industriDESIGN

Material Library
A sense of material
Daniel Ståhl

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Materialbibliotek

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Abstract

This day of age when an increasing demands for better and more environmental friendly material is requested. At the same time is also higher demands on the designers to develop new products for the future. To design new products which express a futuristic feeling and a “must-have-feeling”. Therefore is there a need to educate better designers and architects for the future a better knowledge for material. Both for existing designers and architects but also for new designers. To encourage learning and discover new material is new tools important, a tool such as a meeting point in which people meet, talk and discover new materials. A meeting place in which a material library has its natural place, a place designers, architects and laymen can visit.

The great advantages of a material library is the possibility to touch and feel the material samples. To invite people to use their senses and learn about materials.

This report focus on how to best build and present a material library in the facility of a public place. But also how to construct a mobile module used as a tool for education. Each scenario has their own dilemma and needs, for example, in the University library at Jönköping has criterion for a module that fits into the regular exhibition. To present new and innovative material samples in a manner that reminds of how people search for books on the shelves.

For the mobile module is focus more towards presenting material samples used in the production today. The presentation is more focus on presenting material samples during a lecture in which the teacher stands in front of a class and pointing towards the material and students are allowed to touch and feel the material samples when they have the possibility to do so. Besides this will the mobile module also work as mobile storage location for each department’s material samples.

Keywords

Material library, Material ConneXion, education, lectures, material samples, industrial design, product design, innovative, innovative materials, material, furniture
Sammanfattning

I dagens tidsälder där ett allt högre krav på bättre och miljövänliga material efterfrågas, samtidigt som kraven på designers att utveckla nya och spännande produkter. Designade produkter som utrycker en futuristisk känsla och ett ”måste-ha-känsla”. Därför finns ett behov av att utbilda framtida designers och arkitekter med en bättre kunskap om material, både yrkesverksamma designers och arkitekter som blivande. Genom att uppmuntra lärande och upptäckten för nya material är nya verktyg viktiga. Verktyg som skapar mötespunkter där folk kan mötas, pratas och upptäcka nya material. En plats där ett material bibliotek har sin naturliga plats där designers, arkitekter och lekmän kan besöka.

Ett material biblioteks stora fördel är möjligheten att klämma och känna på material prover. Det inbjuder folk till att använda sina sinnen för att lära sig om material.

Denna rapport fokuserar på hur ett material bibliotek bäst kan byggas och presentera material i nya miljöer. Även hur en mobil modul kan användas i utbildningen. Båda scenarion har sina unika problem och behov. Till exempel på högskolebiblioteket i Jönköping har kriterier för hur en modul ska passa in i den vanliga biblioteksmiljön. Som att presentera hur material på ett liknande sätt som påminner besökande om att leta efter böcker i hyllorna.

Den mobila modulen är mer fokuserad på att presentera material som används av industri idag. Presentationen är mer fokuserad till föreläsnings och seminarium, där föreläsaren står framför klassen och pekar på materialen och där studenterna själva kan klämma och känna när tillfälle ges. Förutom det ska den mobila modulen även fungera som en förvaringsstation för avdelningarnas material prover.
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1 Introduction

1.1 Background
University library in Jönköping, HBJ\(^1\), plans to acquire a material library from Material Connexion, this library is limited to only present new materials. The School of engineering, JTH\(^2\), has a request to add more material to the collection as a complement to the material provided by Material Connexion. The completing material is those material that today is used within the industry.

The purpose of the project is to create a system to present the material samples. Also provide a system that can show a material illuminated and a module that can be used as a tool for education. In which the lecturer easy can present materials for the students, whom in their turn can touch and feel the material.

The theory is that with the guidance of a material library a bigger understanding for material, curiosity and discovery of new unexpected material can take place. A material library can assist and ease the development of the regions different production companies.

1.2 Objectives
The master thesis objective is to design and develop a system for which a material library can be presented within the HBJ facilities at campus Jönköping. The stand system will provide that the material can be hanged, placed or in another way to be displayed. In the final proposal should also include an assessment of how the facilities should be adapted to the material library.

Besides that, HBJ also wishes:

- Investigate in what way a material library can be integrated within JTH’s education and if there is any interest from the other schools at Jönköping University.
- Investigate of the significance a material library could have on research at JTH.
- Investigate how important a material library is to the relationships for the company within the region.

Except the design of a system for the library to present the material will this thesis also provide a mobile module which will work as a support for the teaching staff. This system will be designed in a similar manner as the material library in full.

Thru an explorative study the implementation of a material library at HBJ, evaluate different alternatives in how a material library can be presented and used for education and research. How the Material ConneXions material library can be complemented with material used by the industry today.

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\(^1\) HBJ – Högskolebiblioteket i Jönköping, University library
\(^2\) JTH – Tekniska Högskolan i Jönköping, School of engineering
Introduction

This study will eventuate in a material library that will be used for education and research at the various schools at HJ. This report will mainly focus on how to best implement a material library at HJ.

A more detailed description is available in the design brief, see Attachment 1, design brief.

1.3 Delimitations

These report is only focusing on how to best implement a material library at University library at Jönköping University.

- This report will not present any new material
- Not develop a material library at other locations than HBJ.
- This project will not develop new materials.

1.4 Disposition

This report is written in the following disposition.

1.4.1 Introduction

The purpose of this chapter is to provide it an initial view of the project, to set the projects objectives and constraints. To get a brief understanding of what this master thesis purpose.

1.4.2 Theoretical background

This chapter is to provide the needed theoretical background for the reader to fully understand the master thesis. A description of the methodology in which this project work is based on.

1.4.3 Method

This chapter focus more on the specific methods and tools used to pursue this project.

1.4.4 Approach and implementation

This chapter describes the process of the work, in which order the different methods was used. How each step was fulfilled and carried out.

1.4.5 Result

This part will present the result of the work described in the previous chapter, in this chapter will the final result be presented and explained.

1.4.6 Conclusion and discussion

In this part of the report a discussion of the project, what advantages has been discovered, what mistakes has been done and can be avoided in the future.

1.4.7 References

The theory this report is based upon is present in this part of the report.

1.4.8 Attachments

Important attachments needed for better describe each part of the project. Also attachments needed for simplify the understanding of the process.

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3 HJ – Högskolan i Jönköping, Jönköping University
2 Theoretical Background

2.1 Design

According to Nationalencyklopedin is design an international term used for product development, thru a craftsmanship shape and develops a product, an environment or a service [1].

The design has a lot of different meanings; a design could be the method of how to design things or to develop new products. Design is often referred to an aesthetic aspect in which the form is the important thing. The word itself is sprung from the Latin word *designo* and means to form, to produce [2]. Design is often used for a multiple of areas, it could be referred to as architecture, interior, graphical, construction and even software development.

Industrial design is to generate new ideas and forms for products that are better suited for the human and the environment. During the last years has the design become a bigger and more important factor to compete about the consumers [3]. A well designed product should satisfy the consumer demands for ergonomic, financial, aesthetic and environmental issues. The product should also have a clear semantic shape, both in form and in color, the user should never doubt about how to use the product.

Today’s market has a huge range of product that is designed, everything from a car to a tool in the kitchen. The designer are working both with new products and redesigning old versions.

Industrial design has changed over the years, from first years of the industrial revolution in England to today. During the industrial revolution did the manufactures realize the need for designed products. When it became easier and cheaper to produce and buy the products the nobility had in their homes did the middle class request and desire to use the same artifacts to illustrate their growing wealth [4]. With an increasing wealth people request and demands for artifacts that shows their wealth. Together with an increasing knowledge of production more advanced products was easily mass produced.

2.2 Material library

The traditional definition of a library was as a storehouse of knowledge, a place in which information was gathered, stored, indexed and collected. This to make it accessible to the members of the community. In this narrow definition of a library is there no possibility to handle electronic information and physical samples such as material. Sense then has the purpose of the library changed and are moving towards an institute that provides an information management in which information distributed and delivered in a more active manner. [5]

There is no general definition of a material library, it is two words put together, material and library. Combined isn’t a correct and optimal terminology and is not easy to define. This because the original definition of a library don’t include the possibility to use material as a document within a library. As it is today there is not much research done about
Theoretical Background

material library, at the moment there is only three Swedish articles found: “Materialbibliotek – Vad är det? [5], Materialbibliotek på Konstfack – en förstudie [6], Materialbibliotek på Konstfack – Rapport fas 2: Initiering och integrering [7].

The definition from the material library at Konstfack is probably the only one found during the research about material library.

A collection based on material samples, actually not a library, just a collection. As the purpose is to collect, classify, catalogue, digitalize and make material samples accessible in a library, have we choose the name of [material library]. The concrete samples is, such as text and picture, an information resource and is a complement to the library’s traditional medium. [6, p. 8]

Materialbiblioteket is a Swedish company that sprung from a project at Konstfack, the project was in collaboration whit the different design department at Konstfack and the library. In this report will Materialbiblioteket refer to the company and the material library at Konstfack will be referred to as Konstfack.

2.2.1 Material ConneXion

Material ConneXion is a commercially material library and was founded 1997 in New York by George M Beylerian [8]. They collect and gather material from all other the world, which a jury of material experts and scientists evaluates to find new and exciting materials. Today is Material ConneXion located in New York, Milan(2002), Bangkok(2005), Beijing(2011), Cologne(2005), Daegu(2008), Istanbul(2011), Seoul(2011), Shanghai(2012), Skövde(2012) and Tokyo(2013) and each office is contributing with material to the database and the material library. At the date of 05-09-14, the material library contains over 7000 materials.

Since then Material ConneXion has grown in size and designers from all over the world uses the ground breaking material library with its database and exhibitions. Besides that has Material ConneXion released a number of books such as The Global resource (Thames & Hudson 2005) and Ultra materials Innovation is changing the world (Thames & Hudson 2007)

2.3 Design Doing

Design doing is an open minded process in which the team members has to be receptive to everyone and everything to be able to archive [9]. It is not about creating a new set of rules to design, it is more to reframe the collective mindset and methods of how to infuse the culture of innovation spirit. There are three general themes to succeed with design doing: open-minded collaboration, courage and conviction.

To have an open-minded collaboration is about listening and respecting each and everyone’s ideas, whether it’s good or bad ideas. Each member in the team has to respect each other to make it possible for the team to achieve something meaningful. This will encourage the team to explore ideas that exist outside the preconvinced paradigm, how

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4 Translated from Swedish
irrational or infeasible they might be. A designer inspires from new ideas, meeting new people and new possibilities.

New design demands for courage and an inspiration of experiment with new ideas. To accomplish great design comes of being brave to risk and try new things, even if the failure is a possibility. The courage is important both to test and try wild ideas, but also let the company board allow their employees to be brave and go outside the box. But courage's is only possibly to have in an open-minded work place.

Even if the ideas seems to fail, great ideas evolve to great design with the conviction of unwillingness of giving into constraints and obstacle. The attitude of seeing constraints as a juicy challenge rather than an obstacle. Even if all of these can flourish in design thinking will innovation through practice of design never get off the ground.

Design doing is like learning how to ride the bike, it is experiential way of doing design. You learn from experience of doing it, you won’t learn from having someone explaining how to do. By observing and interacting with others on a more advanced level is design doing a social learning [10]. Combining experiential and social learning means design as craft rather than a secret process with a design as an outcome.

Many people has an issue with being creative, for them creativity is an innate talent. Giving them a task such as creating a prototype will create anxiety and scared. According to David Kelley this comes from memories from the judgmental comment as a child [11] [12]. With the help of prototyping their ideas in an environment which allows to ideate without the fear of being judged increases peoples creative confidence.

### 2.4 Ideation

The purpose of ideation is to generate a lot of new ideas, there is a number of method to use during an ideation session. It is important to work without any constraints and to think expansively. This gives the advantages of creating wild ideas and visionary ideas can spark [13]. For ideating a number of tool is possible to use, most common is to sketch. Another common tool to ideate is brainstorming, within the brainstorming methodology is there a number different techniques to use. As a complement of sketching is model building a suitable alternative. This provides with the possibility easier to see how the shape and idea works, what constraints ease or complicate the design.

### 2.5 Group ideation

A pen is many designers tool of choice, to the matter that they need one to think. With the help of pen and paper releases the designer’s ideas and get a concrete form [2]. The designer can then present the ideas for the project group and they can easily discuss the ideas. With the help of the sketches can the work continue with the concepts and finalize it in a prototype.

There are different kinds of sketching and drawing depending on what phase of the process the project are. The simplest form is the ideation sketch, a simple and quick sketch that could be napkin or on small paper. The design sketch is more detailed and can present different lines in the appearance, it could include main measurements.
For more detail works and with the base from the sketches is the blue prints, this conclude views, functions, measures and principles of manufacturing. This together with cross sections and exploded sketches provides with important details of how to produce, manufacture and put the different part together.

To present sketches is often renders used, this gives a realistic illustration of how the final model can be.

### 2.6 Design, build, test

With the help of cardboard, clay or foam it’s easy to test and try the different concepts. To build scale models is a good complement to sketches and computer modelling. The mockups has the possibility to easy and quick illustrate and test different concepts in a way that either sketch or computer modeling can do [14].

With the models to present for the audience gives them the possibility to touch, turn, twist and feel the ideas. It also gives them the possibility do simple test of the product. To experiment, try, test and evaluate is an unsurpassed method of how to solve different issue.

Design, build, test is a method developed by Professor Alice Agogino for NASA’s jet propulsion laboratory. It’s a three step analogues method based on the older method Goal-action-feedback loops from 2002 [15]. In the first step a design, build and test process is undergoing to identify and to redo those mistake discovered during the process, see Figure 1. The errors discovered in the test depends on how far iteration have to be. After an evaluation of an error a decision is made to discover if the error is a fabrication error or a design error.

![Diagram of design, build, test](image)
In the second step of is the design-build-test placed in a context of a larger project, see Figure 2, Phase 2 of design, build, test.

![Figure 2, Phase 2 of design, build, test](image)

In the third and last phase Agogino added feedback loops to earlier test the models in order to discover errors, see Figure 3.

![Figure 3, Phase 3 of design, build, test](image)

### 2.7 Project

A project is a temporary organization that is suitable to solve a unique task or a problem, with its own budget and with a specified deadline. As long as these four criteria are fulfilled is a project. The organization of a project group is often picked from different part of the regularly organization and from the line production. This gives the possibility to short cut the company’s organization and provide a thinking outside the box.

According to Tonnquist [16] is there a general project model to define each phase of the project, see Figure 4. Each phase has set of milestone in which a gatekeeper can to approve the project moving forward or stop it.

![Figure 4, General project model](image)
Pre-study: Analyze the project conditions and specify the task
Planning: Produce the plans for how to execute the project
Execution: Work in the project and solve the problem or task
Closure: Evaluate and liquidate the project

Choice of method for how to work within the project depends on the goal, each method is a tool of how to best get the answer to solve the issue. According to Tonnquist is a too specified choice of the method and goal gives delimitation of the project group. The outcome of the pre-study should provide some alternative roads on how to finalize the project. On what demands there is on final solution.

2.8 Project planning

To plan a project is to organize the work, analyze the risks, calculate costs and plan for time and resources [16]. When planning for a project it’s not necessary to plan in detail, plan to far ahead could sometimes be contra productive and prevent the possibility to adapt for change in the outside world. There is a lot of tools is a helpful for planning.

The key of successfully plan a project is in three steps: Define the goal; what shall you do to get there; How much time shall each activity take [2]. Smaller project is easy to have control without any bigger effort of planning, but for bigger project where it more or less impossible to easy get a quick overview. Therefor is it important to plan and calculate the amount of time for each step. During the work progress could it be a good idea to keep track of actual time each phase took.

The visual tool of planning project is a Gantt-schedule, the process of creating a Gantt starts with a Work-breakdown-structure, WBS. This work structure gives a visual illustration of what work that has to be done. A work structure shows the lowest level of what has to be done. This follows of a net planning that present dependencies and running time of each work process. The next step is to do an activity list which is a detailed list of what has to be done and when. The list also present responsibility. The Gantt is a visual tool of the activity list that visually present the time consumption and dependencies of each activity. Besides that a Gantt also shows the progress of the ongoing work. [16].

![Project planning process](image-url)
The maximum of time a project take depends of the amount of ambition and budget. It’s theoretical possible to design a small object for a couple of years equally as it can take a couple of months. If a work takes longer time than necessary the price of development will increase and the price of the final product also increase the longer a project will proceed. To plan the process of the development will optimize the time it takes for a new product. A well planned project will increase the possibility of a successful project or a product.

### 2.9 Semantics

A part of the function is the way of how the product communicate with the user. The most common is the shape, surface and the look of a product. But even sound or smell has an important aspect of how a product communicate with the user. If a new product is released without any predecessors is it important that the product semantic speaks a clear language and that each part feels natural to use [2]. If a product is redesigned is it important to keep significant recognition factors. If shapes are repeated in the design it creates a more coherent design.

Our semantic experience is one factor of recognition, buttons, switches and handles are examples of that. Our experiences tells us how to use them instinctively, this experience is possible to cross use in other designs.

### 2.10 Color

The human can recognize huge variety of colors and each color has its own meaning and association. At the same time has colors different meaning in different regions and countries. For example is the color white in the western countries a color of innocence but in China is it a color for mourning.
3 Method

3.1 Brainstorm

Brainstorm is a method used to create new ideas within a group of people work together to find new ideas and solutions. A group should contain between three and six persons [17]. It’s important to have a positive environment during the brainstorming session and together with a number of basic rules to provide new ideas. Such as no criticism, think outside the box, combine and complement ideas within the group and a big amount of ideas is sought. There is a number of different method to use during a brainstorming session to solve different solution depending of what kind of problem to be solved.

3.1.1 The 4Cs

Is a method for brainstorm and the objective is to in a quick way gather and organize information about any subject using four common keywords. Originally the 4Cs stands for Components, Characteristics, Challenges and Characters. For this session it’s redefined as F.U.U.L. – Forma (Shape), Upptäcka (Discover), Utveckla (Develop), Lösningar (Solution).

3.1.2 Vote for the ideas

This method a two part method of using brainstorm, first a group session when the different groups has a brainstorm session over a flip board paper together with the question of issue. The groups present their findings to the rest and afterwards will each individual grade of the three best answers from the other groups. The process of grading each other starts as an individual process in silence so each person has the possibility without influence of others. [18, p. 16]
3.2 S.W.O.T.
The analysis of the situation is often called S.W.O.T-analysis and that is an acronym for Strength, Weakness, Opportunities and Threats, see Figure 6 p. 16. The purpose of an S.W.O.T-analysis is to analyze the present of the market. After the mapping of the possibilities to take some conclusions of what possibilities and gaps there is in the project. At the same time identify hidden opportunities in which the project can strive into new directions [16].

S.W.O.T analysis starts with a study of the organization to better understand how it works in compares with its competitors. The method studies factors both inside the company and outside to determine the possibilities and threat of the project or product. [19].

The benefits of the S.W.O.T it creates overview, provides direction, identifies challenges and reveals opportunities in a visual diagram.

<table>
<thead>
<tr>
<th>POSITIVE</th>
<th>NEGATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTERNAL</strong></td>
<td></td>
</tr>
<tr>
<td>STRENGTHS</td>
<td>WEAKNESSES</td>
</tr>
<tr>
<td>OPPERTUNITIES</td>
<td>THREATS</td>
</tr>
<tr>
<td><strong>EXTERNAL</strong></td>
<td></td>
</tr>
</tbody>
</table>

Figure 6, An illustration of a S.W.O.T-analysis

3.3 Function analysis
The intention of the function analysis is to ease and simplify the process of categorize the different demands and wishes of a product. In the completed analysis should contain a complete summarize of everything that has been discovered during the initial work of the project. The purpose of the function analysis is to express function and not in solutions [14]. In a brief and orderly manner, including the result of the research and interviews.

A proper function analysis describes the function briefly with a verb and a noun. For example “Fit hand” or “Facilitate access”. This gives a quick tool to briefly write down properties that are important. Together with a classification of what is the main (MF), necessary (NF) and desirable functions (DF) provides the possibility to prioritize which functions that are important.
3.4 Design brief

A design brief is a short summary of the project, which includes important factors for the project such as the due date, the budget, name of the requesting persons and so forth [20]. The brief defines the basic rules of the project, with in the brief both the designer and the purchasing company knows what to do and the price. According to Peter L. Phillips a brief is a necessary thing that is important in almost every project, however if the partners don’t agree to a brief an amount of risks is taken.

A good brief according to Phillips concludes of the following chapters:

- Project overview and background
- Category review
- Target audience review
- Company portfolio
- Business objectives and design strategy
- Project scope, Time line and budget
- Research data
- Appendix

Each chapter concludes of a number of essential questions that defines the parameters for the design project.

3.4.1 Project overview and background

In this part of the brief is the project clarified, what the business or company needs, what object the project contains, the outcome of the project and who is the owner of the project. In short is this the summary of the project, most people won’t read the complete brief and would probably only read this first part. [20]. In this chapter is the deadline and what budget the project has included.

3.4.2 Category review

The category review is a way of defining which industry the company works and it’s not always that obvious. The risk of thinking to narrow is that the design becomes too limited. It’s essential that this chapter includes information about the company and the competition. Other important question to ask in the discussion about “What category or categories are we in?” is a list of what products or services is included in the project. Which advantages and disadvantages they have. A similar list of the major competitors.

A description of how the product is going to be priced and promoted. For the designers is this important to know, the risk is that the product won’t be suitable for its purposes. A brand overview to identify the both the own company as the competitors brands. Which is the identifying semantic values of the companies brand and of the competitors.

Which trends are ongoing within the category and what has these trend for influence on the project. At the same time, what trends are luring in the future. What strategy business has the company, are they focused on price, quality, environmental issues or are they focused on partnerships or alliances.
3.4.3 Target audience review
Who do we design for, who is the final user, who is going to buy this product? To define the end user simplifies for the designer in many aspects. A too wide description of who the target is preventing to design, for example: Mother, is it a young mother, old mother, a grandmother. Is she well educated or is she unemployed. What national, cultural and regional heritage is she from? Each subgroup has its own demands and preferences of usage of products. A good understanding of the target audience gives a better understanding of the audience.

3.4.4 Company portfolio
The company portfolio is vibrant when an external consultant design company is working with a company. At the same time even important for an in-house design department. It is a time consuming part to do, but when it’s done it’s easy to maintain and update. This chapter gives an explanation of the company’s and its activities.

3.4.5 Business objectives and design strategy
With the foundation in the first chapter in the design brief this chapter specifies the plan for how to proceed in the project. Too form the strategy of how to approach the design process. It’s vital that all the key stakeholders have reached an agreement of this part. If well formulated this part will work as a contract for the project.

3.4.6 Project scope, Time line and budget
This chapter provides with the critical parts of the how to succeed in the project. It clarify for everyone involved in the project has an understanding of and agree to every aspect of the project. This section provides with the possibility to for the design manager to break the design project into discrete parts. Each partner of the project will therefor get a bigger understanding of how the different part of executing the project. At the same time a knowledge of different deadlines within the project.

This chapter should at least contain a precise description and a time frame for each activity. Who will be involved in each phase and who will work as a gatekeeper for each activity and also how big budget each phase has.

3.4.7 Research data
During the initial discussions of a project with the design team it’s likely that a number of question want be answered. If these question is important for the project and the process it’s best to list them in the brief and determine that who will answer them and then.

3.4.8 Appendix
This is an optional part of the design brief, in the appendix those things the managers of the project can place things they not are sure where to put in the document. It could be documents that summarize research data, news clipping, photograph and other visual materials.
3.5 Stakeholder analysis

Everyone who effects of the project in different levels is a stakeholder. Together with the SWOT-analysis creates the foundation of the stakeholder analysis. It’s important to know who will be and will not be effected of the project, because each stakeholder has different need of knowing what happens.

The stakeholders are separated into three different groups depending on level of interest and effect of the project, see Figure 7. The most important group to take into consideration is core stakeholders. These stakeholder has a determining or driving roll of the project. The second group is the primary stakeholders [16].

The primary stakeholders are a group that will be highly effected by the project and therefor will also have a saying about the project and its different parts.

The third and last one is the secondary stakeholders, these have a low interest and will most likely don’t have an effect on the project.
3.6 Design for all five senses
Is a method based on Jinsop Lee’s idea that design should appeal to the senses and that attract the user in a higher level [21]. Five senses theory is a tool that could be used during test and see how the users respond to the design and device. Even if this method has some drawbacks such as difficulties using in large test groups. Also, there are some people that has some disabilities and can’t fully use the method. Despite these drawbacks, it is a good method to use for better understanding a good design [22]. The more senses that are attracted, the more will the client and user like it.

This method is based upon people’s estimation on how they feel about a design, experience or service in the aspect of a sense. For example, can a beautiful photo or painting score a high grade on sight and low grades on the rest. A dinner at a fancy restaurant could score high grade for all five senses.
3.7 NCS
NCS, Natural Color System is a Swedish standard for how to present color. It is the natural color system and is based on how people see colors and based on the six elementary colors blue (b), green (g), red (r), yellow (y), white (w) and black (b) [2]. The last two is often mentioned as colorless. The first four colors together forms the color circle, see Figure 9, and together with black and white forms a three dimensional color space, see Figure 10.
The color circle is a horizontal cut thru the color space. It illustrates the relationship between the four colors and reads clockwise. Each midtone color between the four elementary colors is described with a percentage ratio. These means that each quadrant is evenly distributed in 100 equally big parts [23]. For example an orange color is described as 90% yellow and 10% red in the NCS-system or simplified as Y10R.

The surface between white, black and one of the four color forms the color triangle, see Figure 11. This triangle is a vertical cut thru the color space is evenly divided into 100 equally big parts. With the base in gray scale from white to black and the tip is the colors maximum Chroma.

To define a color is there a number of graph lines crossing the triangle, each line has a specific definition. In Figure 11 is color connection of blackness and Chroma defined. Besides this two is there a number of other combinations to be used, see Figure 12.

Whiteness and blackness are each other’s opposites and the color code is read with the reference to black. In the lower scale is the Chroma defined. Chroma is the preference that expresses the relation between the two nearest elementary colors.
In the example in Figure 10, is the complete color code written as NCS S 1070-Y10R. The letters NCS S\(^5\) in the beginning is to define which standard of color it is. After that is the four numbers that defines the amount of blackness, 10 %, and what Chroma the color has, 70 %, finally is the four digit that present the basic color as a yellow paint with a perceived red tone red, 10 %., see Figure 13.

### 3.8 Function analysis

A function analysis purpose is to express functions, not solutions. To analyze each problem, product or just a part of a product forces the function analysis of what not to achieve. More to strive towards new and perhaps better solution of the product [14].

The final function analysis strives to present the research in a concentrated summary. A well performed function analysis is a brief and easy read presentation of what has been discovered during the research, interviews and so on. It will also work as a checklist of what is supposed to be included in the product.

A function analysis defines the functions with a noun and a verb, such as *allow transportation* followed by a classification which defines it as a Main Function (MF), Necessary Function (NF), Desirable Function (DF) or Unwanted Functions (UF).

The main function is unique for each product and because there is a primary need for the product to fulfill is there only one MF. All other functions are known as supporting functions and are supposed to fulfill or support the MF. The literature provides with an example of a coffee cup, the main function in this example is to provide fluid intake.

Those more important functions are mentioned as necessary functions, this are necessary to fulfill the MF. In the example of the coffee cup is *allow liquid filling and holding liquid*.

\(^5\) If the letter S is missing from the color code it is referring to an older standard and can be a slightly different tint in the color.
These function ensures the possibility of drinking coffee. It’s not necessary that these are majority of the functions.

The majority of functions will usually be graded as desirable functions and are those who will define extra but not necessary features. Such as lifting a cup without a perfect grip, the weight of the cup or the size. These are desirable functions and are not important to design specific solutions for them. In a functional analysis these functions are written as *spare fingers* or *own volume*. These functions are desirable to have.

The last category is unwanted functions, these are functions that don’t gives a functional advantage for the product. An example of this could be a décor line on the cup or its shape. However these functions could be important in some situations, a décor line could have a significant factor during the sale. The same with the cup, its shape could depend on the market. A cup for example naval purpose could be design with a narrower top to prevent spill.

**3.9 Persona definition**

The intention of writing a persona is to give the abstract fact a human face. To get a more living feeling of the target group. A persona represent a specific group of people with a set of common demands. [2]

The persona definition is a method used to define users to the related product. The range of personas created and considered as target for the project gives a possibility for the designers to focus on a specific user during the ideation phase.

The work of creating a personas is a five step process. It starts with generating a list of potential users. This list will be based on the research, hypothesis and design principles. After that a list of user attributes is created, this attributes are based on demographic, psychographic or behavioral aspects. In the third step a number, between three and ten, of user types is defined. The forth step is to create a persona for each type. Each persona is a combination of the attributes decided in the earlier steps. The final step is to create a visual profile for each persona [19].

This methods advantages broadens the mindset for the designer, builds empathy, defines direction and inspire ideation. With the input from the findings done previously in the process will this provide a set of personas based on different attributes to ease the concept exploration.

**3.10 Market analysis**

To make a realistic assessment of the market and if they will accept your idea. In the market analysis is it important to analyze the target group, what services and product there is, who from the target group who will use the product, how big the geographical area is and what possibilities and threats there is [24].
3.11 Scenarios and storytelling
Storytelling is a method in which a scenario is constructed around a person’s experience of the product. The scenario is about the product complete experience from first impression of the commercial until it gets disposed. What value a product has, which brand value there is and trends and competitors.

3.12 Ideation session
Ideation sessions is a form of brainstorming, it encourages to generate a big number of concepts during a short time without judging. The group of participants comes with different background to give the different views to the sketching. This method promotes collaboration, brings a new perspective to the project and structures the ideation. With the outcome of new ideas and concept of how to proceed the work.

3.13 CAD-modelling
To design and create volumes in a computer is a computer aided design, CAD, software a necessity. One method used by CAD-software is polygon modelling, this creates a huge amount of small surfaces called polygons and this creates a mesh looking surface. If it is a curved surfaces will it be dived into smaller polygons.

Another method used by CAD-software is to define surfaces with lines and outlines, between them a surface can be created. The advantages of this is the lines can be independently changed to modify the surface.

3.14 Software
3.14.1 Autodesk Alias Design 2013
Alias is a surface modelling software, it has the advantages of creating advanced surfaces. The program is often used in auto design.

3.14.2 Keyshot 4 64 Floating
A software for create photo realistic pictures of CAD-modelling. The software is also capable of creating short movies and virtual reality, VR, clips. VR has the advantages of letting the user determine in what angle to look at the model.

3.14.3 Microsoft Project 2013
A software for planning project, it simplifies the possibility get a simple and quick overview of the project.

3.15 WWWWWH
Is a method for thoroughly understand the problem, the acronym stands for “Who, What, Where, When, Why and How”. A basic rule of among a number of professions is that to best get the full story is know the who, what, where, when, why and how. There is a number of fundamental questions that can assist for getting good answer to aid the work process [25].
3.16 Unstructured interview
An unstructured interview is an interview session in which the researcher can adopt and modify the question during the interview. To assist the research a list of topics is planned of things that needs to be covered during the session [25].
4 Approach and Implementation

4.1 WWWWWH
A number of question was determined to set the basic of the project.

- Who is affected?
- Who needs the problem solved?
- Who could stand in the way of a solution?
- When is the solution needed?
- Where does it happen?
- Where else does it happen?
- Where is the best place to solve the problem?
- Why is this solution needed?
- Why is it difficult to solve?
- What is most important?
- What are your goals?
- What are the elements of the problem?

This question was works as foundation to better understand the project, to identify possible strengths and threats. They are a thinking experiment to provide a description of the project in words.

4.2 Design brief
In the beginning of the project was the design brief written, to define and declare the fundamental parts of the design project. During the writing of the brief it was sent to supervisor, Mattias Lorentzi, at the university library and to the supervisor, Lars Eriksson, at JTH for feedback and correction. Lorentzi did also add text concerning the point of view from the university library. Eriksson contributed with feedback.

4.3 S.W.O.T-analysis
The purpose of the S.W.O.T-analysis is to identify the projects strengths, weakness, opportunity and threats.

The work started with identify the strengths of University of Jönköping\(^6\), HJ. Which advantages there is on campus, what are the capabilities in technology, facilities, people and research. [19]

What aspects of HJ will make the implementation of a material library difficult. Which financial aspect is there, which technology will complicate things. How is the weaknesses an obstacle in compares to other universities?

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\(^6\) University of Jönköping, HJ, is the collective name for all schools at campus and the university library.
Approach and Implementation

Which opportunities is there of an implementation of a material library at HJ. What happens in the competition towards other universities? In what areas and research fields can a material library improve the HJ’s possibilities in research?

Which external and internal threats is there for the project? What kind of gatekeepers is to take in consideration?

The answers for each category of questions is briefly written in the 2x2 grid, see Figure 6 p. 16.

4.4 Function analysis
Parallel to the research is the function analysis, FA, being developed. The FA’s purpose is to specify the functions needed for the material library. The work started by listing and classifying the functions discovered during the research. The list where classified by MF, NF and DF. These became a checklist of the products, to secure that nothing was left or missed in to the final product.

4.5 Market analysis
To create a better understanding of material library looks like and if there is more material libraries in Sweden. Also to investigate if there is distributors of material samples. The market analysis was divided into two separate perspective, both an external and an internal market analysis was made.

This investigation was undertaken with the help of Internet and discussion with the handlers from both the HBJ and JTH. For the internal analysis a mail was sent to the different schools at the HJ to staff who may have an interest of a material library.

4.6 Stakeholder analysis
With the help of the stakeholder analysis is the different stakeholders for this project identified. There is five major stakeholder to the material library and each stakeholder can be divided into sub groups.

4.7 Study visits
A number of study visits has been undertaken for this project. Each visit has been undertaken as an unstructured and informal interview with a number of basic questions: “How do you present your material?”, “How have you built your material library?” and “What have you noticed with your material library?” The camera was an important part of each visit to photograph each location. The purpose of each visit has been to get a picture of how each existing library today is constructed and how they present their material.
4.7.1 Material library, Konstfack

A study visit was made to Konstfack in Stockholm and their material library to see how their material library is presented and constructed. At the same time have a discussion about their thought of the future and to learn from their mistake and successes.

Before the study visit to a phone call was made, during this call did Per Nordgren, responsible for the material library at Konstfack, explained how their material library works today and their issue. He also talked about its history.

The work of constructing the material library at Konstfack started in 2003 and during two years Oliver Schmidt, with the intention of present how a material library can look like. It is located in the facility of the library. From the beginning was it also educational thoughts with integrate the material library to the education and there was also a course about how to ideate with the help of a material library.
4.7.2 Materialbiblioteket, Stockholmsmässan

During the trip to Stockholm a visit to Materialbiblioteket at Stockholmsmässan was also conducted. This visit gave some valuable ideas of how to construct a material library.

The Materialbiblioteket is an offspring from the material library at Konstfack. In which they are both built on the same focus and purpose. The Materialbiblioteket is today a consultant to help companies to discover new material suited for their line of work [26]. In their facility is the possibility to visit them for workshop about material and to touch and feel the material on display, see Figure 15. Their services is provided to architects, industrial designers and students.

Figure 15, Course held at Materialbiblioteket [26]
4.7.3 Material ConneXion, Skövde

The visit to Material ConneXion in Skövde was undertaken to get a better understanding for how they think about their material library. During the visit Anders Breitholtz, manager of Material ConneXion in Sweden, presented how they constructed and work with the process of finding new materials. How they think about dividing the material into groups.

Material ConneXion have categorized their material library into 5 groups, each group is color coded: Naturals, green; Process, red; Metals, blue; Ceramics, orange; Polymers, raspberry.

The material is presented on plates in an A4 size, each material has a following information tag which is presenting the materials. They are in the process of changing signs to a simpler and easier system to understand, see Figure 17. This system also include of a barcode and a QR-code together with the semantic symbols for different features, see Figure 18.
Material ConneXion delivers four boxes per year with 15 material in each box, see Figure 19. The boxes is categorized into different themes such as: Design issue, future of …, fashion issue and process issue. Each box includes of material sample, a material tag and a card.
The material tag gives a brief description about the material such as who the manufacturer, which category and from which country the material comes from. Besides that information is the tags also including a brief description of the material, purpose and contact information, see Figure 20.
4.7.4 **Stockholm furniture and light fair**
The visit to Stockholm furniture and light fair 2014 was an inspirational trip for how the trends of this year. Also to see how material was presented.

During the two days at the fair a huge variety of furniture’s and materials was displayed. A Japanese material company had a display from which much inspiration was collected, see Figure 21 and Figure 22.

![Figure 21, Material display by Material attraction](image)

![Figure 22, Material display by Material attraction](image)

4.7.5 **University library of Umeå**
A trip was planned to the University library of Umeå, shortened as Umeå in this report. After initiating phone call to Umeå in which they presented their thoughts of they built their material library. They also mentioned that the architecture education at University of Umeå are creating an own material library.

After the conversion with both library and the architecture education a decision was made not to go to Umeå. Some additional question was mailed to the University library to better understand their future thoughts about their collection.

They got the following questions:

1. Will you replace the old materials when Material ConneXion distributes new materials?
2. What will happen to the old materials?
3. What planes do you have to develop your material library?
4.7.6 MRL, Linköping University

MRL, Material Realisation Laboratory, is a material library at Linköping University. Students, researches and local companies has the possibility to make an appointment and visit the material library to touch, feel and explore the material samples. They can also do studies on suited production methods and surface treatment. The facility has the possibility to test different lights to explore what happens to the materials [27].

Besides the possibility to book a meeting is the MRL open to visit 10-12 each Thursday. However was this visit cancelled on short notice and due to misunderstanding was a new visit never booked.

4.8 Design for all five sense

Some students was ask to grade a lecture in different aspects, first based on a classical lecture in which only PowerPoint presentation was used. Secondly they were ask to estimate how material samples had for impact on the lecture. They graded there experience from zero to ten in each sense.

4.9 Persona definition

To get a good perspective of the users going to use the material library and in what kind of scenarios three different scenarios was created with three different personas. This three personas defined as the student, the professor and the designer. Also in which scenarios they might need a material library.

4.10 Facility

As a part of this project a suitable location for the material library. The University library suggested a location in the library that today is not used for any purpose. This location is located on the second floor and was previously used for store paperwork from the European Union. Today is the shelves empty and the space is used for studies, see Figure 23.

Figure 23, Suggested location for the material library
Suggested location is a long and narrow corridor with empty shelves towards the wall and study places along the window with natural light from the library roof. The space is 23.85x3.175m in dimension and is reached through two doors and two bridges, see Figure 24.

Furniture that today is located in the location can for this project changed. The narrow space creates a difficulty in how to occupy the location and some consideration has to be taken into people with disabilities using wheel chairs. By Swedish building regulation is some dimensions regulated for designing homes for easing the usage of wheel chairs. These dimensions has been taken under consideration for placing furniture. The regulation stats the need of turning spots for 1.3m [28]. With this limitation is only possible to furniture the surface up to 1.8 m from the wall.
4.11 Illumination

To best illuminate the material a test of what kind of luminaire would be the most suitable. LED-luminaire was quickly determine to be the most suitable choice, however was a test needed to decide if the luminaire should be a spot light or a dispersed luminaire.

A dispersed luminaire will illuminate the material sample over a wider surface and at the same time has it the possibility to illuminate a complete carrier, see Figure 25. With the advantages of that it doesn’t matter where on the carrier the plate will be placed.

A spot light will only illuminate a specific spot and will give the possibility target a material sample, see Figure 26. The disadvantages is that the need of make sure that the material sample is placed directly underneath a luminaire each time it’s moved.
During the test two different spot lights were tested to see how the material sample was illuminated, see Figure 27. The difference between the two spot lights is that the version of Figure 27 has a more focused light than Figure 26.
4.12 Ideation
During the whole process of the project has the ideation been continuously ongoing. This process has been undertaken with the help of sketching and discussions.

The sketching sessions has been focused on form and functions, testing the shape of the modules to see how they works. This has developed the ideas continuously together with the discussions. As well as material of choice and colors.

4.12.1 Concept ideas for presentation plate
During the whole process of ideation has the plate been working as a common thread, a plate that will work as a base for presentation of the material. Threw out the process has two size been in focus, A4-size\(^7\) and A3-size\(^8\). Those size has been chosen because of their familiar size.

The first idea is based on how the Materialbiblioteket presents their material, a panel on which the material is mounted with a thin metal wire and a small information tag. The tag contains information about the material.

\(^7\) An A4 paper has the dimension of 210x297 mm
\(^8\) An A3-paper has the dimension of 297x420 mm
The second idea is similar on Material ConneXion solution, with the material sandwiched between two smaller plates, see Figure 29. Each plate will also contain an information tag with the same information as in the first idea.

The third idea is a plate in landscape format, this gives the advantages of using the information card which is a part of the box of material from Material ConneXion. This idea is also based on the purpose of that the plate could be self-hanging without any extra surface to place the plate on.

For the library module is there requested to hang the material on hooks ease their work with the material library. There for was a number of hooks gathered and presented for the material, see Figure 31. Also was different height test to see which alternative was the most suitable for this project, see
All the presented hooks was turned down and some new alternative had to be presented for the library.

After the rejection of the hooks a new set of hooks was presented for the library, this presentation was made by mail and feedback was afterwards received, see Figure 33.
A decision was made to use the top left hook, this decision was to take in reconsider because of the product was taken out of the product range. A new set of hooks was taken under consideration and material samples from HABO group. This hooks was mounted on a MDF to evaluate them, see Figure 34.

On the backside of the plate is there a track milled, for a better grip to remove the plate from the mobile module. The distant between the short side of the plate to the milled track was an inquiry maid to a number of student within the Industrial design program at JTH. A general consumption was that it was better to have a shorter distance, than a bigger, see Figure 35. A bigger distance could be hard to reach or give the impression of that the material is strongly mounted on the plate. Therefor was the recommendation that a short distance invites to be more careful while pulling the plate from the mobile module. Even if the difference between the two tracks differs one cm, is the impression to use the more narrow track more suited.
4.12.2 Concepts ideas of the library module

The ideation sketching started with sketching some different scenarios, see Figure 36. The purpose is to test and see how the different situations and solutions could work. These sketches provided with some basic ideas on how to continue.

With the help of function analysis and discussion were some of the ideas chosen to continue working and developing. Some ideas seemed interesting to try and test to see how they became in a bigger and more detailed sketch.

The library module is calculated to at least exist during a ten year period, with a yearly delivery of new materials from Material ConneXion of 60 new material will the material library after ten years consist of 600 materials. At the moment of this thesis is undertaken will this system will only present material provided by Material ConneXion.

The plate for which each material is stored and presented on is possible to use in both system.
The first idea has a simple cubistic shape with chamfered corners, see Figure 37. It is a low module and has the possibility to present two material on each side. In total has it the capability of presenting eight materials. On the chamfered corners is a sign that present the category of the material on the module.

This design were refused because of the possibility to presenting a big amount material on each module. For a presentation module in which a low amount of material is going to be presented on a big open space with a lot of people moving this design could work. For this project didn’t fulfill the needs and demands.

![Image](image1)

**Figure 38, Presentation library module idea 2**

The second idea was is a pine shaped presentation module, with a narrow and retracted top and a sturdy bottom part, see Figure 38. This design feels like it doesn’t match the facility of the university library, however this design was develop in to a more easy design.

This was developed into one of the three concepts, concept three.

![Image](image2)

**Figure 39, Presentation library module idea 3**

The third idea is an inspiration of material library at Konstfack, see Figure 39. This provides with the possibility to have a long row of low modules placed under a window or likewise and it also gives the possibility to store related literature connected to the library.

This idea was refused based on a meeting with the supervisor at the library. They didn’t like the idea of move books from the regular collection and locate them in the material library. This will provide with the disadvantages of finding literature, when it could be double located.
Approach and Implementation

This idea is a result of the ideation session, the learning from that session was to have surfaces that communicated with the modules content, see Figure 40. The principle of this idea is to have an open module in which it’s possible to see through. The sides are formed as L-shaped in which a presentation of the modules category.

The fifth idea is a further development of the forth idea, however is this a wider module. This module has an outer frame that are divided into three parts, the middle part is color coded to communicate the modules category, see Figure 41.

Each shelve has a leaning material plate, the advantages of a leaning plate is to simplify for the viewer to see each material.

This idea is the base of one of the finished concepts.
This concept idea is a variation of the fifth idea, with the same outer shell but with drawers instead of leaning surfaces, see Figure 42.

The disadvantages with this module is that has a single-sided design in a two-sided presentation. This means that the materials is visual from both side and gives a limitation the expected amount of material. However is this idea a possibility to continuously develop for the future, then with the possibility to have drawers the prevent drawers.

This idea is a development of the sixth idea and provides with the possibility to present material from both sides, see Figure 43. The drawers are narrower than the previous idea. Besides that is the drawers rails built that manor that they are tilting down too easy for the viewer to get a better view of the material.

This idea had been hard to “close” and prevent for dust. With the effect of a heavier work load for the staff to clean each box and material for dust.

Aspects to take in consideration was words like openness, airiness, unity and the ability to handle a big amount of material.
4.12.3 Concept ideas for mobile module

Besides the module system for the library a mobile module has been developed. This system is design with the purpose of being an aid for the teachers to assist them in their education about materials.

All mobile module is design with an existing table trolley as a starting point, see Figure 44. The reason for this is that the table trolley is a well-known and familiar system often used by the teachers and lecturers. A limitation important to take in consideration is that the mobile module has to be able to pass through doors and into elevators.

![Figure 44, Inspiration for the mobile module](29)

This system will present material that today is an existing material used by the industry, depending on department and school will each user fill the mobile module according to their needs. The sketches is more focused on the outer form, the interior of the mobile module is for this stage not important. The shape of the adaptable depending of the amount of plate that will be stored in the mobile module.

The plate for which each material is stored and presented on is possible to use in both system.
This mobile module is an open trolley in which the plates easy can be accessed from each side, see Figure 45. On the top surface is there a vent to place the plate during lecture, this vent will make it easy for the student to see the material while the teacher is talking about it.

The disadvantages of this module is that the sides are open and there is a risk of that the material accidently falls off and there is no cover for dust.

The second mobile module is a covered trolley with one side opening, this opening works both as a cover for the material and for the presentation stand for the material during the lecture, see Figure 46. On the inside of the hatch is there a list for placing the materials.

This idea has the possibility to both cover and protect the material. At the same time make it easy for the students to easy see the material during the lectures.
The third mobile module is to its shape rounded in the corners. As hatch is there a slide hatch that covers the materials. For presentation is there an easel that can be lifted and standing on top of the module.

This solution differs too much from the other product with its rounded corners. Another issue with this idea is that the easel steal too much space inside the mobile module.

For the distance between the plates was a number of different height marked on a plate to see the difference, see Figure 48. 70 mm was chosen with the possibility of easy adapting if a material sample demanded more space. Majority of the material samples from Material ConneXion was below one cm in thickness.
4.13 Ideation session
An ideation session took place together with other students of the Industrial Design program at JTH. During this session the project was presented for the group who asked questions to better understand the purpose. This session became more a verbal brainstorming session than a sketching one, in which the project was clarified and better defined.

Some loose sketches were made to illuminate possible solutions for example the way of hanging the materials.

4.14 Workshop
4.14.1 University Library at Jönköping
A workshop was planned to be implemented with the staff at the university library at Jönköping. During this workshop two brainstorming sessions were planned and implemented.

The workshop was planned to be 2x60 minutes, each session was planned to cover different aspects of planning for the material library. For each session the staff received three questions to answer during the brainstorm. The first part was more focused on how the staff at the university library would have done to build the material library themselves. To discover useful and valuable ideas from the staff on how to build the material library.

To the first session the staff had to think about the following three questions:

- What is important to think about from the perspective of the staff of the university library when constructing a material library?
- How would the staff of the material library do?
- What part must be included to succeed with a material library?

The second part was more focused on how they would have done afterwards to maintain the interest of the material library.

For this session the question the staff had to consider was:

- How do we get the best result of a material library?
- What is possible to apply to the university library and vice versa?
- How do we do to increase the number of students in our facilities and use our selection?

4.15 Mid-presentation
The mid-presentation works as a halfway checkpoint together with the teachers and the client. This is a valuable meeting for feedback of the ideas and make sure that the work is progressing in good order. As well as the work is going on in the correct direction. During this thesis was the mid-presentation with the school a classical mid-presentation. The mid-presentation with the library was constructed in a different manner.
4.15.1 Mid-presentation at school
The first mid-presentation was held at school for the teachers and the students of the Industrial design program. During the mid-presentation was the project first presented in general terms and which conditions is defining the project.

After that was the three different concepts presented. The feedback received during the mid-presentation at school were later implemented in the final design.

4.15.2 Mid-presentation at the University library
This mid-presentation was in a different manor. It started with a presentation for the handler Mattias Lorentzi, to inform him about the work. After the scale models left on sight for evaluation from the library staff to see and think about the different concept. They did also have the possibility to see the material of choice for building the final model.

After a couple of days a following up meeting was held together with Mattias Lorentzi and Lars Eriksson. During this meeting a discussion was held about the different concepts and their advantages and disadvantages. In the end of this meeting a decision was taken to have a meeting with the group responsible for the material library at the University library.

Based on the decision and the discussion from the second meeting some development with the model took place and also the mobile module.

4.16 Model building
A number of scale models was built after the mid-presentation, the models was in scale 1:30. The models was built in white 1000 gram/m² cardboard and tools of choice was a carpet knife, wood glue, glue gun, cutting board, ruler and scale bar, see Figure 49 p. 51.

Figure 49, Some tools for building models
4.17 Color and construction material
Because of that the material presented is the important factor of this project is it important that the colors and material used for the presentation module kept as neutral as possible.

A comparative research was made with some existing furniture’s to identify a suitable thickness of the construction material.

4.17.1 Colors
For the shell of all modules was a neutral color desirable, therefor was a number of neutral and pale colors selected from the NCS S table, see Figure 50. The colors will be on both the library module and the mobile module. The four colors of 0502 is considered to have too much Chroma and towards one of the four elementary colors. They were therefor deselected. The two remaining colors is two different tints of white.

For the plate color is it not possible to use white color, these because the possibility that a material received from Material Connexion could be white. Therefor is it important to use a different neutral color for the plate, an alternative to white is to use a grey tint for the plate, see Figure 51

The colors above 30% black, the colors to the right in the figure, is considered too dark. These color could be to dominate compares to the material. Same with the colors below 25% black. These three colors could be too close to the white in the presentation module.
4.17.2 Construction material

A number of material was gathered to investigate how they would look like in white. All the material samples was gathered at Beijer bygg in Jönköping except one, which was collected from the school workshop. Each material was painted white before they were compared to each other.

The material was compared based on how each material was perceived for texture, both look and feel, and how the texture affected by color.

Plaster was chosen as a wild card, for this purpose, the plaster is considered too fragile. Even if this specific plaster was reinforced with fiberglass. The painted surface may be considered neutral, see Figure 52.

OSB is a material that used in constructions for walls. It’s a material that uses scrape from wood sawmills. It gives a surface with a lot of, both visual and sense, texture and in this project not recommended, see Figure 53.
MDF is a board material made from wood fiber. A good material to use for constructing furniture. For this project strongly recommended, see Figure 54.

Plywood neutral material with good feature for this project, while painted it has a low visual texture, a good alternative to use for the presentation modules, see Figure 55.
Masonite is a board reminding of MDF, but not suitable for this project because of the boards don’t have the necessary stability features for the presentation modules, see Figure 56.

Chipboard is a material made from chips from the saw mill pressed together. As a material for presentation module it’s a good alternative. However the edges has high visual texture, see Figure 57.
Form plywood is a variation of regular plywood, fitted for wet conditions. This material is especially used for forms to concreting. The downside compares to regular plywood is that the material is hard to paint because of surface treatment. The surface needs to be treated in some manner before painting.

To determine a good thickness of the construction material a study of furniture in the facility was made. A book shelf was located with a thickness that feels sturdy and stable, the shelf thickness was measured to 19 mm, see Figure 59. This was set as a reference and compared to other furniture’s.

In our own places in the office landscape most students has a desk, a drawer and in some cases a shelf. This shelf is bought by the students them self and has a thickness of ten
mm, see Figure 60. This shelf feels a bit wobbly and do not provide with the wanted expressions of sturdy and stable. Therefore was this thickness rejected.

![Figure 60, Book shelf with ten mm thickness](image)

The desk has a thick board as a working surface, see Figure 61. This surface has a thickness of 24 mm and express sturdy and stable, however as a shelf this thickness could be too heavy for movement.

![Figure 61, Desk top with 24 mm thickness](image)

The drawer has two different thickness, Figure 62. The horizontal thickness is 29 mm and the vertical is 19 mm.
To use two different combination for this is more to provide a stable surface to place different object. This also shows the possibility to combine to different thicknesses.

4.18 Exhibition and testing

Because the late arrival of the prototype had some final testing take place during the exhibition. Such as good ways of mounting the hooks on the plate and how to ensure the mounting of the luminaires. These test had to take place after the discovery of that the hooks fell down. A discussion about how to best mount the hooks was taken in collaboration with Toni Bogdanoff, laboratory technician at JTH.

The same issue was discovered with the luminaire during the mounting, the double sided tape had problem sticking properly.
5 Result

5.1 WWWWWH

From the initiating work of trying to identify important aspects of the project, to guide during the process of developing the product has the question from chapter 4.1 been a good support. The answers to these question and has been modified and revised during the project.

Those persons who are affected of these project is the library staff, teaching staff and students. To fully succeed is it mainly required an interest from the organizations of School of engineering and University library, with the delegation from the organizations is it possible for a material library to succeed. Otherwise is there a risk of knowledge and interest disappear when a key person quit their post. The project has to be aware of persons during the process who could dislike the concept, biggest risk is to that persons with a similar idea doesn’t appreciates challenging ideas or stressed staff that feels that work load will increase.

This solution is needed in the common education for students and teachers, as a complement to the traditional education of materials. But also as an inspiration for design-, mechanical- and architecture companies in the region of Jönköping.

Material library is something that has an increasing demand today with a higher level of knowledge and bigger demand of environmental friendly products. Therefore has the mechanical, design and construction industry a higher demand for a presentation platform of new innovative materials. Today is university cities a logical location for material library, in Sweden is there a number of location that today has or will create a material library. Stockholm has for example on located at Konstfack, Borås, Linköping and Umeå University is locations that today are developing their own versions of material library in different perspective. Outside Sweden is there a number of material library located either by universities or companies specialized on material library. In Sweden is the Material ConneXion and Materialbiblioteket the two main contributors of material for material library.

The library should be located in a central location in which a people has an easy access, the university library should therefore be a perfect location for a material library as a public space. As a complementary should each school at Jönköping University have its own node, with specialized material for them.

This project is focused on how to best present material samples in a manner that the material sample has the star role. To present material samples in a good manner in which the presentation will and can create an interest, curiosity and explore after new materials. The problematic aspect of this is to avoid to create a presentation module which create a distraction from the material sample.

Important aspects of creating a successful material library is to create something that attract people’s curiosity. Both in the long term and in the short term perspective.
Therefore is the goal to create a uniform presentation module for Jönköping University and the University library. A system that students and staff easily can recognize and dare to use. With these as foundation is the problematic elements important to take in consideration. Such as manufacturing principles, construction material, color, illumination and how to present material.

5.2 Design brief
Material ConneXion was early defined as a supplier for the material library, therefore was the material library to be planned in consideration with their material samples. JTH had request of adding material from the production industry and integrate both the existing material samples with the material samples from Material ConneXion in the regular education.

HBJ had a request of investigate the possibilities of integrate the material library at HJ and to see if there is an interest from the other schools besides JTH. Also see how a material library could impact on research for JTH.

To read the design brief in its full see attachment 1.
5.3 Market analysis
During the first search was a Swedish thesis report discovered, Materialbibliotek – Vad är det?, by Jenny Berggren. In her report she explains and define a material library from the definition of a regular library and how to best integrate a material library into a library. The Internet research also presented the reports from the construction of the material library at Konstfack by Oliver Schmidt. In his first report he present the prestudy of how to build the material library at Konstfack and in the following up report focus more into initiation and integration of the material library.

Schmidt had a short time employment for Konstfack with the purpose of creating the material library, after that he started the company Materialbiblioteket at Stockholm.

The market analysis showed that there is a number of distributers of material samples for to construct material library. Besides Material ConneXion whom was contracted by the school for supplying material samples is there a number of companies with the same purpose, see Figure 63 (For a bigger picture see chapter 8.2.1 Market analysis). For example Raumprobe, Matech and MatériO.

The result of the research was that the number of actual material library in Sweden was limited9. University of Umeå, Konstfack and Linköping had created their own and was operational. However did the market analysis show tendencies of startups at more universities.

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9 This research took place during the spring of 2014.
At HJ was a mail sent to different institutions at the different schools and some institutions did proclaimed some interest of having a material library at the HBJ. However, did they have some problem of connecting a material library to their courses, with the exception of JTH. The building department showed a clear interest of being a part of the material library and they also suggested to use a room at JTH for constructing a material laboratory in which samples of existing and today used materials by the industry. This location should also include a space for light booth to illuminate the different samples in different lights.

5.4 Function analysis

The function analysis sets the basic rules for the design, in this case is the main function to present material together with its supporting functions. The functional analysis purpose is to keep the focus on what the design should solve.

To best create a system that can present material samples in a way is some supporting functions required, see Figure 64 (For a bigger picture see chapter 8.2.2 Function analysis). In this design is it important to invite the user to touch the samples, to feel and create an opinion about the material. This could be assisted with illumination of the samples. For a better understanding is some basic information required about the material, an information tag is there for important to have attached to the plate.

A functional analysis was made to cover the material library in full, this will provide crucial information about the material library.

The main function is to present material and which functions that best support in how to present the materials, see attachment in chapter 8.2.2. To best presenting materials is to make it possible for touching the samples and inform what the specified material could be used for. Other functions which is desirable for presenting material samples is luminaire, transportation of the samples to lectures or seminars.

<table>
<thead>
<tr>
<th>Function</th>
<th>Class</th>
<th>Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touch</td>
<td>NF</td>
<td>To touch and feel the material</td>
</tr>
<tr>
<td>Information</td>
<td>NF</td>
<td>Present the materials information</td>
</tr>
<tr>
<td>Collect</td>
<td>NF</td>
<td>Gather material on a board</td>
</tr>
<tr>
<td>Prevent</td>
<td>NF</td>
<td>Avoid loss of the material</td>
</tr>
<tr>
<td>Transportation</td>
<td>DF</td>
<td>Transport the material</td>
</tr>
<tr>
<td>Illumination</td>
<td>DF</td>
<td>Illuminate the material with basic lights</td>
</tr>
<tr>
<td>Lecture</td>
<td>DF</td>
<td>Make it possible to teach in location</td>
</tr>
<tr>
<td>Assignments</td>
<td>DF</td>
<td>To use the material library for presentation</td>
</tr>
<tr>
<td>Seminar</td>
<td>DF</td>
<td>To use the material library for education</td>
</tr>
<tr>
<td>Illumination</td>
<td>DF</td>
<td>Illuminate the material with different lights</td>
</tr>
</tbody>
</table>

Figure 64, Function analysis
5.5 Stakeholder analysis

Even thou the project had a slight change during the process\(^\text{10}\), is the stakeholders the same. The core stakeholders is the staff at HBJ and JTH, this two groups are considered to be the main users and handlers of the material library, see Figure 65. Students at JTH and school of health, HHJ, together with staff and students at HLK is considered to be primary stakeholders. This groups will use the material library as a complementary to their education but it will probably not be integrated in their regular day education. Finally is the secondary stakeholders, people who will primary use the material library as an inspiration or to look with curiosity.

5.6 S.W.O.T. analysis

As part of the market analysis an S.W.O.T.-analysis was made, in this the strengths, weakness, opportunities and the threats for the project identified, see Figure 1Figure 66 (For a bigger picture see chapter 8.2.3 S.W.O.T.-analysis).

The material library has many good strengths and opportunities that easy could be implemented into the concept of a material library. The creation of a material library

\(^\text{10}\) The change is smaller and doesn’t affect the design, it’s clarify and separate the material library in to be Material ConneXion in the University library and existing production material in JTH.
creates a meeting place between students, companies and the university, a place to meet and intrigue people’s curiosity.

With the help from a material library HJ has the possibility to create a platform for research about new materials, to intrigue students to develop new materials in collaboration with companies for the future.

The danger with the material library is people don’t see changes and that the library develops and expands.

### 5.7 Study visits
#### 5.7.1 Material library, Konstfack

Konstfack has chosen to present their material library with an existing solution with the shelf *Expedit* from IKEA and with “tool board” mounted at the wall, see Figure 67. Some material is hanging on the wall and some is placed in the shelves.

![Figure 67, Material library at Konstfack Stockholm](image)

Konstfack has except the material also placed literature in the shelves, instead of having the literature separated from the material and located in their “regular” placing. This gives the possibility to find related literature adjacent to the material and books next to each other. For example is a specific material is located together with books categorized as a related design topic, see Figure 68 p. 65. This gives the advantages of having the relevant information in connection with the material and the users don’t need to search for the information on another location.
Konstfack has during the years since they opened the material library noticed a decreasing interest of the collection. Except the perception of the number of persons that are looking at the material is this confirmed with a decreasing number of lending of material associated with the collection. During the meeting did the staff have no solution of how to break the trend of the decreasing interest.

As a result of the decreasing interest are that they dismantling their collection and moved some material to the library’s basement. Even if parts of the collection is located to the basement it’s still available for the students.

5.7.2 Materialbiblioteket, Stockholmsmässan
Materialbiblioteket in Stockholm present their material in three different ways. The companies rent spaces in the material collection, either by space in a short booth, on a shelf or on a panel. Besides that the companies also get published online on the e-Showroom [30].

5.7.2.1 Short booth
The short booth is L-shaped and made by Masonite boards, see Figure 69, and it’s possible to place four short booth in a section with their back towards each over. Each booth is 1.86 meters high with an individual width of the walls of 1.10 and 0.77 meters wide [31]. This gives that each module has a presentation space of 3 m². On the smaller wall is a presentation of the company that contributed the materials. The short booth is their large presenting system.
Most of the materials are mounted on panels with a thin wire or mounted directly on the hook.

5.7.2.2 Shelves

The second alternative they provide is a shelf system, which is their medium alternative for presenting. Each shelf has the dimension 400x885 mm and contains up to four levels.
For each shelves the companies rent they will get a sign with the description the material, their services and how to get in contact with the company, see Figure 71. This together with a holder for business cards [32].
This system can also be adapted to contain textile material, see Figure 72.

5.7.2.3 Panels
The third alternative Materialbiblioteket uses to present material is panels of 400x400 mm. This is the smallest format they uses and on each panel will contain an explanatory text about the material, contact information, pictures and logotypes [33].

5.7.3 Material Connexion, Skövde

5.7.3.1 Categorizing materials
In an organization a lot of persons are involved into develop a new product, however the person who put the pen on to the paper decides about the form, material and shape. Most of the time is it the designer or the architect who is the first to start ideate the form and the aesthetics of the product. About 60 - 80 % of a projects cost occurs on the drawing board, according to Anders Breitholtz Material ConneXion in Skövde, how will designers and architects learn more about materials.

Before Breitholtz start to work at Material ConneXion he started a company called Råvara (raw product) in Gothenburg, early on was Volvos design department visiting them. Even if Råvara didn’t have many material sample did Volvo find new materials, because of the “only” talked to colleagues, visits fairs and read magazines connected to their profession. This contributed to the risk that designers didn’t read anything about material used by architects and vice versa.

When we started Råvara we started we stacked material samples in piles, after a while we started to think about how to categorize the samples and called them in different groups,
like Material ConneXions eights groups, said Breitholtz. We learned at Råvara that
categorizing material is not that easy, especially then material samples contains multiple of
other materials. People has different definitions of the materials and this provides with
difficulties for search for materials. What we learned at Råvara was something really
simple and fundamental simple. If we instead could categorize the material samples within
their basic materials and can extend and combine the parameters for searching would it
simplify the search for material samples, see Figure 73. With Anders Breitholtz model is it
possible to first combine to groups into a suitable structure and after that define what
kind of product raw product will become. In the figure is the product a laminate board
made by a natural and a polymer material. This model is possible to extend and include
parts such as production methods, drilling etc.

A product, such as a chair, contains a lot of different material groups. For example,
“Sjuan” by Arne Jacobsen contains at least eight different materials put together, see
Figure 74. To search for those materials Sjuan contains in a material database could have
some issue identify and find them. But for the design process is not the material itself the
most important to search for. Instead is the materials features more important to search
for, says Breitholtz. Is the material transparent, semitransparent? Do I want to have a
material which is weatherproof?

11 The pictures are collected from two web sites, the left [32] and to the right [31]
The strength of a material database such as the one from Material ConneXion is that it has good possibilities to search for special properties. For a designer, this is a more inspiring way of working and better suited for discovering better choice of material for the products.

The majority of the materials in Material ConneXion are different material combinations. There is a connection between innovation and combination, it’s precisely the way nature works, combining different materials. To create material design is about combining different materials and use their properties in a new material. If we can create a material that is a conflict with our knowledge about those materials, we will create a “wow experience” and experience innovation. For example, a polymer that is stronger than steel, Endumax, MC# 7144-01, is eleven times stronger than steel and is weight for weight the strongest tape on the market. It looks and feels like steel, but it is a polymer.

The interesting thing of a material library is when we start to touch and feel we start to interact with the sample, says Breitholtz. With the support of the fingers and the eyes do the user start to interact with the material sample, to get a deeper understanding people start to use their nose and ears to continue explore the sample. To interact with a material creates a bigger understanding of materials than some strength numbers, the interaction creates something relatable.

5.7.3.2 Future of materials

That is coming is probably a tagging of the materials, there is a lot of material in Swedish building from the late 60th million program nobody know what it is. To be better handling the material in the future will there be a higher demand for tagging and labeling materials used.

It is certain that material will be more expensive in the future, it’s not durable to dig up materials from the soil to make one product and dump it or burn it. It’s even better to dump it than burn it, because from when the material is excavated from the ground some knowledge, energy and add complexity while the material is processed. For each step of the process will environmental impact and the value of the material will increase. If we in one lifecycle burns the product will all the knowledge and energy only become heat. If we instead dump it as a landfill it is possible to reuse in the future.

What is missing today is the specifiers, the designers, constructor or architects, not involved in the process of developing new materials. If they had the possibility to make decision, they could create a material that will cost this much, have this lifecycle and endure for this period. Today is the only one group who has this knowledge and I think the will be an increasing demand for material designers ahead.

12During the late 60th and early 70th was a million apartment built, these apartment was built to solve the immediate shortage of housing crisis and to raise housing standard the in Sweden. The areas these building was built upon is today suburbs outside the cities, known suburban areas is Rinkeby (Stockholm), Råslätt (Jönköping) and Rosengård (Malmö) etc.
5.7.4 University library of Umeå

Umeå sent picture of how they are presenting their material from Material ConneXion. They have hanged their material on five nylon threads in a window, see Figure 75 p. 71.

In their plan for the future of the material library is to keep expanding as long as they have room for more material. They don't have any plans for how to do then the material library gets filled and are more focused on to solve that when it comes to that. In the long perspective they have initial thoughts about starting a collaboration with Umeå School of Architecture. But it is nothing they had a deeper discussion about.

Figure 75, Material ConneXion at University library of Umeå

5.7.5 Summarize of the study visits

The field trips provided with important aspects for how to construct, implement and continue to exist.

To construct a material library is focus more towards keep it simple, let each material sample to be in focus. It's a risk that if there is to many materials in same location that it will become hard to receive and the presentation will become overwhelming. Another risk if a material library feels overwhelming is that users may have problems to see newly arrived material samples.

Another issue discovered was the importance of satisfying the visitor's expectations, it's important to continuously provide with the feeling of something new is happening. Not only by having a continuously flow of new material, make sure that the material library feels alive. To do so it's possible to create events such as material workshops or conferences for special invited guest, such as students, researchers and companies. The important aspect is to show that the material library is alive.
5.8 Design for all five senses
A regular lecture which contains only a PowerPoint presentation and a lecturer has a tendency to become monotonous. The response from a couple of students is that a lecture has a big focus on sight and some about sound, see Figure 76. Besides that is there nothing that trigger the human mind and curiosity.

If there instead integrate the possibility to add material samples to the lecture more senses activates and the student’s curiosity increases, see Figure 77. This will provide an increasing interest of material among students, designers and fabricators.

Even if smell and sound doesn’t score that high on the graph is there still some materials that encourages to smell the samples or tapping or bending the samples. The majority of material samples is not possible for tasting, however is this something that could happen. In those case would the grade of taste increase.
5.9 Persona definition

5.9.1 Student

The first scenario of the persona is a student at JTH, she will use the library for research as a part of an assignment, see Figure 78. She will most likely walk around to touch and feel the material samples to discover new material to use in different assignments.

**Persona - Student**

Name: Elina Petersson  
Age: 22  
Occupation: Design student  
Purpose: School assignment in which she going to present a material for her classmates.  
Method: Walks around in the material library to touch and feel. Take pictures and search in the database for the material.

*Figure 78, Persona – student (Photo: Tim Robberts @ www.gettyimages.se)*

5.9.2 Professor

For the professor could the material library be used for a number of purposes, see Figure 79. Such as research for the students as part of an assignment, it could be a part of the research for the professorship. It can also be a tool to use during the lecture, to better explain different materials for the students and let them touch and feel how the material feels, sounds and smells like.

**Persona - Professor**

Name: Steve Erik Svensson  
Age: 47  
Occupation: Professor  
Purpose: Teaching students about plastics and want to present plastic material for the students to touch and feel.  
Method: Brings a larger amount of plastic material to lecture and passes them around the students during class.

*Figure 79, Persona – Professor (Photo: Gregory Castansz @ www.gettyimages.se)*
5.9.3 **Designer**
The third scenario is the entrepreneur who work as a designer, who want to do some own research for ongoing project as well as future ones. To walk around the material library to find inspiration.

![Persona - Designer](Photo: andresr www.gettysimages.se)

5.10 **Workshop - University Library at Jönköping**
Thirteen persons attended to the workshop and was divided into three groups (four, four and five). The workshop lasted for two hours divided into two parts.

5.10.1 **Graded brainstorm**
During the first hour the participants first had a session in which they first thought about how they were going to build a material library. For their assistants they had whiteboard pens and flipchart papers. To their help they had a number of question as a guide.

After the initial brainstorming session, they first presented the findings of the groups discussions. After that they individual had the possibility to mark the three best ideas from the other groups. This grading provide with the possibility of identify what aspects the library staff feels is the most important for the material library.

The outcome from the workshop was thoughts about how to lend materials, if it’s possible to add the samples to Primo\(^\text{13}\). How and where to place the material library and how to adapt the facility to fit a growing material library.

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\(^\text{13}\) The catalogue system used by the library for the literature.
There was some aspect that stood out from in the evaluation, besides things concerning how to connect to Primo and how to search for materials. Besides placement, structure and shelf arrangement is collaboration with the schools of HJ and companies was something that was highlighted, see Figure 81.

5.10.2 F.U.U.L.

Second part of the workshop the focus turned to how to make the material library sustainable for a long time. This time the group had post-it notes for their help during the brainstorm.

The groups focused on create a collaboration with the schools, in which the schools was responsible together with a coordinator from the library. With the help of integration between the schools and the library could create a material library in the front line, see Figure 82. They meant that a material library can create a boost for the HBJ both at HJ and companies in the region. But also create a good reputation towards other libraries in worlds of libraries.
5.11 Concepts
To create a uniform language of all concepts is each corner made with a chamfer. As well as the other corners as the individual boards has this chamfer. All concepts has also the same construction material of birch and MDF-boards.

5.11.1 Concept 1
In Concept 1 is a free standing module with an L-shaped short side. The L-shaped surface provides with the possibility to use a presentation sign of what each shelf contain, see Figure 83.

The material sample is meant to be mounted on plates which are placed in a track. The purpose is that the plate will be possible to remove from the standing.

Figure 83, Scale model of concept 1
The construction material of choice is white stained birch in combination of a category color made in MDF-board, see Figure 84.

![Figure 84, Render model of concept 1](image)

Each module has a base size of 900x300 mm with a height of 1700 mm. The width of 900 mm is based on the possibility to easily expand the shelf into wider modules, this makes it possible to have shelves that is 900, 1800, 2700 and continuously.

The short side is set to be 300 mm based on expression of feeling stable. Each module is supposed to be free standing in the library and as a spectator feel like it’s possible to walk by the module with making it fall over with the help of wind draft or in some way make it fall.

With the three carriers on each side it’s possible to present three material sample on each carrier, in total will it be possible to present 18 material samples on each module. The module is prepared to add a fourth carrier.
5.11.2 Concept 2

Concept two is an alternative in which the material samples is placed in drawers, see Figure 85. Each drawer will be able to open in both directions and contains of two samples. Its base size is set to 900x400 mm and 1700 mm high. In total will it be able to store 32 material samples.

The module is designed to have an outer frame containing a wide color strip presenting the modules category. The central strip is made of MDF-board and has two smaller strips of stained birch, see Figure 86.
5.11.3 Concept 3

The third concept which the plates of material samples is placed on leaning surface, see Figure 87. The base size is 900x300 mm and 1700 mm high. The purpose of the leaning surfaces was to make it easy to observe the samples.

This module is designed with a MDF-side in color symbolizing the category of material samples. Each leaning surfaces and the top is made of stained birch, see Figure 88. There is a possibility of removing the leaning surface, each surface is designed to be self-looked of its own weight. The surfaces is supported by two studs.
5.12 Midpresentation, School of engineering

The feedback from the midpresentation at JTH where mainly focus on the present design of the concepts. Such as material of choice for the modules and colors. Such as advantages and disadvantages of having the selected material choices.

An important aspect was that the module design was taking too much focus from the material samples. With modules with partly stained birch and partly a colored part was the risk to high influence the experience of the material samples.

Instead of having birch as a construction material MDF was considered to be a better material of being more neutral. At the same time was the colored surface considered to be too powerful and eye catching, it would be better to scale the colored surface to a smaller size.

With this information in combination with feedback from the tutor was the concept built in scale before the presentation for the University library.

5.13 Midpresentation, University library

The midpresentation for the library took place in three steps, first was the scale models presented for the contact person. The staff had the possibility during a week to evaluate each concept. After that a meeting with the contact person at HBJ and the tutor took place in which the feedback from the library staff was presented.

With this information a following up presentation was decided together with the focus group of the material library and the tutor. For this meeting a new scale model of concept one was built based on the learning outcome and the feedback. An important aspect was that the carriers could be built to create some depth, this could protect the material samples better and prevent people to bumping into them and make them fall.

For the third and final step of the midpresentation for the library was renders, scale models, hooks and luminaire research prepared and presented. Besides scale models on the concept was also a model of the mobile module built and presented.

The outcome of the midpresentation with the library was that they wanted to have two versions of the module. One version for presenting newly arrived and contains two plates in width and one version that contains four plates in width. They also wanted that each module contained four fixed carriers instead of three.

An alternative of the category sign was presented and a discussion about how modules would look like if the HBJ system was integrated on to them. The presented idea was considered to be good as long the final solution was easy to maintain.

For illuminate each carrier was their request for a dispersed luminaire. It could be problematic to use spot lights because this demands for the plates being placed correctly every time.

The presented hooks, see Figure 31 and Figure 32 p. 41, were rejected because of a mismatch with the modules.
Result

They look poor in compares with the design of shelf.

A request was to try and find more designed hooks and if there is a possibility, locking hooks.

Based on the request of having module which is two and four plates wide, was also the width of the module set. The four plate wide module was decided to be 1.2 m wide and therefore was the two wide set to be half the width. This made the both modules modular and easy to extend.

With the feedback from the midpresentations was the concepts finalized.

5.14 Luminaire

During the midpresentation was the research about different types of luminaires presented. Initially was a spot light recommended, however the library staffs feedback was crucial and a dispersed luminaire was considered to be a better solution. They meant that the risk of slightly misplacing outside the illumination the material sample would be to high risk.

![Figure 89, Illuminated plates](image)

5.15 Colors

With the learning outcome from the research in which different colors was compared to each other was the white set to NCS S 0500-N and the grey to NCS S 2500-N, see Figure 90.

![Figure 90, Colors for this project.](image)
5.16 Plates
The original hooks intended for the plates didn’t feel well designed in this context, as the hooks looks poor in compares to the design of the shelf. After midpresentation was new hooks presented and a decision was made of ordering a certain model, however was the alternatives out of production. A new set of hooks was quickly discovered and samples was ordered from the HABO-group. These hooks was tested on to the plate and compared. This test revealed Thule diamond, see Figure 91, was the option most suitable. In compares to the two other options was these hook easiest to mount.

However it was discovered during the exhibition to be unreliable and did fell down on a number of occasions. After the discussion with Toni Bogdanoff is the solution to remove the adhesive pad and use super glue instead. Bogdanoff did also suggest to mill a track for the hook.

On the front side the plate is there a milled surface to place the identification card for each material sample, see Figure 92. For each material sample follows two cards, the second one will be placed together with the sample.
On the back side will a track be milled on the lower part of the plate, this track if for ease the plate’s removal from teacher’s module, THJMM42, see Figure 93.

![Figure 93](image)

5.17 Model building
5.17.1 Concept models
From the model building some important lessons learned. Both details and constructions learnings. This are important to take in consideration in the final solution. One learning outcome from the scale models was the importance of having a guide for the plates, a guide that makes it easy to place the plates on the correct place, see Figure 94. Both on the upper and lower part of the carrier.

![Figure 94](image)

 Noticed during the prototype building and testing was that an absence of an upper guidance for the plate, see Figure 95, hampered the placement of the plate. This guidance is necessary for a simple and intuitive place and replace the plate, the absence of this created some annoyance and forced the user to look.
For the second and third concept was stability an issue to take in consideration. Especially for the second concept was stability bars mounted to keep the stability and the possibility to make it stand. However if this is an issue due to the production material is not investigated.

5.18 Final models
HJBMC2W, HJBMC4W and THJMM42 has some common aspect in their design language that will provide a familiar feeling and a recognition factor of all three.

The important aspect is that the material sample is the star, meaning that the modules and the plates has to be neutral: in shape, material and color.

For constructing material of all three modules is MDF-board chosen, this is a neutral and discrete material. Other material was tested and refused depending on that they were considered to take too much focus from the material samples.

To lower the production cost for each module it’s recommended to produce them at a carpenter with the possibility to use a CNC-milling machine.
5.18.1 HJBM2C2W

HJBM2C2W is an acronym that stands for University library in Jönköping, Material ConneXion two plates wide. The HJBM2C2W is the basic module, primarily used for presenting newly arrived materials.

The module is a two-sided presentation module with eight material samples on each side. Each module has a number of features which is supposed to present the material in the best way possible and in a pedagogical aspect. This features has an impact of the design.

The features that each module contains is:

- Replicable sign
- Removable plate
- Illuminated material sample
To get a quick glimpse of what material category there is in the module is each module equipped with a replicable sign in the upper left corner. This sign is also located on the short side, in the same manner as the ordinary shelf in the library. There is nine different signs, six of those are based upon Material ConneXions color scheme and the ninth is to only to present news, see Figure 97.

<table>
<thead>
<tr>
<th>Ceramics</th>
<th>Polymers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>Processes</td>
</tr>
<tr>
<td>Metals</td>
<td>Naturals</td>
</tr>
<tr>
<td>Cement</td>
<td>Glass</td>
</tr>
<tr>
<td>News</td>
<td></td>
</tr>
</tbody>
</table>

Each sign is placed behind a Plexiglas board, either by a separated cardboard or on a printed directly on the Plexiglas. The bracket in which the signs is recessed surfaces with a track on each side in which the Plexiglas will slide into, see Figure 98. Depending on what category of material the shelf present is the sign replicable.
5.18.2 HJBMC4W
HJBMC4W is an acronym that stands for University library in Jönköping, Material ConneXion four plates wide.

The HJBMC4W is basically the same as HJBMC2W, the difference is in the amount of material that is possible to store in the module. Instead of having the capacity of presenting 16 material samples has HJBMC4W the capacity of presenting 32 material samples in the same module. The dimension of this module is 1200x300x1700 mm. 1200 mm is chosen to create an adaptable and modular system which can be easily extended in combination with other units of HJBMC4W or HJBMC2W.

Both HJBMC4W and HJBMC2W uses the same production technique, material and supplies. Therefor are they both fully compatible.
5.18.3 THJMM42
THJMM42 is an acronym that stands for Teacher at University of Jönköping, mobile module, four by two. This module is a tool for teachers in an easy way transport and store a huge amount of material samples used during lectures, see Figure 100. It is possible to store up to 72 material samples inside the trolley, between each slot is there 70 mm. This distance is in most cases enough to store materials and those cases a sample needs more height it's possible to remove plates above to create more space. The basic dimension of the mobile module is 900x650x725, this size makes it possible to easy bring the trolley throw narrow spaces such as doors and elevators.

![Figure 100, THJMM42](image)

It is a double sided trolley with a double door on one side and a single door on the other side. The double door makes it possible to easy access the material samples, it’s also possible to access material samples from the other side of the unit. This because of the tracks inside are uninterrupted and the plates can be pushed all the way thru, see Figure 101.

![Figure 101, Interior of the THJMM42](image)
The single door opens upwards and create a presentation surface for the material samples. Besides having a picture lath, there is also included a slightly angled surface facing the students, see Figure 102. The slightly angled surface creates a secondary surface to place material samples with the possibility to still see the samples from the students’ perspective.
5.19 **HJBMC2W – Prototype**

The prototype of the model was outsourced to a carpenter\(^\text{14}\), after some discussions a decision was made for simplify the model, both to lower the price and to ease the building of the prototype.

5.19.1 **Differences**

There are some differences between the prototype and the virtual version of HJBMC2W. In the final design of the model is the carriers replaced with a single shelf, this shelf has a 50 mm ledge as the original design, see Figure 103. Besides that is also the track for placing the plate changed, this depth is less than the original design. With the shelf design did also the back ledge disappear, see Figure 104.

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\(^{14}\) Alltsnickeri.se i Jönköping AB
With the change from carrier to shelf did also the need of having a box that contained the transformer for the LED-luminaire, see Figure 105. The bottom shelf provides with the possibility to hide the transformation.

Figure 105, Cover box for the transformation

To mount the material on the plate a hook was chosen to be quick and easily mounted. However the downside of the hook is that the pre adhesive pad started to slide and then fall off after some time. This doesn’t give any qualitative impression, the same issue is it with the luminaire. The double sided carpet tape used for mounting the luminaire didn’t work according to expectations, see Figure 107. With the help of a stronger tape the luminaire did attached better, see Figure 108.
Figure 107, Double sided carpet tape [34]

Figure 108, Acrylic double sided tape [35]
Result

The space that contain the sign has a complex design that is hard to easy produce, see Figure 109. The problem with the placement is that the milled track on the side is hard to create with machinery.

Therefor is this placement simplified on the prototype, instead of having a track is place for the sign milled into one lower surface without any track containing the sign, see Figure 110.

As seen on the two pictures above is also the internal milled edge removed from the prototype for simply the production.

After a discussion about how to simplify the design did the designer and the carpenter agreed on how to proceed.
5.19.2 Learning outcomes
The simplification of the carrier to a shelf gave two unexpected problems. The first issue discovered was the placement of the plate was hampered, this because of that the absence of the back ledge. When there is no back ledge there is no guidance for the plate to know where the track is, see Figure 104 p. 90. The back ledge should extend 20 mm beneath the carrier.

Changed of the tracks depth didn’t have any effect on the plate, there was an initial concern that the track couldn’t support the plate. The depth was deep enough.

Something discovered during the exhibition and the test period was that the shelf sounds each time some removes a plate. The sounds origin is from the plates balances in the lower track and hits the sides in the upper track. This could easily be solved by mounting a small rubber ribbon on the sides of the upper track.

The box that covers the transformer purpose is just to cover, with the cover is the transformer hidden, but it has to be possible to open it for maintenance.

The size of the carrier could be optimized, the 50 mm front ledge and the 20 mm extension of the back ledge is recommended to keep. However is it possible to let the internal size of the carrier be two 19 mm MDF boards.

To prevent the hooks from falling off should a hook with no adhesive pad be used and the hook should be mounted in a milled track on the plate with glue. Parallel with exhibition is some testing with mounting implemented. These test shows that the double sided carpet tape had a better attachment then the adhesive pad. Even with the combination of double sided carpet tape and adhesive pad, but this solution is not satisfactory. For a final solution of mounting the hooks is first remove the adhesive pad, mill a track and glue them in its place. Alternative is to redesign a hook optimized for this purpose.

The result from the tests is that the double sided carpet tape inappropriate for mounting the luminaires, for this is the acrylic double sided tape a better temporary solution. But for a long term perspective could the mounting of the luminaire be screwed, instead of using a double sided tape.

For the mounting of the sign it’s better to redesign the bracket, instead of having the track for the sign in the middle of the mounting, see Figure 111. It would be better to move the track so it is in line with the rear side of the mounting.
To produce HJBM2W it is recommended to investigate the cost of produce with a carpenter together with a CNC-milling machine, the cost of having it handmade by a carpenter is high. The price for producing the prototype in the same manner as the virtual model will cost 10,000 – 15,000 SEK. Even if the prototype was simplified did the cost per unit end up just below 10,000 SEK.
5.20 THJMM42 – Scale model

Besides that HJBM2C2W was built by a contractor was also the THJMM42 built, this module was built in the workshop at School of Engineering and built in scale 1:2.

5.20.1 Differences

In general is the THJMM42 virtual model and the scale model the same, the difference is small change on the top part, see Figure 112. This change contribute to create a leaning presentation surface. With a height difference of 2 cm between the middle and the side provides with an angle to better display the material sample.

Another small change is a small bracket for the single lid, this bracket is needed for stability in the joint between the side surface and the top surface, see Figure 113.
5.20.2 Learning outcome
Some important lessons was made during the build of the THJMM42, things that needs to be adjusted to create a good solution for the final product. To begin with something to make sure that the joint between the big side surface and the top surface, for the prototype this was solved with a small bracket to maintain stability. For the final solution could a better solution to use a triangular MDF-board to make a more designed adjusted solution.

Another learning outcome is that the three internal walls is too long, they need to be shorter to make it possible to make the presentation lath on the big hatch fit.
6 Conclusion and discussion

This thesis is mainly focused into how to develop a presentation module for a material library. However, to create a material library that will live for a longer period of time is the presentation modules only a small part. It is impossible not to think about material library in a bigger perspective, but thesis only scratches the surface.

To meet the futures demands for design and architecture is there an increasing need for environmental friendly material. There is an increasing need to educate designers and architects in new innovative materials. This because of the price for raw material most likely will increase in the future depending on there is only a certain amount of raw material in the ground. In combination with a higher demand for new products and buildings will force designers and architects to find new, better and cheaper materials.

In each profession there is today lack of knowledge about material not concerning them, an architect has good knowledge about material concerning constructions and building. The same with designers, there knowledge of material is more focused into the products. Each group reads magazines, visits fairs and talks to people connected to their profession with the result of having a bit narrow knowledge about material.

Lack of knowledge about material is problematic from two perspective. First, not knowing about material connected to the “other profession” create an unconscious limitation for each projects design brief. Second, this limitation might force designers and architects into choosing unnecessary expensive material. As Anders Breitholtz talked about, the designer and the architect are the one who put the pen onto the paper and make the decision of how the final result will become. Instead of choosing the same material as they always have done, why not letting them develop or explore for new materials. Therefore will the demand for material designers increase.

To inspire architects and designers about new materials is the creation of a public meeting space important. A place designers, architects and laymen can meet and talk about innovative materials is a foundation for developing new materials. A material library is the foundation of this, in combination with a regular conference in which the participants can participate in seminars, workshops and lectures about materials. This can and will inspire designers and architects to learn about materials inside the “others profession”.

The other part of this is to inspire students to work more with materials, to create possibilities for them to search for new materials suited for their projects. This will provide with material designers that can find, explore and develop new materials and new combinations of materials.

As a part of something bigger will and can a material library inspire students, designers and production companies for the future. As long as a material library feels alive, strives to develop and invites people to meet. With a more hands on education of material will encourage designing students to search and explore for new materials. In combination with the database from Material ConneXion is there possibilities to search for other
features than CES\textsuperscript{15}, such as water resistance, acoustics, usage temperature, outdoor usage etc. with different grading’s of high, medium and low. With the Material ConneXions database is it possible to search in a more general aspect of materials, instead of the more specified search in CES. This makes it possible to find other possible and unexpected materials for the intended purpose.

To use these possibilities in the education can create a higher interest of searching for new materials. These tool will and can provide the possibility to find material suited for the future.

During this project, some things got removed from the schedule. For the presentation modules could this have some effect on the final design, especially on the mobile module. These changes affect more on the whole of the concept of a material library as a meeting place. A study visit to Linköping University was planned, but this was canceled the same day because of sickness and due to misunderstanding a new meeting was never scheduled. From this visit could have provided with useful knowledge about constructing a material library for each school containing existing material samples and how to use a material library in the everyday education.

The process of choosing construction material, a number of material was selected, however several of these material was chosen with the knowledge that they wouldn’t meet the specification. Those material was included both for curiosity and to have a broader selection of construction material. Roughly there are three different ways of how to choose material. By generalizing it the designer, the engineering and the database way.

While designing a new product, the designer, has a well-known palette of material to use and choose from. They gain knowledge about materials from visiting fairs, read magazines and talk to each other within the branch. There palette of materials grows based on trends, production and usage of the product. This tacit knowledge\textsuperscript{16} is hard to explain and grows with experience.

Engineering way of selecting material is more focused on testing a huge variety of materials. Each material is analyzed and compared to other samples in the test. This is a slow process and for project in which material has special demands for durability a good way of working.

The third option of choosing material is actually a variety of different tools, for example the databases from Material ConneXion and CES are two different ways of discovering materials. CES is focused on searching materials with the help of numerical hard values for restrictions and limitations. As long as the limitations and restriction is known, CES is a good tool to use and it can provide with good material specialized for its purpose. However its advantages is also its limitations, for inspiration of discovering new materials

\textsuperscript{15} CES is a software used for searching material based on specified limitation of materials. The software has the possibility to find materials within specified limits.

\textsuperscript{16} Tacit knowledge is hard to transfer person to person by writing or verbalizing, tacit knowledge is described as a know-how and gain from learning by repeating.
Conclusion and discussion

is CES not suitable at all. CES is a good tool and especially suitable for the engineering way of selecting material for new products.

The database from Material ConneXion has a different approach of searching for materials. Instead of searching with the help of hard values, Material ConneXion is more focused on searching for soft values (low, middle and high). With the guidance of the function analysis it is possible to discover new innovative and unexpected materials suitable for the design. A search in Material ConneXion is continuously sorting suitable materials and for each limitation the number of suitable material reduces.

For this project the decision had to be about which construction material to use, and it was necessary to be taken early in the project. The two main material was Plywood and MDF. The rest of the material tested was brought in to see if they could be an option. Only one material sample was good enough but was turned down because of the higher workload for preparation before painting, Plyfa is a plywood suitable for wet or moist environments, but it needs to be grinded before painting.

This half way method of design and engineering way of choosing material was for this project an unnecessary step. The test would have been enough just with the two primary material in mind, MDF and Plywood. For the rest of the material test did only provide with a visual reinforcement of the expected result. This was only time consuming and didn’t add any new knowledge concerning this project.

For most project the design way in combination with the search in Material ConneXions database enough. These search can provide with new knowledge and inspiration of materials for future designs. In combination with an open and continuously material library exhibition in the university library, it will provide with greater knowledge of materials for design. However a search in Material ConneXion is not always sufficient for project with extreme demands of materials. Such as parts of airplane, car and construction materials. In these example could parts be punishable by extreme demands and is best handled by software like CES and the engineering way of choosing material.

The next thing that got removed from the schedule was a workshop with the teaching staff, the purpose of this workshop was to gain knowledge about of how to best integrate the material library into the education. As a substitution was student discussions in combination with discussions with some teachers at JTH used as an underlay for the mobile module.

An alternative solution for constructing a material library is to use the plates in combination with the existing shelves in the library. This provides the possibility of a low cost solution and will keep the same form language as the other shelves.

Therefor is it recommended to do a study visit to Linköping University and, if necessary, have a workshop with the teaching staff to better implement a material library in each school at HJ. Göran Hellborg architect SAR/MSA at building department at JTH should also be included into the project of develop a material library at JTH. His ideas are similar to the MRL in Linköping.
The learning outcome of the project work is more focused into the methodology, for the next project a better planning of which method to use and in with purpose. Also to summarize the result of each method in the report. The advantages of this is the possibility to have a “debrief-book” and with the result continuously entered into the report is everything collected to easy debrief the project, both for yourself as a project manager and to the client. For this project was it some issue to the possibility of debriefing and report progress each week, due to the lack of a “debrief-book”.

Working with design doing created some new challenges, the process has all along been focused into having an open-minded state of mind, courage and conviction. To work with an open-mind is to be opened for new ideas and solution, to listen to other persons ideas and to evaluate all ideas, both good and bad ideas. The courage to do things outside the own comfort zone, to turn down ideas that is outside the projects purpose or has the risk of creating a giant side track. At the same time to accept ideas that will carry the project forward. The conviction of being able to bring the project forward makes still alive, if the project management don’t have the conviction of the project it will become a dead project that only cost time, money and effort into ending up in nothing special.
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8 Attachments

8.1 Attachment 1, design brief

8.2 Attachment 2, graphical figures
  8.2.1 Market analysis
  8.2.2 Function analysis
  8.2.3 S.W.O.T.-analysis
  8.2.4 Persona – Student
  8.2.5 Persona – Professor
  8.2.6 Persona – Designer
  8.2.7 Graded brainstorm

8.3 Attachment 3, Gantt

8.4 Attachment 4, drawings for HJBMC2W

8.5 Attachment 5, drawings for HJBMC4W

8.6 Attachment 6, drawing for THJMM42
Attachment 1, Design brief, Material library

Short Summarize
Jönköping University, HJ, plans to create a material library with material from Material ConneXion, this material is limited to only contain newly produced material. JTH has a request of using standardized production material as a part of the material library. This for illustrate material which is used today and be a complement to the material from Material ConneXion.

This project purpose is to create a presentation system in which the material samples will be visualized. Also will it do a research of the possibility of using a material library as a part of the lecture at School of Engineering in Jönköping, JTH, and investigate a possible interest of a material library from the other schools at Jönköping University. Besides that create a material library for those material used today by the production industry in the region in which Jönköping is a part of.

Company’s/clients objectives
University library at Jönköping University, HBJ, which for a suggestion about how to a material library can be designed and contained within the facility of the library. This includes a suggestion of a module system in where the material samples can be places, hanged or in another way displayed. The suggestion should also include an assessment of how the facility should be adapted.

HBJ also which for:

- Investigate how a material library could be integrated to JTH’s education and also what interest there is for the rest of Jönköping University.
- An inquiry of what significance a material library could have on research at JTH.
- An inquiry of what significance a material library could have for the university contacts with regional companies.

Students objectives
Thru an explorative research do a study of how to implement a material library at HBJ, to evaluate different alternative of how to best present and use a material library in education and science research. How to best complement Material ConneXion with material used by the production industry today.

This study shall result into a material library that could be used for education and research by the different schools at HJ. This report will mainly focus on how to best implement a material library at HJ.

This work will be finalized for presentation at May 14th 2014.

Newsworthy
By creating a unique rallying point for students, staff at HJ and the regional companies in which both new and existing material can be displayed. In which HBJ provides with a material library there they can categorize, inspire and expose contemporary and future material. This service will provide HJ good possibilities to create a higher understanding of those material used today and future materials. The material library can used with advantages in the teaching and research various schools at HJ.
Courses the thesis based on
- Design communication 1-3 (School of Engineering, master courses)
- Design research methodology (School of Engineering, master courses)
- Ergonomic (School of Engineering, master courses)
- Materials and design (School of Engineering, master courses)
- Introduction to industrial design (School of Engineering, master courses)
- Building design (School of Engineering, bachelor courses)
- Building technology (School of Engineering, bachelor courses)
- Design management (Borås university)

Method
This study will be conducted exploratory, together with three workshops during the initiative phase alternative to have two workshops and a focus group meeting. The purpose of this workshop is to get involvement of the library and teaching staff connected to the subject. Besides the workshops will at least three fieldtrips be conducted: Konstfack in Stockholm, Design school at Umeå and Material Realisation Lab, MRL, in Linköping. If there is possibility also do a fieldtrip to Material ConneXion in Skövde. The purpose with the fieldtrips is to see how different material libraries are constructed and what problems there might be.

Each week will a short report be mailed to the teacher, in which the result of the week will be presented and the planning for the upcoming week. Besides the weekly mail is Wednesdays schedule for theses related meetings, such as lectures, tutor meetings and so on.

Time plan
The project is divided into different phases with the following date as milestones.

Milestone 1, ~1\textsuperscript{st} Mars – Workshop 1
Milestone 2, 19\textsuperscript{th} of Mars – Mid presentation
Milestone 3, 14\textsuperscript{th} of May – Presentation of thesis
Milestone 4, 27\textsuperscript{th} of May – Exhibition of prototype on the Xfair and in the university library

Phase 1
- Kick off
- Literature studies
- Initial ideation
- Field trip to Umeå, Linköping and Stockholm for visit their material library
- Field trip to Material ConneXion in Skövde

\textit{Result of this phase:} Presentation material for the workshop

Phase 2
- Workshop 1, library staff
- Workshop 2, teaching staff
- Summarize of workshop
- Continues ideation

\textit{Result of this phase:} Three concept to mid presentation

\textit{Milestone 2, 19\textsuperscript{th} of Mars}
Phase 3

- 3D-modelling
- Mockup building
- Workshop 3, library staff for evaluation of mock up and concept *(Alternative a focus group from the library)*
- Finalizing ideation
- Preparing presentation

*Result of this phase: Finished prototype and presentation material*

*Milestone 3, 14th of May*

Phase 4

- Posters
- Preparing the exhibition

*Result of this phase: Exhibition material for the exhibition and Xfair*

*Milestone 4, 27th of May*

Report writing will proceed parallel with the project.

**Budget**

To accomplish this thesis is some financial support needed, this support till be used for the following:

- **Field trips:** Umeå, Linköping, Skövde and Stockholm
- **Working material:** For workshop: such as Post it, pens, paper and paper glue
- **Presentation material:** For model building of mock ups, model build of prototype, posters and report

**Further information**
7.2 Attachment 2, graphical figures: Market analysis

External Stakeholders
- JIBS
- HLK
- HS
- JTH
- HHJ

Internal Stakeholders
- Student Educational Staff
- Library Staff
- Educational Staff
- Research Student
- Student Educational Staff

Universities
- Linköping University
- Konstfack
- Umeå University

Companies
- Design Companies
- Manufacturing Companies
- Production Companies
- Innovative Companies

Material Libraries
- Material Connexion
- Raumprobe
- Materialbiblioteket
- Matech Matério

International Work
- Preparatory Year
- Architectural Engineering
- Building Projects/Civil Engineering
- Product Development and Design
- Dental Hygiene
- Prosthetics and Orthotics
### 7.2.2 Function analysis

#### Analysis of functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Class</th>
<th>Restriction</th>
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<tbody>
<tr>
<td>Present</td>
<td>HF</td>
<td></td>
</tr>
<tr>
<td>Enable</td>
<td>Touch</td>
<td>To touch and feel the material</td>
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<tr>
<td>Present</td>
<td>Info</td>
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<tr>
<td>Contain</td>
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<td>Prevent</td>
<td>Theft</td>
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<td>Enable</td>
<td>Illu</td>
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<td>Lectu</td>
<td>Make it possible to teach in location</td>
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<td>Enable</td>
<td>Assign</td>
<td>To use the material library for presentation</td>
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<tr>
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<td>Semi</td>
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## Material library

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## Analysis of functions

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<tr>
<td>Attached</td>
<td>Material</td>
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<tr>
<td>Move</td>
<td>Hatch</td>
<td>DF Facilitate loans</td>
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### Light booth

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Different light sources
## Analysis of functions

**Project:** Master Thesis  
**By:** Daniel Ståhl  
**Page:** 5  
**Date:** 2014-01-28

### Presentation disc

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7.2.3  S.W.O.T.-analyse

S

MEETING PLACE
STUDENTS
SCHOOLS
COMPANIES
NEW MATERIALS IN A STEADY FLOW
PRESENTING NEW MATERIALS
OPENED FOR EVERYBODY
TOUCH AND FEEL
INVITES TO USE ALL THE SENSES

W

BULKY
LONG TIME BETWEEN DELIVERIES
"WROUNG MATERIAL AT THE WRONG TIME"
NO MATERIAL PRESENT

O

INCREASING INTEREST OF MATERIAL
COLLABORATION BETWEEN SCHOOLS
CONNECTIONS WITH COMPANIES
SPREAD KNOWLEDGE OF MATERIALS
INCREASE KNOWLEDGE OF MATERIALS
MATERIAL COUNCIL
RESEARCH DATA
GREATER INTEREST OF HJ AND HBJ
NEW MATERIALS IN PRODUCTS

T

DISINTEREST
NO RESPONSIBLE
OUT OF MATERIAL FLOW
FEEL'S LIKE NOTHING HAPPENS
INTERFERES WITH REGULAR ACTIVITIES IN THE LIBRARY
**Persona - Student**

Name: Elissa Petersson

Age: 22

Occupation: Design student

Purpose: School assignment: in which she going to present a material for her classmates.

The assignment is to discover and present a material that is eco-friendly, durable and with the purpose of being used for a bicycle helmet.

Method: Walks around in the material library to touch and feel. Take pictures and search in the database for the material.
Persona - Professor

Name: Sten Erik Svensson
Age: 47
Occupation: Professor
Purpose: Teaching students about plastics and want to present plastic material for the students to touch and feel.
Method: Brings a bigger amount of plastic material to lecture and passes them around the students during class.
Persona - Designer

Name: Enna Nilsson

Age: 35

Occupation: Designer

Purpose: Redesign a product for a well known company and are looking for a new material of choice to use in the product.

Method: Walks around in the material library, to look, feel and touch. Searching for inspiration of material and texture.
7.2.7 Graded brainstorm
<table>
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<td>35,44</td>
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<td>Phase 3 - Modelling</td>
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<td>Thu 14-03-2C</td>
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<td>Wed 14-04-03</td>
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<td>Workshop/fokus group</td>
<td>2 days</td>
<td>Mon 14-03-3</td>
<td>Tue 14-04-15</td>
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<td>3D-modelling</td>
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<td>Tue 14-05-273</td>
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