# ROLLOR X

## DESIGNING A LOW-COST PACKAGE THAT ENABLES SUITS TO BE TRANSPORTED CREASE FREE.

MASTER THESIS INTEGRATED PRODUCT DESIGN.

Maarten Ornée • 2017

ROLLOR TECHNOLOGY

TU Delft

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# PREFACE

This report will describe my final work as a MCs student at the faculty of Industrial Design Engineering of the Delft University of Technology. This is my pièce de résistance, my graduation project of the Master's programme Integrated Product Design. This project has been developed in collaboration with and supported by Rollor B.V.. A start-up company in The Hague which is specialized in developing rollable garments carriers in which users can transport their garments crease free. I was lucky enough to end up at Rollor for an internship last year and after that even more lucky to create this graduation project together. This project has been an amazing journey for me as a designer. Experiencing the development of a product that is created by your own two hands is every designers dream. I am very grateful to have experienced that.

I want to give special thanks to Peter Hoogland, who has been my company supervisor for almost a year, for all his guidance, professional input and support during this project; to Teun van der Laan and Robert Hoes, owners of Rollor Technology, for giving me this wonderful opportunity. And many thanks to Quiel Beekman and Henk Kuipers, my mentor and chair from the TU Delft, for all their coaching, input and support during the last half year. And to all of my friends and family who have helped me throughout this project, thank you all very much.

I am proud to present you my master thesis. Please enjoy!

Maarten Ornée

# EXECUTIVE SUMMARY

## Introduction

Have you ever had the struggle of figuring out how to bring your suit or other neat garments with you whilst traveling? You strangely and carefully fold them to make sure they would stay crease free. But at arrival you still had to take them to the dry cleaners? So did Teun van der Laan, co-founder of Rollor. He decided to take action and came up with the Rollor. The Rollor is a patented, rollable, garment carrier that is designed in such a way, that delicate garments can safely be rolled up within. Allowing the user to transport their garments crease free and have them ready to wear upon arrival (Figure 2).

## Design framework

Initially, the Rollor was designed as a replacement of the standard garment bag. However, the Rollor has developed itself into a more luxurious product that, price wise, could not compete with the garment bag. The aim of this graduation project was to redesign the Rollor, so that it would be a worthy competitor of the garment bag. After doing an extensive user research for this project however, it became clear that the Rollor can never totally be a replacement for the garment bag. The main reason for this: the Rollor cannot be used for storing your garments, but is solely designed for transporting them crease free. But storing garments, followed from the user research, is one of the main reasons where garment bags are used for. So the Rollor could only compete with the garment bag on transportation. The idea was for customers to get their suit in a Rollor, instead of a garment bag. But since the Rollor cannot store garments, only transport them, this would make the Rollor an addition to the garment bag and not a replacement.
So that road seemed to lead to a dead end. But this was not the case. In order for the new Rollor design to compete with the garment bag, it had to be made as cheap as possible. Preferably a design that would be made out of one type of material and that has the ability to be reduced in size for shipping and storage saving. Being forced to find a solution for these design problems, a design emerged that would change the course of this graduation project.

## The solution

This new design, is called the Rollor X (Figure 1). Next to a Rollor consumer product line, Rollor also has a line for online packaging, called the Rollor Express. This is a cardboard version of the Rollor that is designed for shipment of garments that are ordered online. The Rollor X has certain advantages over the Rollor Express, which makes it a perfect addition to the online packaging line of Rollor. In contrast to the other Rollor products, the Rollor X is not round, but has a distinctive hexagonal shape. It is completely foldable and is made out of a single cardboard sheet. It can be flattened and be shipped easily in stacks. Strongly reducing the shipping costs and saving lots of storage space in comparison with the Rollor Express. The Rollor X is rolled up in steps, giving it its distinctive shape. Although garments are not rolled up in a fluent motion, as with the other, round Rollors, the functionality of the product stays the same and still falls under the same patent (Van Oefelt, 2017). The construction of the Rollor X provides a rigid composition. Therefore, the Rollor X is strong enough to be used as a package on its own. Which is also a large advantage compared to the Rollor Express, that has to be send in an extra box. This saves money, time and material. In collaboration with multiple manufacturers, a fair amount of different prototypes have been made. Optimizing the design which each prototype to, in the end of the project, come with a product that is almost ready for production.


**Figure 1** This figure shows a preview of he Rollor X. The new design for online packaging.



**Figure 2** This picture shows a user unpacking his suit from his Rollor Essential. One of the Rollor consumer product line.


**Figure 3** This visual shows how it would look like to receive a garment in a Rollor X at home.

# READING GUIDE

In order for the reader to get a better grip on this graduation thesis and its content, it is recommended to read this reading guide. Each chapter begins with a short introduction. Giving the reader a quick insight what to expect in that chapter. All chapters are in turn subdivided in sections. Key insights that are obtained during the project shall be presented in red-coloured boxes as is shown below. A few special terms with a particular meaning that are used, can be found in the glossary. Possible unclear English words are translated in Dutch in the English-Dutch dictionary. Both the glossary and the dictionary are presented here on the next page.

The design phases in this project intermingled, rather that follow up on each other (this is discussed in more detail in paragraph 1.3). This makes it difficult to discuss each topic in a chronological order. This causes one to read certain aspects of certain topics in earlier chapters, while that topic will be discussed in its entirety in a later chapter. For example: some outcome of the research can be read in chapter one. However the entire research is discussed in chapter two.

This thesis will begin with a brief project overview. Starting with a summary of the development of the graduation assignment. Followed by the main design goals that need to be met at the end of the project, and an overview and explanation of the unique design process that is used during this project. The next subject that is discussed is the research. Consisting of internal, external and user research. Finishing with the conclusions of the research. After that the entire design process is run through. Showing what steps were taken to get to the final result, explaining how the research results made a change in the assignment direction, giving a view in the conceptualisation process and shows how prototyping has supported this project. In the next chapters the final result of this project shall be presented: the Rollor X. Giving insight in its usage, production and shows its advantages relative to the current situation. This thesis shall be concluded with conclusions, recommendations for Rollor and a short evaluation of this project. More details on prior analyses, prototyping, testing, ideas and other additional information and materials are documented in the appendices.

### Insights

1. Whenever key insights are obtained in a particular section, they are presented as such.



# GLOSSARY

### Garment
A piece of clothing; used especially in contexts where you are talking about the manufacture or sale of clothes.

### Die cutter
Machine that uses steel die, made in a particular shape, that is pressed unto a certain material (such as cardboard) to easily cut out that shape.

### E-commerce
Electronic commerce. The buying and selling of products and services by businesses and consumers through an electronic medium.

### M.o.q.
Minimum order quantity. This is the minimum order size accepted by a supplier.

### Volumetric weight
A calculation that reflects  on the density of a package. The volumetric weight is calculated (length*width*height/5000) and compared with the actual weight of the shipment to ascertain which is greater; the higher weight is used to calculate the shipment cost.

# DICTIONARY

### Crease
Een vouw of kreuk.

### Corrugated cardboard
Golfkarton

### Die cutter
Een stansmachine

### Garment bag
Een pakzak

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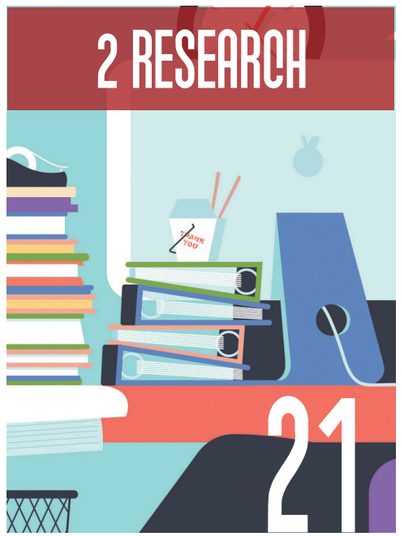
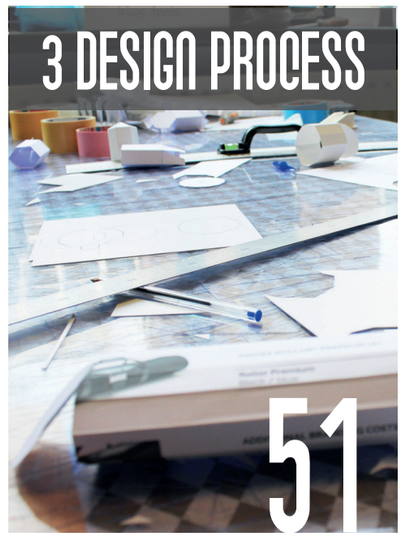












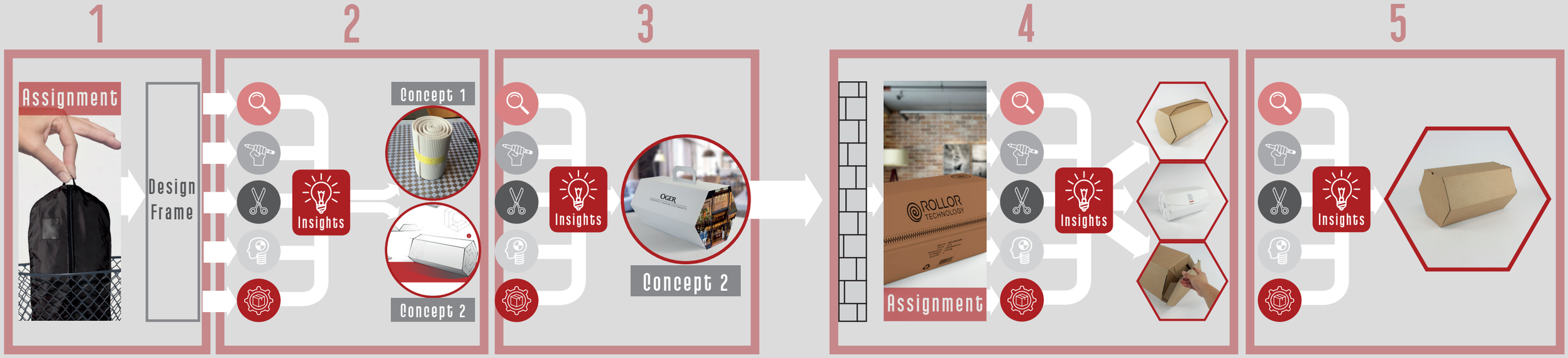
# Chapter 1

# THE PROJECT

This chapter starts with an overview of the project. Showing how the Rollor X has been developed from an assignment to an actual product. Then the origin of this graduation project is presented with the project assignment. Followed by the main design goals that need to be achieved and lastly an overview of the unique design process that has been gone through in this graduation project.

# 1.1. PROJECT OVERVIEW

Contradictory to more common design project approaches, in this project the different project phases were run trough simultaneously, e.g., in other projects the design phase follows the research phase. In this project the findings from researches could directly be implemented in the design process and vice versa. This paragraph gives an overview of this design process divided into five phases.




## 1 Defining assignment and design frame

The first phase of the project started with defining the graduation project. Together with Rollor an assignment was created. After that, the expectations for this project were set up. Together with the design goals and criteria, these formed the first design frame. This functioned as a framework which was used as a reference to help approach and resolve new problems during the design project.

## 2 First researches and conceptualization

In this phase the first researches where held. Consisting mostly of internal research and talking with material experts. Together with this research, the first small quick and dirty models where made of the first concept ideas. Insights obtained from the research could be implemented directly in the conceptualization. Finally, two main concept directions could be distinguished.

## 3 Concept choice

The concept directions were looked further into and more tests were done to validate whether the concept directions were worthy to continue with. During this evaluation process, the first concept turned out not to be plausible. In the mean time the second direction showed great potential. Therefore it was chosen to continue with the second direction. The two concept directions are more elaborately discussed in paragraph 3.2.

## 4 The wall and first prototypes

Phase four in the project started with a small obstruction in the design process. For imaginative purposes this obstruction is called: the wall. What this obstruction was and how it is overcome will be explained paragraph 3.4. After this obstruction there was a change in the scope of the assignment. Leading to a new concept direction of which the first prototypes were made. The influence of prototyping in this project is discussed in paragraph 3.5.

## 5 Embodiment and final design

The final phase of the design process consisted of obtaining insights from the prototypes and talking with production experts. Repeating this process eventually lead to the final design of the Rollor X.

# 1.2. GRADUATION ASSIGNMENT

This paragraph explains the origin of this graduation project. How, together with Rollor, the assignment was formed and what insights from the research caused for a change of assignment, which eventually lead to the Rollor X (Figure 6).

## Project Origin

During the first semester of the college year 2016-2017, it was chosen to do an internship. This was to help with the orientation for an graduation assignment in the second semester of that year. After some searching a match was found with Rollor. Both parties where satisfied with the collaboration during this internship, so at the end of the internship this graduation assignment was created together with the company and the graduating student.

## Research insights

During the project, certain insights were obtained by doing research from witch could be concluded that, no matter how the Rollor would be redesigned, it could not fully replace the garment bag. The majority of the research participants indicated to use garment bags particularly for storing their garments. Storing garments is something the Rollor is just not designed for and so it had to be concluded that the Rollor could not be a complete replacement of the garment bag. All researches and insights will be further discussed in chapter two.

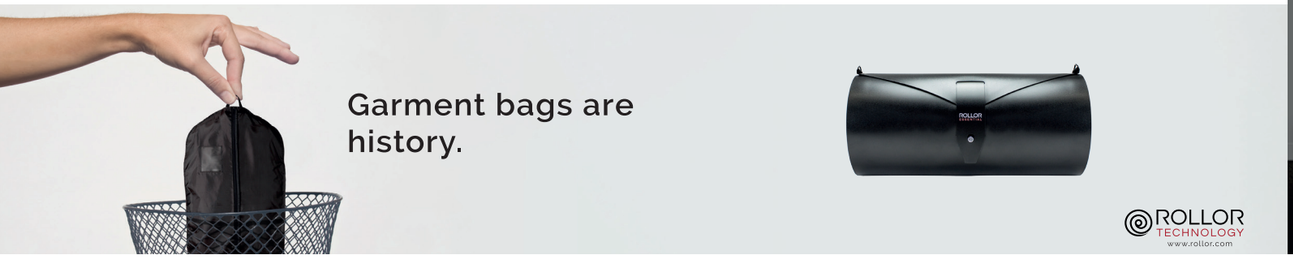



**Figure 4** This figure shows a Rollor advertisement telling that a better alternative to the garment bag has emerged: the Rollor Essential.

## Initial assignment

When the initial idea of the Rollor was created, the vision of the founders was that the Rollor would replace the standard garment bag (Figure 4). The Rollor, however, has developed itself into a more luxurious product that, price wise, could not compete with the garment bag. The idea of this assignment was to turn that around and make a Rollor design that could do just that. With the goal of creating a significantly cheaper redesign of the Rollor Essential (shown in Figure 4) that could also be reduced in size, in order to save space during transport and storage. The idea then was that retailers would give away their sold garments in this new Rollor design, by replacing the standard garment bag.

## Assignment change

With an unreachable goal of replacing the garment bag, it was needed to review the project's assignment. This project had an unusual design approach (will be explained in paragraph 1.4). Simultaneously with the research phase, the conceptualization phase also was in full motion. In order for the new Rollor design to compete with the garment bag, it had to be made as cheap as possible. Preferably a design that would be made out of one type of material and that had the ability to be reduced in size for shipping and storage saving. Being forced to find a solution for these design problems, a concept was created that could reach the initial design goals: be cheap and able to reduce in size. When the assignment was reviewed, it was seen that this concept could be a good addition to the Rollor Express line (Figure 5). The Express is a product that is specially designed for online packaging and is a cardboard edition of the Rollor. (The different Rollor products and their user categories are more elaborately discussed in paragraph 2.2 and 2.3.) Since the Express is not robust enough to be send as a package, it must be put in separate box for shipment. Shipping Expresses takes up lots of space. Clients who order a larger amount even receive the Expresses disassembled and have to assemble the Expresses themselves with a specially designed assembly table from Rollor. One can imagine that this takes some effort and could cost too much money for potential clients. The new concept would eliminate these complications. The new assignment now is: *Designing a low-cost package that enables suits to be transported crease free. With the ability to be reduced in size, enabling easy shipment and storage* (Figure 5). The research has also shown that the vast majority of garments used by participants were suits. Therefore it is chosen to use suits as criterion for this project. The design goals are further discussed in the next paragraph.




**Figure 5** The new assignment shall focus on redesigning the Rollor Express (right). A cardboard Rollor that is specially designed for online packaging.

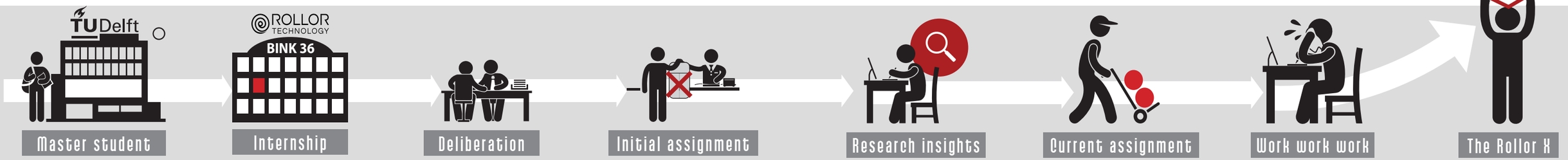
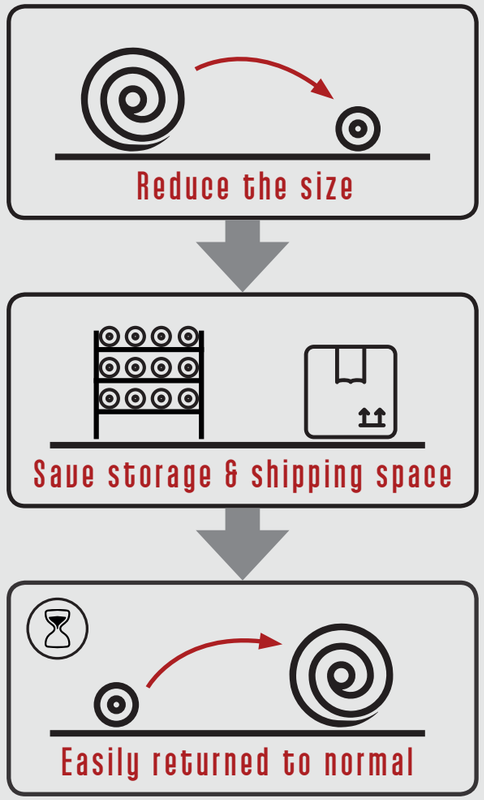



**Figure 6** This figure is a timeline that illustrates the origin of this graduation project, how, together with Rollor, the initial assignment was created and how research insights have lead to an assignment change. Eventually the project ends with the Rollor X.

# 1.3. DESIGN GOALS

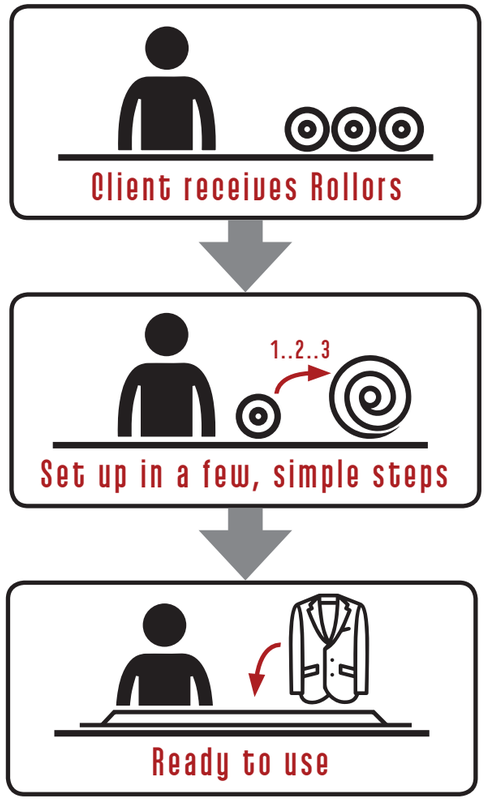
The design goals were shortly mentioned in the previous paragraph and will be more elaborately discussed here. The design goals help to stay focused on what is determined to be most important in this project. Throughout the project, these design goals are used to check whether the design still meets its original objectives. The scope of the graduation assignment has changed during the project, as explained in the preceding paragraph. However the same design goals also apply to the new assignment. There is only a slight change of criteria: the Rollor X will be a redesign of the Rollor Express and not of the Rollor Essential, as in the initial assignment. In this project, three main design goals can be distinguished. These are illustrated and explained on the right.

## 1 Able to reduce size



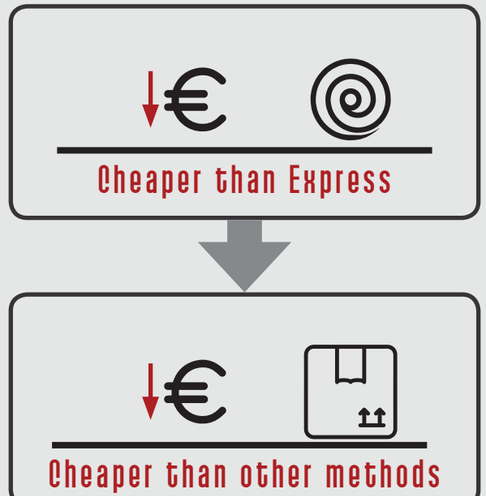

Size reduction is a must-have for this project. The amount of space that is currently used to ship Rollor Expresses is very high. A 12-piece box with assembled Expresses is 581*430*1330 mm. Also if a client orders disassembled Expresses, the minimum order quantity (m.o.q.) is 5000 pieces. All components are then spread over 19 pallets. By using less space and use that space more efficiently, there can be a significant saving in shipping and storage costs. A thing that one must keep in mind is that, when the Rollor X arrives in its minimized form, this needs to be reversed pretty easily. Especially after being stored or shipped for a longer period of time. This may not cause any complications. How the Rollor X is going to be able to minimize its size is not yet determined at this point.

## 2 Easy to use




There is a lot involved when a client uses Rollor Expresses (in the case of unassembled Expresses). The client needs to assemble the Expresses themselves, by using a specially designed assembly table to put the rails on the sheet and connect the handle to the Rollor. This takes time and if not done right, can easily result in the Express not working properly. It is highly desired that these kinds of assembly steps will become unnecessary with the use of the Rollor X. The aim is that the Rollor X can be set up quickly in a few simple steps and is instantly ready to use. Whether the Rollor X can be set up quicker than a standard shipping box is hard to say in this stage. This will not be a requirement, however is may not differ to much. So the set up time is set at a maximum of 1.5 times of that of a standard box.

## 3 Cheaper than current solution




Currently there are several methods used for packing garments for shipment. These methods are competitors for the Rollor X and are widely discussed in paragraph 2.4. It is a requirement that the Rollor X is cheaper than the Rollor Express and preferably also most other common packaging solutions in order to create a better business case. However, to cost less than the most standard of shipping boxes is highly unlikely. The prices for current packaging methods and the expected price for the Rollor X are presented in paragraph 2.4 as well.

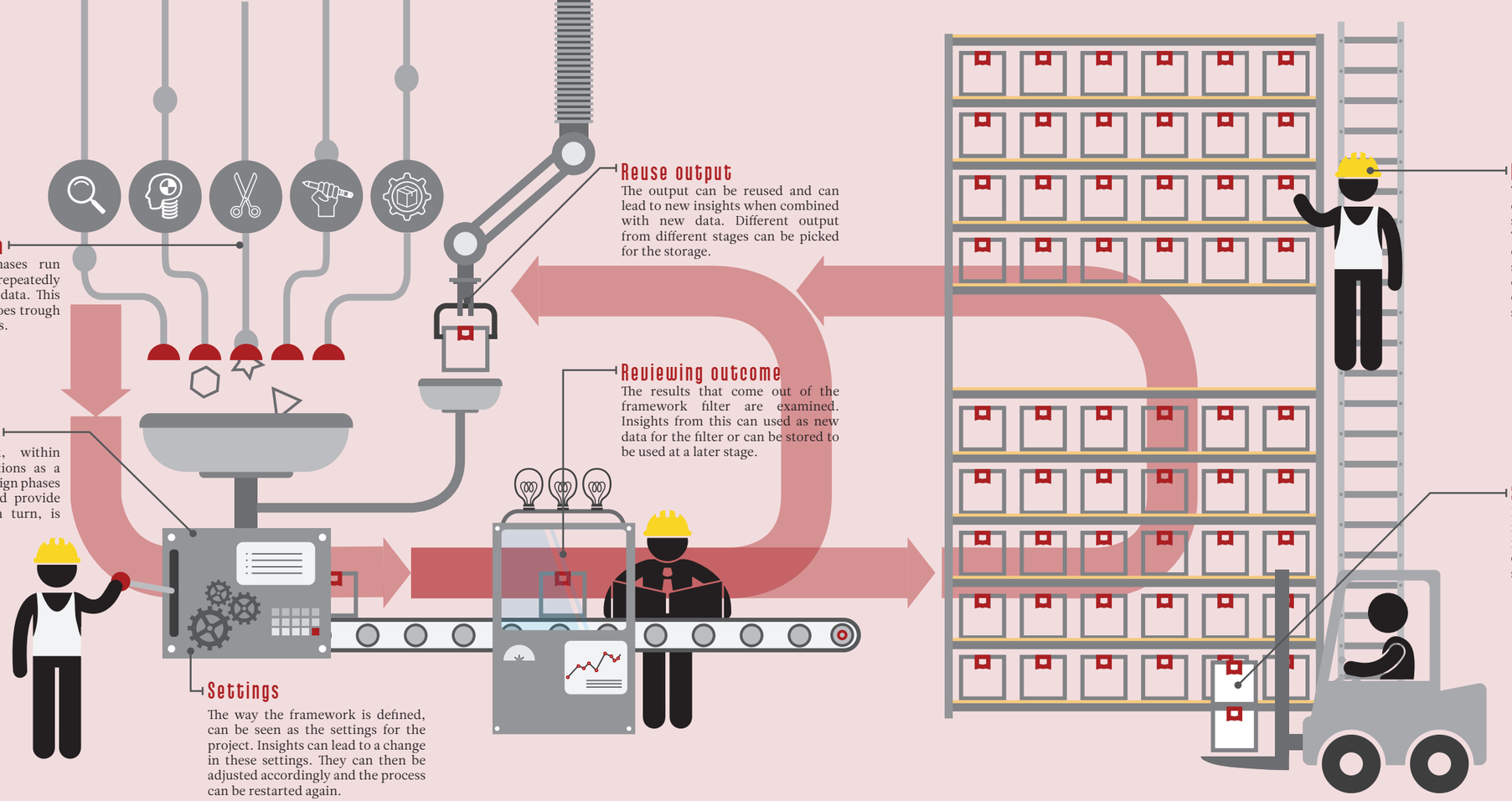



**Figure 7** This figure shows a detailed visualization of the design process. It illustrates the iterative process of constantly using input from the different phases to create output, such as new ideas, insights or solutions. Where each output is reviewed and then reused to create new input or stored for later use. ,

# 1.4. PROCESS OVERVIEW

The structure of the design process has been shortly mentioned in previous paragraphs. Unlike a more general design process, which starts with a research phase and is then followed by other design phases after each one has ended, this project used a more unique approach: the five different design phases that were distinguished, were gone through simultaneously and intermingled throughout the project (Figure 8). The first ideas that came out of the research phase could directly be drawn out, be made into a quick-and-dirty test model and would give insights that then could be implemented in the development phase and back in to the research phase. This quick, iterative process repeated itself constantly and led to a very efficient and effective design process. This iterative process is visualized in Figure 7.

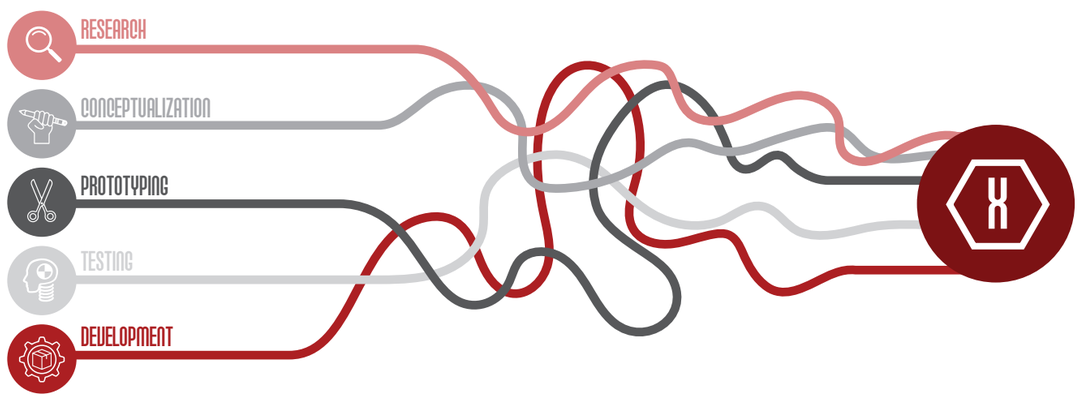
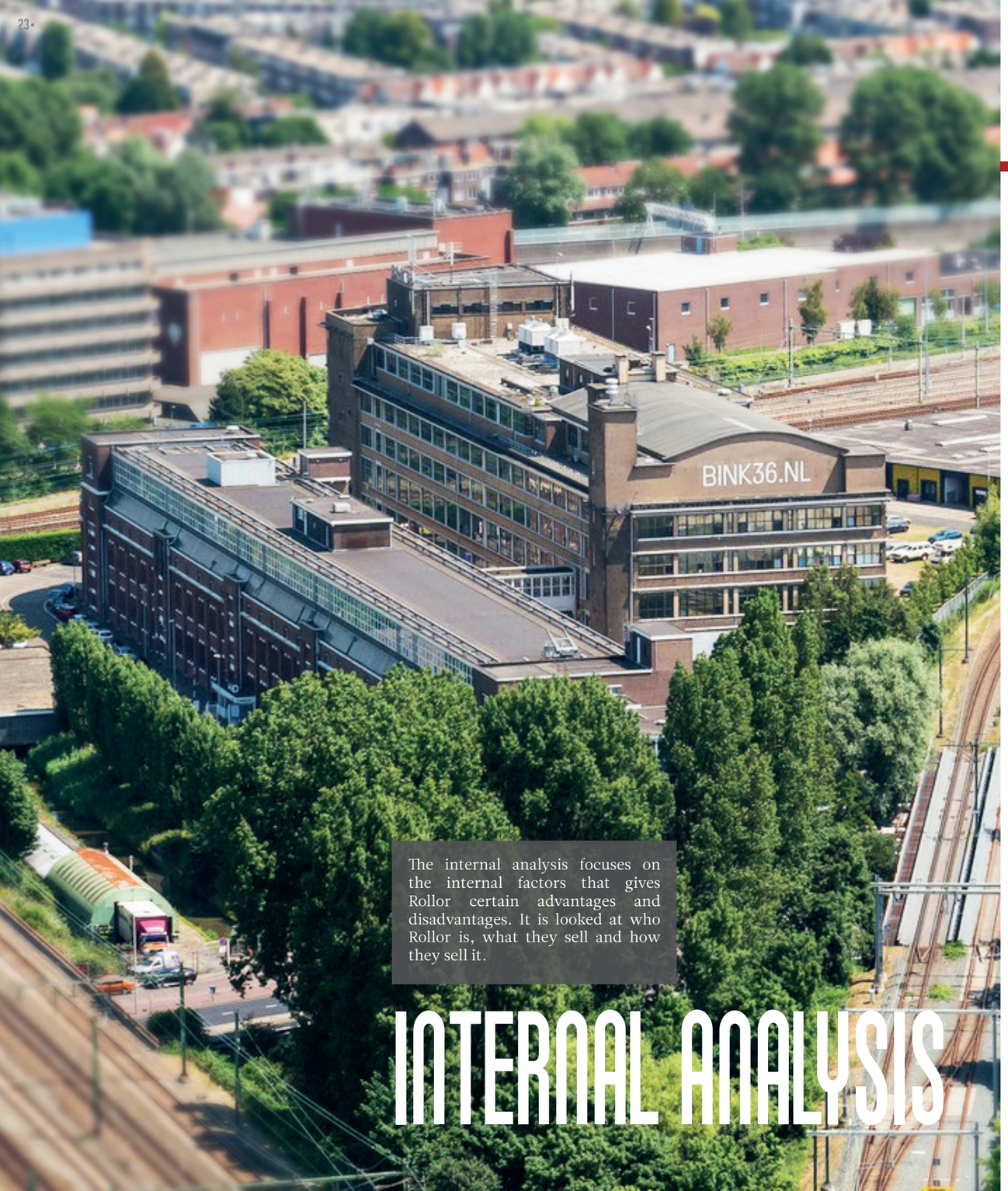



**Figure 8** Additional to Figure 7, this figure abstractly visualizes how the phases in the design process have interacted with one another and over time, has lead to the Rollor X.

# Chapter 2

# RESEARCH

The research segment of this project can be divided into four sub-sections: Internal analysis, external analysis, user research and conclusions. The main findings of each sections is discussed in this chapter. All insights that were obtained from the research are combined and discussed in the final section of this chapter.




The internal analysis focuses on the internal factors that gives Rollor certain advantages and disadvantages. It is looked at who Rollor is, what they sell and how they sell it.

# INTERNAL ANALYSIS



## 2.1. ROLLOR

Rollor is a product design company stated in The Hague. Rollor has designed a product that allows clothing to be packed in a compact, protected and crease free manner. This products is called the Rollor (Figure 9). The way the Rollor works is simple. It is based on rolling up of garments between the upright rails, which is demonstrated in Figure 9. When Rollor is rolled up these rails create space for the garments and eliminates sharp angles and any possible outside pressure. Therefore, everything between the rims will not wrinkle, will not get dirty and cannot be damaged. This a patented principle and is called Rollor Technology.

### Organisational Overview

Rollor is slowly expanding. The company now consists of four employees (Figure 10). Rollor has two founders. They form the management of Rollor and are also the owners, together with the other shareholders. One manager is mainly responsible for the sales, where the other focuses on the general operations. The employees are the head of design, the graduating student and a part time employee, who works a few hours on a daily basis. The graduating student is working under the guidance of the head of design.

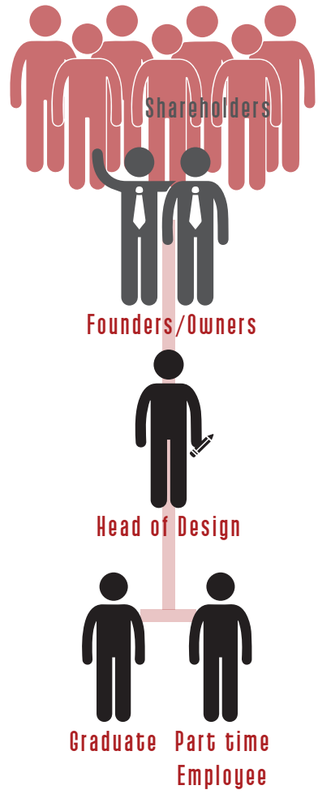



**Figure 10** The Rollor organisation tree.

**Figure 9** This picture shows the Rollor In action. The suit is softly folded in half and then laid in the Rollor, where after the Rollor is rolled up and closed.

# 2.2. PRODUCT PORTFOLIO

The figures below show the current product portfolio of Rollor. All products consist of two basic components: a rectangular sheet and foam rails on each of the long side. Each product is shortly explained and presented with the retail price.

## Essential

The Essential, as the name says, is the base product of Rollor. It consist of a plastic sheet with foam rails on its long sides. This construction is the base for the rest of the Rollor products.

€69

## Prestige

The Prestige is a more extravagant version of the Essential. The plastic sheet is covered with fabric and the product is featured with leather edges and closure.

€95

## Premium

The Premium is even more luxurious. With more leather features combined with chrome end caps and buckle. The Premium is wider than the other Rollors. This causes that suit jackets do not have to be folded.

€179

## Weekender

The Weekender is an add-on hand luggage piece that can be attached to the Essential or Prestige and is specially designed for short trips. The Weekender has enough baggage space for an extra pair of clothing, laptop and some other small items. It is not yet for sale.

N.A.

## Female Express

## Male Express

The Express line is made of corrugated cardboard and is specially designed for online packaging. When ordering a suit online with one of the customers, your suit will be send to you in a Rollor Express. Which has a female version for female garments and a male version for suits.

€7

**Figure 11** The current Rollor product portfolio.

# 2.3. CURRENT BRAND STRATEGY

The branding strategy defines what a company stands for. It's the entire experience your prospects have with your company, product or service (Frederiksen, 2017). The goal here was to define Rollor's branding strategy so that the yet to be designed product, fits within this strategy. This was done by identifying Rollor's brand identity, who the Rollor users are and how they are targeted.

## Brand identity

The brand identity of a company is the outward expression of the brand including its name, trademark, communications and visual appearance (Kapferer, 1989). It is how a company wants to be perceived by the consumer and symbolizes the brand's differentiation from its competitors. Rollor is still a young company and relatively new to the market. It has been hard to pinpoint what the brand identity of Rollor is. Some efforts have been made in the past by the company to define their goals and visions. However, a real consensus has not yet been made in order to set clear brand guidelines (Hoogland, 2017). The Rollor employees do seem to look in the same direction, however, they use a different choice of words to describe what Rollor stands for. One says Rollor 'dares to be innovative', while the other would say that Rollor 'lets you carry or send your garments carefree'.
One thing that can be said with certainty is that Rollor is extremely client-oriented. Being a startup gives Rollor the advantage of being flexible and really involve costumers in the design process. There are, for example, clients that want a Rollor for dresses, shirts and even for lead aprons or special pillows. Rollor is very open for every client that feels that a Rollor suits with their product and makes sure this client gets the right type of design.

## Target group

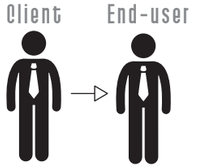
The Rollor product portfolio focuses on three user categories: consumers, business to business(B2B) consumer gifts and electronic commerce packaging (e-commerce). Where the last two both fall under B2B and the consumers under business to consumers (B2C), as displayed in Figure 13. On the other hand, the B2B gifts are also consumers products since, in the end, these products are also used by consumers. To avoid confusion between a B2C consumers/customers and a B2B consumer/customer. B2B customers shall be referred to as clients and their customers shall be referred to as end-users(Figure 13).
The Rollor Express line is specially designed for online packaging and is only used for e-commerce, where the clients are mostly established in the retail business. The Express already used by companies such as the Bijenkorf and Oger. The e-commerce shows great possibilities because in involves very large volumes (Hoes, 2017).
The other Rollors can be bought by consumers but can also be used for B2B clients. Where, in both cases, the Rollor can be personalised. Consumers can choose to add a logo or name on the closure and/or on a doming sticker, which is put on the end caps (Figure 12). B2B clients have the same options but also have the opportunity to make more adjustments to the design. Such as adding a fabric, choose a different colour or changing the thickness of the foam rail. This is possible for an ordering size of 2000 pieces or more.


**Figure 12** This figure gives an example of the Rollor customization options. Customers can add a doming sticker on the end cap or add a name on the closure (left). With an ordering size from 2000 pieces, more options are possible such as adding fabric (right).



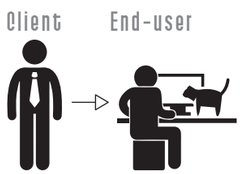
B2C

B2C




B2B consumer gifts

B2B




E-commerce packaging

**Figure 13** This figure visualizes the three Rollor user categories: consumers, B2B gifts and e-commerce packaging. The latter two fall B2B marketing and consumers under B2C marketing.

## Insights

1. Rollor does not have an actual brand strategy but is very client-orientated.
2. E-commerce shows great potential since it involves extremely large volumes

The external analysis looks at the opportunities and threats existing in Rollor's environment. Rollor is compared with its competitors and trends in the packaging industry are examined.

# EXTERNAL ANALYSIS



## 2.4. COMPETITORS

Rollor is situated in a niche market. However, niche markets also have competition. A quick look was given into the competitors of Rollor in order to define the position of the Rollor relative to these competitors.

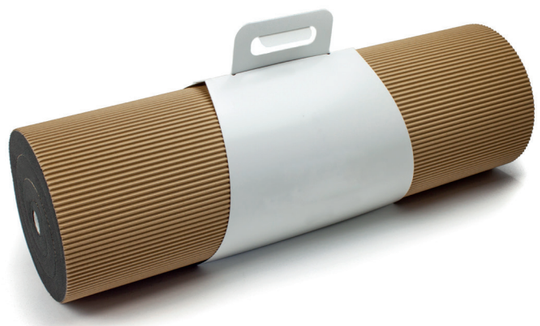
### Competitor categories

When looking at the Rollor competitors, they can, just as with the Rollor products, be divided into categories. These categories here are B2C products and e-commerce packaging. Where the B2C product competitors consist of a large variety of garment bags and the e-commerce packaging consists of different kinds of garment packaging solutions. To make a quick overview, both categories have been divided into three different price classes, shown in Figure 14. Please note that both groups have different price indications. The prices under the consumer products are retail prices and the indicated prices for the e-commerce packaging are cost prices.
For both categories, the Rollor equivalent product is compared next to it. It can be seen that the Rollor consumer products falls under the midrange to high end products. When the initial idea of the Rollor was created, the vision of the founders was to replace the standard garment bags. The Rollor however has developed itself into a more high end product that, price wise, cannot compete with the garment bag. However it does offer the best solution for packing your garments crease free. Another aspect that the Rollor does not (yet) has, mostly seen with the more expensive garment bags, is the possibility of packing more clothes than one garment. Rollor is fully aware of this fact and a solution for this is already in development.
When it comes to the e-commerce packaging, the Rollor Express is clearly a high end solution. The Express seen in Figure 14 is the wide version of the Express line which is used by companies as the Bijenkorf and Oger. As stated in paragraph 1.2 the focus of the project is shifted to the e-commerce packaging. Competition in this category shall then be of more interest for this project and are therefore more looked into on the next pages.


**Figure 14** This figure shows Rollors main competitors, where the prices under the consumer products are retail prices and the prices under the e-commerce packaging methods are cost prices.


Plastic Packaging


Standard Packaging



Premium Packaging

**Figure 15** This figure show the three packaging categories that are defined.

## Current packaging methods

When looking at the competitors for the Rollor X, three packaging methods can be distinguished. These methods will now be referred to as plastic, standard and premium packaging, as can be seen in Figure 15. To see how different each packaging method is, multiple suits have been ordered online with various clothing stores. The unpacking of each order has been captured and mutually compared. One of the unpacking results for each packaging method is shown in Figure 16 on the next two pages. The unpacking insights are combined with the other packaging insights on the next page.

## Volumetric weight

Most shipping companies determine the shipping price of a package based on the weight of the package or the density of the package. This density is indicated with the volumetric weight. The volumetric weight is calculated (length*width*height/5000) and compared with the actual weight of the shipment to ascertain which is greater. The higher weight of the two is used to calculate the shipment cost. In terms of sending garments, one always looks at the volumetric weight. Rollor has determined to be even more appealing than a standard packaging box by having a lower volumetric weight. This boundary is set at a weight of 5 kg (the volumetric weight of a standard package from a certain competitor).

## Insights

1. Price wise, the Rollor cannot compete with the standard garment bag.
2. Rollor does not have the possibility of containing multiple garments
3. Rollor has the best solution of packing garments crease free.
4. Rollor X needs to have a volumetric weight of <5 kg.

Plastic Packaging

Standard Packaging

Premium Packaging

**Figure 16** A collage of unpacking a plastic, standard and two premium packagings.

## Unpacking results

Figure 16 shows the results from unpacking each packaging method. One must keep mind that each order had a different suit so the result must be used with caution. The material of a suit is a strong influence on whether the suit can easily be creased or not. When looking at the results above, a clear difference is seen in the first sight one gets when opening their packages. Where the transportation process has caused the suit in the standard packaging to look very messy. Both premium methods show a nice view of the suit once the package is open. It can be seen that the suit in the Rollor Express has shifted a bit to the side. Causing a crease in the left sleeve. The white suit shows a view creases on its lower back and in the centre of the pants. Both premium packaged suits show a clear overall result in comparison with the plastic and standard packaging. More unpacking results can be found in the appendices.

# 2.5. TRENDS

This paragraph covers four interesting trends concerning packaging and e-commerce. These trends are to be closely studied and implemented in the redesigning of the Rollor X.

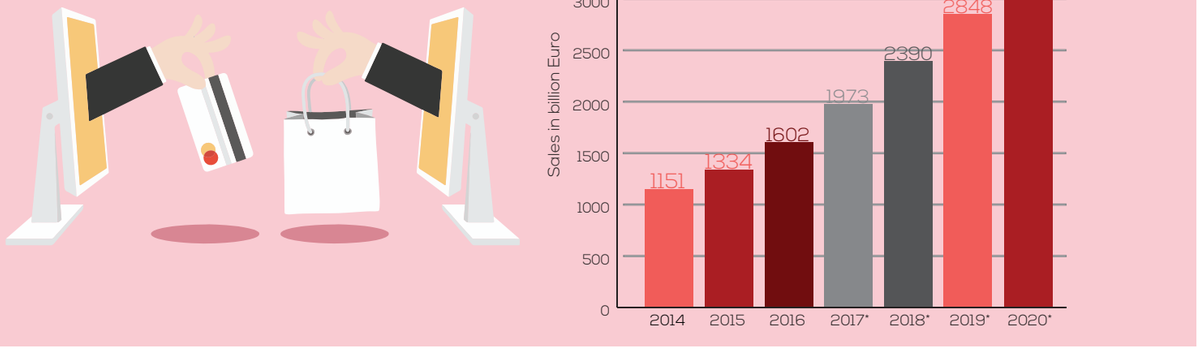



**Figure 17** This diagram shows the annual retail e-commerce sales worldwide from 2014 to 2020(Statista, 2017).*The sales from 2017 to 2020 are estimations.

## E-Commerce growth

E-commerce is growing fast. Purchasing good online has become a everyday habit for many people world wide. Some choose to make online purchases for convenience, others because of the competitive price offered by some e-commerce platforms (Statista, 2017). In 2017, the annual e-commerce sales in the retail branch worldwide are estimated to be €1973 billion (Figure 17). This number is expected to almost double in 2020 (Statista, 2017).
With this growing market, companies are selling products online more and more and try to make this online shopping experience as convenient as possible for their customers. An important part of this convenience is free returns. An aspect that is made use of extensively. A 2016 study showed that two thirds of the participants have said to send at least one item back (Clancy, 2016). “These days we are noticing a trend of consumers buying multiple sizes of the same product so they use their bedrooms as their changing rooms”(Bloor, 2016).

## Unpacking experience

For e-commerce packaging, the shipped package is the most direct touch point and connection with the customer that a business has with their online sales. Delivering a complete brand experience extends beyond the product itself and transcends into the whole unpacking experience (Larazza, 2015). Putting your product in a certain box and send them away, just is not going to cut it anymore. One needs to present there products on arrival in order to provide additional value for your customer as well as your business through the ability to create a memorable and shareable experience (Larazza, 2015). Studies have found that 52 percent of consumers are likely to make repeat purchases from an online merchant that delivers premium packaging (Dotcom, 2013).

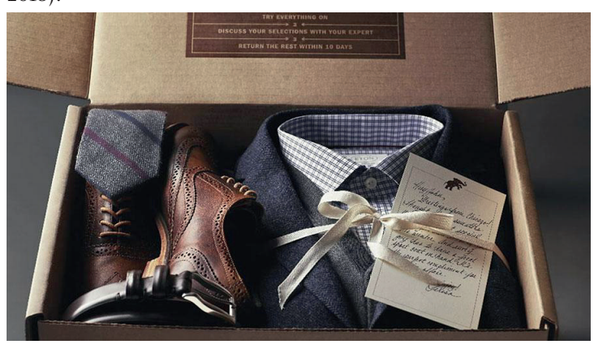



**Figure 18** An example of a package from Trunkclub where its content is thoughtfully laid out in order to create a presentation and experience when opened.




**Figure 19** Example of packages from Trunkclub where it is chosen to have custom printed box to accentuate their brand and create a pleasant experience.

## Creative packaging designs

With a growing demand for customization as the online sales of consumer goods increases (Figure 17), the need for creative packaging is increasing as well (Roberge, 2017). As previously said, one needs to create a memorable and shareable unpacking experience. That experience starts with the exterior of the package. The use of customized shapes or appearance for packaging to complement a product is a great way to ensure a lasting impression on consumers (Figure 19). Creativity does not only has to be in the appearance. One can also get creative with the reusability of the package.

**Figure 20** This is a sustainable packaging made from waste straw which is converted to a pulp, called Npulp®.

## Sustainability

Companies used to focus only improving their product, brand image and customer experience. Times have changed however and companies have shifted their attention to packaging as well. And they are realizing the importance of sustainability in this aspect (Hill, 2017). The disposing of packaging causes a lot of waste. For this reason, sustainable packaging has a fast growing popularity and companies are looking in all kinds of ways to create less impact on this planet (Figure 20). This trend is not only visible with companies but it is also seen in the demands from customers. Consumers are willing to pay more for products that are locally sourced, produced with quality materials and resonate as authentic (Yuska, 2017).

### Insights

1. Retail e-commerce is growing fast with more consumers buying more products.
2. A great unpacking experience is important.
3. Having a creative packing design is a trend that helps with the unpacking experience.
4. Sustainability is an important aspect in the packaging industry.

In order to get a better insight in how users use and store their garments, user research has been done. This is user research is divided in several use interviews and a user questionnaire.

# USER RESEARCH



## 2.6. STORAGE AT HOME

Research has been done on how frequent suit wearers use their suits. This is done by viewing inside the closet of a participant. The goal here was to get insights in how such a frequent user stores, uses and maintains his suits.

### Daily worn suits not in garment bags.

The participant wears a suit to work everyday. Since his suits are used daily, he finds no need for keeping them in a garment bag. His work is at walking distance from his home. There is no need for him to carry his suit with him, he already wears it on the way to work. In his office he hangs up his jacket over his chair (Figure 21).

### Garment bag for transport & neat suit.

As seen in Figure 21, only one suit is in a garment bag. This suit is not used on a regular basis so is preferred to keep in a garment bag. The other times this user used garment bags is for when he goes to the dry cleaner, a wedding or if he needs his suit a day later when he goes somewhere.

**Figure 21** This figure shows the storage, usage and maintenance of suits of a participant.

**Insights**

1. Daily worn suits are not stored in garment bags.
2. Garment bags are used for transporting suits and to store neat suit.

# 2.7. STORAGE IN TRANSIT

Two participants were found that both were going to attend a wedding. Both were asked to document there packing and shipping process of their suits. This could shed some light on the way people transport their suits to a special event. Both processes have been put in a small timeline.

### Special suit kept in garment bag.

The participant stated that he has a suit for special occasions, such as weddings, which he does not wear on a regular basis. Therefore, this suit hangs in a garment bag in his closet. The same garment bag is used while transporting the suit.

### Shirt put in the same garment bag.

For his own convenience, the participant said to put his shirt in the garment bag together with his suit. “The garment bag had enough space and this was the best place for the suit so it would not get creased on the way.” The bag was then laid out on the couch, when the subject made his final preparations.

### Garment bag takes up entire back seat

A car was used for transportation. The participant said that he did not want to fold his garment bag. “The suit had to be laid out on the back seat, covering it entirely. Once at the hotel room, the suit was hung up.”



1. Whether suits are stored in garment bags differs per user.
2. Car is good way to transport suit in garment bag, but needs a lot of space.
3. Folding garment bag is experienced as pleasant.

Insights

### “A folding bag is nice to use.”

The second participant had to attend a wedding as well. He also kept his suit in a garment bag in the closet. The zipper of this bag however, is broken so it is always open. But the bag can easily be folded in half and has a handle. It is experienced as a very nice way for transporting suits.

### Garment bags against dust & for ease.

The participant was asked whether the same bag was used for storing his suit, even though his zipper was broke. He said that he kept all his suits in garment bags in his closed, and all of them have broken zippers. The bags are used to prevent dust accumulation and he used moth protection inside his entire closet. He finds it easy to just grab a suit in bag, only needs to fold it in half and it is ready for travelling.

### Flat surfaces are preferred in transit.

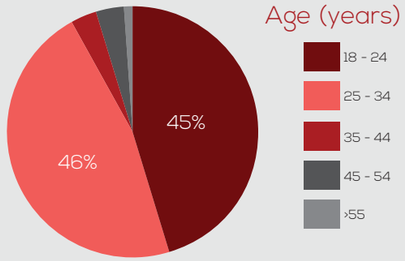
In this case, a car was used as well. First the suit was laid on top of the rest of the baggage, but then it was preferred to put it on a flat surface. It was put on the rear shelf. This was the best place, although it has not the best reachability for putting object on it.

**Figure 22** This Figure shows the storage of suits of two different participants who are going to attend a wedding and bring their suits with them.

# 2.8. USER QUESTIONNAIRE

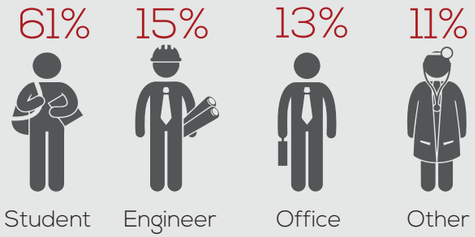
This questionnaire made to get quantitative data of how users store, maintain and use their delicate clothing. The insights obtained from this questionnaire will play a significant role in this graduation project.

## User information


The questionnaire consists of short series of questions that could be filled in online, which was done by a total of 111 respondents. The age of the respondents does not matter per se. Although it found that the respondents from older age categories make more use of delicate clothing and therefore can lead to more interesting insights than the younger respondents.

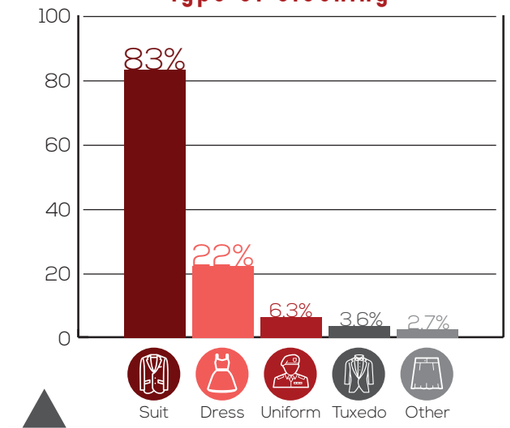
### Professions




61% Of the respondents have indicated to be students. 15% Have an engineering background, such as Construction Costs Experts and Production Team Leader at Shell. 13% Have an office job en 11% is categorized as 'Other'. Such are doctor, dentist or security guard. As expected, students have the least usage of delicate clothing. 57% Uses their delicate clothing less than one time a month.

## Delicate Clothing Use

### Type of clothing




When it comes to delicate clothing that consumers want to transport safe and wrinkle free, suits are the vast majority.

Of the respondents, 83% filled in to be in possession of a suit. An expected but still very high amount. Next in line was 'Dress', with 23% followed by 'Uniform', 'Tuxedo' and 'Other'. Such as a skirt or blouse. It can be said with certainty that when it comes to delicate clothing that consumers want to transport safe and wrinkle free, suits are the vast majority.

### Storage


On the matter where and how it is kept, 75% of the respondents have said to keep their delicate clothing in a closet or clothing rack. 87% Has also said that their clothing are hanging. Since there was not a single respondent that said something else beside hanging their clothes and using some form of closet to store them, it can be assumed this applies for everyone.
A total of 60% has indicated to make use of a garment bag of some sort to store their clothing. When looking at the difference between the frequent user group (42% uses garment bag) and the less frequent user group (59% uses garment bag), it can be seen that the frequent user group makes less use of garment bags. However, due to the amount of respondents and the formulation of the question in the questionnaire, it cannot be said with certainty that there is a relation between those two factors.

### How often used

To indicate how many times the respondents use their delicate clothing. The usage is divided in four groups: (Almost) daily use, (almost) weekly use, average of 1 time a month, less than 1 time a month. From now one there is spoken of *frequent users* for daily and weekly users and *non-frequent users* for monthly users or less.

### Occasions of use


The occasions on which the respondents use their delicate clothing can largely be put into two main groups. 49% of the occasions were work related and almost 45% are festive occasions, like weddings, galas or dinners. The other 8% consist of occasions like presentations of funerals.

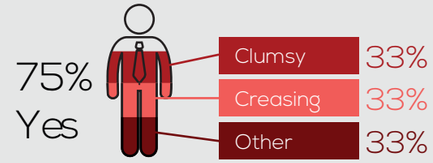


## Delicate Clothing Transport

### General transportation


It was asked to choose the way wherein the clothing is transported generally. 49% Said to generally transport their clothing by already wearing them. 42% Said to use a garment bag and the other 9% said to use a suitcase or another kind of bag.

### Experienced complications transport




The respondents were asked whether they experienced any complications with transporting their delicate clothing. Around 25% stated to have no problems or barely any problems with the way they currently transport their delicate clothing. Meaning, that around 75% did encountered complications with transport. From that group a third indicated to have complications with the size or experience clumsiness. Also, a third indicated to have problems with creasing of their clothing.
Interesting to see is that from the group that said not to have any problems, half of the respondents indicated to already wear their clothing and the other halve indicated to transport with a garment bag. However, when looking at the answers, one can see that most respondents that indicated to, generally, already wear their delicate clothing, said the problems they encountered are still whilst transporting their cloths by hand. Either in a garment bag of some sort or not. So that means that most of the complications with size or clumsiness are when people are carrying their clothes by hand. The same thing can be said about complications with creasing of the clothing.

## Insights

1. 83% of the respondents has a suit. Suits will be the garments to focus on.
2. Almost every user hangs up their clothes for storage.
3. 60% of the users indicated to make use of a garment bag.
4. As good as all complications are with transporting cloths by hand. This is creasing or clumsiness.
5. A Rollor can not store garments. Seeing the large us of garment bags for storage. It can be concluded that a garment bag needs to be provided with the new Rollor.

# 2.9. ROLLOR JOURNEY

A participant was found which had to go on a two-day business tour. He had to travel by bike, tram and train, whilst carrying his suit. An excellent opportunity to do a user test with a Rollor. The goal of this test was to obtain insights in the use of a Rollor when traveling with different kinds of transport.

## Insights

1. Participant did not anticipate on the fact he could not put a hanger in his Rollor.
2. Folding suit neatly in the Rollor can be found difficult.
3. Rollor is ideal for traveling.
4. Rollor easily rolls when stored.

### Difficult to neatly fold suit.

The subject told that he experienced some difficulty with folding his jacket nicely in half and then laying it in the Rollor. The pants gave no problems with that. He also foresaw a problem that he could not bring a hanger in his Rollor. However, he did not know that Rollor already sells foldable coat hangers.

### Good to have your hands free.

The handling of the Essential was experienced as pleasant. The biggest benefit he found was having his hands free.

### Trolley strap as addition.

During public transport he found the Rollor very handy. He could easily store the Rollor. Although, he said it would have been even more nice to have a trolley trap, just as with the Prestige. That way he could always have put the Rollor on top his trolley.

### Rollor slides forward.

During cycling he found a bit annoying that his Rollor kept sliding from his back to his front. Especially since the Rollor was hanging at the height of his steer and could interfere with his steering.

### Suit came out perfect.

The subject was a bit sceptical about the way his suit would come out of the Rollor, since he kept it in there for almost 12 hours. But he was happily surprised that his suit came out perfectly, no crease was found.

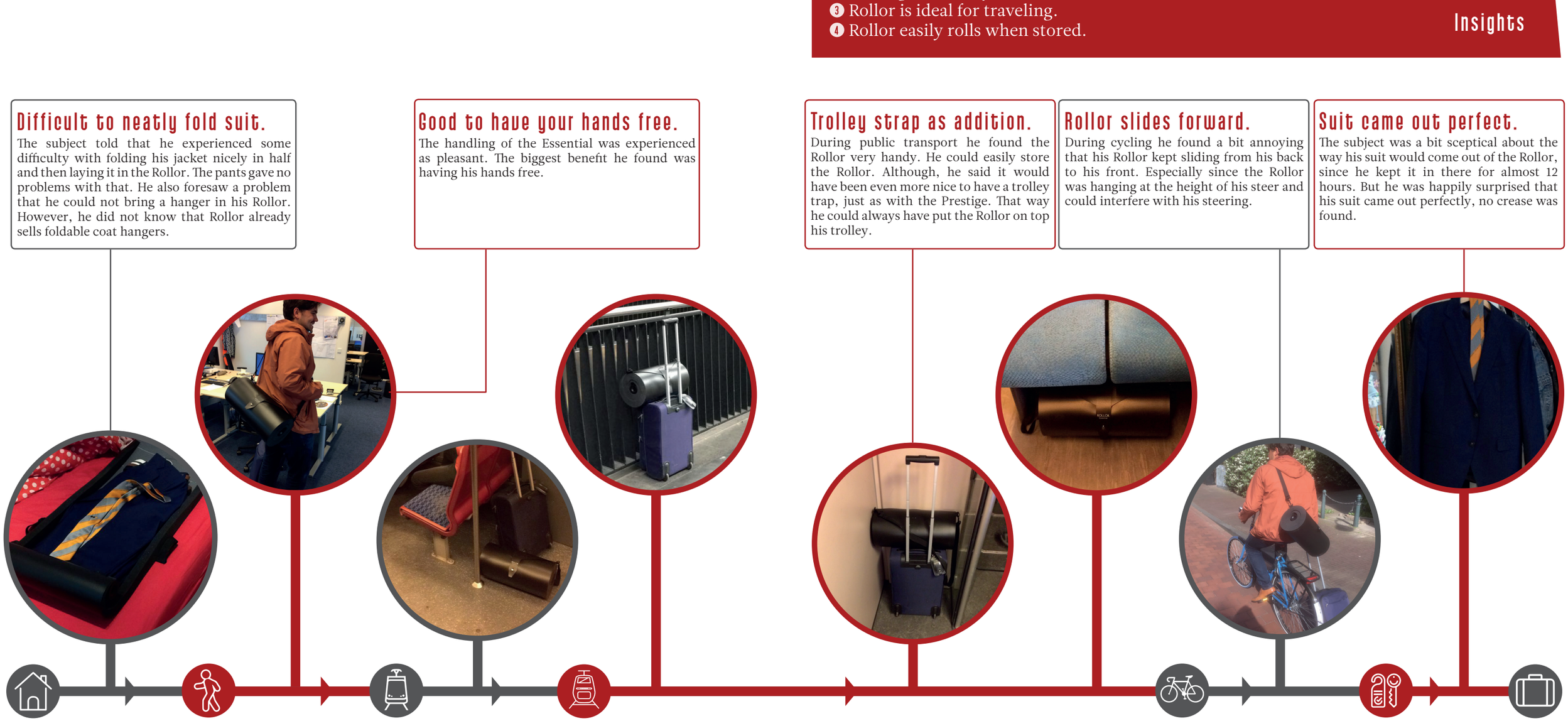


**Figure 23** This Figure shows a timeline of the journey the participant made with the Rollor.

The findings from the research are combined and discussed in this final sub-chapter. Looking at the competitors, a product journey and the impact of the research insights on the new design.

# RESEARCH CONCLUSIONS



## 2.10. COMPARING PRODUCTS

At the end of this project, the product needs to be a low-cost package that will need to compete with other packaging solutions. It will need to have the same functionality as the Rollor Express and at the same time, be more interesting for potential clients than a standard shipping box. Meaning that unpacking experience of the Rollor X needs to weigh up to the extreme low price of standard boxes and/or be just as cheap or even cheaper (if possible). As also seen in the trends, a good unpacking experience provides additional value for your customer as well as your business, since 52 percent of consumers are likely to make repeat purchases from an online merchant that delivers premium packaging.
Since it will be low-cost relative to the more premium packaging methods (Figure 24), the Rollor X may lose some points on the unpacking quality of the suits. Because of this price-quality ratio, the Rollor X is situated in a gray area between the premium packaging and the standard packaging. Throughout the project these packaging methods are used as comparing products for the Rollor X in terms of costs, unpacking quality of garments and ease of use.

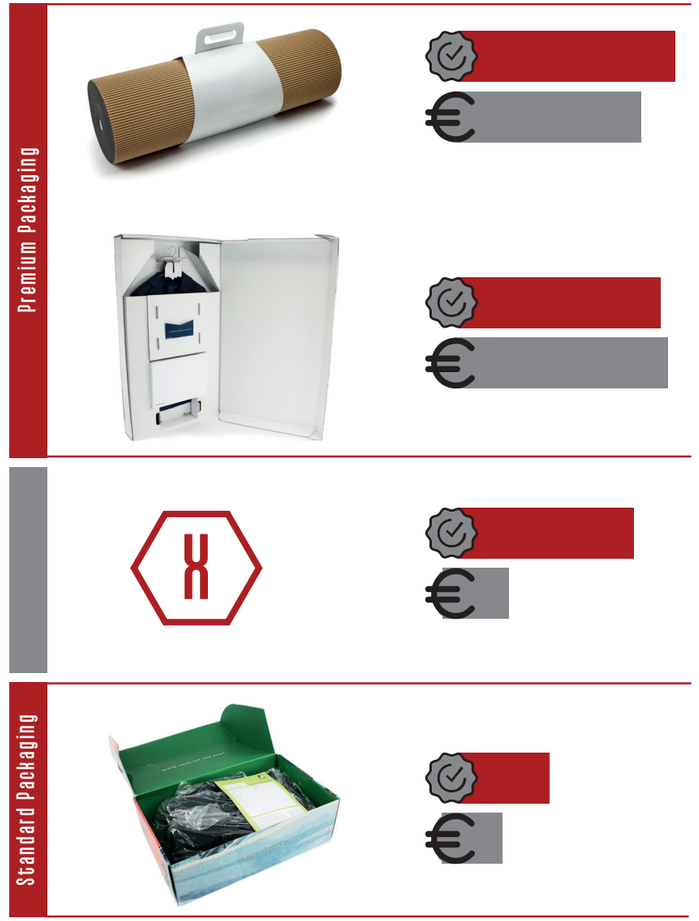
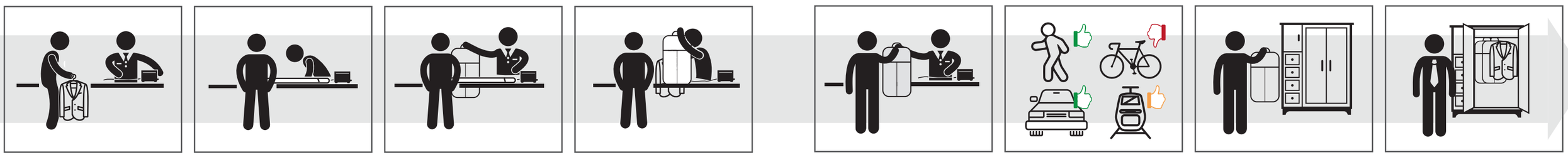



**Figure 24** This visual shows an quick overview of the desired price-quality ratio between the Rollor X and the other packaging methods.

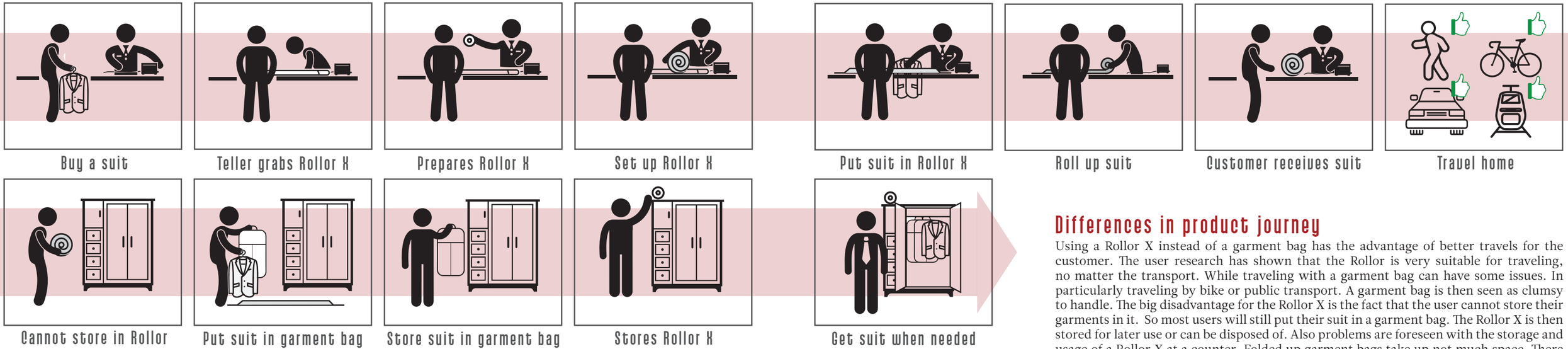
# 2.11. PRODUCT JOURNEY

With the insights from the research, a product journey for Rollor X could be made. This journey is according to the initial assignment and shows the advantages and disadvantages of receiving a suit in a garment bag or in a Rollor X.




## Garment bag

## Rollor X




## Differences in product journey

Using a Rollor X instead of a garment bag has the advantage of better travels for the customer. The user research has shown that the Rollor is very suitable for traveling, no matter the transport. While traveling with a garment bag can have some issues. In particularly traveling by bike or public transport. A garment bag is then seen as clumsy to handle. The big disadvantage for the Rollor X is the fact that the user cannot store their garments in it. So most users will still put their suit in a garment bag. The Rollor X is then stored for later use or can be disposed of. Also problems are foreseen with the storage and usage of a Rollor X at a counter. Folded up garment bags take up not much space. There has not been found a way for the Rollor X to be folded up as much as a garment bag. And when the teller needs to put the suit in the Rollor X, the entire counter needs to be used, since the Rollor X is going to be pretty large. Combined, it can be concluded that the Rollor X is not going to replace the garment bag in this situation.

# 2.12. IMPACT ON DESIGN

The change is in assignment has been one of the key elements that came out of the research. But the research brought more insights that are very valuable. These insights can be clustered into three main design requirements to which the Rollor X must comply. These requirements are discussed in this paragraph.

## Sustainable design

Sustainability is going to be a very important aspect of the Rollor X. The new design shall be a packaging for garments. As stated in the trends, the disposing of packaging causes a lot of waste. Therefore the new design needs to create as less impact as possible. Not only is this good for our environment but this can also have a positive influence on the assessment process of potential clients. With the trend that not only companies are striving for more sustainability, but that consumers are demanding it more and are even willing to pay more for sustainable products, being able to sell sustainable products to client can be a great benefit. This also fits the profile of a new, fresh company such as Rollor.

## Unpacking experience

It has been made clear that delivering a great unpacking experience is very beneficial. The current Rollor design already is a innovative way to transport garments and receiving them in an Express gives a consumers a pleasant surprise. Unpacking the Rollor X can not be inferior to this and preferably rise above it. This is most direct touch point and connection that clients will have with their customers, so this a critical moment that needs to be maximized. Having a creative design can also help in this manner. As already mentioned, the experience starts with the exterior. Having a customized shape or appearance is great way to ensure a lasting impression on consumers.  And having a unique packaging method helps even more.

## Design for transport

The focus of the new assignment is transporting garments crease free. The Rollor X needs to be designed so that it may not cause any obstructions and can withstand  incautious use during the transport process. It is foreseen that the current round design of the Rollor causes troubles in this process. Also, one cannot assume that their package will arrive at its destination unscathed. The Rollor X needs to be robust enough to take a few blows and strong enough for other (heavy) packages to be placed on top of it.

Chapter 3

# DESIGN PROCESS

This chapter shows how the research findings affected the design process. Starting with the two concept directions that were established and the final concept choice. Followed by the contribution of prototyping for this project and a summation of the main design challenges that needed to be overcome in order to end up with the Rollor X. This chapter ends with a consultation with production experts and the list of requirements that followed from all different design phases.

# 3.1. CONCEPT DIRECTIONS

Out of the conceptualization phase came two concept directions, as shown in the project overview in paragraph 1.1. In this paragraph these two directions shall be shortly discussed.

## Concept direction 1

### The idea

The idea of this direction is about making use of the material properties of the foam rails. Foam can easily be compressed together and greatly reduce in size. This property lends for the rails to be rolled up very tightly and forms the basis for this concept direction (Figure 25). Concepts were made from the same materials as the Rollor Express. Due the fact that these materials were quickly available and could easily be prototyped with. It even turned out that the corrugated cardboard was a good material for rolling up the concept very tightly. However, the material did wear off rather quickly after rolling it multiple times. But at the time, this was a secondary design challenge of which was expected that it would not cause too much difficulty to overcome.

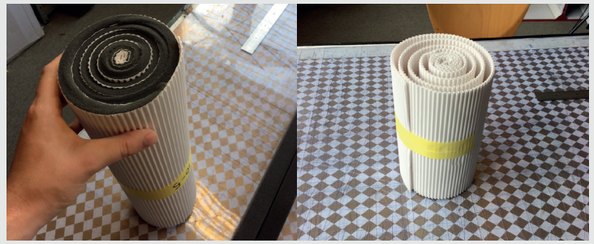


**Figure 25** This figure shows two concept ideas. Both are based on the idea of rolling up the concept very tightly. But the concept idea on the right had an extra function of folding it half and then rolling it up. Reducing the size even more.

### Main design challenge

The main design challenge sat with the foam rails. With some quick tests, where a foam rail was rolled up very tight, the foam returned to its initial state almost immediately after if was rolled back out. The rail could then be rolled up normally without any problems. But the outcome of the longer during tests were less positive. The rail lost around 3 mm in height, which is not a big issue per se, but the biggest problem was the loss in pressure resistance (Figure 27). When trying to roll up the rail normally, it automatically rolled up tightly again. This was a big problem. The idea of the concept is to save storage space, so it needed to stay rolled up for a certain amount of time. After being rolled up all this time, it should be able to be used immediately. So it could not lose its pressure resistance, otherwise it would make the concept unusable (Figure 26).

### Concept validation

A visit was paid to foam experts in order to find a foam that would maintain its pressure resistance after being compressed for over a longer period of time. The answer, unfortunately, was that such a foam does not exist. A foam that quickly returns to its original state after being compressed for a longer period of time is hard to find. One that also has a rather high compression resistance, as needed for this concept, does not exist (Van der Berg, 2017). More details on this visit are found in the appendices. The experts told that the foam with the best properties for this, was the foam that was already used by Rollor. But unfortunately, that foam just did not cut it. Therefore it chosen to put this concept direction on hold and continue with concept direction two.

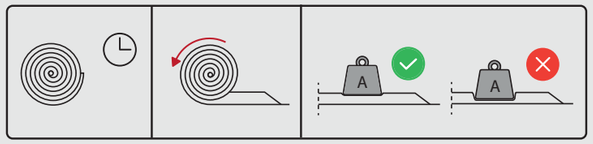



**Figure 26** After being compressed for a certain amount of time, it is desired that, when the Rollor is unrolled, the rail is (as good) as firm as it was before it was compressed.

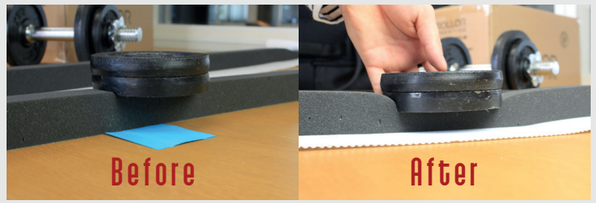



**Figure 27** This figure shows the loss in pressure resistance in the foam rail after being rolled up tightly for four weeks. More results of the rail test are found in the appendices .

**Insights**

1. A foam with the right material properties for concept direction one to work, does not exist. It was therefore chosen not to continue with this direction ,but to focus on concept direction 2, of which the working principles could be validated with the use of small models.

## Concept direction 2

### The idea

The development of concept direction two ran simultaneous with that of concept direction one. The main idea of direction two is that it can be flattened entirely which will save a lot of space during transportation and storage. Then it can be set up by folding up the core and rails. After that, the concept can be rolled up just as any other Rollor products. These steps are visualized in Figure 28. This idea was inspired by a handy toolbox called the Rolykit (Figure 29).

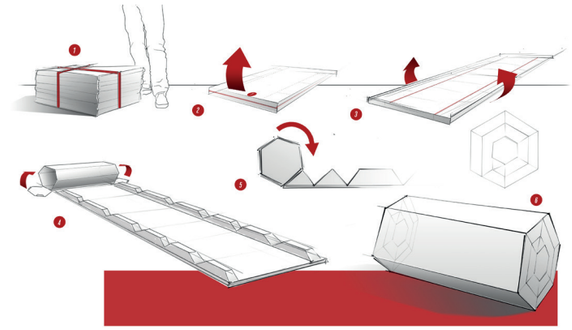


**Figure 28** This figure visualizes the working principles of concept direction two. Where the product can be flattened entirely and set up by folding the different components. Then it can be rolled up and function as other Rollor products.

### Main design challenge

The main design challenge for this concept was how to go from a completely flattened product, to the product to be folded in such a way, so that it would be able to roll up. Preferably, this concept would be made out of a single piece of material. Which would save in production and material costs. As can be expected, solving this design challenge would not go easily. The entire concept consisted out of multiple, smaller design challenges, but these challenges are further discussed in paragraph 3.6.

### Concept validation

To validate the working principles of this concept, a lot of small models were crafted. (How prototyping has influenced this project can be read in paragraph 3.5.) After multiple failed models there was a breakthrough in designing concept direction two (Figure 30). A construction was created where the rails would consist of trapezium shaped components that where connected by foldable spacers. These rails could be flattened and easily set up. Doors inside the trapezium components cause for a rigid system and the shape of the trapezium provide the possibility for the rails to be rolled up. This breakthrough, and the setback with concept direction one, lead for choosing concept direction two to be further developed in this project.

**Figure 29** This figure shows the Rolykit, a plastic rollable toolbox design in 1973 by Samuel Meijering.

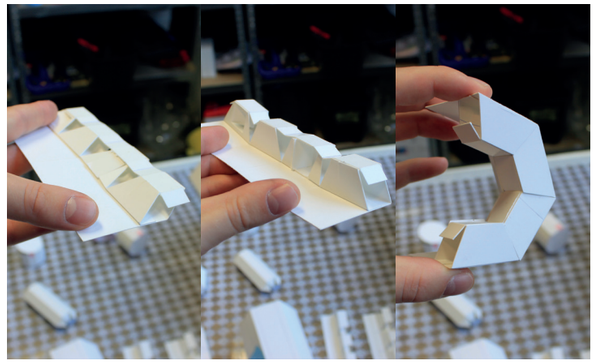


**Figure 30** This figure shows a model that defines the working principle of concept direction two. The rail consist of a trapezium shape construction that can be set up by folding. The trapezium shapes cause for the rail to be able to role up.

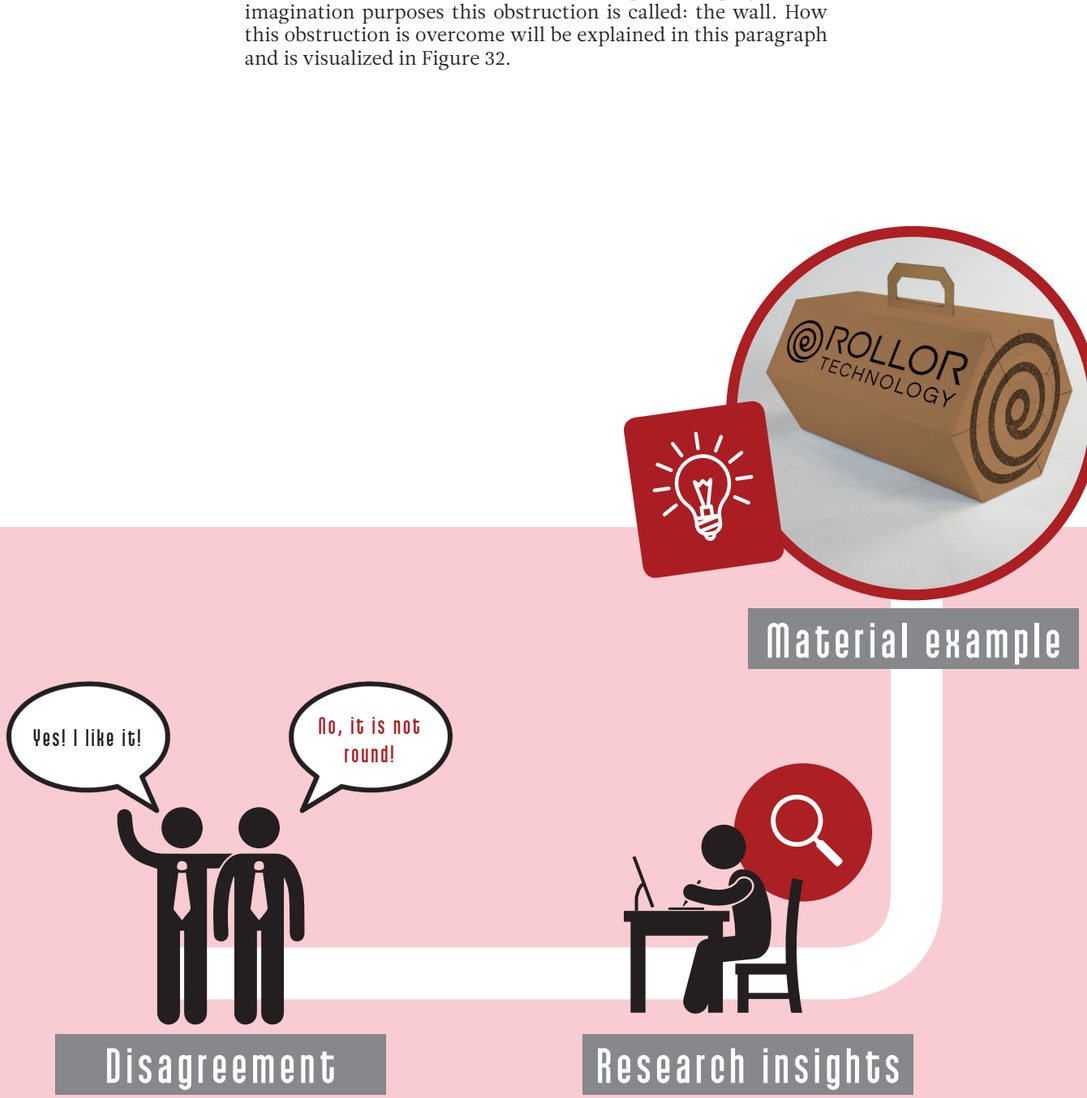
# 3.2. CONCEPT CHOICE

After choosing the concept direction, a one-to-one scale prototype was made. From this prototype, together with the insights obtained by the earlier models, an ideal image for the concept could be created (Figure 31). This ideal image shows the possibilities one can have with this new concept. Since the entire product is made from one, flat sheet (material not yet determined), it can easily be printed on all sides. Giving endless possibilities  to the appearance of the concept. The hexagonal shape ensures that the concept can easily be set down anywhere. (So it will not give any problems rolling over during transport.) The flat sides also provide the opportunity to easily add extra features, such as a handle for example, as shown in Figure 31. However this image does not represent the current design direction. As discussed already in the beginning of this thesis and shown in the project overview in paragraph 1.1, insights from the internal research lead to a change in the scope of the project. This caused for this ideal concept image to change. This will be picked up in the next paragraph.


**Figure 31** This figure visualizes an ideal image of the chosen concept direction where an end-user bought a suit at Oger (a current client of Rollor) and received it in the new Rollor concept.

# 3.3. THE WALL

Halfway the project, a small obstruction was come across. This obstruction consisted of two things: an internal disagreement about the concept direction within the Rollor management and research results that contradicted the scope of the project. For imagination purposes this obstruction is called: the wall. How this obstruction is overcome will be explained in this paragraph and is visualized in Figure 32.




## Internal disagreement

During the final steps of finalizing the two concept directions, both Rollor managers were individually presented with the ideas. One manager had a preference for concept direction one, while the other strongly preferred concept direction two. This put the project in a slightly unpleasant situation. After discovering that concept direction one was not feasible and concept direction two had great potential, the chosen concept direction (number two) was presented to the Rollor management. Again, one manager was very enthusiastic and the other did not see this concept working. According to him, the hexagonal shape would not work for Rollor. Customers want a round shape (Van der Laan, 2017). Luckily, with the other manager and the head of design being enthusiastic about this direction, he could be convinced for this project to continue with this concept direction. After that, it only took a few improvements in the design and a couple of enthusiastic investors for him to totally get on board of this concept. What also played a significant role is the fact that the Rollor X falls under the Rollor patent (Van Oefelt, 2017).

## Change in scope

As mentioned in paragraph 1.2 the original assignment was not feasible anymore. With an unreachable goal of replacing the standard garment bag, it was needed to review the project and see whether there were areas that could be redefined in order for the concept to still be of use. One thing immediately popped up. Multiple concept visuals were made in order to show the material and print possibilities of concept two. One visual was made were the concept was made out of brown cardboard, almost like a package (see 'Material example' in Figure 32). This got the team thinking: could the concept be redesigned, so that it could function as package on its own. This way it could be used for sending suits and maybe be an addition to the Rollor Express line. This idea made the entire Rollor team enthusiastic, so the scope of the project would be adjusted where the new concept would be a low-cost package that would be used to transport garments crease free.

**Figure 32** This figure visualizes how an internal disagreement about the concept and unfavourable research results caused the project to hit a wall. However, a new idea lead to a change in concept that lead to overcoming this wall.

# 3.4. DESIGN PROTOTYPES

Prototyping has played a crucial role in the development of the Rollor X. This paragraph will discuss how the many prototypes have helped with constantly testing and improving the Rollor X and eventually have lead to the final concept design. From small five-minute-models and proof-of-principle prototypes to full, working prototypes. Each could be used to test and enhance certain aspects of the design. The most influential insights are visualised in Figure 33. Each step is further explained here.

## 1 Paper cut outs

The first ideas were drawn on paper and cut out. These so called five-minute-models helped to quickly realise that the trapezium shape in the rail could be used as a replacement for the foam rail. Where this newly shaped rail is completely folded and had the possibility of being flattened again.

## 2 Rail construction

With a positive outcome of the five-minute-models, the next step was to figure out the right construction for the rail. For ease of use purposes, it was desired that each trapezium part was connected to one another. So that the entire rail can be set up as a whole. Also a solution had to be found how to secure the rail, once is has been set up. After a large variety of possibilities it was found that foldable spacers connecting the sides of the trapezia would be the easiest solution. This solution in shown in step three.

## 3 Proof-of-principle

Now that there was a construction for the rail, it was time to make a proof-of-principle model consisting out of a core and multiple rail parts. With this model, the first rolling motions could be tested. Although the rolling did not went that subtle, it proved that this entire concept just might work. The construction of the core was still discarded at this moment. Early five-minute-models for that had shown that this would not be a big design challenge. So that was set aside for the moment. The focus therefore would stay on the rail and the construction as a whole.



## 4 First scaled full model

With a construction chosen for the rail and a proven design principle, a first scaled model of the full design could be made. This model gave a good view on how the concept could eventually look like. Also it functioned as a follow up of the previous proof- of-principle, where it again showed that a folded, rollable solution was feasible. It could as well be seen that the rail construction proved to be very unstable when rolling the model (also seen in Figure 33, step 4). A solution needed to be found to get the rail fixed, once it is been set up.

## 5 Fixing the rail

Without a fixed rail, the concept would be to unstable and would not work properly. Different types of solutions were tested to see which work best and which could be easily implemented in the design. The best solution for this problem was to put door-like flaps in the trapezia. These flaps are pressed in when the rail is set up, causing a fixation of the trapezia. Since the trapezia are now connected by foldable spacers on top, only a few trapezia had to have such a flap in order for the entire rail to become rigid. Another benefit of this solution was that the flaps could be pressed out again, enabling the rail to be put back in its flattened state (shown in Figure 33, step 5).

## 6 Full scale prototype

The design now really began to take shape. With a proven construction and a new idea for the fixation of the rail, it was time for the next big step: creating a full scale prototype. A digital cut out of the design was made and send to a cardboard printing and cutting company. Having everything aligned to the millimeter, this prototype would be the next closest thing to the eventual design. This new prototype was cut out and had grooves made in for folding. But setting it up still took a lot of work. The grooves were not that deep, so every fold had to be made extra sharp by hand. But the end result was a very good working prototype. First garment test now could be done and could be shown to investors.

## 7 Final concept design

After the success of the first full scale prototypes, came a change in the assignment. Which lead to the need of the concept to be strong enough to be send as a package. A first quick transportation test with a prototype proved that having flaps on the side, highly enhanced the rigidity of the concept. This was quickly implemented in the next prototype that was made with thicker cardboard. This thickness shown to be excellent and would be used with further prototypes and, with some improvements, this would be the final concept design.

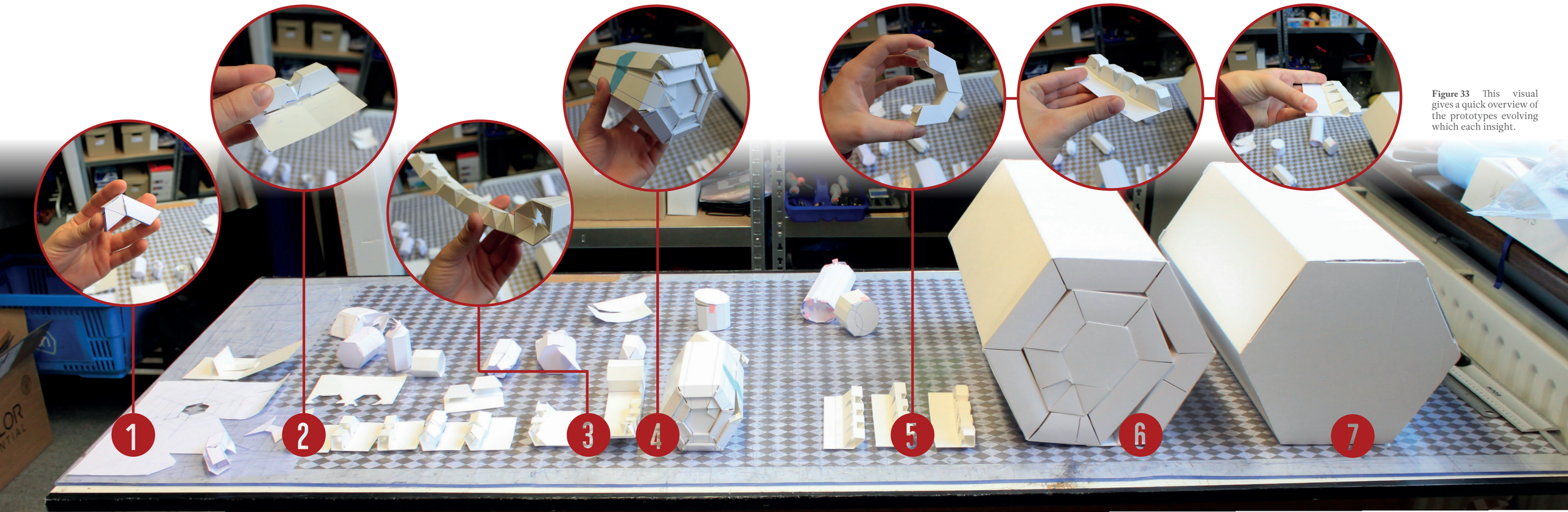
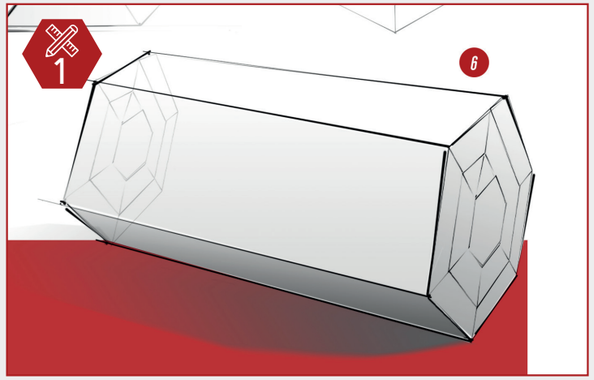



**Figure 33** This visual gives a quick overview of the prototypes evolving which each insight.

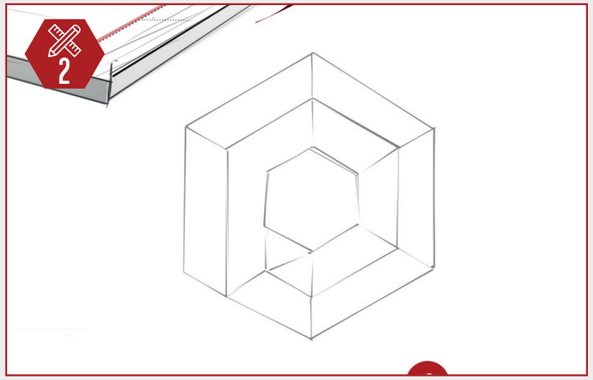
# 3.5. DESIGN CHALLENGES

Throughout the project certain design challenges had to be overcome in order to achieve the design goals. The main design challenges are shown beneath and are briefly explained. The solutions for these challenges are presented further in this paragraph with one of the later Rollor X prototypes.



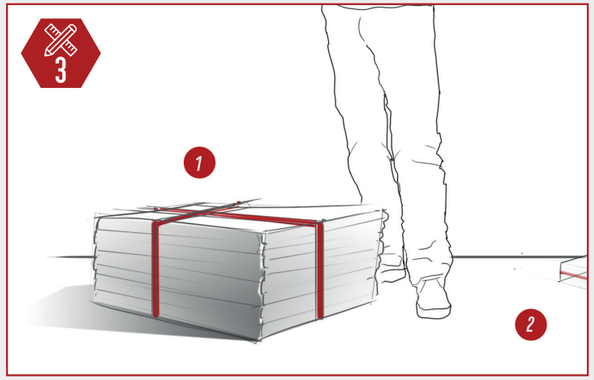

## Strong enough to withstand transportation.

During transport, packages are not always handled with care. Since the Rollor X will function as a package on its own, it needs to withstand possible careless handling during this transportation process.



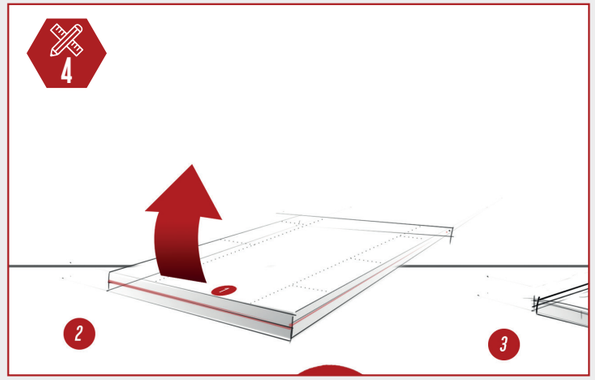

## Make a design with a smaller core.

The core of the current design is quite large and essentially is redundant space. Reducing the size will also result in a smaller Rollor X but also affects other dimensions. It needs to be sorted out if this is possible and then, how much smaller the core could be made.



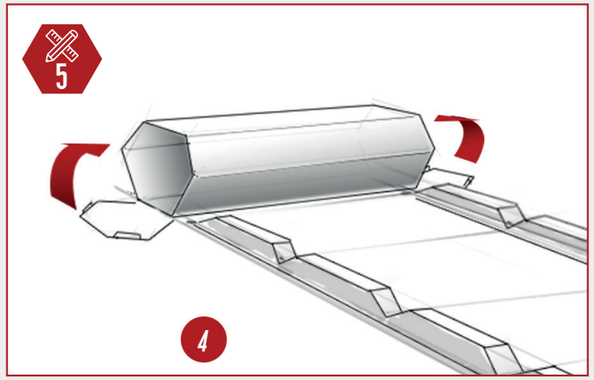

## Able to reduce size for storage and shipment.

One of the most important aspects of the redesign is that it is able to be reduced in size. This will save a lot of space and money during storage and transportation.



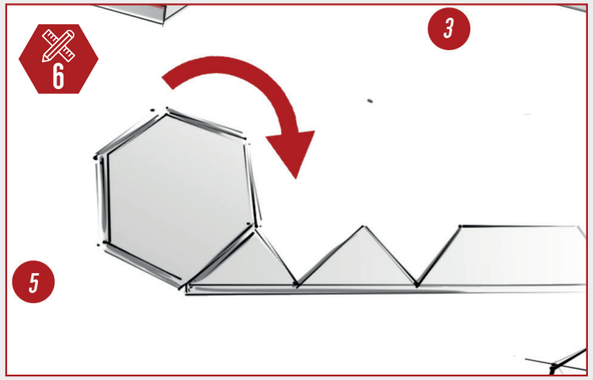

## Produced from one piece of cardboard.

In order to keep production costs as low as possible, the Rollor X needs to be produced from one piece of cardboard. Another reason for this is that it discards any assembly tasks for the user. They just need to fold up the Rollor X and it is ready to use.



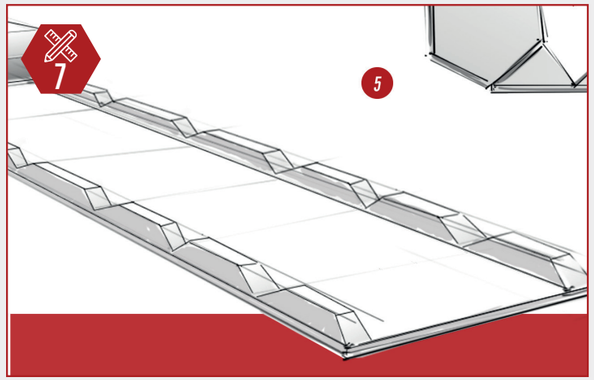

## Design core that is easily set up and rigid.

The Rollor X needs to be set up easily. This will start by setting up the core. Since the core is used as starting point for rolling up the Rollor X, it needs to be rigid.



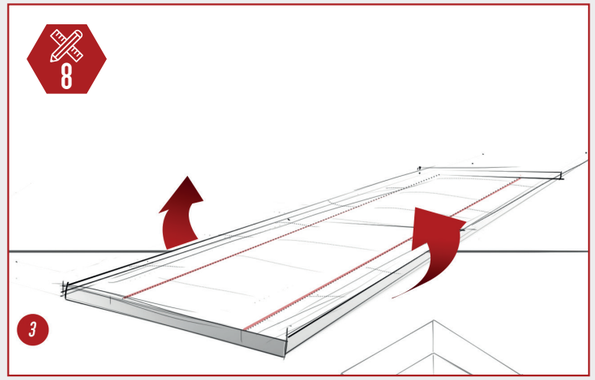

## Connection between core and rail.

The connection between the core and the rail is very important. This will support the first steps when rolling up the Rollor X. If this not goes effortlessly, it will negatively affect the entire rolling sequence.




## Fixed rail that is rigid and can be flattened.

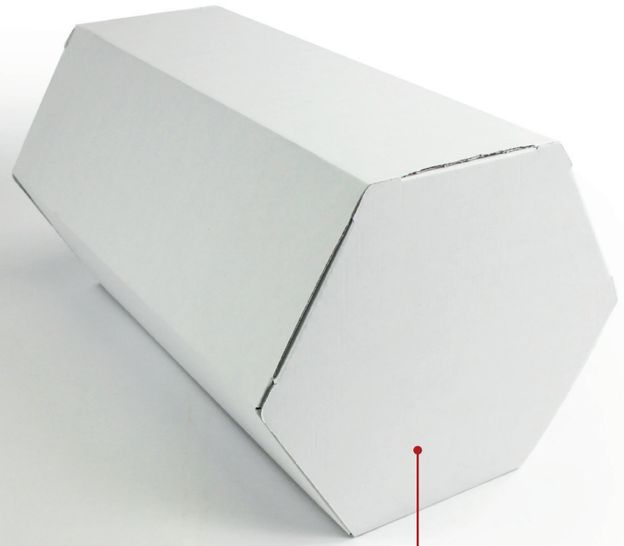
The rails are a important component of the Rollor X. They need to be rigid in order for the Rollor to be rolled up. However, they also need to be able to be flattened in order the fold up the entire product for shipment and storage.




## Be rollable whilst being folded as well.

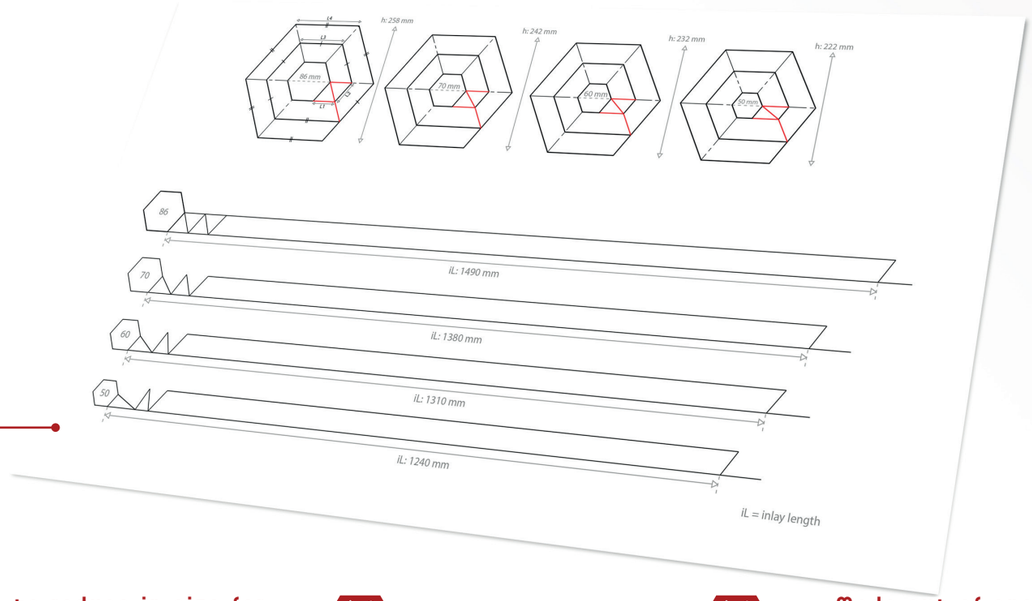
Rolling and folding are two principles that do not work well together. Finding a combination of folding up the core and the rails, while also being able to roll up the design was a very big challenge.

**Figure 34** This visual shows the main design challenges that had be overcome in order to end with a good design. Each challenge is briefly explained.



## Doosopmaat.nl prototype

After the first working prototypes, a visit was paid to Doosopmaat.nl. A company that has an expertise in developing custom made packages. With some adjustments to the design, they could make the prototype of the Rollor X that is seen in the next few pages. This model is made from 2.0 mm thick cardboard and is cut out with automatic CNC cutting machines.

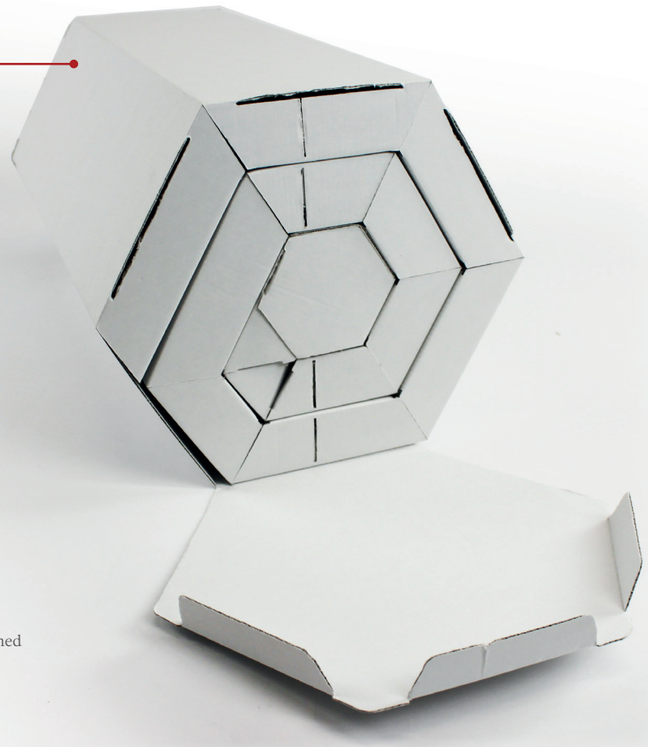



## 2 Make a design with a smaller core

All dimensions of the Rollor X are depended on each other. The rail height is the basis for this. If this gets higher or lower, it will affect the total size and length of the Rollor X. Reducing the size of the core will do the same and also affects the shape of the rail-core connection, as shown in the visual on the right. For this prototype it was chosen to keep the larger core, for it would not give any problems with this connection. These problems will be addressed in a later stadium when the core size is adjusted.

## 1 Strong enough to withstand transportation

When sending a package, one needs to make sure their package is sealed up good and can take a few blows, because packages are not always handled with care when shipped. Closing flaps on the side were added to the design of the Rollor X to ensure that the entire product is sealed up right. Another feature of these flaps is that they increase the rigidity of the entire design. Tests have shown that this design is strong enough to endure the shipping process.



## 3 Able to reduce in size for storage and shipment

This design needed to have the ability to be completely flattened and, in order to fit on a regular pallet, should then be able to fold in half. The challenge was that the design would not get to much layers of cardboard, otherwise the material could tear under pressure when the flattened product would be folded for transport.

## 4 Made out of one piece of cardboard

Creating a design that could be produced out of a single sheet of cardboard was challenging. All components had to be connected but also had to move separately from each other, e.g. the entire rail needs to be set up in one motion, but each rail component needs to fold against one another separately. This all had to be done without making the design too complicated to set up.

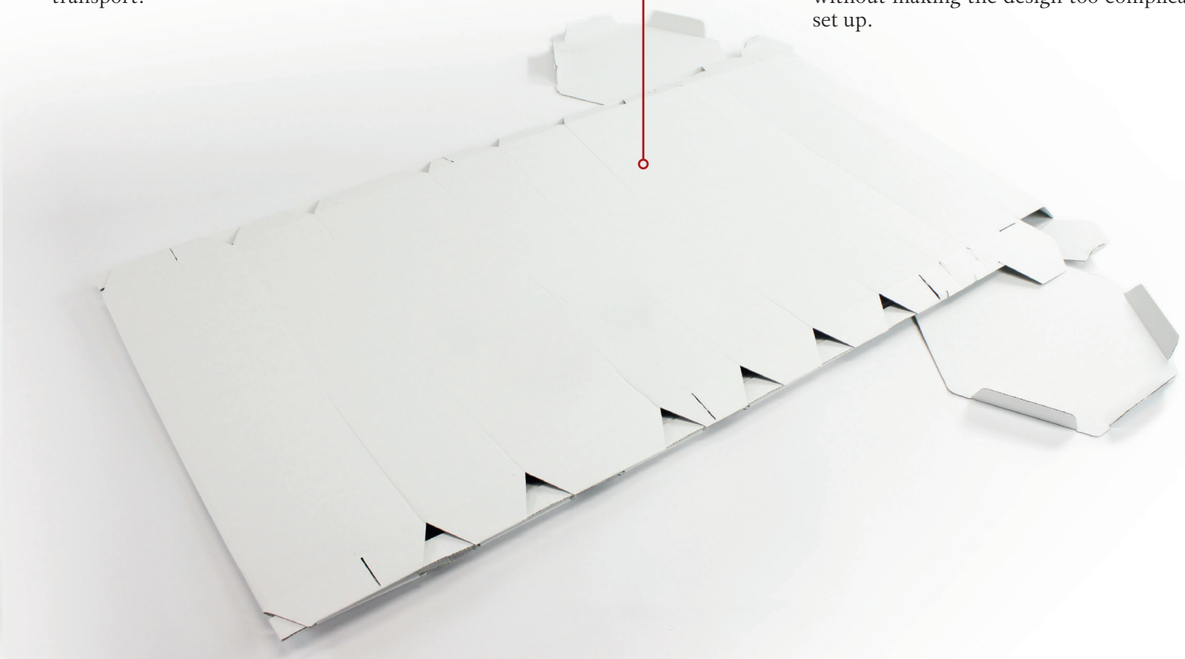


**Figure 35** This spread shows the design challenges 1–4. Each challenge is explained and is connected with the corresponding photo in the visual.

## 5 Design core that is easily set up and rigid

The hexagonal shape of the core can easily be flattened and set up. The challenge here was to design the sides of the core so that they could be set up just as easy as the rest of the design and would provide a rigid construction for the core. The solution consists out of two closing flaps. One inside flap that is enclosed by the core and provides rigidity to the core. Followed by an outside flap that secures the construction (see left visuals).

## 6 Connection between core and rail

In order for the rail to roll properly around the core, a certain connection needed to be made between the core and the rail. This connection supports the core between the first rolling steps. The solution was a row of alternately placed triangles that could fold in an accordion-like way, which is illustrated in the visuals on the right.

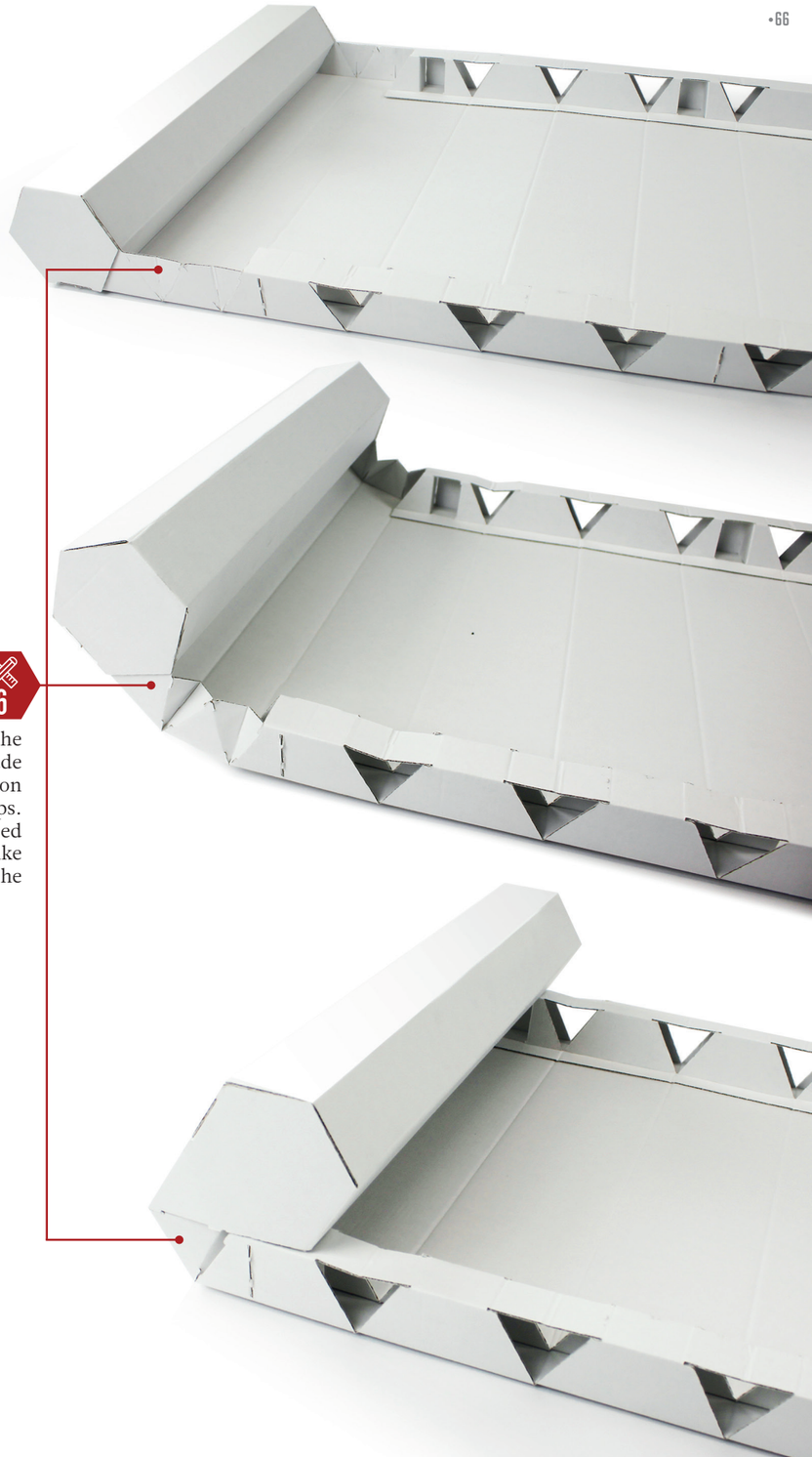
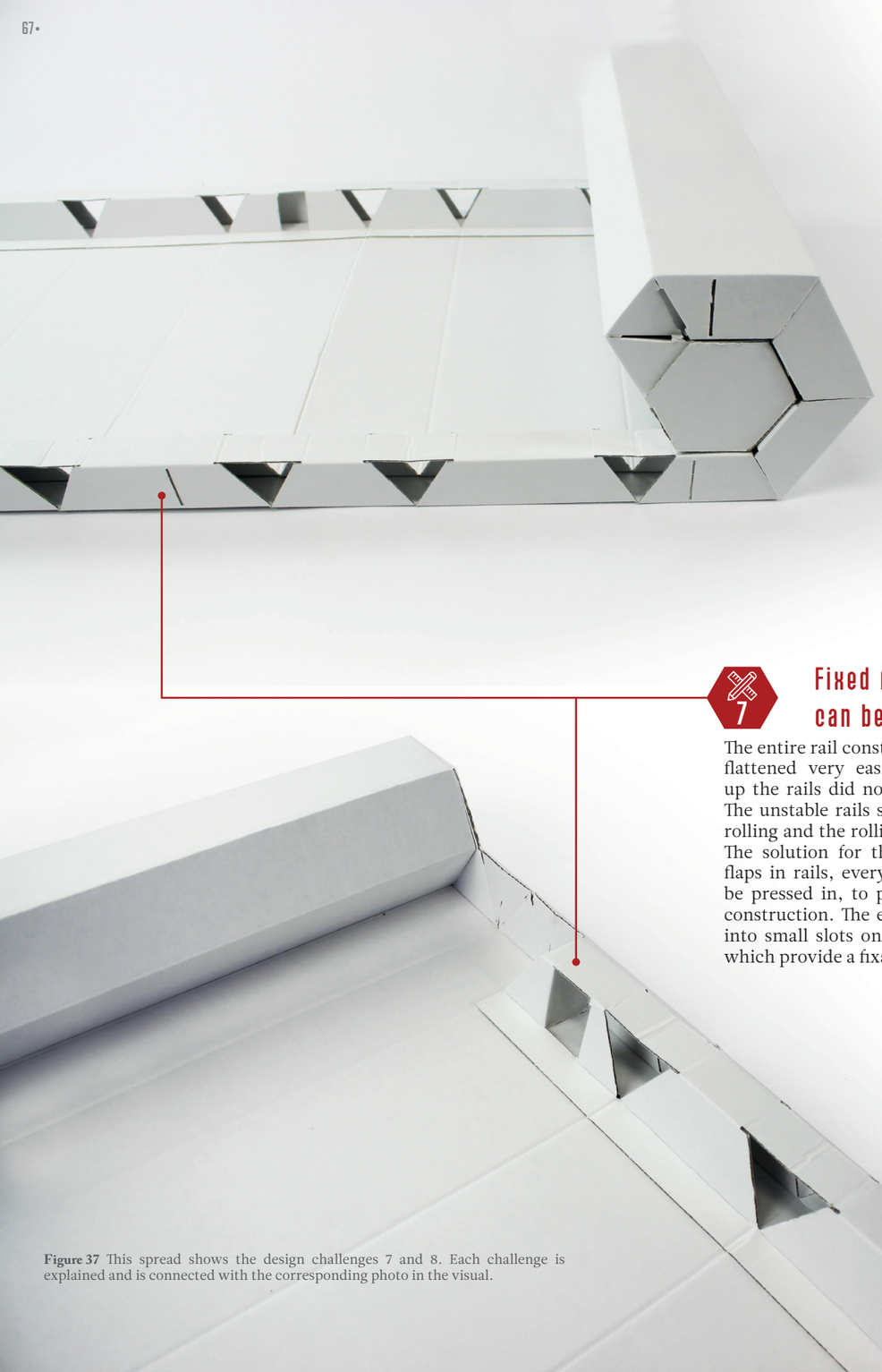
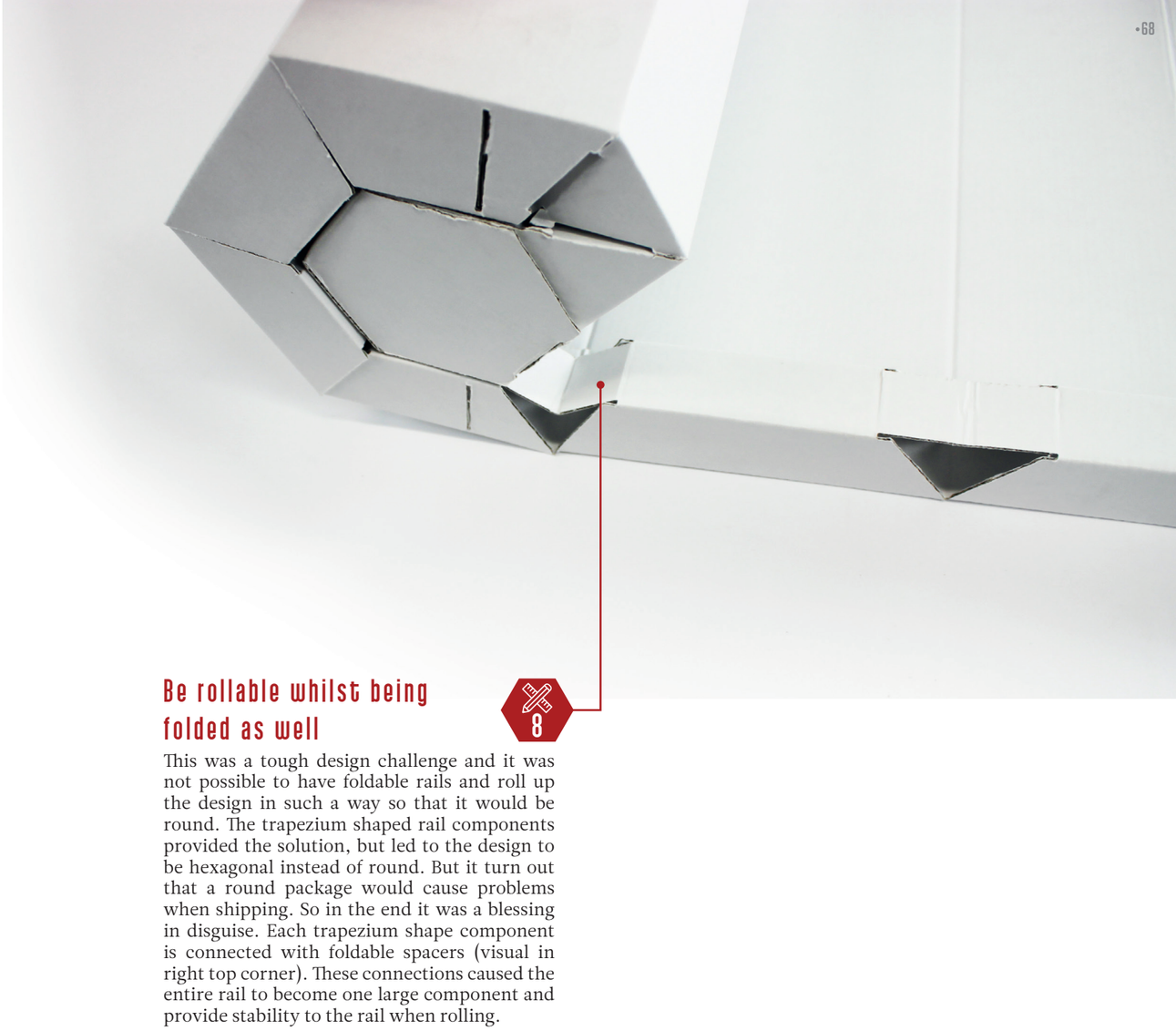


**Figure 36** This spread shows the design challenges 5 and 6. Each challenge is explained and is connected with the corresponding photo in the visual.



## 7 Fixed rail that is rigid and can be flattened

The entire rail construction could be set up and flattened very easily. However, just folding up the rails did not provide enough stability. The unstable rails sometimes collapsed during rolling and the rolling itself went a bit wobbly. The solution for this was to place door-like flaps in rails, every few trapezia. These could be pressed in, to provide stability to the rail construction. The end of the flaps are pressed into small slots on the other side of the rails which provide a fixation of these stability flaps.



## 8 Be rollable whilst being folded as well

This was a tough design challenge and it was not possible to have foldable rails and roll up the design in such a way so that it would be round. The trapezium shaped rail components provided the solution, but led to the design to be hexagonal instead of round. But it turn out that a round package would cause problems when shipping. So in the end it was a blessing in disguise. Each trapezium shape component is connected with foldable spacers (visual in right top corner). These connections caused the entire rail to become one large component and provide stability to the rail when rolling.

**Figure 37** This spread shows the design challenges 7 and 8. Each challenge is explained and is connected with the corresponding photo in the visual.

## Insights

1. This prototype has shown that all design challenges were overcome.
2. Since the design is produced from one cardboard sheet, it is expected that is could easily be produced on a larger scale, however this needs to be discussed with production experts.

# 3.6. PRODUCTION EXPERTS

With a good working prototype it was time for the next step. The team had a meeting with Smurfit Kappa. A company that designs and produces cardboard based packaging world wide. Together with lead designers and managers from Smurfit Kappa it was talked about the possibilities of producing the Rollor X. The outcome of that meeting is discussed in this paragraph.

## The visit

During the meeting the Rollor Team showed the Smurfit Kappa (SK) designers the current prototype of the Rollor X. Together, it was discussed how the Rollor X could be developed by SK, how the design must be altered in order for it to be produced on a large scale. Present at the meeting were: Robert Hoes, Rollor Founder; Peter Hoogland, Rollor Head of Design; Maarten Ornée, graduate at Rollor; Bart van Herck, General Manager SK Olen (Belgium); Herman Vermeulen, Design & Technical Sales Manager SK Benelux; Bart de Groot, Head Design Department SK.

The SK team was very interested in the concept of the Rollor X and together with the Rollor team they could brainstorm on how the Rollor X should be produced. In the end a few challenges emerged and plans were made for the next steps that needed to be taken for producing the Rollor X.


**Figure 38** The Smurfit Kappa Experience Centre in Oosterhout, the Netherlands. This is where the meeting was held.

## Production

The current prototypes of the X are cut with an CNC cardboard cutting/groove machine. One cut-out takes five minutes. In order to produce on a large scale, it was thought that the X should be cut out by cardboard die cutter. The cut-outs would then go through a folding/glue machine to fold up the raised edges and core. Then the X would be folded one time to save space in transport. This process was confirmed by people of SK. However the design needed to have alterations at some critical points in order to make his happen. These points are summed up in Figure 39.
Next to these points, a couple of other production challenges came forth:

- With die cutting, the creases are better than with the CNC machine. However, it is expected that the customer still needs to apply extra pressure when folding afterwards.
- The industrial printers SK uses, print upside down. Meaning, when the products need outside printing, the sheets need to be turned before they go in the die cutter. Otherwise the wrong side will be printed.
- Almost all parts of the cut-out fold in the same direction. For the parts that fold the other way, a reverse crease can be made with the die cutter.

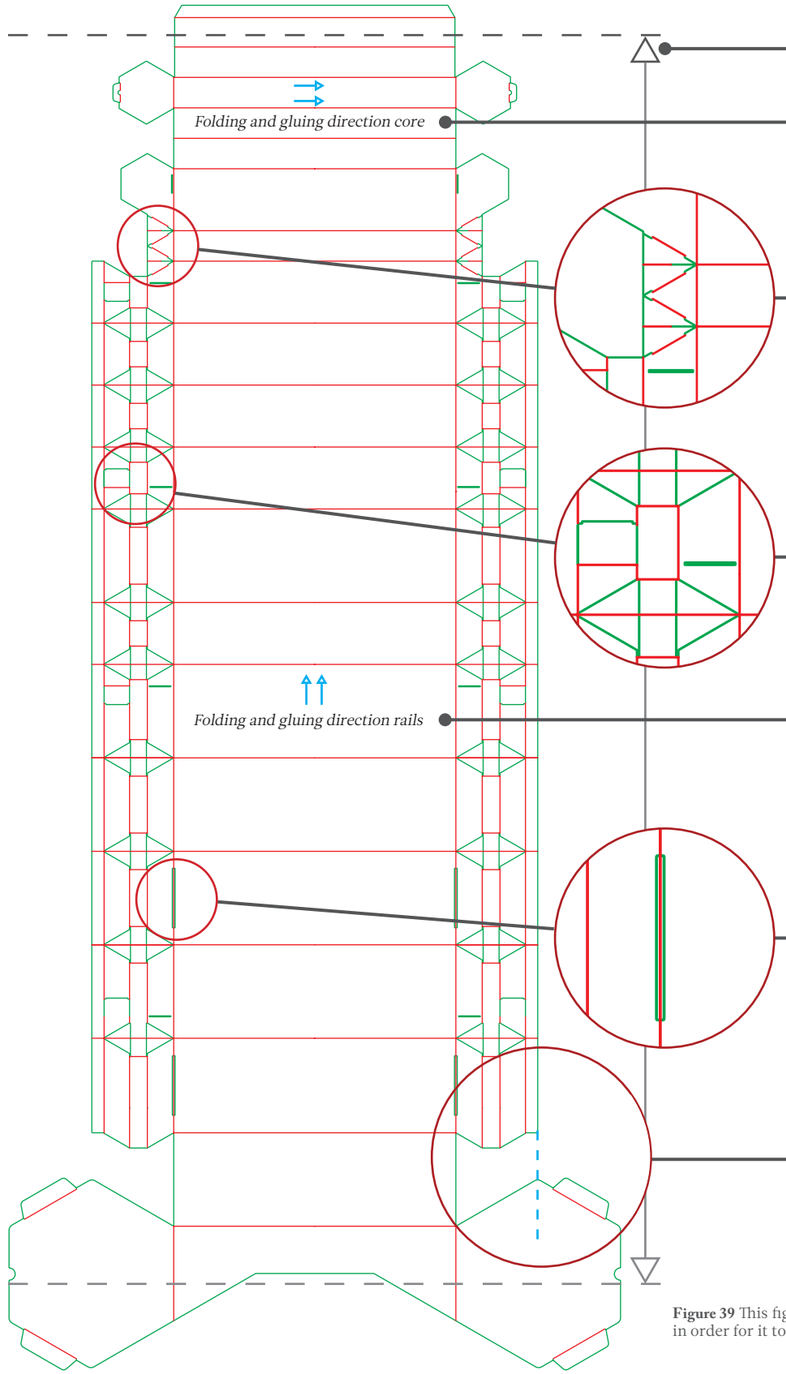
## Next steps

A prototype cut-out has been given to the designers of SK. They will take a closer look at the design and how this should be altered in order for the X to be produced with the desired machines. Within a not yet specified time, they will provide us new design proposal of their own. This will be followed with the production of a first cutting form, with which a test production of 500 Rollor X's will be produced. Only then can be seen what problems may occur when using a die cutter and how his will affect the production line.

## Insights

1. Producing the Rollor X on a larger scale is highly plausible.
2. For the Rollor X to be produced on a larger scale, alterations needs to be made to the design (Figure 39).
3. Primary tests need to be done with a die cutter in order to really discover the plausibility of large scale production.






## Design improvements

### Rollor X cut out is too large
*Maximum cut and print size is 1980 x 1200 mm. The cut out of the X, which too long.*

### Two folding/gluing directions (1)
*The folding and gluing direction of the core is perpendicular to that of the rails. Causing the X to be put trough a folding/glue machine twice, each with another insert position. This will increase the production time and costs.*

### Core-rail connection difficult to function
*As already know with the Rollor team, this core-rail connection has shown to not function properly. The SK team also recommended to redesign this or, if possible, leave it out. Maybe an adjustment tot the shape of the core could replace this connection.*

### Details are to small for die cutter
*The small slots for the reinforcement flaps for the rails, are too small for the cutting machine. The minimum blade distance is usually 4mm. The same goes for the small notches at the corners of some of the triangles.*

### Two folding/gluing directions (2)
*The folding and gluing direction of the core is perpendicular to that of the rails. Causing the X to be put trough a folding/glue machine twice, each with another insert position. This will increase the production time and costs.*

### Details are to small for cutting machine
*These slots also less than the minimum blade distance of 4mm. Which could cause problems with production.*

### Closing flaps to wide for folding machine
*In order to fold the rails with the folding/glue machine, the rails need to have a cleared run-up. Meaning no part of the cut-out can exceed the width of the part that needs to be folded.*

**Figure 39** This figure shows which parts of the design needed to be altered in order for it to be produced with the desired machines.

# 3.7. LIST OF REQUIREMENTS

Based on the insights that were obtained from the research, the design process and the meeting with Smurfit Kappa, a list of requirements could be made for the final design of the Rollor X and is presented below. The list of requirements will be used to verify whether the final design fulfils its intended purposes.

## Design

1. The new design has to fit within the company's current brand strategy (being very client-orientated).
2. The design preferably falls under the Rollor patent.
3. Unique design for unpacking experience.
4. Possible to be transported with standard couriers such as UPS (not falling over on conveyor belt).
5. Garments inside need to be sealed off just as much as with a standard package.
6. Able to reduce size for bulk transportation and storage.

## Use

7. Easy to use: setting up the Rollor X needs to be self-explanatory or explained with few simple instructions.
8. Ready to use upon arrival at clients: no extra assembly steps needed.
9. Making the Rollor X ready for shipment should be accomplished with a view simple actions.
10. This can not take longer than 1.5 times of setting up a standard shipping box.

## Quality

11. Needs to withstand the transportation process of packages.
12. Garments need to come out as good as with the other Rollor Products.
13. End user needs to have a good unpacking experience.
14. Needs to withstand pressure of packages put on top. (Defined as 30 kg, maximum weight to send with Post NL)

## Production

15. Easily be produced on a large scale.
16. Cost price €1-2.
17. Needs to be made from sustainable materials.
18. Made out of one cardboard sheet.
19. Only one folding/gluing direction.

## Dimensions

20. Volumetric weight (l* w * h/5000) needs to be under 5 kg.
21. Max. sheet size (max. die cut/print size) : 1980 * 1200 mm.
22. Needs to fit on regular EUR-pallet (800 * 1200 mm).




**Figure 40** This visual shows the large variety of prototypes that have been made before ending up with the final design. With the first prototype shown prominently in the lower left corner.

# Chapter 4

# THE ROLLOR X

This chapter will present the final design of the Rollor X. Starting with a product overview and a use scenario. Followed by going deeper into the details with the product specifications and the production of the Rollor X .

# 4.1. ROLLOR X OVERVIEW

This paragraph gives a quick overview of the final design of the Rollor X. Showing potential branding opportunities and the biggest changes to the design relative to the previous prototype

## Two insert flaps

Instead of three insert flaps, the large closing flap now has only two. This significantly increased the easiness of closing the Rollor X. This top insert flap has made place for a small notch where a finger can be place behind for smoothly opening the large closing flap.

## Insertion guiders

The edges above the slots where the insert flaps are inserted stick out a few millimetres. These serve as insertion guiders for the insert flaps, so they can be put in more smoothly.

## Print possibilities

The Rollor X has a lot of print possibilities. In essence, the entire product can be printed, both inside and outside, in colour or black. However, printing on both side comes with extra cost, the same goes for printing colours. This will depend on the wishes of the costumer.

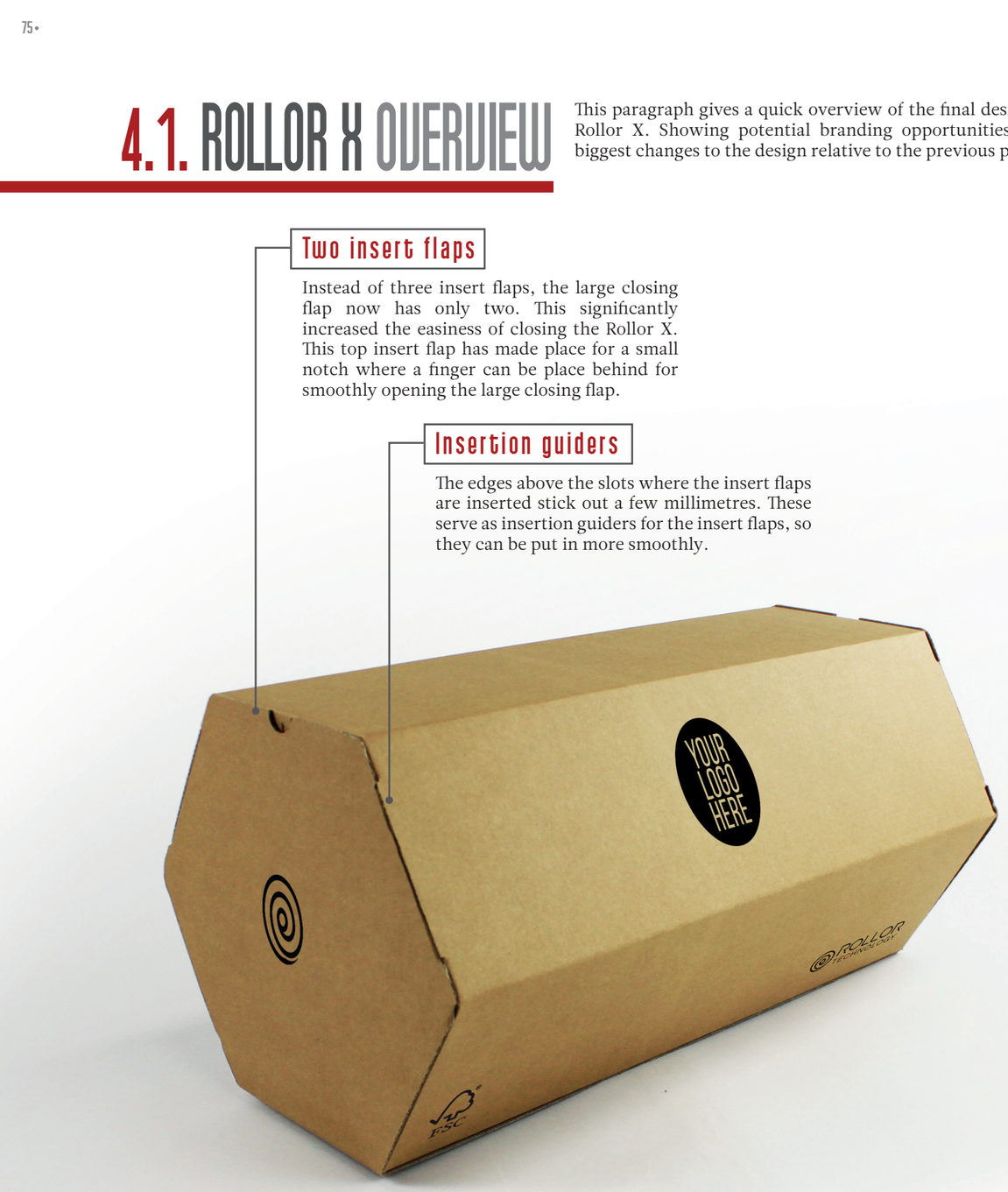




**Figure 41** This spread shows an isometric view (left) and a front view (right) of the Rollor X.


**Figure 42** This visual shows an isometric view of the Rollor X with a suit. .



## Altered core-rail connection

The biggest alteration in the design is the connection between the core and the rail. The previous connection did not work properly and had to be redesigned. Inspired by an idea of the Smurfit Kappa design team, the core and rail now are not connected anymore. The closing flaps of the core have extensions that function as a support for the core when the rolling starts. A simple and very effective solution that also enables the core to be decreased in size. Making the entire Rollor X smaller. Causing it to reach its desired volumetric weight.

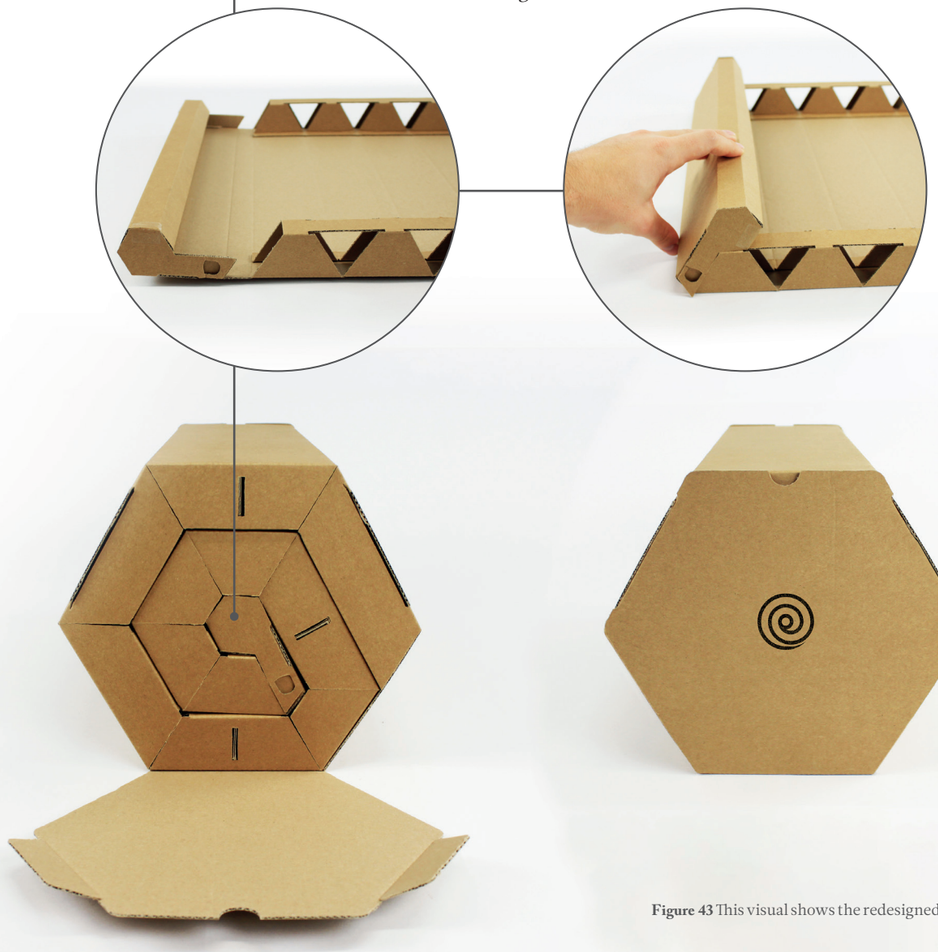


**Figure 43** This visual shows the redesigned rail-core connection.

# 4.2. USE SCENARIO

This paragraph runs through the use scenario of the Rollor X. From the point that a client receives a Rollor X to the point that their suit is rolled in and is ready for shipment. This is done in six easy steps.

Step 1

## Fold Rollor open

A client receives a stack of a certain amount of folded Rollor X's. The client then picks up the top Rollor X. The first step for usage is folding it open.

Step 2

## Set up the core

Once the Rollor X is fold open, the core can be set up. This is done by folding up the core and put in the closing flaps. This is done on either side.

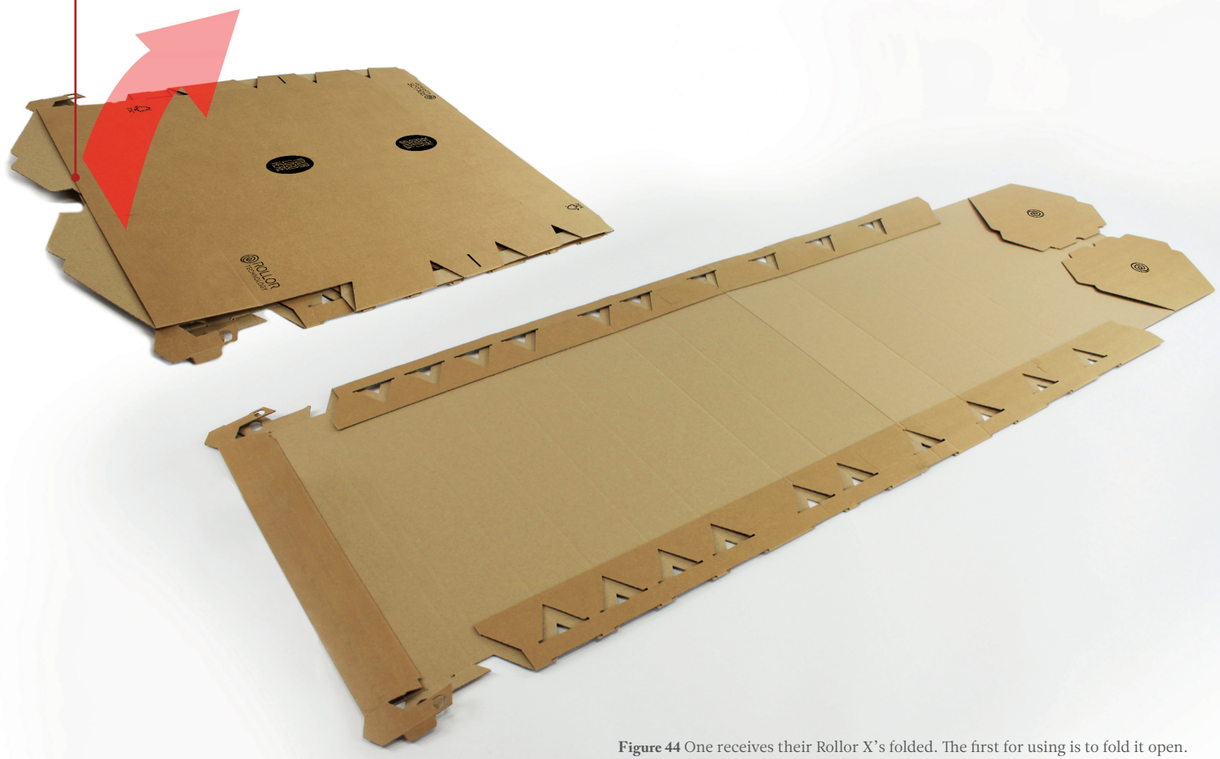


**Figure 44** One receives their Rollor X's folded. The first for using is to fold it open.



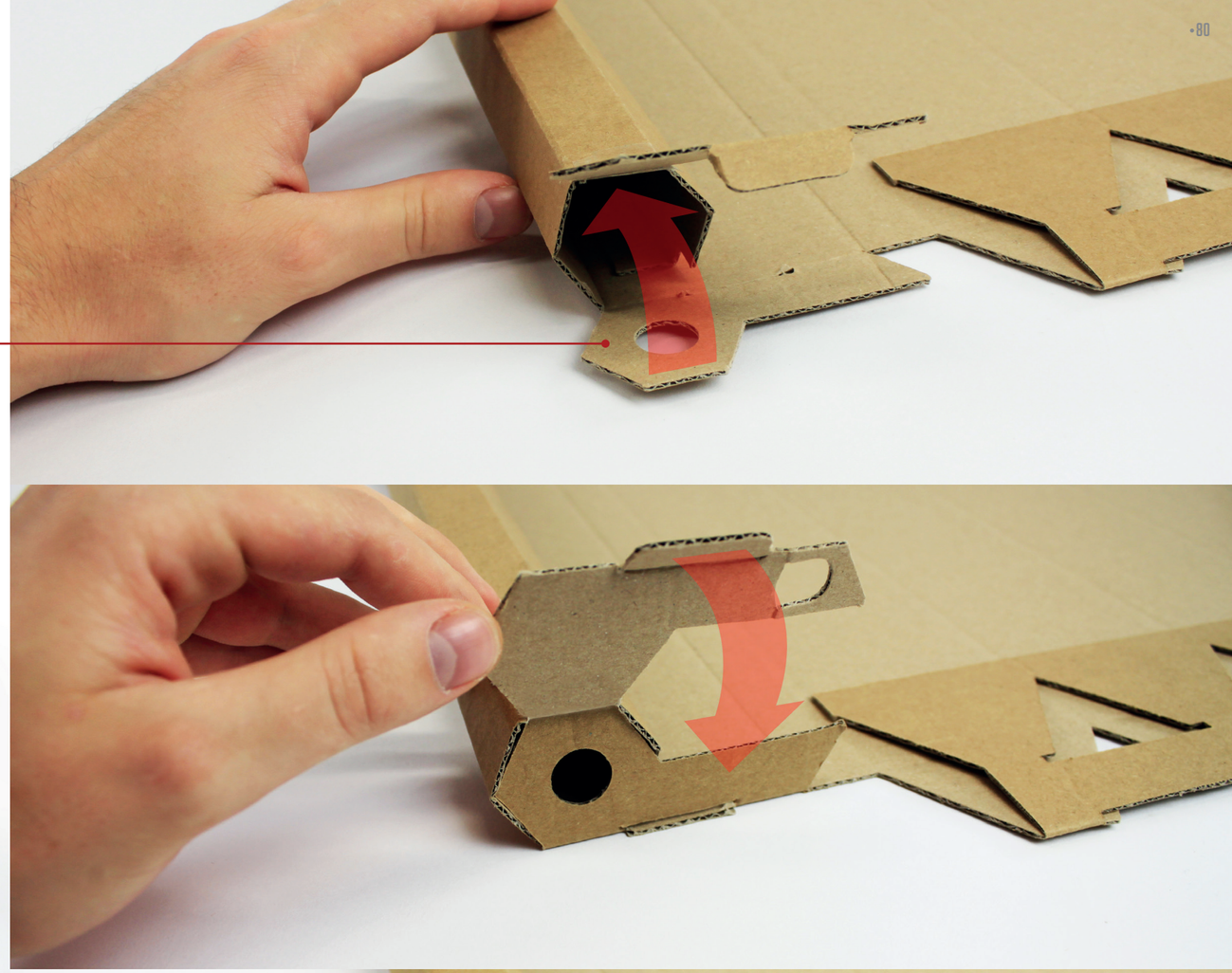
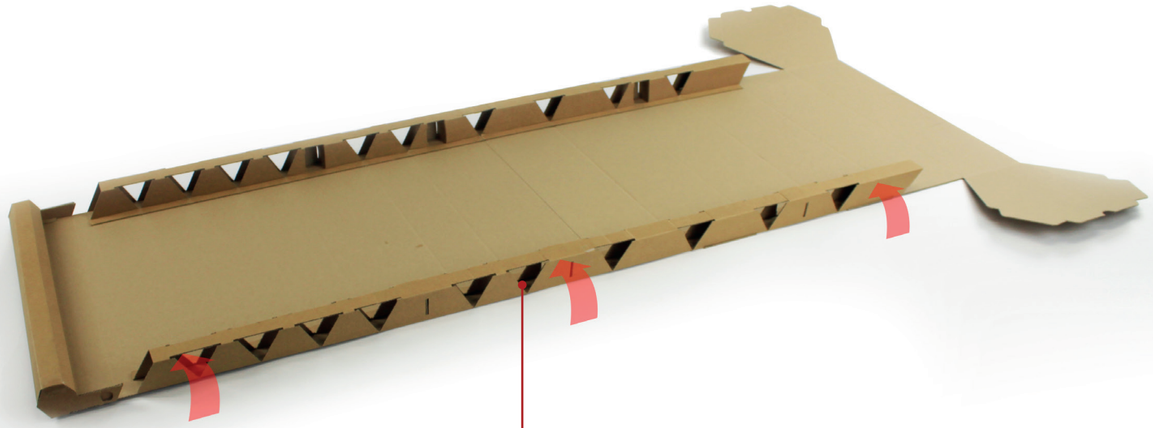


**Figure 45** This visual shows how the core is set up in three easy steps.



## Step 3 Set up the rails

With the core set up. The next step is to set up the rails. First, the rails are easily folded up. Then the stability doors inside the rails are pushed in to give it its rigidity (see below). Each rail has three stability doors.

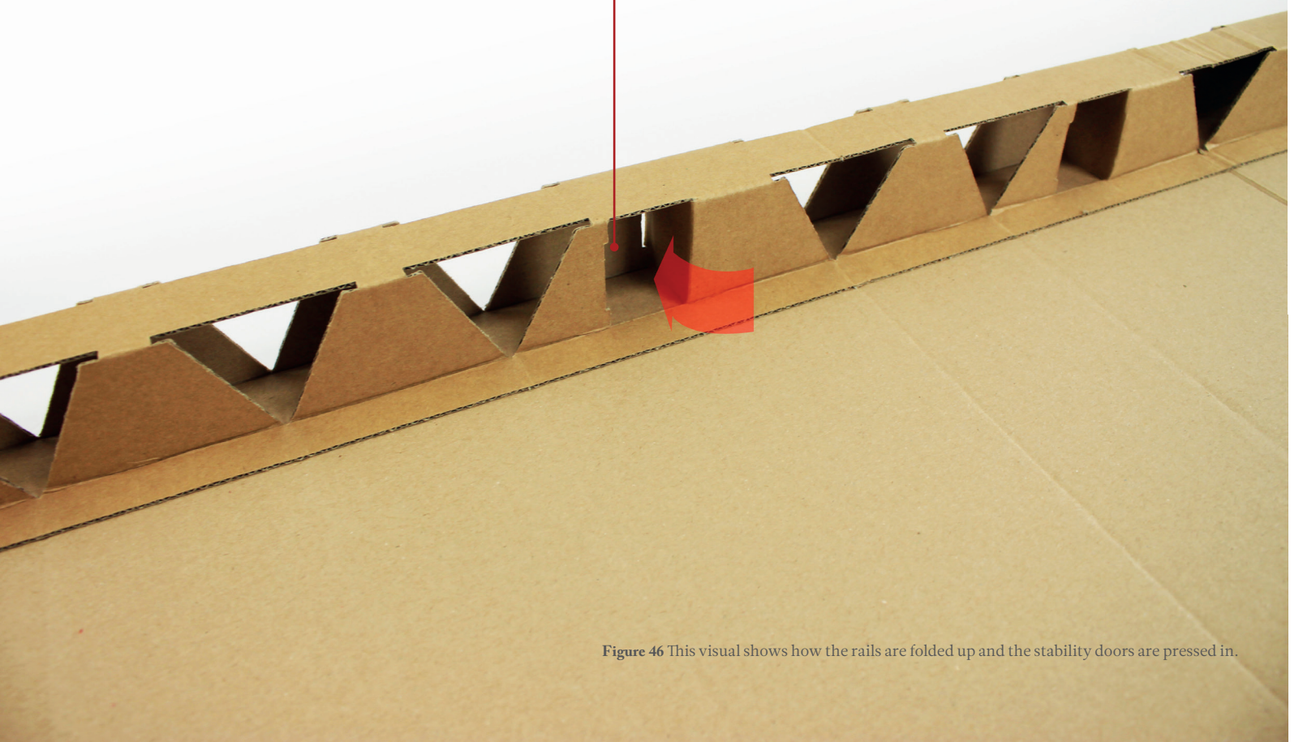
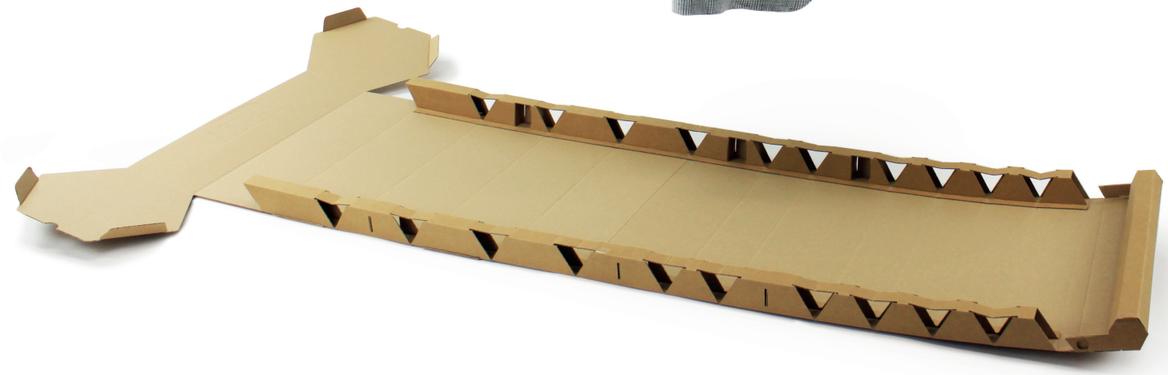


**Figure 46** This visual shows how the rails are folded up and the stability doors are pressed in.





## Step 4 Pack the suit

Now the Rollor X is ready to use. First the pants are laid in the Rollor. Then the jacket is neatly folded in half and laid on top the pants. Then the Rollor can be rolled up, starting at the core. These steps are visualized in Figure 48 and Figure 49 on the next spread.

**Figure 47** With the core and the rails set up, the Rollor X is ready to use.

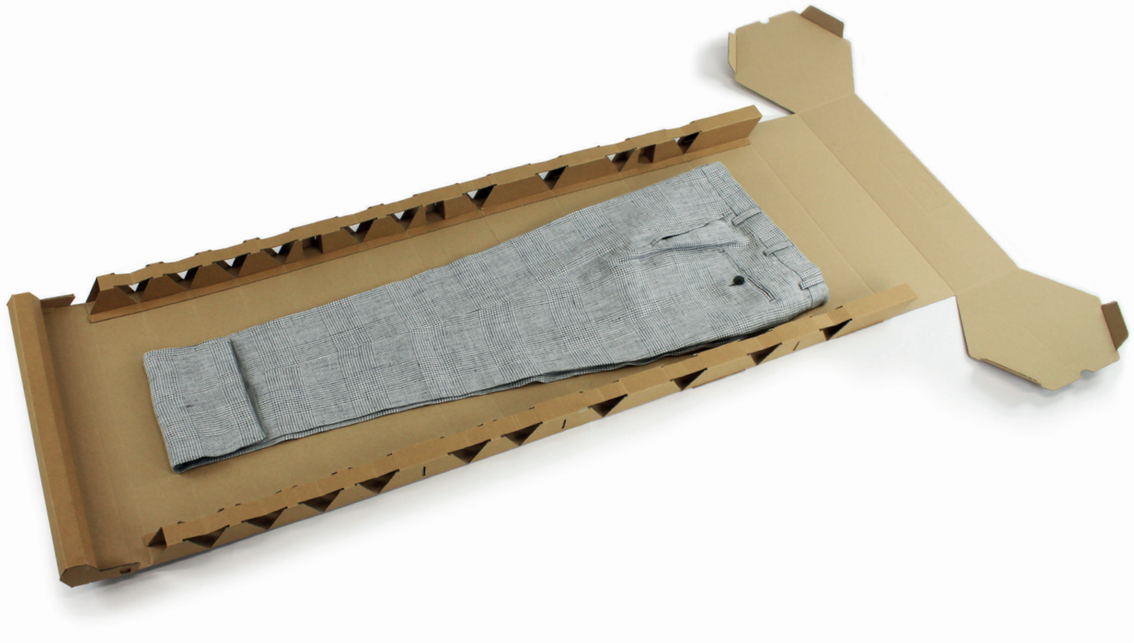


**Figure 48** This visual shows how, first, the pants are laid in the Rollor, followed by a neatly folded jacket.

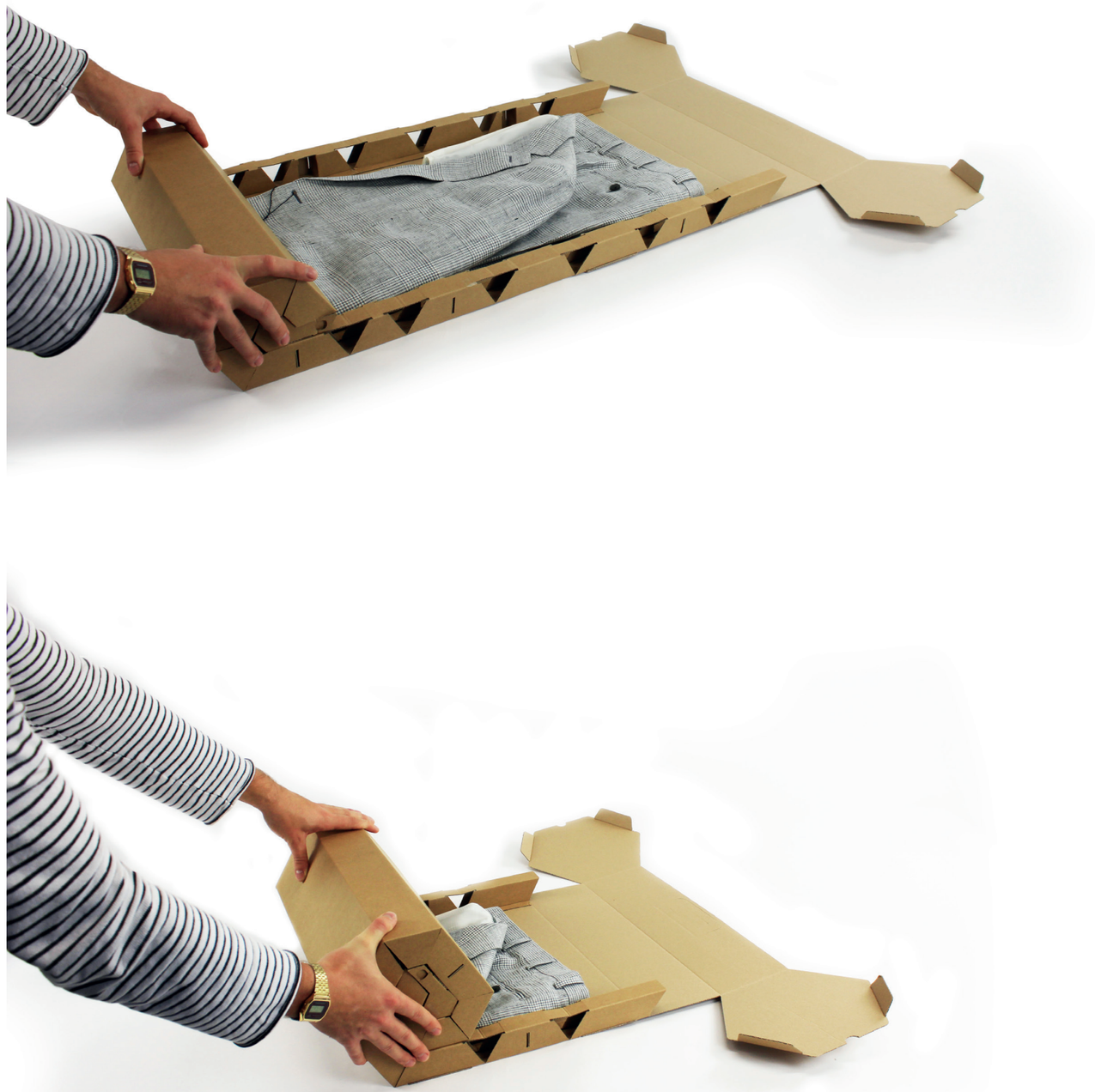
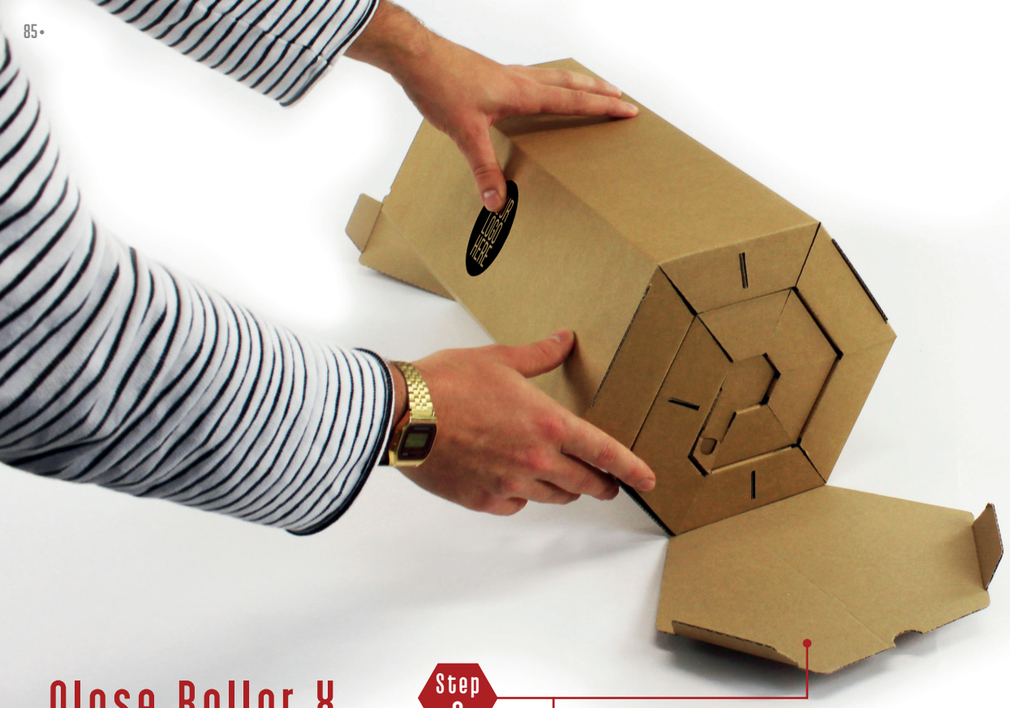


**Figure 49** When the  entire suit is neatly laid in, the Rollor can be rolled up.



Step 2

## Close Rollor X

The Rollor X needs to be rolled up until the final plane. It can then be closed with the closing flap on each side. This is done by sliding the insertion flaps in the slots on the side of the Rollor.


**Figure 50** This visual shows how the Rollor X is closed up.



Step 6

## Ready to ship

The Rollor X is now ready to be shipped. The final steps would be to put a sealing tape over the closing flaps and the top plane, to ensure that the Rollor cannot open during transport, and put on a shipping label.


**Figure 51** The Rollor X is now ready to be sealed and shipped.

# 4.3. PRODUCT SPECIFICATIONS

This paragraph shows the Rollor X's product specifications. More detailed dimensions can be found in the technical drawings in the appendices.


## Material

- Corrugated cardboard.
- Type: E-Flute
- Thickness: 2 mm
- Weight: 430 gr/m2
- 80% recycled material
- FSC certified

These material properties are from the final prototype which is seen here in Figure 52, but also apply for the final design of the Rollor X. Only the cardboard composition can differ. This prototype used a composition of 80% recycled material. However this can easily be altered to a more sustainable composition if need be. Either for brown or white cardboard.

## Dimensions

- L*w*h: 450*250*215 mm
- Weight: 420 gr
- Volumetric weight: 5 kg

With the smaller core, the size of the Rollor could be reduced enough to get end up with a volumetric weight of 5 kg. The requirement was to get below 5 kg. Which actually is achieved (4.9 kg). However, shipping companies round these numbers up to an half. So the only way to end up under 5 kg is to get 4.5 kg or lower. This is however not feasible.

**Figure 52** This visual shows the dimensions and material properties of the Rollor X.

# 4.4. PRODUCTION

The entire design is created in such a way, that it can be produced on a large scale. The production of the Rollor X is broadly thought out. For the final design a production proposal has been made. This paragraph shows a schematic representation of this proposal and explains the different production steps.

## Stack of cardboard sheets

Stacks of cardboard sheets are placed in front of the die cutter. They will be put under the die cutter one by one. These sheets can be printed or non-printed. This would be done beforehand.

## Die cutter

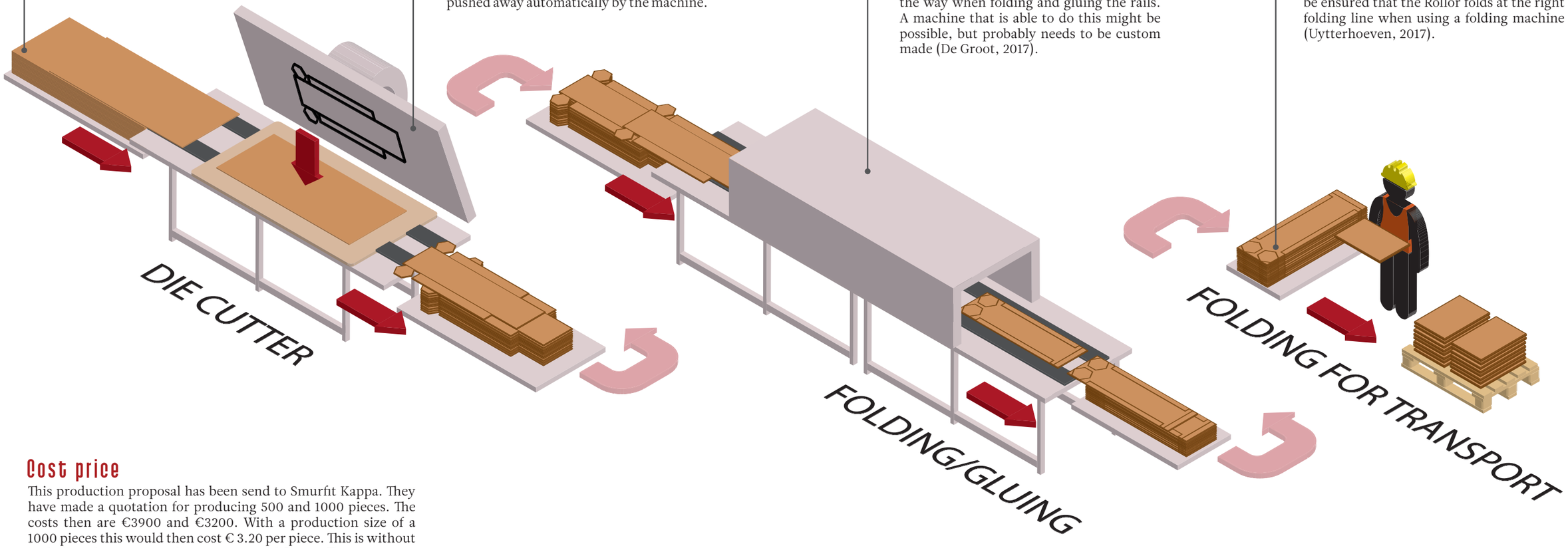
The outline of the Rollor X is made into the steel die of the die cutter, then the cardboard sheets are run through, with the die cutter making exact cuts, each and every time. Residual material is being pushed away automatically by the machine.

## Folding/gluing machine

The cut out Rollor X's then run through the folding/gluing machine. Where in a fluent motion the rails and core are folded and glued the to the sheet. The closing flaps are also folded, so that they will not get in the way when folding and gluing the rails. A machine that is able to do this might be possible, but probably needs to be custom made (De Groot, 2017).

## Folding and stacking

When the rails and core are folded, the last step is to fold the Rollor X's in half and stack them on a pallet, ready for transport. This needs to be done by hand. The Rollor X has got so many folding lines, it can not be ensured that the Rollor folds at the right folding line when using a folding machine (Uytterhoeven, 2017).




## Cost price

This production proposal has been send to Smurfit Kappa. They have made a quotation for producing 500 and 1000 pieces. The costs then are €3900 and €3200. With a production size of a 1000 pieces this would then cost € 3.20 per piece. This is without including the one-time die cutter costs of €2650. These costs are much higher than expected. This is largely because no folding/gluing machine was yet been found at the time of this quotation. Therefore these actions are done by hand in this cost estimation.

**Figure 53** This figure is a schematic visualisation of the production proposal of the Rollor X. Cardboard sheets (printed or not printed) are first cut out by a die cutter followed by folding and gluing the rails. The Rollor X is then folded in half and stacked on pallets.

Chapter 5

# PROOF OF CONCEPT

In this chapter the main advantages that the Rollor X has are put together. Followed by the results of suit and delivery tests. Proving that the Rollor X does what is needs to be doing: transporting garments crease free.

# 5.1. MAIN ADVANTAGES

This paragraph shows the main advantages that the design of the Rollor X has over the Rollor Express. This concerns the design possibilities and the difference in assembly steps that are needed in order to use a Rollor X or a Rollor Express.

## Easy to personalize

The Rollor X can be completely printed. This gives customers the possibility to easily personalize their Rollors.

## Completely made from cardboard

The entire Rollor X is solely made from cardboard. Smurfit Kappa has indicated that they have more than 60 standard types of cardboard. Varying from completely white (for colour printing) to completely brown and up to 100% recycled material. Making the Rollor X a very sustainable product.




## Falls under Rollor patent

ROLLOR TECHNOLOGY

Although the garments are not rolled up in a fluent motion, as with the other, round Rollors, the functionality of the product stays the same and still falls under the same patent.

**Figure 54** This figure shows the possibilities for the appearance of the Rollor X.



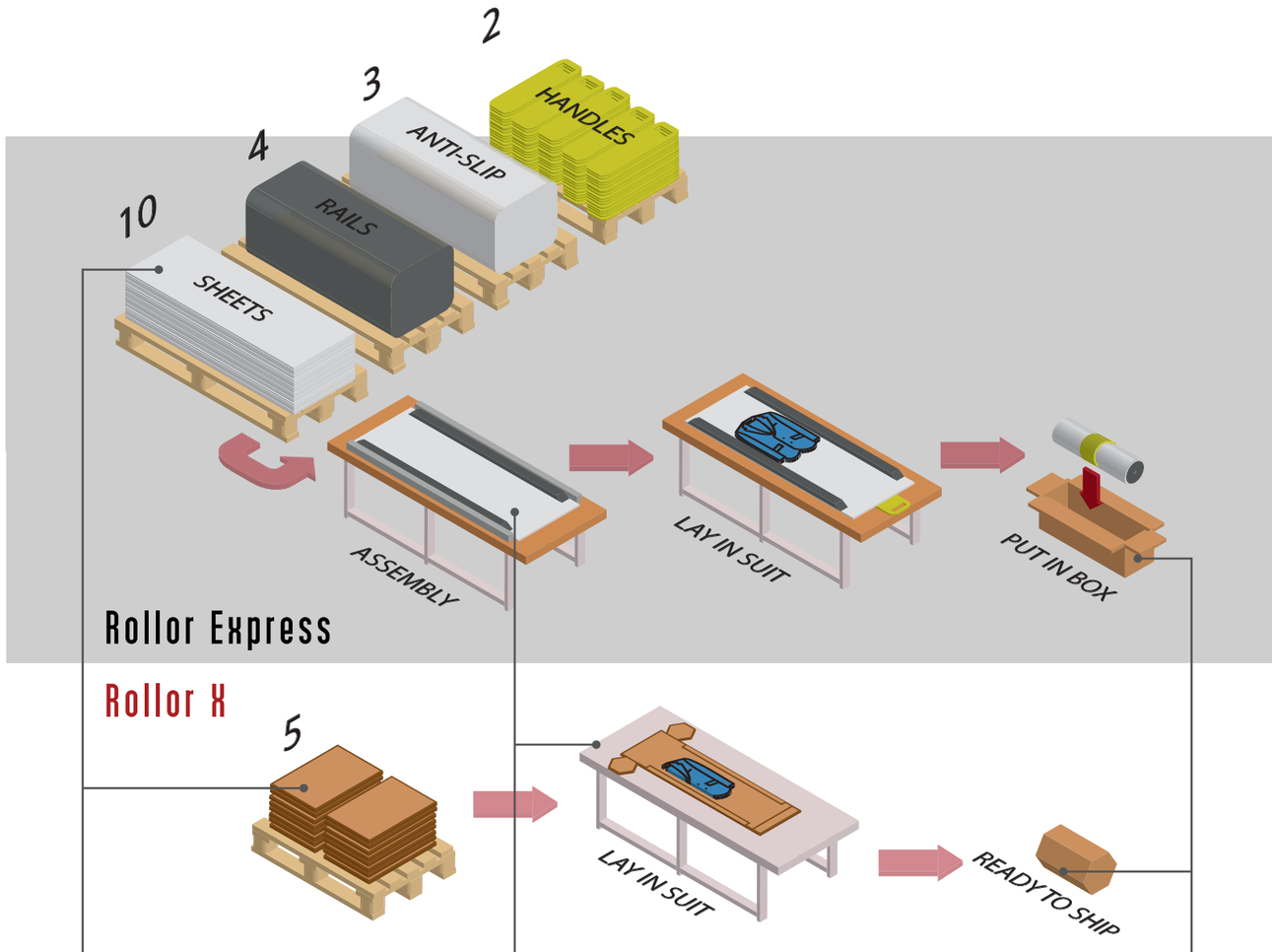



**Figure 55** This is a visualization of the assembly processes of the Rollor Express (above) and the Rollor Express (below).

## Less storage

These storage sizes are for 5000 pieces (M.o.q. for Rollor Express). Were the Express has 17 large and 2 normal pallets, the Rollor X only needs 5 normal (EUR) pallets.

## No assembly needed

The Rollor X is ready to use upon arrival. Where the Express needs to be assembled, the Rollor X just needs to be folded open, quickly set up the core and rail and the suit can be rolled up.

## Rollor X is the packaging

No extra packaging is needed to transport the Rollor X, unlike the Express. The Rollor X is strong and rigid enough to withstand the, sometimes harsh, transport process.

# 5.2. SUIT TESTS

Multiple test were done where suits were put in the Rollor X for a certain amount of time. The suits were then photographed and compared with how the suits came out the original packaging. Two of these comparisons are shown in this paragraph.


**Figure 56** This figure shows the suit test results of a Zalando test and Suit Supply test. In both tests, the Rollor X showed better results.

## Conclusion suit tests

With each test, the suit was reconditioned with a garment steamer. After it dried, it was put in the Rollor X for one or two days. In the Netherlands, this is the average time for a package to send and arrive at its destination. The result were conclusive: suits in the Rollor X came out better than the packaging they were ordered in. More test results can be found in the appendices.

## Zalando test results

Figure 56 shows a Zalando suit that was send in a standard package and was put in a Rollor X. A clear difference can be seen with that suit coming out of the Rollor X. Some hard creases that would not dissolve with the reconditioning are still visible after the suit came out of the Rollor X. If the suit was professionally cleaned it is expected that the results are even more positive.

## Suit Supply premium package results

On the right in Figure 56 one can see the results of a suit from Suit Supply. The difference between the results from the Suit Supply package and the Rollor X is a lot smaller than with the Zalando package. However a slight improvement can be distinguished. The explanation for this is that this suit was send in a premium package of Suit Supply. As shown earlier in Figure 15, in paragraph 2.4. This packaging method is also designed for suits to be transported as crease free as possible. Again, it is expected that the results would be more positive if the suit was professionally cleaned before putting it in the Rollor X.

# 5.3. DELIVERY TESTS

To validate whether the Rollor X can withstand the, sometimes harsh, transportation process, two test were done. One test where the Rollor X was send back and forth with Post NL. The other test was to check whether the Rollor X could hold a potential weight of 30 kg. The results are shown below.

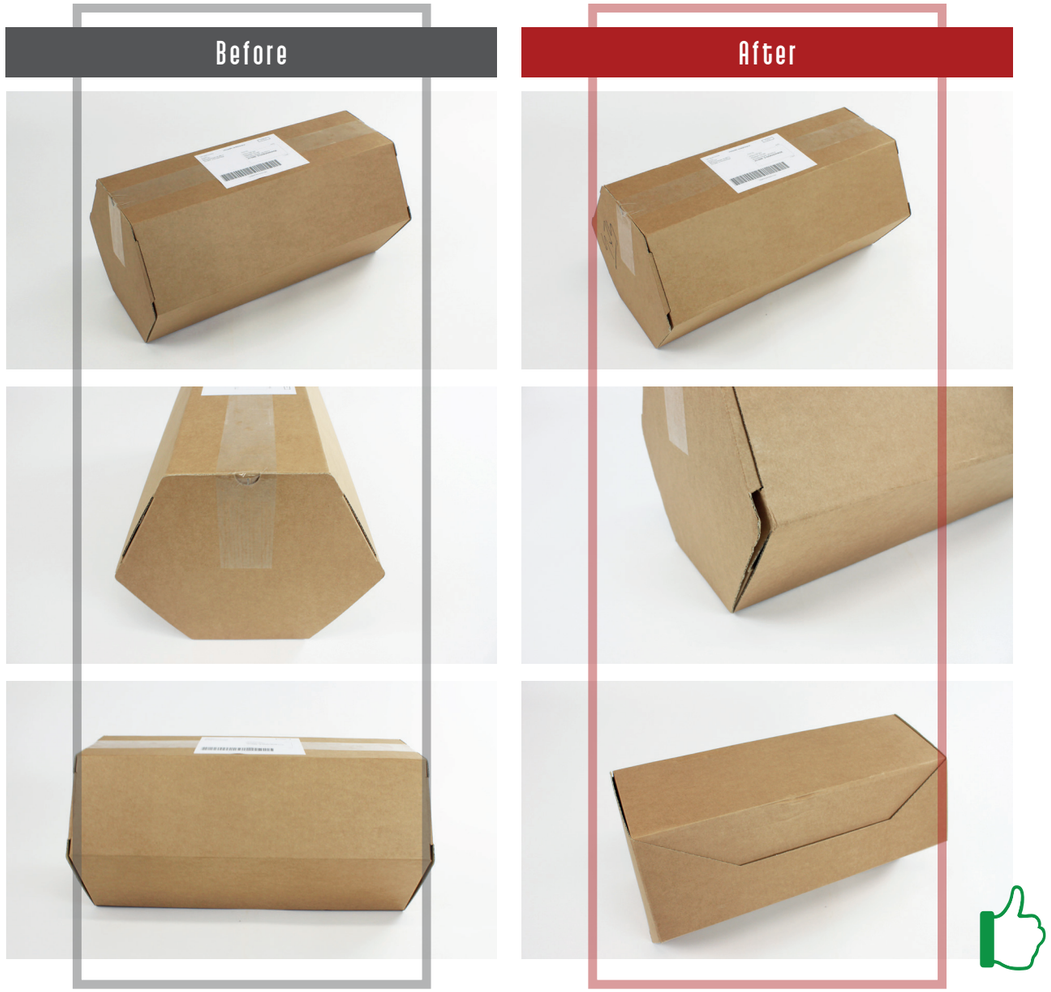



**Figure 57** This visual shows the result of the delivery test that was done with the Rollor X. It can be seen that the Rollor X only suffered minor damage.

## Delivery test

Figure 57 shows the results of the delivery test that was conducted with the Rollor X. A suit was put in the Rollor X and was send away, for it to return to the design studio the next day. It can be seen that the Rollor X only suffered some minor damages in the middle and on the corners. This was expected, since these are the weakest points of the Rollor X. Besides these damages, the Rollor X passed this test with flying colours.




**Figure 58** This visual shows that it is possible for the Rollor X to hold a weight of 30 kg.

## Weight test

It is possible that a package can end up at the bottom of a truck and other, more heavier packages, are put on top. The maximum weight one is allowed to send in a package with Post NL is 30 kg. This was the required weight that the Rollor X must be able to hold. To simulate a situation were a larger, heavier package is laid on top of the Rollor X, a test was held with books and weights, with a total weight of 30.3 kg (Figure 58). The Rollor X held this without any effort.

# Chapter 6

# EVALUATION

This is the final chapter of this thesis. The final design shall be evaluated with the aid of the list of requirements. Followed by the conclusions and recommendations. This chapter ends with a few final words in the epilogue.

# 6.1. LIST OF REQUIREMENTS CHECK

The list of requirements will be reviewed to verify whether the final design fulfils its designed purposes. This will provide an overview of the current status of the final design. Each requirements has been reviewed and an explanation is given per section.

## Design

- 1 The new design has to fit within the company's current brand strategy (being very client-orientated).
- 2 Design preferably falls under the Rollor patent.
- 3 Unique design for unpacking experience.
- 4 Possible to be transported with standard couriers such as UPS (not falling over on conveyor belt).
- 5 Garments inside need to be sealed off just as much as with a standard package.
- 6 Able to reduce size for bulk transportation and storage.

## Use

- 7 Easy to use: setting up the Rollor X needs to be self-explanatory or explained with few simple instructions.
- 8 Ready to use upon arrival at clients: no extra assembly steps needed.
- 9 Making the Rollor X ready for shipment should be accomplished with a view simple actions.
- 10 This can not take longer than 1.5 times of setting up a standard shipping box.

## Quality

- 11 Needs to withstand the transportation process of packages.
- 12 Garments need to come out as good as with the other Rollor Products.
- 13 End user needs to have a good unpacking experience.
- 14 Needs to withstand pressure of packages put on top. (Defined as 30 kg, maximum weight to send with Post NL)

## Production

- 15 Easily be produced on a large scale.
- 16 Cost price €1-2.
- 17 Needs to be made from sustainable materials.
- 18 Made out of one cardboard sheet.
- 19 Only one folding/gluing direction.

## Dimensions

- 20 Volumetric weight (l* w * h/5000) needs to be under 5 kg.
- 21 Max. sheet size (max. die cut/print size) : 1980 * 1200 mm.
- 22 Needs to fit on regular EUR-pallet (800 * 1200 mm).

Accomplished.

Partially accomplished.

Not accomplished.

Not validated.



## Design

All requirements that were set for the design were met. The appearance can easily be customized differently for every client. The Rollor X uses the same technique as the other Rollors and therefore falls under the same patent. That the design is unique is undeniable. The unique design has been checked by a UPS spokesman, he says that the design would not give any complications during the transport process. The Rollor X can be sealed tight and is able to be flattened for bulk transportation and storage.

## Use

The use requirements still comes with a few unknowns. The Rollor X can be set up in a few simple steps, ready for shipping garments, without any extra assembly steps. However user tests need to be done in order to determine how self explanatory it is to set up and what kind of instructions might be needed to do so. Also, setting up the Rollor X should not take much longer than a standard shipping box, but this is highly depended whether the user is familiar with the design. When alterations are made to the final design, could also have an influence on the set up time. More on that is discussed with 'Production'.

## Quality

Quality tests have proven that the Rollor X is resistant to the transportation process, being rigid enough to take a few blows and strong enough to hold 30 kg. Quality tests with suits have also shown that suits are less creased being put in a Rollor X than other packaging methods. No clear difference has been identified between using the Rollor X or a Rollor Essential. It was however seen that the way a suit was laid in could have a large influence on the results. Whether end users had a good unpacking experience could not yet be tested. In order to validate that, a large amount of end users need to be interviewed.

## Production

Together with Smurfit Kappa, it was looked at whether the current design lends itself to be produced on a large scale. This is possible, however some further design steps need to be taken. No solution has been found for gluing the rails industrially. (Not even a machine that solely glues and folds the rails.) This now has to be done by hand. This also led to higher production costs than desired. These costs are now set on €3.20 - €3.90 per piece.

## Dimensions

Being able to reduce the size of the core has led the Rollor X to reach a volumetric weight of 4.9 kg. (This rounded up to 5.0 by shipping companies as explained in paragraph 4.3.) The cut-out of the design easily falls within the maximum sheet size and when folded once, two stacks of the flattened Rollor X fit on a regular EUR-Pallet.

# 6.2. CONCLUSIONS & RECOMMENDATIONS

## Conclusions final design

The objective of this graduation project was: '*Designing a low-cost package that enables suits to be transported crease free. With the ability to be reduced in size, enabling easy shipment and storage*'. This objective has been divided into three main design goals. These design goals are individually evaluated here.

### 1 Able to reduce size

The ability to reduce in size was extremely important for this project. The many prototypes and the final design have proven that this design goal has been accomplished (see also Figure 59). Being able to be completely flattened gives the Rollor X great advantages with storage and shipping relative to the Rollor Express. A EUR-pallet can hold a 1000 Rollor X's, were this amount of Rollor Expresses would have be divided over four (large) pallets. The Rollor X can be stored as long as needed and can be used at any moment without having complications with setting it up.

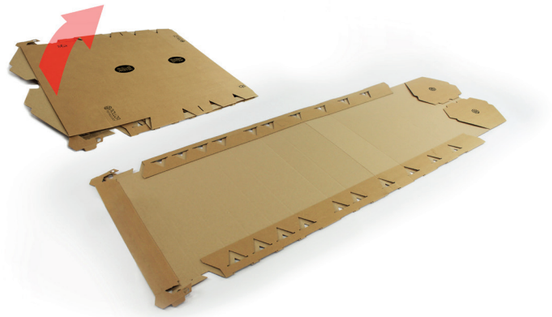


**Figure 59** This visual shows the Rollor X in its flattened state.

### 2 Easy to use

The next feature that the Rollor X needed to have was an ease of use. Meaning that it needs to be ready for use on arrival and should be set up in a few simple steps. A client cannot have any extra assembly steps, as with the Rollor Express. It is believed that this design goal has been accomplished as well. The Rollor X is made ready by simply setting up the core and the rails. Although user tests need to be done to verify how simple this is experienced by users, it is expected that no large alterations are needed to the current design.

### 3 Cheaper than current solution

In the beginning it was said that the Rollor X needs to be cheaper than the Express and preferably cheaper than other common packaging solutions. The desired production price is later set on €1- €2 per piece. These prices are unfortunately not feasible with the current design. The costs price of the final design is €3.20 - €3.90 per piece (depending on the production size). The main reason for this is the fact that the gluing and folding needs to be done by hand since no machine is able to complete these actions. So although the current prices are lower than those of the Rollor Express, it must be concluded that this design goal has not been accomplished completely.

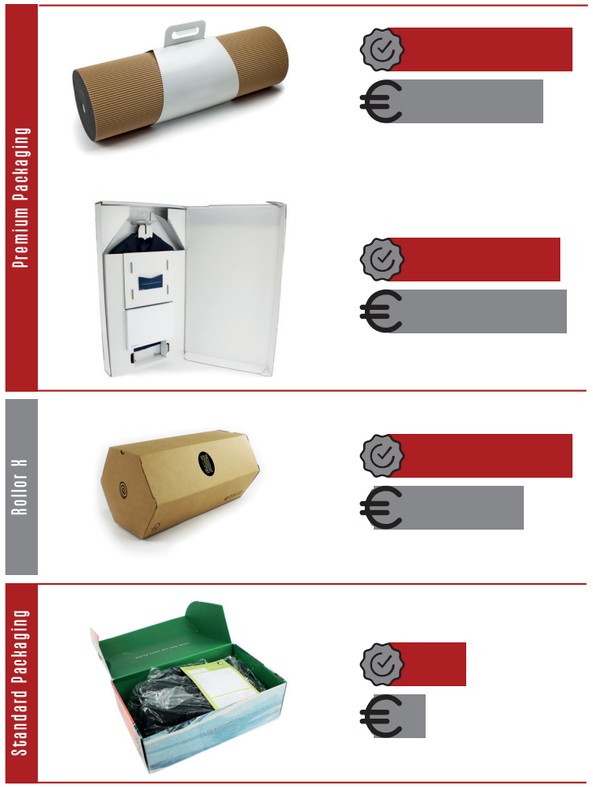



**Figure 60** This visual shows an overview of the price-quality ratio between the Rollor X and the other packaging methods.



Figure 60 has been shown already in paragraph 2.10, only now the final price-quality ratio is presented instead of the desired one. On the quality aspect, the Rollor X is not inferior to the Rollor Express, as concluded from the suit tests. However, the price is higher than desired, as previously mentioned. So overall, when returning to the assignment posed at the beginning of this thesis, it is possible to state that this objective has been accomplished, with the side note that the price is not as low as desired.

## Recommendations

During the course of this project, the design of the Rollor X could be seen evolving. From a small paper model to a product that is almost ready to be produced. Practically every requirement and goal of this project has been reached. But in order for the Rollor X to be the best packaging method it can be, there are three things that need to be further looked into: reducing cost price, conducting users tests and research whether not being able to send coat hangers in the Rollor X is a huge issue.

*Reducing cost price:*
The current cost price is too high. It has been said that this is mainly caused because the folding and gluing cannot be done mechanically. It is recommended to search for a design solution where no gluing is needed. A cost estimation for this was made by Smurfit Kappa and the costs were estimated at €0.90 - €1.20. This is a significant difference with the cost price with gluing. Another large benefit of having a design that does not need to be glued is that the only production method that is then needed to create the Rollor X, is die cutting. The design of the die cut mould can easily be send to other factories in other countries. So that the Rollor X can be produced over there, instead of shipping large amount of Rollor X's.

*User tests:*
As stated earlier, two aspects still need to be validated with the use user tests: how setting up the Rollor X is experienced and whether end users have a positive unpacking experience with the Rollor X. The Rollor X is quite simple to set up, although it is expected that an instruction of some sort is needed for first time users. For example, it could be possible that some indications are printed on the Rollor X. Further, the Rollor X is a unique packaging design that has never been seen before. So it is expected that end users are pleasantly surprised when their garments arrive in a Rollor X. But this can only be said with certainty when this has been researched with user tests.

*No coat hangers:*
A coat hanger does not fit in the Rollor X. Currently, interested parties have not indicated for that being an issue. Some things can also be said about how necessary it is to send a hanger with every delivery. Maybe, sending hangers is then an extra perk clients get when choosing the Rollor Express instead of the Rollor X. Nevertheless, clarifications on this matter can help with establishing a better business case for the Rollor X.


**Figure 61** A final view of the Rollor X. A (low-cost) package that enables suits to be transported crease free.

# 6.3. EPILOGUE

When I look back on this project, to see how far this project has come and  what an amazing journey this has been, I instantly get a smile on my face. The end result is far more than I could have ever dreamed of in the beginning of this project. I could have not done this without the great support from my supervisory team. For pointing me in the right direction with the right set of tools, but letting me go to seek out my own course.
I was really satisfied with the approach of the design process. Being able to switch between the different design phases caused for a pleasant variation in the weekly activities that were done. This really fitted with me as a person. Being occupied with the same subject or phase can quickly become a drag. Causing for me to be distracted very easily. Switching phases made it possible to keep the entire project fun and interesting. I quickly realised that this approach was somewhat chaotic. With the help of a self-made digital scrum board, I could easily monitor and keep track of all my activities. Creating a controlled chaos where I could put everything that went on inside my head on display. This way of working was very useful for me.
Another large benefit of this design process was that, for example, whenever I got an insight or idea while doing research, I could quickly insert this in the conceptualisation phase. Exploring that idea and test it. I could then draw conclusions from that and implement those again in the research phase. Creating very quick and efficient iterations. This kind of process might not be applicable in every project. But if someone had the chance of doing this, I would totally recommend it.
Working at Rollor was fantastic. I could not have pictured a better company to graduate at (that's what they all say!). I had a lot of fun, learned a lot and experienced things that I would not have experienced if I had done a project somewhere else. Being a small company, I head direct contact with the management. As said in the thesis, I hit a small wall during the project. Both managers had a different opinion of the chosen concept. This came as a bit of a surprise, since both managers had been at all the meetings, so I did not present something totally new. But as it turned out, with every meeting we were talking about the same things, but we all had an other expectations of the outcome. So my tip to future graduates is: make your expectations clear.. This way you will not be in for a surprise when you present your concept or idea. Luckily, this was something I could learn on time, since I had a lot of contact with the management. But the best thing about graduating at Rollor, which at the same time was the most exciting experience I had with this project, was being able to join the manager and head of design in meetings with manufacturers. Where we would discuss my design and make plans for manufacturing it. That is truly the peak of my project and I am very proud and happy that I this project made it that far.

A lot of things have happened whilst writing my thesis. My project, as in graduating project, came to an end and I had to put all my energy in writing this thesis. But in the meantime, the development of the Rollor X at Rollor kept going. Together with Smurfit Kappa the design was fine tuned. The rails and core of the Rollor X are not glued anymore. A clever way was found to fold them up and fix them without having to glue them. A final design has just been made and has been checked by Smurfit Kappa. A first test batch of 175 pieces will be delivered by Doosopmaat at the end of this month. (This will still be cut out with a CNC cutting machine.) Then, changes to the design that will come from this test shall be implemented in a redesign and a first batch of 2500 pieces will be made with a die cutter by Smurfit Kappa. I am very excited about all of this! And the best part of it all: I will still be a part of this project! Rollor has offered me a job and I gladly accepted it. So my Rollor journey is not over. In fact, it probably just begun!

Thank you all for reading my thesis, I hope you enjoyed is as much as I have enjoyed this project.




**Figure 62** Me being busy at the cutting table.

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