industriDESIGN
BOX FOR DELIVERY
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Abstract

The aim of the project is to design a box for the delivery system that the company Helpa.se offers. This project is made in collaboration with the company helpa.se from Jönköping, which is a company that offers a web platform that allows people to shop online and quickly get the products delivered to a chosen location.

This box is a fundamental part of their delivery system since it acts as an intermediate in the process of giving the goods ordered online to the final customer. The idea is to design a product that allows delivering expensive products that need to be protected against robbery and also prevent them from breaking or getting damaged during transport. The requirement is that the box must contain a lock with a code that only the customer knows, in order to give safety to the courier, because even if thieves threaten him in order to steal it, he is not going to be able to open it. Therefore, the point of threaten him is lost. The box must also be resistant enough to withstand break in attempts and rough transport.

The thesis consists on developing a new design concept for a box that can be used for the described requirements and suitable for both the courier and the customer of helpa.se in order to be successful. Therefore, the project has been carried out from a human-centered design approach. The design is based on ergonomics, functionality and sustainability and is suitable for the main user since it is designed taking into account his/ her needs.

The result is a delivery box that combines simplicity, functional design and safety. It is available in two different sizes in order to fit products of different sizes. Its characteristics makes this box an innovative product in the market that fulfills the user- and safety requirements and solves the analyzed problems.
Sammanfattning

Målet med detta projekt är att designa en låda för leveranssystemet som företaget Helpa.se erbjuder. Detta projekt är utfört i samarbete med företaget Helpa.se från Jönköping, som är ett företag som erbjuder en webplattform som tillåter människor att handla på nätet och sedan snabbt få varorna levererade till en utvald destination.


# Table of Contents

Abstract ........................................................................................................................................... ii  
Sammanfattning ............................................................................................................................ iii  
Table of Contents ......................................................................................................................... iv  
Table of figures ........................................................................................................................... viii  
Table of tables ................................................................................................................................ x  
Acknowledgements....................................................................................................................... xi  

1 Introduction........................................................................................................................... 6  
1.1 Background ..................................................................................................................... 6  
1.2 Objectives ........................................................................................................................ 6  
1.3 Purpose and research questions ................................................................................... 7  
1.4 Company .......................................................................................................................... 7  
1.5 Delimitations ................................................................................................................... 8  
1.6 Disposition ...................................................................................................................... 8  

2 Theoretical Background ....................................................................................................... 9  
2.1 Design process ................................................................................................................ 9  
2.1.1 Design Approaches................................................................................................. 9  
2.1.2 Design Thinking .................................................................................................... 10  
2.2 Delivery .......................................................................................................................... 12  
2.3 History of delivery services ......................................................................................... 12  
2.4 Logistics by bike ........................................................................................................... 14  
2.5 Code lock ....................................................................................................................... 14  
2.6 Human factors .............................................................................................................. 15  

3 Method ................................................................................................................................. 17  
3.1 Gantt chart .................................................................................................................... 17  
3.2 Literature review ........................................................................................................... 17  
3.3 Stakeholder analysis........................................................................................................ 17  
3.4 User studies ................................................................................................................... 18  
3.4.1 Personas ................................................................................................................. 19  
3.4.2 Interview ................................................................................................................ 19  
3.5 Image board ................................................................................................................... 19  
3.6 Storyboard ..................................................................................................................... 19  
3.7 Task analysis .................................................................................................................. 20  
3.8 Functional analysis........................................................................................................ 20  
3.9 Benchmarking ............................................................................................................... 20
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.10</td>
<td>Ergonomic analysis</td>
<td>21</td>
</tr>
<tr>
<td>3.11</td>
<td>Brand analysis</td>
<td>21</td>
</tr>
<tr>
<td>3.12</td>
<td>Product design specifications (PDS)</td>
<td>21</td>
</tr>
<tr>
<td>3.13</td>
<td>Idea selection</td>
<td>22</td>
</tr>
<tr>
<td>3.14</td>
<td>Prototyping</td>
<td>23</td>
</tr>
<tr>
<td>3.14.1</td>
<td>Mockup</td>
<td>23</td>
</tr>
<tr>
<td>3.14.2</td>
<td>3D modeling</td>
<td>23</td>
</tr>
<tr>
<td>3.14.3</td>
<td>Rendering</td>
<td>24</td>
</tr>
<tr>
<td>3.14.4</td>
<td>3D printing</td>
<td>24</td>
</tr>
<tr>
<td>3.14.5</td>
<td>Surface finishing</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Approach and Implementation</td>
<td>25</td>
</tr>
<tr>
<td>4.1</td>
<td>Project planning</td>
<td>25</td>
</tr>
<tr>
<td>4.2</td>
<td>Project brief</td>
<td>25</td>
</tr>
<tr>
<td>4.3</td>
<td>Emphasize</td>
<td>25</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Stakeholder analysis</td>
<td>25</td>
</tr>
<tr>
<td>4.3.2</td>
<td>User study</td>
<td>26</td>
</tr>
<tr>
<td>4.3.2.1</td>
<td>Personas</td>
<td>26</td>
</tr>
<tr>
<td>4.3.2.2</td>
<td>Questionnaire</td>
<td>27</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Functional analysis</td>
<td>29</td>
</tr>
<tr>
<td>4.3.4</td>
<td>Task analysis</td>
<td>30</td>
</tr>
<tr>
<td>4.3.5</td>
<td>Ergonomics</td>
<td>31</td>
</tr>
<tr>
<td>4.3.5.1</td>
<td>Manual material handling (MMH)</td>
<td>32</td>
</tr>
<tr>
<td>4.3.5.2</td>
<td>Designing for carrying</td>
<td>32</td>
</tr>
<tr>
<td>4.3.5.3</td>
<td>Handle design</td>
<td>34</td>
</tr>
<tr>
<td>4.3.6</td>
<td>Benchmarking</td>
<td>35</td>
</tr>
<tr>
<td>4.3.7</td>
<td>Brand analysis</td>
<td>36</td>
</tr>
<tr>
<td>4.3.8</td>
<td>Material analysis</td>
<td>40</td>
</tr>
<tr>
<td>4.3.8.1</td>
<td>Plastics</td>
<td>40</td>
</tr>
<tr>
<td>4.3.8.2</td>
<td>Metals</td>
<td>41</td>
</tr>
<tr>
<td>4.3.8.3</td>
<td>Evaluation</td>
<td>41</td>
</tr>
<tr>
<td>4.3.8.4</td>
<td>Manufacturing methods</td>
<td>41</td>
</tr>
<tr>
<td>4.4</td>
<td>Define</td>
<td>43</td>
</tr>
<tr>
<td>4.4.1</td>
<td>Product design specifications</td>
<td>43</td>
</tr>
<tr>
<td>4.5</td>
<td>Ideate</td>
<td>43</td>
</tr>
<tr>
<td>4.5.1</td>
<td>Idea generation</td>
<td>43</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>4.5.2</td>
<td>Concepts</td>
<td>44</td>
</tr>
<tr>
<td>4.5.2.1</td>
<td>Concept 1</td>
<td>44</td>
</tr>
<tr>
<td>4.5.2.2</td>
<td>Concept 2</td>
<td>45</td>
</tr>
<tr>
<td>4.5.2.3</td>
<td>Concept 3</td>
<td>46</td>
</tr>
<tr>
<td>4.5.2.4</td>
<td>Concept selection</td>
<td>46</td>
</tr>
<tr>
<td>4.5.3</td>
<td>Final concept development</td>
<td>47</td>
</tr>
<tr>
<td>4.5.3.1</td>
<td>Definition of the elements needed</td>
<td>47</td>
</tr>
<tr>
<td>4.5.3.2</td>
<td>Dimensions</td>
<td>48</td>
</tr>
<tr>
<td>4.5.3.3</td>
<td>Dimensions selection</td>
<td>52</td>
</tr>
<tr>
<td>4.5.3.4</td>
<td>Second round of concepts</td>
<td>52</td>
</tr>
<tr>
<td>4.5.3.5</td>
<td>Concept 1</td>
<td>53</td>
</tr>
<tr>
<td>4.5.3.6</td>
<td>Concept 2</td>
<td>54</td>
</tr>
<tr>
<td>4.5.3.7</td>
<td>Concept 3</td>
<td>55</td>
</tr>
<tr>
<td>4.5.3.8</td>
<td>Concept evaluation</td>
<td>55</td>
</tr>
<tr>
<td>4.5.3.9</td>
<td>Refine</td>
<td>57</td>
</tr>
<tr>
<td>4.6</td>
<td>Prototype</td>
<td>58</td>
</tr>
<tr>
<td>4.6.1</td>
<td>3D modeling</td>
<td>58</td>
</tr>
<tr>
<td>5</td>
<td>Result</td>
<td>61</td>
</tr>
<tr>
<td>5.1</td>
<td>Final design</td>
<td>61</td>
</tr>
<tr>
<td>5.2</td>
<td>Features</td>
<td>62</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Handle</td>
<td>62</td>
</tr>
<tr>
<td>5.2.2</td>
<td>Lock cover</td>
<td>63</td>
</tr>
<tr>
<td>5.2.3</td>
<td>Customer identification</td>
<td>63</td>
</tr>
<tr>
<td>5.2.4</td>
<td>Lock</td>
<td>64</td>
</tr>
<tr>
<td>5.2.5</td>
<td>Strap</td>
<td>65</td>
</tr>
<tr>
<td>5.2.6</td>
<td>Anti-sliding material</td>
<td>65</td>
</tr>
<tr>
<td>5.2.7</td>
<td>Hinges</td>
<td>65</td>
</tr>
<tr>
<td>5.2.8</td>
<td>Fitting surfaces</td>
<td>66</td>
</tr>
<tr>
<td>5.2.9</td>
<td>Side holder</td>
<td>66</td>
</tr>
<tr>
<td>5.2.10</td>
<td>Inside cover</td>
<td>67</td>
</tr>
<tr>
<td>5.3</td>
<td>Technical specifications</td>
<td>67</td>
</tr>
<tr>
<td>5.3.1</td>
<td>Materials</td>
<td>67</td>
</tr>
<tr>
<td>5.3.2</td>
<td>Ergonomics</td>
<td>68</td>
</tr>
<tr>
<td>5.3.3</td>
<td>Dimensions</td>
<td>70</td>
</tr>
<tr>
<td>5.3.4</td>
<td>Components</td>
<td>70</td>
</tr>
<tr>
<td>5.4</td>
<td>Aesthetics</td>
<td>71</td>
</tr>
</tbody>
</table>
5.4.1 Shape....................................................................................................................... 71
5.4.2 Color....................................................................................................................... 71
5.4.3 Graphics................................................................................................................. 71

5.5 Prototype ....................................................................................................................... 72
  5.5.1 Milled pieces .......................................................................................................... 72
  5.5.2 3D printed pieces .................................................................................................. 74
  5.5.3 Surface finishing .................................................................................................... 74
  5.5.4 Final model ............................................................................................................ 75

6 Conclusion and discussion ................................................................................................ 77
  6.1 Discussion of method.................................................................................................. 77
  6.2 Discussion of findings ................................................................................................. 78
  6.3 Conclusions ................................................................................................................... 79

7 References............................................................................................................................ 80

8 Attachments......................................................................................................................... 83
  8.1 Gantt chart .................................................................................................................... 84
  8.2 Product design specifications ...................................................................................... 85
  8.3 Sketches ......................................................................................................................... 87
# Table of figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Helpa.se cargo bike.</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Helpa.se logo.</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Process representation</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Design thinking.</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>Delivery by horse.</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>E-commerce preferences</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
<td>Delivery price preferences</td>
<td>13</td>
</tr>
<tr>
<td>8</td>
<td>Logistics by bike.</td>
<td>14</td>
</tr>
<tr>
<td>9</td>
<td>Lock</td>
<td>14</td>
</tr>
<tr>
<td>10</td>
<td>stakeholders map.</td>
<td>18</td>
</tr>
<tr>
<td>11</td>
<td>Project stakeholders.</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>Roberto persona.</td>
<td>26</td>
</tr>
<tr>
<td>13</td>
<td>Messenger persona moodboard.</td>
<td>27</td>
</tr>
<tr>
<td>14</td>
<td>Claudia persona.</td>
<td>27</td>
</tr>
<tr>
<td>15</td>
<td>Helpa.se customer moodboard.</td>
<td>27</td>
</tr>
<tr>
<td>16</td>
<td>Task analysis</td>
<td>30</td>
</tr>
<tr>
<td>17</td>
<td>helpa.se bike.</td>
<td>31</td>
</tr>
<tr>
<td>18</td>
<td>Hand distance from the lower back.</td>
<td>33</td>
</tr>
<tr>
<td>19</td>
<td>Vertical lift region.</td>
<td>33</td>
</tr>
<tr>
<td>20</td>
<td>Torso twisting and sideways bending.</td>
<td>33</td>
</tr>
<tr>
<td>21</td>
<td>helpa.se service. [1]</td>
<td>36</td>
</tr>
<tr>
<td>22</td>
<td>helpa.se header [1]</td>
<td>37</td>
</tr>
<tr>
<td>23</td>
<td>helpa.se Webpage [1]</td>
<td>37</td>
</tr>
<tr>
<td>24</td>
<td>helpa.se typography [1]</td>
<td>38</td>
</tr>
<tr>
<td>25</td>
<td>colors meanings</td>
<td>39</td>
</tr>
<tr>
<td>26</td>
<td>helpa.se color</td>
<td>39</td>
</tr>
<tr>
<td>27</td>
<td>Webpage icons [1]</td>
<td>40</td>
</tr>
<tr>
<td>28</td>
<td>Injection molding process</td>
<td>42</td>
</tr>
<tr>
<td>29</td>
<td>Rotomolding process</td>
<td>43</td>
</tr>
<tr>
<td>30</td>
<td>Rotomolding design guidelines</td>
<td>43</td>
</tr>
<tr>
<td>31</td>
<td>Concept 1</td>
<td>44</td>
</tr>
<tr>
<td>32</td>
<td>Concept 2</td>
<td>45</td>
</tr>
<tr>
<td>33</td>
<td>Concept 3</td>
<td>46</td>
</tr>
<tr>
<td>34</td>
<td>Elements needed</td>
<td>47</td>
</tr>
<tr>
<td>35</td>
<td>Possible dimensions</td>
<td>49</td>
</tr>
<tr>
<td>36</td>
<td>Option 1 dimensions</td>
<td>50</td>
</tr>
<tr>
<td>37</td>
<td>How to carry option 1</td>
<td>50</td>
</tr>
<tr>
<td>38</td>
<td>Option 1 on cargo bike</td>
<td>50</td>
</tr>
<tr>
<td>39</td>
<td>Option 2 dimensions</td>
<td>51</td>
</tr>
<tr>
<td>40</td>
<td>How to carry option 2</td>
<td>51</td>
</tr>
<tr>
<td>41</td>
<td>Option 2 on cargo bike</td>
<td>51</td>
</tr>
<tr>
<td>42</td>
<td>Second round of concepts sketches</td>
<td>52</td>
</tr>
<tr>
<td>43</td>
<td>Second round concept 1</td>
<td>53</td>
</tr>
<tr>
<td>44</td>
<td>Second round concept 2</td>
<td>54</td>
</tr>
<tr>
<td>45</td>
<td>Second round concept 2</td>
<td>55</td>
</tr>
</tbody>
</table>
Figure 46. Final sketches ........................................................................................................... 57
Figure 47. Lock lid variation 1 ................................................................................................. 58
Figure 48. Lock lid variation 2 ................................................................................................. 58
Figure 49. Lock lid final idea ................................................................................................. 58
Figure 50. Handle placement variation 1 ................................................................................ 59
Figure 51. Handle placement variation 2 ................................................................................ 59
Figure 52. Handle placement variation 2 ................................................................................ 59
Figure 53. Color variations ..................................................................................................... 60
Figure 54. Two sizes product ................................................................................................. 61
Figure 55. Handle attachment ............................................................................................... 62
Figure 56. Handle placement ................................................................................................. 62
Figure 57. Lock lid .................................................................................................................. 63
Figure 58. lid ............................................................................................................................ 63
Figure 59. Handle placement ................................................................................................. 64
Figure 60. Lock instructions ................................................................................................. 64
Figure 61. Strap ...................................................................................................................... 65
Figure 62. Bottom view .......................................................................................................... 65
Figure 63. Hinges .................................................................................................................... 66
Figure 64. Open box ............................................................................................................... 66
Figure 65. Stackable system ................................................................................................. 66
Figure 66. Side holder .......................................................................................................... 67
Figure 67. Velcro .................................................................................................................... 67
Figure 68. Box inside ............................................................................................................. 67
Figure 69. Box inside ............................................................................................................. 69
Figure 70. Box inside ............................................................................................................. 69
Figure 71. Boxes stored in the bike ....................................................................................... 70
Figure 72. Exploded view ....................................................................................................... 70
Figure 73. Color variations ................................................................................................... 71
Figure 74. Helpa logo ............................................................................................................. 72
Figure 75. Instructions ............................................................................................................ 72
Figure 76. Milled pieces ........................................................................................................ 73
Figure 77. Glued pieces ......................................................................................................... 73
Figure 78. Piece with spackle ............................................................................................... 74
Figure 79. Piece with spackle ............................................................................................... 74
Figure 80. Painted pieces green ........................................................................................... 75
Figure 81. Painted pieces grey ............................................................................................. 75
Figure 82. Pieces together ..................................................................................................... 75
Figure 83. Exhibition ............................................................................................................. 76
Figure 84. Gantt chart ............................................................................................................ 84
Figure 85. Sketches 1 ............................................................................................................ 87
Figure 86. Sketches 2 ............................................................................................................ 88
Figure 87. Sketches 3 ............................................................................................................ 89
Figure 88. Sketches 4 ............................................................................................................ 90
Figure 90. Sketches 5 .......................................................................................................... 91
Table of tables

Table 1. Project stakeholders. ................................................................. 25
Table 2. Functional analysis- courier. .................................................... 29
Table 3. Functional analysis- helpa.se costumer. ................................. 29
Table 4. Functional analysis- Producer .................................................. 29
Table 5. Grip on the load .................................................................... 33
Table 6. Floor surface ........................................................................ 33
Table 7. Stability of load ..................................................................... 34
Table 8. Benchmarking. ................................................................. 36
Table 9. Benchmarking. ................................................................. 41
Table 10. Concept 1 evaluation ............................................................ 56
Table 11. Concept 2 evaluation ............................................................. 56
Table 12. Concept 3 evaluation .............................................................. 57
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1 Introduction

This report describes the design of a box for delivery for the company helpa.se from Jönköping as part of the final Master thesis on Industrial Design at Jönköping University.

1.1 Background

Delivery is the activity in which the product is going to be involved. It is the process of transporting goods from a source location to a destination. Helpa.se provides transportation of packages of any kind of dimensions from local stores to their customers, particulars or companies. These goods are delivered via roads by bicycles if the delivery point is in Jönköping city and car or truck if it is in the outside. The company tries to minimize as much as possible the carbon footprint in the city area using this kind of transports since they use bike and trucks and cars are always powered by biogas, ethanol or electricity.

The company is focusing right now on the transportation by bike (see image on the left), some of the advantages are that they are faster than cars since they are less susceptible to traffic and can generally move and travel at faster speeds during rush hour. They also reduce the load on traffic in the city, are cheaper and good for the environment as mentioned before. The main disadvantage is that delivery by bike can be dangerous for the messenger, since it is exposed to thieves that can take the goods easily by hurting or threaten him.

Helpa.se delivery system is based on a messenger that buys the goods at the local store and then puts them in a box, which has a code lock (the company has already bought it), and only if you have that code you can open it and take the things inside. The box has to be manufactured in a very resistant material, which minimizes the risk of breaking it. The messenger doesn’t know the code, is only the customer that has ordered the goods who knows it. By this method, the risk of robbery is minimized since there is no option of opening it without the code and since the messenger doesn’t know it, there is no option to threaten him.

1.2 Objectives

The project in collaboration with the company helpa.se includes the design of a box that will be used for the home delivery.

This box is one fundamental part of their delivery system because it is going to be the intermediaries in this process to give the goods ordered to the costumer. The design has to be based on ergonomics, functionality and sustainability and be suitable for the main user taking into account its needs.

This box can contain any kind of product that the people order such as medicine, tobacco or alcohol. The main focus for the design of the product is security since it is going to be
transported by bike and there is a risk of robbery. The idea is to give safeness for the person who is going to be in charge of the delivery. The box will be implemented with a code lock that won’t be known by the person who makes the delivery. Only the person that receives the package is able to open the box and take the things from the inside of it.

1.3 **Purpose and research questions**

The problem consists in finding a successful product that combines safeness, aesthetics and ergonomics.

The research is mainly focused in;

- **Ergonomics**: the product is going to be transported by a person and can be sometimes very heavy. It is going to be the main tool for the person who works at this service and needs to be comfortable for him.
- **Materials**: the product needs to be manufactured in a material which combines safety (bulletproof if possible), is light and can be easily manufactured.
- **User experience**

**Research questions:**

- How can the box be designed so the goods inside can’t be taken without the code?
- Which is the most suitable material for a safe and light box?
- How can we improve helpa.se customers experience while using their service?
- How can the box be designed in order to be suitable for cargo bike delivery?

1.4 **Company**

Helpa.se is a web platform that allows people to select which local area they want to shop in and buy from them any kind of goods that are delivered to their homes, company, delivery point… In the same day they order it. Helpa.se messengers transport the shipment from the physical store to the customers chosen delivery point. The idea comes from people that don’t have enough time to go to the shop, they can’t do it or simply they want to have it easily in their homes without going out.

Helpa.se provides transportation for any kind of packages at a reasonable price. It promotes local shopping and gives the opportunity for big and small stores to convey goods and services to customers with a fast supply and good customer service. They are in charge of buying the item from the local store and deliver it in the same day.

Helpa.se has started in Jönköping but will be further developed in other cities or countries around the world. [1]
1.5 Delimitations
The project is based on a design proposal which result will be a non-functional prototype scale 1:1. This project is not going to contain the design of any of the electronics included in the product, these parts are already defined and will be provided by the company. Manufacturing methods will be analyzed so that they can be understandable and adapted to the product but the project won’t explain them in detail.

1.6 Disposition
The project is going to be organized in different sections:

Section 2: Theoretical background.
Introduction to the project, description of the theory that explains the problem and research about it.

Section 3: method.
Analysis of the procedure followed in order to develop the project.

Section 4: approach and implementation.
Implementation of the methods described in section 3 with their corresponding results.

Section 5: result
Final product, resultant from the project that is going to be delivered to the company.

Section 6: discussion and conclusions.
Conclusions of the result of the project and process followed.

Section 7: references
Sources where the information has been taken for the project.

Section 8: appendices
Additional information
2 Theoretical Background

2.1 Design process

- What is design?
  “Design is a profession that is concerned with the creation of products, systems, communications and services that satisfy human needs, improve people’s lives and do all of this with respect for the welfare of the natural environment. Design involves problem finding, problem solving, analysis, invention and evaluation guided by a deep sensitivity to environmental concerns and human-centered aesthetic, cultural and functional needs.” Charles Owen (2004) [2]

- What is a process?
  A process is a series of activities performed in order to achieve a particular result. Every process counts with an input and an output. In between these two stages, there is something happening, a transformation, called process.

  Every process is different in itself, it depends on the results that want to be achieved and do not have fixed beginning or endings.

However, what they have in common are two basic stages; analysis where the problem is broken into parts for examination, and synthesis, where the situation is reassembled based on the study made during the process. It is very important to understand the design process and life cycle to achieve good results. The process followed determine the quality of the result in any kind of process. [3]

A design process differs from the scientific method on the process followed. In scientific method, all the parameters of the problem are defined in the beginning in order to create the solution. Nevertheless, design processes may seem ambiguous compared to scientific methods because of the different paths that can exist between the phases.

Design processes are nonlinear processes, this means that some activities are suddenly necessary in different stages of the process and iterative, which means that it requires many cycles during the process depending on the needs in each moment. In some cases, it is necessary to have many loops but in others, it is not necessary to iterate. Generally, the more loops done leads to more successful results and less chance of failure for the process. [4]. By doing this, hidden parameters can be discovered and this leads to new alternatives and innovative solutions. [5]

2.1.1 Design Approaches

While designing is important to take into account users emotions. If a designer does not understand users emotions, can generate unexpected responses from them while using his products. Understanding the emotional responses of product users can help in designing products that surpass the mere satisfaction experience. A way to improve design and design processes is to use the understanding of the relationship between users and...
products. Designing better with this initiative leads to products that are easier to use, more authentic and engaging.

The different approaches when designing based on Pieter Desmet and Paul Hekkert (2009) article are:

- **User based approach to design:** the creativity will arise from user’s emotions and experience. The design process has to be based then in techniques that involve the users in different stages of the design, such as idea-generation stage or product testing-stage. This approach intends to discover unknown, undefined or unanticipated consumer needs.

- **Designer based approach to design:** the designer is the author and provides his design with his own visions and principles without taking into account the user’s emotions.

- **Research based approach to design:** relationships between the product and users’ emotional responses are identified and evaluated thanks to a research and emotion measurement. It starts by a questionnaire in which users report their responses and using statistical techniques, the responses are identified.

- **Theory based approach to design:** this approach is suitable for product optimization since it requires existing products and specific users in order to evaluate them. Cupchick (1999) distinguished three levels when evaluating products and improving the emotional impact in the users: sensory/aesthetic, cognitive/behavioral and personal/symbolic. [6]

### 2.1.2 Design Thinking

Design thinking is a methodology; it is the process for creativity and innovation. There are different versions of the design thinking process depending on the stages defined for each of them. Each of these stages can be repeated and occurs simultaneously as explained in chapter 2.1 Design process. [7]

In this project, it is going to be based in 5 stages: empathize, define, ideate, prototype and test, explained below. In all of these different stages, creativity is the essential element and it makes the whole idea to be in continue evolution.

This methodology is based on logic, imagination and intuition reasoning in order to explore the most suitable solutions for the stakeholder since it is a human centered innovation process.
Empathize:
“*To create meaningful innovations, you need to know your users and care about their lives.*” [8, page 2]
This first step consists in understanding how people do things and why do they do it that way, their thoughts and needs. This is a very important stage since the problems that designers try to solve are basically other people’s problems. Designers put it in practice through observation and recognizing the different needs or manifestations of the users. A good empathize work helps to be more creative and see things from another point of view.

Define:
“*Framing the right problem is the only way to create the right solution.*” [8, page 3]

The main goal of this step is to clarify and focus in the problem in order to start looking for possible solutions. It is a way of arranging all the information gathered in the first step. Designers craft a problem statement to work on. This statement guides the designer to focus in the different needs of the user based on the designer’s new understanding of it. It also narrows the problem just to make easier to find the solution.

Ideate:
“*It’s not about coming up with the ‘right’ idea, it’s about generating the broadest range of possibilities.*” [8, page 4]

Ideation is about generating different ideas in order to solve the problem that the statement contains. It provides the main information to create the final solution. The more ideas the designer has, the better. It is about finding the most ideas possible so the designer can select the best one afterwards and work on it.

Prototype:
“*Build to think and test to learn.*” [8, page 5]
This stage is based on generating different artifacts that helps the designer to take some decisions while designing the final concept. It helps the designer to get closer to the solution. There are many ways of prototyping but all of them have in common that they are used to interact and communicate with the final user.

Test:
“Testing is an opportunity to learn about your solution and your user.” [8, page 6]
With all the prototypes that designers make during the prototype stage, designers solicit feedback from the final user to work again on their empathy and understand them a little bit more and find new solutions or possible problems. To be clear, it makes a better design. It can be made by testing with a physical object or simulating a real context of the user’s life.

2.2 Delivery
Delivery is an activity based on transporting goods from a location to a delivery point.

2.3 History of delivery services
Moving goods from one location to another has existed for several millennia. The first recorded examples are from 2400 BC from Egyptians, who transported documents carved in to stone and materials to build the pyramids.

However, delivery services have changed dramatically over the years. Changes in the goods transported, the expansion of geographic scale of the marketplace, changes on customer needs, range of services offered and new communications technology are some of the reasons why it has been changing. [9]

Animals such as camels, dogs or horses were used to help deliver mail and packages before the invention of motor vehicles. In that time, anything that wanted to be delivered could take many days even months until it arrived to its destination or go missing.

With the invention of the vehicle packages arrived earlier, cheaper and more reliable. Nowadays, delivery is dominated by a few huge companies that can deliver products by air, land and sea. New technology and ideas are transforming the way delivery is understood, drones, automation are starting to appear in this activity, facilitating the process. [10]

The process has been reduced in time so you can receive your package in the same day as you order it; companies like UberRush [11], Walmart and google express have put it in practice.
Same-day delivery has an increasing demand and has changed the way people shop and it is a good opportunity to connect local infrastructure with e-commerce. The demand of customers when they buy online regarding delivery leans to receive the goods that they order as fast as possible (see image below).

Consumers are not familiar yet with this kind of delivery, but a survey conducted by McKinsey in Germany, France, Sweden and the UK indicated that 50% of the population would be willing to pay for this service from 6 to 7 Euros for a 59 Euros purchase and more than 70% would be willing to pay 3.50-4.50 Euros. This fraction of the population are mainly people living in small households, people that have a long working schedule and consumers with high incomes that would pay for this service. [12]
2.4 Logistics by bike

Bike has an important role in the modern logistics chain. It is implemented in new logistics concepts where the environment and sustainability are essential. Delivery by bike is the most sustainable way, while fast and reliable in congested urban areas. Logistics by bike are an eco-friendly alternative to regular delivery and it is estimated that cargo bikes improving this service can do 50% of the light delivery.

The companies dedicated to logistics by bike usually work on a small scale, collecting the packages and distributing them through the city. They substitute vans, which are polluting urban areas and makes the messenger lose an enormous amount of time and money on the street in congested areas. Local governments are trying to decrease the number of vans in the city center because of these reasons. [13]

The main advantages are:

- Cargo bikes are faster than vans in congested traffic conditions or places where the speed limit is regulated.
- It is possible for cargo bikes to park in places closer to the delivery destination since they are smaller and need less parking space.
- Cargo bikes don’t produce pollution since they don’t use fossil fuels
- Cargo bikes produce less noise pollution than motor vehicles.
- Cargo bikes messengers improve their health while the delivery since it is an active operation.
- Cargo bikes do not require a special license of the driver to operate, this means that anyone can drive it and can produce jobs for people that do not have high qualifications in local communities.

Some examples of the use of cargo bikes are:

UPS is running a project in order to implement ebikes due to its benefits. These bikes can cover long distances and carry heavy loads due to their electric motor.

DHL together with the cargo bike firm Larry Vs Harry from Denmark has developed a carbo bike specially designed with a theft proof box that is fitted to the bike and makes safer to deliver and leave the bike parked on the street.

2.5 Code lock

In order to protect the goods that are going to be transported inside of the box. It is going to be locked with a special lock chosen by the company. The model of the lock is LS100 and it belongs to the company ACSS.

This code lock will set some restrictions for the design of the product since it needs to fulfil some requirements in order to work. It’s main characteristics are:

IP43: this means that the product is not waterproof it cannot be exposed in
the outdoor open air or in a place where water can reach it, because it will break.
Battery life: Around 3 years if it is used 30 times a day. It should be easy to replace in case it runs out of battery.
Dimensions: 151x38x33mm

The functioning of the lock is very simple. The instructions are:
To lock:
1. Press any 4 digit code
2. Press √ situated below the knob on the left side
3. Turn the knob
To unlock
1. Press the same code
2. Press √
3. The lock opens automatically

To cancel or delete what was written before press X [14]

2.6 Human factors
Human factors is the science that studies the physical and cognitive capabilities and limitations of humans and applies it into design. Human factors contribute to the design and evaluation of products, environments and systems in order to adapt them to the people. The result of using human factors in a design process is the improvement of the operability of the product, equipment or process that is going to be designed. [15]
Human factors are related to a user-based approach to design (see chapter 2.1.1 design approaches). It works with all the factors that affect human performance. The different areas involved in ergonomics are:

- Cognitive ergonomics: this area is based on mental processes (perception, memory, reasoning and motor response) that affect in the interaction between the humans and the elements of the system.
- Organizational ergonomics: this area is based on the optimization of sociotechnical systems. It works with work organization, job satisfaction, demand and decision latitude and leadership.
- Physical ergonomics: this area is based on the human characteristics related to physical activity:
  - Anthropometry: it is based on the study of body sizes and other characteristics associated to them. The measurements in this study belong to body sizes, shape, strength, mobility and flexibility. It is very important to take into account the different measurements of the population the product is going to be for. These measurements vary depending on their gender, age or place they are from. Anthropometry data is classified by samples of subjects with the same characteristics. [16]
  - Biomechanics: it is based on the explanation of the human body working mechanically but as a biological system. Designers should be aware of the movements of the human body when designing any kind of product. This data
helps designers to determine where the items that are going to interact with the human should be placed. The different movements of the human body define how the product is going to be used. [16]
3 Method

3.1 Gantt chart
A Gantt chart is a tool used to plan the schedule of the project. It organizes the activities of the project over time and includes the start, the end, and all the dependencies between the tasks that are going to be done during the project. The duration of each task can be visualized in bars, their length depends on their duration.

It allows to easily see the different activities, when they begin or end, how long they last. [17]
See appendix 1

3.2 Literature review
Literature review is the first step in a research project. It is based on the collection and synthesis of existing information that can be found in academic papers and use it to inform the preset project. [18]

3.3 Stakeholder analysis
“A stakeholder is defined as individuals or organizations who stand to gain or lose from the success or failure of a system” Nuseibeh and Easterbrook (2000)
It means that a stakeholder is every person that is related with the project and their perspectives must be taken into account to design a successful product.

When using a user-centered design approach (see in chapter 2.1.1 Design approaches), it is necessary to learn more about the user/users of the product that has to be designed to ensure its quality. This is not enough to produce a successful design in a project where there are more people involved. To the understanding of the main user needs and problems it is necessary to add the goals and perspectives of the rest of the users involved with it. This process can be denominated as stakeholder analysis.

Having different stakeholders in the same project can be a problem since each of them has their own goals. It can be said that a good product is the one that maintains a high level of satisfaction of all the stakeholders with fewer conflicts as possible. The aim of this analysis is to synthetize the different worldviews and analyze them in order to create a product that meets all stakeholders’ requirements reducing conflicts.

Steps to make a good stakeholder analysis:

1. Identify organizational stakeholders: Identify the stakeholders related with the project.
2. Prioritize stakeholders: record all the data about the stakeholders in a table that shows all the information specifying their goals, objections to the project and power on it. The influence of each of them depends on their power and interest in the project.
The stakeholders can be classified in a map (see figure below). The place of each of the stakeholders shows the actions that have to be taken during the project in order to be successful. [19]

![Stakeholders Map](image)

**Figure 10. Stakeholders Map.**

3. Understand stakeholders’ perspectives: conduct a research based on all the stakeholders in order to understand them better and be able to develop design solutions based on them.

4. Incorporate stakeholder perspective into design: add these stakeholders’ requirements into the product that is going to be designed.

### 3.4 User studies

Once the user has been identified, it is important to find out its needs. User needs have to be considered from the start of the project in order to get the most successful solutions for their problems as soon as possible. User studies aims to discover their needs and how users perform the tasks with the product in order to evaluate them and design according to their requirements.

User studies are based on obtaining feedback from the observation and analysis of the interaction of the user with the product.

When starting a user study the following steps are very important:

- Set the objective of the study. Specify the goals of the research.
- Decide the methods and techniques that are going to be used in order to reach that goal.
- Design the tasks that the user has to perform. They have to be clear enough and realistic so the user can perform them. A bad explained task can influence badly the results of the study.
- Determine the context where the study is going to be performed.
- Decide the data that needs to be recorded.
- Determine the users that have to be involved in this study.
- Prepare all the material needed to develop the study.
Since not all techniques fit for all products and situations, there are many different ways to perform this studies. The ones that are going to be used in this project are:

- Ethnographic field studies
- Interviews

Both techniques complement each other when analyzing the user. These techniques are going to be applied to personas. [20]

### 3.4.1 Personas

Personas are the potential user of the product. This persona represents a key population of this users. The characteristics of these personas need to be defined in the beginning of the user study in order to develop it based on them. The number of personas for each product can vary depending on how many people is going to be direct related to it but should be small, only focused on the key target audience. Each persona has a visual representation, with their name, description and details about interest and behaviors. These characteristics can be defined in storyboards, posters, text.

Personas are a way to make the user more real for the designer and facilitate their task while designing [21].

### 3.4.2 Interview

The interview is based on a discussion between the researcher and the main user about the topic. The procedure is to ask questions to the stakeholders about their needs. This is a process controlled by the interviewer, who formulates the questions.

There are two types of questions when doing an interview; closed questions, which can be answered only with something predetermined by the interviewer (Example: Yes or no) or open questions which can be answered freely. [22]

### 3.5 Image board

This technique is based in a collage consisting of images and text related to a defined theme. It helps to get an overall idea of the topic this product is going to be based on. Image boards can be based on many different themes depending on what they want to express or provide inspiration, for example style, aesthetics, moods, context, target audience… They are used to summarize ideas and as a visual tool to focus on while designing, they are able to communicate with images complex ideas clearly. [23]

### 3.6 Storyboard

A storyboard shows in an ordered way a story between a person and a product. This story can be represented in many ways such as drawings, sketches or pictures.
This technique is used to specify how the users interact with the product and also how external things to the system interact with it. It is beneficial when testing products because tests can be compared to the predictions shown on the original story board created earlier. [24]

### 3.7 Task analysis

This analysis helps to understand better the relation between the product, the task and the user. It is based on observing the user how he perform the tasks in order to identify user’s goals, how the user develops tasks and how their previous knowledge affect to the tasks.

It is good to perform this kind of analysis in the beginning of the process since it is a tool that can help in the concepts development afterwards. [25]

### 3.8 Functional analysis

Functional analysis is the part in the design process where the requirements for the product are defined. The aim is to describe the main characteristics of the product, the user group and the purpose of it. This analysis helps designers to take decisions such as what elements are essential on the product and how the user interface is constructed.

The functions are classified in four different groups depending on how much needed are in the product to work. Describing the functions instead of solutions helps the designer to generate new ideas to solve those functions. These groups are:

- **Main function**: is the function that has to be fulfilled in order to make the product work
- **Necessary function**: it has to be met in the product.
- **Desirable function**: it is not a priority but it could improve the design.
- **Unnecessary function**: functions that don’t complement the product and can be avoided because many times disturbs on the performance of it.

Functions are expressed in a sentence that contains:

- **Feature**: the function expressed with a verb
- **Noun**: it is connected to the feature
- **Note**: it complements the meaning of the noun

[26]

### 3.9 Benchmarking

Benchmarking is a tool based on the research of products related to the one that has to be designed. It is used to check the possible competitors, know if the product that is going to be designed can be on the market or evaluate how much people would pay for it. By knowing what the competence has, is possible to improve the design since it is possible to test and evaluate what people prefer and
the possible problems in the existing ones. Benchmarking studies are different for each product and situation, information gathered depends on the needs of the designer in each case. [27]

3.10 Ergonomic analysis
In order to have the best design for the product is important to take into account some characteristics of the user and the way he interacts with it. Ergonomics is the process of designing products based on the study of interactions between the product and the user. [28]

3.11 Brand analysis
A brand identity express visually what the company wants to communicate to the outside world. This identity has a specific name, logotype and visual appearance. A brand identity makes products recognized; it creates emotional connection and reflects the image of the company adding value to the products. It adds functional aids to the product that costumers associate with certain benefits that the brand offers. This brand identity is also something that the company has control over and can modify respect to the requirements that the outside world have. This technique consists on the analysis of those elements that form part of the brand in order to apply them to the product identity. [29]

This analysis can be performed in two steps, defining the following aspects:
1. **Strategic brand identity**: based on the identification of the core identity, target costumers, brand positioning and brand heritage. This will give an idea about what makes the company different from its competitors, their own identity that makes them unique.
2. **Visual product identity**: is based on the study of the product typologies that the company produces, differentiating aspects of them respect to the competence products, product aspects reflecting brand identity (explicit features, verbal description of key characteristics, implicit features) and visual analysis of portfolio. It describes the elements that distinguish specific brand products from products from other companies and typical characteristics for the brand products, common for all of them. [30]

3.12 Product design specifications (PDS)
The product specifications is a very important tool while developing the product. It is used to enumerate all the requirements and constraints that must be met in the product that has to be designed, and ensure that the product meets the user requirements. The concepts of the product generated should be based on the product design specifications in order to be successful. There are different kinds of specifications:

Technical specifications: characteristics of the product.
- **Performance**: describes what the product needs to do.
• Requirements of the product considering the customer demands.
• Ergonomic requirements (size, weight…)
• Functions
• Things related to use
• Material requirements
• Aesthetics
• Size
• Environment of the product (interaction and conditions)
• Safety of the product
• Life of the product
• Standards and requirements
• Maintenance of the product
• Recycling and expected disposal
• Manufacturing process requirements and limitations
• Packaging requirements

Methodological specifications: characteristics of the process.
• Quantity of products
• Launching date of the product
• Manufacturing time
• Time in stock

These specifications must be described in the early stages of the design process when the research is enough to be able to define them. Nevertheless, product design specifications is a living document, which means that it changes while the development of the project, adding more things when there is more knowledge about it. [31]

### 3.13 Idea selection

Concept evaluation is a method that helps to choose the correct concept in order to develop it in the following steps. It provides the correct information to make the decision.

Each of the concepts are evaluated according to how much value they bring to users and providers. Each of the concepts are given different scores in their user-value and provider-value. These scores are plotted in a diagram, translated into coordinates. This provides a basis to compare them and gives an idea about which concept to develop and which could be combined.

1. The first step of this method is to create a criterion in order to evaluate the user and provider value.
2. Then, it is necessary to create a solution evaluation matrix with different columns in which user-value and provider-value are listed.
3. The third step is to choose a scale to score each solution and score each of them to finally record a total of scores for each criterion.
4. The forth step is to plot the solutions in a diagram.
5. The last step would be to analyze the solutions. This diagram is divided into two parts divided by a diagonal line. This line creates two different triangles. The higher triangle contains the concepts that better designed and would have better acceptance in the market. This is because the solutions in the high user-value and high provided value triangular are high-priority. [32]

3.14 Prototyping
This method is based on producing a model of the product. It helps to receive feedback from the different users, evaluate its characteristics, and take decisions. Prototypes can be produced with many different kinds of materials and techniques.
The main purpose of this method is to have an idea and be able to receive feedback from the users and also to give the designer some clues about it and possible advantages and disadvantages of the product. With all this information, the user is able to optimize it and find new ideas. [33]

3.14.1 Mockup
Mockups are an important part in user experience design that helps to test ideas quickly in order to improve them. Mockups provides different approaches for exploring ideas in an easy way before using more complicated processes and expensive resources. Mockups are created in early stages; it is a step before creating non-functional prototypes.
Mockups are used for testing and learning and can be made out of as simple materials as paper or cardboard. [34]

3.14.2 3D modeling
3D Modeling is the process of developing three-dimensional surfaces in order to create an object digitally. Although they are in 3D, they can be shown as a 2D image through rendering (see chapter 3.14.3). This kind of representations usually follow the sketching process and they help to visualize the product with computer. It's used to develop the concepts and represent ideas.
Models can be created manually or automatically with a 3D modeling software. The software used for the 3D model in this case were Inventor and Alias from Autodesk.

Inventor is a 3D CAD software that allows creating mechanical design, documentation, and product simulation tools in a professional-grade. It is similar to other CAD programs such as SolidWorks, ProENGINEER, CATIA and Solid EDGE. It provides tools to create different pieces and assemblies. The basics of this program are pieces, built by 2D sketches that can be drawn in a plane and
extruded afterwards. This modeling system is very intuitive since it is quite easy to control all the dimensions and parameters of the piece. It provides modeling flexibility, each designer can decide the way he wants to design, with its parametric parameters. It can work with any kind of files from other 3D CAD programs maintaining the same settings.

Alias is a surfacing software that provides sketching, concept modeling, surfacing and visualization tools for designing. This product doesn’t go that much into mechanical details as inventor, it is oriented toward styling and appearance of the products. [35]

### 3.14.3 Rendering

It’s the process of generating a digital image from a 2D or 3D model in a realistic way. In order to get this image, it is necessary to use computer programs based on 3D computer graphics.

There are a lot of different rendering programs, the ones used for the project are: KeyShot and VRED (Autodesk).

Keyshot was used for simple renders, trying different materials and first concepts since this software is easier to use and the time of each render is shorter than in VRED. [36]

VRED was used for high quality renders, final renders of the product in order to visualize it in a more realistic way. [37]

### 3.14.4 3D printing

3D printing is an additive manufacturing process that consists in making a three dimensional solid object from a digital file by laying down layers of material to create it.

The model of printer used is makerbot. [38]

### 3.14.5 Surface finishing

When the pieces are out from the 3D printer and milling, it is necessary to carry out a process in order to give the final properties to the surface. It is used to improve the appearance and resistance.

The first step is to sand and put spackle in order to cover the pores and make the surface smoother. After the spackle is dry, is necessary to sand it down and add filler. The filler will cover the small holes and create a good surface to paint.

Painting is the first step, when the surface acquires the color.
4 Approach and Implementation

4.1 Project planning
To start with the project, a project planning was done in order to divide the different tasks on time and make sure that it was possible to do in the time estimated. The project was divided in the different steps pointed out in the design thinking process, and at the same time these steps were divided in other different tasks. The different activities were gathered with deadlines in a Gantt chart. (See Attachment 1. Gantt chart)

4.2 Project brief
Next step was to describe the project and make sure that it was clear for both parts, student, teachers and company. The description of the project can be seen in chapter 1. Introduction

4.3 Emphasize

4.3.1 Stakeholder analysis

The stakeholders of the project and their definition can be found in the table below.

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Position</th>
<th>Goals</th>
<th>Objections to project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anne-Marie</td>
<td>Company owner</td>
<td>Improve the service for costumers and messenger</td>
<td></td>
</tr>
<tr>
<td>Daniel</td>
<td>Supervisor of project</td>
<td>Check that the product is adequate</td>
<td></td>
</tr>
<tr>
<td>Messenger</td>
<td>Main user</td>
<td>Improve their way of transporting and security</td>
<td></td>
</tr>
<tr>
<td>Local shops</td>
<td>Helpa.se customers</td>
<td>Increase their sells</td>
<td></td>
</tr>
<tr>
<td>Person who orders</td>
<td>Helpa.se customers</td>
<td>Improve their way of buying</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Project stakeholders.

Figure 1. Project stakeholders.
Anne Marie as the company owner is the most interested and powerful stakeholder followed by the person who orders the product online and is going to receive it at home. These stakeholders are then the most important ones and it is important to take into account specially their requirements and needs. The messenger and local shops have high interest but low influence but they are important since they can be valuable sources of relevant information.

4.3.2 User study

4.3.2.1 Personas

Two different kinds of personas have been defined to carry this project:

1. Courier:

   Roberto is 35 years old. He is married and has one daughter who is 2 years old. He has not studied at university, but he has a lot of experience from different fields because he has worked since he was 16 years old. He and his wife live work in Jönköping, where they live. He is very interested in new technology and sports.

   Typical day: He wakes up very early every day to open the warehouse and prepare all the things necessary to start with the delivery. Since he needs to be always available for possible deliveries, he has to have lunch at work with his workmates. When he finishes his working hours he expends some time with his daughter until his wife arrives home and then they have dinner, watch some movies and go to sleep. Delivery is a very exigent job so he needs to work 7 days per week, nevertheless he works less hours during weekends.

   He is responsible for the delivery of the products, which is the main activity of the company where he works. It is a small company with only 4 workers. They form a small family and have a lot confidence between them, which makes a perfect work environment.

   Job role: In charge of delivering products from the local store to the customer of the company where he works by bike.

   Skills: He is in a good physical shape since he needs to be biking the whole day. He is a responsible person since he carries valuable things and make sure that they arrive without any damage. He is very active and cheerful; he always receives customers with a smile.
2. Helpa.se costumer

Claudia is 60 years old. She has one daughter and one son that are 30 and 34 years respectively. She lives in Jönköping’s outskirts with his husband. She is a very active person. She has been working in a big company for 30 years as an accountant and she is very happy there. In her free time she goes to the gym or meets her friends. She also spends some days of the week taking care of her grandsons. She is always very busy!

She likes new technologies, and she is used to buy online because that helps her to save time to spend it doing her favorite activities.

Job role: in charge of the accountant department.

4.3.2.2 Questionnaire

A questionnaire was made to Henric Warjo. He is an employer from the company in charge of delivery and transports and is going to be transporting the product:
Questions:
1. How many hours delivery service works a day?
   - We are delivering from 6:00 to 20:00

2. How often are you going to use the box?
   - There is not a specific time. It really depends on the product that we are going to deliver; we will only use it when someone orders expensive products that need some extra security. And most of the time the product is going to be in the bike or in the car, that is when we go to the place we have to deliver it.

3. Where do you prefer to carry packages?
   - Back
   - Front
   - Side

4. Would you like to have the option to change position when carrying the product?
   - Yes
   - No

5. Will you use gloves?
   - Yes, I think so. Some working gloves.

6. Do you need to carry something extra such as papers that the user needs to sign?
   - No, instead of having the regular signing system well substitute with our phone. All the information will be there so we do not need anything else.

7. How many boxes will you carry at the same time?
   - Only one

8. In case you deliver 2 or 3 boxes, for example. And you buy the items from the same store, how do you differentiate the different boxes?
   - I think it would be useful to have some space or something to add the name of the customer so it is easy to differentiate them and don’t mix them.

9. Would you like the box to have something special?
   - I think it is enough if the box is easy to carry

10. In case you have carried delivery boxes before, have you ever felt that there is something missing in them?
    - I have never carried them, so I don’t know.

Conclusions:
The box has to allow the courier to change position when carrying it. Taking into account that he is going to be working on delivery many hours a day he can feel tired and changing position can be beneficial.
The handle should be designed so that the courier can pick it up with gloves, taking in consideration its restrictions. The box should be able to distinguish from the other boxes with the name of the costumer that orders.

### 4.3.3 Functional analysis

A functional analysis was made in order to determine the different functions of the product. The functional analysis changes depending on the different stakeholders that interact with the product because each of them has their preferences regarding the product.

Courier: is the person that expends most of the time with the product, carrying it.

<table>
<thead>
<tr>
<th>Main function</th>
<th>Necessary function</th>
<th>Desired function</th>
<th>Unnecessary function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide safe storage</td>
<td>Store things safely</td>
<td>Withstand bullet impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be portable</td>
<td>Provide different dimensions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be compact</td>
<td>Have Coded opening</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be comfortable</td>
<td>Express professionalism</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Withstand impacts</td>
<td>Express simplicity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be easy to open</td>
<td>Be light</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be easy to close</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 2. Functional analysis- courier.*

Person who orders goods:

<table>
<thead>
<tr>
<th>Main function</th>
<th>Necessary function</th>
<th>Desired function</th>
<th>Unnecessary function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide safe storage</td>
<td>Be easy to understand</td>
<td>Express high quality design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be user friendly</td>
<td>Express service unique</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be easy to open</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 3. Functional analysis- helpa.se costumer.*

Producer:

<table>
<thead>
<tr>
<th>Main function</th>
<th>Necessary function</th>
<th>Desired function</th>
<th>Unnecessary function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide safe storage</td>
<td>Be produced cheaply</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Be easy to manufacture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 4. Functional analysis- Producer.*
4.3.4 Task analysis

The task analysis includes all the activities that involve the product that has to be designed. The figure 16 below describes using the storyboard technique in 9 steps the service that the company helpa.se offers to users where the product takes part.

1. The courier of the company in charge of the delivery prepares the bike and checks before going anywhere his task, the place where he has to buy things from.
2. The courier goes by bike to the store where he has to buy what the costumer has ordered.
3. The courier goes with the box to the shop.
4. The courier buys the goods and puts them in the box and locks it so the things inside are safe.
5. The courier puts the box in the cargo bike storage place.
6. The courier goes by bike to the place where he has to make the delivery somewhere in the street.
7. The courier arrives to the place where he has to make the delivery and gives the box to the costumer.
8. The courier opens the box with the code that has been provided from the service helpa.se the moment he made the order.
9. The courier takes the empty box again and puts it inside the box storage place. The box is ready for a new use!

There are different problems that emerge from the task analysis because they can affect the way the user communicates with the product. These problems can be solved in the new design improving it.

- The courier should know how to open the box and close it safely using the lock that only the person who orders the goods knows.
- The box should be designed from an ergonomic point of view since he is going to carry it and place it in different places and it wouldn’t be good if it interferes in the courier’s health.
- The box should be intuitive so that the courier doesn’t need to explain the person who receives the goods how to open it every time.

Below can be seen images of the bike that is going to be used to deliver the product.

![Figure 17. helpa.se bike.](image)

They have two different bikes and storage sizes. The small one is a normal cargo bike and the big one uses an electronic bike since it can transport much more weight.

### 4.3.5 Ergonomics

The ergonomic study is going to be based on the operations that the personas described in section 4.3.1 Personas. The first persona is going to place the goods bought inside the box and carry it to the persona 2 place as explained in section 4.5 task analysis.

The issues that can emerge are:
Physical activities:
- Manual material handling
- Musculoskeletal

Receiving information:
- Display design

Process information:
- Too much information

4.3.5.1 **Manual material handling (MMH)**

Manual handling is defined as the activity of moving items with the hand or hands. The load can be lifted, lowered, carried, pushed or pulled and can be animate or inanimate. [39]

Manual material handling can contribute to two different groups of injuries:

- Cuts, bruises, fractures.
- MSDs: The repeated exposure to ergonomic factors such as awkward postures, contact stress, force, static postures, and vibration over time can cause musculoskeletal disorders (MSDs). Belongs to MSDs any injury, damage or disorder of the joints in the limbs or back. Studies indicate that workers that perform manual handling have very high risk of back injury and about a forth of European workers suffer back pains because of it.

Prevention of these injuries is vital, since these injuries can have serious consequences to workers. It is in designer’s hands to reduce the risk of having these problems designing tools that help the users to have a correct position while performing manual handling. [40]

4.3.5.2 **Designing for carrying**

The operation that is going to be evaluated in this case is carrying because it is the task that the worker is going to do. In this specific activity, the risk depends on the load weight, the frequency of the operation and the posture of the worker in that moment.

Designers have the power of changing how the user interacts with the product and modify his posture in case it is prejudicial for his health. The different postures that the user can adopt can be measured. Shown below different factors that affect the user when carrying things. Each case is marked with a color that indicate how bad are for the user, if it is green, it means that the user doesn’t suffer much but if it is red, means that the posture has to be examined and avoided. When designing is important to help the user the most adequate posture, which are the ones in green preferably.

- Hand distance from the lower back:
  The risk of injury increases when the distance between the hands of the worker and the weight is bigger. The load should be as close to the body as possible.
  In some cases, the load is big and the user has to open his arms in order to reach it. Note that in this situation arm muscles can’t produce force as effective as if the load was closer to the body therefore injuries risk increases. [41]
• Asymmetrical torso/load:
The risk of injury decreases when the torso is symmetrical; both hands are in the front of the torso. And it increases when only one hand is used and it is situated on one side.

• Torso twisting and sideways bending

The risk of injury is minimum in this case when there is no torso twisting. The works case scenario is when torso twisting and sideways bending happen at the same time.

<table>
<thead>
<tr>
<th>Grip on the load</th>
<th>Good grip</th>
<th>Reasonable grip</th>
<th>Poor grip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-designed handles or handholds</td>
<td>Poor handles or handholds</td>
<td>Loose parts, irregular objects, difficult to handle</td>
<td></td>
</tr>
<tr>
<td>Loose parts that enables comfortable grip</td>
<td>Fingers clamped at 90 degrees under the item</td>
<td>Unpredictable loads</td>
<td></td>
</tr>
</tbody>
</table>

For more information about handle design, see chapter 4.3.5.3 Handle design.

<table>
<thead>
<tr>
<th>Floor surface</th>
<th>Good surface</th>
<th>Reasonable surface</th>
<th>Poor surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry an clean floor</td>
<td>Dry floor but uneven</td>
<td>Contaminated and wet floor</td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Grip on the load.

Table 6. Floor surface.
• Stability of load:
Unbalanced load or moving contents are dangerous since the center of gravity is not stable and can’t be placed close to the middle of the body. Sudden movements can affect on workers balance and make them fall. [42]

<table>
<thead>
<tr>
<th>Good stability</th>
<th>Reasonable surface</th>
<th>Poor surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance load</td>
<td>High loads in the bottom</td>
<td>Unstable loads</td>
</tr>
</tbody>
</table>

Table 7. Stability of load.

4.3.5.3 Handle design
A handle is anything that can be picked up by a user hand. Different handles need different features depending on the product; they can be small or big, sharp or round, confusing or easy to use…
The type of grip varies in each person and it depends on factors like posture, force needed, size of the hand… In order to design a handle as good as possible is necessary to have a checklist with all the different points to take into account. This checklist contains general factors for handle design adapted for different users and situations.
The first thing is to look at the types of handgrip, which one is the one that the user is going to have in the product? There are considered 6 different types (Mackenzie and Iberall 1994):
• Power grip
• Pinch
• External precision grip
• Internal precision grip
• Ulnar storage grip
• Other power grip

After defining the type of handgrip, a possible checklist for handle design could look like the one below:

1. Size: length at least 10 to 15 centimeters to be able to fit the width of the palm. This measurement depends on the range of population that is going to manipulate the object. It has to be longer for large-handed population. Take into consideration if the user is going to manipulate with gloves or not, then the length has to be different. The thickness should allow the thumb to cover the end of the middle fingers in order to be comfortable.

2. Shape: in order to avoid sliding, the handle should have uniform diameter and smooth surface. To secure it more about sliding, the center of the handle should be thicker than the rest. It is important that there are no sharp edges or high spots where the handle is going to be hold. They make the handle uncomfortable and can originate injuries in the user.

3. Surface: a smooth surface makes the handle more comfortable. Roughness depend on the product where it is going to be applied. It is important to take into account the possibility of originating blisters and cuts due to a bad surface or not
appropriated for the task. It is also good if it is insulated from vibration and electricity in case it is going to work in work environments.

4. Security: it can implement protection against sliding because the user can slide his hand and damage himself. Gentle finger grooving can be applied sometimes.

5. Surroundings: fingers can be damaged if the surroundings of the handle are not clean enough.

6. Special other features: cleaning compounds, be able to be replaced to be used for different users… [43]

4.3.6 Benchmarking

This box is a new concept of product, this is why it is not possible to find existing ones in the market. The benchmarking is going to be based on similar products, some of them used for delivery (parcel delivery boxes) and other used for security reasons, such as security boxes and document boxes, which contain combination code lock.

<table>
<thead>
<tr>
<th>Picture</th>
<th>Name</th>
<th>Features</th>
<th>Size</th>
<th>Material</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Portable fingerprint biometric lock case" /></td>
<td>Portable fingerprint biometric lock case</td>
<td>Fingerprint sensor lock, Security cable, Memory sponge</td>
<td>200x185mm</td>
<td>19 gauge steel with durable powder</td>
<td>879.23 SEK</td>
</tr>
<tr>
<td><img src="image2.png" alt="Master lock key store" /></td>
<td>Master lock key store</td>
<td>Water resistant, 4 digit programmable combination, Dual locking levers</td>
<td>130x95x50mm</td>
<td>zinc</td>
<td>223.16 SEK</td>
</tr>
<tr>
<td><img src="image3.png" alt="AquaVault Outdoor Security box" /></td>
<td>AquaVault Outdoor Security box</td>
<td>Lever key, Corrosion resistant, Reprogrammable 3 digit lock, Removable strap</td>
<td>228.6x127x165,1mm</td>
<td>ABS and stainless steel</td>
<td>178.71 SEK</td>
</tr>
<tr>
<td><img src="image4.png" alt="Waterproof crushproof carrying security box" /></td>
<td>Waterproof crushproof carrying security box</td>
<td>4 bracket latches, Extendable rod self-locked</td>
<td>357x269x187mm</td>
<td>ABS</td>
<td>751.32 SEK</td>
</tr>
<tr>
<td><img src="image5.png" alt="Electronic security box" /></td>
<td>Electronic security box</td>
<td>Battery operated, Digital locking, Foam lined inner compartment</td>
<td>304.8x152.4x279.4mm</td>
<td>steel</td>
<td>948.99 SEK</td>
</tr>
</tbody>
</table>
As it can be seen in the table 8 above, the similar products based on boxes to storage things safely are very varied. What they have in common is that they are for private use, its particulars who buy this product to have it at work or home to keep their belongings safely. They have different dimensions depending on the things that keep inside and in some cases are available in different dimensions depending on the user needs. The materials used are mostly metal and ABS which are very resistant materials but can’t withstand big forces like bullets or heavy machines.

The appearance of each of them is different, but is not something that designers have been working a lot on. They have basic shapes and colors, which makes them very simple. Most of them implement a coded lock to increase security.

4.3.7 Brand analysis

In order to find a manner that communicates that the product that will be designed for the company helpa.se really communicates the brand identity a brand analysis was made. This analysis is divided in two steps as explained in chapter 3.11 Brand analysis.

1. Strategic brand identity:
Helpa.se is a recently created company that started in 2014 and it provides costumer with a service based on a webpage where they can order products from a local shop and then receive them at home thanks to their personal delivery system (see image on the right). It lacks brand heritage since it has been created some years ago.
Although there are some companies that have similar services, helpa.se offers a unique service, which didn’t exist before.
Their strategy is to promote local economy by selling their products and facilitate the users their access with a fast and green supply. Their idea is to help customers from a loyal, positive and responsible point of view.

2. Visual product identity:
Helpa.se doesn’t own any product yet because what they do is to provide a service. The box will be the first product that differentiates them from the other delivery methods added to the bike delivery. The only elements that can be analyzed in order to get an idea about the brand is the logotype and webpage design and graphics that can be seen below.
Approach and Implementation

Figure 22. helpa.se header [1].

Figure 23. helpa.se Webpage [1].
Both are characterized for a simple look where predominates the colors white and green (#2fab65) and rounded shapes in their elements and font. These elements will be explained further below.

Font psychology:
Typographies are a very communicative part since they are used to communicate to the customer what the company is about and their services. There is a lot of psychological background behind them. Fonts influence customers subconsciously [44]. This psychological process works in different steps, summarized below:

1. We perceive a font
2. The different font components that form it are distinguished by the brain, activating perceptual associations. The brain untangles the visual traits of fonts.
3. Then we activate direct associations giving meaning to each of the fonts depending on the knowledge that each person has or their historical precedence.
4. These activations lead the brain to a specific emotional feeling.
5. We form our positive or negative evaluation after processing this information and comparing it to the topic it is related to.

The typography used in this case is Museo Sans Rounded 900 (see figure 24 below) which main characteristic is its rounded shape. This typography is used to reinforce the company’s image, giving a kind and nice impression to the customers.

What font psychology behind this font says about the typography that helpa.se uses for its webpage is [45]:
- Since it belongs to the Sans-serif group, it is known to be the most readable fonts via screens.
- Sans-serif fonts also express informality and innovation
- Bold fonts express power
- Rounded fonts express comfort and softness
- Straight fonts express stability
- Mixed case fonts are most readable
- Condensed fonts express tightness and precision

The logo font has also the same characteristics, but in this case the font is more attractive, warm and engaging due to its connected letters.

Color psychology:
It is also important to explain color psychology since it is something that also influences customers. Colors have different meanings and the factors why people associate them to one meaning or another depend on the experience, culture differences and context where the
color appears. Apart from that, each color has its own meanings and associations (see figure 25 below)

<table>
<thead>
<tr>
<th>COLOR</th>
<th>MEANINGS AND ASSOCIATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Anxiety, Arousing, Daring, Dominant, Energy, Excitement, Health, Life, Love, Passion, Power, Protection, Spirited, Stimulating, Strength, Up-To-Date</td>
</tr>
<tr>
<td>Orange</td>
<td>Abundance, Arousing, Comfort, Daring, Excitement, Extraversion, Fun, Happiness, Lively, Security, Sensuality, Spirited, Warmth</td>
</tr>
<tr>
<td>Yellow</td>
<td>Arousing, Cheerful, Confidence, Creativity, Excitement, Extraversion, Friendliness, Happiness, Optimism, Self-Ease, Sincerity, Smiley, Spirited</td>
</tr>
<tr>
<td>Blue</td>
<td>Calm, Comfort, Competence, Coyness, Dignified Duty, Efficiency, Intelligence, Logic, Peace, Reflection, Relaxation, Reliability, Security, Serenity, Soothing, Successful, Tender, Tranquility, Trust</td>
</tr>
<tr>
<td>Purple</td>
<td>Authenticity, Charming, Dignified, Exclusive, Luxury, Quality, Regal, Sensuality, Sophistication, Spiritual, Stable, Upper Class</td>
</tr>
<tr>
<td>Pink</td>
<td>Charming, Cheerful, Feminine, Gentle, Nurturing, Sincerity, Soft, Sophistication, Tranquility, Warmth</td>
</tr>
<tr>
<td>Black</td>
<td>Dignified, Efficiency, Elegance, Emotional Safety, Glamour, Power, Richness, Ruggedness, Security, Sophistication, Stable, Subtance, Tough, Upper Class</td>
</tr>
<tr>
<td>White</td>
<td>Calm, Clarity, Cleanliness, Down-to-Earth, Happiness, Heavens, Honest, Hygiene, Innocence, Peace, Purify, Serenity, Sincerity, Soothing, Tender</td>
</tr>
</tbody>
</table>

From an aesthetic point of view, colors can:
- Influence the choice of the brand for the customers
- Attract attention
- Increase the loyalty of the brand
- Improve the usability of the design
- Enhance the credibility of the product/brand

The color chosen for the company is green, see figure 26 on the left. Green is a color that shows security, nature, peace, comfort and health. This is exactly what the company wants to show to the customers and makes it a reliable company.

| Figure 26. helpa.se color. |

Other elements:
Helpa.se also uses other kind of elements in their webpage such as icons that represents the variety of products that helpa.se can provide you. These icons are in the same green color as the other elements included in the webpage and the logo. They round shapes and color gives them a kind and friendly aspect.
Conclusion:
Helpa.se can be perceived as a friendly, calm and innovative company which main goal is to be in contact with their customers and provide help with a innovative and unique, formal and unique service based on their needs. It intends to be always next to the customers and provide them the best service possible. The green colors enhance their sustainable and nature-friendly service.

4.3.8 Material analysis

One of the requirements of the product is that it has to be “bullet proof” or at least be resistant to big impacts that the product can suffer. By having this high resistant material, we make the product safer and if someone is going to steal it we make sure that is not going to be opened and let that person to take the goods inside. The idea is to reduce at maximum the possibilities of breaking it.

Based on this first requirement and thinking about materials that can be easy to mold, therefore have an easy and as cheap as possible manufacturing, two big groups of materials are going to be studied; metals and plastics. These materials are the most commonly used for this application.

4.3.8.1 Plastics

Plastics are synthetic or semi-synthetic materials that can be used in a huge range of applications thanks to their good characteristics that makes them a very versatile material. We can find a huge range of types and categories of plastics depending on their characteristics. In this case, the division that is going to be used depends on their impact resistance since it is the main interest for the product, as said before. [46]

We can find brittle plastics: These materials should be avoided because they lack toughness. The impact resistance is not good and can break easily. They don’t absorb energy prior to fracture and break without plastic deformation. Belong to this group PS, PSU, SAN and PMMA. Although this plastics can be modified adding reinforcement or additives that improves their characteristics.

High resistant plastics:
In this category we can find materials like GMTex (PP, PA, TPP with woven and laid fibers), ABS, HDPE, PC, TPO, HIPS, PP, PBT, ASA. Even if these materials have specific characteristics, they can also be modified and improved adding different kind of reinforcements.
4.3.8.2 Metals
Metals are hard, opaque, shiny and have good electrical and thermal conductivity. It can be shaped in many different ways. They are found on nature, extracted and processed afterwards to get the material that is going to be used in manufacturing methods. They are mostly used in applications where the product has to resist impact damage or carry large loads.
From all the metals, the most common ones for this type of application that the product is going to be for are zinc and steel. Both are used nowadays for safety boxes.

4.3.8.3 Evaluation

<table>
<thead>
<tr>
<th>Plastics</th>
<th>Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to mold</td>
<td>Good strength</td>
</tr>
<tr>
<td>Easy to color</td>
<td>Possibility to recycle</td>
</tr>
<tr>
<td>Light weigh</td>
<td>Heat resistant</td>
</tr>
<tr>
<td>Easy to modify characteristics</td>
<td></td>
</tr>
<tr>
<td>Good surface finishing</td>
<td></td>
</tr>
<tr>
<td>Faster to produce</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not all can be recycled</td>
<td>Heavy weigh</td>
</tr>
<tr>
<td>Need to have surface finishing operations</td>
<td></td>
</tr>
<tr>
<td>Design limitations</td>
<td></td>
</tr>
</tbody>
</table>

Table 9. Benchmarking.

4.3.8.4 Manufacturing methods
The two manufacturing methods more appropriate to manufacture this kind of pieces that give the best results for the surfaces are Injection molding and Rotomolding.
Explained below in what they consist, their advantages and disadvantages.

Injection molding:
Injection is a continuous process in which the plastic is melted and introduced with pressure inside of a mold. This mold has the shape of the final piece. Injection molding is very popular because it can be produced products with very diverse shapes and sizes. It is an easy and quick method that can be adapted to different production levels and costs depending on the pieces that have to be manufactured. This process is mainly used for thermoplastic and thermosetting polymers.

The process consists in different steps:
The first step is to introduce the raw material in the hopper, that gravity feeds the process. This material is introduced in a screw where it is heated and pushed forward into the mold. The screw makes such force that the material is injected with high pressure in the mold, filling all the different cavities and creating the piece. Molds are made from high resistant metals and represent the highest price when using with injection molding manufacturing. Then the piece is cooled down, the mold pens and different ejectors helps pushing the piece from the mold in order to be able to take it. The process can be seen in the figure below.
• Design guidelines:
In order to get a fastest process, it is important to design thin wall thicknesses, because they cool faster. Cycle times are shorter, parts weigh less and the plastic used is less (reducing costs in material). A good range is between 2 and 4 mm. Uniform thickness walls help to fill the cavity more easily and also avoids shirking of the pieces. In case that the wall thickness can’t be uniform, the change should be as gradual as possible.
Ribs should be designed in order to increase the bending stiffness without adding thickness. The thickness of these ribs shouldn’t be more than the wall thickness in order to avoid sinking effects.
Mold drafts facilitate remove the part from the mold. It must be an offset angle parallel to the mold.
Textures and lettering have to be included in the mold surfaces.
Avoid sharp conrners in the design because they increase stress concentration. At least have a radious that is 0,5 times times the material thickness inside. [47]

**Rotomolding**

It consists in a rotational mold with the negative shape of the final product. Each mold is developed and adapted to each product. The products that can be produced with this type of manufacturing process vary between 0,5 and 300 kg. It is a economic process that can produce varied pieces for different industries.

The product is manufactured in different phases; the first one is filling the mold with the material in powdered resin form. Then the mold is closed and heated (between 230-380 degrees) till the material is liquid and rotated (4 – 20 revs/min.) at the same time around the horizontal and vertical axis so the material is attached to the walls of the mold. When the material has adapted its shape to the mold, the cooling starts. The mold rotation stops and the product is removed from the mold in the last phase when it is solid. See process in figure below.
The mold is usually divided into two different halves or three or more if there are complex parts. This mold is made out of aluminum or sheet steel. Lower cost than vacuum molding or blow molding. The price is not excessively high for short production products. There is not a waste of material because the full charge is used in the product manufacturing.

The disadvantage is that the choice of materials is limited and the costs of it can be high because of the additives that make it thin powder. [47]

- Design guidelines
  It can happen that in different parts of the piece the thickness varies, but it can be controlled altering the speeds and speed ratios of the mold.

4.4 Define

4.4.1 Product design specifications

See Attachment 2. Product design specifications

4.5 Ideate

4.5.1 Idea generation

Before the concepts were generated, different Sketches were made based on different ideas based on simplicity and innovation. The idea was to gather all the possible solutions in order to group them or decide the most interesting ones to create the first 3 concepts. The sketches can be seen in Attachment 3 Sketches.
4.5.2 Concepts

The first round of concepts come from the ideas generated in earlier stages.

4.5.2.1 Concept 1

![Image of Concept 1]

This concept is based on a regular box that opens in two halves. It contains a hidden lock, which makes the box safer since it doesn’t show that it is something valuable inside. It can be carried by the courier in two different positions; using the handle, placing it on one side parallel to the body and on front thanks to the hand holders placed on the sides. The handle can change position and it is able to hide and put at the same level as the top part of the box to facilitate the storage.

The shape of the box facilitates the storage inside of the cargo bike.

The inside of the box is covered with Velcro, it is a soft material easy to clean and it allows to put some bands in order to attach the goods inside.

In order to differentiate the customers one from the other, each box includes a color code that will be send to the customer at the same time as the code to open the box.

Regarding colors: it has been used the green color from the logotype and white since they are the main colors of the company.
4.5.2.2 Concept 2

This concept has different dimensions. It is thought to be for bottles since it has a larger shape and not as deep as in concept 1. The opening is vertical and allows seeing the interior completely.
The lock is not covered in this case so the customer can easily see where the opening is and the interaction with the product could be easier.
The box has two positions; the courier can carry it on the back like a backpack or on one side thanks to its handle.
Both handle and backpack bands are made out of a soft textile to ensure comfort of the courier.
The interior also includes Velcro for the same function as in concept 1.
4.5.2.3 Concept 3

This concept comes from the inspiration of watch boxes. The idea is to give a “fancy” feeling to the customer that receives the product.
The color of the box is green and it has more rounded shapes.
In this case, the box opens horizontally to one side, sliding all the content to the exterior.
The handles are made out of leather, which makes it a more exclusive product.
The lock is covered by a transparent plastic cover on one side. The transparent plastic lets the customers localize easily the lock.
The idea is that this box can be scaled in different dimensions. The company would have in this case two different dimensions, one for smaller things and another one for bigger things.

4.5.2.4 Concept selection

In order to select one of the concepts to continue developing the product, a meeting with the company was held. Anne-Marie (owner of the company) and Henric (courier) were present in this meeting.
The concepts were presented to the company in order to receive some feedback and agree on some guidelines to work and develop the product for the final phase.
After watching the three concepts, the company decided to continue with the concept 1, the positive points that made them select it were:

- It has the best shape to storage inside of the cargo bike.
• The lock is hidden so it doesn’t show that there is something valuable on the inside
• The courier can change positions.
• The color code could be very useful to distinguish different zones in Jönköping county
• Using Velcro in the inside is a good way to fix the things and avoid that they move and break, especially for bottles.

They also pointed out some things that could be added in order to make the product more interesting and adapter to the courier.

• It could also include the idea in concept 2 regarding the differentiation of the boxes. A plastic piece where they can put the number of the order.
• The box could include some rubber feet to avoid that it slips inside of the cargo bike
• The box could include some kind of system that makes easy to make a pile of them. For example, lego pieces.
• The box could also have the possibility of adding a band so the courier can hang it on his shoulder.

4.5.3 Final concept development

4.5.3.1 Definition of the elements needed

With the company specifications and after the meeting, all the elements that have to be included in the product were defined. The reason why this elements were not defined before is because the company didn’t know exactly what to include and it came later in the process. An image board was created including all the different things that the product must have (see figure 34 below)
1. Handle: to facilitate the carrying activity to the courier.
2. Lock: the lock is provided by the company
3. Lock cover: the lock has to be covered so it doesn’t show that the product contains something valuable and decreases the risk of robbery
4. Customer identification: something where the company can put the number of the customer or something that identifies each of the different customers. This will make the task easier for the courier.
5. Bulletproof material.
6. Anti-sliding base: so the boxes don’t move when they are being transported in the storage place in the bike.
7. Band: it allows the courier to hang the box on one side. Easier to transport.
8. Side holder: the courier can transport the box in front of him using the side holders.
9. Hinges: that allow opening and closing the box and the lock cover.
10. Fitting surfaces: to make easier the storage inside of the storage place. The different boxes fit one into the other.
11. Interior: the interior has to be adapted for the content and take into account that there are going to be fragile things inside.

4.5.3.2 Dimensions

One of the last requirements was defined in the mid-presentation with the company. The new requirement was that they wanted to transport 5 boxes at the same time, which means that they have to fit at least in the smallest cargo bike that they have. That space was measured in order to define the final dimensions. To start with the dimensions definition, a scheme with all the possible options was made in Photoshop in order to evaluate them. The scheme can be seen below.
All the options were evaluated considering transportation requirements:

- Options 1 and 4 were discarded because it was only possible to carry 4 at the same time. The company was thinking about this idea, so the courier had to carry one of the boxes on him. The idea as to use as much space as possible.
- Option 3 was discarded because the boxes designed in that case were not deep enough to fit big bottles inside.

In the end, only options 2 and 5 were developed further in order to get a final solution.

Two cardboard models of the options 2 and 5 were made in order to evaluate the dimensions. For each options there were pointed out some advantages and disadvantages in order to take the final decision.
Option 1:

- **Advantages:**
  - Many bottles can be fitted in.
  - Big dimensions to fit every kind of product
  - Easy access to the things inside because of its large area.

- **Disadvantages:**
  - The dimensions are too big and it can be difficult to transport
  - Not all the boxes can be seen from the top of the storage box. The courier might have to take out some of the boxes in order to have access to the ones that are placed in the bottom.
  - It can be very heavy because of the amount of products that can be fitted in.
Option 2:

Figure 39. Option 2 dimensions.

Figure 40. How to carry option 2.

Figure 41. Option 2 on cargo bike.

- Advantages:
  All the boxes are more accessible. The courier can see all of them when he opens the storage place and pick easily the one that he needs in every moment.
  Still many bottles can be placed inside.
  Easy access to the bottles if they are placed vertically.
  It leaves some space left if the courier needs to carry something else.
  It can be possible to place 6 instead of 5.
- Disadvantages:
The box is too tall and there is some space that is never going to be used but decreases
the courier comfort.
Small objects are more difficult to take if they are placed in the bottom of the box.

4.5.3.3 Dimensions selection
In order to select the proper dimensions for the product, the research was sent to the
company to see which one could fit their needs best. The dimensions chosen where the
ones in the second option, the reasons why it was chosen were:
1. The space inside is enough for the quantity of things they want to store.
2. The bottles are more accessible and easy to take.
3. It is easy to transport
4. It can be reduced in height and take advantage of this space and create a box that
can fit in that space for smaller products.

4.5.3.4 Second round of concepts
After the definition of the dimensions, there was a second round of concepts, focusing on
the different parts defined in chapter 4.5.3.1 Definition of the elements needed.
To start, three concepts were sketched with pen and paper see image 42 below

![Figure 42. Second round of concepts sketches.]

In order to visualize the different concepts better and have a better understanding of the
different parts, each of the concepts were modeled in 3D and rendered. This helped to
see the different geometries better and also evaluate them from a more accurate
perspective. The models were done in Inventor and renders in Keyshot.
4.5.3.5 Concept 1

Figure 43. Second round concept 1.

Characteristics:

- The lock is covered by a lid attached to the box with a hidden hinge that allows the opening movement without interfering with the product or crashing on the surface.
- The colors used are green and white. White is the predominant color, which shows simplicity and clean design.
- In the front, there is a sticker with the graphics used for the company giving it a kinder look.
- It has two different ways to identify the customers. The color code that can change depending on the area where the box is going to be delivered and a second place where a sticker can be placed and removed easily with the number of the order.
- It can be hold from the sides.
- There is a band included in the big size of the box in order to be able to hang on the shoulder of the courier.
- It is available in two different dimensions. The small box can be stored on top of the big box perfectly since it has some fittings on the top surface and in the bottom of each box.
4.5.3.6 Concept 2

- It has a band with a hook that can be removed if it is not necessary or attached if necessary. The place where it is attached is a whole that is made with the product.
- The customer can be identified with a paper that is introduced in a plastic thing on top of the box. This also facilitates the courier to see it easily.
- It can be hold from the sides.
- The lock is covered with a lock that can be moved upwards.
- The box is identified with the name of the company in the front.
- The colors used for this concept is green and white again but in this case green is the predominant one. A darker color can help in case the box is scratched or damaged since it is less visible.
- The box is available in two different sizes. The area that allows the fitting between the boxes corresponds with the whole bottom area of the box.
4.5.3.7 Concept 3

- It has a band with a hook that can be attached on a ring that is implemented in the box bottom part.
- A color sticker can identify the customer. In the sticker appears the number of the order. This sticker is printed by helpa.se and the courier sticks it when he puts the goods inside at the shop.
- It can be hold from the sides thanks to the handles that are implemented on the sides of the bottom part of the box.
- A lid that can be lifted upwards covers the lock. The lock has an easy access.
- The colors used are green and white.
- The logo is situated in the front of the box, extruded and in another color to make it pop up from the surface and gives it more importance.

4.5.3.8 Concept evaluation

In order to evaluate the different concepts, it was applied the concept evaluation technique explained in chapter 3.13 Idea selection. Each concept was evaluated taking into account its different parts. The most evaluated parts of each one where the ones developed further for the final concept. The points given in order to evaluate go from 1 to 5. 1 is the less important and 5 is the most important.

The different evaluating points are:
• Manufacturing: indicates if it is easy to manufacture or not. In this case is an important element because if it can be difficult to manufacture, the product is not going to be produced.
• Aesthetics: how the product looks, if it is attractive to the user.
• Cost: if it is cheap or not to manufacture.
• Usability: taking into account the different customers, it is important that the product is easy to use.
• Functionality: overall, if the product fulfills its requirements and can be used correctly.

The punctuation given to each of the different points for each concept is multiplied for the importance of each element. The reason why it was made this way is because not all the different points have the same importance when designing a product. The result that appears in “final punctuation” is the sum of the different results in each column when multiplying importance and punctuation (numbers in blue).

<table>
<thead>
<tr>
<th>Concept 1</th>
<th>Importance</th>
<th>Identification</th>
<th>Band attachment</th>
<th>Side holder</th>
<th>Lock lid</th>
<th>General aesthetics</th>
<th>Fit in system</th>
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Table 10. Concept 1 evaluation.

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<th>Lock lid</th>
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<th>Fit in system</th>
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</table>

Table 11. Concept 2 evaluation.
In color green appears the solutions with more punctuation of the three different concepts. In color red appears the solutions that are not going to be developed further. The concept with better results is concept 2.

4.5.3.9 Refine

Before creating the final 3D model, some sketches were made to explore new shapes and ways to implement all the different solutions shown in the second round of concepts. The sketches were specifically focused on the stackable system and lock lid, which were the more problematic parts of the design.
4.6 Prototype

4.6.1 3D modeling

In order to develop the final product that can be seen in chapter 5.0 Result, 3D modeling software was used to visualize the different shapes and elements that could be implemented. Experimentation about the different shapes and features was done in order to find the most appropriated one. Below can be seen the parts that result more complicated to develop and the different variations for each ones.

Lock lid:
On the lock lid there were some different variations before the final result since there were many aspects to take into account.

Figure 47. Lock lid variation 1.

Figure 48. Lock lid variation 2.

Figure 49. Lock lid final idea.
The first idea was to make it completely manual. The user would have to lift it with his hand. With this solution, the lid needs to be bigger so the user has space to put its fingers inside and lift it. The problem is that if the lid is bigger it also looks more unstable and since it is only attached with a hinge in the top of it, it could be easy to break it.

The final concept consists on a button that if pressed, opens the lid. The user can easily localize it and open the lid without necessity of putting any extra effort. To know more about the opening system see chapter 5.2.2 Lock cover.

**Handle attachment to the box:**
Another of the focuses was how to attach the handle of the box to it, since the lid is going to be manufactured in one piece and the handle has to be attached to it.

The first idea was to make the handle in a softer material that could be forced to attach it.

The second idea was to create a division in the place where the handle was going to be placed in order to have two pieces that could be screwed one on the other once the handle was placed inside.
Any of those ideas was used since forcing the material or screwing was not suitable.

When all those different parts were totally defined, the concept was almost finalized and some variations in color and materials (see Figure 53 below) were sent to the company to evaluate the concept and see if modifications were needed or not for the final result.

![Figure 53. Color variations.](image)

1. The first variation uses the characteristic helpa.se green color with different graphics in form of stickers on the front part of it. The paint used is matte in this case. This color was chosen because it is the main color of the company and it is used in all their products and graphics.

2. The second variation has two different grey tones in shiny paint and the company logo in white in the front part to make it contrast, and pop up from the grey. Since they use green for all their products right now (cars, bikes…) it could be interesting to use a more neutral color.

3. The third variation mixes metallic green paint and metallic grey paint. The idea was to give a more “safety box” look, more robust and heavy.

After a meeting and discussion about it with Anne-Marie, the concept chosen was the first one since she thought it represents better the company and the green color is better for it.
5 Result

This chapter includes the final product, the description of it, images and final prototype of it in order to be understandable.

5.1 Final design

The final concept is a simple, clean and compact design of a box for delivery. It can be found in two different sizes that the courier can use depending on the size of the goods that he has to transport. The big size has been thought for big and expensive products such as bottles and the small size is adapted especially for medicine. In order to minimize the manufacturing costs, both boxes share the same pieces but the bottom part, which in the case of the small size will be smaller.

It is easy to carry thanks to its handle on top of it. The box provides safety thanks to the lock that it includes in its frontal part. The lock comes completely covered in order to improve safety and protect it from the weather, since the box is going to be carried on the street and it can be raining or snowing for example. Also the material in which is manufactured is very resistant, which will prevent it from breaking in case someone steals it (see chapter 5.3.1 materials).

The box is stackable, which means that both big and small size of box can be put one on top of the other. This facilitates the transport and prevents them from falling and breaking.
The size of it has been perfectly designed to be adapted to the small cargo bike that the company has. The courier will be able to transport 12 of the boxes (6 small size and 6 big size) at the same time.

5.2 Features

5.2.1 Handle

The handle is placed in the top of the box. It can have two different positions.

1. When the handle is being used, it is placed perpendicular to the top surface of the box. In this case the user holds it to transport it.
2. When the handle is horizontal. Its top part is at the same level as the top horizontal surface of the box. This second position is used when the boxes are going to be placed one on top of the other, so the handle is not disturbing.

It is attached to the top part of the box thanks to two metallic pins that go through it and are attached from the inside. The pins are made out of steel which prevents them of breaking when lifting the box in case there is something very heavy in the inside.
5.2.2 Lock cover

The lock cover is placed in front of the box. On it appears the logo of the company which makes the surface differentiate from the main box, but it has the same green color as the rest of the product because of company requirements. The idea is that the lid does not show much so people that don’t know the product doesn’t know that there is a lock and so it contains something valuable inside. Nevertheless, the button that appears just below it, indicates that there is some kind of lid that will open if pushed.

The lock cover opens with a simple system that consists on a soft opening hinge. When pushing the button, the lid will open automatically. In order to close it the user only has to push the lid back to its place. This button is easy to find since it has different color. By using affordances, the button appears surrounded by a recess, which indicates to the user that the button goes inwards and it has to be pushed.

In order to allow the lid to open completely and don’t disturb the user when he is going to use the lock, the top of the box has been specially designed with a curve. When opened, the lid rests on this surface.

5.2.3 Customer identification

In order to identify de different boxes and know for which customer they go to, they include a transparent plastic piece on top of it with space to insert paper that can be printed on the company and has the code/name of the customer it goes to. This paper could include colors depending on the area where it is supposed to be delivered to make it clearer for the courier.
5.2.4 Lock

The lock is placed in the bottom of the box since it is a very heavy part and it could make the whole box tilt if placed in the lid for example. In order to place it on the box, it has been taken into consideration that it needs to be covered and at the same time easy to access. The reason why it needs to be covered is that people associate lock to something valuable, so people would know that there is something expensive and it has higher risk of robbery.

Hiding the lock has also some disadvantages when placing it, because the user needs to interact with it and be able to put the code without problems. This is why, the vertical surface has been flushed with the lock surface. The user can see the lock without problems from any direction and interact with it.

Since there is going to be many different customers using this lock and not everyone has been in touch with this kind of technology, the box includes some instructions above the lock to guide the user.
5.2.5 Strap

The box can be transported hanging on the courier shoulders like a bag. It includes a strap that the courier adds if necessary. The reason why this band is not always permanent in the box is because it could be disturbing when placing all the different boxes on the cargo bike. The strap is made out of a textile material and placed on a hook. This hook can easily be attached to the sides of the box. For this purpose, there are two metallic pieces, one at each side.

Figure 61. Strap

5.2.6 Anti-sliding material

In order to avoid the boxes slide with the movement when transporting, it has an anti sliding material on its bottom. It is based on a rubberized surface that increases friction between the bottom of the box and the surface where it is placed so it doesn’t allow it to move.

Figure 62. Bottom view

5.2.7 Hinges

The hinges are a very important part of the product, makes the box be able to be open and they are also very fragile, because if placed it wrong could make the box very unsafe. The hinges can’t be placed outside because they could be easy to break and be a problem for safety. For this reason, new hinges have been designed specially for this product. They are placed on the inside and allow the box to open in 90 degrees.
5.2.8 **Fitting surfaces**

The geometry of the product has been specially designed in order to be stackable easily. It consists in two extruded parts, one at each side of the box that fit perfectly on the space left for the courier to put his hands and carry it. The geometry matches with the general aesthetics of the product and gives it a stylish look.

5.2.9 **Side holder**
The box is possible to hold on the sides. A recess has been designed on the bottom part of it, where the courier puts his hands. Its geometry stops it from sliding from the courier’s hands and has a curve that adapts to his hands.

5.2.10 Inside cover

The inside of the product is covered with Velcro (see figure 67 on the left), which gives a more soft and warm feeling and also allows to attach elastic bands on the sides that go around the product. The thought behind is that if the product is fragile and can be damaged with the movement, it can be attached to the walls of the box to avoid its movement inside.

5.3 Technical specifications

5.3.1 Materials

One of the requirements of the product is that it should be stiff, resistant to any kind of impact to avoid being broken easily if someone steals it and also light weight. The challenge is to find a material that has both characteristics and also can be easily molded. The
different materials that were considered in the beginning can be seen in chapter 4.3.8 Materials analysis.

**Box**

The material chosen for this product is TPO. TPO is formed by:
- Polypropylene which provides the material stiffness and temperature stability.
- Cross-linked EPDM rubber: That gives elasticity and impact resistance to the material.
- Minerals such as glass fiber or carbon which improves stiffness and dimensional stability to the manufactured piece.
- Polyethylene.
- Different kinds of additives that changes specific properties to the polymer. In this case it could be used additives to make it more resistant to scratches and to fire. This will improve the durability of the product.

This material is commonly used in applications were toughness and durability is needed such as automotive bumpers and dashboards and as a replacement for metal and other polymers such as ABS and polycarbonate.

It can easily be processed by injection molding, extrusion and blow molding.

**Handle:**

Since the handle doesn’t need to be that resistant, it could be manufactured in PP, which is a very cheap material and has good qualities. It can also be easily molded.

**Metallic parts:**

For the metallic parts such as the hinges and the pieces where the hooks are attached on the sides, it has been chosen steel, because they are very delicate pieces where high resistance is needed. Also we can get very good properties with smaller thicknesses.

### 5.3.2 Ergonomics

Ergonomic aspects have been taken into account when designing the product. One of the main issues was to try to avoid that the courier gets damaged because of heavy weight of the product. The design decisions taken are:

**Physical ergonomics:**
- The material in which is going to be manufactured is light, which reduces the weight of the whole box, and makes it easier to carry.
- As it appears in chapter 4.3.5.2 Designing for carrying the best positions when carrying a product is to keep it in front in order to avoid torso twisting, holding it close to the lower back and with a symmetrical load. The side holders have been designed in order to solve this problem. The user can hold the product in front of him thanks to its hand holders, one on each side, closer to his back and so reducing the risk of injuries.
• The side hand holders are long enough to be able to fit the width of the palm and so be comfortable for the person that is carrying it.
• Due to the type of product, the load will always be in the bottom, which reduces the risk of injuries.
• The length of the handle is enough so the width of the palm fits.

• The handle has been designed so the center of it is thicker in order to prevent sliding when carrying.

Cognitive ergonomics:
• Affordances have been used in the case of the button so the user can easily identify that he has to push it instead of doing any other operation with it.
• The parts that the user has to interact with has a different color than the background (grey on green parts) as it can be seen in the button to open the lid so the user can easily localize them.
5.3.3 Dimensions

When designing the box, one of the main considerations was that it should fit the more boxes as possible in the same bike. The most important dimension is the width and height of the box, that determines how many boxes fit in the cargo bike at the same time. Also it was taken into account that the box was not extremely big to carry it, since it would be a problem for the courier. The weigh, which is an important factor when transporting is reduced when the box is smaller.

After a deep study on different dimensions (See chapter 4.5.3.2 Dimensions) it was chosen 280X290X340mm for the big size box and 280x290x150 mm for the small size box. The small size box on top of the big size box could fit perfectly inside the cargo bike and they could store 12 at the same time (6 big and 6 small).

Regarding ergonomics, the handle size was designed with the dimensions found during the research. The diameter of the handle is 25mm which is the recommended diameter for this kind of handles.

5.3.4 Components

The image shows the exploded view of the elements explained in previous chapters. All the components are screwed, except the lock lid, that is attached thanks to its hinge and the open button that is inserted. The top lid is attached to the main body of the box with two interior hinges, see more about the hinges in chapter 5.2.7 Hinges.
5.4  Aesthetics

5.4.1  Shape

For the product has been chosen rounded shapes since they predominate in helpa.se profile. They give a friendly look and makes it more user friendly. This shapes also avoid damage on the user, since it is going to be hand held it is a very important issue. In order to create the rounded geometry for the whole product it has been taken into account that the space inside isn’t reduced.

In places like the stackable piece, the shape has been determined by the hand holder, since it has to fit on it perfectly.

In the pieces that require ergonomics such as the side holder and the handle, sharp edges have been avoided to avoid injuries and also the shape has been adapted to the hand to make it more comfortable (see chapter 5.3.2 ergonomics).

5.4.2  Color

Main color

The color chosen is the one that shows in the image below. It is the main characteristic color of the company, used on most of their products. The color was taken from the company graphic manual.

Second color

Added to that color, it has been used grey. This has been applied to different accessories like the handle and the button and also in the box its middle part, which has the different movable parts. The idea was to differentiate the parts that the user can interact with it with parts that are static.

5.4.3  Graphics

Logo

In the front of the box appears the logo of the company in its white variant since it is going to be put in green background. The logo is visible enough from long distances and makes the box identify where it is from.
Pattern
It has been implemented the characteristic pattern of the company because it makes it differentiate easily. It is a graphic that has been used by the company in all their products and gives the company special touch to it. The pattern also gives a more informal look and doesn’t look like something very valuable is inside because of its rounded and friendly shapes.

Instructions
In the case of the graphics for the instructions, it is necessary that the font is clear so the user doesn’t misunderstand the information. The font used for the text is Calibri, which appears in their graphic manual. The reason why this font was chosen from all their fonts is because it is easier to read. The graphics represents exactly how the lock looks and also the box so the user can recognize easily what it is talking about.

5.5 Prototype
For the final prototype, two different methods where used in order to get the general shape of the product and a final surface finishing common for both type of pieces.

5.5.1 Milled pieces
The milled pieces are made out of foam. The tool used to create them was a CNC machine. The box was divided into several pieces with 5cm height. The reasons why it was not possible to mill in one piece is because the product has big dimensions and tool can only mill 5 cm. Also to get different details, it is necessary to split it because the machine only works on the top surface.
When all the pieces were milled, they were put together. First, it was measured in which place they had to be in order to fit perfectly. Then wooden sticks were placed in holes previously drilled on the foam so the pieces where resistant and not moving. After the wooden sticks where placed, wood glue was used to stick the surfaces.

Due to the machine tolerances, the pieces didn’t fit well together the first time, so it was necessary to sand down all the surfaces in order to make them smoother and also remove the parts where it shows the steps that the machine has done. After sanding, spackle was put in the surface in order to cover the possible wholes that could appear after the sanding. Some parts that couldn’t be milled were 3D printed and then glued in the foam pieces.
5.5.2 **3D printed pieces**

The 3D printed pieces normally need more surface treatment than milled pieces since the different layers that the printer has been doing are very visible and leave a bad quality surface. The pieces are covered with spackle first, sanded and then they received the same surface finishing as the milled pieces.

5.5.3 **Surface finishing**

Filler was used on top of the different pieces in order to fix the surface and make it smoother. Between layers of filler, spackle was used in order to cover the possible holes or split lines that appeared during the process.
When the surface was completely smooth. The pieces were masked in order to paint in two different colors.

Figure 80. Painted pieces green.

Figure 81. Painted pieces grey.

5.5.4 Final model

The last step was to put all the pieces together, using glue and screws.

Figure 82. Pieces together.
Figure 83. Exhibition
6 Conclusion and discussion

In this chapter I will discuss about the project as a whole, how it has been developed and in which level the expectations have been met.

6.1 Discussion of method

First, I created a Gantt schedule in order to plan everything. I think that this is a fundamental point when starting a project because all the process is going to be based on that. I can say that I followed the Gantt schedule almost until the end, and it is something that I am very happy at it because it means that from all this years of studies I have learnt how to plan and organize the time and estimate the time for every task.

After this, I chose the method to follow during the whole process. Since the product is mainly based on the user, and user needs, I thought that the best idea was to choose a method that is more adapted to it, and is a human centered method. I chose design thinking as a guideline through my whole project although I made some modifications in some cases adding my own methods when needed. I am sure it was a good idea because it helped me a lot.

The project started with the brief. This brief was made together with the company and we decided about how the product should be, define the expectations from them and the different requirements for it. Since it is a completely new product, and the company does not have knowledge about design, I was the one that proposed them different ideas on how the different requirements should look like. In the end, we both agreed and signed the brief that served as the start.

Once the brief was clear for both parts, company and me, I started collecting data. I took the information from different sources, mainly literature reviews and internet webpages. I also made some interviews when I visited the company in order to get closer to the problem and understand it better. Regarding reliability, I always tried to check that the sources where I was taking the information were reliable. I didn’t have any problems checking it from literature reviews since I chose books written by teachers or scientists, but when looking for information on the internet is not easy to know if that source is 100%, which makes it a big disadvantage. I think that in research I made a good job, although it would have been better if there were an existing product like this in the market to compare with. It would help me a lot especially in the first stages of the project, because I was not sure of what to do. When I thought, I had enough research to go on to the next phase I finish it and started with the concepts.

When creating different concepts I first started with simple sketches with pencil and paper. This helped me to visualize all the ideas that I had and evaluate them in a easy and quick way. During this phase I had help from my classmates who sometimes gave me very useful feedback. I think it was very good to receive feedback from people that was not that involved in the project because they always see it with fresh eyes and can give useful tips, complement the project and make it more interesting. I made the three
different concepts in Photoshop instead, using the graphic tablet because I feel more comfortable and I wanted to practice in digital sketching. I am very happy with the result of them. The feedback for the three concepts from the company was very positive and gave me motivation to continue with the project.

I didn’t want to create the final concept just after the selection of one of the previous concepts because I wanted to go deeper in details, so I decided to make a second round of concepts. These three concepts were evaluated separately and it helped me to realize possible problems that could make me lose a lot of time with the final design. I made the three concepts in very easy 3D models and rendered in order to incorporate colors and textures. The idea was to add something extra that make this concepts differentiate from the first ones and see the improvement. I think in the end this second round of concept was very useful and a good choice.

The final concept came from the different ideas of this second round of concepts. This final concept definition took me longer than expected because I had more problems than I thought from the beginning. The project started to become more complicated the more details I put into it. I made a more complicated 3D model with every detail, and use VRED as a rendering software, which takes longer than KeyShot but I think that gives better quality of the renders. It is very useful to check all the proportion, dimensions, and product in different environments and gives tips to improve.

At the same time that I was doing renders, I started with the model. I thought that it could be good to start the model before doing posters and other things because what I have always experienced is that the model is always the last thing that I do, and I usually commit mistakes because there is no time. This is why I tried to start it as soon as I had the final geometry. I am happy that I did it that way because I had more problems than I expected with the machines that I used and some other problems that surged in between.

As a general conclusion, I would say that the method that I used was the correct one, and I am very satisfied with it and with the result.

6.2 Discussion of findings

A product that doesn’t exists is not an easy task to design, since it is difficult to compare or to see where other products have problems in order to be able to improve them. On the other hand, is easier to get good results and something new because it is a completely new product.

Even if it looks like a very simple product from a user perspective (It is a box), when designing it has more difficulty than it seems to have. Adding a lock can be tricky because you need to adapt it to your design, and there is nothing you can do to change it. Sometimes is easier to choose those kinds of things afterwards in order to adapt them to your design than the other way around. Anyway, this specific case was taken as a challenge.
The research carried out in the beginning of the project about helpa.se service was crucial for establishing the main users of the box, because the whole project was going to be based on their needs, since it is made from a human-centered perspective.

Since this box is going to act as a tool for the courier in order to perform his work, it was also very important to take into account ergonomic factors, in order to prevent muscle skeletal injuries that can damage the worker.

In order to help the company to success with their service, is also necessary to give a good impression to the customer. This product must also make the customer satisfied.

Although in the beginning I was not so sure of the extent of this thesis and how deep I could go with a product that seemed to be very simple, I must admit that it has been very interesting to work with it and I have learned a lot through the whole process.

I think that the project has set up a good start for the company to develop the final box for delivery.

### 6.3 Conclusions

Delivery is a service that is constantly changing and evolving as new needs emerge from the users and services like e-commerce grows. This new product covers the demands of a new delivery system that attempts to satisfy the user’s needs. It is a completely new product, that pretends to solve the issue of delivering with safety and also give a good service to the customers. This product will make the company acquire great success and also make the service more reliable and secure for from the customers perspective.

This new box for delivery is my response to the needs of the company to create a safe storage place where they can transport goods and serves as a intermediaries between the physical shops and the customer. Adapted to the courier, which is going to perform his job with, and the final customer of helpa.se. It is innovative, simple, clean and durable.

For further work, it would be necessary to go deeper in materials and manufacturing choosing the best one with an specific manufacturer and create some tests on the product before producing some real products in order to test its possibilities and find possible problems that could be improved.
7 References


[6] Design and emotion


[28] Ergonomics lecture, Sara Kallin, March 2017


[47] Diseño y desarrollo de componentes de plástico inyectados (II): la piezza, Javier Castany, Maria Aránzazu Martinez, Jorge Aísa. Universidad de Zaragoza
8 Attachments

<table>
<thead>
<tr>
<th>Attachment 1</th>
<th>Gantt chart</th>
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<tr>
<td>Attachment 2</td>
<td>Product design specs</td>
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<td>Attachment 3</td>
<td>Sketches</td>
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## 8.1 Gantt Chart

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8.2 Product design specifications

Technical specifications: characteristics of the product.
Functions:

- The product has to allow to store goods.
- The product should provide safety for the goods that are stored inside of it.
- The product should be able to be opened and closed.
- The product should allow being carried

Performance:

- The product should be suitable for the stakeholder expectations: courier and customer of the company.
- The product should be intuitive and easy to operate.
- The product should meet the health requirements indicated in ergonomics.
- The product must be suitable for any kind of customer that helpa.se can have taking into account also people with disabilities to operate.
- The product should fit in a cargo bike wagon

Requirements of the product considering the customer demands:

- The product should be user friendly
- The product should aware the customer about the benefits of using this kind of service.
- The product should engage the customer and promote this kind of service.
- The product should provide safety for the courier

Ergonomic requirements:

- The product should be easy to carry
- The product should be comfortable for the courier
- The product should ensure the courier health.
- The product should be easy to operate
- The product should avoid elements like sharp edges or materials that can damage the user

Things related to use:

- The product has to implement a combination code lock.
- The product should withstand being opened and closed many times during the day.

Material requirements:

- The material has to be robust
- The material should withstand bullet impact
- The material should be waterproof
- The material should be certified and environmental friendly
- The material should be light
Aesthetics:
- The product should be attractive for the customer
- The product should show the company’s identity
- The product should enhance the company’s strategy

Size:
- The product should be adapted to the content that is going to be inside.

Environment of the product:
- The product should be resistant to dust and dirt.
- The product should be resistant to any kind of impact.

Safety of the product:
- The product shouldn’t break under any kind of impact.
- The product should be designed so that the user don’t suffer any kind of damage while using it.
- The product should avoid pinching risk of the user when closing/opening.
- The product has to be light.

Life of the product:
- Desirable a life in service between 5-10 years.

Standards and requirements
Maintenance of the product:
- Easy maintenance of the lock in case it breaks
- Easy maintenance of the open/close mechanisms in case it breaks
- Easy cleaning

Recycling and expected disposal:
- All the materials used in the product should be recyclable.

Manufacturing process requirements and limitations:
- Manufacturing process should be cheap

Methodological specifications: characteristics of the process.
Quantity of products:
- This product is going to be produced in small scale, between 1 and 5 approximately (to determine, depending on the demand).
8.3 Sketches

Figure 85. Sketches 1.
Figure 86. Sketches 2.
Figure 87. Sketches 3.
Figure 88. Sketches 4.
Figure 90. Sketches 5.