The only rule in this phase is to never evaluate the ideas. Evaluation of ideas can be made later on. Generating and evaluating ideas, always have to be separated. They can only be mixed when you know exactly what you are doing. [7]

2.3.4 Prototype

To prototype means that an idea takes a physical shape. The prototypes can be made of whatever and be very rough in the early stages, the important thing is that the designers and users can test the idea and functions to evaluate it. [7] The prototype will, as the project goes on, have a greater and greater finish, quality and function. In the end the prototype will appear and work exactly as the product is designed.

The idea of prototyping is among others:

- Exploration: to think while you work and develop more solutions. [7]
- Testing: to test the function of ideas and concepts or evaluate with users. [7]
- Solve disagreements: a prototype is a good way of communicate in the design team. [7]

“If a picture is worth a thousand words, a prototype is worth a thousand pictures.” [7]

2.3.5 Test

The prototypes will be tested in this phase according to function, usability, design etc. Here is the chance to refine the solution to make sure that the problem is solved in an as good way as possible. Sometimes, if the prototypes fail the testing the project step back to sketching table and the early stages in the Bootcamp Bootleg method. [7] The testing is the final step in the method and works as a divider in the iterative process. Either, the product pass and more and better prototypes can be build and further tested. Or it fails the testing and goes back for one more loop in the process.

2.4 Acoustics

This part will explain the basics of acoustics and the theory of how to stop unwanted sound. There are two types of acoustics, sound and noise. Sound is wanted and often needed, it can be music, talking etc. Noise is unwanted and is for example produced from machines, ventilations, traffic, combined talking from many people etc. This is of course an individual definition, one kind of music can be sound to someone and noise to someone else. [12] The two different words sound and noise will be used in the report to describe wanted or unwanted acoustics.

Noise is almost everywhere and it is produced from something, e.g. a machine. The machine vibrates and sets the surrounding air in oscillation. The oscillation is soundwaves which are propagated in all directions like ripples on water. How fast the waves propagate depends on the medium that it is passing thru, in the report the medium is always air. [13]

Low frequency sound (bass) is very hard to block while high frequency sound (treble) is easy. The treble has often one specific direction and can easily be stopped, even with thin materials. On the other hand, bass has no direction and can penetrate very thick materials. [14]

There is two ways for sound to spread, thru the air or as vibration thru pipes, floors etc. the vibration transmitted sound is not relevant for the report and will not be further discussed. The air born sound can take two ways to the receiver, direct or reflected. [12] See Figure 4. The direct sound goes direct from the transmitter to the receiver while the reflected sound bounces at walls, floors or ceiling before reaching the receiver. [12]

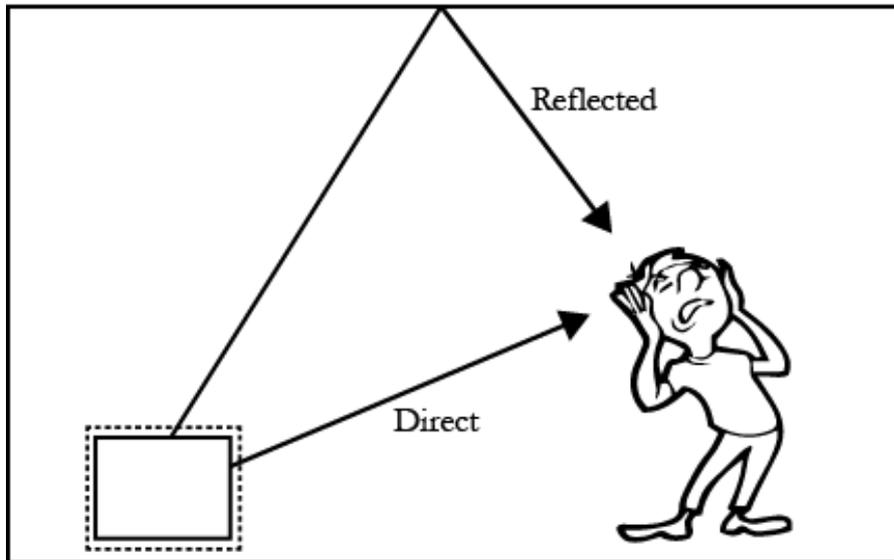


Figure 4. Reflected and direct sound.

2.4.1 Noise control in rooms

The reflected sound can be reduced by absorption. Absorption pads will then be mounted in the ceiling and on the walls. The sound absorbs by a porous material by friction loss, the momentum of the wave transforms to heat energy in the material. [12] The amount of loss is a function of how tight the fibers are packed and thickness of the material. [13] The direct sound will be reduced by blocking the way for the sound with a wall or screen. The sound reflects on the wall or screen to be absorbed by the absorbers at the ceiling or walls in the room. [12]

2.4.2 Material properties for absorbing sound

A good sound absorber has to have some specific properties. The most common material for absorbers is a porous material, like mineral materials, foams, fabrics, and so on. [13] It has to be porous due the sound wave must be able to cause the air to vibrate down in the material to transform the sound energy to heat energy. Therefor it must be possible to force air thru the material to have an efficient absorption. [13] If the porosity is too low the sound can't enter the material and will reflect, if the porosity is too high the sound can pass thru the material without any friction loss. The term when combining porosity and the possibility for air to pass is called flow resistance. [12]

The density of the absorber just affects the result slightly and the choice of which density to choose is a question of cost and installation. A softer material is easier to cut and to press fit to the installation. [13] The density is connected with the flow resistance but not the most important factor.

The flow resistance increases with the thickness of the material, therefor is the absorption greatly connected to the thickness. Low frequency sound is much more efficient absorbed by a thicker material. The absorption is also depended on the frequency of the sound, a high frequency sound absorbs more and vice versa. [12] See Figure 5.

Frequency (Hz) \ Material	125	250	500	1000	2000	4000
Rock wool 25 mm	9	23	53	72	75	77
Rock wool 50 mm	20	53	74	78	75	77
Rock wool 100 mm	68	84	82	78	75	77

Figure 5. Table over sound absorption in percent (%) [12].

When an absorber is mounted on a reflective wall, as they usually are. The sound will pass the absorber and reflect back. Standing waves will appear in the room, the speed of the air will be greatest at $\frac{1}{4}$ wavelength from the wall which means that the maximum absorption can be made at that distance. The wavelength depends on the frequency of the sound. This means that if the absorber is placed with a certain distance from the wall, a certain frequency will be maximized absorbed. [12]

2.4.3 Diffraction

When installing a screen there will be a sound shadow behind. This occurs when the size of the screen is relatively bigger than the wavelength of the sound. When the size reduces or the wavelength increases the sound will bend around the edges of the screen. The screening function reduces and eventually the sound shadows disappear. The sound bending phenomena is called diffraction and is possible to calculate. [12] The calculation is simplified to be easier to calculate but will give a reasonable approximation. [13] However studies show that the screens in real life doesn't give the expected value, as it does in laboratory studies. The reason for this is that in a real room does the sound reflect on the surrounding walls and ceiling. To really get the most out of a screen the reflective surfaces in the surroundings have to be reduced. A method to this is to find out which surface that are going to be hit by the sound. This can be done with a simple sketch and then place sound absorbing pads on the surfaces. [12] See Figure 6.

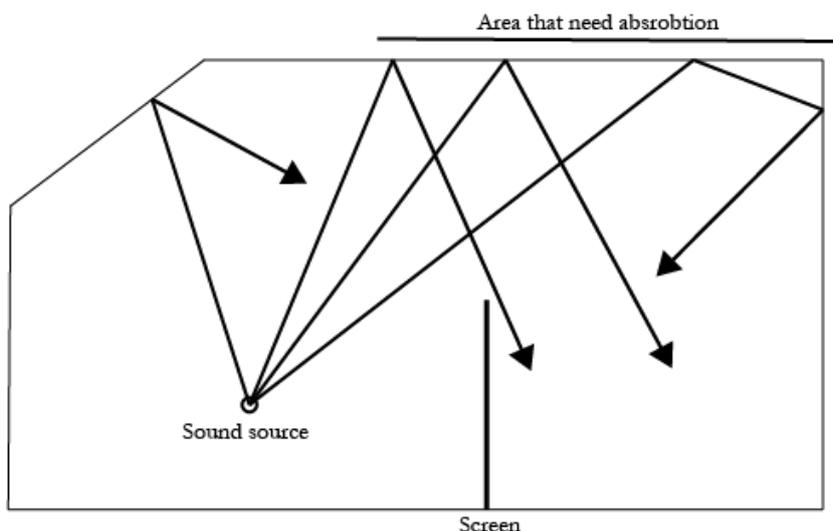


Figure 6. Sketch over reflections in a room.

To calculate the insertion loss from a screen the following figure and formulas are used. The formulas work best for large distance [12] but give a hint of the effect even on smaller distances. The calculations give the insertion loss (IL) in dB. See Figure 7.

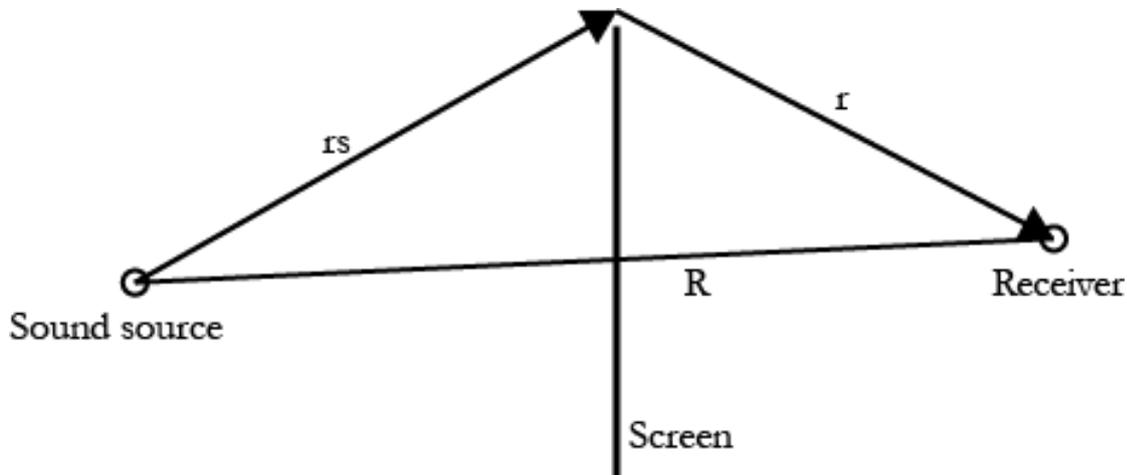


Figure 7. Figure for calculating.

At first the Fresnel number have to be calculated. [13]

$$N_F = \frac{L-R}{\frac{\lambda}{2}} \quad [13]$$

Where $L = r_s + r$ [13]

And λ is the wavelength of the specific frequency. [13]

$$\lambda = \frac{c}{f} \quad [12]$$

Where C is the speed in m/s of the sound in the specific medium, (343.4 m/s in air, 20°C) [15]

And f is the frequency in Hz. [12]

When the Fresnel number is calculated the approximate IL can be calculated. [13]

$$IL \approx 10 \log(4\pi^2 N_F) \quad [13]$$

As seen only the active screen size and the distance from sender to receiver that depends to the result. Clearly the screen must have an absorption to stop the sound from passing thru the screen. It cannot either be made of reflective material thou then the sound level will be larger at the sender side. [12]

2.5 Anthropometry

Though the screen will be easy to move there need to be a handle. To dimension the handle, the size of hands need to be studied. To find the largest and smallest measurements the 1st and 99th percentile have been used, see Figure 8.

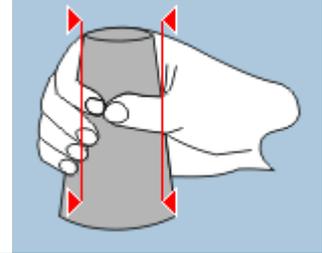
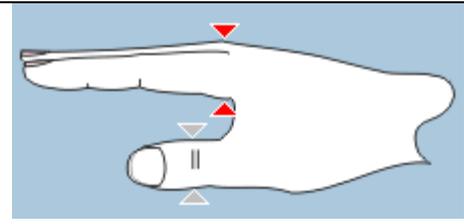
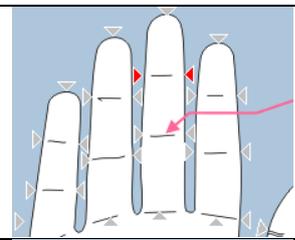
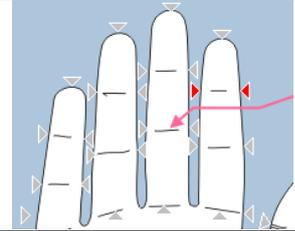
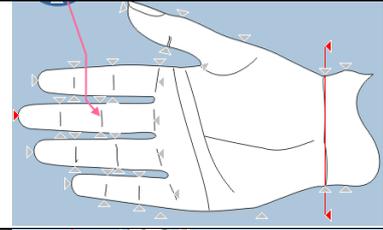
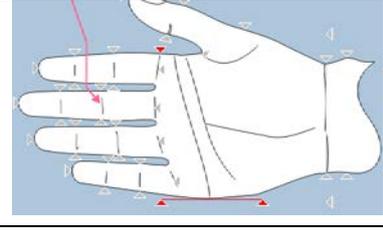
	<p>Smallest grip: 31 mm (British female 18-64)</p>
	<p>Largest hand thickness: 35 mm (British male 18-64)</p>
	<p>Widest middle finger, first joint: 21 mm (British male 18-64)</p>
	<p>Widest index finger, first joint: 21 mm (British male 18-64)</p>
	<p>Longest distance from wrist to top of middle finger: 214 mm (British male 18-64)</p>
	<p>Widest hand: 99 mm (British male 18-64)</p>

Figure 8. Table over anthropometry of human hand.

All pictures and measurements in Figure 8, are gathered from an anthropometry computer program called PeopleSize.

3 Method

All methods used in the project are explained in this chapter. The methods are described in a logical order to ease the reading. When the methods were used in the project they were used in an iterative way, meaning that they were used many times over and over again.

3.1 Function analysis

The function analysis is a tool to help the designer to find out why a specific product exists or why it should exist. [16] The function analysis is used early in the process to find the functions that the product requires. It can be both technical and visual functions. The functions are explained with two words, one verb and one noun. For example: fit hand, express quality, absorb sound etc. [16] [17] The reasons why it's only two words is because the important thing is to come up with the functions, not to write them. Two words goes quick to write and more time will be spent on thinking. [17] The functions will then be ranked in, main function (M), necessary function (N), desirable function (D) and unnecessary function. [17] All products have only on main function, the main function is why the product exist, for a pen is for example, make mark. [16] The necessary functions is functions required to enable the main function, for a pen it's for example, enable grip or contain color etc. Desirable functions are those that are not needed for the function but might be good to have for other reasons. [16] On the pen it can for example be, show logo, feel soft or contain fastener etc. Unnecessary functions might be crazy ideas that are written down not to forget them or perhaps it is functions that have been changed in the analysis and no longer is necessary. If we for example started out to design a casual pen and wrote both contain ink and contain lead, one of them will be unnecessary while deciding which type of pen we are designing.

3.2 Activity analysis

All tasks consist of a lot of steps which forms the activity. The activity analyses divide the task in to all the small steps. The steps can be both physical and cognitive. A physical step means something the user does which require a physical movement, for example open a door. A cognitive step is what happens inside the head, for example to know which way to open the door at. This gives a good overview of how the product is used and how the user is interacting with it. [18]

3.3 Competitor analysis

Competitor analysis is a tool to find out what products that already exist and what their functions are. The analysis gathers all similar product that can be found, and compare them according to features, e.g. height and price. It's important to try to find an own unique feature or function. If it looks and work just like all others the costumer will chose product just after price, availability or image etc. But with a special positive function the costumer might find a greater value in just your product and will buy that one. [16] In the competitor analysis pros and cons of the existing product can be applied and it's easy to see what is good and bad with existing solutions.

3.4 Trend analysis

Trend analysis is to figure out how the future might look. It's about to find out what materials, shapes and colors etc. that are assumed to be popular. It's important to know what's coming to be able to design a product that fits in the future. Taida is a method for trend analysis. The name, Taida, stands for the words, Tracking, Analyzing, Imaging, Deciding and Acting. The words describe the method well but briefly it's about to track what you see, to be observant on changes around you and try to see a direction of where the trends are going. To analyze what you see and connect the inputs to other design areas or other time periods to see connections and reasons why things and taste are changing. When you have an idea of the trends you imagine the future and try to fit your product to that environment and opinions. The two last steps are to decide what to do and to evaluate the idea and then make a plan of how to implement it on the market. It is important to be aware of the changes even during the analysis not to miss anything. [19]

3.5 Visual design brief

The visual design brief is to show thoughts about the products in an easy way. The design brief consists of pictures which describes the product. It can be divided into different parts to show different aspects of the product, for example, textures or shape. The design brief is a very good way to gather all the ideas and elements expected to be include to the product. It is also very good to use when talking about the product in the early design stage thou the thoughts are visual and it's easier to understand. The pictures reinforce the words and creates a total image of what is wanted to be expressed.

When looking at a good and well done visual design brief, a hint of the final product will be visual.

3.6 Brainstorming

Brainstorming is a method to generate a lot of new ideas. The brainstorming can be done in different ways, but always in a group because it is working on each other's ideas. One idea leads to another. All ideas coming up have to be noted and most important, is to never judge or evaluate the ideas during this period. [7]

Some rules or guidelines to follow are: Never criticize or judge, this is to create a positive and inspiring atmosphere. A high number of ideas is wanted and the ideas can gladly be wild and crazy. [16]

3.7 Sketching

Sketching is a way of show and explore ideas and concepts. The benefits with sketching instead of building a digital 3D model is that it goes much faster to visualize the idea, it's easier to do changes and quicker to come up with a large number of concepts. To sketch the ideas, force the designer to concretize the lose thoughts. The sketch gives a picture which can be shown to the team. To start the discussions from a sketch is always easier than trying to explain the ideas. Sometimes a sketch is easier to understand than a technical drawing, which means that the functions and features easier can be analyzed. The sketches will later serve as an underlay for the digital model. [16]

The designer has here a responsibility against the client. Beautiful sketches which are nice to look at might easier be choose even if the product or function is not the best. For the designer to be professional all sketches need to have the same quality and manner. [16]

3.8 Prototype

To build prototypes is an important step in the design process. In the early stage the resolution of the prototypes can be very low, it's better to spent time on generate more prototypes. Early prototypes can be a piece of cardboard, it just has to hold the desired function. Simple blocks or tape on the wall can sometimes work as prototypes, it depends on the product in the project. A final prototype can be exactly as the final product with all the same functions, colors and materials. [7]

When you can hold a prototype in your hands you feel the shape and functions and will discover solutions which would have been impossible to see on sketches. [16]

3.9 Testing

A lot of feedback on the design is received when testing the prototypes with users, if it's done in the right way. The designer has to know what to test, and to test it in the right environment with users that later are going to use the final product. [7] How the designer interact is also to take in consideration, the designer can't lead the tester into some special thoughts. The designer must stay neutral and just explain what the tester should do. Sometimes maybe there should be no explanation for the tester of what to do. That will test the products semantics. [7] The last and most important part when testing with users is to observe, the designer can learn very much just from observing how the users interact with the prototype. For example, how they hold it in the hand, how they think about the buttons etc.

3.10 Design for manufacture and assembly

Design for manufacture (DFM) is defined as: establishing the shape of components to allow for efficient, high-quality manufacture. [20] The key is to find the best manufacturing process for every component and to follow the specific methods guidelines. It's possible to design the component in such way that there will be no sink marks or surface imperfections etc. The right method will also reduce the waste of material. Often the component need after processing and moved between processes, holds for fixturing and lifting can be implemented in the design to ease these steps. [20]

Design for assembly (DFA) is to design the components and product to be as easy to assemble as possible. Almost all products are more than one component, which are assembled. Assembly takes time, which is money and that's the reason to minimize the time and effort to put the components together. [20]

To assembly a product, a person or a machine have to first collect all components then handle the components to have them in the right orientation and last to mate them. Every step creates an operation which is proportional to the number of components. So to make the assembly more effective is to reduce the operations, the best way to do this is to minimize the components. Below follows a list of examples to design for assembly. [20]

- Minimize components
- Minimize fasteners.
- Design the product with a base plate.
- Make it possible to mount everything on the base plate without moving it.
- Avoid components to tangle while stored together.
- Make the components symmetrical.
- If the component can't be symmetric, make it clearly asymmetrical.
- Make assembly from one direction possible.
- Use chamfers to simplify insertion.
- Maximize accessibility to the components.

3.11 Presentations

It doesn't matter how good the design work is if the message doesn't reach the stakeholders. The stakeholders can be the clients, the leaderboard or the users etc. The presentation is equal important as the contents and how the presentation is made have a big effect on the total impression. The presentation needs to be targeted to the listeners and suitable material will be used. Material to use can be posters, drawings, slideshows or an exhibition. [16]

The design work is not just grabbed from the air, it's built upon facts, ergonomics, semantics etc. be sure to show this to get a professional expression. Presentations during the design process can for example be to keep the client informed and involved in concept decisions. The process presentations aim to present the status of the project and to make decisions. These decisions make the project to move forward. [16]

In the end of the project there usually is a big presentation where the final prototype is showed and explained. This is the time to make a fancy presentation and to be proud of the work. [16]

4 Approach and Implementation

The project started with a meeting at the company where the problem area and goal were presented for me. I got a tour around at the company and were showed how they work and what kind of material they use. They are really keen of having high quality and nice materials. It felt like a company that fits my personal opinions about products and furniture.

The meeting was with my contact person at the company. We agreed on that I was supposed to create a product for them that solved the problem presented. To next meeting I said I would have come up with a planning and a project description to present at that time.

I did a planning over the project where I used a Gantt chart to visualize it. The plan was to follow the Bootcamp Bootleg methodology and to be finished in good time before the presentation.

At the second meeting I presented the planning which looked fine for the company. I also presented my thoughts about the project. My thoughts were about what kind of material they usually use, if they have a design guide to follow and what the product should express. I got an explanation over a system that the company uses while naming their products. The company have a system in their products were they name them with a number from 1 to 5. The number tells which quality it is. A table in the 1 series is just a table that works, it is cheap and not special in any way. The 3 series is more expensive, better looking and a better table according to functions and components. The highest series, number 5, is an exclusive table, the functions are the best, the materials are carefully selected and the design and esthetics are high, also the price is higher. The screen should fit the 5 series, which means that the functions, materials, design and esthetics has to be super well thought thru.

Considering material, the company are comfortable with both wood and aluminum. If using solid wood, the volumes shouldn't be too large due to that becomes expensive. Aluminum is very much used at the company today especially anodized aluminum. So to design something that would fit the company's existing products, aluminum is a smart way. For the main body of the screen molded felt should be used. This is a method and material they already use and are familiar with.

When discussing functions of the product there have to be some special function or extra good features which creates a greater value. To create a greater value means to provide more than just solving the main problem. For example, enable an easy storage, a smart way of producing the product or a new material.

So after the second meeting a list of demands were gathered. The list was short in the beginning but were developed during the project duration. Here is the first list of demands presented.

- Fit 5 series (Ragnars ranking system)
- Molded felt
- Absorb sound
- Included functions
- Feel dynamic
- Build together with each other

To feel dynamic means that it will have the expression of quick and easy moving. It should not feel like a screen which are supposed to stand at the same place for a long time. And to build together is to be able to place screens next to each other to create a greater screen or a pattern to work better in different situations. The screens might be able to be connected to each other in some way.

These are the core demands and which have got the most consideration during the work.

4.1 Empathize

Now did the design work start with empathizing which is the first step in Bootcamp Bootleg methodology. The phase aims to gather information about the design area, learn and understand about the users and get in depth with the problem.

The first thing I did to understand the users was to do an activity analysis. The analysis cover all involved steps while using a screen. The steps written in italic is cognitive steps and the others are physical. It's a lot of steps just to fetch and remove a screen. It shows clearly in the analysis that it's important that the product shows where to grab it, which side that is down and to be clear and easy to put on the hanger. The product must communicate to the users in a semantic and understandable way.

The physical steps as carry the screen can be simplified by study the anthropometry of the users. This generates a comfortable grip area and a proper size. To make the placement easier the weight and stability of the screen have to be, and to feel correct.

1. *Want a screen*
2. Find a screen
3. *Understand where to grab the screen*
4. Grab the screen
5. Carry the screen
6. *Understand how to place the screen*
7. Place the screen
8. Use the screen
9. *Want to remove the screen*
10. *Understand where to grab the screen*
11. Grab the screen
12. Carry the screen
13. *Understand which direction to place the screen on*
14. Put the screen on the holder
15. *Understand that the screen is correct placed*

After the activity analysis I were wondering how the existing products are solving the problems and how they are designed. I created a competitor analysis where a lot of different screens were compared. The screens were gathered and collected in a chart. In the chart were also all information about the screens noted. Personal pros and cons were also added to all products.

14 screens from 12 different companies were collected and evaluated, see Attachments 1, competitor analysis.

Findings from the analysis is that the majority of the screens have a height between 400 and 500 mm. The width differs a lot thru the screens but many have a value between 600 and 800 mm. Discoveries from the comments is that many have a very static feeling, they are placed on a surface and then they are supposed to stand there for a while. In combination to the static feeling they are also hard to store in a smart way when it's not needed. On the other hand, are those that feels static very stable and will not fall if someone hit the table. There are a few that are flexible and these feels dynamic and easy to move. But they often have ugly edges where the bending occur. An idea might be to apply the feeling from a flexible screen to a static. The impression from the screen can be that it's possible to bend. One of the screens in the survey have a hole in the top. This hole invites to grab the screen there and to move it quick and easy. The hole is also a smart way of hanging the screen to store it when not in use. Those which are not bended have a foot to stand on, this foot is required for the stability but it takes a lot of valuable space. The foot will also create sound when the screen is moved and scratched along the table. According to the shape, some of the screens have shapes of squares with sharp edges and other are organic with soft shapes. There can maybe be something in between.

After analyzing the competitors, I wanted to explore what the trends in furniture and design are today and what it might be in the future. It is important for the product to be modern as well as being possible to last over a longer period of time concerning trends. I did a trend analysis following the Taida method described above.

To track trends, it is good to be at a place where new designs and trends are showed, like the furniture fair. The trend analysis was mainly made at the Light and Furniture fair at Stockholm 2016. A lot of common trends were discovered, the trends were mainly shape, colors and material. The same trends were shown in all kinds of product, not only on screens. The shape trends that were discovered were big radiuses, simple shapes with basic forms, surfaces with many angles. According to color it was pastel colors. And there was very much wood, metal strings and acoustic materials. Many products are very thought thru with smart and innovative solutions. To offer really good products in terms of functionality in combination to nice design is also an observation which is worth to keep in mind.

When it comes to the desktop screens at the fair most of them looked the same. The majority were squares with sharp edges. There were just a couple that differ from this. But on big screen walls were there a lot of different shapes. There were many very organic and also sharp but bended in some way. Those big screens gave a lot of inspiration,

especially to use the structure and shape of the screen to make it stand. See attachment 2, photos from the furniture fair.

To know what the trends in architecture are I were looking at different online magazines over modern architecture. Very much of the modern buildings are very edgy and with flat surfaces. Many houses have a lot of angles and are not looking like the traditional houses. Even the inside of the houses are applying to this edgy style. Stairs and windows often are tilted in some way to create an expression which is not the traditional. See attachment 3, modern architecture.

This modern architecture style is a style which also fits very well to Ragnars style of existing products. But when compared to the rounded products with big radiuses at the fair, the trends go in different directions. But I think that a combination of the styles creates an interesting product that can fit in many different environments.

4.2 Define

The steps so far have been to learn about the problem and to see what is existing. This information will be further converted into statements that will frame the rest of the work. The statements can be seen as a compass with six words, who, what, when, where, why. All words are now set and if somethings change later in the process the whole first part of the project have to be redone and the result will no longer be the same.

The next step in the process is to define the work, which means to set the frame and the goal for the work. To set frames the frames differ from who you are designing for. If considering the designer as an author. All people who are interested in reading the book are stakeholders. But the book can have different meanings too the readers. The people interested in the screen are the users, the buyer, manufacture & assembly and Ragnars.

To find all functions for the product I did a function analysis following the method described above. The functions were divided in the four different stake holders. This division reach all the different aspects of the product. The main function was set to provide screening which feels correct. Other important findings from the analysis is that the product have to visualize the logo of the company and express quality. Also it has to be easy to produce and to have suitable properties for screening. The analysis worked as the guidelines during the rest of the project. See attachment 4, function analysis.

To be able to somewhere at the product show the logo is a very important function for Ragnars. I know from previous projects that the logo is essential but it is a function that is easy to forget. The logo will also send a message to the user that the company are proud of the product and can stand behind it. If the user knows the company from before they will associate the product with functionality and quality, as the company stands for.

Visual briefs were the next thing to do to try to visualize the feelings and ideas of the final product. All briefs will be shown and described below.

Feeling of user

The brief is describing how the user should feel when using the product. The desired feelings are calm, private and home, see Figure 9. When feeling this way, the user should have a good mood for working. The feeling the user should have is to have a private and calm place, like home, when it can be stormy and stressful outside of this area. It should feel like entering a peaceful place.

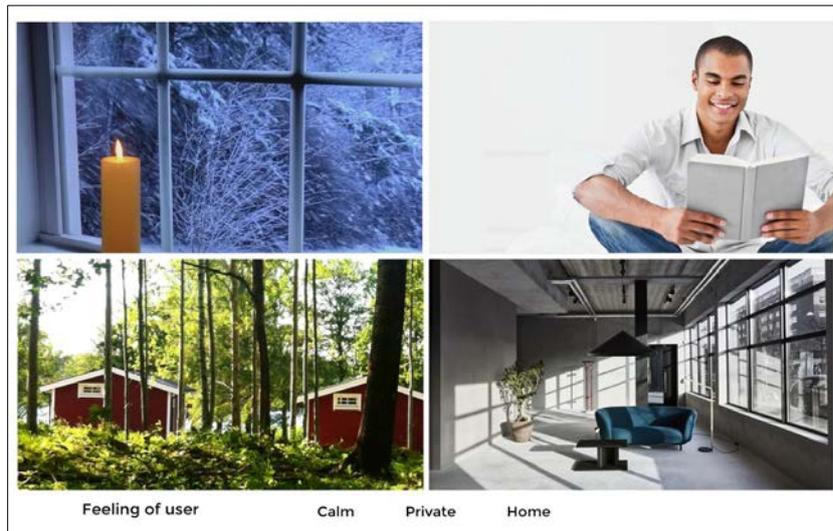


Figure 9. Feeling of user

The shape

The shapes of the product should express the feeling of; simplicity, dynamic and strong, see Figure 10. With simplicity means that the product consists of basic geometric shapes with no complicated areas. The simplicity will also increase the dynamic feeling which refers to be mobile and easy to move and change as the user wants. The product should feel strong to give an expression of a shelter and to protect the user from noise and stress.

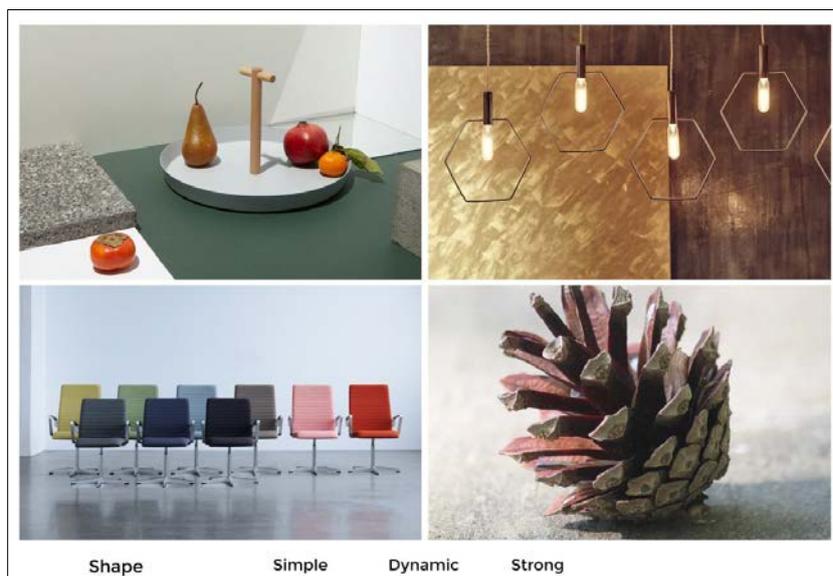


Figure 10. The shape

The problem

This brief shows the problem very well, Figure 11. People sit very close to each other and have a hard time to concentrate. Even the environment around the table is a stressful and busy atmosphere due to people walking and other work tables. It is obvious that the environment can be largely improved. The peoples in the pictures are working alone but sometimes groups have to work together. To be able to work as a group the group have to be divided from the others not to disturb or be disturbed.



Figure 11. The problem

The environment

The environment where the screen is going to be used is mainly offices, Figure 12. The screen is going to be used at big tables where people work together and between people working side by side. The screen will also work to screen between computer screens. Generally, is the office spaces big and open with a lot of employees. To notice is when to store the product not all offices have walls to store it at. Some offices have a lot of windows and other have shelves on the walls.

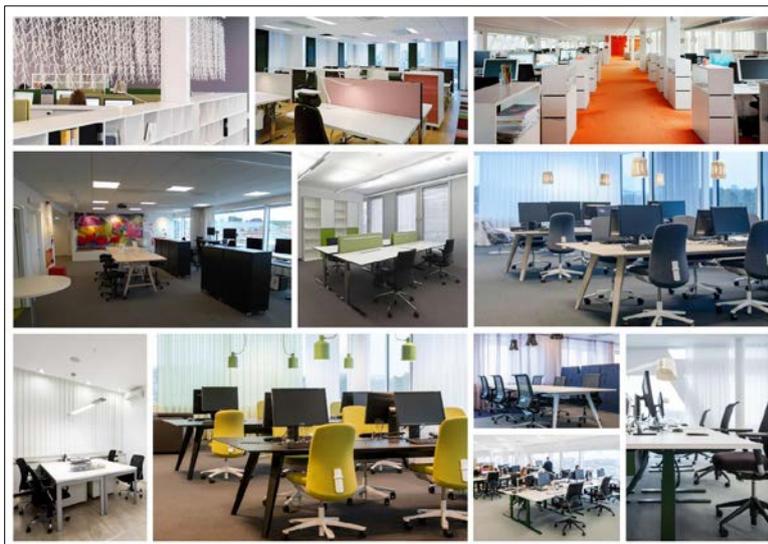


Figure 12. The environment

Ragnars

The brief over the company were made, to be able, to fit the products that the company already have, Figure 13. The products are very straight and square with dark colors and small details. The products have high quality and are built to last and to be functional. To be functional the products are well thought thru with smart solutions, good material and timeless design.



Figure 13. Ragnars

Existing screens

The brief over existing products is in addition to the competitor analysis and shows how different the product can be, see Figure 14. It also shows different solutions, for example how to make it stand and how to store it. The screens are all very different to each other the thing connecting them is the material and the soft feeling. The material comes from that it has the same main function, to absorb sound. To take further from this brief is the smart ways of store some of the screens when it's not in use.

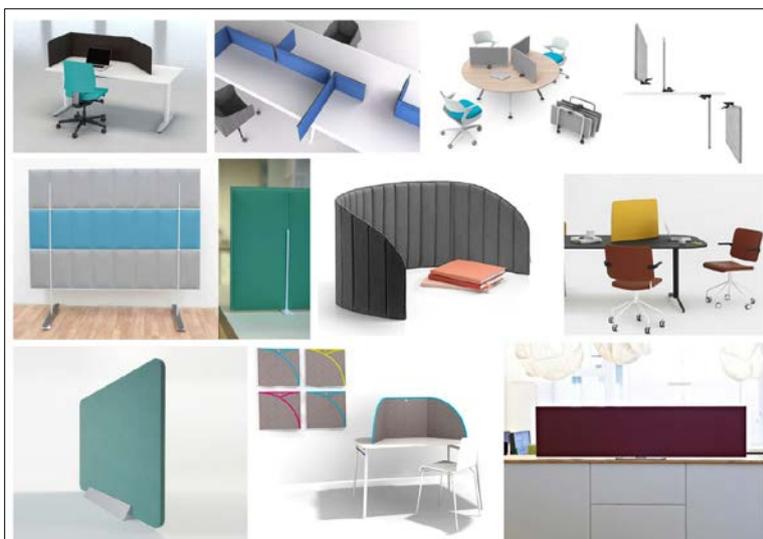


Figure 14. Existing screens.

The briefs are a great way of explaining thoughts and ideas. They were also used as reminders and inspiration around the workplace when I was working. To be reminded all the time was very good for me though I then know what I was doing. I did also put up my latest ideas around me as well to see them all the time and to be forced to judge and to think of them.

I had now a great understanding of the product and the problem. It will be a screen that absorbs sound as well as it contains extra functions in some way. It's important that it express quality and premium product. After the theoretical background I also know that the screen need to have a thickness and to be filled with a material that can absorb sound.

4.3 Ideation

From now on I worked a lot with sketches, CAD (computer aided design), renderings and prototypes. This process is iterative and goes back and forth many times, it will be described in the same way as it were proceeded. To ease the reading many pictures will be used.

I started the ideation with sketching a lot. I sketched all ideas I got to be able to see it, to evaluate or to develop it further. During the sketching I was talking to friends and looking at online furniture shops to gain inspiration and more ideas. The first sketches are shown in Figure 15 and Figure 16.

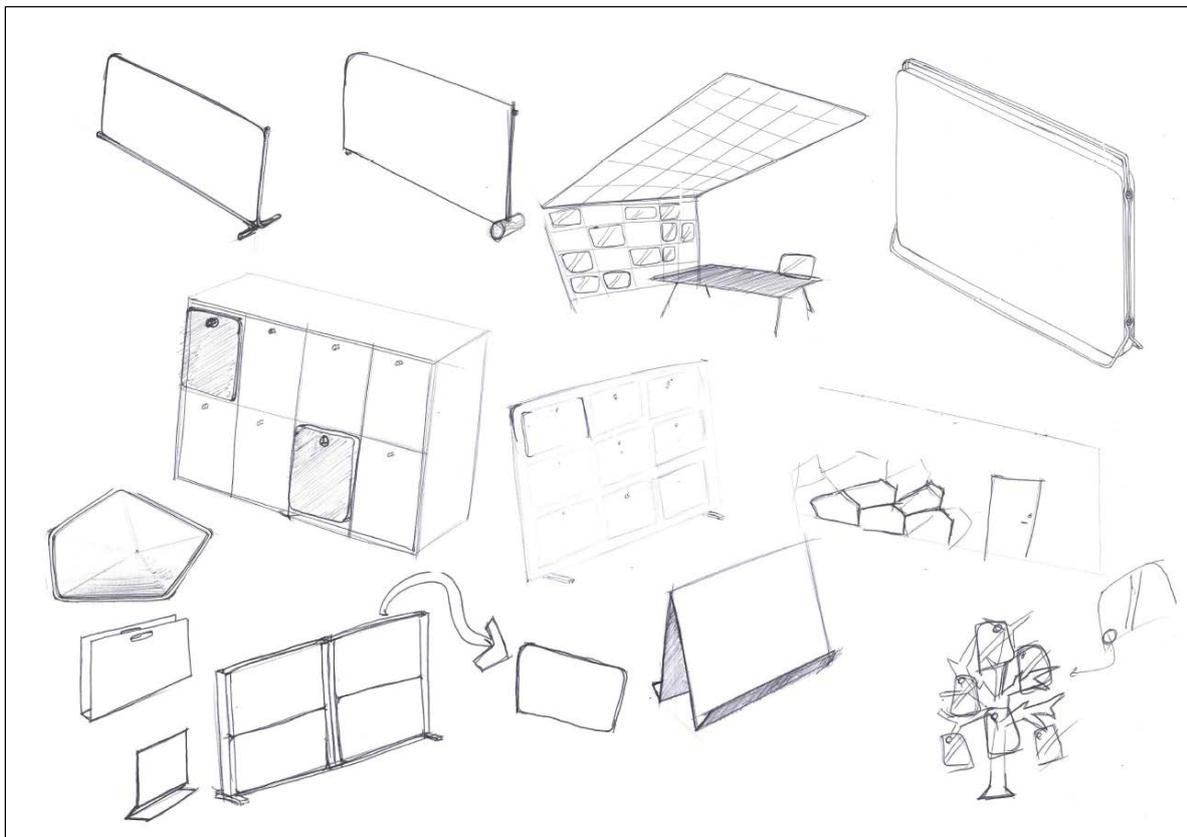


Figure 15. First sketches 1.

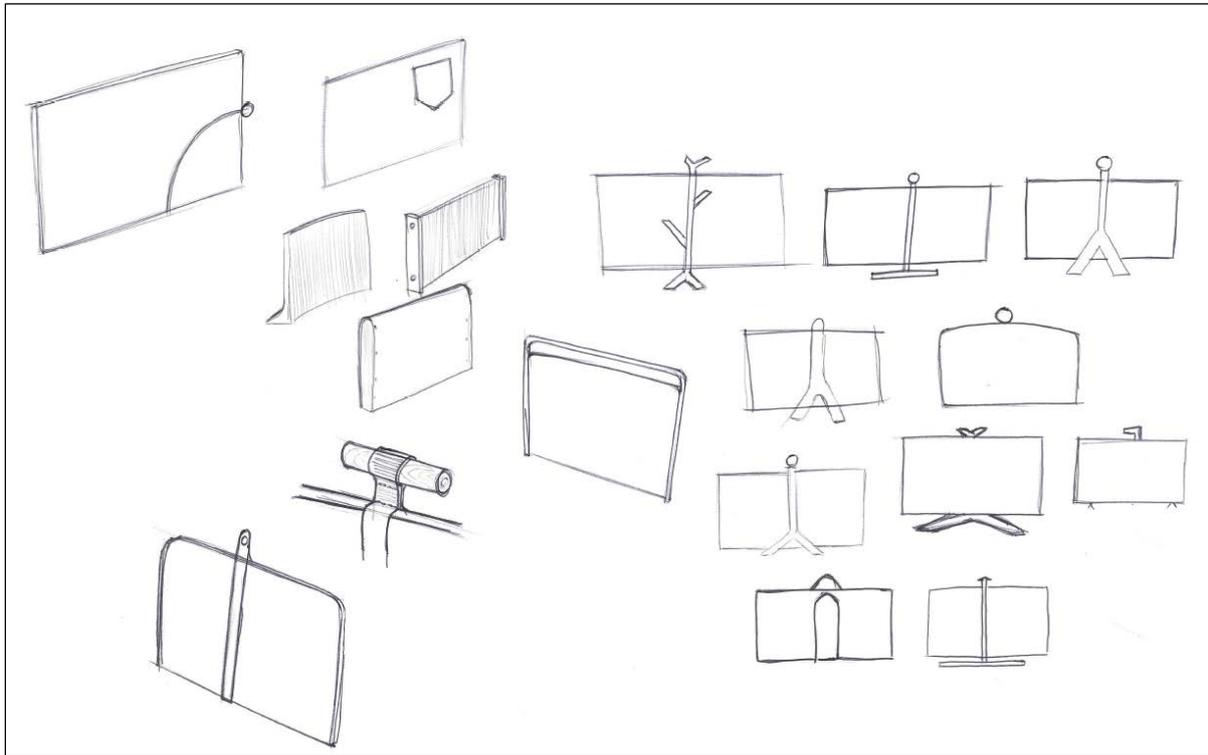


Figure 16. First sketches 2.

The first sketches, Figure 15, were investigation different ways of placing the screens. I had ideas of a modular wall screen where the smaller screen could be removed and used on the table. A similar idea was to store the smaller screens on a big screen when they were not in use. To use a big screen as a storage place would remove the need for a wall or another system to be able to store the screens. Another way of smart storage would be to use the locker doors to hang the screens on. In that way, if every employee has one locker each, they would get one personal screen each.

In Figure 16 I focused on the ease of moving and lift the screen. I tried different handles at the top and the handle should also work as a hanger when store the screen.

To further develop the sketches, I created them in CAD and rendered pictures of them, Figure 17. The screen on the picture to the top left has the idea of to be able to place the screen at any way. I think it's a fun idea, but it creates many problem according to stability and the ability to store it. The other ideas in Figure 17 shows the storage concept with a big wall screen and hanger on the table screen. In Figure 18 is the idea of placing the screens at the locker doors showed. This is an idea I like and think might work good. To continue with this idea, I need to find out measurements of standard lockers.



Figure 17. First renderings of early ideas.



Figure 18. Screen placed on locker.

From all sketches and renderings above I realized that the design is too complicated, too much things. The trends and also the company advocate smart solutions and simple design. I continued with more sketching and tried to keep it simple and smart. To use the material and shape of the screen to make it stand were now the idea I had. In Figure 19 there is many ideas where the screen is curved or bend to create a base for the screen. To create a pattern of the screens when they are stored became important from this sketches the idea of that is make the screen more useful and esthetic.

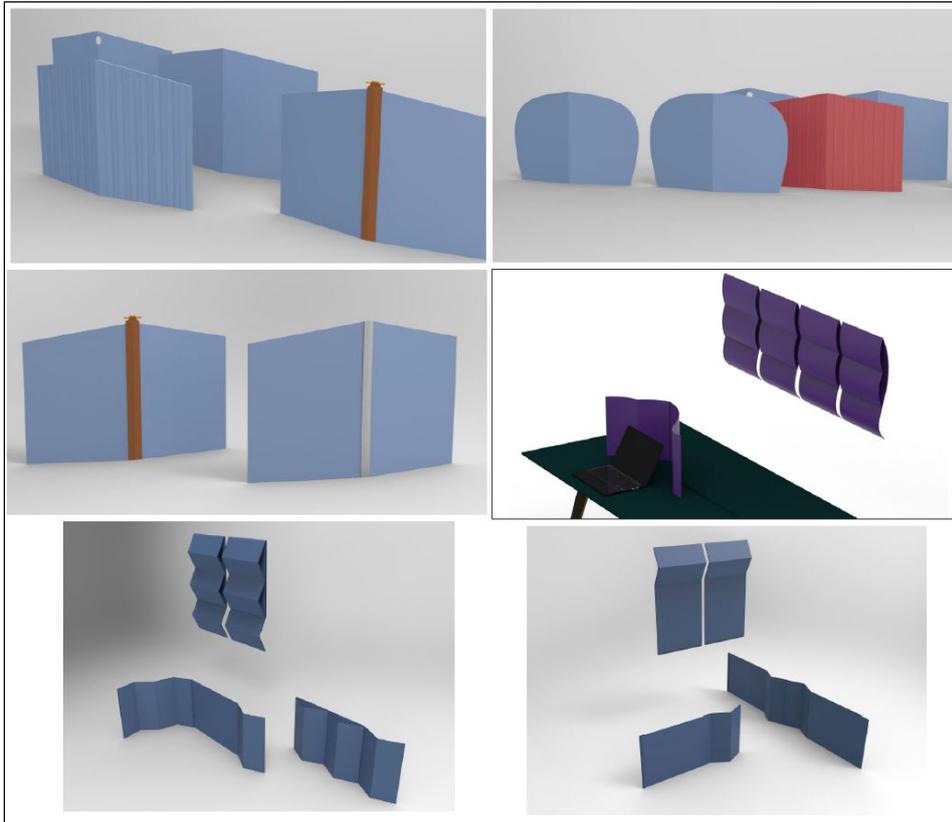


Figure 20. Renderings of different ideas.

Though the symmetric concepts were the furthest simplified I continued working with that to make it better according to sound absorption. To have better absorption properties there have to be a thickness of a porous material. The solution was to use two thick felt sheets and only press them on the outside to create a stiff frame and a softer inside. The frame makes the screen stable while the inside absorbs sound see Figure 21.

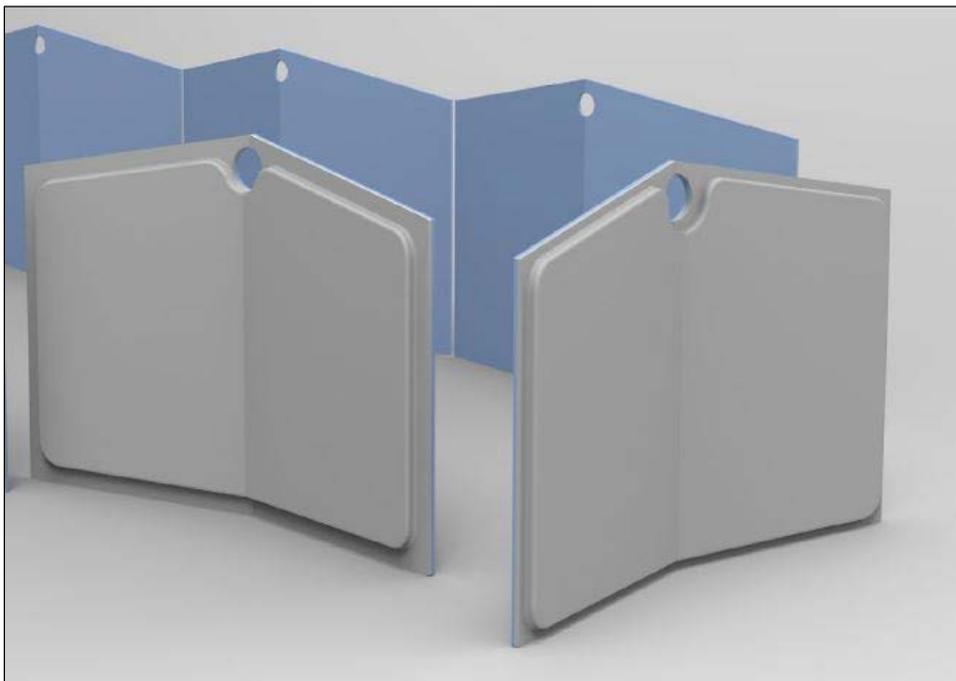


Figure 21. Acoustics improvement at concept.

From this stage I wanted to improve the visual effect while the screen is stored. I came up with the idea of a honeycomb pattern. The honeycomb is very popular on furniture, which I saw at the fair in Stockholm. A pattern would give the product a greater design feeling and a more interesting product. The honeycomb pattern was created by changing the shape of the screen and to create a shelf. The pattern occurs when the screens are stored at the wall, see Figure 22.

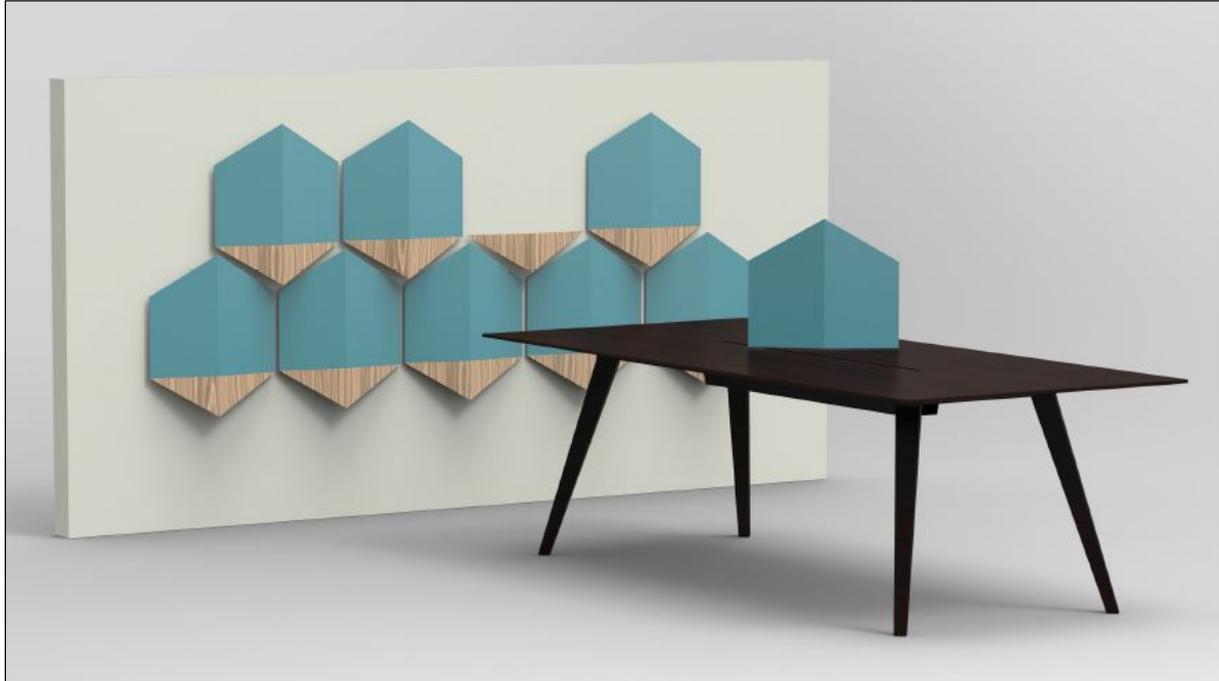


Figure 22. When stored at the wall a honeycomb pattern is created.

Finally, I ended up with three concepts which I presented for the company.

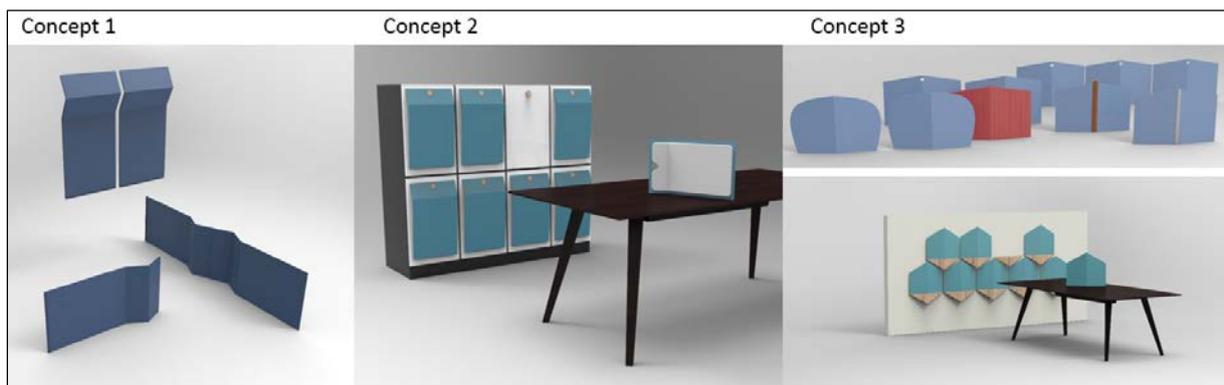


Figure 23. Three different concepts.

4.4 First presentation

Everything created so far were presented for the company. When presenting for the company I were talking to my contact person. I had prepared a presentation printed on papers to be able to easily bring it and show it. The presentation started with the competitor analysis, function analysis and the different briefs. I showed the different analysis and pictures and at the same time explained everything and told what my thoughts was. The presentation continued where I showed all sketches and renderings

which is the same as those presented here in the report. We discussed a lot over the concepts and the findings were that I should continue with concept 3, Figure 23.

The discussion with my contact person over the concepts started with the idea were the screens are placed on the lockers, concept 2, Figure 23. He liked the idea and thought it is a smart way of storing the screens but the problem is that there are no standard dimensions on lockers. This creates problem with finding the size of the screen and how to make it work in reality.

The self-standing screen, concept 1 did he really like thou it had a lot of Ragnars feeling. It stands in a smart way and it looked very simple. At the same reasons he also liked the symmetrical concept 3. Concept 3 is better due to the screen have a natural direction. It's obvious which side is up and down. At the other screen both sides can be placed down which is a problem if the screen needs extra weight to stand stable. Then the screen can be placed wrong and the ease and impression will decrease.

About the honeycomb pattern at Figure 22 he liked the idea of the pattern but it will be too much for the costumer to mount and install on the wall. The shelves are big and requires a lot of space and material which is bad both for the buyer and the producer. Also the screens get to sharp top according to me when they have to have this hexagonal pattern.

So we decided to continue with concept 3 from Figure 23. To help the decision a quick table over the discussed properties were created, Figure 24. In the table it's easy to see that concept 3 were the best to continue with. I would investigate which side the soft material should be on. Questions to answer are. Should it be on the inside or outside? Or maybe both? How does the placement affect the acoustics properties? I also need to find out the dimensions and the size of the hole. To solve the task, the plan was to build prototypes and to ask people who are experts in sound and acoustic.

Concept	Direction	Stability	Storage	Easy to use	Handle	Idea
1		x		x		
2			x	x		x
3	x	x	x		x	x

Figure 24. Table over concept evaluation.

4.5 Refinement

After the meeting I quickly created a prototype of cardboard just to get a feeling of the product and to see if the screen could stand. The prototype worked well and it seemed that it can be both stable and good looking. To build a simple prototype helped me a lot when figuring out which dimensions the screen should have, with the screen I could measure and imagine how it would appear while changing something.

Then I started to sketch a lot over how the proportions should be. I tried to implement the golden ratio but it didn't turn out good. So to find the dimensions I conducted a more engineering way. The normal work area is 70 cm wide so I said the screen should be 70 cm, then one screen can be placed in from of the work area. Also many tables are 60 to

70 cm deep or 120 to 140 when it's big meeting table. This gives that the screen fit all tables perfect except the 60 cm deep, but then the screen can be slightly angled and it will be inside the table. When placing two screens after each other on a 120 cm table the screens will have to overlap, but that's not a problem. To decide the height, I looked at the competitors and they are mostly from 40 to 50 cm high. I decided to make my midpoint 50 cm high and the sides 40 cm. This proportions created a harmonic and good looking shape, see Figure 25. Also my contact person said that traditionally a screen has been 48 cm high. This distance make that the worker will be below the screen when sitting forward in a work position but when raising the eyes, they are able to see over the screen. This makes it possible to work undisturbed and still talk to the neighbors when needed. I decided to have the highest point 50 cm and the lowest 40, this means that I am around that distance and the function can be applied to people with different lengths.

To find the angle I draw different angles and tried to place them at tables and to just look at them to see what felt best, see Figure 26. The angle ended up to be 145 degrees, this makes the screen fit at a workplace and it's angled enough to stand stable.

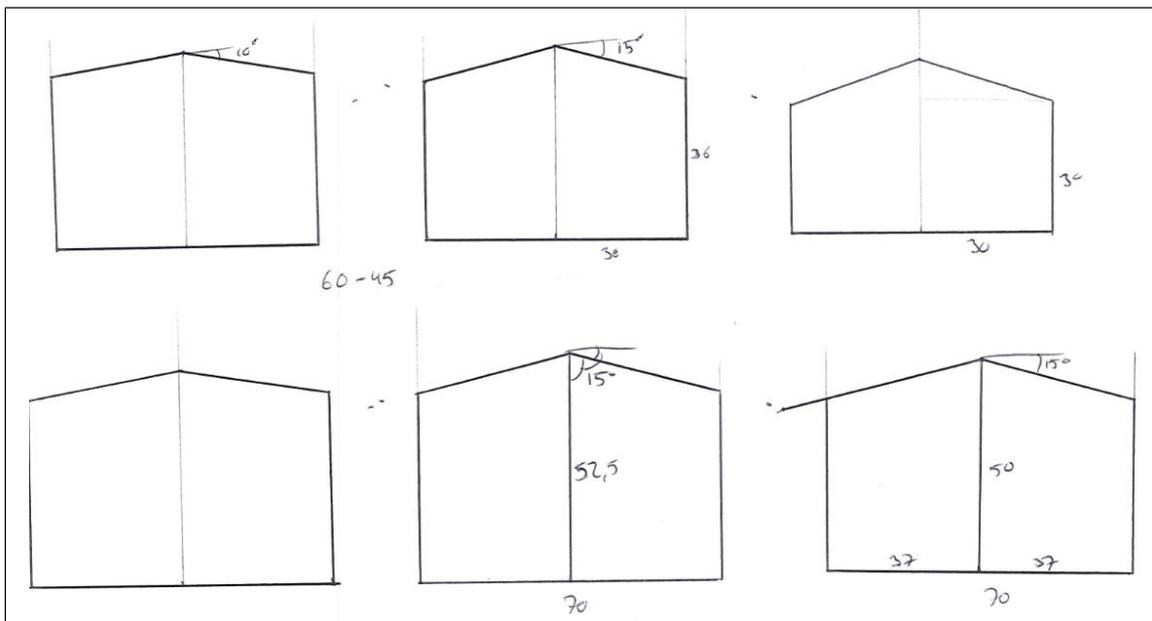


Figure 25. Trying different sizes and proportions.

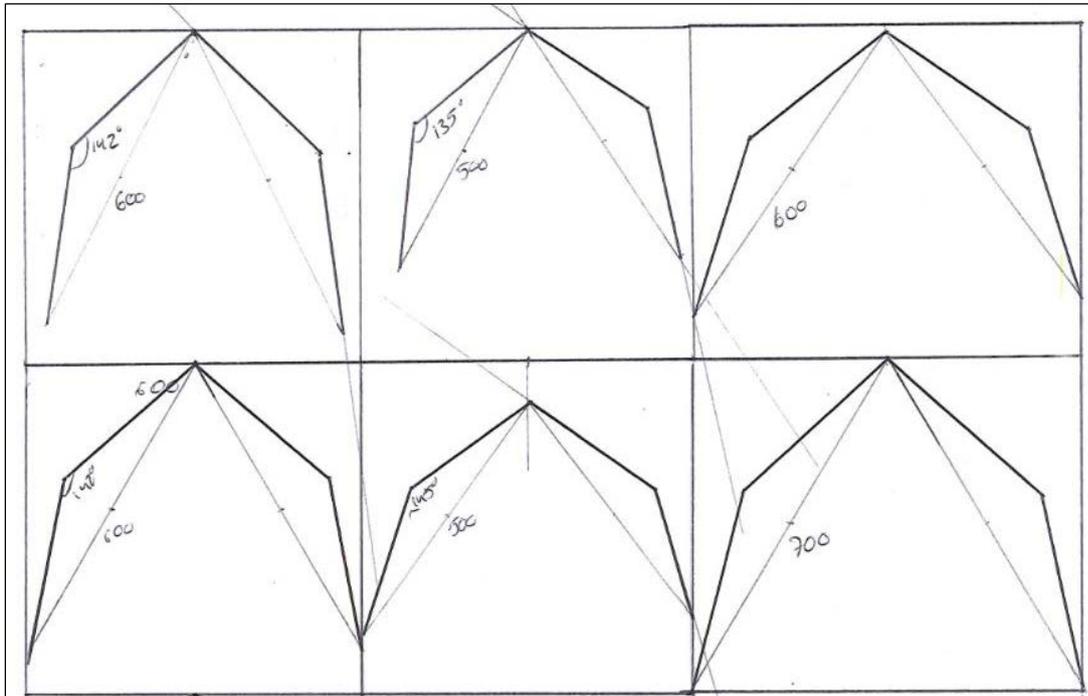


Figure 26. Trying different sizes and angles.

When the proportions were set I build two prototypes in real size and with realistic appearance. To build the model I used a plexiglass sheet as the frame and added softer plastic foam (Sika block) to create the thickness. Everything where then covered in felt to give the right view and touch. For pictures from the model building see Attachment 5, prototype building. The prototypes looked exactly as the final would do but the weight and sound properties were not correct. According to Bootcamp Bootleg what I did was prototype to test. I build the prototype to test specific things. And the testing gave that the size were very good and the angle made the screen stable. The stability was thou a bit unsure when the weight was a lot heavier than what it's supposed to be. The prototypes did also show that the dimension of the hole needs to be bigger. The plan was to have 40 mm diameter but I couldn't find any drill tools in the workshop with that diameter so I used 38 mm but it was too small to nicely fit two fingers. I build two models where the soft material was on different sides. This was to test which looked the best and to see if the stability changed. The one with the soft on the outside were more stable but the appearance were more or less the same. The decision was to build one more model with soft on both sides.

To find out whether the sides of the soft material had any impacts on the acoustic properties I went to Nya Musik which is a music store. I brought renderings of all three proposals, soft on the outside, inside and both, see Figure 27. I met a guy who had been studied acoustics at university level and were very much in to sound and music. He said that there is nothing that will be better to only have one side absorbing. If the other side is hard, the sound will bounce on that side. So the best way when it comes to sound is to make both sides soft and absorbing. The angled design gives the screen better properties when it's attached to a wall. The sound will hit the screen and some of it will be absorbed and some of it will continue thru and bounce at the wall. The sound will then once again

hit the screen, now, due to the different air distance between the wall and screen a wider frequency spectrum will be absorbed. Because of the wavelength of the sound, it has different optimum distance out from the wall where it can be absorbed as the most. The screen creates different distances thanks to the angle which is a good sell point for the product. To get this information were very useful for me and it gave a clear answer to the acoustic sides.

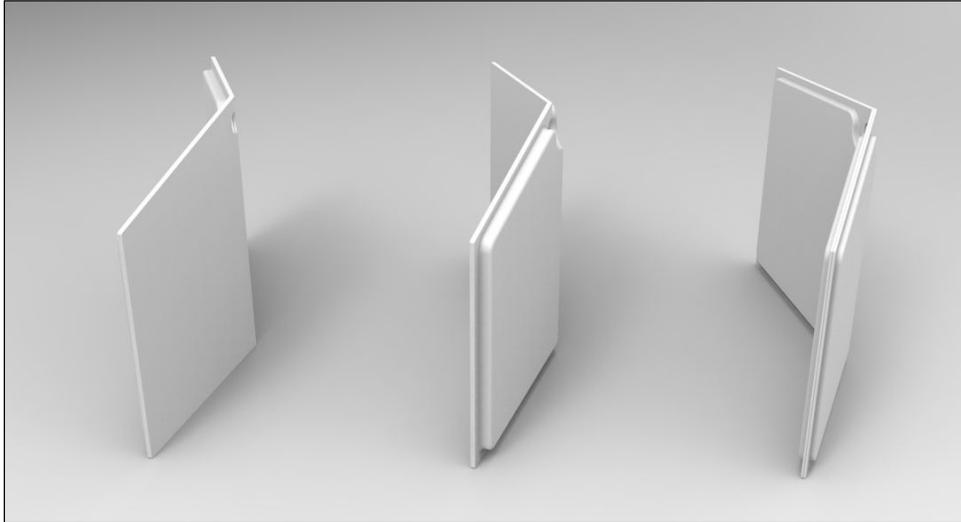


Figure 27. Three different ideas.

4.6 Second meeting

A new meeting was booked with my contact person and I presented the both screens. He liked the prototypes and thought the finish were good and that I had created them quick. He also liked the sizes and angles, we tried to place the screen in many different combinations on a table and everything felt good. When seeing the two types of placement of absorber also he thought that I should try to do a screen with double side absorption. To have both sides will also remove all questions from costumer why it's only on one side.

We discussed different places to store the screen at. The obvious place is on the wall but it can also be placed under the table, on a pole or in the ceiling, see Figure 28. Why it should not be stored in a locker or a box is that the screen will then lose its function. Even if the screen is not placed on a table, but in the room, it will absorb sound and create a better sound environment. The contact person liked the color combination between light gray and dark gray. The contrast gives a lot of impression and it also reflect the feeling of the company.

When the meeting ended we had decided that I should build one more model with absorption material on both sides. To do this I got an absorption material called Fiberspring, which they use in big screens today. When using the material, I will get a prototype with more realistic weight so the stability can be tested. I will investigate how and where to store it. I should also send drawings over the screen to the company to be forwarded to a manufacturer which they use to work with. We want the manufacturer to tell if it's possible to produce, if I need to change somethings and if it will work.



Figure 28. Different storage placements.

4.7 Prototyping

I build the new model with the same method as the first ones, used plexi glass for the frame and covered everything with felt. But this time I placed the softer Fiberspring material inside the frame instead. Also I increased the size of the hole to 45 mm, which according to both testing and anthropometry from theoretical background is a better dimension. The screen got a lot lighter and the impression very much better. It felt more worked and with a better balance when having material on both sides. One problem that occurred due to the weight were that the stability was decreased and the screen could easily fall. This I think would also be a problem at the real product which means it have to be solved. And it has to be solved in a good locking way.

To make the screen stable it had to be heavier in the bottom and to achieve this something has to be attached to the screen, either on the outside or the inside. If the weights would be placed inside the screen they have to be placed there during manufacturing which might be possible and it will create a smooth and slim product. It can maybe also be a problem to place something during manufacturing. I choose to apply the weight on the outside partly due to that it might be problem on the inside and mainly due to that it can be a nice detail which will raise the design level and give a higher impression. When attaching something on the outside, I will also have the possibility to play with color combinations.

To create the weight, I realized that I need metal to have high density and I thought of steel. To illustrate different ways, I created Cad models and rendered pictures of the different ideas, see Figure 29. I had the idea of that the logo of the company can be punched in on the metal to visualize the logo on a good way. I know that it is a method Ragnars already do to visualize the logo. I found out that I liked the metal strip that goes all around the screen the most. That design will also increase the stiffness of the screen which also affect the stability. The strip is not in line with the bottom of the screen just to make the screen stand on the felt to make the screen silent when placed and moved on a

table. If I used steel as a base it would have to be covered with something to achieve a silent usage. I created the strip but to ease the production for me I took two strips which I just bend once on the middle and screw them together on each side of the screen. The screen got a lot more stable both because the stiffness and the weight of the metal strips. The impression of the screen raised as well, it got a natural base and a good completion of the product. Even the screwed used for the attachment became a detail which contributed to the raised impression. The endings of the strips at the model does not look very good at the ends but that will not be a problem if the strip is bent around the edges, see Figure 30.

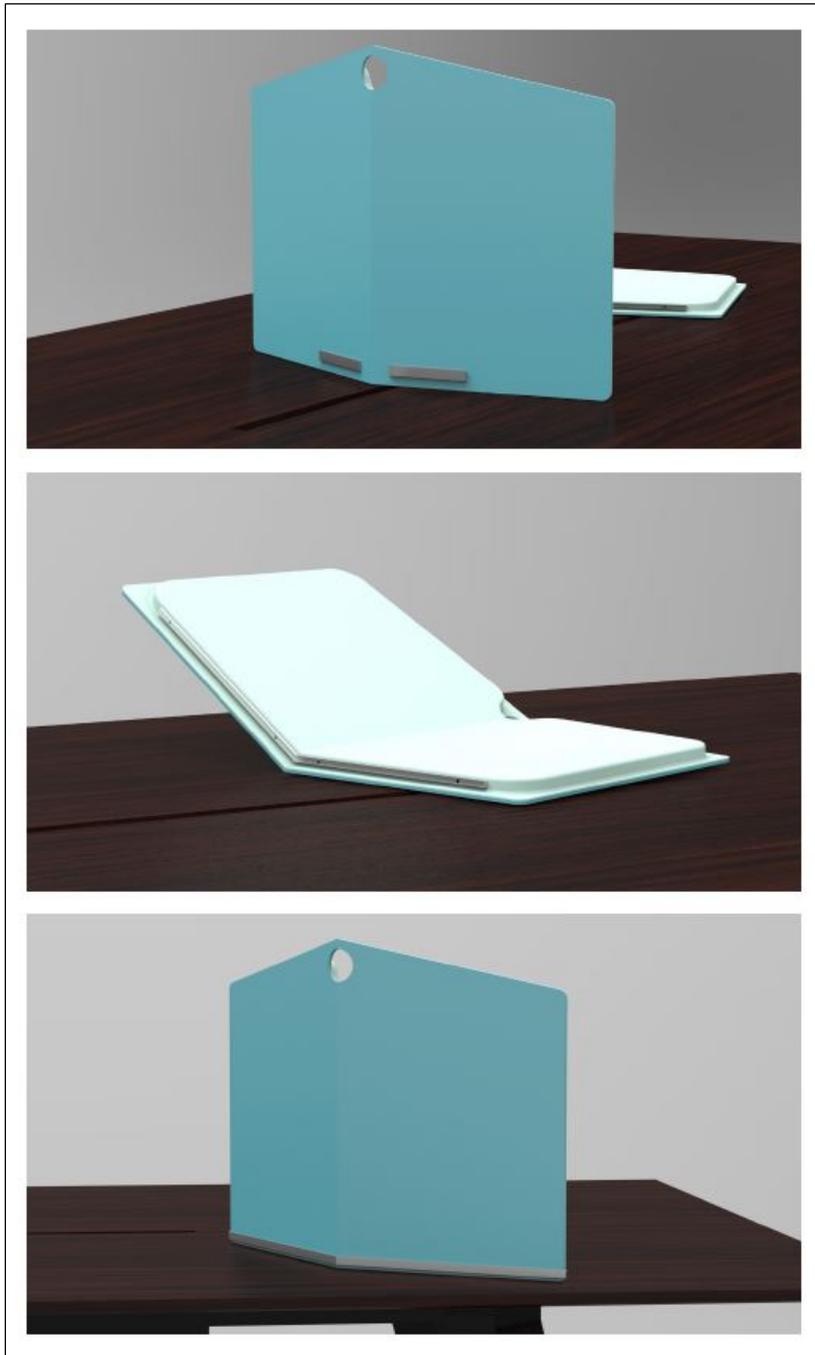


Figure 29. Ideas of stabilization.



Figure 30. Not a nice ending of the strip.

To make the endings of the metal strip better the solution was to bend the strip all the way around the whole screen as seen in Figure 31. In this way the ends of the metal strip will be in the middle at the inside of the screen and will be hard to see. It will also reduce the number of components thou its only one piece.



Figure 31. Good way of ending the metal.

The drawing was sent to the producer in Finland and I was waiting for reply. During the waiting I didn't want to do anything with the screen thou it might have to be changed again. During that time, I started to design the storage place for the screen.

4.8 Storage

It felt too much to design one solution for every possible storage place so I had to focus on one. After the meeting with Nya Musik I learned that the most effective way to absorb sound is at the walls. So to maximize the functionality of the product I decided to focus on wall storage. Another reason why not to continue with storage under table is that all tables look different and have different material. To create a solution for all types of tables might be a large and complicated task. Not to continue with the pole storage is because the sound absorption will not be as good as at the wall. Both ways are otherwise good solutions and will be suggestions to further work.

To start the process, I started with milling a small wood stick because the first idea I had was to use that as a hanger. Why I started with a small prototype was to get a feeling of it and to try how it works. I noticed quickly that the screen tilts when it's hanged due to the center of gravity is not straight under the hole. When the screen tilts it will not look good hanging on the wall with the dark side out. So to solve this I thought that I could turn the screen around to have the light side out. In this direction the base of the screen will rest against the wall and make the screen vertical.

When I tried to hang the screen on the wood stick I noticed that it was hard to apply the screen because my fingers where in the way of the stick. To be able to hang the screen I needed to use two hands. This was something I wanted to avoid to ease the use. To solve the problem, I thought of using wire which were bended to have proper strength. The wire hade two sides pointing forward and when placing the screen, the fingers will pass between the sides, Figure 32. This way worked very well, but it didn't look good at all. Neither the hanger or to place the screen with the light side out, which forced me to continue developing.



Figure 32. Test of wire hanger.

I thought back to my vision of the screen to be easy to use and to hang it seemed to mostly create problems. To ease the use as much as possible I thought that a shelf would be the absolute easiest way of placing it. We are used to place things at shelves and we know for sure that it will stand stable. I had already in the project designed one shelf for the honey comb pattern which my contact person liked. The problem with the shelf was that it was too big and too much effort to mount. I wanted to simplify the shelf and started to CAD some different ideas, see Figure 33. I wanted to keep the pattern but it is now an extended hexagon which will create a kind of honey comb pattern. At the left model in Figure 33 I thought of having the pattern still on the wall even when the screen is not there. To achieve this the frame is made of metal wire and also the support for the shelf. At the concept in the middle I removed the frame and thought that it will only be a pattern while applying the screen. This will give the screen an esthetic function when it's stored which I liked the idea of. At the right concept I simplified the middle more and it consists of only one bended metal sheet. The shelf has all the required features. It will create the honey comb pattern, it will provide a stable storage and it is super easy to use. To ease the usage even more the edge of the shelf is bended upward to create a board to guide the screen in right position and to prevent it from slipping of, see Figure 34. The idea is that the shelf can have the same color as the metal strip to match together.

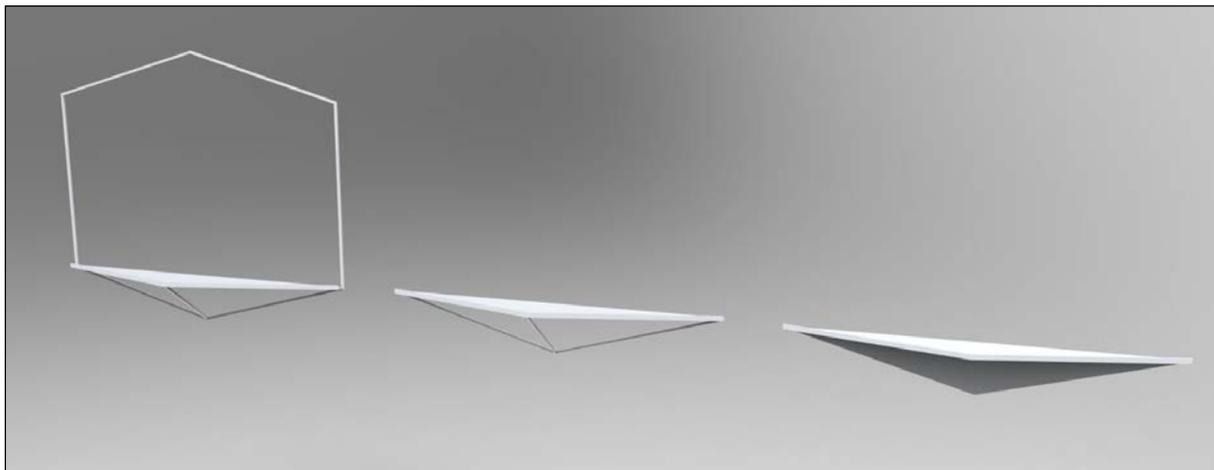


Figure 33. Ideas of shelves.



Figure 34. The final shelf.

When trying different things with the wood stick I accidentally discovered that if the stick is pointing downwards the screen can be hanged on it, see Figure 35. The off-centered center of gravity creates a lever effect at the hole and makes the screen to jam and even hang vertically. This was exactly the kind of extra design feature I would like to implement to the product and it is something the company will appreciate. The new way of placing the stick generate that the screen can be hang with the dark side outwards, which is the nicest way and it will hang straight. I created a prototype and found out that to make it work practically the stick have to jointed or flexible to prevent the screen from getting totally stuck and ease the usage. This was something I wanted to solve to be able to use the hanger as the final concept.

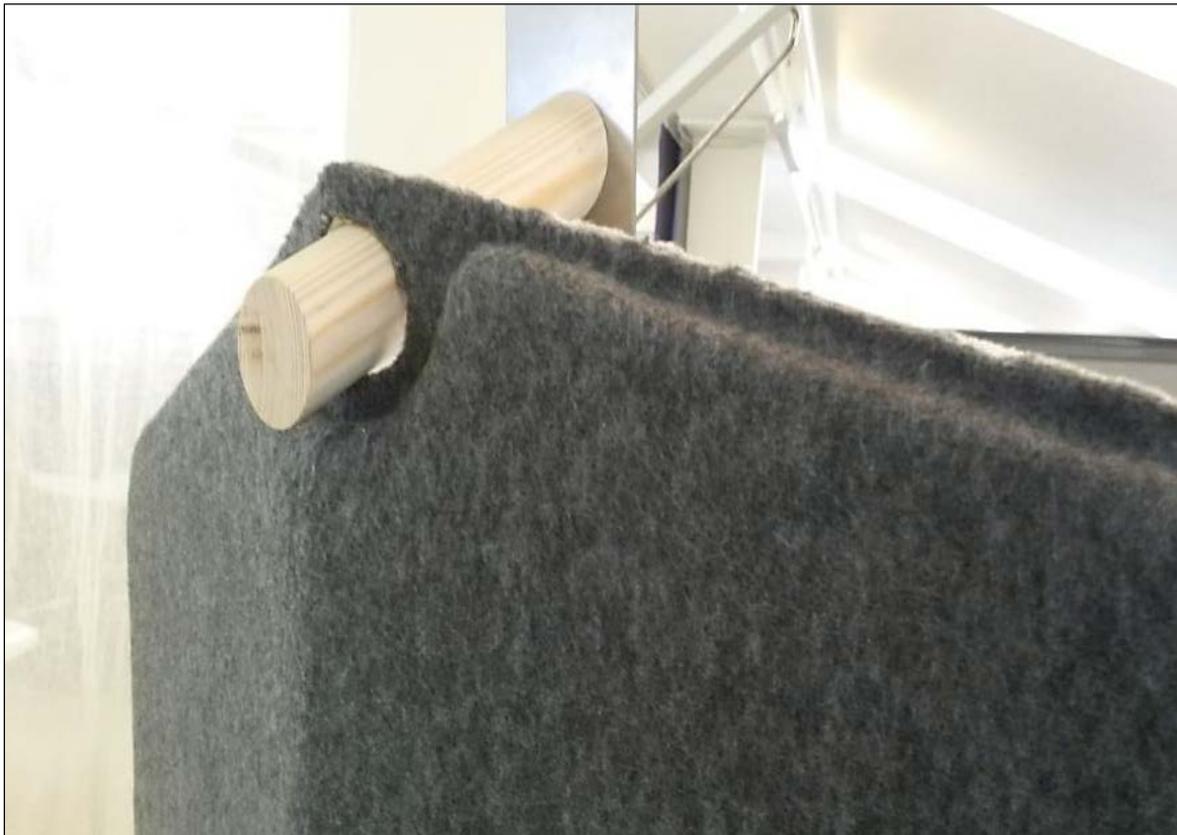


Figure 35. Wood stick hanger.

4.9 Third presentation

I booked a new meeting with the company where I presented the new double-sided model, the stick hanger and the shelf. I was talking to my contact person and he really liked the hanger. He thought it looked like it will not work and gives an impressed feeling when it does work. We decided that I have to solve the fastening to the wall and how it can be jointed. An easy way to make it a bit flexible is just to use the flexibility in a metal material. I think that small flex will be enough and make the hanger work perfectly. I also want to have place for the logo at the hanger.

About the shelf he said it was a good solution and nice feature to catch up and create the pattern. I will use it at the fair and maybe it can be the backup plan if the wood hanger would not work as good as wanted on the final product. We than discussed the screen

and he thought it looked good and the feeling was realistic. I explained that the metal strip was needed to stabilize the screen. The thing he wondered about was why I have chosen steel and if it could be changed to aluminum. Why I choose steel was due to that it is heavier than aluminum and the weight is important. To change the material, I also need to increase the volume to have the same weight. To be able to use an extruded aluminum profile would be very easy according to production and mounting. The only thing to do with the profile would be to bend it once and attach it. We talked about different solutions using L and U profiles. The problem with using a profile is that the screen will stand on metal which creates a sound against the table. But after testing with an aluminum profile against a table we noticed that the sound wasn't so bad at all and a solution with aluminum base would work. Another advantage of having an aluminum base of the screen is that it will not be worn out as the felt base might have been. Using a U profile will be the best solution thou it gives the largest mass and it will enclose the screen and make it more stable. If we are lucky it might only be to glue the profile to the base of the screen to attach it. Ragnars is also using a lot of aluminum in their existing products and this change will raise the recognition of the company in the screen. I got a profile which fit my prototype to test the new idea and see if it works. I also need to figure out again how to shape the endings of the profile to make it look good.

The contact person also had got reply from the producer who said that the screen is possible to produce. This was good news and it meant I didn't need to change the design. My contact person and the manufacturer will start a discussion over the product and how to proceed.

4.10 Finalizing

I changed the base on my prototype to the aluminum profile and it looked a lot better and it actually became more stable than before. The sound from the aluminum against the table were not bad at all and it was possible to glue the screen to the profile. The aluminum solved many problems. When using a U-profile the shape gives the possibility to create the bottom part slightly thicker than the sides to gain a little more weight and increase the stability, Figure 37.

To end the profile, I did fast sketches and choose the one that had the simplest expression, the smallest risk for damaging the table with sharp edges and had the best fit for the screen, Figure 36.

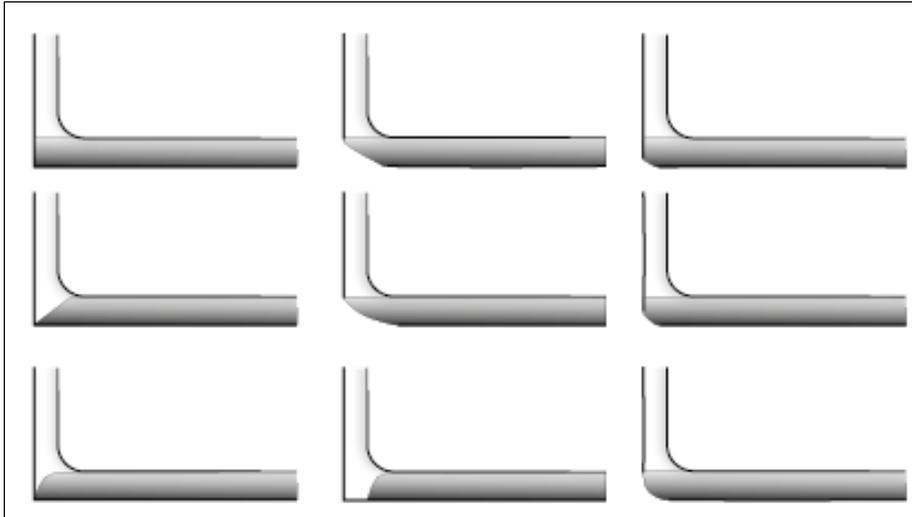


Figure 36. Endings of aluminum profile

I changed the prototype of the hanger to a bended aluminum sheet, this prototype enables the metal to flex and create the needed flexibility to make the screen stay on the hanger. The hanger and the shelf were than drawn in a computer program and drawings were produced. The drawings were sent to Ragnars for help to produce them to the exhibition. The benefits with letting the company produce them is that they will look perfect and get a specific color that looks like natural anodized aluminum which is the planned final appearance.



Figure 37. Final model.

5 Result

The result is a screen which will be placed on the table between employees to screen and absorb sound. The functions, properties and dimensions will be described in this section. This is the result of the design approach described above. Only the final features and functions will be presented.

5.1 Functions

The main function of the screen is to provide screening, in this means both visual and acoustic screening. The acoustic screening works due to sound absorption and blocking the sound. The material in the screen works well to absorb sound. To improve the absorption, the thickness need to be raised, this was gained when choosing to have the acoustic material on both sides of the screen. The angled surfaces make the sound to split and bounce in different direction. When the screen is placed on the wall the absorption function will still be there and it will even work better thou the sound pass the screen twice, due to bouncing at the wall, Figure 38. The angel makes the screen to absorb a wider range of frequencies. Due to different wavelengths has the sound wave different distance after a bounce where it will be as most absorbed. The angel creates a variety of distances behind the screen making the screen absorb more sound.

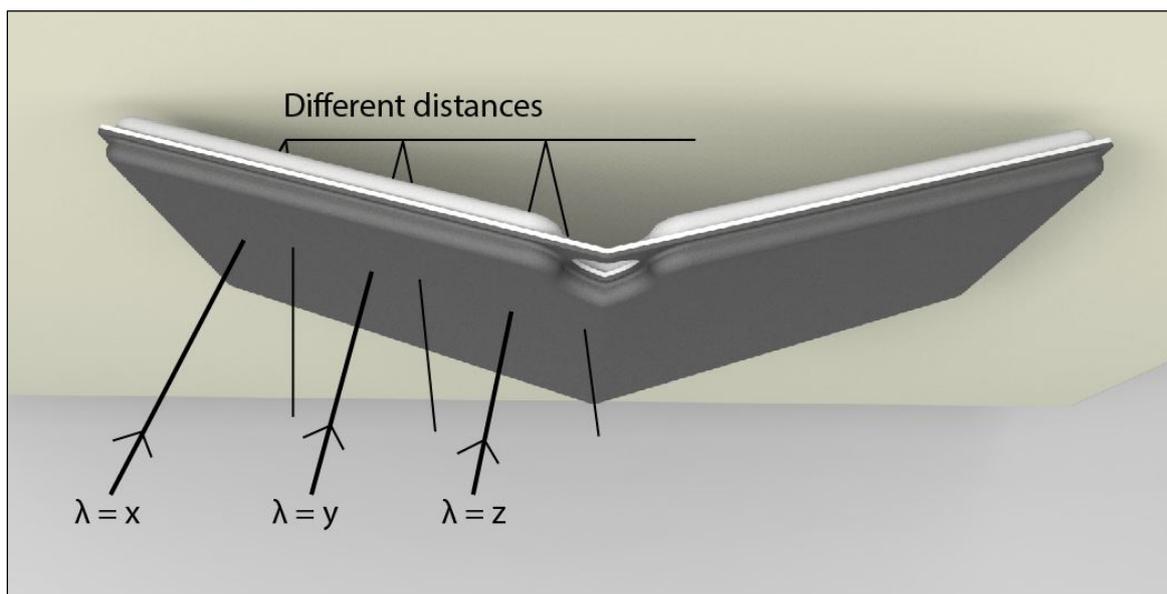


Figure 38. Different distances behind the screen after wall bounce.

The function of visual screening is clearly working thou the screen have material which is not transparent and a proper size. The size is crucial to the feeling of privacy and it feels very good, how the sizes were set will be explained in chapter, size and shape below. The size does satisfy the feeling of visual screening and privacy.

It was important to make the screen feel dynamic and easy to use. To enhance the dynamic feeling I made it look easy to move, this was made thru the hole in the top. The hole invites the user to grab it and quickly move it. To be easy to use, it also has to be stored in a good way and to be stable when standing on a table. The storage is solved with

using the hole to hang the screen on a wall, or it can be stored on a shelf. The ease of moving the screen will also make it easier for the cleaners when wiping the tables. They can easily lift the screen with one hand and wipe under it with the other.

Maybe the most important function was to make the screen to stand stable. After the prototype with correct weight it was obvious that the screen would need help in some way to be stable. The screen has an aluminum U-profile under the base to provide stability. The profile makes both the screen stiffer and it also provides a weight to help the stability. The stiffness is increased due to that the aluminum profile don't bend as easy as the screen do. It's good that the stiffness is increased because without the profile the screen tends to fold up when it is pushed and creates an angle closer to 180 degrees which make it unstable.

The aluminum base will make the screen more resistant against wear from usage. And it creates a perfect place to place the logo at. The profile is flat at the side and a punched logo there looks very good. The placement is at all times visible and the company can be displayed a lot.

If using more than one screen on a table, the screens can be fitted tighter to create a bigger screen or to be more useful. The sides of the screen are vertical which give the possibility of placing them flush together. The angle increases the possibilities and creativity to place the screens in a way that is perfect for every moment, see Figure 39.

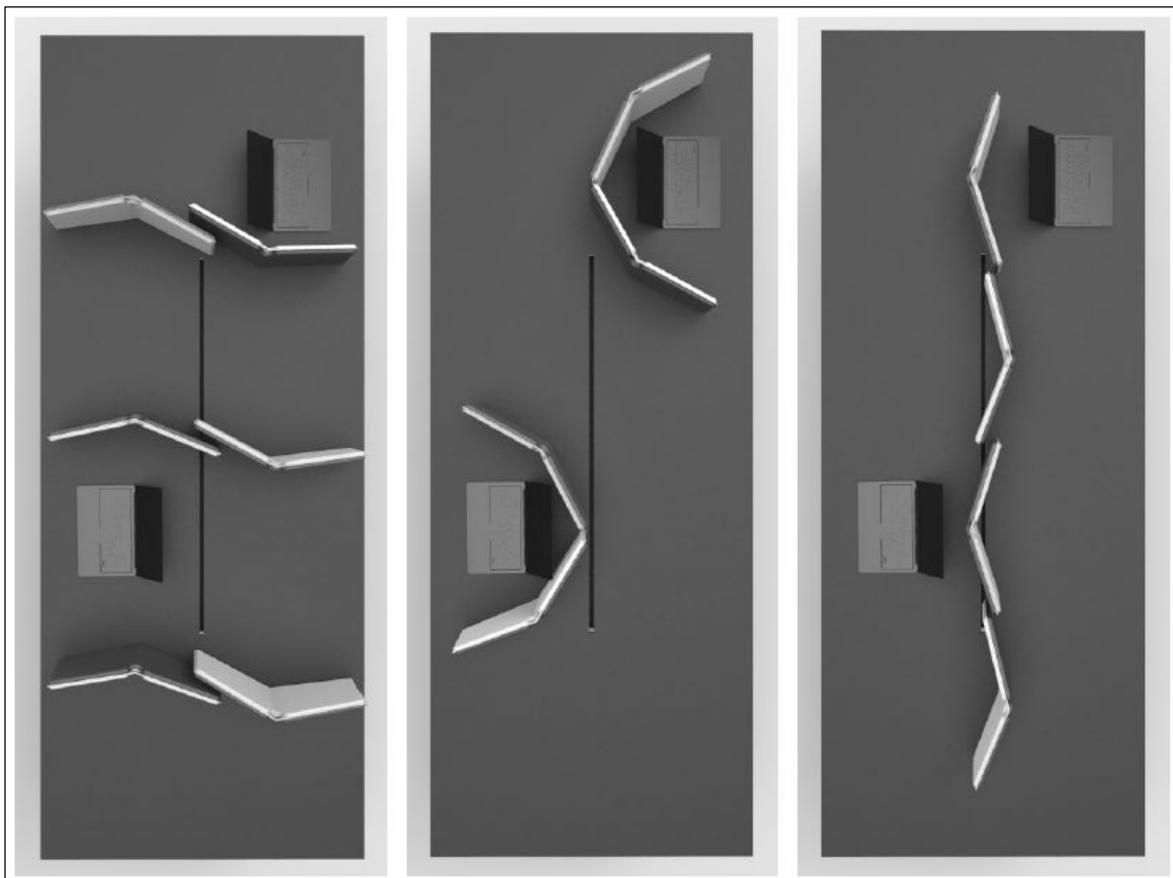


Figure 39. Different ways of placing the screens.

5.2 Colors

The colors I have chosen for the screen is dark gray and light gray. Why I chose that was that I felt good in the beginning, and when testing it, it appeared to be very good. The colors fit the company's style, where a lot of the products are dark. They also have the contrasts between black and chrome or aluminum, the contrast is very strong at the screen which make it fit the existing products. To make the screen strict and not playful contributes to the professional and premium feeling which is the company's target group. The inside of the screen is light to create a better work environment concerning light. The light gray color reflects the light from the luminaires and make the work area lighter than comparing to the dark gray. I chose light gray instead of white, which would have been better according to light reflection, due to it is more resistant against contamination. White felt would quickly have been dirty and looked bad around the hole where it's supposed to be lifted. Of course it's possible to produce it in different colors as well but my decision is to always have the same light gray on the inside and then change the color of the outside. The colors to be chosen for the outside should always be darker than the inside to keep the contrast.

The aluminum profile can be anodized in different colors, the standard is natural anodization. Again it can be anodized in different colors to match the outside of the screen or maybe the office it's placed in or the costumer's color.

There is a lot of possibilities to play and create different color combinations and this is an option I am presenting. This will create a greater value for the costumer. The standard colors are dark and light gray and nature anodized aluminum, Figure 40.

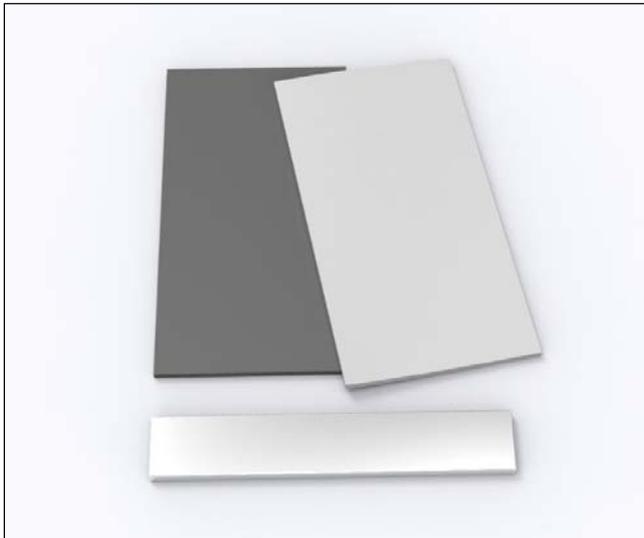


Figure 40. Light and dark gray felt and nature anodized aluminum.

5.3 Materials

Felt it is a material that fit in most offices and will not be perceived as odd or weird. The feeling of it is soft and warm which will cause no problem when sitting close to the screen. To have felt on the outside creates a feeling of sound absorption. Since the screen also is sound absorbing the absorption will be expressed as much greater.

The aluminum expresses a feeling of premium and quality. This is feelings attached to the company's value and the expression of other products. The company does use a lot of aluminum which make the screen to fit the assortment. Aluminum is a good choice also for environmental aspects and that it is a metal people usually not are allergic to. The soft aluminum makes the production easier and to punch the logo will be easy.

5.4 Size and shape

During the whole project the focus have been to simplify the design, which have been accomplished. The product is very simple, there is nothing unnecessary and the design show the functions in an easy way. The shapes are straight lines, and circular radiuses and holes. To use basic geometric shapes, the impression will be simple and clean. We are trained to recognize geometric shapes. We can immediately see if a line is not straight or if a hole is not round. So to use straight lines and round holes the user can feel relaxed when observing the screen.

The volumes and axis are ordered in a way that is the optimum according to Rowena Reed. The screen is the dominant volume with a vertical axis. The aluminum profile is the subdominant volume with the axis horizontal in the direction of the profile. The sub ordinate volume is the hole, wish have the axis in the direction of the hole.

To fit the 5 series that Ragnars have it is important to have a premium feeling of the product. The straight lines and the contrast color contributes to this feeling. The straight lines do also fit the rest of Ragnars assortment and style. To apply the observed trends, I chose to create the inner edges of the screen rounded and soft, see Figure 41. This connect the product to the modern trends when locking closely at it. When looking from a distance the sharp edges of the frame will be visual. This combines the company style and the modern style. The rounded inner edges emphasize the feeling of sound absorption and calmness.



Figure 41. Rounded inner edge and sharp outer.

The outer sizes of the screen are shown in Figure 42, the width of 700 mm comes from that the normal work space has that width. To have the same distance gives the possibility to cover the whole side of the area. To have a bigger screen would remove the possibility for some placements. The outer height is 400 mm and the inner is 500 mm this place my screen in the centrum of average heights of other existing screens. Testing shows also that it is a height that feels good, you get a feeling of privacy and you can still look above it if you want. The height is also not too high to make it difficult or hit your feet when carry it in the hole on the side of your body with straight arms. The angle is 145 degrees, this is an angle that is big enough to make the screen stable and small enough not to occupy too much space.

The diameter of the hole is 45 mm, this comes from the anthropometric measurements to fit two fingers at the first knuckle.

The frame around the screen is 10 mm wide, the frame is the structure of the screen and need to have a proper size. At the bottom the frame is 15 mm to be able to fit the aluminum profile which want to be 15 mm high. Why the profile wants to be as big as possible is to use the weight of it as much as possible. The profile is a U-profile to have more mass than an L-profile. The U-profile is easier to attach than L-profile thou it can be glued on.

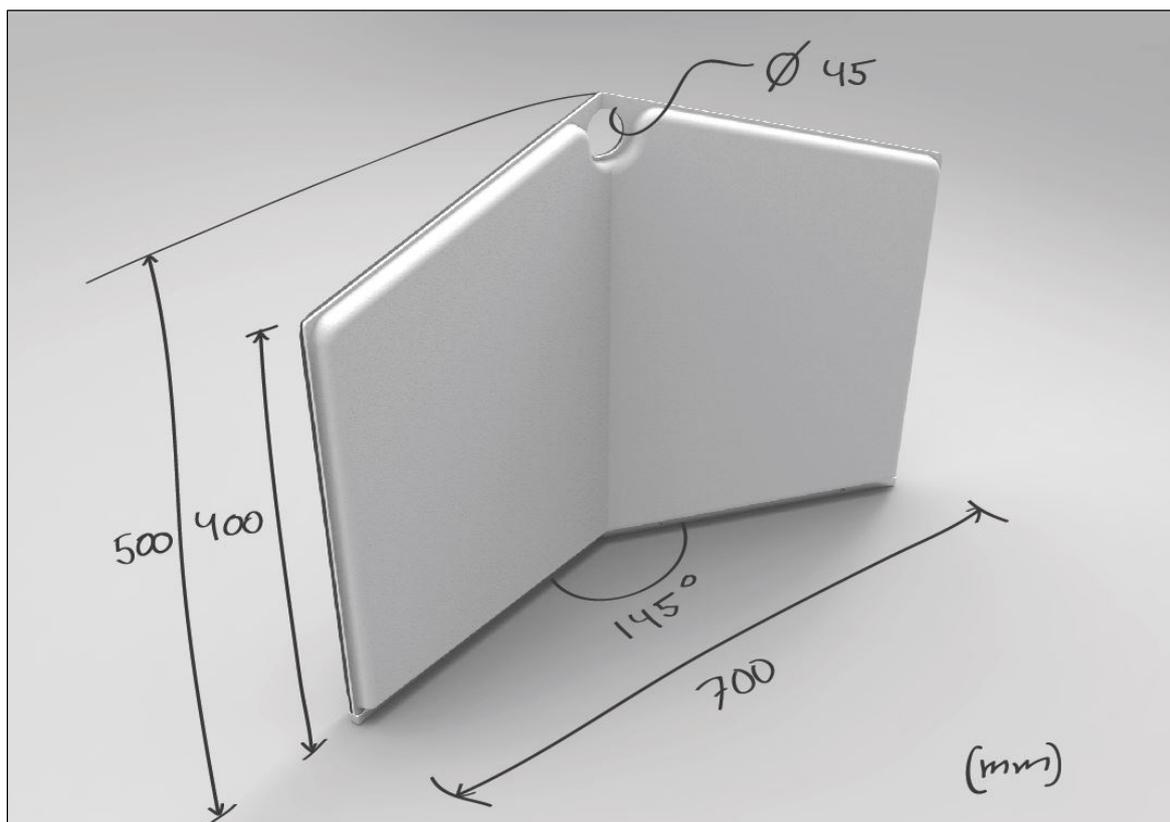


Figure 42. Sizes of the screen.

5.5 Hanger and shelf

The self is produced in 1.5 mm aluminum sheet with nature anodized finish. The finish is the same as the U-profile on the screen. The lower part of the shelf has the same angle as the top of the screen, this makes it possible to create a stretched honey comb pattern on the wall when stored, see Figure 43. As seen in Figure 34 there is a small edge on the front of the shelf, this is to guide the screen into right place and to prevent it from falling off too easily. The shelf is attached with two screws in the wall.

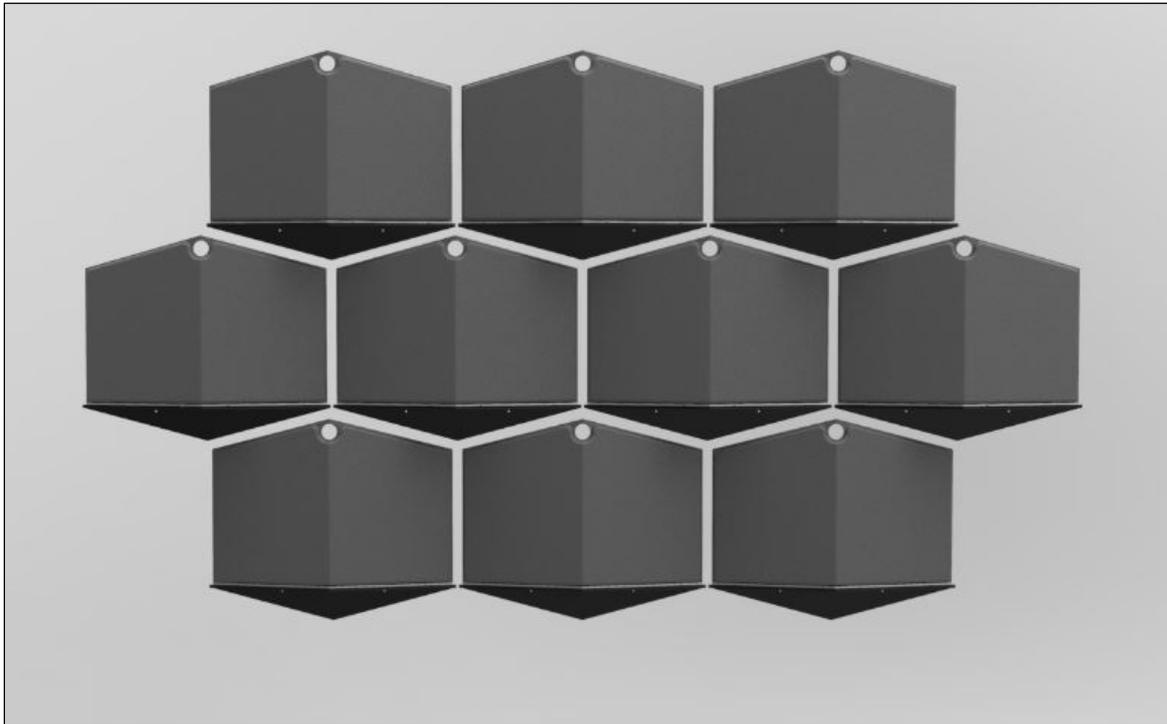


Figure 43. Stretched honey comb pattern.

The pattern gives the product a higher value for the customer though it appears very nice and good looking even when it's stored. It is also something that the company likes though it's easier to sell the concept.

The hanger is produced of ash wood and 1.5 mm aluminum sheet. The appearance is unusual though the hanger is pointing downwards but the function is really good and it makes the screen to hang vertical, Figure 44. The aluminum is also here nature anodized and the wood is ash to fit the company's assortment. At the top of the aluminum part is the company's logo placed. To make the hanger to work it was important to be able to move the stick a little bit, this movement will ease the use. If the stick is static it will be very hard to remove the screen from the stick. The movement is created by the flexibility in the aluminum due to the way of bending it. The flexion the hanger produces is enough to create the easier usage and still be stable enough to hold the screen.

A feature of the hanger is that it can only be used to this screen, it's impossible to hang anything else on it. This is good though then users will not use it for their jackets or bags.



Figure 44. Picture of the hanger.

5.6 Economics

The production cost is calculated over a production of 1000 screens. This means that for example the cost of the tool is spread over 1000 products.

Material cost: 923 SEK

Manufacturing cost: 53 SEK

Other costs: 176 SEK

Total: 1151 SEK

The calculation has been made by my contact person at the company. According to him the price for the customer will be.

Screen: 2800 SEK

Hanger: 250 SEK

Shelf: 250 SEK

6 Conclusion and discussion

Thoughts and reflections over the result, method and project will be discussed here. The discussion takes up parts that didn't fit in the result part. The discussions analyses how things have been if other methods and approaches were used. The decisions are important to give the reader a deeper understanding of the design methods and why things were chose as they were. The section ends with a short conclusion over the project where the report will be summed up.

6.1 Discussion of result

The result is a screen, a shelf and a hanger. The screen is the main focus and will also have the main part of this section. The decisions that lead to the result will be discussed.

6.1.1 Compared to requirements

The report and project started with a list of demands, the demands were: fit 5 series, use molded felt, absorb sound, have included functions, feel dynamic and be able to build together with each other. I think all requirements are fulfilled in a good way. The screen fit the 5 series due to the simple but well thought out shape. The straight lines and angles are element that Ragnars use a lot and especially in the highest class. Even the contrast color contributes to the high-end feeling thou it creates a strict and professional impression. It feels like a product that can be used in modern offices. The screen is produced of pressed felt and the felt have been used in a way that use the properties very well. Both the acoustic and stiffness properties are used from the felt. The screen is self-standing due to the possibility of heat treat the felt to make it stiff. As well as the inside of the felt is porous and absorbs sound in a good way. The extra functions of the screen are that it can be stored and moved quick and easy. Even the way of storing it with the wood stick gives an extra touch to the screen. The hole for grabbing and hanging is the key to the functions. Without the hole the screen would feel a lot more static and the feeling would be that it should not be moved. Now the feeling and impression is that it should be moved a lot and used in every moment. The straight sides make it possible to put many screens close to each other to create a bigger screen or a pattern to screen in different ways when needed.

The research question to be answered was:

- How to solve the need for screening at a modern workplace according to Ragnars design language?

To reach an answer for the question, it was divided into smaller questions which was:

- Which function will be included?
- How will it look?
- How will it work?
- What is Ragnars design language?
- How can it absorb sound?

- How will it be produced?
- What are the future trends and needs?
- How can it provide a greater value for the company and the users?

The main question has been answered in the report by answering the smaller questions. The answer is to use the developed screen. The smaller questions have been used as guidelines to provide the greater question with fragments which were put together to generate all properties of the screen. The main question was formulated in a way that didn't say if it was a table screen that should be developed. The goal was to screen the workplace and the solution became a table screen. To not just create a random screen, it had to fit Ragnars style, otherwise the company will not like it and not sell it. It's hard to measure if the screen fit the company but according to me it fits well and when talking to my contact person it does also fit the company.

When it comes to the function analysis which in a way also is requirements. The analysis is presented in attachment 4 and shows that the main function is to provide screening, which it does very well. It is easy to use, easy to store, it stands stable, it's possible to produce, it's easy to produce, it has appealing design and it can display the logo. This is some of the function that it fulfills. Some functions that were mentioned which is not fulfilled is the possibility to store personal things on or in the screen also not design to put post its or thumbtack needle on it. This was a decision I made to keep the screens clean and always good looking. Also due to that the screen not will be used as a static screen covered in notes. If no one puts notes on the screens they will also not feel personal and the screen can be shared and moved easier also according to feelings.

The requirements have been fulfilled due to the methods I have used. If other methods were used another result would have been achieved. How the methods have answered the research questions and formed the final result is described in 6.2 discussion of method.

6.1.2 Materials, colors and shapes

During the whole process everything have been simplified as far as possible. To simplify left me with straight lines and geometric shapes. The simplification keeps the essential in the feature and removed the thing which is not needed. For example, at the aluminum base. Before it was two metal strips attached with screws, the simplification made it to one bended aluminum profile which can be glued on. This removed the screws and also the small edge of felt under the metal creating a simpler expression but also a stricter and well thought thru. But if I make it to simple the functions and vision will be totally wrong. It has to be done with a balance, if simplifying it to the simplest nothing would be left. It still has to fulfill the requirements and be a useful product. The simplification has been a help to understand what the important parts in the product are.

The simple design removes thoughts from people's head why I have been doing in a specific way, now you see what it is and no questions can be asked. This is also a way of making the users concentrate on their work instead of thinking on the screen. The colors are also simplified thou it is dark and light gray. The colors fit everywhere and they don't

express any unwanted feelings. This is also why no pattern have been created, neither in colors nor in structure. To keep it simple and strict have been a big part which I think I have been successful with.

Felt is a good material for sound absorption but it also expresses a feeling and touch of sound absorption. With this I mean that only the view of the material creates a feeling of sound absorption. To have the expression of sound absorption will increase the impression of the physical absorption. The material does also give a warm and cozy feeling which is important when the users sit close to it during long time periods. Why the material creates these feelings is due to perception. The perception of felt is that it is used for absorption and for blankets. This is what the users know from before and will apply the same vision on the screen. This gives the screen a better experienced function.

One desired function was that the screen itself should be as quiet as possible when moved around on a table. To achieve this was why there were no metal on the underside of the base in the first prototypes. But when changing to the aluminum profile there had to be a metal base. My expectation was that it should create a bad and scratchy sound, but it didn't. I think the smoot surface of the aluminum creates less noise and that it becomes isolated in some way due to the felt inside. This shows the good things of creation prototypes to test. There were many problems solved and benefits gained when changing material. And the only thing that were about to stop that was my own assumption.

6.1.3 According to the company and trends

Compared to the visual brief in the approach section is the screen fitting the company's style and existing products. The brief was made to illustrate the company so it is a reference which can be used. The brief consists only of products and pictures from Ragnars assortment. The style of Ragnars is very simple and strict, this is achieved by using straight lines, squares and smart solutions. The screen fit those preferences very well both according to me and my contact person. The smart solutions come from the way of using the felt in two ways, the handle and the way of storing it. The wood stick that is pointing downwards was something the company really liked. The impression of that it will not work but still work really good is why my contact person liked it. This is a feature that make the product more interesting. Again the solution was discovered by using prototypes and to test, it would be impossible to figure out that solution with just sketching.

When it comes to modern trends in furniture the screen fits according to the soft and rounded corners on the inside of the frame but also the edgy outside. The combination of soft and hard is how I interpreted the trends after the furniture fair in Stockholm. When looking at the pictures in attachment 2 you can see the combinations in many products and I think it is an interesting meeting which I guess will stay for a while. The thing that doesn't fit that well is the colors I have choose. The trends in furniture are pastel colors in playful combinations. But to better fit the company the gray was chosen. And the possibility to produce the screen in different colors is still there and the change is easy to do. If the product becomes a product with long life in the future other color trends will

be popular and the company is forced to change colors. So it's good that the changing step is easy. To change colors only the felt, have to be bought in different color and then it's the same process. But when looking at modern architecture as shown in attachment 3 the colors are matching very well. The architecture is very much black and white which is similar to my light and dark gray. Even the shapes of the architecture are very similar to the screen. It's a lot of edges and angles, which creates interesting effects instead of creating the same effect with color. To use color with less expression the shape will be the most interesting part.

The light and dark gray is also reflecting the company's style thou they use a lot of dark colors in combination with metal. This creates a contrast in the same way as the color combination does. To use aluminum is also a way to better fit the company because they use it a lot, especially natural anodized aluminum. To fit the company is maybe the most important feature after providing screening. If the screen doesn't work no one will buy it and if it doesn't fit the company, they can't sell it.

The company likes the product and they are in writing in discussions with producer of how to continue to produce the screen.

6.2 Discussion of method

Discussion of methods are presented in this section. The discussion takes up how the methods was chosen and the use of them. The used methods lead to the presented result, but if other methods would have been used a different result might have been achieved. How the methods shaped the result is the focus in this part.

6.2.1 Prototypes

The way I have approached the work is designer based. [21] This means according to Desmet and Hekkert that the designer can be seen as an author. The author writes the book and the reader interpret the text and feel different things while reading. The same way the designer design the product that the user use and see and feel different feelings. In a designer based approach is it the designer which have set the frames of the work which is what I have done. I have also got some frames from the company but in this case they are seen as part of the designer. What the final product actually express and provoke in the users is unknown for me. This might be a step to test before launching the product. Hopefully the emotions of the users are as I have thought they should be when designing. What is known and sure is that the problem of crowded offices is real and needs to be improved.

To test my ideas, I have built prototypes during the whole process. The prototypes have led me to new ideas and new solutions. The way of working with iterative process and testing a lot, have created a better solution compared to using the first idea. Every loop I have done in the process makes the product a bit better in some way. For examples is the metal base a result of testing the stability and to use aluminum is a result when testing with the company. When testing and showing for and with the company I have learned a lot of silent information about the company. What I mean with silent information is

elements and shapes the company uses without reflecting over it. In the beginning of the project I didn't know very much of the company's design language though they had hard to explain and show it. But now after meetings, presentations and discussions I have a great understanding of how they want to have things, what they usually use and what the feeling of the product should be. So, to test and show different ideas the core values of the company have been interpreted in the screen. I think this way of using design to find out information also is a designer approach, though I have been in charge of the prototypes and all testing materials is created by me. It's my thoughts that are visual and maybe if I had shown different things the company would have said something else or liked other things.

The method where the outcomes is both design and research is called research through design. [22] This is what I have done, I gained both design and knowledge from my work.

To use design methods, I have gained knowledge about the company but also about the felt material. To use the material properties in two ways at the same time is a result of generative thinking which created a solution with only the frame of the screen to be heat treated. The knowledge about that the wood stick hanger pointing downward is working is a result of prototypes and testing.

6.2.2 Method and result

I chose to use a design thinking methodology by using Bootcamp Bootleg, why I chose that methodology is because it is the one I have been using the most before and feel comfortable with. If I had used other methods, I guess the result would have been different. A similar method is the double diamond, Figure 45. The two methods are in many ways similar. For example, is the first diamond in the double diamond method exactly the same as the two first steps in Bootcamp Bootleg, Figure 46. The goal of these steps is to find, empathize and define the problem or statement. This part has been the same neither which method used. In the second diamond and the three last step in Bootcamp Bootleg is the main difference the test part. For me it has been the testing that have been the engine and most important part of the project. I am sure of that with a method without focus on testing I would have reached a totally different result. In the double diamond method is the iterations only between ideation and prototypes, if you just build a prototype you don't know what to continue with when going back to ideation. There have to be a meaning of the prototypes, for example to test something. When testing, different result will be achieved and the ideation have something to be built upon. The prototypes will also be built in different ways depending on what the aim for the testing are. When I wanted to test the sizes of the screen I did a prototype in cardboard. When I wanted to test the appearance I did the prototype of a hard plastic material and when I wanted to test the stability and sound absorption I build the prototype in a material as close to the final material as possible. This is an important part of the prototypes which easily will be forgotten in the double diamond method.

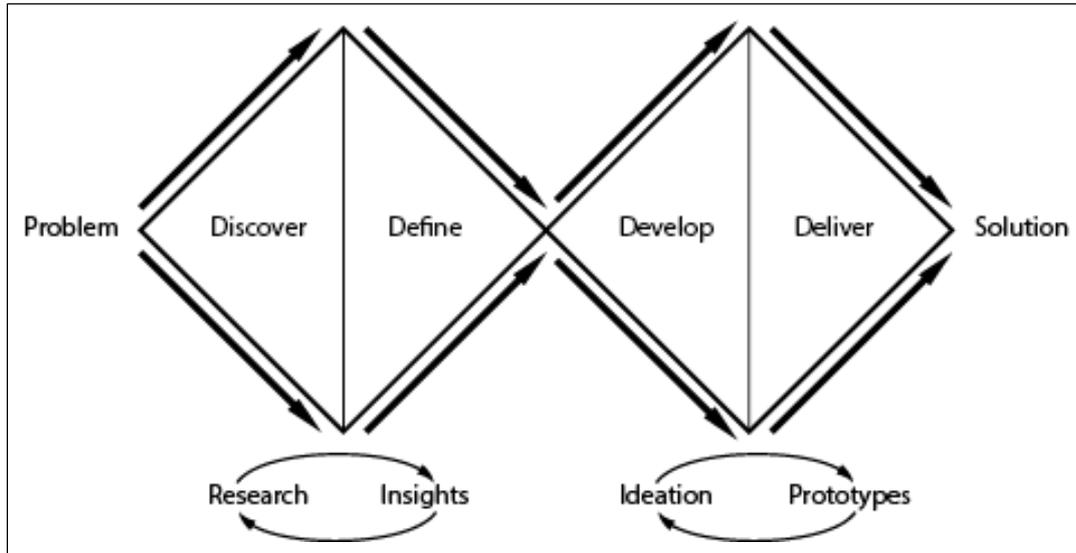


Figure 45. Double diamond.

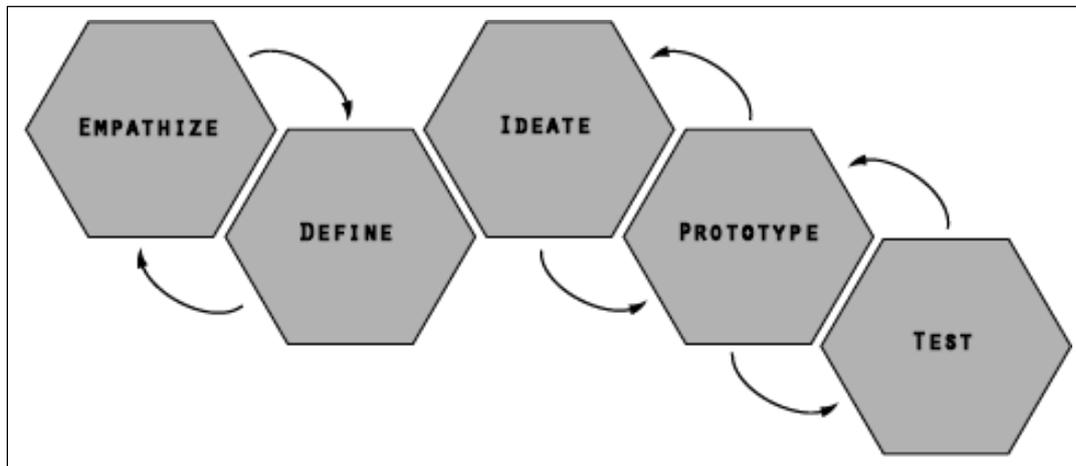


Figure 46. Bootcamp Bootleg.

Personally I think the word develop in double diamond is too wide, it's almost the same as all the three last step in Bootcamp Bootleg. To develop is according to me the whole process and not a single step. Therefore I prefer Bootcamp Bootleg with clear and specific steps, I know exactly what to do all the time. Another positive side is that there is a lot of suggested activities to perform under every step in Bootcamp Bootleg. This gives me a lot of tips and tools to find out what I am looking for.

When looking at the two different methods I think double diamond looks more complicated and harder to understand. This makes that I have to spend effort on understanding what I am doing during the process. When following Bootcamp Bootleg it's easier to know where I am and what I am doing. This give me more time and power to put on the actual design work.

Overall the idea of both methods is to iterate. That one thing leads to another, which is very important in designing, the best ideas will never be the first. Also the first definition part of the methods is the same and when the definitions have been made you can't change them. If you change the definition late in the project all ideation and development

have to be redone due to the frames and aims have been changed. The design work is built upon the statements set in the beginning.

In the iteration loops evaluation have been done and mostly it is based on my own thoughts. These evaluations have made the decisions and result to mirror me and my thoughts. This makes me as a designer very important for the result. Another designer would have gained another result with the same methods. This is of course due to my own taste, ideas, vision, experiences and tacit knowledge. This is the unknown knowledge which I have inside me. This knowledge is important to use and makes the product unique due to the designer.

Another way of developing products is to use the funnel view. The funnel starts with a lot of ideas which narrows down to where only one is left, Figure 47. This is also what I have done, it started with a lot of ideas that were narrowed down. But instead of just passing thru the funnel once I have been going thru it many times with different ideas and trying different things. The way shown in Figure 47 is for me a more engineering way of solving a task. When the goal is fully defined and you can follow the funnel to get there. For example, this method has been used on small part in my project. When figuring out how to attach the metal o the screen I had some ideas, putted up definitions, sketched some ideas and then used the best idea. But as a main method this would not be good thou the iteration and testing is not possible. It's from the testing the knowledge about the product is gained.

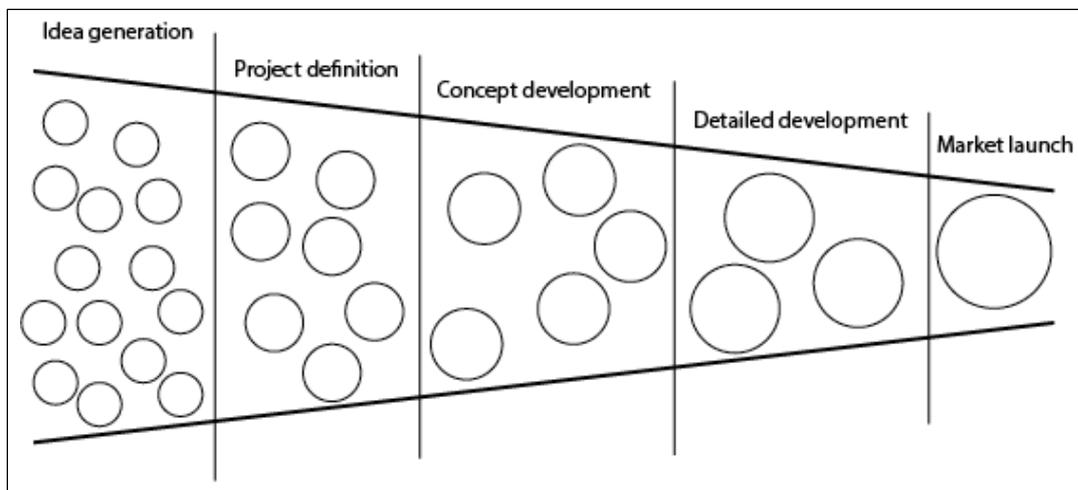


Figure 47. Funnel idea of product development.

For me the method and all steps have been a great help to reach the result and to make the result to fulfill the requirements. The most important part to fulfill the requirements is to state the problem and the frame correct in the start of the project. If the frame is wrong the whole project will have the wrong aim and will end up in something which is not wanted. When I stated the frame I thought thru the idea and problem and tried to understand how it could be solved. Then as the most important step I discussed the frame with my contact person at the company. He agreed on the frame and from this step I could rely on the base I had created. To know the requirements and understand them, I would say is the key to be able to fulfill them.

6.3 Discussion of project

The project has been very fun and I have learned a lot. I have learned how it is to work in collaboration with a company to develop a real product. The most important findings are to communicate and be open. To listen to tips and questions during the process give much valuable input to the project. This input is gained thru being open minded and thankful for other people's opinions. It's important to remember that I don't design for myself, the design is for the company and the users. To keep that in mind makes it easier to do changes and to kill darlings. The input I have got from the company has been very useful and essential to reach the final result. We have had discussions over choices at every meeting and after every meeting have I felt that many huge steps have been taken. The discussion with my contact person was also good thou he has very much knowledge both about the company's values and what is easy and difficult to produce, this makes the discussion valuable for me. At the meetings I have got a lot of question over why I have done in a specific way, I did always have an answer to the decisions but I noticed that everything can be improved or simplified. The questions started discussions which ended in a new solution. Except the meetings the company have been very good during the project to help me with materials and contacts.

To improve for the next project, I think I will have even more contact with the company. The tips from them are very valuable and the questions they ask are relevant and they are very in to their field. My contribution to the projects are to force them to think in new ways and to ask questions.

6.4 Further work

To be able to sell the product as a perfect solution, more work has to be put on the shelf and the hanger. There might be better ways of attaching the self to the wall than just screws, it would be nice with hidden attachment points. The hanger needs adjustments in the angle and distance due to that the prototype of the screen don't have exactly the same weight and angle as the final product. This differences might cause my hanger not to fit the final screen. It's very important that the properties are right otherwise the screen will not be able to hang at all. The idea of storing the screen under the table is a good idea and I would like to see a solution for that in the future. But to make that possible maybe one type of table or table legs needs to be chosen. The product will then only fit that types of table. I think it will be very hard to find a solution that will fit all kinds of table.

To sell a product like this I have understood that it's important to know exactly how much sound it absorbs. This is because the competitors mark their screen with numbers like that. So to proceed with this screen is to do measurements to know exactly all properties according to sound.

My solution is to glue the aluminum profile to the base of the screen which works very well at the prototypes. But for real and in everyday use it might not be strong enough, this needs to be tested and evaluated. The testing needs to be done with the real screen and the real profile.

6.5 Conclusion

The screen ended up in a way that I had imagine and I am very proud of my work and the result. I am happy that the requirements could be fulfilled and that the company likes the design. The good and open communications with my contact person was very helpful during the project which I am thankful for, as well as for all the help with contacts and material I have got. I am looking forward to see where this product ends up in the future.

The product is the result and the result is the product of the methods.

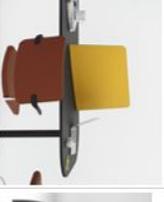
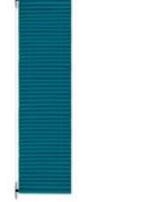
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8 Attachments

8.1 Attachment I, competitor analysis

Picture							
Company	Tecno	True design	Horreds	Glimakra of Sweden	Glimakra of Sweden	Glimakra of Sweden	Fraster
Name	Multy	Mask	VX Tillbehör	LimbusSoft	Limbus	LimbusCampus	ZigZag
Height (mm)	400	500	365	450	450	360	380
Width (mm)	950	450	480	600 and 800	600 and 800	700	800-2400 (200 mm step)
Depth (mm)	480	150	35	33	40	100	
Weight (kg)		3		3,1 and 4,1	5 and 6,6	3,3	
Pros	different angles. Stable, nice edges	fun shape, interesting, innovative, sculpture	stable, simple, system, movable	nice splitline, nice foot, nice shape	simple foot, nice splitline	smart storage on wall, good design, like the frame, easy to move	Simple, easy storage and moving, stable
Cons	Static, hard to store	Hard to store, static, can't build system	heavy, squarish, hard to store	static	heavy, static, very square	thick, hard edges	ugly bendings, can fall easy, looks cheap
Picture							
Company	zilenzio	Edsbyn	Wobedo	Acousticearts	EFG	Slalom	HEY-SIGN
Name	Focus	Ease Bordskärm	MyPlace and MyPlace Maxi	ARCHITECTS DESKTOP	EGF Free	ECODESK	Table module Wave
Height (mm)	320 and 450	450	500 and 490	450 and 600	390 and 390	400, 600 and 800	430
Width (mm)	1185, 1980 and 2970	600 and 800	500 and 900	1600 and 2000	900 and 1000	600-1800 (200 mm step)	1500
Depth (mm)		70	60		500 and 700	30	
Weight (kg)							
Pros	Different sizes, flexible smart construction	Nice shape, easy, stable	Smart storage, simple possible to build system, many colours, stable	different base selections (center, two circular, magnetic.	Good screening, flat storage, stable, can build system	good looking, smart solutions same screen in many ways	Good looking, easy shapes many colours, nice feets
Cons	Hard to store, can't be straight	Heavy, Hard to move, hard to grip, feel static	Can't be straight, childish	Only very big, very square, hard to move	Looks bad, hard to move	Hard to store	Hard to store, static, very wide

8.2 Attachment 2, photos from the furniture fair



8.3 Attachment 3, modern architecture



8.4 Attachment 4, function analysis

User				Buyer			
Function		Note	Type	Function		Note	Type
Provide	Screening		MF	Last	Long		NF
Absorb	Sound		NF	Smart	Solutions		NF
Easy	Storage		NF	Low	Price		NF
Easy	Usage		NF	Look	Good		NF
Appealing	Design		DF	Absorb	Sound		NF
Smart	Solutions		DF	Environmental	Friendly		DF
Contain	Storage	Of personal stuff	DF	Fit	Office	In style	DF
Nice	Materials		DF	Attach	Eachother	Together	DF
Stable	Standing		NF	Appealing	Design		NF
Environmental	Friendly		NF	Nice	Materials		NF
Attach	Eachother	Together	DF				
Attach	Postits		DF				
Minimize	Space		DF				
Appear	Thin		DF				
Reduce	Noise	From screen	DF				
Maximize	Stability		NF				
Enable	Moveability		DF				

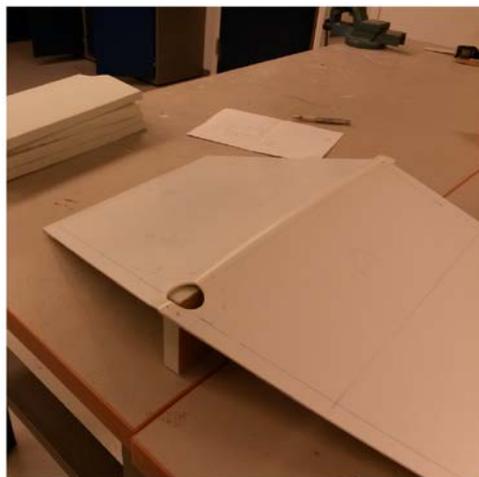
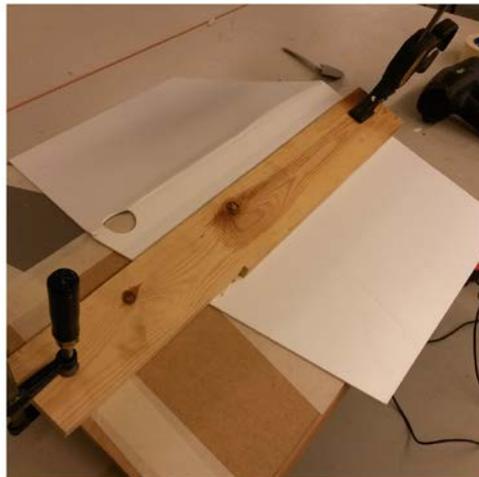
Manufacturer & Assembly				Ragnars			
Function		Note	Type	Function		Note	Type
Easy	Assamble		DF	Fit	Existing	Products	DF
Minimize	Processes		DF	Alow	Production		NF
Minimize	Components		DF	Minimize	Cost		DF
Alow	Production		NF	Express	Design		DF
Express	Design		DF	Express	Durability		DF
Minimize	Cost		DF	Included	Functions		DF
Ergonomic	Design	For assebbly	DF	Express	Dynamic		DF
Safe	Production		NF	Express	5 Series	Ragnars ranking	DF
Minimize	Emissions		NF	Show	Quallity		DF
Minimize	Waste		NF	Vizualize	logo		DF
Use	Standard Components		DF				

8.5 Attachment 5, prototype building

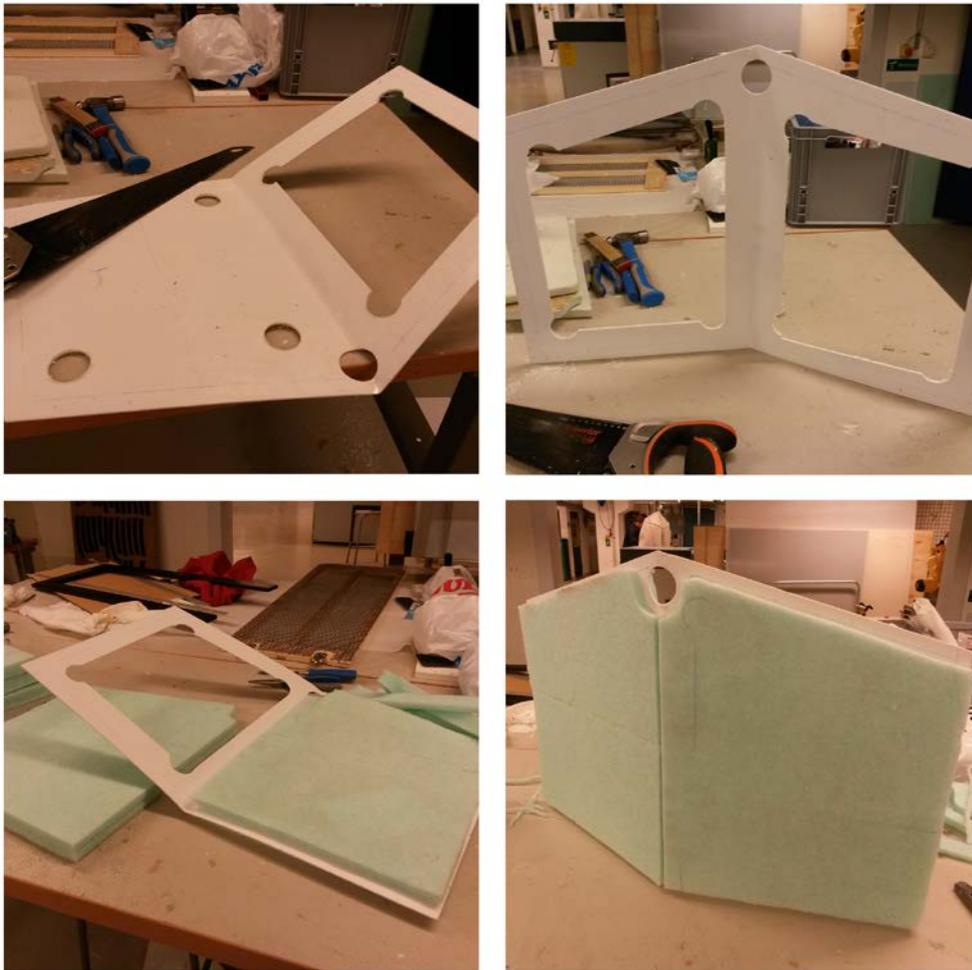
First cardboard prototype



The structure is made of bended plexi glass. This is how I bended it using a heat gun.



To fit the absorption material, I cut out the inside of the plexiglass, creating a frame.



This were then covered in felt. The felt is glued in place.





I cut and bended the aluminum profile and got some help to punch the logo at it.



Prototypes over the hanger.



Final prototype of hanger.



Final prototype of screen.

