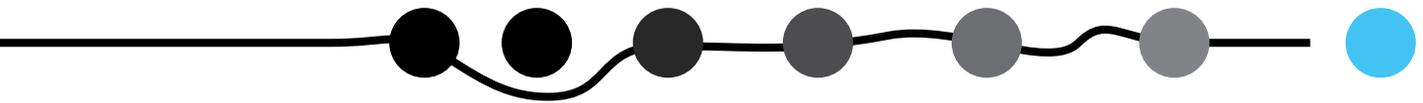


# *CONNECT THE DOTS*

An investigation of developing and producing commercial products



LUND UNIVERSITY

**Connect The Dots**

*An investigation of developing and producing commercial products*

Degree Project for Master of Fine Arts in Design, Main Field of study  
Industrial Design, Lund University, School of Industrial Design

Design Sciences

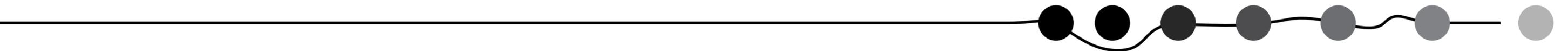
Examiner: Karl-Axel Andersson  
Supervisor: Per Liljeqvist

Ola Nystedt, 2012

ISRN: 000-XXX-000

# *CONNECT THE DOTS*

An investigation of developing and producing commercial products



## THANKS TO

Karl-Axel Andersson - Examiner

Per Liljeqvist - Supervisor

Lars & Marika Nystedt - Grönlunds Plåt AB

Bengt Henrysson - Lammhults Snickeri AB

Rickard Wiger - Gjuteribolaget AB

Bo Wiger - Vimmerby tenn AB

Håkan Karlsson - Mandus Wire AB

Daniel Nestenborg - FP Glasmagasinet AB

Bengt-Ove Johansson - Tryckta i Markaryd AB

Krister Johansson - Tryckta i Markaryd AB

Urban Harrysson - Fcubic AB

Carina Brantvik - Brantviks Måleriverkstad AB

Ronny Nilsson - Torsten Nilssons Snickeri AB

Roger Lönnberg - Hylte Formplast AB

Pia Hansson - C&D Snickeri AB

Joakim Månsson - TF Berglunds Mek AB

Pelle Lundberg - Liros Scandinavia AB

Ulf & Lena Ekdahl - For lending me your car

Jenny Ekdahl - For full support throughout the project

## ABSTRACT

The goal of this project was to gain a broader understanding of the process of developing design ideas into commercial products by producing a low volume production run of 100-1000 units based upon a set budget of 40.000 SEK.

Appropriate manufacturing processes was selected and evaluated regarding costs and suitable volumes. Design ideas was developed by meeting with Swedish producers carrying out the different processes. The ideas were evaluated strategically upon the findings from the producers to fit the projects criteria.

A hanger and a wall hung valet stand where selected to be produced in low volume batches. A development phase for the products where completed by try-outs, prototypes and further evaluations.

After the products where produced, assembled and packed they were sent out to a possible sales channel for evaluation and to investigate the potential in selling the products.

*Syftet med projektet var att få en bred insikt i hur utvecklingen av designidéer till kommersiella produkter går till genom att producera en liten produktionsvolym av 100-1000 enheter baserade på en förutbestämd budget på 40,000 kronor.*

*Passande tillverkningsprocesser valdes ut och utvärderades utifrån ekonomiska aspekter och lämpliga produktionsvolymen. Designidéer utvecklades genom att möta svenska producenter som utför de olika processerna. Idéerna utvärderades strategiskt utifrån slutsatser från mötena för att passa projektkriterierna.*

*En hängare och en vägghängd herrbetjänt valdes att produceras i liten serie. Utvecklingsfasen för produkterna slutfördes genom tester, prototyper och ytterligare analyser.*

*Efter att produkterna tillverkats, monterats och packats skickades de ut till en eventuell försäljningskanal för att utvärderas och för att undersöka potentialen att sälja produkterna.*

## SUMMARY

This project is aimed to investigate the process of developing product ideas into feasible and marketable products. In order to grasp a bigger perspective and connecting the involved steps of product development, a low volume production run was produced.

In order to produce a small batch whilst keeping a profitable outcome the first stage of the research was focused on finding suitable production methods fitting the projects pre-decided budget of 40.000 SEK and stated amount of 100-1000 produced units.

Investigating production methods was initially done theoretically by reading literature. The literature was read in order to define which manufacturers to contact and visit for the following field trips.

Meetings with people working with the manufacturing processes were then arranged in order to investigate Swedish subcontractors' attitude to small-scale production and see if there were any possibilities for collaborations.

Researching the possibilities within the producers' activities and creating a personal relationship with the producers was an important aspect of the project leading to a better understanding of production in general.

The meetings did not cover all aspects of production such as production costs. Therefore example products were sent out to the relevant producers in order for them to evaluate and calculate the price and feasibility of the products.

The example products that were used were created during the prolonged ideation phase that started from the first meeting.

From the estimates and quotes received on the example products product ideas could be generated and were evaluated strategically from factors such as production possibilities, estimated costs and timing.

The product ideas that turned out to fit the projects demarcations the best was a hanger and a wall hung valet stand. The chosen products were then developed and optimized for production. During this phase tasks such as final cost calculations and suitable packaging was also finalized.

When the products had been produced, assembled and packed, product samples were sent out to Designtorget, which was one of the possible sales channels.

The project is shaped by a learn-by-doing-manner and has delivered an eye opening process and an in depth experience of how small-scale production is carried out in southern Sweden.

## TABLE OF CONTENTS

8	Abstract
10	Summary
12	Table of Contents
14	Timetable
15	Overview
16	Foreword
17	Background
18	Terminology
19	Brief/Aim/Demarcations
20	Methods
22	Schedule
25	Part 1; Production Methods
47	Part 2; Producers
85	Part 3; Costs and feasibility
99	Part 4; Design phase & Ideation
135	Part 5; Production/Distribution
167	Part 6; Final Conclusion/Discussion
170	References

TIMETABLE

<i>WEEK</i>	<i>TASK</i>
(week 1-6)	Briefing/Background/Project Plan Suitable Production Methods Field-trips/Meetings, - Producers
(week 7-11)	Costs/Quotes/Feasibility Idea Evaluations Synthesis / Creation Sketching 2D /3D Production definition
(week 12-20)	Prototypes Connecting parties involved Development of products; production Production/Distribution

OVERVIEW*WEEKS*

- 1 Briefing
- 5 Production methods / Producers
- 4 Further correspondence
- 1 Design phase
- 9 Development/Production/Distribution

## FOREWORD

Sweden has processed and refined materials for centuries whilst developing different skill sets and abilities to produce well-built and good looking products. Due to a globalized market Swedish production is often set aside for a cheaper alternative that is carried out abroad.

I have an ambivalent relation to production on a globalized market. I live in a modern society following its rules and I can't help myself getting caught in the price war and eagerness of getting a "good" price.

On the other hand I really appreciate products that you know or at least think you know are fair to all sides. Products that have the right price and are worthy of the price where no compromises have been made where someone or something come out as utilized losers or useless.

I'm not saying that production for the Swedish market outside of Sweden is totally wrong though I sometimes wish that the same rules for humanity was applied everywhere. That people are paid properly for what they are doing and can enjoy the working conditions. Of course this would increase the price of many products and the fight for selling unrealistically priced products could hopefully fade out or at least giving the products a more humane price-tag, where you can rely on humanity and remove the unrealistic products and replace them with products that cost what they are supposed to. A market where the price isn't the main punch, where the fight instead is concentrated more on quality and function.

**"I'm fascinated and inspired by processes and systemized progression.**

**I'm seeing possibilities and advantages in understanding the integrity of processes and I believe that if you look at objects in its full context you will be able to achieve better results yourself"**

**-Ola Nystedt**

## BACKGROUND

In design education most focus is towards the product in its final context.

Products are mostly designed to fit a specific user whilst lowering impact on the environment or changing a specific system, but often a project is ended with the result of a story with an associated sketch or prototype, the project seldom reveals if the idea is feasible on bigger scale than just being an idea.

Even though designers get trained to understand production methods, stories of how production and design not always meet are very common.

If the involved actors would see a broader perspective and understand all steps of developing a sketch into a final tangible product, the actors could be linked together and make a difference for all parties involved.

Combining and handling as many aspects as possible in a process is important in order to be able to make real differences and improve communication through out the full process, not only for the end user or to please the environment.

What can be done to understand and glimpse a broader perspective in 20 weeks?

This project will concentrate on Swedish production, trying to look at;

- What kind of possibilities are there for a Swedish small-scale production aimed for Sweden?

- What is needed as a young designer to reach out with products on the Swedish market and at the same time make it work economically?

- Is it possible to produce competitive products for the Swedish market without having a known brand?

My master thesis has an aim to investigate Small scale batch production carried out in Sweden. During the way of the project meetings with producers will be held, producing products with the help from subcontractors will be done and finally an attempt of selling the products will be made.

All of this in order to grasp a wider perspective of production, producers and distribution.

## TERMINOLOGY

### Defining Batch Production:

Annual production of 100-5000 units.

Production steps are taken one at a time not in a continuous production line.

Batch production is often used for products that have varieties in design or when producing small volumes.

#### Advantages:

- Flexibility
- Low investment

#### Disadvantages:

- Risk of high unit price
- Set up costs can result in a substantial part of the cost price

### Defining Production Volumes:

One-Off: One

Low Volume production < 100

Batch production: 100-5000

Mass production: > 5000 unit/year

### Defining Costs:

*Cost price* - Price of product from the producer

*Wholesale price* - What the retailer pays for the product

*Retail price* - What the end consumer pays at the store

## BRIEF

Produce a small batch of a consumer product fitting a specific sales channel.

The amount of products will be decided upon the production costs limited by a personal budget set to 40.000 SEK. The budget shall also cover expenses for the development and the distribution of the product.

The parts of the product will be designed to fit a relevant manufacturing process carried out by local producers in southern Sweden.

### *Second Brief*

Investigate and gain a broader understanding in the process of developing a product from a concept to a final product that is available to the end user by;

Designing producing and distributing a small batch of a consumer product fitting a specific sales channel.

The amount of products will be decided upon the production costs limited by a personal budget set to 40.000 SEK. The budget shall include expenses for the development and the distribution of the product.

The parts of the product will be designed to fit a relevant manufacturing process carried out by local producers in southern Sweden.

### *Aim*

The main goal is to gain a better understanding of the production procedure, meaning costs, production methods, and delivery. Part of the project is also getting insight in sales channels and selling to the targeted consumer.

### *Demarcations*

The product will consist of a maximum of three materials and two surface treatments. This was decided in order to gain as much knowledge in production methods as possible within the time frame of the project.

The design process will be short, one week focused time, in addition it will be carried out simultaneously during the first half of the project.

The amount of products will be aimed to be at least one hundred and a maximum of 1000 units. This to end up with a small batch and nothing else. Also to result with a product with a relevant cost price between 40-400 SEK.

The budget is based upon a first estimation of all the projects expenses. Some modifications may be done to the budget throughout the project if demanded.

The product will be aimed to have Designtorget as a possible sales channel and will therefore be adjusted if necessary to fit Designtorget. Designtorget is chosen thanks to its rapid selection process, though other sales channels might be targeted as well.

The product is due to the choice of sales channel going to fall into one of the categories of domestic accessories, interior design, smaller furniture, office or kitchen accessories.

## METHODS

In order to set a starting point the decision was made to define a budget and then look at production methods that could fit that budget.

The production methods were chosen in a theoretical manner by reading books about manufacturing techniques and materials. The literature provided a good overview and valuable information regarding suitability for small scale production fitting a specific budget.

Based on the information extracted from the manufacturing books the different production methods were evaluated and discussed. The evaluation of the processes provided a numerical indicator to the process. This to represent its suitability for the project, however the numbers shall never be considered as a truth, only as indicators and as a method of organizing the outcome.

From the concluding discussions about the processes a few suitable production methods were investigated in practise by visiting local producers that are active within the chosen methods.

During the field trips the aim was to look at their activities as well as creating relations with the people at the companies for possible future cooperation. By the gained knowledge and various impressions from the field trips the companies were evaluated and given numerical indicators.

After an open ideation phase multiple design ideas were evaluated by the continuous correspondence with selected producers.

Based on the evaluation, suitable products were chosen for further development, simultaneously as the sales channel was

investigated and contacted. Inquiries were sent out and meetings held to assure prices and feasibility of the products.

By consulting the producers the final products were prepared and changed if needed for the production.

The final design was produced in order to investigate production, relations with the producers, deliveries and payments.

Sending in the product to Designorget was done in the way that they have stated on their web page, this to act as any one applying.

The product was sent to Designorget as quickly as a final prototype could be produced. This in order to save time and know as early as possible if changes had to be made for them to accept the product or if new sales channels should be contacted.

If Designorget declines my first applications the process of this will be covered, though further work in finding other sales channels will be done, it will not be covered by the report due to time limitations.

# SCHEDULE

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Briefing																				
Methods / Producers																				
Design phase											Design phase (focused)									
Example quotes / Costs/Further correspondence																				
Production / development for production																				
Distribution																				
Documentation																				
Presentation																				

In order to be able to execute this project a quick start is needed where the brief and background is to be stated within a week.

The theoretical research is done within a week. Since the aim of the project is meeting people and understanding procedures more time was given to this compared to reading literature.

The main goal of the meetings is to gain all needed knowledge of costs and production in order to start with the ideation phase.

Due to that it is hard covering all wishes of the outcome from the meetings during the meetings, a period for clarifications and further correspondence is needed.

Since product ideas develops along the way the ideation phase will start with the first meeting, though it isn't until the focused design phase all aspects are sorted and active decisions can be made.

From self-made predictions the production will be executed within 6-7 weeks.

Distribution will be continuous according to sales, the aim is to be able to distribute first set of products in the middle of May whilst finishing off the rest of the production.

The presentation will be done within two weeks prior to first hand-in of the report, the project will be documented during the full time.

# PART 1

## RESEARCH PRODUCTION METHODS

In order to produce a small batch whilst keeping a profitable outcome it's important finding suitable production methods.

The goal with the initial research for this project is to choose reasonable production methods and finding producers that are willing to produce a low unit production run.

Investigating production methods was initially done theoretically by reading literature. The read literature was mainly [1]*Manufacturing Processes for design professionals* by Rob Thompson, [2]*Making it* by Chris Lefteri, and [3]*Manufacturing engineering and technology* by Serope Kalpakjian and Steven Schmid.

The literature was read in order to define which manufacturers to contact and visit in my following field trips. Meetings with people working with the manufacturing processes were then arranged.

## PRODUCTION METHODS SUITABLE FOR BATCH PRODUCTION

The research provided an overview of the production methods with estimates and approximate informative detailing.

The following factors are the ones chosen to start with for this project and can be good to consider when a product is designed to be produced in multiple copies.

- Number of units compared to initial costs
- Production time
- Number of production steps
- Tooling costs
- Material costs
- Complexity of manual labour
- Desired end price and profit

These aspects provide guidelines for choosing a suitable production method. Yet it is crucial to arise awareness of the overall context when making strategic decisions. In order to do this its therefore also important to consider;

- Build quality
- Value adding aspects such as design, local production and concept strength
- Suitability for preferred market/product category
- Amount of parts in every product and desired margin of every part

*(For a complex product the margins can vary on the different parts whilst retaining a profitable margin on the end product. However for a low volume product with few parts it is hard to*

*have a greater margin on one part or the other.*

*In many cases it is therefore important to look at the full price of the total production run to be able to keep the profit to a plus side. In other cases low margins can be accepted because of the large amount of sold products which often result in small profits on every sold item but with a large profit from the overall sales.)*

With the set budget the list of production methods suitable for this project were reduced.

The main and most common production methods that could fit this project are the following:

- **Manual or NC-controlled machining**  
(lathe, milling, drilling, sawing)
- **Additive Manufacturing,**  
(printing, Ink-jet)
- **Processing Sheet**  
(press braking, punching, metal spinning, tig & mig welding)
- **Casting/moulding**  
(sand casting, tin casting, dip moulding)
- **Processing metal tube and wire**  
(NC-bending, NC-welding)
- **Cutting Techniques**  
(water jet, laser cutting, die cutting)
- **Surface treatments**  
(powder coating, spray painting, anodizing)

The following chapters, in short, explain the production methods and aspects to be considered when choosing a method.

## Manual Machining

*Including cutting techniques: Turning, Milling, Drilling.*

*Suitable for: One-off to thousands depending on the complexity of the part or number of steps in production.*

Manual machining is the use of machines that are manually controlled by a human being. The technique is basically using a solid piece of material and cutting of the unwanted material, a little like carving on a log with a sharp edged knife.

Manual machining could be an option for batch production. The important considering for manual work is the amount of time the production step demands since the biggest expense in manual machining often ends up being the labour costs.

Most likely the desired part could be produced with a different method than manual machining. However automating production steps mostly include special tooling that increases the initial investment. Mostly there are no special tooling involved for manual machining which means that some steps in producing a part can be manual and still be profitable if the batch is small enough.

## CNC-Machining

*Computer Numerical Controlled (CNC) including cutting techniques: Turning, Milling, Drilling.*

*Suitable for: One-off to thousands depending on the complexity of the part or number of steps in production.*

There are many types of NC-machines. Mostly used are so called NC-Mills. The

principle is similar to manual machining only that you tell the NC-machine what to do with a computer generated programme, CAM. These programmes are often created from a CAD-file.

The NC-technique allows virtually any shape to be created in almost any material. The NC-mills run on a number of different axis allowing it to move freely around the solid piece of material as it cuts its way through it, creating the shape.

This kind of production method can be slow and therefore not primarily suited for mass production. Though there are some giant companies using this method for volumes of millions due to the high tolerances that can be achieved compared to other methods.

The method is used in all kinds of production and is best suited for one-offs to batch production. It is an effective method even for small runs especially due to that the set up costs are low and many kinds of materials can be processed.

## Additive Manufacturing

*In many cases also known as Rapid Prototyping methods.*

*Suitable for: One-off to low volume production.*

Rapid Prototyping or Additive manufacturing is commonly used in product development and prototype building but is also becoming an important stepping stone even for batch production. To shortly illustrate the method the rapid prototyping machine makes a physical copy

of a 3D-CAD drawing, mostly building the object by adding thin layers of material on top of the other. Some machines can print the objects in multiple materials within the same building action.

In many cases using a Rapid prototyping method can achieve the same result as moulding a part, only that there are no tooling costs involved. However the method is considerably slower than moulding, meaning that it is hard to motivate as production method for mass production.

As the name hints Rapid prototyping is mostly suitable for one-offs, prototyping or batch production. However the method can produce almost any shape which makes it competitive since this is hard to achieve with other production methods.

The surface of the parts can vary depending on the machine and the material. The parts can also be questionable regarding tolerance and quality, yet the development of the method is still in its cradle and small steps are taken continuously to improve the technique.

Companies offering production using Additive manufacturing are available though the number of businesses offering batch production are few.

## Processing Sheet

*Including: punching/blanking, press braking, metal spinning, vacuum forming.*

### Punching/Blanking

*Suitable for: Hundreds to mass-production*

Punching and blanking are used for cutting metal. Circular, square or more complex

holes can be created. The tool is basically brought through the material with high pressure and speed leaving a hole or piece in the shape of the tool.

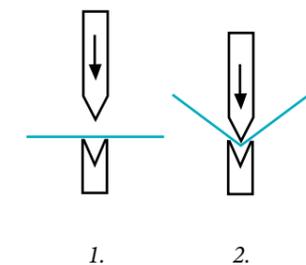
The tool cost is relatively low, approximately 5000 SEK and up depending on size and shape. The method is rapid with up to a hundred punching actions a minute making this method a cost effective alternative when creating holes or small pieces of sheet metal.

According to Chris Lefteris - MAKING IT the method is preferable with making holes or pieces with a size up to 85 mm in diameter, this due to that the prize of the tool increases with its size. If the size of the holes or punched pieces exceed 85 mm, other manufacturing alternatives for the parts can be more profitable.

### Press braking

*Suitable for: One-off to Mass production*

Press braking is used to bend sheets of metal. The procedure is to force a blunt knife like tool on to the metal sheet that is resting on a crease, the tool is then forced into the crease resulting in the metal sheet



to bend, (see image below).

The method can be done automatically

with robots mounting and dismounting the sheets but press braking is regardless of this often done as a manual step in the production since the set up time and costs for an automatic press brake can be extensive.

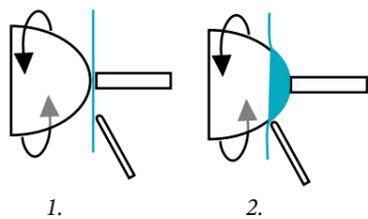
Even though when done manually Press braking is relatively quick resulting in a method that is suited for batch production.

There are no tooling costs when using a Press brake though complex actions may need special tooling. The number of different tools that the producers can offer are usually depending on the different products that they produce or have produced before.

#### **Metal spinning**

*Suitable for: Low Volume to Mass production depending on what material is used for the tool.*

Metal spinning is a process where a piece of round sheet metal is turned on an axis and pressed over a shape with a stick like tool creating a rotationally symmetrical



metal profile. (See image below).

The method is used to produce for example satellite disks and lamp shades. A tool is needed and can be produced from wood

or different kinds of metal. What kind of material the tool is made from is depending on the number of units that it shall be able to produce.

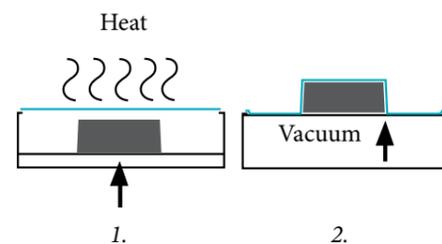
In most cases when producing only a few pieces a wooden tool could be suitable, but for a batch of thousands a special steel is needed in order for the tool to last.

The process can be cheap compared to alternatives such as pressing since only one tool is needed. Tooling costs for metal spinning are relatively low meaning that it could be a method even for a few units though they would result in a high unit price.

#### **Vacuum Forming**

*Suitable for: One-off to Mass production depending on material used for tooling.*

Vacuum forming is a process where vacuum is applied to one side of a heated plastic sheet resulting in the plastic sheet



to wrap itself around a pre-made tool. (See image below)

Vacuum forming is an effective way to process plastic sheets. Examples of what the process is used for are vehicle interior, packaging and lampshades.

There are many different vacuum forming machines, ranging from simple manual machines to complex automated machines which allows the method to be effective in various types of production sizes.

The tools can be made from different materials and shapes meaning that set-up costs can be adjusted to fit the unit count. Though it is important to keep in mind to produce the tool from a material that lasts through the entire production run. For shorter runs a thermoset plastic is preferred whilst for longer runs a metal tool is needed.

Draught angles have to be considered to avoid parts not releasing from the tool.

#### **Cutting methods**

*Including: Die Cutting, Laser cutting, Water-jet.*

##### **Die Cutting**

*Suitable for: Hundreds to mass-production*

To gain a better understanding of Die cutting you could compare it to cutting through a flattened dough with a biscuit cutter.

Die Cutting is a method used for cutting thin sheet material into various shapes. Shapes are cut with knives that are mounted on wooden boards. The possibility to cut, score and perforate a sheet in one action makes it an effective method for creating foldable pieces.

The method is commonly used for producing packaging and for cutting materials such as paper and plastics. The tool cost is low and the speed of the process

is very rapid which makes this a useful method for all types of production. The amount of materials that can be cut with Die cutting are not as many compared to Laser and Water-jet cutting though it is substantially quicker.

##### **Laser-cutting**

*Suitable for: One-off to mass production*

Laser cutting is a method for cutting with a laser beam, programmed to follow a path from a CAD file. A highly intensive beam of light melting its way through different materials in various thicknesses.

Materials that can be cut are metals, plastics, paper, wood, fabrics, glass and ceramics yet all laser cutting machines are not suited for all kind of materials.

Lower end machines cut plastics and wood whilst more advanced machines cut their way through almost any material including ceramics and glass.

Multi-axis laser cutting machines are also available, these machines can be programmed to follow paths not only on a 2D drawing but also on and around complex 3D-geometries.

There are no tooling costs involved for Laser cutting since the beam is controlled by a CAD file. Though the process can be slow compared to other cutting techniques.

##### **Water-Jet cutting**

*Suitable for: One-off to mass production*

Water jet cutting provides similar results and actions as a laser cutter only instead of a beam of light there is a high pressurised fine jet of water that is forced out from a nozzle at a pressure of 20.000-55.000 psi.

The water alone can cut, though the water can also be mixed with an abrasive, often fine grained sand that makes it possible to cut through hard and thick materials such as stainless steel or marble.

Examples of materials that can be cut using Water-jet technology are steel, glass, plastics, stone, wood and ceramics.

There are no tooling costs when using Water-jet technology but it can be time consuming. The jet is controlled in similar ways as a laser cutter with a CAD file, providing the cutting paths for the machine.

A Laser cutter can in many cases be a better alternative than Water-jet since it in most cases is quicker and the cutting edges are likely to become smoother.

## Moulding/Casting

*Including: Sand casting, tin casting and dip moulding.*

### Sand casting

*Suitable for: One-off to mass production depending on the steps that are automated.*

Sand casting is a method for casting metals. Sand has the ability to withstand hot temperatures that makes it a good material to cast in.

In order to cast in sand a duplicate of the shape that is to be produced is needed. The duplicate can be made from wood, foam or any hard material, yet the same rule applies as with many other manufacturing methods - a hard material for the duplicate if the production run is large, whilst a soft material such as foam or wood if the run

is short.

The moulds are a mixture of sand and bonders, such as clay or oils. There are many bonders available depending on the tolerance and durability of the mould that is desired.

The duplicate is pressed into the sand mixture whilst the sand bonds. The duplicate is then removed and the mould is ready to be used. There is a possibility to divide the mould into more than one or two pieces meaning that undercuts are possible.

The surface of the moulded part is often ruff because of the sand grains, some after treatment is therefore necessary to achieve a smooth surface.

Sand casting is an old technique that is evolved in many different directions. Fully automated production or manual craftsmanship. Sand casting is therefore suited for many different production runs and sizes.

### Tin casting

*Suitable for: One-off to mass production depending on the moulds that are created.*

In comparison to other metals tin is easy to cast, this due to the low melting point (around 230 C°). This means that you can mould tin in moulds that are made from plaster, rubber, steel or sand.

Because of the diversity of available materials to use for the moulds the initial costs of a production run can be adjusted to the amount of units of the production.

For a complex shape and low unit production a rubber mould will work fine. The production costs for a duplicate and a

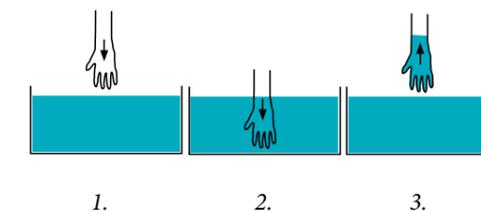
rubber mold is a couple of thousand SEK and up.

Important to keep in mind is that tin is an expensive material. Since tin has a high density the pricing can be an issue of bigger objects even though the set up costs are low.

### Dip moulding

*Suitable for: Low volume to mass production.*

As the name suggests Dip moulding is the process of dipping a former into a liquid polymer bath. The former made of ceramics is dipped in a latex bath, then letting the material that stuck on the former



dry off. When dried the latex material can be removed from the former. (See image below).

Examples of products that are produced using this method are party balloons and latex gloves.

Dip moulding can be done manually but it is also possible to automate the production. The speed of a fully automated Dip moulding production can be rapid and therefore an efficient method for mass production. Manual production will take longer but is an effective production method for low volume production.

## Processing metal tube and wire

*NC-Bending and Welding Tube/Wire*

*Suitable for: One-off (though with a high unit price since set up time is the same for one and thousands) to mass production.*

Numerical controlled bending machines are common when building furniture and products out of tubes or wire.

The tube/wire is brought through the machine and at the output of the machine were the tube or wire comes out there are a set of different clamps and cutters that act according to the computer generated program controlling the machine.

The process is highly automated, with a continuous action the machine bends the part and cuts it into the right length. The generated programme is based on the desired angle and radius of the bends.

There is almost no waste material using NC-bending machines. The process is quick and no investment in tooling is needed resulting in a cheap and effective production method.

### NC-Welding

*Suitable for: One-off (though with a high unit price since set up time is the same for one and thousands) to mass production.*

Numerical controlled welding is used for making the process of welding more efficient than manual welding or where there are many small actions involved.

The process is similar to NC-milling. The welding actions are controlled from a programme generated from a CAD file where coordinates respond to where the machine is supposed to weld.

In order to get the machine to function well a welding jig is used to make sure that the location of the object that is to be welded responds to the programmed actions.

This production method can be fully automated resulting in an effective process even for mass production, however the set up time can be long. A better alternative for smaller runs and batch production is often a semi-automated use of the machine where an operator loads the jig with new parts to be welded.

### Surface Treatments -

*Including: Powder coating, Spray painting.*

*Most surface treatments are suited for all kind of production runs covering all types from one-off to mass production. In most cases it is a question of how manual or automated the treatment method is. The following three sections cover three of the most common treatments for applying a cover or a paint to the produced piece.*

#### **Powder coating**

*Suitable for: One-off to mass production.*

Powder coating is a technology mostly used for giving a protective cover and applying a colour on metal. The process is a dry finishing action where a fine grained polymer powder adheres to the metal piece electrostatically and is then cured in an oven.

The method provides a high quality protective surface. The powder is a fine mixture of resin, pigments, fillers and binders.

The fine powder is sprayed on the work piece either manually by a hand held spray

gun or automatically where the spray guns are automated.

Since there are possibilities for the procedure to be fully manual as well as fully automated this process suit all kind of production runs.

#### **Spray painting**

*Suitable for: One-off to mass production.*

Spray painting is a fast and efficient way to apply surface treatments. The process is executed by applying liquid borne materials onto a surface. Most spray painted surfaces are treated with more than one layer where every layer provides functions such as filler, primer, colour, or protection.

The quality of a spray painted surface may vary depending on the skills of the person operating the spray gun, however the possibility to create many different surfaces means that it is a highly flexible method.

Mostly spray painting is a manual step in the production run, yet for large series of home appliances or in the automotive industry it is often an automated step with robots handling the spray guns.

Since there are possibilities for the procedure to be fully manual as well as fully automated this process suits all kind of production runs.

#### **Anodizing**

*Suitable for: One-off to mass production.*

Anodizing is a process used to treat the surface of Metals, mostly aluminium, magnesium and titanium. The process builds up an oxide layer on the surface, this thin layer is hard, protective, self-healing and chemically neutral.

The process of anodizing is built upon 3 stages; etching, anodizing and sealing.

The first etching stage cleans the work piece and prepares it for anodizing. The surface is either etched or brightened in chemical baths. Etching results in a matt finish, brightening creates a high gloss surface.

The second phase, the anodizing is done by sinking the work piece into an electrolytic solution. A current is passed through the work piece which works as an anode and an electrode which is the cathode. This process creates a porous oxide layer. The layer thickness is depending on the amount of time in the bath, the current and temperature. The thickness of the oxide layer can vary from 5-50 microns.

Colour can be added by either mixing cobalt, or tin metal salts to the bath or dipping the work piece in a dye prior to sealing.

The third and final stage of sealing is done by putting the work piece into a hot water bath. The sealing process seals the oxide layer and creates a hard and durable surface.

Since the process of anodizing stretches from large number and highly automatic to small number and manual it does suits all kind of production runs.

# PRODUCTION METHOD EVALUATION

## SUITABLE FOR BATCH PRODUCTION

	Unit cost <i>Added cost of production</i>	Suitable Volume <i>In production</i>	Tooling/Set-up <i>Costs</i>	Tolerances <i>Low/High</i>	Speed <i>Slow/rapid</i>	Producer <i>Available for the project in southern Sweden</i>	Gut-feeling <i>Can method suit the project</i>
<b>Manual Machining</b> <i>Chipping: Lathe, Mill, Drill</i>	● ●	● ● ● ● <i>One-Off to Batch</i>	● ● ● ● ●	● ● ● ● ●	●	● ● ● ● ●	● ● ●
<b>CNC-Machining</b> <i>Chipping: Lathe, Mill, Drill</i>	● ● ●	● ● ● ● ● <i>One-Off to Mass production</i>	● ● ● ● ●	● ● ● ● ●	● ●	● ● ● ● ●	● ● ● ●
<b>Additive Manufacturing-</b> <i>Rapid prototyping</i>	● ●	● ● ● <i>One-Off to Batch</i>	● ● ● ● ●	● ●	●	● ● ● ● ●	● ●
<b>Punching/Blanking</b> <i>Metal sheet</i>	● ● ● ● ●	● ● ● <i>Batch to Mass production</i>	● ●	● ● ●	● ● ● ● ●	● ● ● ● ●	●
<b>Press Braking</b> <i>Metal sheet</i>	● ● ● ●	● ● ● ● ● <i>One-off to Mass production</i>	● ● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ●
<b>Metal spinning</b> <i>Metal sheet</i>	● ●	● ● <i>Batch to Mass production</i>	●	● ● ● ●	● ● ●	● ● ● ● ●	● ●
<b>Vacuum forming</b> <i>Plastic sheet</i>	● ●	● ● <i>Batch to Mass production</i>	●	● ●	● ● ●	● ● ● ● ●	● ● ● ●

	Unit cost <i>Added cost of production</i>	Suitable Volume <i>In production</i>	Tooling/Set-up <i>Costs</i>	Tolerances <i>Low/High</i>	Speed <i>Slow/rapid</i>	Producer <i>Available for the project in southern Sweden</i>	Gut-feeling <i>Can method suit the project</i>
Die Cutting <i>Sheet Material</i>	● ● ● ● ●	● ● ● ● ● <i>Batch to Mass production</i>	● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ●
Laser Cutting	● ● ●	● ● ● ● ● <i>One-Off to Mass production</i>	● ● ● ● ●	● ● ● ● ●	● ●	● ● ● ● ●	● ● ● ●
Water Jet Cutting	● ● ●	● ● ● <i>One-Off to Batch</i>	● ● ● ● ●	● ● ● ●	●	● ● ● ● ●	● ● ●
Sand Casting <i>Metal</i>	●	● ● ● <i>One-Off to Mass production</i>	● ● ●	● ● ●	●	● ● ● ● ●	●
Tin Casting <i>Tin</i>	● ● ●	● ● ● ● ● <i>One-off to Batch production</i>	● ● ●	● ● ● ●	● ●	● ● ● ● ●	● ● ● ●
Dip Moulding	● ● ● ●	● ● <i>Batch to Mass production</i>	● ●	● ● ●	● ● ● ●	●	●
NC-Wire/Tube Bending	● ● ● ● ●	● ● ● ● ● <i>Batch to Mass production</i>	● ● ● ● ●	● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ● ●

	Unit cost <i>Added cost of production</i>	Suitable Volume <i>In production</i>	Tooling/Set-up <i>Costs</i>	Tolerances <i>Low/High</i>	Speed <i>Slow/rapid</i>	Producer <i>Available for the project in southern Sweden</i>	Gut-feeling <i>Can method suit the project</i>
NC-Welding	● ● ● ● ●	● ● ● ● ● <i>Batch to Mass production</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ●
Spray Painting	● ● ● ● ●	● ● ● ● ● <i>One-Off to Mass production</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●
Powder Coating	● ● ● ● ●	● ● ● ● ● <i>One-Off to Mass production</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●
Anodizing	● ● ● ● ●	● ● ● ● ● <i>One-Off to Mass production</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ●

## PART 1: SUM-UP

### PRODUCTION METHODS: SUITABLE FOR BATCH PRODUCTION

The theoretical research provided an overview of the production methods, though there are still many questions to be asked before knowing if any of these methods suits the project. However this initial research provided a selection of methods to investigate further.

To choose a budget as a starting point, showed to be an effective approach in pointing out production methods for this project. The budget pointed at methods having the following attributes.

- *Rapid production actions*
- *No or low tooling costs*
- *Low material costs*
- *Rapid treatment processes*

The literature provided the information if a method might fit this project, it did not answer thoroughly about costs, tooling costs or volumes. To be able to take a decision whether the method fit a batch between 100 and 1000 copies, further research was needed.

In many cases the production will be more costly per unit when producing a small batch, however batch production means that there will be a short run and a few products to keep in stock. Meaning that the supply chain can and should be kept short for keeping a positive profit.

The literature did not answer whether the time for the total production run could fit within the frames of this project, which was needed information to be able to carry on with a specific method.

With the variety of production methods that can be suited for batch production a lot

can be made but not all types of products are reasonable to produce in a batch since the market value of the product does not correspond to the cost price. Products where the price of the production actually represent its value is the key to a successful batch production.

Batch production often use methods that are significantly slower than methods used in mass production meaning that a quality insurance can be made along the way of the production.

The way for the project to continue is as the methods state, to contact and investigate producers carrying out the processes. As many of the earlier researched methods are to be covered by the coming field trips and meetings as possible.

Most methods that are chosen in this section are available in southern Sweden meaning that location wise southern Sweden does offer a diversity in producers and manufacturing methods.

The question is if the subcontractors are willing taking on a low volume production within the time frame of this project.

These are questions asked and answered in the following chapters.

## PART 2

### RESEARCH PRODUCERS

From the initial research suitable production methods could be extracted and local producers executing the methods was contacted.

The goal with the field trips was to investigate Swedish subcontractors' attitude to small scale production and see if there was any possibility for a collaboration.

Understanding the possibilities within the producers' activities and creating a personal relationship with the producers was also a desired outcome of this second part of the research.

The field trips were executed by contacting the producers explaining in short my aim for the project to see if a meeting could be arranged.

## PRODUCERS

### SUITABILITY/AVAILABILITY

There are many producers working as subcontractors in Sweden. Many of these companies were founded during the post war. Since Sweden was relatively well kept from the war and Europe was in big need of supplies Sweden had the economic climate for small companies to grow and many companies were founded. A lot of the small sized family owned companies that were founded then are still active.

The producers that were visited were all chosen from the manufacturing processes they are active within.

They were chosen with the meaning to cover a big variety in materials and methods. The sizes of the companies were kept relatively small. The desired outcome from the meetings was to gain knowledge of;

- If the producer is willing to produce a small production run.
- The possibilities within the frame of their production.
- Aspects to keep in mind regarding their production such as costs, material and construction.
- If their delivery times could fit the project.

Finding the producers was done by visiting different websites that register producers regarding their activities and services.

Some producers were found by asking various contacts for suggestions on producers that could fit my project.

Producers were also found by search engines and articles.

With limitations in time and the likely need of revisits a final number of 13 different

companies at 14 different locations were selected and visited. During the process of finding and contacting the companies a total of 17 were contacted. Four of them turned out not providing what was searched for in this project.

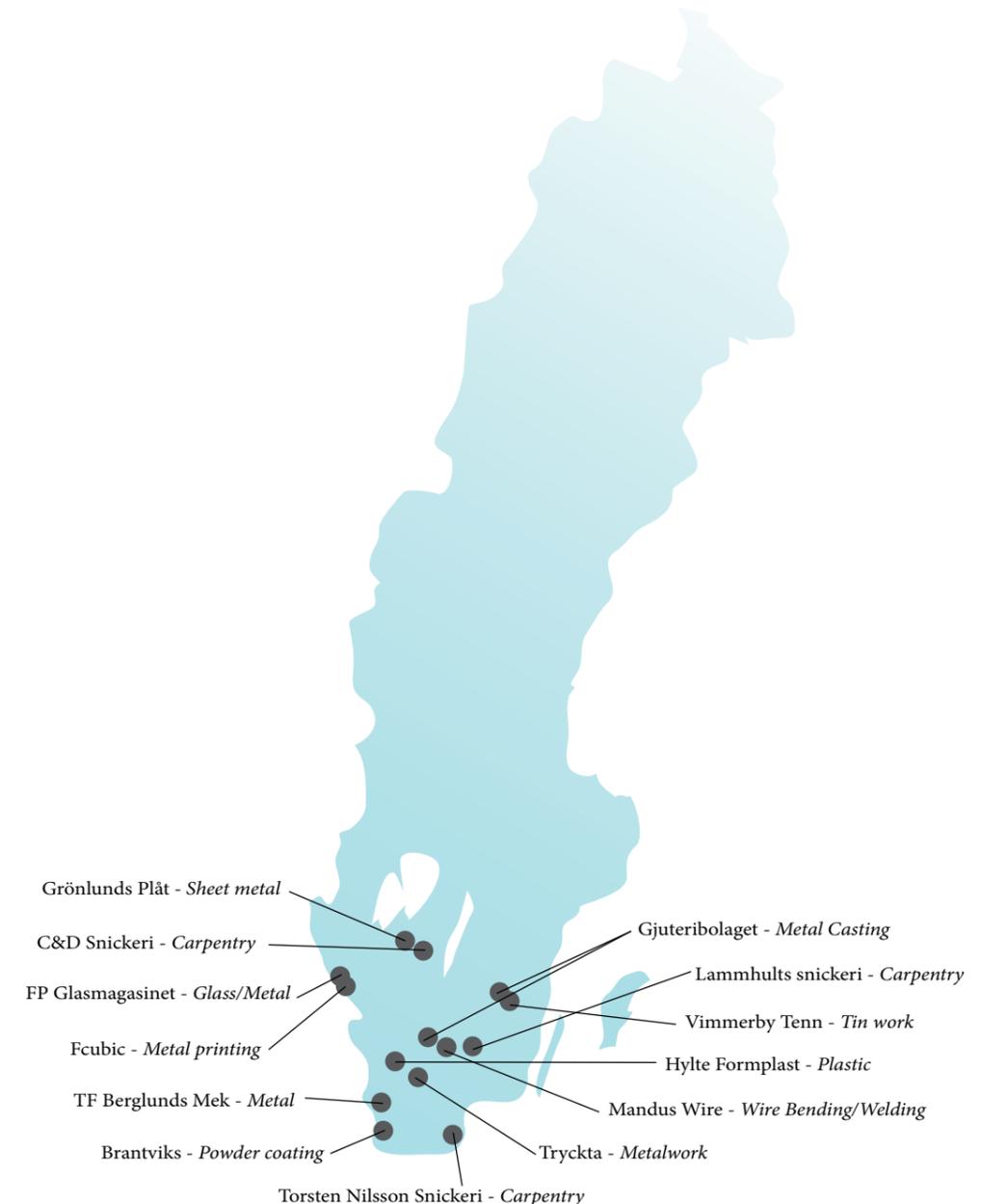
Only one of the visited 14 gave a negative answer to working with smaller production runs due to setup costs. All the other companies were interested and had at that point a positive attitude working with smaller production runs.

The following part of this chapter shortly presents the companies and the useful knowledge the meetings provided.

From the previously chosen methods the following have been investigated further.

- *Manual or NC-controlled machining*
- *Additive Manufacturing,*
- *Processing Sheet*  
(press braking, punching, metal spinning, metal & plastic welding, vacuum forming)
- *Casting/moulding*  
(sand casting, Die casting, tin casting)
- *Processing metal tube and wire*  
(NC-bending, NC-welding)
- *Cutting Techniques*  
(water jet, laser cutting)
- *Surface treatments*  
(powder coating, spray painting)

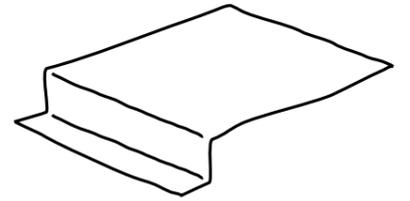
Some methods have been added in this step mostly due to that the chance of investigating the method accrued.







SHEET METAL



## GRÖNLUNDS PLÅT AB

SKARA, VÄSTERGÖTLAND

Grönlunds Plåt AB is a subcontractor producing series from tens to tens of thousands.

The business started off in the 19th century. Nowadays Grönlunds Plåt is a modern sheet metal company with around 50 employees.

Examples of products that they produce are lockers, air vents, litter bins, pharmacy interior and ceiling tiles.

The material that is processed is sheet metal, including thicknesses up to 3 mm.

The tools and services that are offered are:

*Shearing, Punching and nibbling Laser cutting, Press brake with robot, CNC-Press brake, Eccentric press, Automatic bending machines, Manual Bending machines, Circular machine, Spot welding, TIG, MIG, and MAG Welding, Robot welding, Powder coating, Assembly, Logistics and Engineering*

### The reason for the meeting:

The main reason for visiting Grönlunds was because they have many different machines and process sheet metal in many different ways.

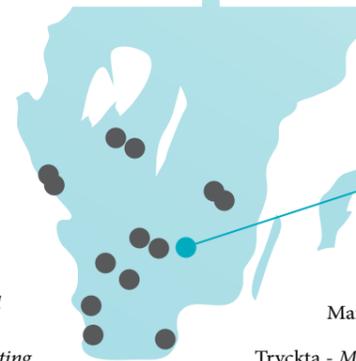
The visit provided an overview of their production possibilities and some hints regarding costs. Since the company also provides engineering help some time was taken to discuss construction of sheet metal products.

Meeting with Lars Nystedt:

At Grönlunds you felt very welcome, the people were willing to give you time to present what you want to achieve and they respond in how they are able to help you.

Grönlunds is one of the biggest companies that was visited, they had tightly scheduled machines meaning that they are not the company for a one-off but for a run of a hundred units or more they are very used to and willing to help out with.

I would consider the possibility to work with Grönlunds in this project as fairly likely.



Grönlunds Plåt - Sheet metal

C&D Snickeri - Carpentry

FP Glasmagasinet - Glass/Metal

Fcubic - Metal printing

TF Berglunds Mek - Metal

Brantviks - Powder coating

Torsten Nilsson Snickeri - Carpentry

Gjuteribolaget - Metal Casting

Lammhults snickeri - Carpentry

Vimmerby Tenn - Tin work

Hylte Formplast - Plastic

Mandus Wire - Wire Bending/Welding

Tryckta - Metalwork

WOOD



## LAMMHULTS SNICKERI AB

LAMMHULT, SMÅLAND

Lammhults Carpentry is a subcontractor producing series from one-offs to hundreds.

The company has strong values connected to craftsmanship and sustainability. The company consists of 10 employees. They mostly build exclusive wooden furniture for many Swedish brands. They have all machines and tools that are needed to function as a modern carpentry.

Examples of products that they produce are tables, chest of drawers, cupboards, bed frames and bed tables.

The tools and services that are offered are:

*Build and assemble furniture, CNC-machining, Edging machine, Spray painting, Product warehouse, Logistics and Engineering of furniture.*

### The reason for the meeting:

Visiting Lammhults carpentry was mainly done to see today's version of industrialised traditional craftsmanship, and to investigate the possibilities of a modern Carpentry.

I wanted to gain understanding regarding what is possible to produce with their machines but also see how much craftsmanship that is left regarding production of wooden furniture. If the skills no longer is needed due to the new technology or if the skills still are reflected upon the result of the furniture.

Meeting with Bengt Henrysson:

At Lammhults snickeri you can really feel that they are not often visited by people

that they don't already have as customers. The people working there were all warmly welcoming you while having a little bit of excitement in their eyes.

Bengt who showed me around was engaged in giving me a good understanding in how they work and what they have the possibility to do. Their production is very flexible and they are welcoming all kind of projects, even one-offs.

I would consider the possibility to work with Lammhults snickeri in this project as fairly low. They produce high priced furniture and their production is mostly suited for products in that category which is not what this project aims for.



Grönlunds Plåt - Sheet metal

C&D Snickeri - Carpentry

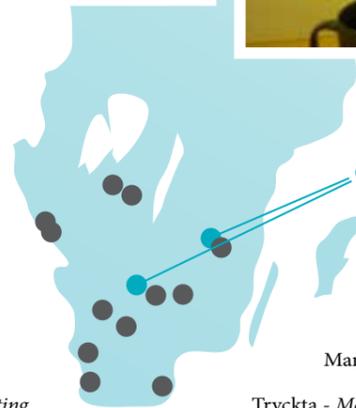
FP Glasmagasinet - Glass/Metal

Fcubic - Metal printing

TF Berglunds Mek - Metal

Brantviks - Powder coating

Torsten Nilsson Snickeri - Carpentry



Gjuteribolaget - Metal Casting

Lammhults snickeri - Carpentry

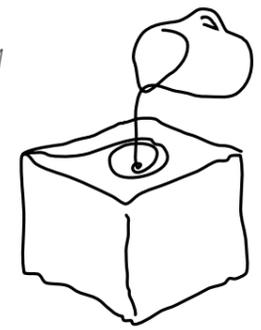
Vimmerby Tenn - Tin work

Hylte Formplast - Plastic

Mandus Wire - Wire Bending/Welding

Tryckta - Metalwork

ALUMINIUM, ZINK, MAGNESIUM



## GJUTERIBOLAGET AB

BREDARYD/VIMMERBY, SMÅLAND

Gjuteribolaget accept assignments from clients in different industries and different size companies. They manufacture products in die-cast aluminium, magnesium and zinc. They offer services including engineering support and guidance through the entire project to achieve a cost effective end-product.

The production series are mostly above thousand, however they have got possibility to sand cast which makes it possible to create one-offs to small batches. The company also offer cnc-milling of solid metals.

Examples of products are camera housings, rims, kitchen-appliance housings, machine parts and engine parts.

The company has 60 employees.

The tools and services that are offered are:

*Die-Casting (aluminium, magnesium, zink), CNC-Milling, Sand casting, Finishing and Polishing, Powder coating, Logistics & Engineering*

### **The reason for the meeting:**

Visiting gjuteribolaget was mainly to investigate sand casting in a slightly bigger scale than one-off production. Even though they do produce objects using sand casting they did not have any sand casting going on at that point.

Instead of seeing sand casting they provided introduction in Die casting which not is a preferred production method for low investment batch production though it provided an overview and basic aspects of casting metals.

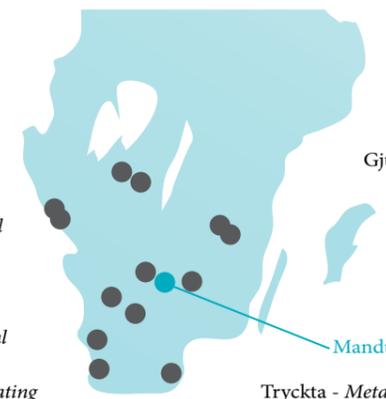
Meeting with Rickard Wiger:

Rickard Wiger was the first employee that I met at Gjuteribolaget. He gave a brief introduction into casting metals and how the company is organized.

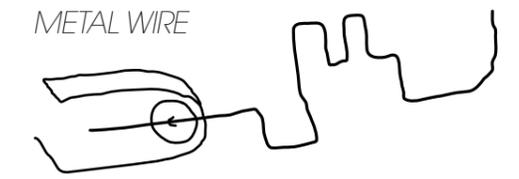
He also talked about the different types of casting methods that they offered and what the differences where.

The likeliness in working with Gjuteribolaget in this project is very low. The set up costs for die-casting is exceeding the total budget for this project by far and sand casting would only be an option if the number of pieces would only be a few since the process of sand casting manually demands a lot of time.

The price of the raw material is around 20 SEK/Kg for Aluminium and 30 SEK/Kg for Magnesium which is within the price frame for my project though Die-casting metal as a process is not possible.



- Grönlunds Plåt - Sheet metal
- C&D Snickereri - Carpentry
- FP Glasmagasinet - Glass/Metal
- Fcubic - Metal printing
- TF Berglunds Mek - Metal
- Brantviks - Powder coating
- Torsten Nilsson Snickereri - Carpentry
- Gjuteribolaget - Metal Casting
- Lammhults snickereri - Carpentry
- Vimmerby Tenn - Tin work
- Hylte Formplast - Plastic
- Mandus Wire - Wire Bending/Welding
- Tryckta - Metalwork



## MANDUS WIRE AB

VÄRNAMO, SMÅLAND

Mandus Wire is a small company situated in Värnamo. The company is based upon three generations of wire bending.

At Mandus the main services that are offered are bending and welding wire.

They are used to short runs and are willing to produce batches below thousand units, thought they as many other producers rather take on larger runs.

Typical products that they produce are store interiors including hangers and gratings. Consumer products such as hangers and hooks.

The tools and services that are offered are: *Bending NC/Manual, Welding NC/Manual, Press brake. They provide out-sourced surface treatments.*

### **The reason for the meeting:**

The meeting with Håkan at Mandus Wire was mainly done to get an understanding of the process of mass-producing bent wire objects.

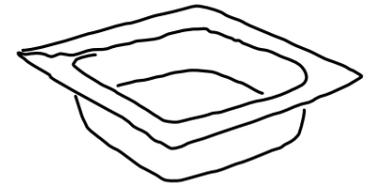
Outcome that was searched for was to get an understanding regarding the costs, abilities of the machines and the services that is provided at Mandus.

### **Meeting with Håkan Karlsson:**

Håkan first showed me around their production. Explained a little bit about every machine and what they could do. Secondly during the meeting we sat down and discussed some examples of products that I brought. We discussed both costs and if their machines could produce the parts.

Håkan was open with the costs and their procedures, though he told me not to display the information directly at his competitors. Which I assured that I wouldn't.

The discussions with Håkan made me understand that bending metal Wire is one of the best options for me with this project so the likeliness of working with Mandus is likely.



SHEET METAL

## TRYCKTA I MARKARYD AB

MARKARYD, SMÅLAND

Tryckta i Markaryd AB process sheet metal in various ways. The company was founded 1961. Today the company has 40 employees. The company offers production as well as consulting with engineering for product development. The company has an extensive client list with hundreds of Swedish companies.

The company mostly produces large batches exceeding a thousand units though they are willing to help out with smaller test runs. They are used to helping out with engineering aspects such as making a product fit their production methods.

Example of products that are produced at Tryckta are satellite disks, lampshades, bowls and much more.

The tools and services that are offered are: *Metal spinning (manual/NC), Deep drawing Punching and Blanking, Press braking, Tube bending, Multi-axis Laser cutting and NC welding, Powder coating, engineering.*

### The reason for the meeting:

Tryckta was chosen mainly of its activities around Metal spinning thought the company has many different tools and services and seeing their activities seemed as a broad source of information regarding processing sheet metal.

Visiting Tryckta was also done to understand the procedure of producing tools for Metal spinning and the actual spinning in itself. Desired outcome was also to understand the abilities, pros and cons with metal spinning and if it could fit the project.

Meeting with Bengt-Ove Johansson:

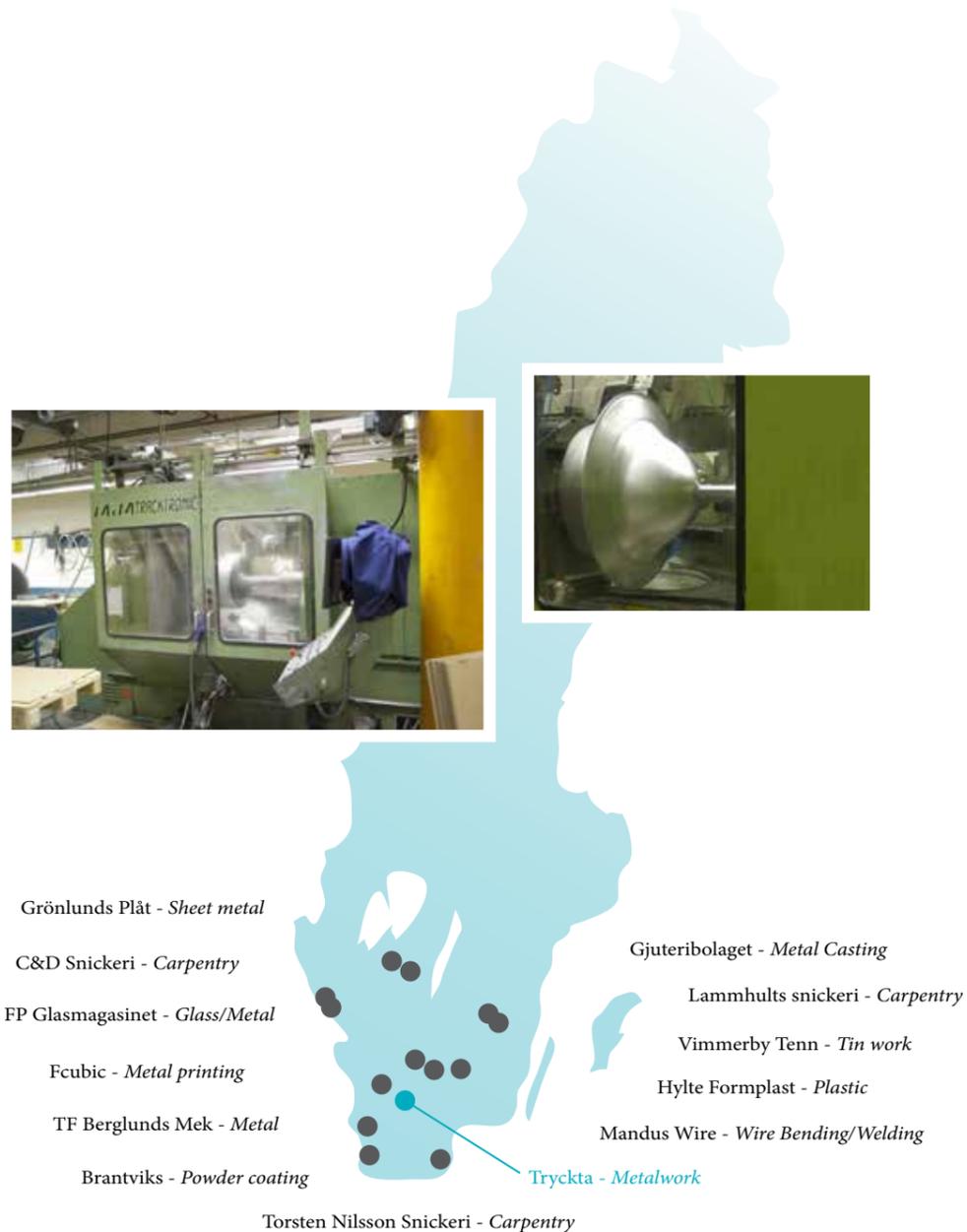
At first Bengt-Ove gave a hard and strict impression, I interpreted him as not really knowing what level I was at regarding knowledge about their production or what I really wanted out from the meeting.

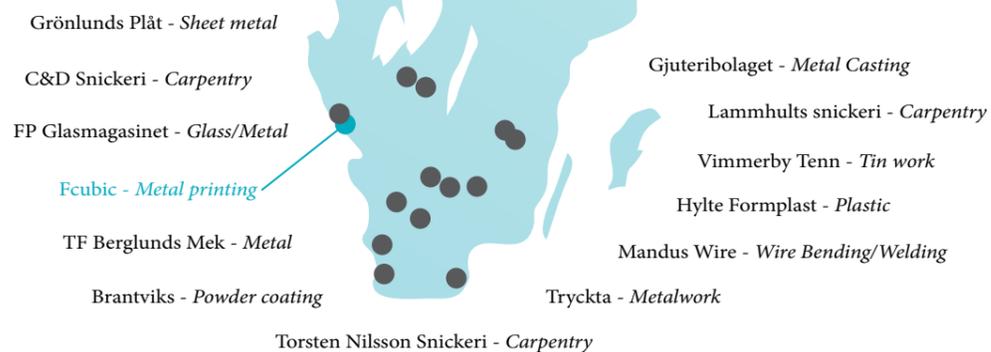
However I asked some appropriate questions and made some fitting assertions about what they were doing and he softened very quickly and became eager in showing me their machines and production.

The experience was interesting since it showed me how important it is to talk the same language to start up good conversations and getting something valuable out of the meeting, for both parties.

It turned out that they worked similar to other visited sheet metal companies the way of working tightly with their clients in order to come up with smart solutions in the production and simplifying it for both parties involved.

Since tryckta mostly is used to larger production runs I would consider the likeliness of me working with them for this project as fairly low, though I would use them in the future if the chance comes since they show a high professionalism regarding their field of processing metal.





## FCUBIC AB

MÖLNDAL, GOTHENBURG

Fcubic is a small company offering printed metal parts with their Digital Metal™ manufacturing method. Its based on an Ink-jet technology working as an Additive manufacturing technique for printing small to medium sized metallic components.

Digital Metal™ is a precision ink-jet technology developed by Fcubic for 3D printing of metal components. The method gives Fcubic the capacity to rapidly produce complex designs and components in metal, in low-to-medium volumes.

Example of products that they produce are: components for aeroplanes, jewellery, medical and dental equipment.

Their main service is to produce low to medium volumes, providing short deliveries and customer specific details where no compromises are to be made.

The tools and services that are offered are: *Digital Printing of small to medium sized metallic parts. Surface treatments such as blasting and electro-polishing.*

### **The reason for the meeting:**

The meeting with Urban at Fcubic was mainly arranged to see the process of printing metal parts and if it could offer any unexpected opportunities.

### Meeting with Urban Harrysson:

The procedure of visiting Fcubic's production was done quickly since there only was one machine. The one machine that they have built. Urban showed me examples of what the machine could do and what the end result looked like. Basically it's offering the same method as any 3D printer but with a

DIGITAL METAL™



high tolerance compared to other additive manufacturing methods.

The meeting ended with me and Urban having long discussions of the best way of using the machine and what kind of area they should concentrate on in the future.

I would consider the likeliness of working with fcubic for this project as small, however I would contact Urban again if the right project comes up in the future. They would be a great source when producing low volume high tolerance metallic parts however the set up costs will go to tryouts since it is a relatively new procedure they are not able to promise an easy production run. Therefore a minimum of 12000 SEK for a test run and set up is needed. Which is hard to motivate for this project.



WOOD



## AB TORSTEN NILSSON SNICKERIFABRIK

BRÖSARP, SKÅNE

Torsten Nilssons Carpentry is a subcontractor producing series from one-offs to hundreds.

The company has strong values connected to craftsmanship and sustainability. The company consists of around 15 employees.

They mostly build exclusive wooden furniture for mostly Swedish brands. They have all machines and tools that are needed to function as a modern carpentry.

Examples of products that they produce are tables, chest of drawers, cupboards and lamps.

The tools and services that are offered are:  
*Build and assemble furniture, NC-machining, Spray painting, Logistics and Engineering of furniture.*

### The reason for the meeting:

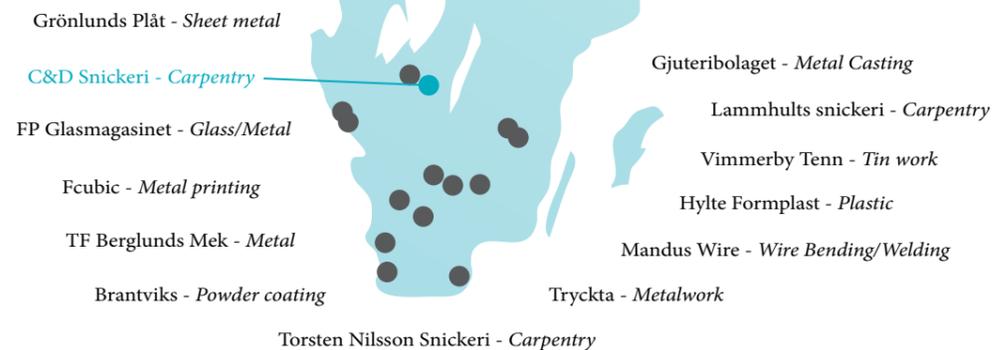
The meeting with Ronny at Torsten Nilsson was arranged in order to investigate a potential producer of table tops or shelves and if their services could fit the project. An other reason for the meeting was to compare the possibilities of the visited carpenters and if there were any substantial differences.

### Meeting with Ronny Nilsson:

Ronny was eager in showing me around their production, he showed me the machines and explained a little about how they work in the production.

We talked about calculating prices of the objects that they produce, he made me understand that it is hard to calculate if there are many steps in production. Sometimes you get it right, sometimes you will have to increase the price for the second batch.

Working with Torsten Nilsson Snickereri for this project is unlikely since the development phase for the production does not fit the timing of the project.



WOOD



## C&D SNICKERI AB

FALKÖPING, VÄSTERGÖTLAND

C&D Carpentry is a subcontractor producing series from one-offs to hundreds.

The company mostly offers customer specific interior and furniture, but also offer batch production of furniture and products, which most are produced from wood but some metal and Corian® is also used.

They have all machines and tools that are needed to function as a modern carpentry.

Examples of products that they produce are tables, hotel and company interiors, handrails and staircases.

The tools and services that are offered are:  
*Build and assemble interior and furniture, NC-machining, Spray painting, Logistics and Engineering of furniture.*

### The reason for the meeting:

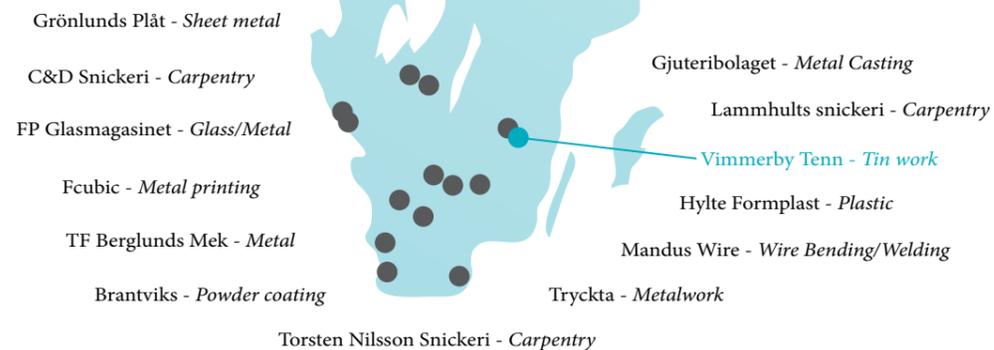
Arranging a meeting with C&D snickereri was mainly done to investigate if they had any other possibilities in production compared to the other carpenters. Also to look at their nc-production which is used to more advanced procedures than the other two carpenters visited.

### Meeting with Pia Hansson:

The meeting with Pia mostly involved at looking at their production. Since they mostly produce custom interior furniture they had a lot of different things going on at the same time. It was inspiring to see. I got to talk to one of the nc-operators about how they usually worked and how they kept downtime low with a such vast production. The key he said is to be quick when programming and doing test

runs. It's a matter of meeting experience and experimentation almost all the time. However knowing the limitations of the machine is a starting point.

The likeliness of working with C&D snickereri for this project is fairly low. The development time and finding a product that could fit their production without costing too much is a too vast project, however the gut feeling I got from the company was very good and I would like to work with them in the future.



## VIMMERBY TENN AB

VIMMERBY, SMÅLAND

Vimmerby Tenn is a small company working with designers and artists designing and producing object out of tin. In Vimmerby, tin production has its roots from the 18th century and has been carried out since then.

Vimmerby tenn is not a subcontractor firstly meaning that if you want something produced by them you also join their rules how to sell the products.

Examples of products that Vimmerby tenn produces and sell through various sales channels are drinking cups and plates, candle holders and sculptural objects.

The tools and services that are offered are: *Small scale production of tin objects, casting is their main production method. They produce the moulds and objects themselves in a handcrafted manner.*

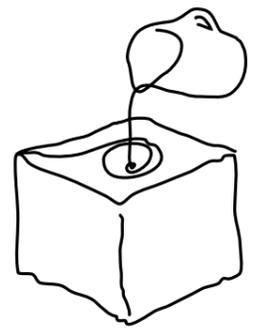
### The reason for the meeting:

The meeting with Bo Wiger at Vimmerby tenn was arranged when visiting Gjuteribolaget. Casting tin can be done in cheap moulds and therefore looking into the possibilities of tin production seemed as a good step for the project, and investigate if the method could fit a batch.

### Meeting with Bo Wiger:

Bo showed me their small workshop and the products that they produce. They mostly work with local artists when designing and producing their objects. Bo himself creates and produces some of his own designs. The company is on the edge of being a hobby workshop but since they have many sales

TIN



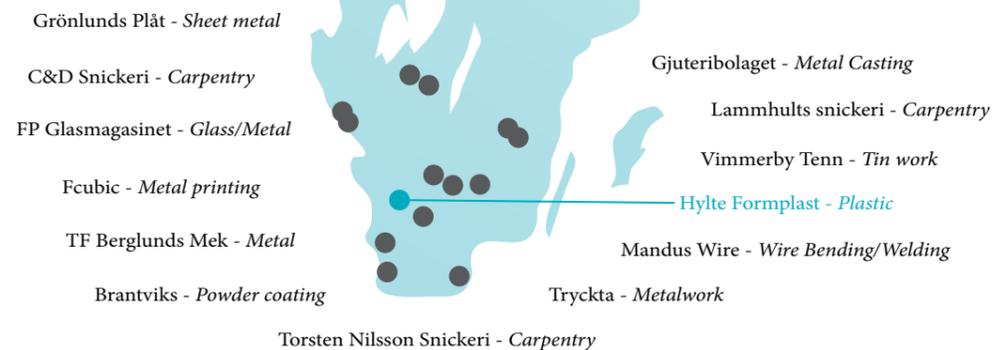
channels in the area they do run a profitable company.

All products are created manually in the little workshop however some of the products have been created in thousands of copies.

Bo would very much want more young talented designers to work with and is very open to working with new people on new designs.

Working with Vimmerby tin for this project could be an option though it would result in changing the strategy of the project and instead of working for myself work with them and creating designs for Vimmerby tenn to motivate them to create a for them large number of 100 units or more. If I would order the pieces the delivery would be too long and the price to high.

However it would be interesting and instructive working with Bo in the future, he is excited about tin work and skilled in producing moulds.



PLASTIC



## HYLTE FORMPLAST AB

HYLTEBRUK, HALLAND

Hylte Formplast is a subcontractor producing vacuum formed plastic details.

The company is small with only two full time employees. They are used to making small to large production runs.

Products that they produce are interior parts to vehicles, display stands for stores, consumer product and battery housings and signs.

The tools and services that are offered are: *Vacuum forming plastic sheets. NC milling, Welding and Bending plastic. They also provide services as making the tools.*

### The reason for the meeting:

The meeting with Roger was arranged to investigate vacuum formed plastic and see if any possibilities could open up. Also to immerse the theoretical knowledge gained from the initial research.

### Meeting with Roger Lönnberg:

During the meeting with Roger he showed me their machines and how they functioned. He explained what to think about when creating the tools and what materials that could be used.

He showed me the NC-mills they use to cut of the rest material.

At Hylte Formplast they offer a warehouse keeping small stock for their clients but also keeping their tools awaiting to be used for the next batch of products.

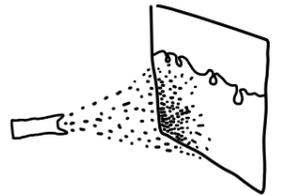
Besides vacuum forming plastics they also offer plastic welding. Welding vacuum

formed plastic parts together could be an alternative to moulding plastic, especially when producing a low volume since there are no set up costs for welding. Even though welding plastic can solve problems regarding costs for low volume runs it is not a recommended method for visual parts since the tolerance and looks of the welding seems are quite ruff.

I would consider it being a relative big chance in working with Hylte Formplast for this project, though I will have to produce my own tool since ordering one from them can be hard to motivate with my budget.

They welcome me back if I ever would need their help even for a low volume batch or one-off.

POWDER COATING / SPRAY PAINTING



## BRANTVIKS MÅLERIVERKSTAD AB

MALMÖ, SKÅNE

Brantviks Måleriverkstad is a Company that offer surface treatments such as spray painting and powder coating. The company was founded 1957.

Products that they treat are everything from consumer products to machine details, and signs for indoor and outdoor use.

The tools and services that are offered are:  
*Spray painting, powder coating and blasting.*

### The reason for the meeting:

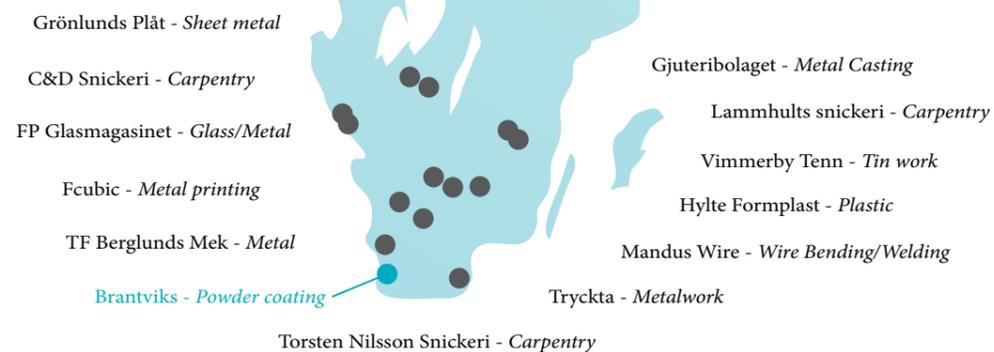
The reason for visiting Brantviks was mainly to investigate their relations to their customers and how willing they are taking on small runs and what kind of delivery times they have.

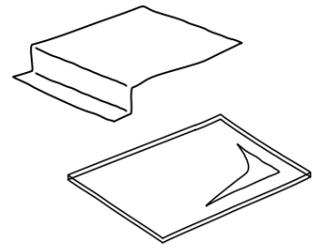
### Meeting with Carina Brantvik:

I have visited Brantviks at many occasions before this meeting, though I have never looked at the production area as now. One of the employees showed me how they manually apply the powder on the metalwork and then cures the powder in their oven.

When talking to Carina I got to know that they try to welcome as many different clients as possible and treating all in the same way undependable on size.

The likeliness of working with Brantviks for this project is very likely since they have a positive attitude against small runs and they offer short delivery times.





SHEET GLAS / SHEET METAL

## FERM & PERSSON GLASMAGASINET AB

VÄSTRA FRÖLUNDA, GÖTEBORG

Ferm & Persson Glasgasinet is a modern glass company offering a wide variety of services including reparation of glass facades, production, delivery and mounting of doors, windows, interiors. The company was founded during the 19th century representing values such as tradition, craftsmanship in a modern way.

Examples of products that they produce are doors, windows, facades, interiors including shelves and mirrors.

The tools and services that are offered are:  
*Custom glass parts including metal detailing, such as frames, deliveries and mounting. Producing, repairing and refurbishment of doors, windows and facades.*

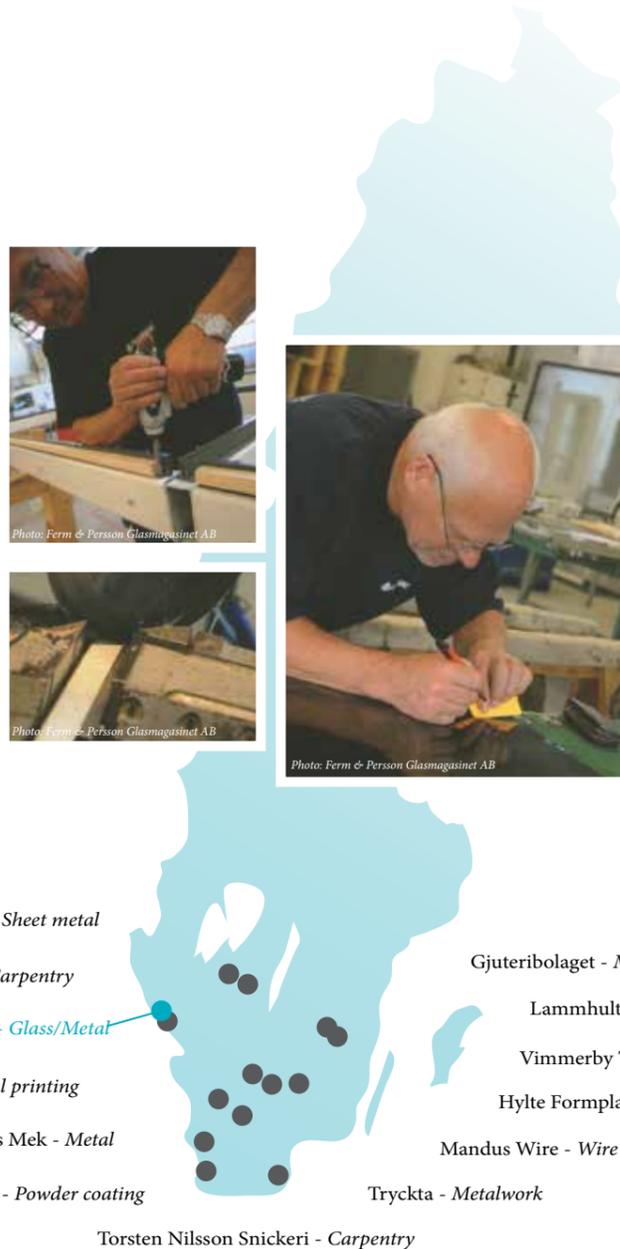
The likeliness of working with Ferm & Persson Glasmagasinet for this project is small. However there is a possibility in the future since they have a wide variety of contacts in production and Daniel does want design consultation in the future.

### The reason for the meeting:

The main reason for meeting Daniel was to see their production but also to discuss a product he had going on that could fit my project. The project turned out to be too big for this project and had to be turned down.

### Meeting with Daniel Nestenborg:

The meeting with Daniel was mainly a discussion of weather if I could help him with a project he had going on. I realised that the project would be too comprehensive to fit the scope of this project and had to turn the offer down, however he showed me their production and explained how they work with their clients. And offered helping me if I needed help with production of glass or metal products in the future.



Grönlunds Plåt - Sheet metal

C&D Snickereri - Carpentry

FP Glasmagasinet - Glass/Metal

Fcubic - Metal printing

TF Berglunds Mek - Metal

Brantviks - Powder coating

Torsten Nilsson Snickereri - Carpentry

Gjuteribolaget - Metal Casting

Lammhults snickereri - Carpentry

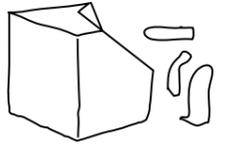
Vimmerby Tenn - Tin work

Hylte Formplast - Plastic

Mandus Wire - Wire Bending/Welding

Tryckta - Metalwork

## CHIPPING METAL COMPONENTS

TF BERGLUNDS MEKANISKA AB

LÖDDEKÖPINGE, SKÅNE

TF Berglunds Mekaniska produces metallic details by various chipping techniques. They provide NC-lathes and NC-mills.

The company was founded in a garage 1973 and has since then expanded and have now many small to medium sized companies as customers.

Products that they produce are mostly components for public areas and components for machinery.

The tools and services that are offered are:  
NC-mill, NC-lathe, Welding, Automatic cutting machine.

**The reason for the meeting:**

The meeting was mainly arranged to discuss a product idea, firstly see if they were able to produce it secondly investigate their price of producing it. The meeting was also arranged to investigate NC-production at a relatively small scale.

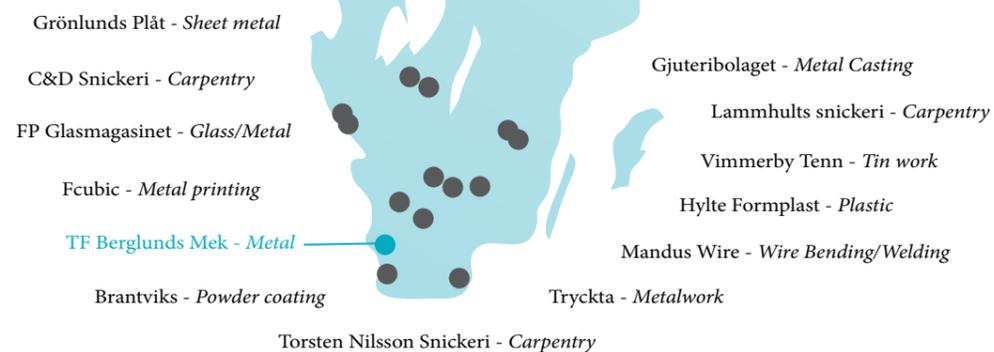
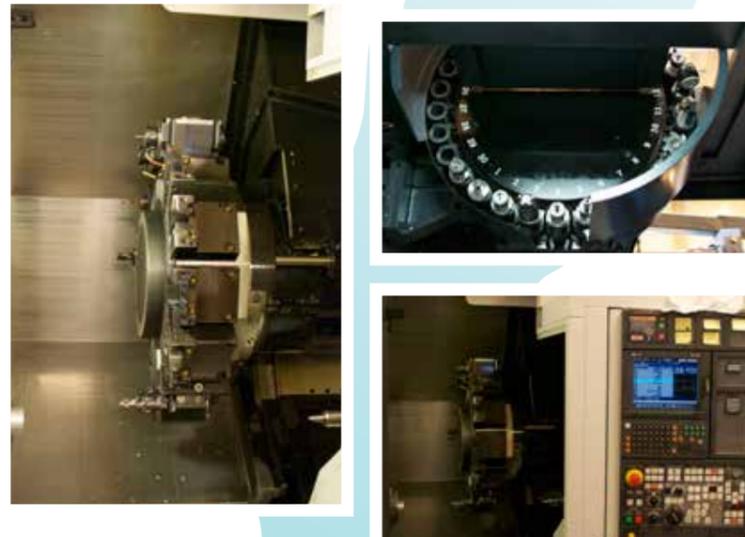
**Meeting with Joakim Månsson:**

The meeting with Joakim provided a good understanding in how they work. They mostly get small orders for metal components. They have a set pricing on the machines at 800-1000 SEK/h. Their strength is their speed of turning technical drawings into final parts.

A discussion about a product idea from this project was brought up and it showed that it could be done quite easily with the machines that they have. However the unit price turned out to be too high which

resulted that no further correspondence with the company was made.

The company is small and the delivery times kept short meaning that it could be a good alternative for production for this project even though the first idea did not fit the cost for the project.



**PRODUCERS**  
EVALUATION PRODUCERS

	Material costs	Set-up before production	Tooling for production	Tolerances of products	Time production/delivery	Small Batch willing or not	Location in sweden	Possibilities In production	Cooperation for this project
Grönlunds Plåt AB <i>Sheet Metal</i>	● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● <i>Batch to Mass production</i>	● ●	● ● ● ●	● ● ● ●
Lammhults Snickeri AB <i>Wood</i>	● ● ●	● ● ●	● ● ● ● ●	● ● ● ●	● ●	● ● ● ● ● ● ● ● <i>One-Off to Batch production</i>	● ● ●	● ● ● ●	● ●
Gjuteribolaget AB <i>Casting Metal</i>	● ● ● ● ●	● ●	●	● ● ● ● ●	●	● ● <i>Batch to Mass production</i>	● ● ● ●	● ● ●	●
Mandus Wire AB <i>Metal Wire</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ●	● ● ● ● ●	● ● ● ● ● <i>One-Off to Mass production</i>	● ● ● ●	● ● ●	● ● ● ● ●
Tryckta i Markaryd AB <i>Metal Sheet/Tube</i>	● ● ●	● ● ● ● <i>Depending on process</i>	● ● ● ● <i>Depending on process</i>	● ● ●	● ●	● ● <i>Batch to Mass production</i>	● ● ● ●	● ● ● ● ●	● ● ●
Fcubic AB <i>Liquid Metal</i>	● ● ● ● ●	● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ● ● <i>One-Off to Batch production</i>	● ● ●	● ●	●
Torsten Nilsson Snickeri AB <i>Wood</i>	● ● ●	● ● ●	● ● ● ● ●	● ● ● ●	● ●	● ● ● ● ● <i>Batch production</i>	● ● ● ●	● ● ● ●	●



## PART 2: SUM-UP

### FIELD TRIPS: PRODUCERS

The knowledge gained from the meetings provided a base to apply on the ideation phase where ideas could be evaluated consciously regarding aspects such as production.

The meetings also provided a chance to immerse the knowledge gained from theory.

My initial thoughts were to find out how much things cost and how you actually prepare a product for production.

I realized quite quickly that the preparation part can be complex to grasp by yourself but the actual preparation for a designer in many cases is the dialogue with the skilled producers. Knowing how the machines work will be helpful when communicating with the producers.

Many of the answers I got regarding costs were put to me as if they didn't know the answer to my questions, one reason for it could be that the questions were too general and not connected to a specific product to calculate the price on.

One conclusion that can be drawn is that there are no straight answers to production costs, the factors can be many, providing no easy way for it to be calculated.

I never got a good overview of the prices from my questions at some producers. But at some producers they could provide me with approximates regarding their production, the companies giving clear answers where mostly the small companies with few machines.

A conclusion that can be drawn from that is

that it is much easier to grasp a problem if there are fewer aspects to calculate.

Another reason for not getting any direct answers might have been because they did not want to go into details and blowing their specific ways of calculating prices or their price of material.

Secondly I realized that you only make yourself a disservice by hoping that a design of yours is ready for production.

It's a great workload to learn all machines and possibilities of a producer. You can get an understanding of what kind of machines a producer has but knowing the restrictions and possibilities of these machines are only those working with the machines daily who fully can tell. It's important not to feel restricted when designing but sometimes it could be good to have some boundaries.

Learning as much as possible about production methods is a great way of meeting and understanding the people working in the production, it helps the producers to identify who you are and how they should act towards you. Also, being able to respond with relevant answers to problems and helping them solve the difficulties in production of your designs is definitely a plus when communicating with the producers.

You will probably never know it all so use the people and their knowledge as early as possible in the design process and you are more likely to succeed with the design.

Producers are in many cases used to turning quick sketches into functioning products

and mostly it is a sketch that they get as base for products that they produce.

The way producers handle the production and deliveries can vary.

Many of the companies that were visited, delivered the items when production of them was done. Others got orders once a week telling what the end consumers had ordered. So in a way some produced specific products to the end user. A little bit like they do in the automotive industry. Some producers even have their own warehouse keeping products in stock so instead of sending their products only to their customer they also ship the products directly to the end user even though they are not the ones placing the order.

Realising that there are many models in how the workload is divided between companies is fascinating, many producing subcontractor offer services including much more than just production, this to ease work for both their clients and the clients customers.

Many producers showed great excitement and will to help even for small batches of test runs and prototypes.

There is a fine line between custom produced furniture from a carpentry and batch produced furniture since many of the steps are manual at carpenters.

It all depends on what volume the producer can offer, comparing mass produced wooden furniture from IKEA and production of smaller carpenters is unnecessary and worlds apart even though the product in

many cases offer similar functions.

Custom furniture are seldom ordered from private individuals, mostly companies.

Even though the producers often have higher margins on short production runs longer runs are preferred because it is ensuring work.

Coatings is usually done rapidly, even though it does add costs to the production it is in most cases a small part of the costs and mostly representing the adding quality and looks of the product.

In many cases keeping a raw material surface is harder and more costly to achieve than adding a step of treating the surface in some way.

Small producers are more likely to help out with a small production run though their unit prices often end up being higher than at the large producer.

Since few answers regarding costs was answered in this research phase a next step of further correspondence with the producers will be held in order to try to get some answers.

## PART 3

### RESEARCH COSTS & FEASIBILITY

Due to that the meetings with the producers gave me few answers to understanding price a second phase was needed to clarify production costs.

In order to get estimates in pricing and feasibility of production, example products were sent out to relevant producers that then evaluated and calculated the price and the feasibility of the products.

The example products that were used were created during the prolonged ideation phase that started from the first meeting. The examples were chosen by looking at the most relevant production methods for this project.

From the outcome of the example products and the possibilities from the producers the product ideas were then evaluated from the factors that have shown to be important for this project and the producers that are possible to use.

## COSTS/FEASIBILITY

### FURTHER CORRESPONDENCE

Talking prices has been a hard part of this project, one reason for that is that the processes and methods explored are complex and many factors are to be considered to be able to give a price of an item or a step in the production.

What was done to get some prices was to send out example objects where the producers applied their costs and calculations on the object. This was an efficient way for the producers to apply answers to my questions.

The example products that were sent out where designed and selected by seeing to that the involved steps in production should be relevant to the different producers and in that way answer as many and complex questions as possible.

In this section example products and processes will be presented for giving a hint of what small scale production done by Swedish producers can cost. The numbers presented are rough and mostly not compared to different producers, saying that there might be cheaper solutions but due to the time limitations for the project few prices have been compared.

The retail prices that are stated are estimates and based upon cost price, wholesale price and retail price. This meaning the cost price times four (Cost prize x 4)

General prices that are good to keep in mind are the following:

*Manual work, (human labour, example manual welding, drilling etc.)*

*300-500 SEK/h*

*Machine runtime: Mostly including operator cost if machine needs one.*

*600-1200 SEK/h depending on what kind of machine.*

*Set up cost for NC- Machines.*

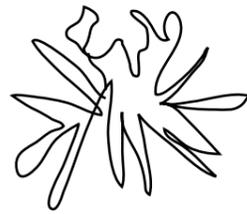
*Approximately 300-1200 SEK, depending on the level of programming and what kind of machine, but regularly same price as the hourly rate of the machine that is to be used.*

*Regarding material costs, material follow currencies in the same way as gold or petrol. Meaning that they can change from one day to another. Large quantities of a material is often cheaper than buying a small quantity.*

Out of respect for the producers no source of the prices will be given. Some producers where open with their prices and other producers never gave me any answers. The ones that did not reply to my inquiries I decided to let go for this project.

The producers' prices are client specific and can therefore be different depending on various aspects.

HANGER: SHEET METAL

**Hanger: 3 mm sheet metal**

Laser cut, bent, welded, powder coated

Material cost: 110 SEK

Laser cutting: 70 SEK(3m30s)(1200 SEK/h)

Bending, Welding and Coating: 95 SEK

Cost price/piece total: 275 SEK (1000 units)

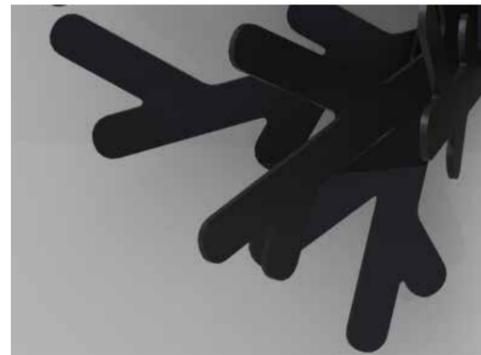
Approximate Retail price: 1095:-

Since there is no brand, no known designer and there is a quite shallow value adding story to it the price is hard to motivate.

Options to making it cheaper would be to reduce the size, shorten the cutting distance, produce a much bigger number and make special bending tools for it.

If this could have been done a reasonable retail price could have been achieved. The product does not suit the projects scope or budget.

The product can not be designed in the way that it was originally designed due to limitations with bending tight angles that are placed close to each other, though minor changes could solve the problem resulting in more parts but significant change in production.



MAGAZINE RACK SHEET METAL

**Magazine rack: 3 mm sheet metal**

Laser cut, bent, powder coated

Material cost: 180 SEK

Laser cutting: 55 SEK(2m45s)(1200 SEK/h)

Bending, Welding and Coating: 35 SEK

Cost price/piece total: 270 SEK (1000 units)

Approximate Retail price: 1095:-

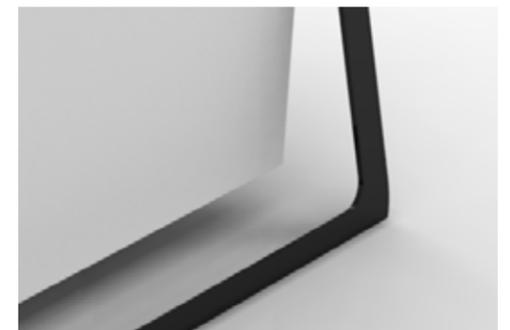
Since there is no brand, no known designer and there is a quite shallow value adding story to it the price is hard to motivate.

Options to making it cheaper would be to shorten the cutting distance, produce a much bigger number and make special bending tools for it.

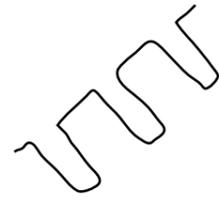
It would be hard to produce this product with a reasonable retail price since only the material cost is leading to a product having a price in the top segment of the magazine racks of today's market. An alternative would be to weld it together out of more parts reducing the amount of scrap metal from the cutting process, but then it would have to be redesigned totally and therefore it does not suit the project.

This part had to be redesigned to fit the available production methods. The issue was the tight angles that had to be done with the press brake. The option would be to produce it in more parts that are then welded together, this would ruin the design.

Producing a tool for being able to solve the bending action would cost around 30.000 SEK



BENT WIRE: SHELF BRACKET



**Shelf bracket: 10 mm metal wire**  
NC-bent, welded, powder coated

Material cost: 8.5 SEK

Machine costs: 7 SEK (800 SEK/h)

Welding and Coating: approx. 13.5 SEK

Cost price/piece total: 30 SEK (100 units)

Approximate Retail price: 129:-

This piece of bent wire was designed to be part of a shelf, the design solutions where the ones that never got worked out properly on this product and therefore was not continued.

It does keep a reasonable price even for short production runs. Bending and powder coating wire is an option for this project.

Feasibility of production:

It showed that some changes have to be made in the design to be able to produce this detail. The issue was the ability of the bending machine that set the constrains.



NC LATHED HOOK: FROM TUBE



**Hook: 16/10 mm metal tube**  
NC-Lathed, powder coated

Material cost: 4 SEK

Set up costs: 0.5 SEK (approx. 1h)

NC Lathe: 20 SEK (2m00s) (600 SEK/h)

Powder coating: approx. 3 SEK

Cost price/piece total: 27.5 SEK (1400 units)

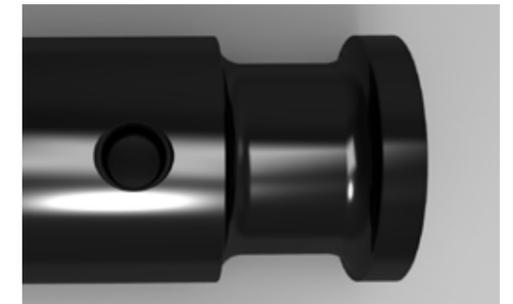
Approximate Retail price: 119:-

This product was designed to include seven of these parts meaning that the cost price per product would land at around 250 SEK and a retail price around a 1000 SEK which for this kind of product without brand or a deep selling story would be unreasonable.

Although the first price was way to high more time was spent on finding a better production method and getting a cheaper price to get a reasonable retail price.

The reason for continuing with the product is partly because of that the product itself can easily be stored at my home which is more or less a must for this project to be profitable and that the product feels that it has got a little twist and that it might be possible to sell. What was done to make this product profitable economically will be covered in an other section.

The product can be produced without any design changes.



BOX: VACUUM FORMED PLASTIC



**Box: 3 mm ABS plastic**

Vacuum formed, NC-milled

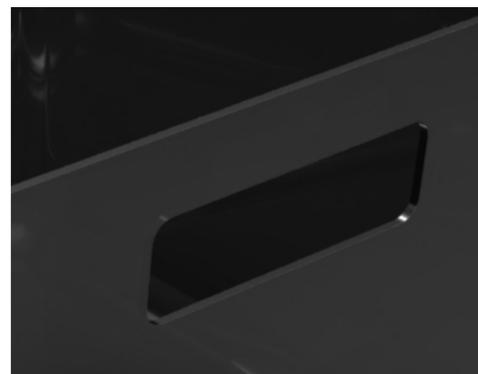
Material cost: 53 SEK

Aluminium tooling: 15 SEK/unit  
(15000 SEK)

Milling jig and set up: 6.5 SEK

Cost price/piece total: 74 SEK (1000 units)

Approximate Retail price: 295:-



This product was an example product sent out to get rough numbers on what it could cost. Since there is tooling involved the part does not get profitable if you produce only a few. Therefore you will have to make at least a 1000 which is the top limit of this project. An option would have been to make the tooling by yourself which would reduce the price significantly for a low number production run.

The hard part with vacuum formed plastic is the finish and the questionable tolerances of the production and therefore finding the right product that fits the method.

It was the questionable quality of the production that made me choose not to continue with the method. The material cost and the milling would be possible to motivate but with a tooling price on top of that it was hard.

Producing this item would be no problem with a vacuum forming machine and an NC-mill.

**COSTS AND FEASIBILITY**  
**EXAMPLE PRODUCTS**

	Material costs	Set-up before production	Tooling for production	Tolerance of products	Time production	Small Batch suitable or not	Feasibility Not regarding price	Gut Feeling Market potential
Hanger <i>Sheet Metal</i>	● ●	● ● ● ● ●	●	● ● ● ●	● ●	● <i>Mass production</i>	● ●	● ● ● ●
Magazine Rack <i>Sheet Metal</i>	● ●	● ● ● ● ●	●	● ● ● ●	● ●	● <i>Mass production</i>	● ●	● ● ● ●
Shelf Bracket <i>Metal Wire</i>	● ● ● ●	● ● ●	● ● ● ● ●	● ● ●	● ● ● ●	● ● ● ● ● ● <i>Batch production</i>	● ● ●	● ● ● ●
NC- Lathed Hook <i>Metal Tube</i>	● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ●	● ● ● ● ● ● <i>Batch to Mass production</i>	● ● ● ● ●	N/A
Plastic Box <i>Vacuum Formed Plastic</i>	● ●	● ●	●	● ●	● ● ●	● ● <i>Batch to Mass production</i>	● ● ● ● ●	N/A

## PART 3: SUM-UP

### CONSTRUCTION/FEASIBILITY

The example products offered good price estimates in production within the most relevant production methods for this project.

Some things turned out to be more expensive than expected, some cheaper.

The information regarding costs was provided and collected in different ways some answers were collected and extracted. From the discussions at the meetings, and others where answered with help from the example products that were sent out to some of the producers.

With the given answers and clarifications regarding feasibility of the products the project was provided with a broad base to be able to take active and relevant decisions regarding the product ideas that had been worked on. New ideas could also be created more consciously.

NC wire bending is a good alternative as a production method regarding costs. For making a profit wire bending compared to the other explored methods is the easiest way to succeed in a low unit production run.

The material is fairly cheap and the production is rapid. The set up costs are low meaning that even small production runs can be profitable. If using the production method as a starting point for a product, wire bending is a very good choice.

All the other methods that has been explored and applied to products are laser cut and bent sheet metal. Lathed metal, Combinations with sheet materials such as wood, laminates, and glass. Alternatives with creating products with value adding aspects through adding standard items such as rope and screws has also been explored.

The production methods except wire bending are trickier to apply at a small scale though it is possible. Finding the right product where the cost price compared to a reasonable retail price is a key factor. Meaning that there is a much higher demand on finding good production prices and producing the right product for the right price to be able to make a profit. The acceleration of the price of the product has to be greater than for example wire bending. Creating a product that people generally are willing to pay a high price for is one solution.

At this stage of the project a selection of producers to continue correspondence with was made, some of the producers provided no answers about their costs which had to be respected. Therefore no further correspondence was held with those companies.

The companies that a continuation of correspondence was held with, were the companies that could offer services fitting the project. The most important factors when continuing or not was their willingness to help and if the process of working with them could be quick enough to be fitted within the frame of this project.

# PART 4

## DESIGN PHASE & IDEATION

The outcome from the meetings and the further correspondence with the producers resulted in covering many of the questions regarding the production, costs and what to consider.

The collected information was ready for being put into practice when developing new ideas and evaluating old ideas.

A period of a couple of days where spent on an open ideation phase resulting in some interesting outcome.

The pre-decided method to evaluate the ideas was done by stating a final list of aspects regarding development of a batch-produced object in small scale and with low investment.

The ideas where evaluated one by one giving a clear view of what ideas to carry on with and what ideas to exclude from the exceeding design work.

## DESIGN PHASE

### VARIOUS IDEAS AND EVALUATIONS

Though this project is one long design process it has a fairly stretched out ideation period continuously flowing through out the first half of the project. Many of the ideas where born along the way at the producers and where discussed during the visits if the possibility was given. Ideas where held to objects that could fit Designtorget as sales channel.

In this section some ideas will be presented and also be discussed regarding factors such as production, costs, delivery and suitability for the project.

Products that will be evaluated are the following;

- *Shelves*
- *Bed tables*
- *Magazine racks*
- *Hangers*
- *Valet stands*
- *Flower pot holders*
- *Salt and pepper containers*
- *Side tables*
- *Stools*
- *Hat racks*

The ideas and objects vary regarding the suitability for this project, this depending much on when the idea occurred. It was not until the end of the ideation phase all aspects where answered and conscious decisions could be made.

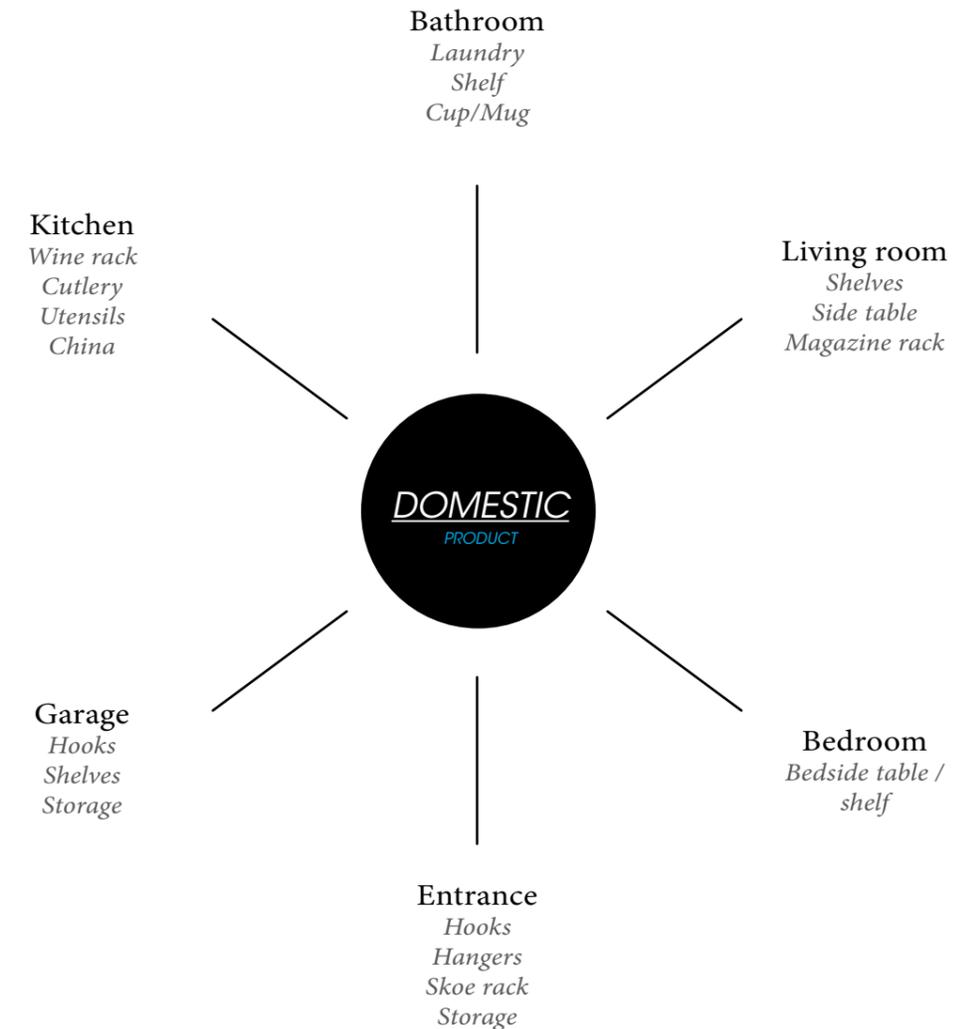
The following aspects all had to be evaluated and discussed to find the product to produce;

- *Cost price / Retail-price*
- *Set-up and tooling in relation to material and production costs.*
- *Location of production*
- *Possibility to produce*
- *Producer willing to produce*
- *Delivery / Time of production*
- *Desired quality*
- *Concept strength*
- *Function/Usability*
- *Storage Volume*
- *Need of mounting parts*

Design factors were also added in this final step seeing to that the concept and functionality is somewhat realistic.

An important factor that was added to the final list of aspects is the size of the product and how it can be stored.

Investing in a storage place is not an option for this kind of project since the margins from the sales easily could result in being payments for the storage location. It would also add an extra step in distribution. Therefore an active choice in adding the aspect of storage volume to the list of aspects seeing to that the product can be stored at home was made.



### Coat Hanger

*Lathed, cut or punched metal hooks and rope*

The cost price compared to retail price for a product like this can be motivated. There are similar products on the market that cost significantly more than what would be needed for this solution.

The hooks can be laser cut and therefore no tooling has to be produced. The set up costs can be kept to a minimum. Though there is a fine line for keeping a reasonable price on the parts when cutting with the laser. Its important not having too complex shapes since that slows down the process and the hourly rate for a laser cutter often exceeds 1000 SEK/h

There are producers in southern Sweden that does produce laser cut objects.

There is no doubt in finding a producer that could and would want to produce the pieces from the previously visited producers.

Detailing about deliveries are not exact on this product but for making the metal parts by laser cutting would take a couple of hours meaning that the time it takes to produce could fit within the frame of this project.

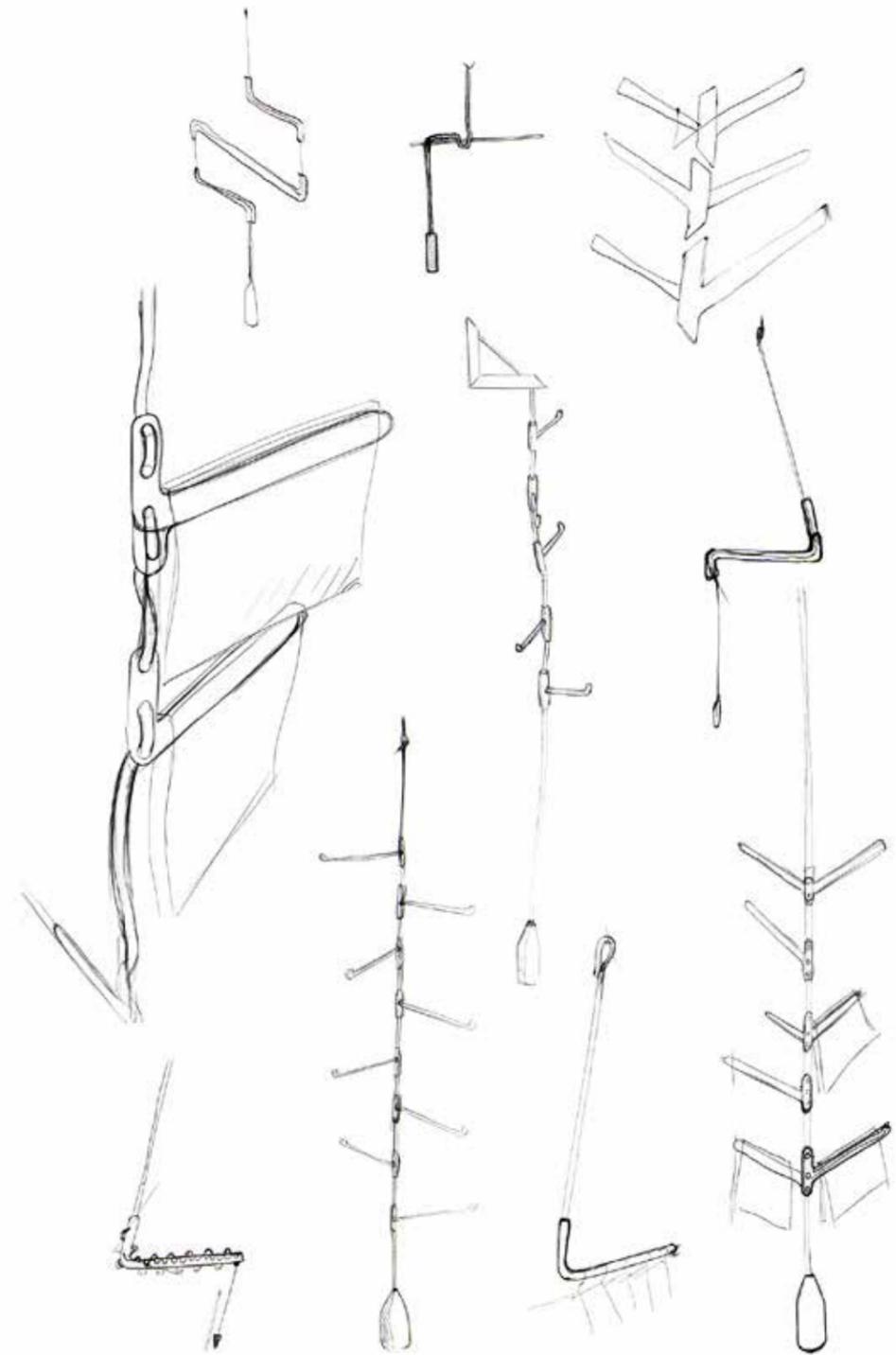
The quality of laser cut metal can be kept high however there might become sharp edged that can be hard to powder coat in a good way.

The concept strength of this product showed to be so strong that other people done almost the exact product before, this was the factor that ruled out the product even though it had all the other factors for being a suitable product for this project.

Simple mock-ups where made with a surprisingly good result meaning that the product would function well.

The storage volume of the product could be kept to a reasonable volume meaning that I could store the product in my home.

There would be some extra time added for mounting the parts, the time would be relatively short meaning that it would still be a motivated choice of product.



*“Main reason for not continuing with the idea is because there are too similar concepts on the market“*

### Magazine rack

*Bent welded and surface treated metal wire.*

NC-bent metal wire can be produced in efficient ways resulting in low production costs. Therefore cost price compared to retail price often conform.

There is no tooling needed for the bending, though welding jigs may have to be built.

There are several producers in Sweden offering NC-bending, and for this project a producer is contacted and willing to produce a test run.

Depending on dimension and shape of the wire a lot can be bent directly from the NC-bending machine. Sometimes additional bends have to be made in the press brake to make the production possible.

The set-up and production of a product like this can be done quickly and for a small batch all products can be produced within only a few days.

The quality of the bends are usually good, however the welding points can vary depending on what result that is demanded and to some extent the skills of the welding operator.

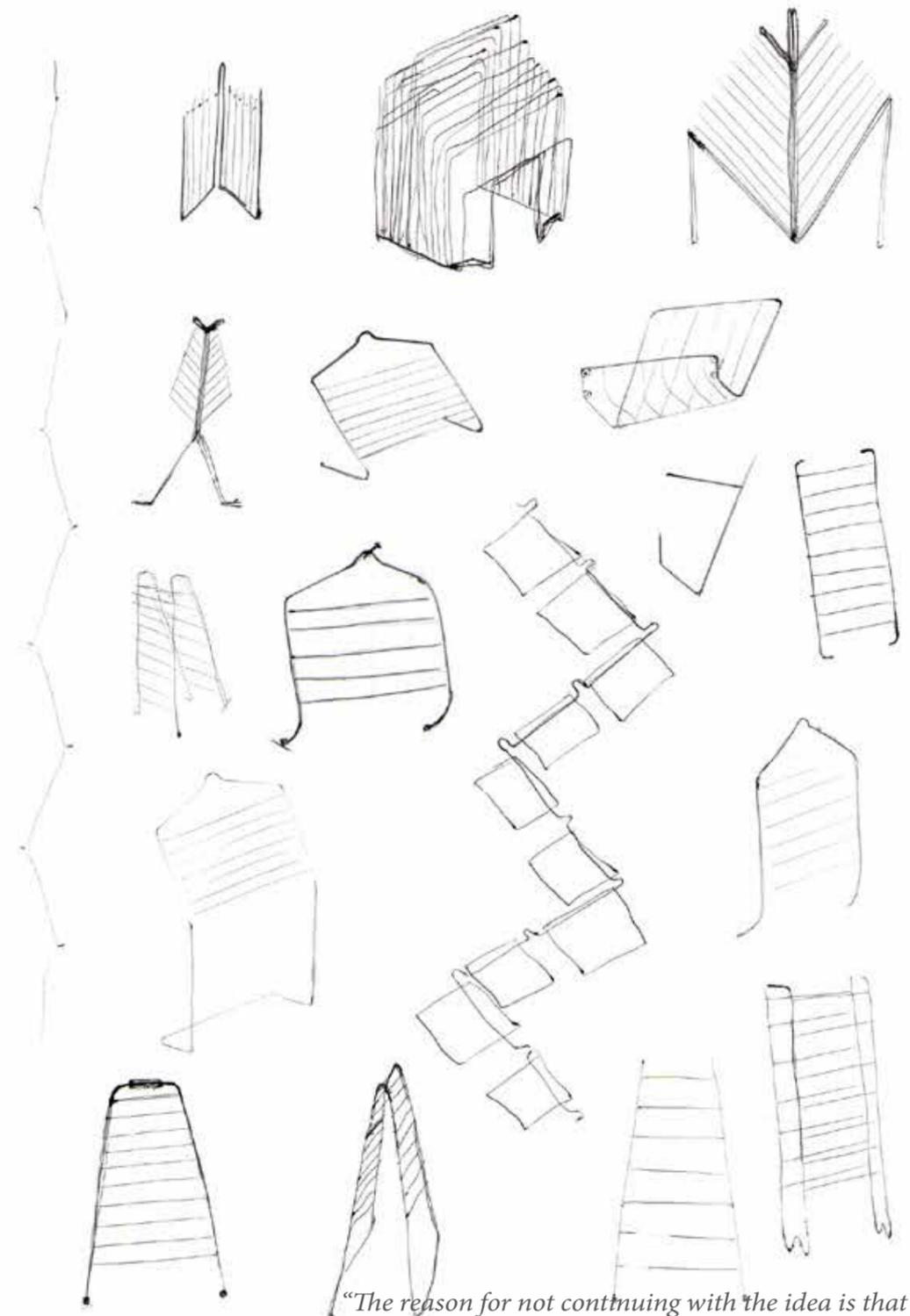
A final design was never set on this idea though some nice design alterations came out of the ideation no alternative seemed to have that extra being able to motivate it for the market where many wire magazine racks already are at production. This is the main factor for not continuing with this product.

Earlier prototypes have been made ensuring the functionality of some of the designs.

An important factor for this product was that it could be stored efficiently, therefore

the flat designs or the stackable solutions where the one with most potential.

The ideas were generally designed not having any extra mounting meaning that the delivered result could be ready to sell.



*"The reason for not continuing with the idea is that no strong concepts were generated"*

### Salt & Pepper containers

*Bent and welded metal tube, wooden end-caps, surface treated metal.*

Estimations in price allows this idea to have a reasonable retail price compared to its cost price.

There is no tooling needed for bending the metal tube though some welding jigs may have to be done for welding and drilling the top cap.

There are companies in southern Sweden that could produce this object. However from the visited producers there is no obvious choice, some comparisons may have to be one.

The production itself for this product (100-1000 units) can be kept short with only a few production steps and could most likely be delivered within 6 weeks depending on the producer.

The quality of the product can and should be kept at a high level to stand out, therefore the welding seems have to be made with high precision and require a skilled operator or an NC-controlled welding machine.

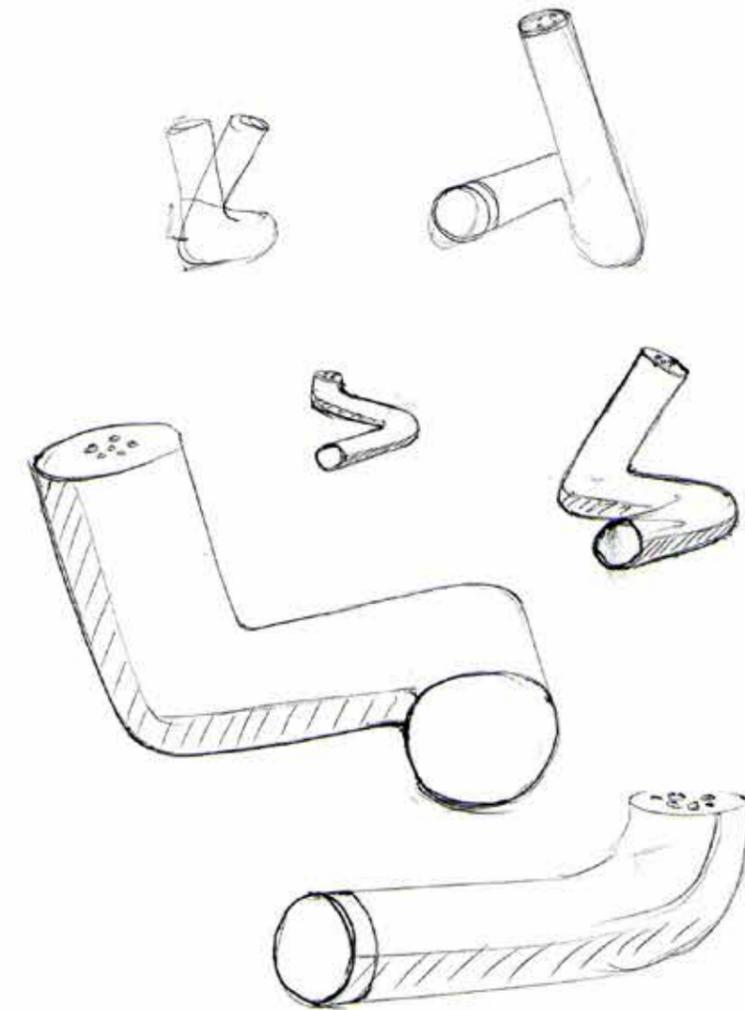
The concept strength of this idea depends on the detailing and the quality of production, Lack of experience regarding quality insurance and time limitations going for a risky product that need a high level of detailing does not seem like the most reasonable choice.

Due to the low grade of needed functionality in a product like this, the product is feasible regarding functionality. What is needed is a reasonable hole sizes for the output holes a good cork that does not come loose and a shape that allows the tube to stand stable on

a flat surface which seems like an executable task.

The product is small and can therefore easily be stored at home.

There is no need for extra mounting except putting the cork in place and maybe pack it in a ask depending on size and surface treatment.



*“The reason for not continuing with the idea is that there would most likely be a long process in achieving the desired tolerances and finish needed for the product to stand out”*

### Side table

*Bent metal wire, wooden table top, surface treated metal.*

For this project there is a risk for producing a product that will end up with a high retail-price. Wooden furniture that are produced in low volume production in Sweden are often high-end products, for this project without a brand and selling story this can be a naive choice of product.

There is no need for special tooling, An NC-mill can solve the production of the table top and an NC-bending machine is suitable for the legs.

Both carpenters and metal wire bending producers are locally suited for the project. The question remains what volume the producer would see as a minimum.

Technically there would be no problems in producing the parts.

The legs and table top are no advanced parts meaning that they can be produced quite rapidly, the process is doable within a week time wise. I would consider the delivery to be done within a month for a small batch from the date of the final order, this depending on the workload of the producers.

The quality of the parts will also reflect the price, this extra noticeable with wooden parts where skill and the duration of production reflects on the quality.

The concept strength is fairly low, though with some usability twists where making it into two low tables or two trays is possible. However the functionality of this multi-use table can definitely be questioned regarding usability and stability. Therefore a lot of time has to be spent on developing this idea into

a solid concept.

The main factor for not continuing with this idea is due to the size and wight for the parts where the option of storing stock products at home not is possible.

Mounting the legs with the table top is necessary, the complexity of this step is not set at the idea stage and therefore there is no answer for this aspect.



*“The main reasons for not continuing with the idea is the storage size and the potentially long process of developing a solid concept”*



### Wire Stool

*Surface treated bent metal wire.*

The cost price for a product like this can be low compared to comparable products produced in other ways resulting in a reasonable retail price. Though the development period for construction regarding stability and production would most likely require to much time for this project.

There is no need for large investment in tooling depending on the construction, though it is possible to create designs without need of special tooling. Set-up time can result in being long depending on complexity of shape.

There is a possibility for producing a wire stool in southern Sweden and depending on volume a producer willing to produce it will most likely be possible.

Producing the product may take some time, yet the majority of time would most likely be spent on the development for getting the desired quality and result.

The stool is a popular furniture that might be at a peak of interest at the moment meaning that there is a market for it. The design is a strong point of sales for a stool which is a tool that this project poses.

The size of the stool could be acceptable if the design allows stacking.

Most likely there will be no need for additional mounting.



*“The main reason for not continuing with the idea is due to a potentially long process of trials and errors during production tryouts”*

### Wire Hat rack

*Surface treated bent metal wire and rope*

The cost price for a product like this can be low compared to comparable products produced in other ways resulting in a reasonable retail price.

There is no need for any investment in tooling and the set-up time can be kept short.

There are producers for this kind of product willing to produce a first batch.

Producing the metal frame can be done rapidly without any complex steps in the production. There might be a need for building a welding jig.

Rope can be ordered and delivered within a couple of weeks, welding the wire parts is done rapidly. Depending on the workload of the producer and the ordered volume approximately 4 weeks is a reasonable time for production from final order date.

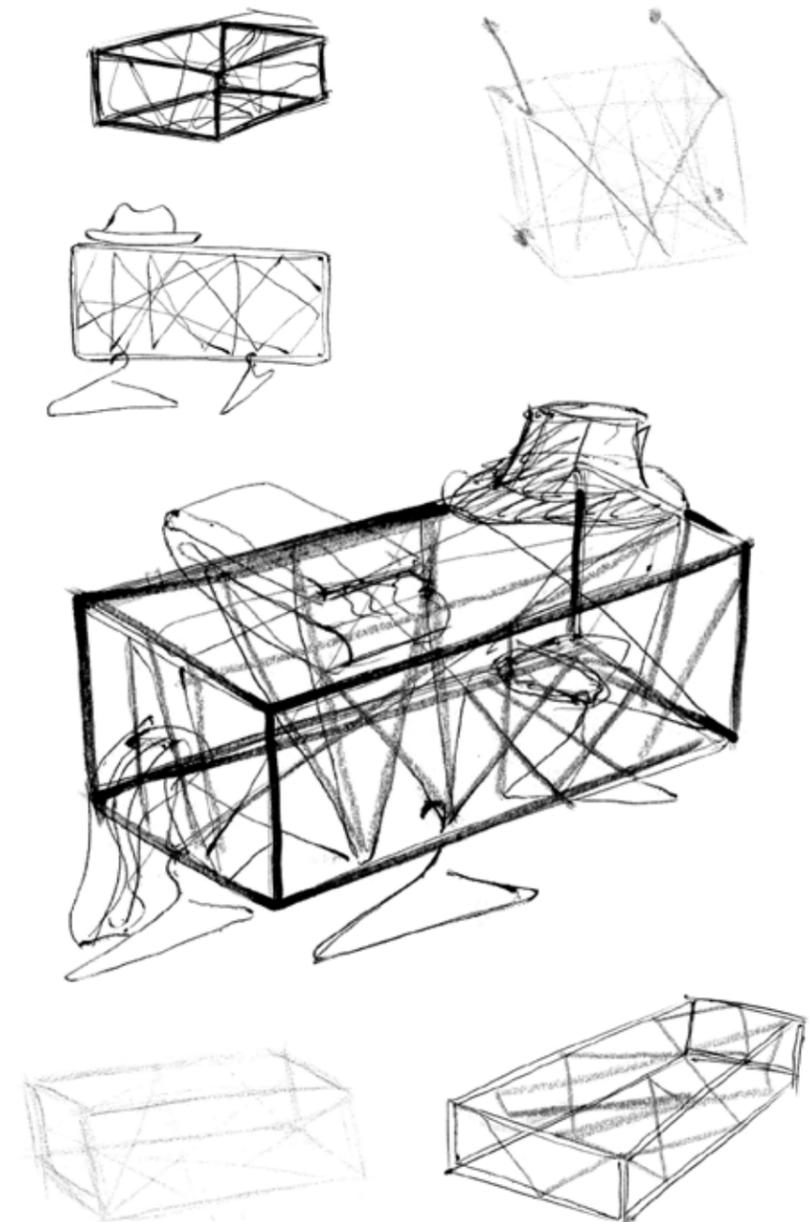
A high quality of the product can be achieved.

There is some interesting parts of the design that could make this into a strong concept.

The usability of a product like this would most likely fill its purpose in an interesting way.

The size of the hat rack could be acceptable if the design allows stacking, however this would result in mounting them before the shipping resulting in a lot of shipped air. The option would be to sell it unmounted leaving room for faults of the mounting if the consumer has to achieve the task by herself.

The size of a mounted product and the fact that a large amount of time has to be spent on every product to mount the rope resulted in this idea not being an interesting alternative.



*“The main reason for not continuing with the idea is due to a large amount of manual mounting and the size of the product”*

## Shelf

### *Surface treated bent metal wire and wood*

The cost price will result on a reasonable retail price. Somewhere between 500-1000 SEK, depending on the level of detailing and what kind of sheet material that is chosen.

There is no special tooling involved for processing wooden sheets. The wire can be bent in a NC-Bending machine.

There are producers of laminated wooden boards as well as solid wood board material in southern Sweden. The wire can also be produced locally.

There might be an issue with an order for the low volume of wooden shelves. During This project no given producer has been found. For the wire there would be no issue to produce around 1000 units and more.

The wooden boards are all produced using standard machines meaning that they can be produced rapidly. The wire brackets would take matter of seconds for the machine to produce. Depending on the work load of the producer a delivery within a month and a half of the final order date is realistic.

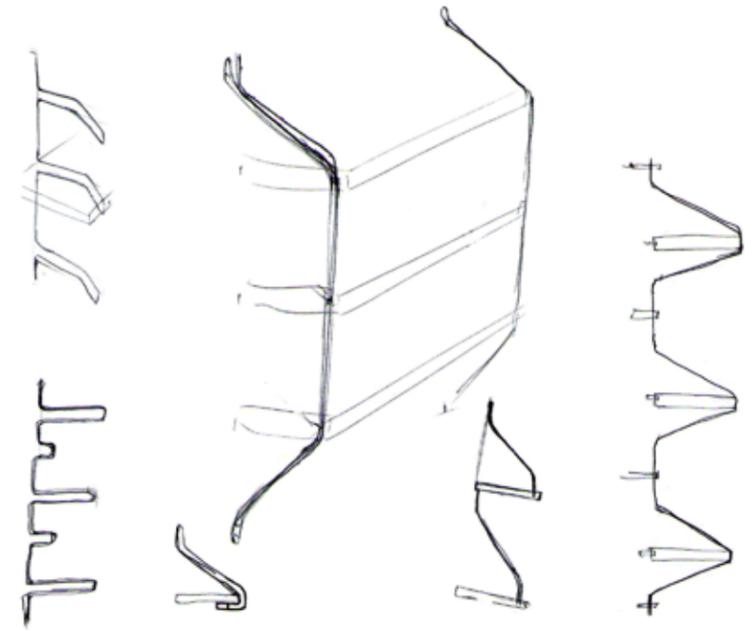
The quality of the wire parts much depend on the surface treatment. The boards can be cut in advanced ways with NC-mills however this will add to the cost price, Cutting and putting lipping on a board is standard procedure and done rapidly with high tolerances.

The shelf does definitely offer something new, the question is how realistic it is to work properly and not being a hassle to mount to the wall.

The size and weight of this product combined with many uncertainties regarding the

functionality where the reasons for not continuing with the product but also factors such as not finding a suited producer for the boards is a consideration taken in to account.

The product would be delivered unmounted and does not need any additional mounting.



*“The main reason for not continuing with the idea is due to the functionality of the product and potentially long process of developing a solid concept.”*



### Magazine rack

Surface treated bent sheet metal and rope/leather handle.

This idea results in a lot of rest material and a large amount of sheet is needed for one unit resulting in a maximum cost price for me being able to motivate the product without selling story or brand to back it up.

The product is complicated to bend and would need a special tool for bending the sheet. The price for the tool would be around 30.000 SEK Resulting in that a small batch would not cover the expenses for the tool. The product would have to be produced in more than 3000 copies for breaking even with the tool investment. With a goal of producing the unit in 3000 copies the investment for tooling would only be approximately 4% on the production costs.

There are producers in Sweden that could produce the product and willing to produce a low volume however the unit price will be high.

The product would take only a few minutes to produce meaning that a production run of a couple of hundred could be produced within a week including downtime and organising the parts between the different steps of production. However the workload of producers often means waiting before they get started and a delivery date within 6-7 weeks from the order till delivery is likely.

A laser cutting machine works with high tolerances and with a which layer of powder coating on the product a very high quality product can be achieved.

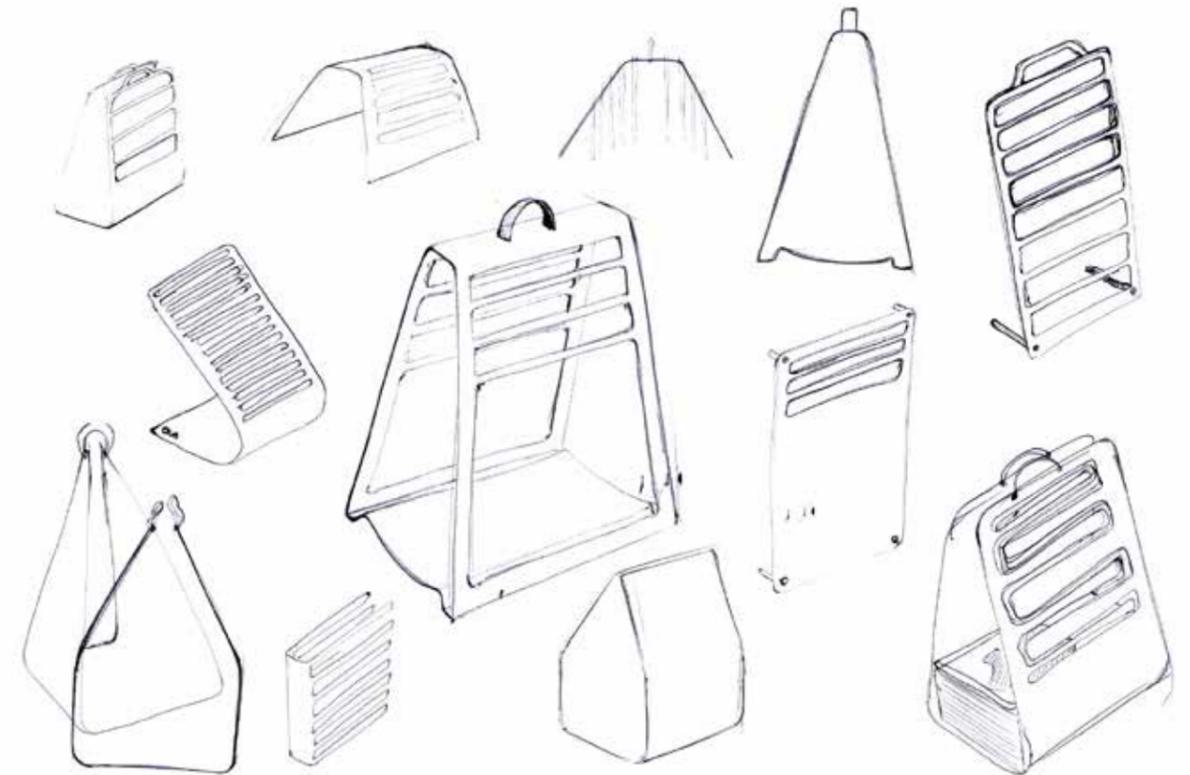
Research has shown is that no similar magazine racks are available meaning that is has a chance of standing out. Though

many of the changes that could be made to lower the production costs would also ruin its form identity resulting in the choice in not continuing with the product.

An earlier version of this product has been made and used for several months showing that it functions very well.

The size of the product results in that a stackable version is needed being able to store it at home. This resulting in it loosing some of its functionality.

A small step in additional mounting is needed for putting the handle in place though this is a short step and could be done easily.



*“The main reason for not continuing with the idea is due to the production possibilities, the amount of rest material and the design changes that needs to be done to make it into a solid concept”*



### Coat Hanger

*Surface treated bent sheet metal.*

This idea results in a lot of rest material and a large amount of sheet is needed for one unit resulting in a maximum cost price for me being able to motivate the product without selling story or brand to back it up.

There is no need for special tooling but there might be a need of a welding jig.

There are producers in Sweden that could produce the product and willing to produce a low volume however the unit price will be high.

The product would take only a few minutes to produce meaning that a production run of a couple of hundred could be produced within a week and a delivery within 6-7 weeks.

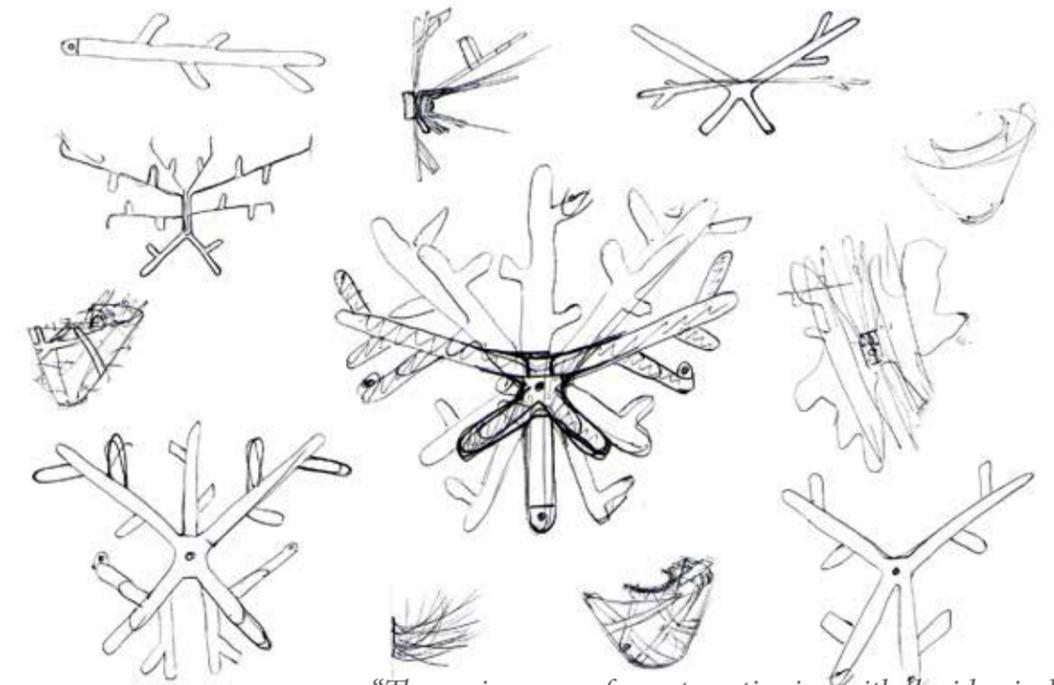
A laser cutting machine works with high tolerances and with a thick layer of powder coating on the product a high quality can be achieved.

Research has shown that there are similar hangers on the market resulting in that it might be hard to stand out with this hanger.

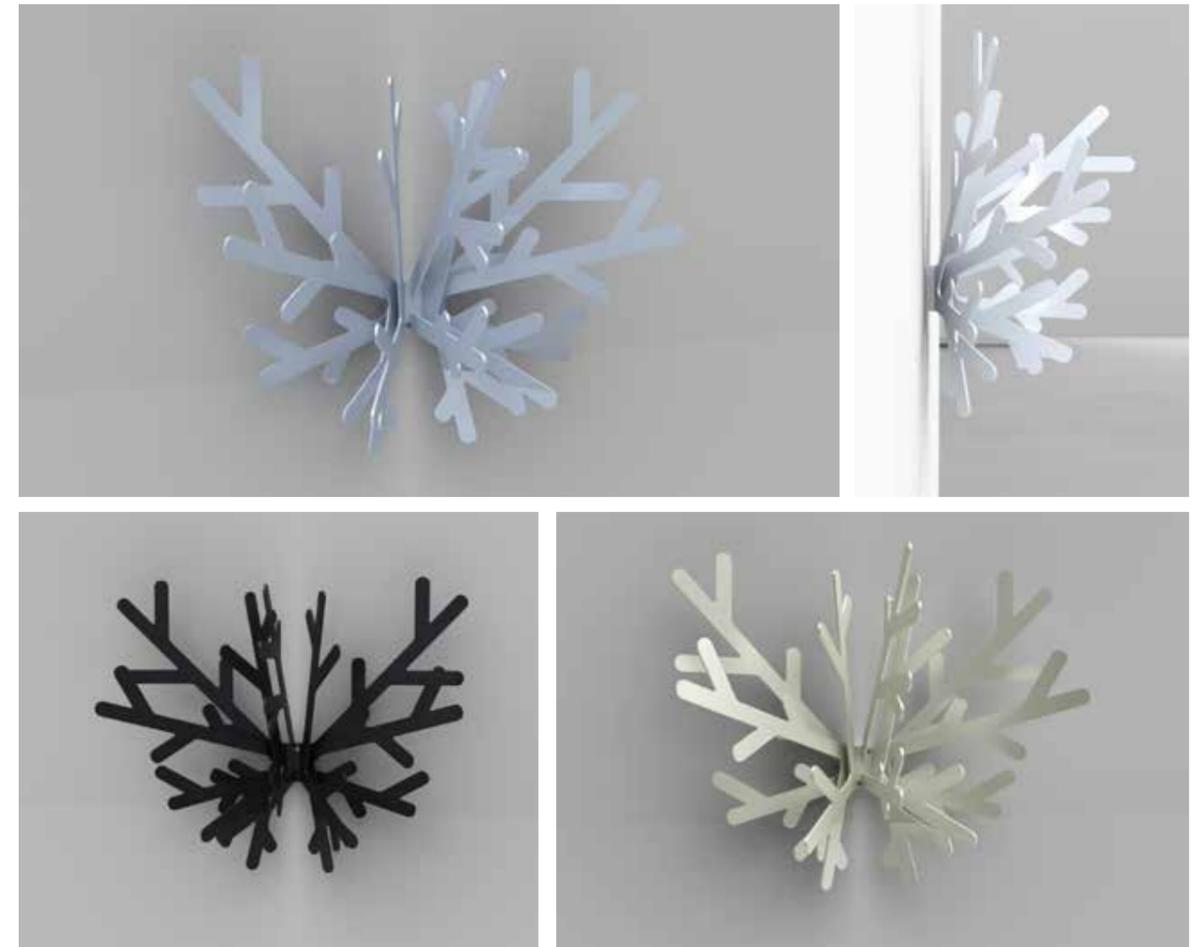
A prototype of this product has been made and used, showing that it functions very well regarding all aspects such as quality and functionality.

The size of the product could fit the limitations in storage space as long as it is kept unmounted.

The product is mounted by the end user resulting in no additional mounting.



*“The main reason for not continuing with the idea is due to that similar products are produced and sold on the Swedish market.”*



### Bed table

*Surface treated bent metal wire and wooden board material.*

With estimations this idea could be produced with a reasonable cost price depending on choice of wooden boards.

There is no need for special tooling for the boards or the metal wire.

There are producers in Sweden that could produce the a low volume of the metal wires however no good source for producing the boards have been found and that is the main reason for not continuing with the product.

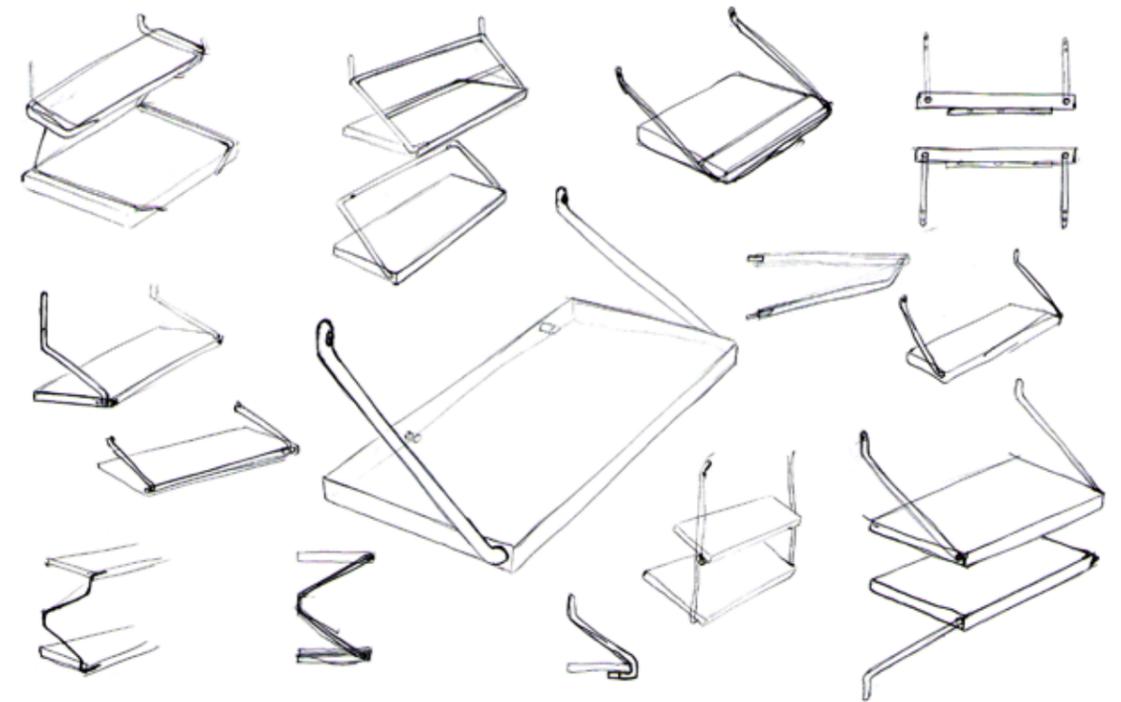
The product could be produced rapidly with standard tooling. The boards can be produced in various materials and therefore different levels of quality can be achieved.

Market research has shown that there are many bed tables on the market however the contemporary design area has openings for a bed table like this to sell. The concept as it is provides no new aspects of a bed table and therefore the looks is what will be the biggest point of sales for this product.

No prototypes have been made and there are some questions regarding the functionality of the product regarding mounting it to the wall.

The size and weight of the product could fit the limitations in storage space as long as it is kept unmounted.

The product is mounted by the end user resulting in no additional mounting.



*“The main reason for not continuing with the idea is because no producers fitting the project was found during the visits”*



## Hanger

*Surface treated lathed metal, screws and rope*

With estimations this idea could be produced with a reasonable cost price based upon material costs, machine costs and set up-time.

There is no need for special tooling, The screws are standard, the hooks can be lathed in an NC-controlled lathe with standard cutting tools and the rope can be ordered from standard dimensions.

There are producers in Sweden that could and are willing to produce a low volume of the metal hooks.

The hooks could be produced within a couple of minutes per unit resulting in a rapid production and they can be surface treated with powder coating resulting in a durable high quality part.

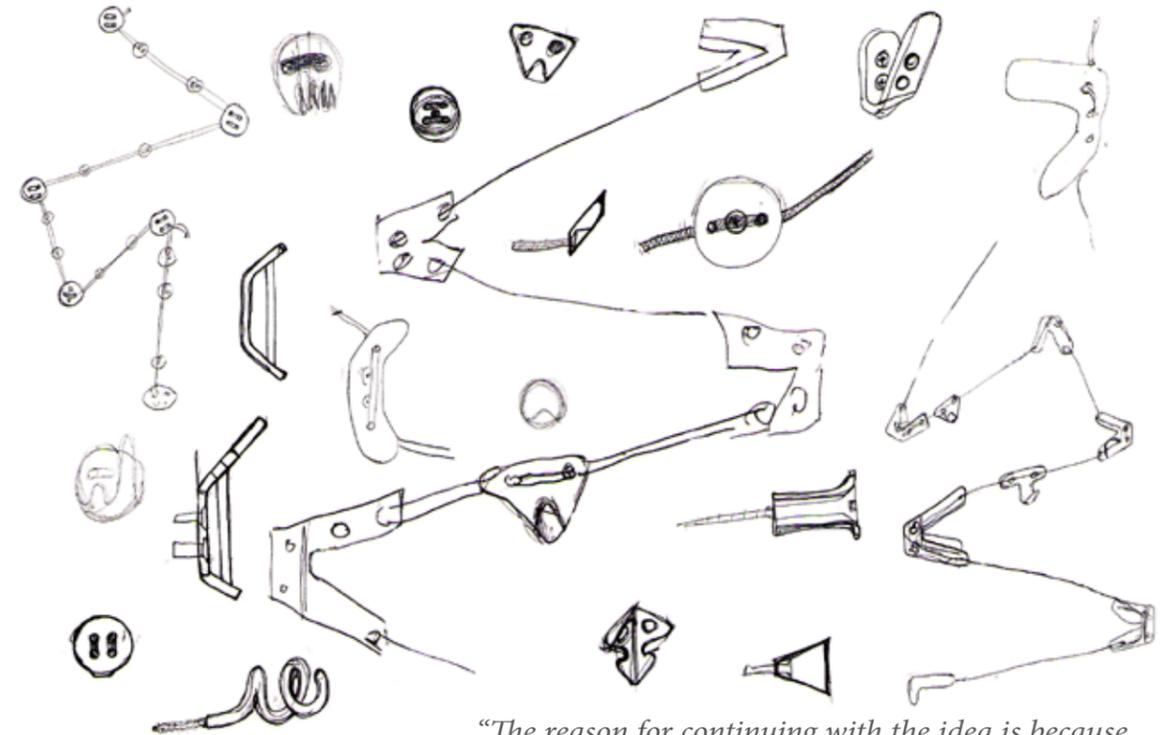
Market research has shown that there are no hangers done with the same solution. The concept provides hanging clothes and accessories in an efficient way with a freedom of the users imaginations when mounting on the wall resulting in that the product provides something extra.

Prototypes have been made and the functionality of the product is good, however there are some questions about mounting the hooks on the wall. In short there are 7 screws that are to be screwed in the wall. A person with basic knowledge in mounting a screw with the use of an electric drill and a screwdriver could solve the mounting easily.

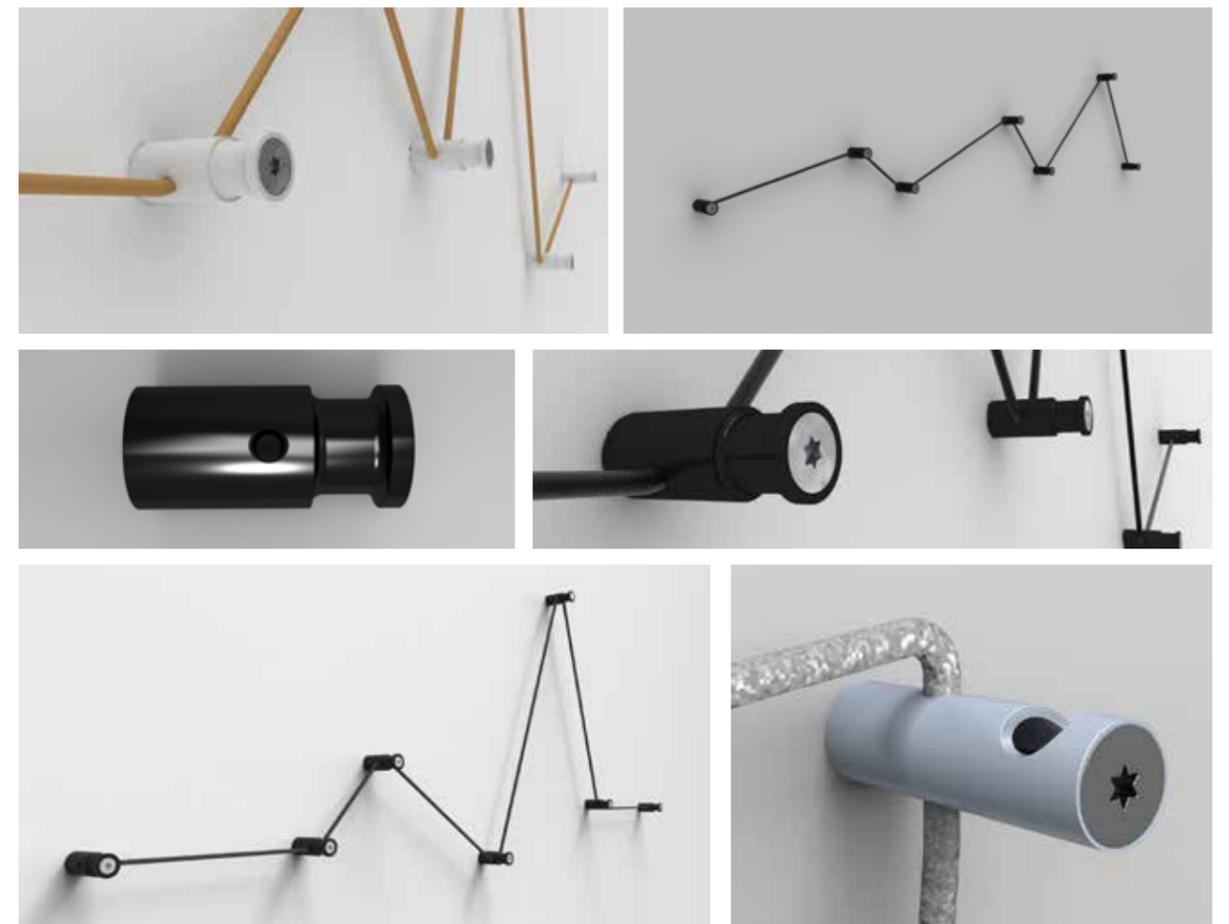
The size and weight of the product does fit the storage limitations. The product can be packed and sold in a small box.

The product does need some additional mounting but with estimations this can be done relatively rapidly.

The product does not contain any obvious reasons not to carry on working with the solution and therefore more time was spent on it.



*“The reason for continuing with the idea is because that it follows all the aspects set up for the project”*



### Wall hung Valet stand

*Surface treated, bent and welded metal wire.*

With estimations this idea could be produced with a reasonable cost price based upon material costs, machine costs and set up-time.

There is no need for special tooling. A welding jig is needed for the procedure of welding the screw holes onto the wire.

There were questions regarding the possibility of bending the complex shape however some correspondence with a potential producer clarified that it is possible to produce and that they are willing to produce a first batch.

Bending the wire could be produced within a couple of minutes per unit resulting in a rapid production the screw holes are welded in the wire manually and therefore adding some time to production.

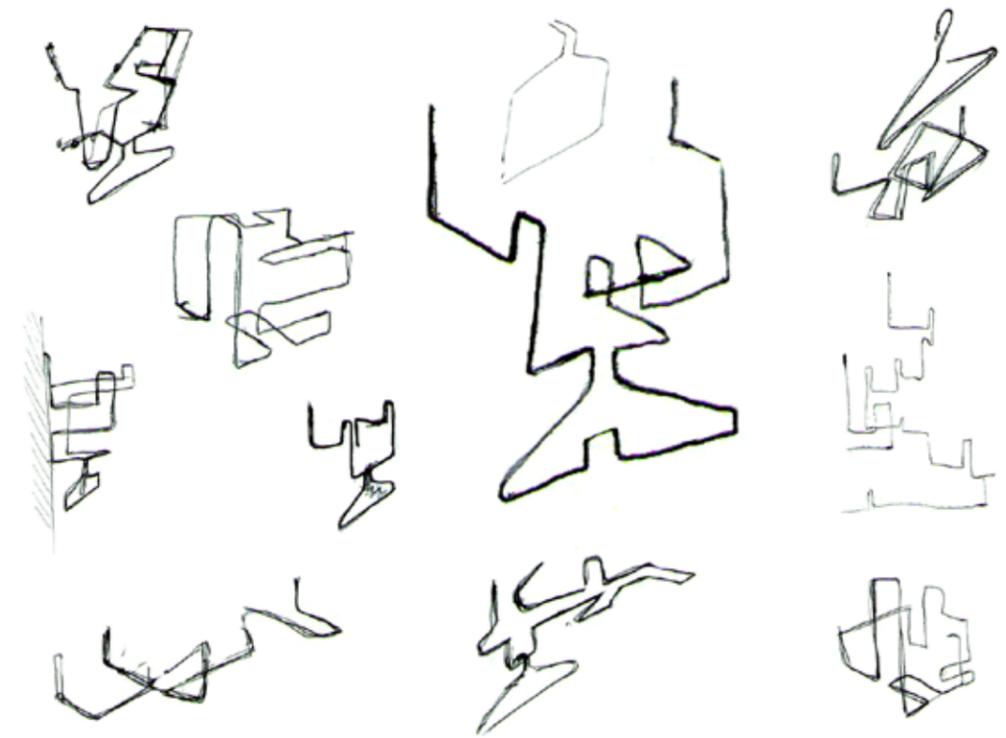
Market research has shown that there are no hangers done with similar design solutions. The concept provides hanging clothes and accessories in an efficient way with an added iconic shape revealing its purpose.

No prototypes have been made and the functionality of the product is not yet tested, though with the simple use and purpose of the product a first positive decision of continuing working with the product is done.

The size and weight of the valet stand does fit the storage limitations if it is possible to stack the stands.

The product does not require additional mounting and is ready to be sold as it is.

The product does not contain any obvious reasons not to carry on working with the solution and therefore more time was spent on it.



*“The reason for continuing with the idea is because it has a great chance of following all the aspects set up for the project”*



PRODUCT IDEA EVALUATION  
SUITABLE FOR BATCH PRODUCTION

	Retail price <i>Reasonable or not</i>	Feasibility <i>for production</i>	Build quality <i>Possible by producer</i>	Time <i>Development/Production</i>	Producer <i>willing or not</i>	Concept strength <i>Sellable</i>	Functionality <i>of the product</i>	Storing <i>Size of product</i>	Mounting <i>Time</i>
Coat Hanger <i>Sheet Metal/Rope</i>	● ● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	●	● ● ● ●	● ● ● ● ●	● ● ●
Magazine Rack <i>Metal Wire</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	●	● ● ● ●	● ● ● ● ● <i>Depending on if stackable or not</i>	● ● ● ●
Salt & Pepper Containers <i>Metal Tube</i>	● ● ●	● ● ●	● ● ● ● ●	● ●	● ●	● ● ● ●	● ● ●	● ● ● ● ●	● ● ● ●
Side Table <i>Metal Wire / Wood</i>	● ● ●	● ● ● ● ●	● ● ● ●	●	●	● ● ●	● ● ●	●	● ● ● ●
Flower Pot Holder <i>Laminate/Metal wire</i>	● ●	● ● ●	● ● ● ● ●	● ● ●	● ● ● ●	● ● ● ●	● ● ●	● ● ● ● ●	● ● ●
Stool <i>Metal Wire</i>	● ● ● ●	● ● ●	● ● ● ●	●	● ● ● ●	● ● ●	● ● ● ●	● ●	● ● ● ● ●
Hatrack/Hanger <i>Metal Wire/Rope</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ●	●	● ● ●

	Retail price <i>Reasonable or not</i>	Feasibility <i>for production</i>	Build quality <i>Possible by producer</i>	Time <i>Development/Production</i>	Producer <i>willing or not</i>	Concept strength <i>Sellable</i>	Functionality <i>of the product</i>	Storing <i>Size of product</i>	Mounting <i>Time</i>
Shelf <i>Metal Wire/Wood</i>	● ● ●	● ● ●	● ● ● ●	● ● ●	●	● ● ● ●	● ●	●	● ● ● ●
Magazine Rack <i>Sheet metal/Leather or string</i>	●	● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ●	● ● ● ●
Coat Hanger - Birdsnest <i>Sheet Metal</i>	●	● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ● ●	● ● ●	● ● ● ●
Bed Table <i>Laminate/Wood/Metal wire</i>	● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ●	●	● ● ●	● ● ●	● ●	● ● ● ● ●
Hanger <i>Metal Tube/Rope</i>	● ● ● ● ● <i>Depending on producer</i>	● ● ● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ● ● <i>Depending on producer</i>	● ● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ●
Valet Stand <i>Metal Wire</i>	● ● ● ● ●	● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ●	● ● ● ● ●

## PART 4: SUM-UP

### PRODUCT IDEAS

Some of the products can be ruled out quite easily and other needed to be evaluated for seeing the possibilities of the idea or not.

The aspects of retail price was dealt with by realistic thinking. How much is the product worth for the potential customer.

Figuring out the set up time and initial costs where done by looking back at the information extracted from the meetings or further correspondence with the producers.

Since most of the ideas where based upon the production possibilities at the visited producers, the possibility of producing the product in southern Sweden was known.

The information regarding if a producer is willing to produce a small batch is based upon what they have told me but also on the further correspondence. Some producers gave different answers at different times regarding their will of producing small batches.

Conclusions that can be drawn is that there are connections in size of company and the preferred volume of a batch.

The production time and deliveries are based on what the producers told me during the visits.

The facts regarding the tolerances and quality of production is based upon the literature as well as by examining products that the different producers produce.

Design aspects where based upon knowledge gained from the five years of studying industrial design and discussions with various contacts.

Aspects on storage volumes and need of additional mounting was based on volume

and weight of the ideas and whether enough storage space could be arranged, following the budget.

Not all projects have the same aspects therefore it is important not to consider the aspects as the only way. Yet they can function as guidelines when figuring out aspects for another project.

Many of the products where evaluated from the first sketches others where tried out with prototypes. The reason for such a short amount of time spent of every product was the tightly scheduled project frame where short focused time was planned for generating the ideas.

Decisions had to be made quickly in order for the production being able to be executed in time.

If I were to redo the schedule for the project, I would not include the production within the time frame rather put more focus on the ideas and really take time for deeper analysis of all the important aspects for the products before taking the final step towards production.

# PART 5

## PRODUCING THE PRODUCTS

In order to end up with reasonable products some time was spent on the development of the product. The additional time spent included final cost calculations and functionality checks and changes.

In line with my methods more details regarding the process of presenting the product ideas to Designorget was made and further correspondence with potential producers to prepare the products for production was carried out simultaneously as developing the final ideas into feasible products.

## THE PRODUCTS

### HANGERS AND HOOKS

Working with products that already solve a recognized problem was needed due to time limitations.

Many of the ideas that occurred in the ideation phase are accepted products in that scene that people do use products like them.

When visiting some of Designorget's shops I realized that products like hangers and hooks already are in a competitive product category. There are many kinds of hangers and hooks at Designorget however it does not necessarily mean that it is a bad thing.

Since products that doesn't sell well are not sold for long at Designorget and most of the hangers and hooks that they do sell have been around for some time, meaning that they do sell and it could be a typical product that they sell well of.

However the products that the ideation phase brought and that turned out to fit this project the best was the Hook-solution: Connect The Dots, and the wall hung valet stand: Väggbetjänt.

The many aspects that had to be considered resulted in a strategic approach to choosing the products to produce in a batch.

The reason for producing two objects in the end where that the budget allowed a total number of approximately 400 items to be produced of a cost price below 100 SEK.

200 units of one item seemed like a good amount to try out the products on the market without making large investments.

Not really daring to invest all money into one product that has been developed in a very short time and set back of some sort may possibly occur.

Another factor is not ending up with to

small orders for the producers and therefore still being able to motivate the producers to produce a first batch of the objects.

The research has shown that producers are willing to take on larger production runs rather than small batches, therefore it's important to consider what the producer is willing to accept regarding production volume.

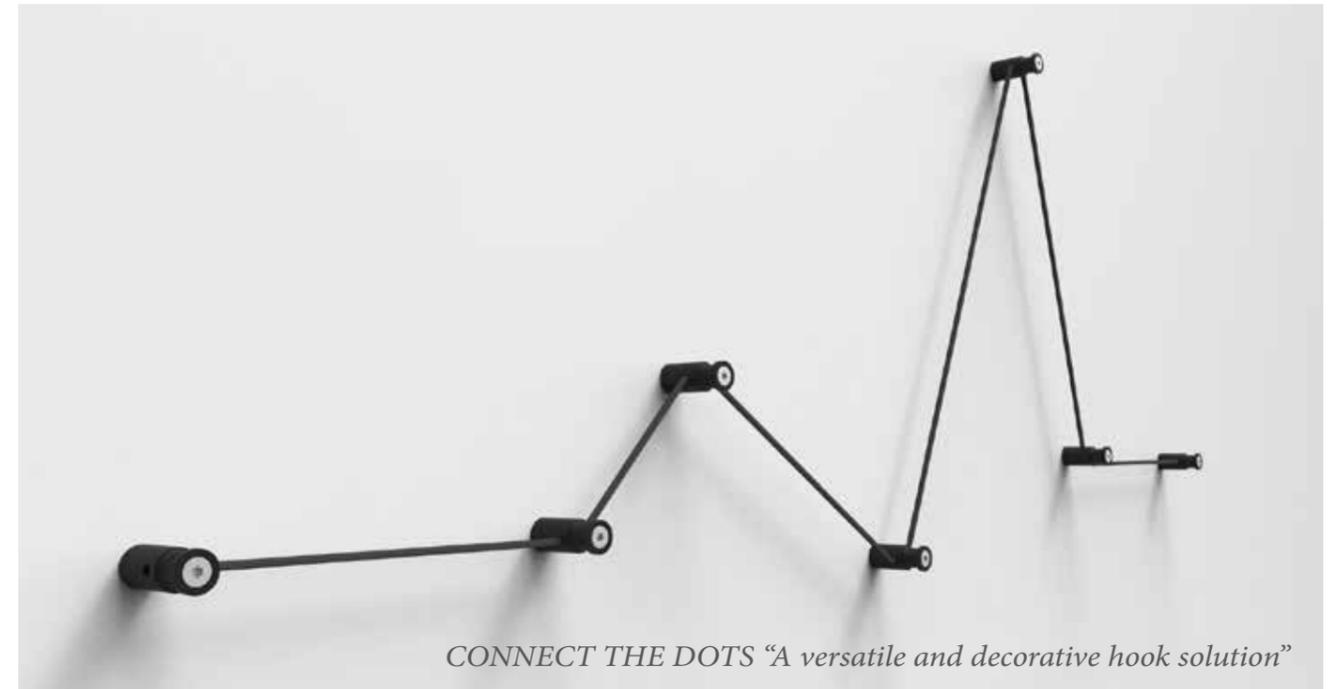
The third and the most important factor for the choice of producing two products was to cover more than one process and since there is a big difference of the products when it comes to production it felt right to carry on with both of them.

From the visits a producer for the valet stand was already set, remaining questions were however if the machine could do the complicated action of bending it, how long it would take for the producer to get it ready for production and how long the production would take.

Connect the dots required more work to be able to be possible to produce, first off the price had to be reduced with 100% which at first seemed unrealistic, however it showed to be a matter of finding the right material and the right producer.

Secondly the new producer had to be contacted for a new quote in order to know if the product could be motivated regarding price and if the producer was able to produce it in time.

A rope manufacturer had to be contacted to find a suitable rope. Finding screws, packaging and solving some technical issues with the product to be able to carry on with the idea also had to be done.



CONNECT THE DOTS "A versatile and decorative hook solution"



VÄGGBETJÄNT "A wall hung one wire clothes hanger"

## CONNECT THE DOTS

### PROCESS

Connect the dots was generated from the basic idea of connecting hooks with rope, opening up another dimensions to the product. The rope also functions as a decorative part of the product creating graphical patterns on the wall that it is mounted on.

At first the idea seemed too simple to not have been done before. Surprisingly no similar product have been found.

Prototypes where built and evaluated. It took some try-outs in finding the right length of the hooks and stating the right distance of the rope from the wall.

A producer was contacted to get price estimates. The price resulted in being to high for the product to be motivated. Though after speaking with various contacts a second reconsideration was done and hopes of finding the right price and the right producer was born.

Simultaneously as new contacts where contacted for quotes other ideas providing similar solutions where tried out though none of the other ideas where satisfying.

Correspondence with one of the new producers gave information of that the thought production method of processing a metal tube was not the cheapest way, instead processing a solid pole of Aluminium would achieve the lowest price and the large demand of a price drop for the parts was achieved.

Using pole also provided the chance of having a larger diameter of the hook, this enabled the hook to be designed to function better as well as having a larger contact area to the wall when mounted.

A final technical drawing of the part was sent out to the producer in order for a final quote and an order could be made.

Before the order was made a quote for powder coating the hooks was asked for by a producer in Malmö and it met the expectations. The chance was also given preparing them for that the hooks would arrive at them within six weeks giving them a chance to prepare for the 1400 parts.

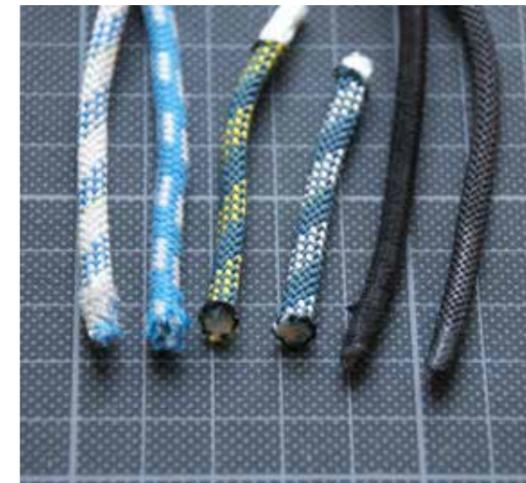
Finding the right screws for the product was done by buying various sized screws. The screw had to be big because of the way that the hanger is constructed, the screws will have to withstand pulling forces in many directions, however the screw can not be too big since the rope shall fit around the screw inside the hook.

The threads on the screws also had to be considered, talking to people in various hardware stores made me realize that wooden screws are the ones that are the best suited for the product. They function very well with wood, as well as with plastic dowels in hard walls such as concrete or brick.

After trying out the different screw options a decision to use a standard wooden screw with the dimensions of 80 x 6 mm was made.

Since the head of the screw is a part of the design finding screws that looked good and had the right size was a challenge.

Finally a good option was found in a hardware store. The price of the screws was below the wholesale price of the other options that was found resulting in buying them without hassle directly from the store at their retail price.



The screws were tested and turned out to function best of all the options that was tried.

During the process of trying out prototypes the rope that was used was not a good option since the quality was questionable.

In the process of finding a rope supplier. A company in Göteborg was found. The company produces high quality sailing ropes.

A visit at their office in Göteborg provided me with some rope options. The ropes were tried out on a prototype and they functioned well. A consideration in using elastic ropes was made though after a try-out it showed not to function in a preferred way.

During the visit to the office of the rope supplier a discussion regarding fastening the rope to the end hooks was brought up. The ideas of using a knot, burning the rope into a lump in the end or using a needle/nail to lock the rope were all options discussed. After try-outs a needle seemed to solve the problem best.

The product is small and contains many parts therefore some kind of packaging is needed.

Options of producing special boxes for the product was considered however the process of designing and ordering would be too time consuming for the project resulting in pre-made boxes was the best option.

Many packaging suppliers were contacted. In the end it resulted in ordering white boxes from an internet based office equipment store.

The store provided a variety in boxes that could fit the product. The prices were within the budget.

A product info leaflet and a label for the packaging was printed on my home printer for this small batch.

Finally all the dots were connected and all the parts were ordered awaiting to be assembled.

Assembling the prototype took approximately 3 minutes resulting in 10 hours for the full batch, however since I can do it myself no extra costs have to be added to the end price.

## CONNECT THE DOTS

### FINAL COST CALCULATIONS

#### Final Cost-price;

Hook  $(8,8 + 3,3) \times 7 = 84,7$

Rope  $2,58 \times 1,8 = 4,7$

Screws  $0,556 \times 7 = 3,9$

Needle  $0,3 \times 2 = 0,6$

Ash, info, label  $3,95 + 0,65 + 0,2 = 4,8$

#### TOTAL :

= 98,7 SEK

sold to designtarget for 189 SEK

Retail Price  $\approx 316 + \text{VAT} = 395,-$

#### Margins:

Designtarget retail price:  $316 + \text{VAT (25\%)} = 395$

Earnings/sold:  $60\% \text{ of } 395 = 237$

$237 - \text{VAT (25\%)} = 190$

$190 - 99 \text{ (costprice)} = 91$

Margin of 91 SEK/sold product

#### Total production costs of 200 products

19740 SEK for parts

Mounting/Packing time/unit 3 minutes

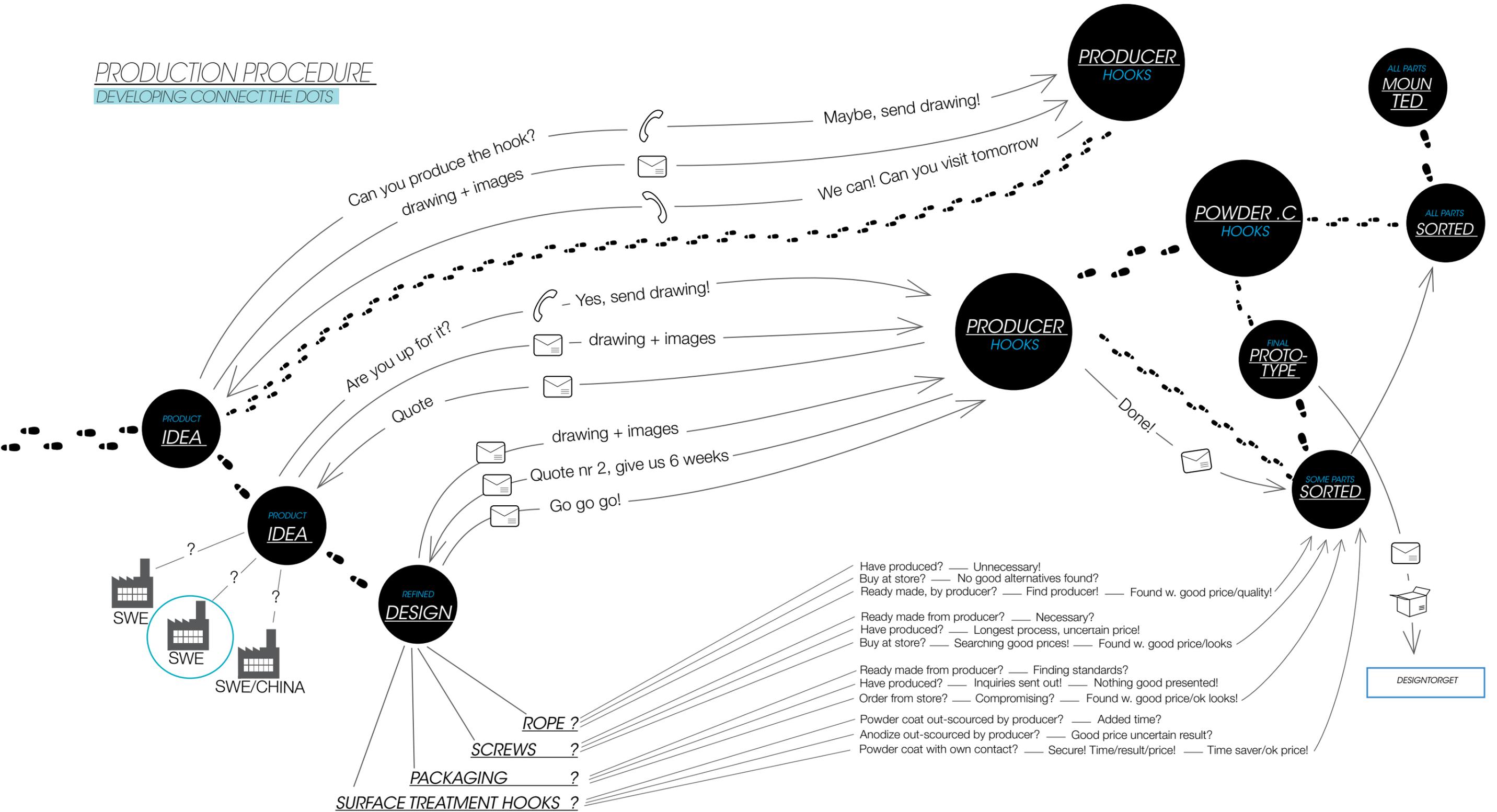
Total 200 Units  $\approx 10$  Hours

Other expenses (fuel, development purchases)

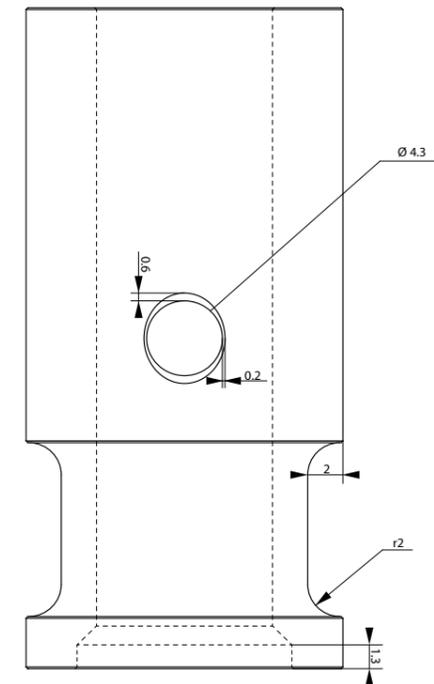
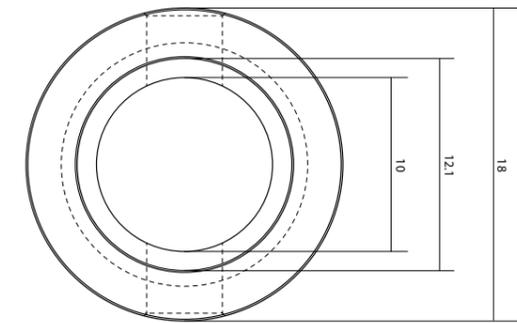
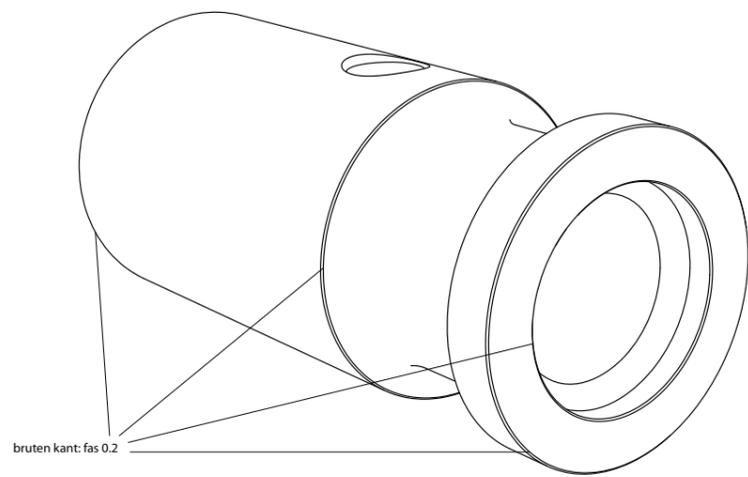
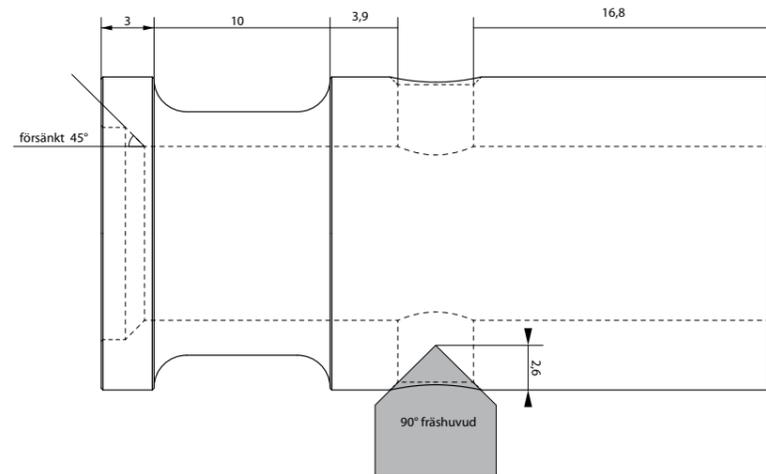
Approx. 400 SEK

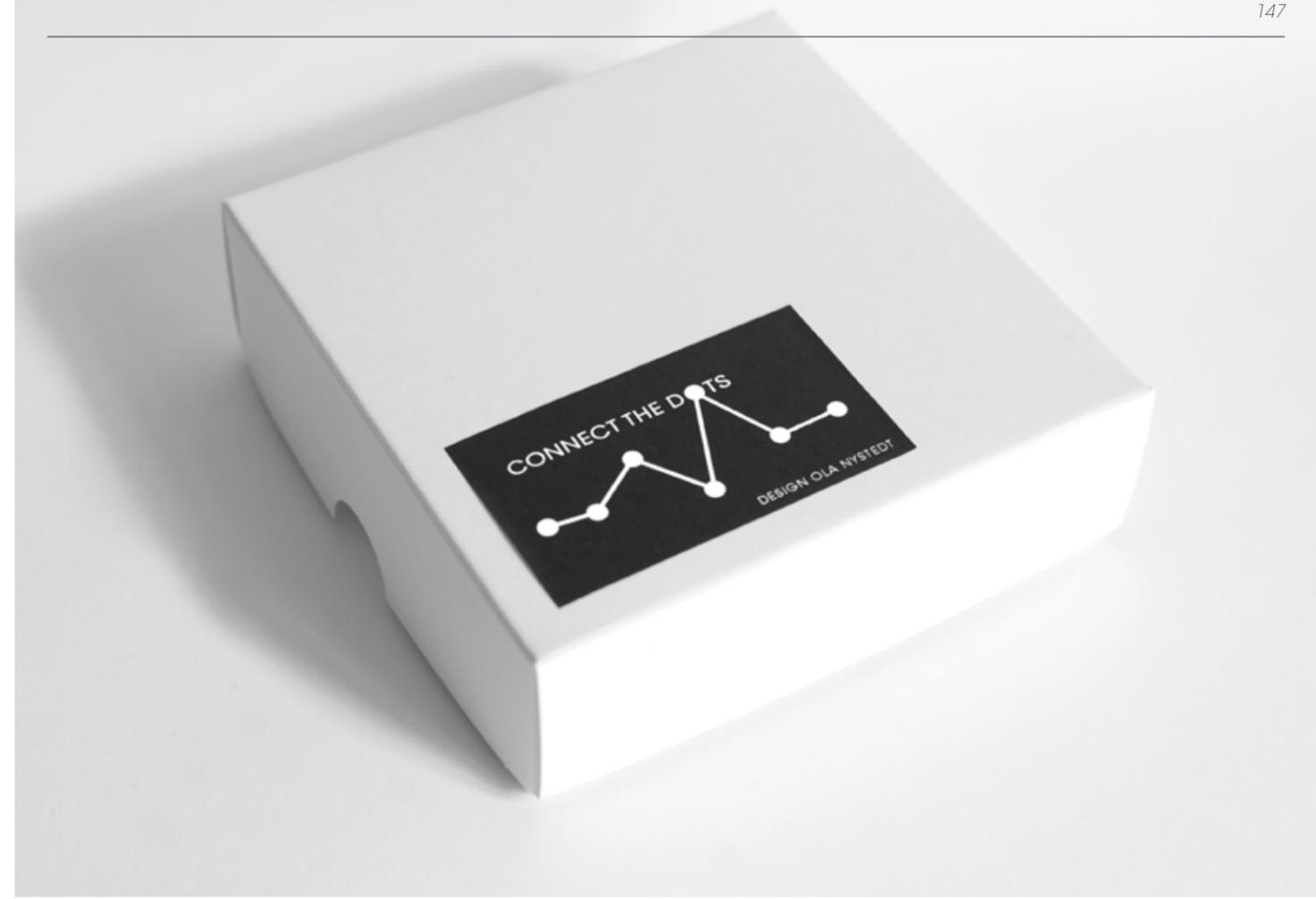
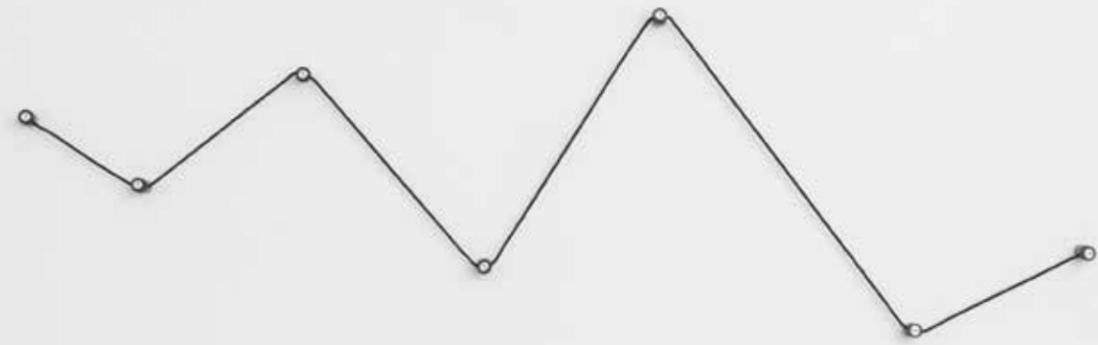
# PRODUCTION PROCEDURE

DEVELOPING CONNECT THE DOTS



PRODUCTION UNDERLAY  
 DEVELOPING CONNECT THE DOTS







## VÄGGBETJÄNT

### PROCESS

From the conclusions made regarding methods that could fit this project Wire bending was the obvious solution, however no good idea was generated for a long time.

With the method set, looking at what had been done and what can be done was important. What are the limitations and the possibilities of bending wire?

The idea of the valet stand came from not succeeding in keeping the price low on the birdsnest hanger. Having the same problem but using other material. Could wire be bent in a way providing solutions for hanging clothes on the wall whilst looking interesting?

Different solutions were tried out by bending thin metal wire in small scale prototypes. Trying to come up with designs that stick out from others on the market.

With a few alternatives the form was tried out by building a CAD model.

A producer was called and asked if the valet stand could be produced with their machines. The producer thought so and a drawing and bending coordinated were sent to them for them to try out the possibilities to produce it.

A meeting was then arranged to discuss the outcome and clarifying shape, size and surface treatments.

The prototype that had come out of their try-outs was not great. They had to cut the wire in two parts and weld them together. It looked ok but not great.

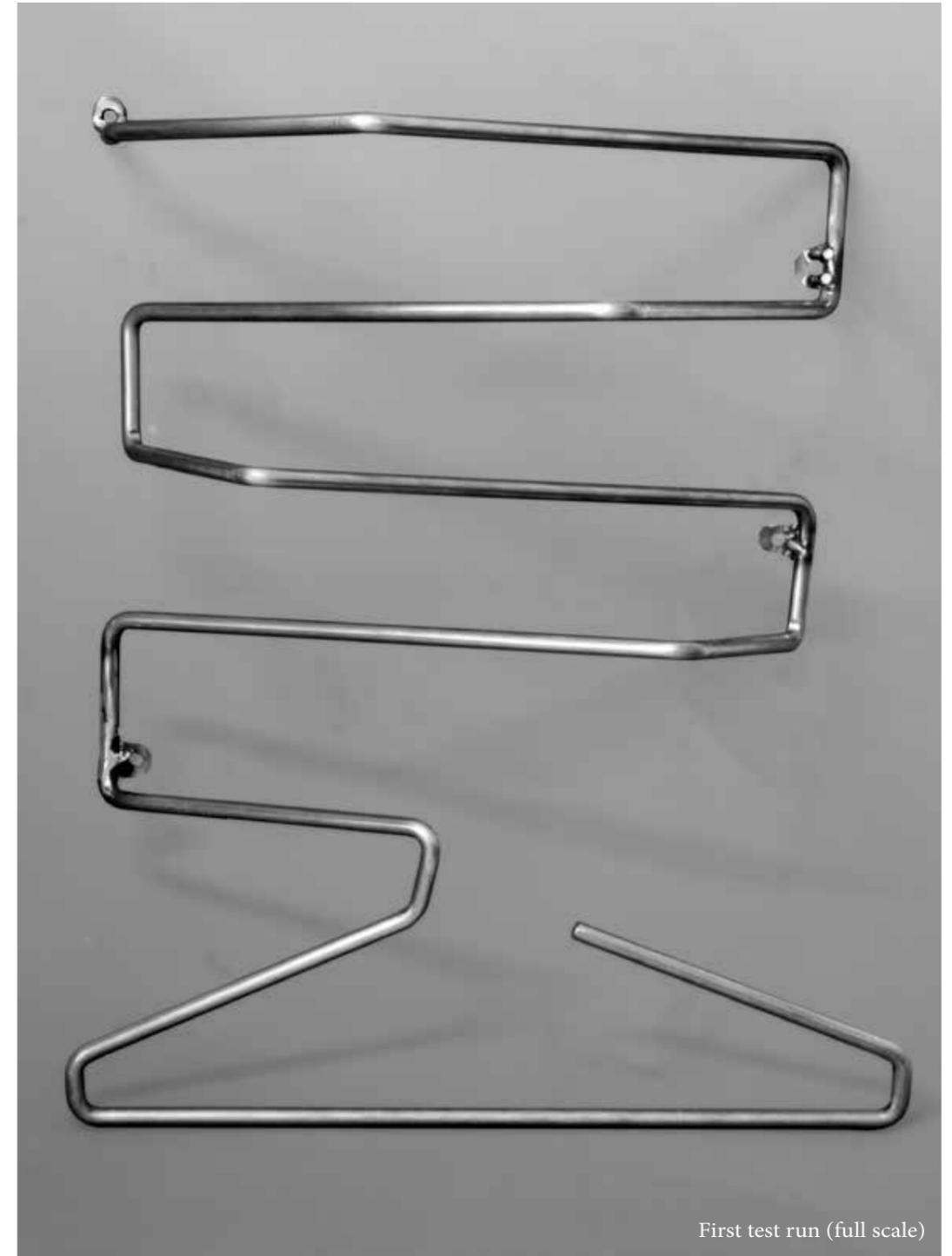
A discussion was held regarding what could be done to change the design to make it possible to produce the stand in one single

part. Some good solutions came out of it and it was back to the drawing table.

Prices were also discussed and it resulted in that the information that was collected in the beginning of the project gave result. The actual cost price of the hanger cohered to the calculations done when designing the product.

The chance of defining the shape was taken for the second round and the outcome from the second round turned out as I wanted it.

Due to time limitations a small test run of 10 units was produced. This was enough for calculating the final price, finding packaging solutions and sending one of them to Designtorget.



First test run (full scale)

For better storing and shipping possibilities the Valet stand is constructed to be stackable. Therefore something preventing scraping between the products when stacked is necessary.

Looking at other wire products and their packaging led me to the idea of packing them in a plastic bag that is closed shut by folding a paper over the opening and staple the paper and bag together. This letting the products to still be stackable and the folded paper works as an area where product info can be printed.

When production, surface treatment, and packaging all was decided all the parts where ordered awaiting to be packed and sent to Designtorget.

Packing the valet stand into a bag, folding the paper and stapling the bag shut took two minutes per unit resulting in 6h 40 min for the full batch. This is something I can do myself thus adding no extra costs.

## VÄGGBETJÄNT

### FINAL COST CALCULATIONS

#### Final Cost-price;

Setup-cost/unit 200pcs ≈ 20/unit

Material: (wire, 4x loops) ≈ 25

Welding jig/welding ≈ 10/unit

Powder coating / Zinc coating ≈ 20

Packaging bag/folded paper ≈ 7

**TOTAL :**

= 82 SEK

sold to designtorget for 164 SEK

**Retail Price ≈ 316 + VAT = 395:-**

#### Margins:

Designtorget retail price: 316 + VAT (25%)  
= 395

Earnings/sold: 60% of 395 = 237

237 - VAT (25%) = 190

190 - 82 (costprice) = 108

Margin of 108 SEK/sold product

#### Total production costs of 200 products

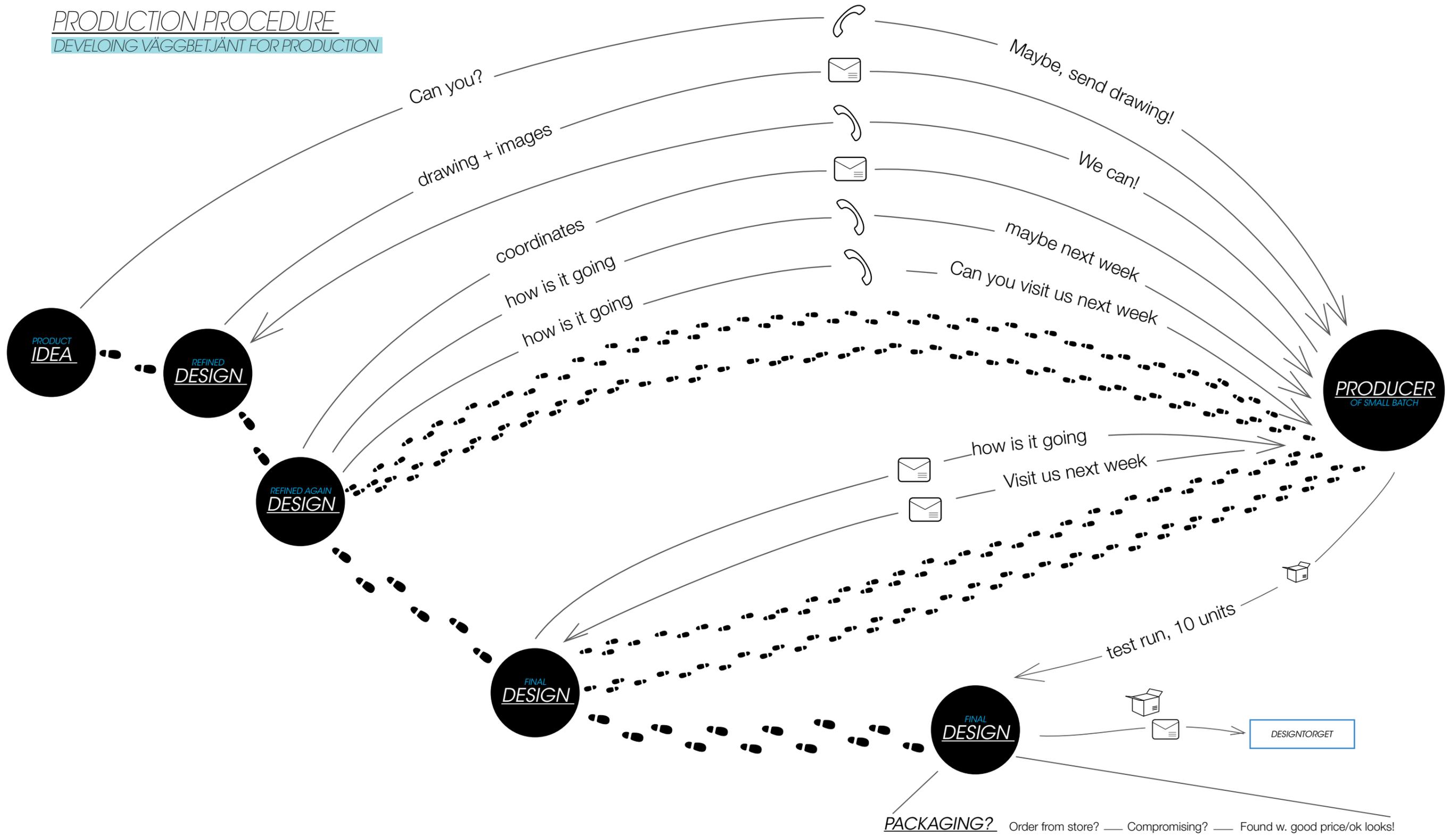
16400 SEK for parts

Mounting/Packing time/unit ≈ 2 minutes  
Total 200 Units approximately ≈ 6 hours 40 minutes

Other expenses (fuel, development purchases) ≈ 1500 SEK

# PRODUCTION PROCEDURE

DEVELOPING VÄGGBETJÄNT FOR PRODUCTION



PRODUCTION UNDERLAY  
 DEVELOPING VÄGGBETJÄNT

Koordinater Herrbetjänt\_\_3.0 (Uppifrån o ner)

Dim. 10mm

Verktygsradie 9,5 på samtliga krökar

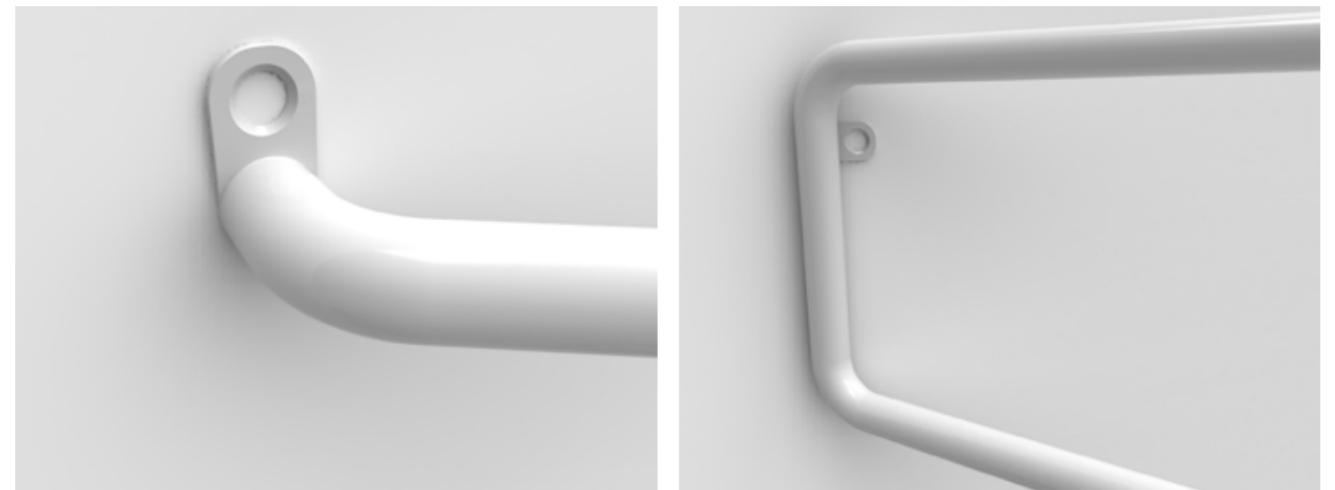
Referensmått:

höjd mot vägg cc270

bredd mot vägg cc400

bas galge cc420

- 1: 600.788,239.765,457.943 (Start Fasning 2mm)
- 2: 600.788,224.765,457.943
- 3: 494.560,155.765,457.939
- 4: 329.004,155.765,457.939
- 5: 211.788,234.765,457.943
- 6: 211.788,234.765,367.943
- 7: 309.551,116.765,367.968
- 8: 514.009,116.765,367.924
- 9: 611.788,234.765,367.958
- 10: 611.788,234.765,277.930
- 11: 531.788,81.765,277.941
- 12: 291.788,81.765,277.941
- 13: 211.788,234.765,277.942
- 14: 211.788,234.765,187.943
- 15: 376.788,147.066,166.380
- 16: 376.788,140.066,144.380
- 17: 201.788,137.989,84.039
- 18: 201.788,140.069,60.380
- 19: 621.788,140.069,60.380
- 20: 621.788,137.989,84.039
- 21: 448.843,140.073,144.366 (Stop Fasning 2mm)







## DESIGNTORGET PROCEDURE

### CONNECT THE DOTS & VÄGGBETJÄNT



Designtorget offers an easy way of applying, an application form is to be filled in at their website, when done with the form you will receive an application number that you are to mark your prototype with. Then send your prototype with attached application number to their address in Stockholm.

The jury looks at new applications every Tuesday and they let you know the same day if they accept your application or not.

A final prototype of connect the dots was made with all the right parts and a finished unit of the Väggbetjänt was taken from the small test run. The application forms were filled in at [www.designtorget.se](http://www.designtorget.se)

The products were then sent to Designtorget for evaluation by the jury.

The following Tuesday an e-mail with the message telling me that the applications had been declined.

The e-mail was a standardized and it said that the applications were turned down due to that the products either did not fit their concept or that they already had too many products in the same category.

I would consider this as partly true, they do sell many different hangers and hooks, meaning that it could be one reason. Though I would consider the products to fit their concept, yet this is only guesses, not truths.

Other reasons could be that it is not always easy to mount products to the wall, you do need to have some skill regarding screwing screws into walls resulting in that it might be seen as a unsafe product to sell regarding complaints from people not managing to mount it to the wall properly.

I would consider the quality to meet

Designtorget's standards. This in comparisons with their other products.

The pricing of the product is set in comparison with their other products and should therefore fit.

Earlier correspondence with Designtorget could have been attempted during the process, though I don't know if it would have done any difference since they only evaluate proper prototypes or finished products.

Conclusions that can be drawn from the attempt is that it is likely better to apply with a product that they don't have already. Meaning that hooks was not the right choice for Designtorget.

New attempts will be made finding alternative sales channels. These attempts will not be covered by this report due to time limitations in the project.

Alternative sales channels not having as many hangers in their product range could be; Design house Stockholm or Norman Copenhagen. Attempts in selling directly to stores or consumers is also an option that might be successful.

## PART 5: SUM-UP

### PRODUCING THE PRODUCTS

Even though the products are simple there are still some questions regarding the functionality of them that by this stage the end users will be the ones deciding if the products are functioning well or not.

However it was important to carry on without hesitation in this project. Since the products never have been the main focus they had to be let go in order to keep to the schedule.

Producing the products was a more complex road than I first imagined it to be. Even when the right producers had been decided and a collaboration had been stated I never got the impression of being a priority. The process was moved forward by calling and asking how they were doing. This meaning that some things in the process from my perspective most likely felt harder than they might have been.

For being relatively simple products seeing to the amount of parts and involved processes the road of finishing them was all other than straight. With long waits between the actions taken, many decisions that had to be considered and always counting the costs back and forth for not ending up with to high sale- prices.

The similarities between the used producers were that they were sometimes hard to reach though when you did they were all service-minded and helpful. And if a promise had been made they did act on those promises. The hard part was getting them to promise something.

A good dialogue with a producer can get you far. The products would not have become anything without the help and the constructive dialogue carried out with the producers along the process.

Though it is possible to produce small batches and low volume production runs and be able to turn some money around if you sell them all the earnings are small considering how much time that is needed for making that perfect product in the first place. You will have to be willing to risk your days spent and hope for larger sales than first predicted for getting paid for the development phase.

For this project it turned out ok, two products were developed really quick with ok margins meaning that if they all sell they will cover most of the time spent and earnings will be made. The problem with doing something quick is that you gamble with the result and quality of the product, therefore risking ending up with products that nobody wants. If you spend too much time on the development of the product you might end up with time spent and initial costs that never will be paid back.

Finding one truth to this balance is outside of this projects frames however with a bit of luck and more experience within the field of design versus production I believe that small production runs can be profitable.

Even though Designtorget delivered a negative response to the products further attempts in finding possible sales channels will be made. These attempts will not be covered by this report.

# PART 6

## FINAL DISCUSSION / CONCLUSION

The goal of this project was to obtain a broader understanding of a full product development, from idea generation to finding production possibilities and contacting possible sales channels. Most parts in this goal were obtained successfully.

## FINAL DISCUSSION/CONCLUSION

### PRODUCTION OF A SMALL BATCH IN SOUTHERN SWEDEN

The reason for investigating this process in depth was that even though after a five year design education I had not been taught enough knowledge to grasp the involved steps in developing a product from the drawing table and to place the finished product in its context where it is to be sold.

I wanted to throw myself into the world of production and learn that you actually can produce on a small scale with a low budget.

During this project and thanks to the way that it was planned I had the chance to experience things I never would have experienced by doing another random school project with too little connection to reality of what it actually means to produce something.

An important part of the project has also been to inspire other young designers in doing similar projects, awake interest of local production and show others what possibilities there actually are close by.

Learning in a theoretical, text based manner never suited me very well. Therefore I shaped my project so that I could get hands-on experience, talk to people and complete tasks on my own.

By stating the demarcations at the beginning I defined a starting point. The demarcations defined a budget, a geographic border to production possibilities within this area and stating the usage context of the final product. This method was a good way to start because I narrowed down a project that very easily could have become to comprising within the tight time limit.

From previous studies on production methods carried out during my education I have had the chance to learn some but never

to go in depth. Therefore I wanted to focus on production possibilities and different production processes in this project. Hands on experience was gained by visiting different producers. This was time wise the longest phase in the project and this phase was definitely the one that gave me the most experience that I believe will strengthen me as a designer in the future.

With experiences comes inspiration, and thanks to my visits at the different producers I was able to quickly generate a vast collection of design ideas that later functioned as a palette of product options for production.

Time was also spent on theoretical research by reading books. The theoretical research provided a good base for my visits. It helped me to choose what production processes to focus on and it became clear along the way that this helped me in order to speak the same language as the producers.

After this project I believe it will be easier for me to produce something partly thanks to the contacts that I've gotten but also because I know what the producers want regarding drawings and production underlay.

The field of production still interests me and I believe that it could become my niche during my practice as a designer. This project has given me the ability to see the entirety of product development better, to understand production processes and to assemble parts into a totality. Now I can make better estimates regarding costs and know what can be done to cut costs and add margins. In this way I will have a better chance of communicating my goals against producers but also have a competitiveness in my role as a designer.

Today I value well made, high quality, equal, fair and unique services and products with a high level of workmanship much more than before. It's now easier for me to create my own opinion and see the underlying factors and thus make better and fairer decisions and purchases myself.

The most important finding that this project has given me is that as a designer you will probably never know it all so use the people around you and their knowledge as early as possible in the design process and you are more likely to succeed with your design.

## REFERENCES

### Articles

<http://www.nyteknik.se/nyheter/automation/cad/article3361678.ece>

Form 2011 Nr 6  
*Monumenten vi inte behöver*, p.20  
Daniel Golling

### Webpages

[http://www.youtube.com/watch?v=n4iivjVOv\\_Y&feature=youtu.be](http://www.youtube.com/watch?v=n4iivjVOv_Y&feature=youtu.be)

<http://i.materialise.com/creationcorner/appear-lamp>

[www.designtorget.se](http://www.designtorget.se)

### Books

[1] Manufacturing processes for design professionals, Rob Thompson, 2007, ISBN 978-0-500-51375-0

[2] Making It: Manufacturing techniques for product design, Chris Lefteri, 2007, ISBN-13: 978-1-85669-506-0

[3] Manufacturing Engineering and Technology, (5th edition) Serope Kalpakjians and Steven Schmidts, 2005, ISBN-13: 978-0131489653

Det Industriella Sverige: Kunskaps Arvet 1897-2002, Martin Fritz, 2002, ISBN 91-973169-9-7

### Visited Producers

Grönlunds Plåt AB  
Skara  
[www.gronlunds.eu](http://www.gronlunds.eu)

Lammhults Snickeri AB  
Lammhult  
[www.lammhultssnickeri.se](http://www.lammhultssnickeri.se)

Gjuteribolaget AB  
Bredaryd/Vimmerby  
[www.gjuteribolaget.se](http://www.gjuteribolaget.se)

Mandus Wire AB  
Värnamo  
[www.mandus.se](http://www.mandus.se)

Tryckta i Markaryd AB  
Markaryd  
[www.tryckta.se](http://www.tryckta.se)

Fcubic AB  
Mölnådal  
[www.fcubic.com](http://www.fcubic.com)

AB Torsten Nilssons Snickerifabrik  
Brösarp  
[www.nilssonsnickeri.com](http://www.nilssonsnickeri.com)

C&D snickeri AB  
Falköping  
[www.cdsnickeri.se](http://www.cdsnickeri.se)

Vimmerby tenn AB  
Vimmerby  
[www.vimmerbytenn.se](http://www.vimmerbytenn.se)

Hylte Formplast AB  
Hyltebruk  
[www.hylteformplast.com](http://www.hylteformplast.com)

Brantviks Måleriverkstad AB  
Malmö  
[www.brantviks.se](http://www.brantviks.se)

Ferm & Persson Glasmagasinet AB  
Göteborg  
[www.fpglas.se](http://www.fpglas.se)

TF Berglunds Mekaniska AB  
Löddeköpinge  
[www.berglundsmek.se](http://www.berglundsmek.se)

Liros Skandinavia AB  
Billdal  
[www.lirosropes.se](http://www.lirosropes.se)



