An innovative and future proof dispenser range

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Disclaimer
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Team introduction

BSc. Kai Smit

He did his bachelors in Industrial Design Engineering and has been a professional speed skater for 10 years. Furthermore, he is working on his second novel of a trilogy; the first one is already published in 2015.

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He represents the department of Human Information Communication Design of the faculty of Industrial Design Engineering. Martijn is also graduated from IDE and has his own design agency. Furthermore, Martijn is a full time lecturer in Design Drawing at the faculty of Industrial Design Engineering.

Ir. Albert Mey (Company Mentor)

As company mentor, he is not authorized as an examiner, but functions as an advisor. Albert is, just like Martijn, an alumni from the Delft University of Technology. Graduated in Industrial Design, Albert is currently Business Intelligence & Innovation Manager at Van Houtum.

Preface

This graduation concludes my time as a student and officially marks the end of my master Integrated Product Design. Finishing this project also sets the beginning of my professional career as a designer.

It was a great experience to design not only a new product, but also a new interview methodology. What was also wonderful, is most probably being the first ever to combine the Vision in Product design method with the Context Variation by Design approach, and implement the CVD approach with the Zaltman Elicitation Technique. It allowed me to do what I like to do best: solving complicated design challenges.

This project has enabled me to improve my preparation skills, the application of academic research, and communication with other professionals.

While the final design was not evaluated by experts on its design and usability, I consider it a great success compared to what I started with. I belief that this design can be used as an inspiration for developing more sustainable dispensers and let Van Houtum gain a competitive advantage.

A word of gratitude

I would like to thank the following people for making this project possible. The process and end result would not have been nearly as interesting or worked out if I had not received help of:

Jo van Engelen, my Chair, who supported me with interesting approaches and an endless enthousiasm towards the project.

Martijn Haans, my Mentor, who provided constructed feedback and a pleasant analytical attitude. I could not tell this was his first role as a graduation Mentor.

Albert Mey, my company mentor, who took a lot of effort in supporting me from a business point of view and gave extensive insights in the world of dispensers.

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Frouke Ronken, Guus Bruijstens, Rob Stevens, and Lindie Feuler, employees at Van Houtum, for their personal attention to various aspects in the process and quick respond to questions that really helped me quickly implement new knowledge.

Bart van Huet, Sander de Kroon, Wim Verberne, Theo Visser, Stefan Peelen, Arjan van Eck for providing me with professional insights in their market expertise. Especially Arjan van Eck, who was very helpful with extensive answers to important questions. Without him, a lot of requirements could not have been set up.

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Bas Flipsen and Joost Vogtländer, for their expertise in Life Cycle Assessment and comprehensive feedback on the manners to construct a viable assessment with recycling recycled plastics.

Marco Bolleboom, for his effort in providing me with a drop test licence.

Mrs. Baledo and Kim Bierhuis, for determining the dispenser's mounting height. Without whom the dispenser would probably be mounted too high.

Dirk, Joost, Lou, Kate, Eva, Olmo, for their support during the whole project and to help me through these hard times with their endless humour and expertise. Without them, this project would have been way too serious.

Finally, I would like to thank my friends and family for their personal support, either by ideas, encouragement, or a healthy distraction. I feel and am lucky to have such people around me and do not want to envision a world without them.

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Executive summary

This research project was about the vision for a new Satino Black dispenser range of Van Houtum. As the initiator of the project, Van Houtum B.V. wants an innovative and future proof washroom dispenser range. Their current dispenser range reaches its final life stage. For this to develop, an unbiased, external vision is necessary to get new ideas and not get too distracted by what the company (Van Houtum B.V.) can or cannot do. In this respect, the company's environmental friendly materials and reutilization cycles are kept in their highest respect. This is done by balancing the inputs from the Delft University of Technology and Van Houtum B.V.

The process was a combination of the Vision in Product design (ViP) method combined with the Context Variation by Design (CVD) approach. According to the ViP method, the reader is taken to the year 2035 and will dive deep into the dispenser market. But instead of limiting the design to one context, three contexts are designed for, which is where CVD comes in. It enriches the design by letting it fit more contexts and thereby becoming more sustainable. Stakeholders were interviewed according to a stipulation of the Zaltman Metaphor Elicitation Technique so conclusions could be drawn with a small amount of respondents. They described by means of metaphors what they seem fit within three contexts: a retirement home, hotel, and an office. Within these contexts, a desired behaviour was chosen to design for. This resulted in a mission statement, from which product qualities were extracted. Together with insights from the exploration or deconstruction phase, the Satino Black Fold (or "Fold") was developed.

The Fold is a more sustainable dispenser by making use of a folding mechanism. The dispenser is made of six main parts that enable it to fold to a smaller package during transport. From the deconstruction phase, it was clear that transport is a major component in the life of a dispenser. What was also clear from this phase, is that competitors are closing in on their sustainability focus and performance. Satino Black's main selling point is its sustainable performance and the story behind it. So the increased performance of the dispenser enlarges the competitive advantage while being more sustainable.
Another aspect of the Fold is the introduction of wrapping. From the deconstruction and interaction design phase, it was concluded that personalization is a big trends in the dispenser world. Competitors already do this, but at a limited rate. Wrapping can give almost unlimited colours and finishes to the dispenser, giving it another competitive advantage. Besides this, the three chosen contexts are already heading towards such an innovation.

The 3MTM EnvisionTM SV480Cv3 is used for the wrapping. This is a PVC and phthalate free wrap, which makes it possible to recycle. Its adhesive is made of an acrylic solvent, which is not only recyclable, but also easily to apply and remove so the recycling of the dispenser is not in danger. It is a printable wrap, so the client can order any design he wants following a standard layout. This order is collected by the wholesaler, but the wrap is installed by professional wrappers. This wrap also adds to the hygienic standard of the Fold, as it covers split lines from the mechanism.
The mechanism consists of a back plate, side panels, front plate, top plate, window and a mouthpiece. They are connected through form fit or click fingers. By hinges and sliders, this dispenser can be decreased by 34% of its original volume. Thereby reducing 1kg CO2 and 14MJ per dispenser, resulting in a 35% reduction in CO2 emissions and energy compared to the current dispenser. It has 3 parts less than the current of which the click fingers already exist.

The Fold gives shape to a sustainability, appearance and styling vision. The belief is that Van Houtum needs to take a next step in their sustainability performance. The Fold exemplifies this by its mechanism. Even though this will only be a storytelling feature, it is a more sustainable dispenser. The wrap adds to the styling vision, but also to the sustainability vision in a storytelling manner. It makes the Fold have a higher carbon footprint and energy output, but the wrap itself can be considered sustainable. Especially the wrap makes this dispenser innovative and future proof.

Glossary

B2B: meaning Business-to-Business. This describes the involving arrangements between different businesses, instead of businesses and the general public.

C2C: meaning Cradle-to-Cradle. Describing a business model that facilitates both the production, use and the end-of-life scenario in a sustainable manner; the product is part of a cycle. Other than Cradle-to-grave, where the product describes a linear process from production to dismissal.

CES: stands for Cambridge Engineering Selector. It is a tool to consult about material and production process information.

CVD: meaning Context Variation by Design. It is a design approach where products are not designed for a single context, but for multiple, resulting in more valid, more sustainable, and less products in the world.

DEPEST: this is an approach to sort trends and developments or context factors by, and stands for Demographic, Economic, Political, Ecological, Social, and Technological. This way, a complete picture of a context can be created.

Harris profile: An evaluation tool to quickly see which ideas or concepts score best on certain criteria.

LCA: Life Cycle Assessment. A technique to evaluate a design on its environmental impact, associated with all its life stages.

MVO: a Dutch term that stands for “Maatschappelijk Verantwoord Ondernemen”. It describes a business that feels responsible for the environment in which they operate. In English it is Corporate Social Responsibility.

Render: a computer processed image, using colour and shading in order to make it appear solid and three-dimensional.

Theoretical saturation: the point in a qualitative research for when more respondents don’t result in different conclusions.

Traffic: the amount of people that visit the washroom during a certain timeframe.

VIP: meaning Vision in Product design. A design method created by Prof. P.P.M. Hekkert in association with Prof. M. van Dijk, that enables product design for the future.

ZMET: meaning Zaltman Metaphor Elicitation Technique. A research method developed by Dr. G. Zaltman that makes use of metaphors in order to get insight into unconscious thinking that drives behaviour of people.

1. Introduction

A dispenser is something, referred to as a machine or container, that dispenses or gives out. It allows its content to be removed and used in convenient and controlled quantities. This can be a vending machine, that automatically dispenses a single item or a measured quantity, but in this case it is about a container, in particular containers that are placed inside the washroom, such as for toilet paper, paper towels, soap, air fresheners, and ladies hygiene. In this section the deconstruction of dispensers on the product, interaction and context levels will be given.

1.1. | Project scope

The assignment was commissioned by Van Houtum B.V. This company is specialized in the recycling of all kinds of paper into toilet paper and paper towels used in public washrooms. But it is not the recycling itself that makes Van Houtum what it is as a company. It is their thinking in cycles. Sustainability is a key pillar on which they stand. Other pillars are hygiene and offering a complete washroom solution.

1.1.1. The dispenser market

The dispenser market Van Houtum operates in is very broad. It is completely a business to business (B2B) market, with a lot of competitors offering similar products for roughly the same prices. Further competition comes from companies offering other drying methods such as warm air blowers and jet air blowers. Most customers want something new, yet timeless. This is understandable, considering most companies have multiple washrooms that all need to be fully equipped.

1.1.2. The company aim

The company states that it wants to use this graduation project to get an unbiased, external vision on a new range of dispensers. Their current dispenser range is reaching its final life stage, and it is aimed for to develop a new line of dispensers or update the existing one. By developing something for in the future, this new dispenser range can have a long life. By offering this design to customers, it shows that it is preparing for the future; as any sustainable company should.

1.1.3. The design assignment

The assignment is to build an external vision for Van Houtum's new range of hygiene paper and soap dispensers in combination with the internal vision on the range build up. This vision is for the year 2035 and based on analysis of the future world, while keeping the company's environmental friendly materials and reutilization cycles in their highest respect.

1.2 | Project approach

This project was separated into four phases, according to the Vision in Product design method (Hekkert & Dijk, 2014). However, a side step is taken specific for this project. There is not chosen to dive into one future context, but to take a step back and apply ViP to three contexts, where the Context Variation by Design approach is best suitable. Another side step is taken in the future interaction phase, where interviews are conducted in a stipulated manner of the Zaltman Metaphor Elicitation Technique.

1.2.1. Phase 1: Deconstruction

In this phase, the current product, interaction, and context will be analysed to get a feeling for dispensers and washrooms in general. What is the story behind such an everyday product?

1.2.2. Phase 2: Future contexts

How will the context in 2035 look like? Especially with regards to washroom dispensers. That is researched in this phase. But, contrary to standard ViP, there is chosen to design for three contexts, as this is much more sustainable. One way of integrating multiple contexts, is by following the Context Variation by Design approach. By carefully selecting three different contexts, the design becomes functional in a broader sense.

1.2.3. Phase 3: Interaction

Defining these contexts will result in a desired behaviour of people, which will be formulated in a mission statement. To know how a dispenser range can cause such a behaviour, it needs certain product qualities. These are found through interviews with multiple stakeholders, which are conducted using a customized stipulation of ZMET. The information gathered from the interviews leads to a so-called intervision. This will be the last step necessary to develop the new product.

1.2.4. Phase 4: New product

Having the product qualities, mission statement, and intervision, ideation and conceptualization can begin. That is what this phase is all about: the embodiment of the new concept design. Focusing on the paper towel dispenser and extrapolating the concept to other important dispensers within the range will give a good perception of all the features and attributes. But only the towel dispenser will be designed to a more detailed level to act as a proof of concept.

1.2.5. Vision in Product

The Vision in Product (VIP) method is a context driven and interaction-centred design method. During VIP, the designer deconstructs the current relationship between product and user in its context or domain. Within this domain, factors are collected in the form of trends and developments. With these trends and developments, the designer can formulate a mission statement that describes how he wants people to behave in the future context. The future context can be 15 to 50 years ahead, depending on the designers choice. The decision is elaborated in chapter 3.1. | The domain.

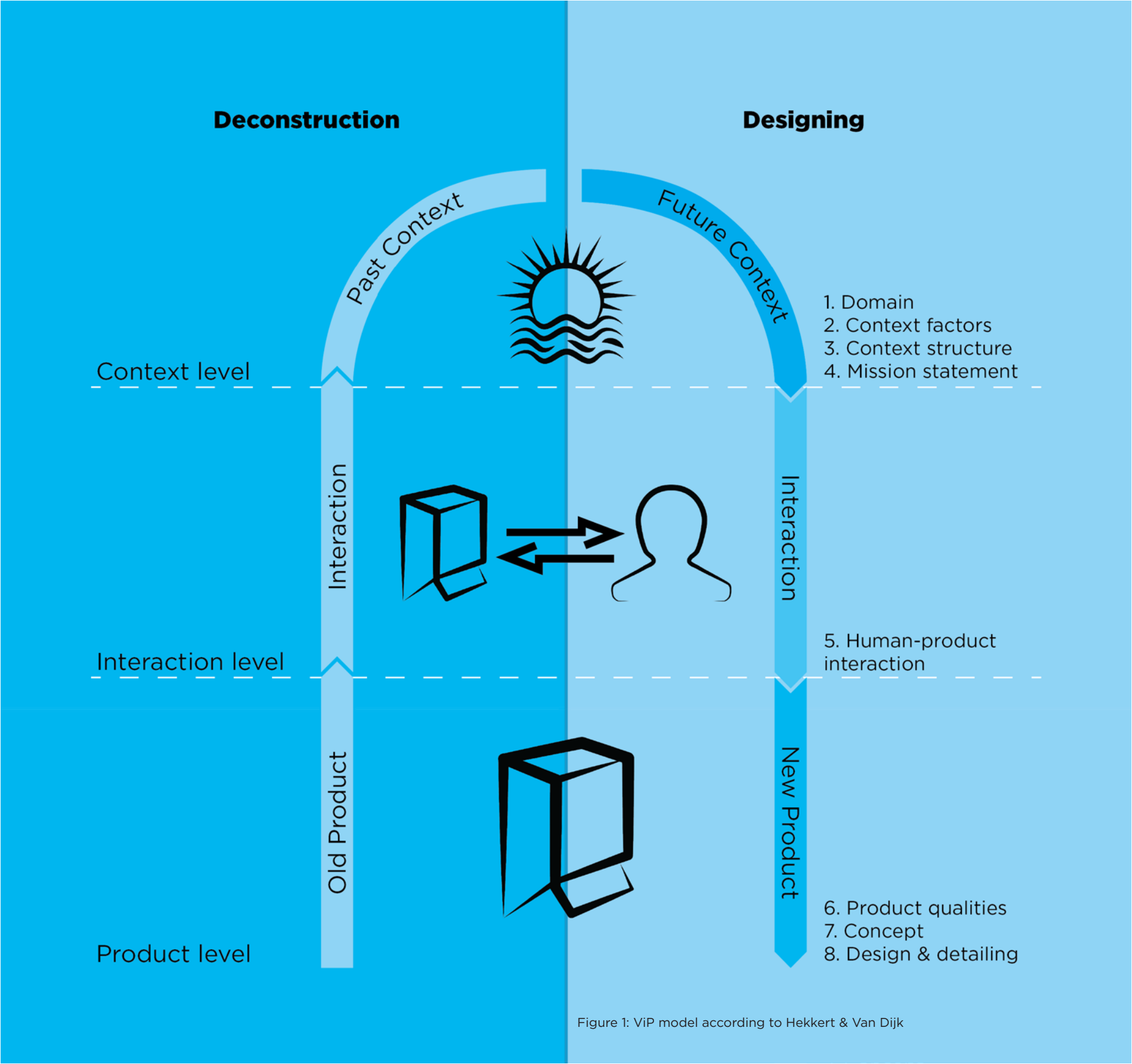


Figure 1: ViP model according to Hekkert & Van Dijk

1.3. | Flushing through history

As this project centres around the washroom, it might be interesting to know about the history of the toilet itself. For most people around the world it is logical to have proper sanitation. However, there are still 2.5 billion people that live without it (Suddath, 2009).

Even for such a well-known product, it is unclear who invented it. The challenge seems to be lying between the Scots (3.000 B.C.) and the Greeks (1.700 B.C.). After a long period of less hygienic ways to do your business, something similar like the modern day toilet came in the form of a box with a lid and France's Louis XI did even more by hiding his toilet behind curtains and using herbs to keep out the smell.

In 1596, it was Sir John Harrington who described a new water closet in the form of a raised cistern with a small pipe down in which water ran when released by a valve. However, it needed another 200 years before Alexander Cummings developed the S-shaped pipe to keep out smells and at the end of the 18th century, the flushable toilet became common. Moving on to 1880's England where there was a prominent London Plumber by the name of Thomas Crapper; hence the name. Crapper patented a number of bathroom-related inventions and became famous for it. But real bathroom innovation took off in the 20th century, with toilet paper that became heavily marketed in 1902. Since then, the toilet has evolved into what we see today. Every day.

1.3.1. Toilet hygiene

Already in medieval times, people found out the relationship between hand washing and illnesses (Knight, 2008). During the outbreak of the Black Plague, people found out that hand washing in warm water and keeping the surroundings clean helped to decrease the effect.

Off course, in those times, royal families had more privileges and more (access to) knowledge. Records show, that back then royals were bathing already. However, it needed buckets to get the tub filled. Therefore, especially in poorer families, the water was preserved for the rest of the family members, from old to young. Hence the saying “don’t throw the baby out with the bath water…”.

Later, during the Regency ages (1811 – 1837), bath houses became popular. Depending on your wealth, you would bathe daily in a cupper tub or weekly in a wooden barrel. When piping came along, bathing became more accessible and more common.

1.3.2. Over versus under: a nice to know

Before toilet paper was common, people would wipe with straw or moss. Toilet paper made a significant contribution to the overall toilet hygiene. But the invention of the perforated toilet paper roll introduced a new argument. Over the past couple of years, a debate has been going on whether a toilet roll should be hanged with the sheets rolling over it or under it (Willet, 2015). Meaning, do you tear the paper at the front of the roll or on the back. Arguments for both options have been going around, but recently this has come to an end. Thanks to the original patent for perforated toilet paper. The inventor of perforated toilet paper Seth Wheeler, illustrated his invention with the paper going up and over the roll.

Images retrieved from ftips.com and para3it.ru

18 **00's**

19 **00**

19 **10**

19 **20**

19 **30**

19 **40**

19 **50**

19 **60**

One of the first soaps available in washrooms

Soap on a stick to prevent theft

1902: Toilet paper heavily marketed

1891: First patent for perforated toilet paper

1857: Toilet paper origin: the bulkpack

One of the first toilet paper roll dispensers

Variations on toilet paper dispensers

Toilet pa
with

1922: paper towels are mass produced in America

Cotton towel roll

1949: introduction warm air dryer

19 70

19 80

19 90

20 00

20 10

20 20

20 30

20 40

oap pump

Liquid alcohol gel soap

Foam soap

Current soap dispenser

The hanging toilet

New rimless toilet

Futuristic toilet seat bidet

aper rolls cap

Variations of toilet paper roll sizes through the years

Current jumbo roll dispenser

Current toilet paper dispenser

1979: German law to offer every guest in food service industry a new towel

Interfold paper towels

Current paper towel dispenser

Centerfeed rolls

Current centerfeed dispenser

Current paper towel roll dispenser

Current cotton towel dispenser

1993: introduction Mitsubishi Jet Towel

2002: introduction Excel Xlerator

2006: introduction Dyson Airblade

Figure 2: timeline of dispensers, toilets and toilet paper

1.4. | The company

Van Houtum B.V. is a Dutch paper recycling company located in Swalmen. Their core business lies within the recycling of all kinds of paper into different kinds of toilet paper. Their whole business model is focussed on thinking in cycles. This sustainable thinking has already lead to a lot of recognition and is the signature when doing business with them and also applies to transport. Van Houtum is doing business within a 300km radius, because further than this results in more emissions from truck transport than they are naturalizing by their recycling efforts.
Next to paper, they also provide dispensers to be able to offer complete washroom solutions. But this does not say anything about what Van Houtum wants to deliver to its customers. For this to establish, the archetypes model (figure 3) was used. It can be seen that Van Houtum is for 60% the everyman. This is translated in finding a solution to the most obvious problem. The other 40% Van Houtum is a creator. Van Houtum looks for a new vision to create something of sustainable value. Knowing this, it would be characteristic to find the most obvious problem and solve this in a sustainable manner according to a vision.

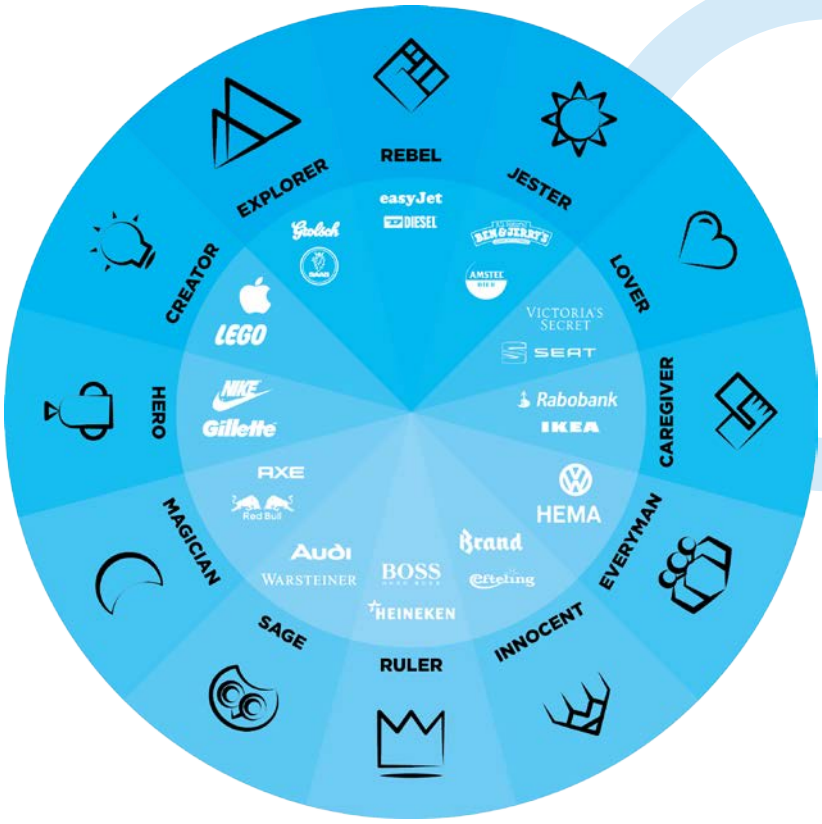


Figure 3: archetypes model to describe a company's identity

1.4.1. Van Houtum's portfolio

Van Houtum offers complete washroom solutions. Meaning, dispensers ranging from paper to soap, and products from ladies hygiene to toilet brush garniture. Most of their items are offered in three lines: the Satino Black, Satino White, and Stainless Steel. Of these lines, Satino Black forms the flagship. It is made of recycled ABS plastic, hence the colour. So when business owners are looking for a very sustainable washroom, Satino Black is their primary option.

The white edition is made of new, first grade ABS, which also explains the colour. This is mainly bought when it suits better with the washroom.

The final line is the stainless steel one, which is considered pretty expensive by a lot of customers, but does offer a very exclusive and hygienic finish to the washroom.

A fourth line is in its early stages, which is called the BriQ line. Of this not fully developed line, only four different dispensers are available. This line is build up from blocks, hence the name. A single dispenser is exactly half of the double.

1.4.2. Van Houtum and competitors

In the market of washroom dispensers, there are a lot of competitors (figure 4). Some of which, for instance Kimberly-Clark and Tork (parent company SCA), are quite a bit larger than Van Houtum. Both offering products internationally and the similar products as Van Houtum. Therefore, they are considered direct competitors. Other direct competitors are DJ Group, Lucart Professional, Euro products, Tork, Vendor, Katrin, Papernet, and PrimeSource. Of these direct competitors, DJ Group, Lucart Professional, Tork, Vendor and Katrin stand out and have a larger portfolio with their touchless towel and soap dispensers or baby cleaning products.

Holland Papier Groep is considered an indirect competitor as it offers only a couple of similar products to Van Houtum's product portfolio. Furthermore, it doesn't offer variations of their dispensers, such as stainless steel. Ecoline has even a more limited dispenser product line-up. Bewima is considered an indirect competitor, as they are mainly focused around cleaning of surfaces instead of human hygiene. CWS belongs to the indirect group, because they don't offer paper towel dispensers, which is one of the core products of Van Houtum.

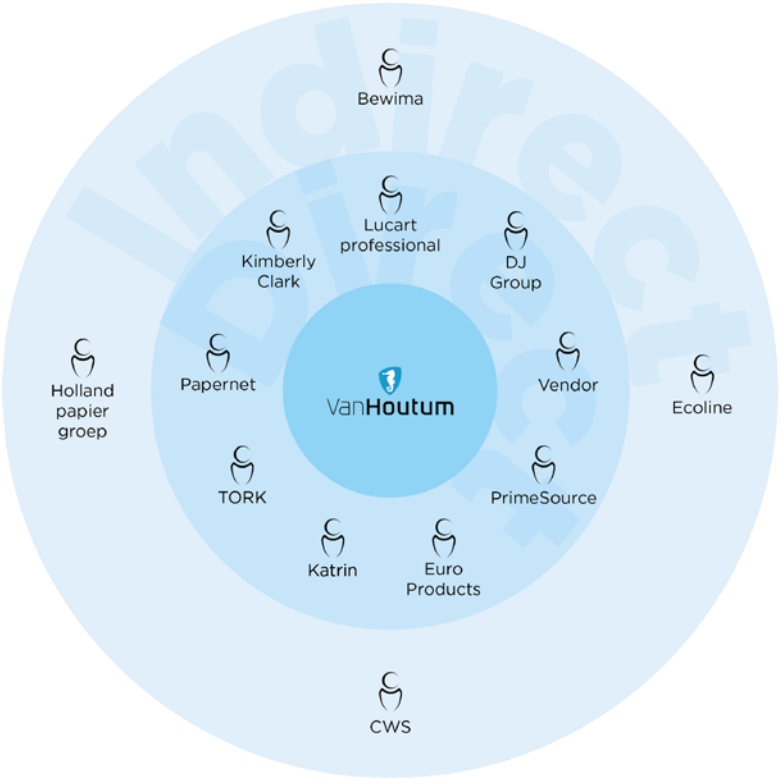


Figure 4: competitors overview

1.4.3. Business model of dispensers

All sales of Van Houtum run through wholesalers. Multiple wholesalers are in business with Van Houtum. It depends on the end user, which wholesaler is involved as an intermediary. There are two ways Van Houtum offers dispensers to its customers (figure 5). Via regular sales, where the end user orders at the wholesaler and the dispensers are delivered 1-1,5 week later. Often the wholesaler is then also installing the dispensers.

The second business model is when the dispensers is delivered on loan. This is only done when the end user signs a contract for a number of years to buy paper from Van Houtum. In this contract, a standard selection of the Satino Black dispensers is made as well as a couple of tiles that the customer can display to show that they are using the most sustainable washroom solution there is. When this contract expires, the end user can decide to prolong it and keep the dispensers, or let the contract end. In the last case, the dispensers are collected by Van Houtum for a second life or to recycle.

1.4.4. Conclusion

When looking at the product portfolio of Van Houtum, they offer a complete washroom range. And with their sustainable approach, Van Houtum is the only one in the market that applies this so thoroughly. This is known by most business owners and can be considered a true competitive advantage. Although most competitors offer similar products or less, there are some that offer touchless dispensers, which is a valuable contribution to their product range. Something, Van Houtum should at least be looking at. Even though this requires unsustainable electronics, the 'on loan' business model of Van Houtum can facilitate the implementation of electronics when disassembly is easy. To look what the possibilities are for a future dispenser range is the main focus of this project.

Figure 5: current business model of Satino Black dispensers

2. The deconstruction

A dispenser is something, referred to as a machine or container, that dispenses or gives out. It allows its content to be removed and used in convenient and controlled quantities. This can be a vending machine, that automatically dispenses a single item or a measured quantity, but in this case it is about a container; in particular containers that are placed inside the washroom, such as toilet paper, paper towels, soap, air fresheners, and ladies hygiene. In this section the deconstruction of dispensers on the product, interaction and context levels will be given.

2.1. | Deconstructing dispensers

How and from what material are current dispensers made? What does the customer need when receiving a new dispenser? What stages do the dispensers of Van Houtum go through during their life? And what is the difference between Van Houtum's dispensers and those of the competition? All questions that this chapter will answer in order to get to know the product that this project is all about.

2.1.1. Dispenser parts and production

Of the three lines that Van Houtum has (Black, White, Stainless steel), the Black line is discussed in detail since this is the focus of this thesis. Of this line, the towel, soap, toilet roll for 2 system rolls, and air freshener dispensers are chosen to be discussed as these are included in the loan structure. Furthermore, the towel and toilet paper dispensers of the BriQ line (the BriQ Double and Single respectively) are discussed as these are significantly different from the Black line. The Black line comes with a transparent mouthpiece, resulting in 4 major components for the housing of most of the dispensers. Often there are more parts, but these are for operational services only.

The housing of all dispensers is made from recycled ABS by injection moulding. They are assembled through form fit and click fingers and thereby do not require any screws or permanent connections. Except for the air freshener which has a metal plate to put the fragrance on. This plate is assembled by two screws. The air freshener does not require a window to keep track of the filling. But for cost savings it makes use of the same housing as the soap dispenser, which does requires a window. This window is welded ultrasonically to the housing. The mouthpiece on the bottom is made from transparent ABS and is either assembled through form fit (towel, toilet roll), click fingers (BriQ) or through ultrasonic welding (soap). Again, the air freshener is an exception on this, as it has a mouthpiece of the same black ABS as the rest of the housing. It has openings in it to get the air circulation going to spread the fragrance.

Figure 6: foto of the housing of a soap dispenser, consisting of three housing parts

Furthermore, there is the difference between a button or a key required to open the dispenser. The button is situated at the back of the bottom, where it is completely out of sight. This button is also made from black, recycled ABS and is connected to a metal strip that guides the force to the top. Here, it is connected to another plastic part that provides two click fingers. So pressing the button below makes the click fingers on top bend.
The other option is to have a key. This key is moulded along with the housing and can be pressed out in the case of BriQ dispensers. Otherwise it is a separate metal pin (Figure 7). Both keys can be used to press two click fingers so the housing can be opened. All dispensers without a button require the same key.

2.1.2. Packaging

Every dispenser is packed separately in a close fitting cardboard box, on which all necessary information is put. Except for which side to open the resulting in service men with troubles finding the most convenient side to open it (Kroon, 2017). Inside the box (Figure 8), the dispenser is wrapped in a plastic bag to prevent damage. Inside the dispenser, a description of the mounting and opening can be found. This paper can also be used to drill the mounting holes at the right position. Next to this description screws and plugs are provided. Because the dispensers are installed by trained service men, the mounting information is not always necessary (Kroon, 2017; Visser, 2017).

Figure 7: Two types of keys. One moulded along with the BriQ (left), the other comes with the system roll dispenser)

Figure 8: An overview of the packaging of a system roll dispenser (without the plastic bag)

2.1.3. Journey of a dispenser

The lifecycle of current dispensers of Van Houtum can start either with new or recycled ABS, resulting in Satino White or Satino Black respectively. However, in both cases the lifecycle (Figure 9) starts with injection moulding. When the dispenser is fully assembled, it can be packed and get ready for transport by truck. First from the manufacturer to Van Houtum, from there to the wholesaler, and finally to the end customer. Van Houtum is holding dispensers in stock to quickly (within 1-1,5 week) be able to supply wholesalers (Huet, 2017). Wholesalers also have a small supply for when end customers need replacements (Kroon, 2017). Depending on the wholesaler they have their own service men or an external party is hired to install the dispensers.

Once installed, the dispensers can do their job and go through a number of cycles of emptying, cleaning, filling, and small repairs until they have reached the end of their economic life span. Then they are collected by Van Gansewinkel by order of Van Houtum, who recycle them. Often, an external party is hired to bring the specs of the chips as close to their original state, after which the chips are sorted on colour and mixed with chips of other plastic household products to be injection moulded to Satino Black dispensers.

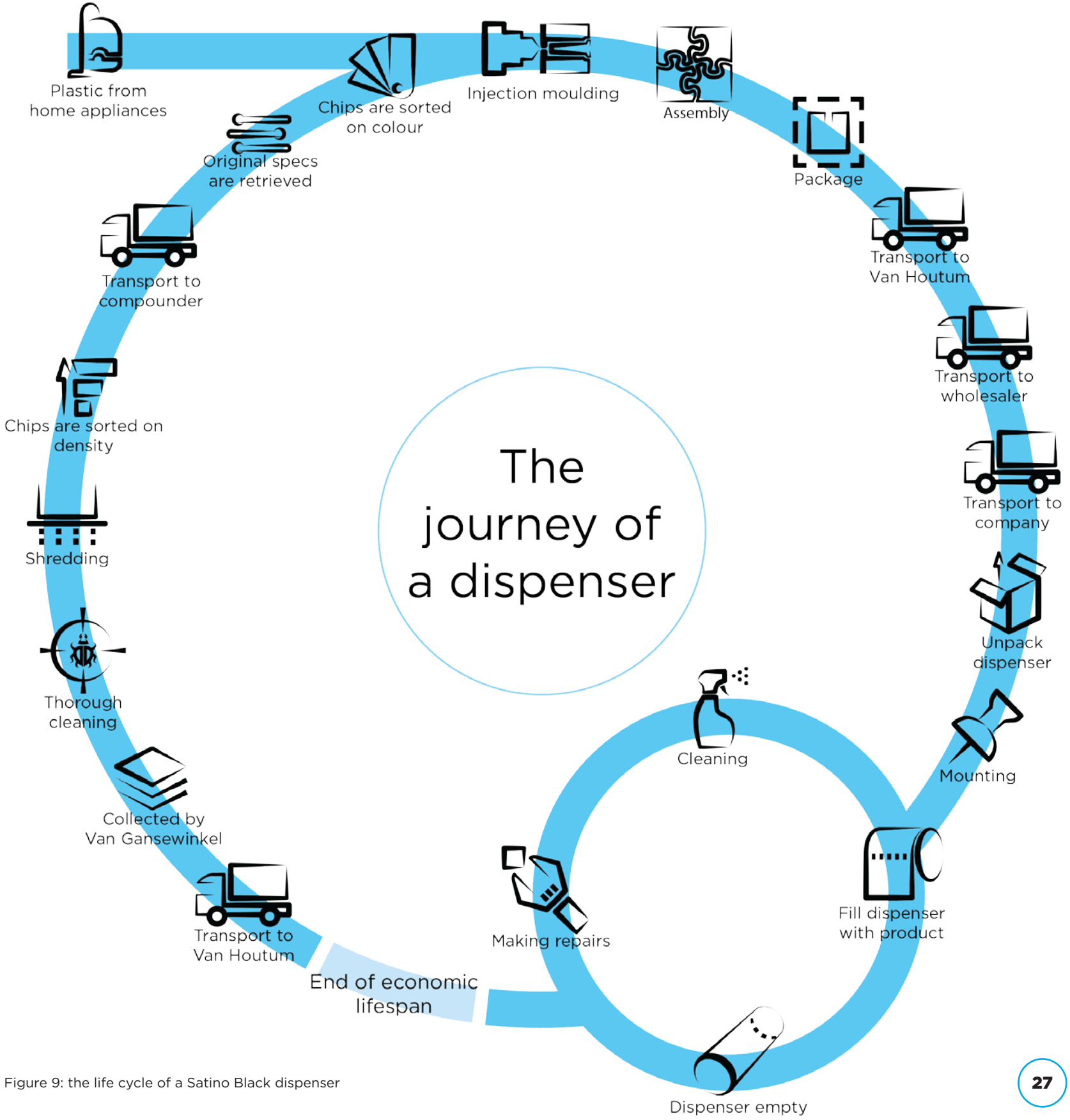


Figure 9: the life cycle of a Satino Black dispenser

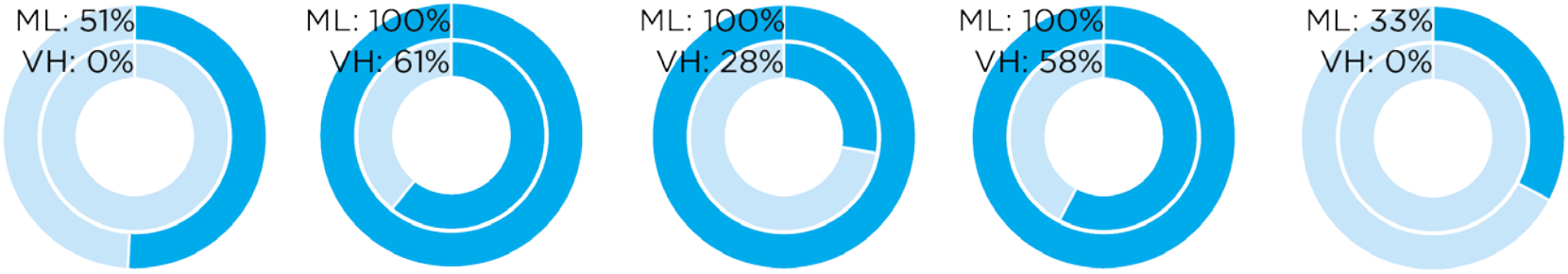


Figure 10: sustainable performance of Van Houtum compared to the market leader

2.1.4. Competitors' products

Van Houtum is recognized for their sustainable approach and is the main company to offer such a washroom solution. However, other competitors are closing in slowly. Some competitors are actively mentioning in their catalogue or website what they do for the environment, but this is mostly related to their main product: paper. Compared to the market leader, SCA, Van Houtum is doing much better in this respect (Figure 10).

In terms of working, the dispensers do not vary that much. Especially with folded paper towel dispensers it is quite simple. What can be seen, is that every company is focusing on hygiene. Which is not at all surprising, but it does not stand out as well. Every dispenser is made from ABS, because of its simple production process and interesting material properties. The main thing that varies between these dispensers is the styling and colour offering. White dispensers are very common, but a couple of competitors also offer a second or third colour (Papernet, Tork, Vendor, PrimeSource, Euro Products, Berendsen, Katrin, CWS, and Lucart Professional). Only a very small selection offers more colours than that (Berendsen, Katrin, CWS).

Dispensers are all boxes. Which is pretty clear in terms of styling. Especially with the paper towel dispensers. The corners and edges are rounded and sometimes surfaces are bended a little, but the overall design is pretty functional and economic: taking as little space as possible while holding as much paper as possible. The dispensers of Van Houtum try to break through this by the large fillet at the top. But this makes it visually much bigger. Besides the fillets, the little window is an aspect that manufacturers vary. Most of the time it is situated at the front, but Tork, Euro Product, Lucart, and Katrin have dispensers partly made from a semi-transparent ABS through which you can see the filling.

2.1.5. Conclusion

Looking at the small amount of parts of most dispensers of Van Houtum, the fact that they are primarily made from recyclable ABS, and that there are no connections that endanger recycling, these dispensers are well fit for recycling. The packaging can be optimized by indicating which side to open and possibilities to combine more products in one package, so that the amount of paper is reduced and can be used for other purposes. So an optimization step in the direction of sustainability can be possible here. And an optimization step in sustainability might be necessary, as competitors are closing in and Van Houtum is losing its competitive advantage. Also considering the large amount of transport during the life of a dispenser. For sustainability, this is unwanted, but with the current business model of dealing through wholesalers, the question is if this can be improved.

Also in styling there are possibilities. When offering multiple colours like Berendsen and CWS, already a competitive advantage is achieved on other competitors. The question is if offering the same amount of colours is enough to make this advantage sustainable.

2.2. | Deconstructing interaction

How do the most important stakeholders interact with the dispensers? What are they influenced by? What values regarding dispensers do they hold? Questions that this chapter seeks to answer in order to get insight what stakeholder are primarily focused on in the design of a future dispenser range.

2.2.1. An introduction in value theory

Value theory encompasses various approaches to determine the way people value things; whether this thing is another person, an idea, object, or anything else (Boztepe, 2007). Using Graeber's value theory approach overview (Graeber, 2001), the economic approach should be used as a main standpoint to know what stakeholder to focus on. A 5th pillar can be identified in the ecological economics, which is also important considering Van Houtum's sustainability focus. It identifies two types of value: donor-type and receiver-type (Lu & Campbell, 2009). Donor-type value: what things were needed in the production of a product or service. Receiver-type: what people are willing to pay for the product or service. The new dispenser range should be future proof, and thereby generate business success. For this to happen, it is recognized at a growing level that superior value should be provided. And one of the key attributes that distinguish breakthrough products from their closest competitors, is the significant value they provide to users (Boztepe , 2007). Currently, Van Houtum is doing this by its unique C2C philosophy. According to wholesalers, this does not need to be enhanced in order to get more sales. But businesses that do not see the added value of sustainability and C2C, should still be tempted to choose Van Houtum's dispensers and its paper over competitors'. Therefore, the interaction of stakeholders with dispensers is partly expressed in value.

2.2.2. Types of value

To dive a little deeper into value theory, there are different types of value arising from user's experience with products. Boztepe (2007) gives afigure (Figure 11) that presents these various types, where (1) Utilitarian Value refers the way a product helps achieving practical ends; (2) Social Value is product's instrumentality in achieving certain social objective, such as affirmation of a social status; (3) Emotional Value is defined as the benefit of a product in terms of the emotions it provokes; and finally (4) Altruistic Value is the sense of being good, as is the case with 'green' products (Boztepe, 2003). Figure 11 gives a more elaborate list of what these types entail. Each stakeholder has its own selection of aspects that they claim.

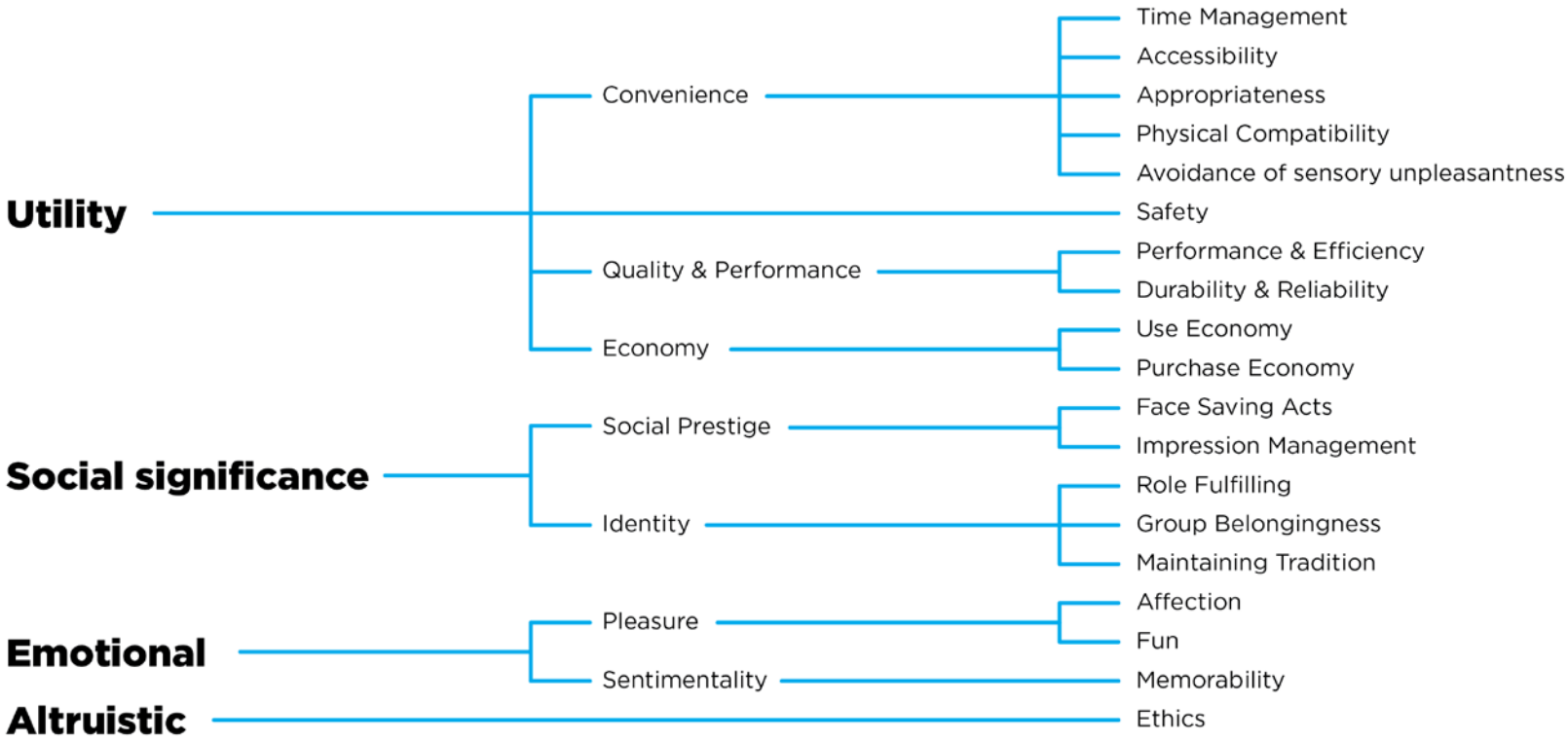


Figure 11: value types accordng to Boztepe (2007)

2.2.3. More important stakeholders

Looking at the journey of the dispenser, washroom dispensers are bought, used, cleaned, and disposed of during their life cycle. In these stages, multiple stakeholders are involved (Figure 12). Knowing what these stakeholders demand and want is essential to understand what dispensers need. This information is acquired by desktop research and interviews.

Not all stakeholders are equally relevant for designing a new dispenser range. Therefore, the most important stakeholders are identified as the wholesalers, end customers, visitors, and cleaning staff. These are most important, as they have the most interaction with them on a daily basis. This interaction is explained further in this chapter.

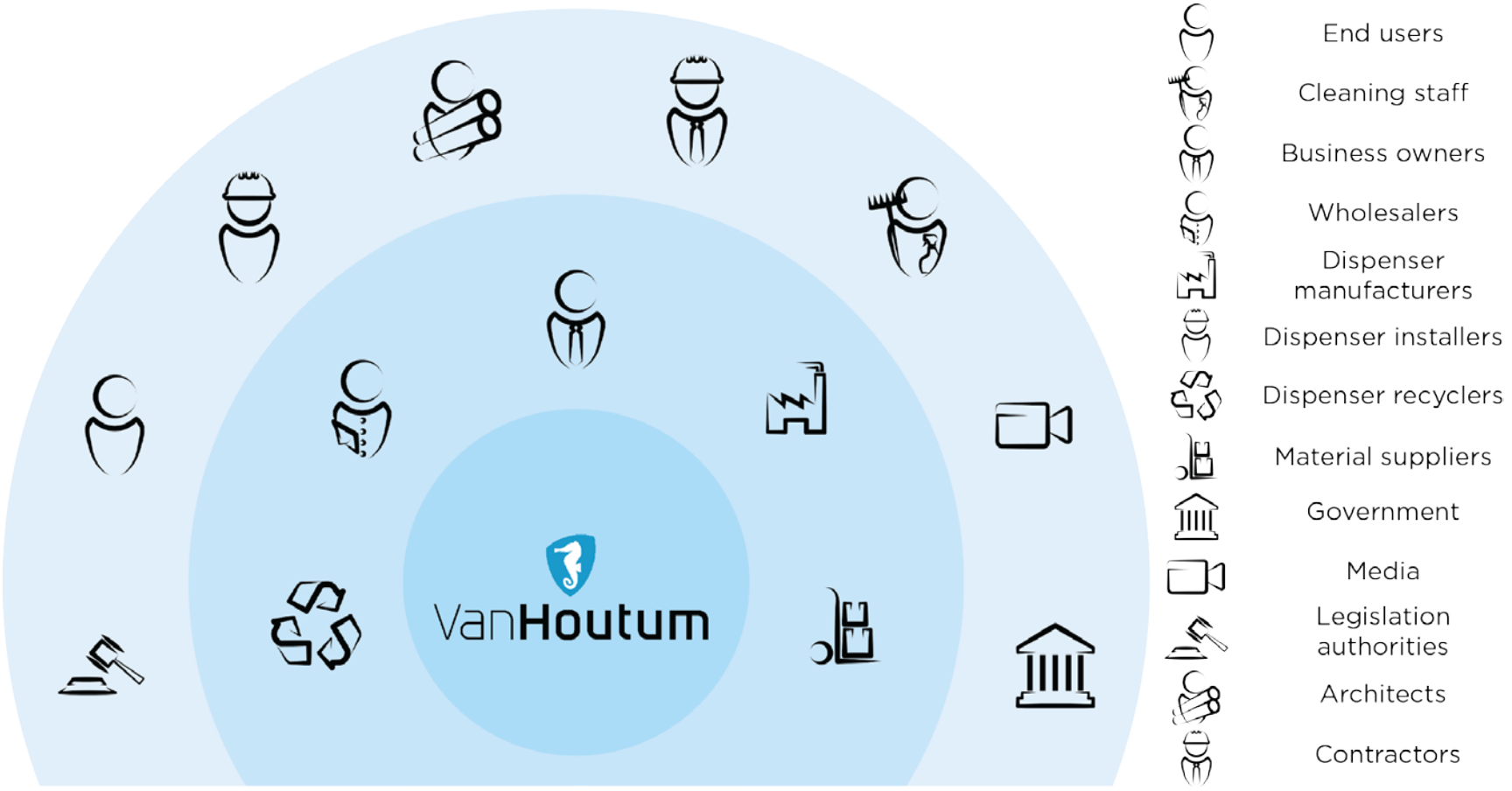


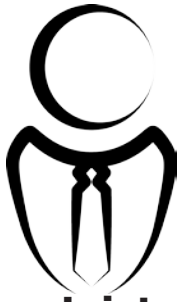
Figure 12: stakeholder overview

2.2.4. Wholesaler's interaction

Wholesalers sell a lot of different dispensers. Some dispensers have more engineering inside them, causing them to get broken more often than others. Resulting in a bad relationship with them and less sales for those dispensers. Wholesalers want to offer safe, durable, and reliable dispensers.
Depending on the wholesaler, they have their own installation service. These men and women need to unpack and install the dispensers. So not only the dispensers themselves, but also the packaging is part of their interaction. Their interaction is defined by accessibility. Also, a lot of wholesalers are in business with Van Houtum because of their circular approach. Which is a kind of social prestige and group belongingness, as well as an ethical value.

2.2.5. Cleaning staff's interaction

Naturally, cleaning staff have an up close interaction with dispensers. Cleaning every surface and hard to reach areas where avoidance of sensory unpleasantness is wanted. All within a certain timeframe, setting time management and accessibility at a high value level. Next to this, they also have to deal with the filling and broken dispensers. Broken dispensers are annoying, because it results in more cleaning due to more contamination, and extra actions to get them fixed. A clear sign that they value quality and performance, but also safety having to open them daily.



2.2.6. End customer's interaction

Employers offer jobs that should be an experience for the employee. "This job is a real challenge and you will work in a dynamic team" is an often used description for a vacancy. It is not so much about the job itself, but what the job brings along. This experience focus is established throughout the work floor and thereby the washroom. By having a nicely designed washroom, with dispensers matching everything, employers want to make this experience come to life. Naturally, this is a way to add appropriateness, social prestige and identity, with in particular role fulfilling and group belongingness.
But it is not all about experience. Of course, the quality and performance play a large role, but also hygiene and well-being are on the top of the list. More and more research is done on the correlation between well-being and profit for businesses. Sickness absence is a major head of expenditure for employers, so they try to get this as low as possible by looking at what is hygienic and makes employees feel at home and safe. This has everything to do with convenience, pleasure, and sentimentality.
Thirdly, sustainability is something employers have to consider nowadays. Not only for the environment, but they are beginning to see that it is also beneficial for their profits. This concept is also made visible inside the washroom. Especially when settling on a new location, every aspect needs to be as sustainable as possible. They rather opt for Satino Black than White, when knowing the story behind it (Kroon, 2017), which is an ethical value.
Also, people have the capacity and tendency to connect objects with meanings that sometimes are disconnected from their utility or the meanings intended by their producers. They often value objects not for what they do or what they are made of, but for what they signify (Boztepe, 2007). In this respect, dispensers can be an added value to show and confirm the philosophy of the company to employees and visitors; a way to maintain tradition.

2.2.7. Visitor's interaction

At a daily basis these people use dispensers. They see them hanging as part of the washroom, they use them, and sometimes also break them. The visual appearance is important. When the right dispenser is chosen, it becomes one with the washroom and feels natural for the visitor. The visitor feels comfortable; an important emotion in one of the most private areas for a person. In terms of value type, this is considered appropriateness, physical compatibility, avoidance of sensory unpleasantness, and safety.

Using them is even more important than the visual aspect. Not just comfort plays a role, but also hygiene. The introduction of touchless dispensers is valuable as most bacteria transfer is caused by direct contact (Nieuwenbroek, 2017). Even after hand washing, a moment when hands should be very clean, people do not want to touch another object in an area which is considered the dirtiest.

Breaking a dispenser is something most people want to avoid. But every once in a while it breaks. Some dispensers more often than others. But breaking them is not the only unfortunate aspect, having washed your hands and discovering that there is nowhere to dry your hands is another. A situation many people can relate to, determined by quality and performance.

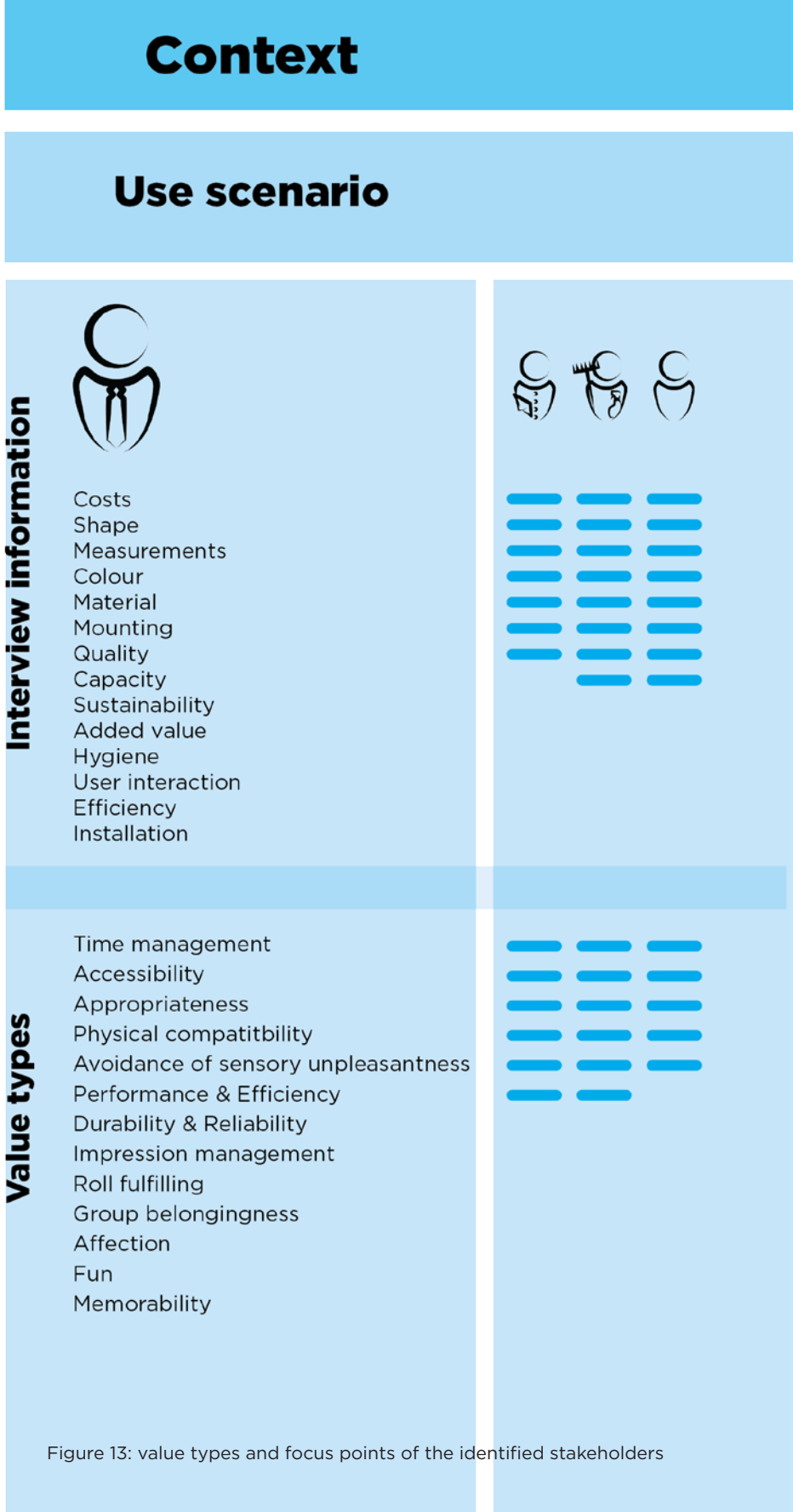


Figure 13: value types and focus points of the identified stakeholders

2.2.8. Use scenario's

Depending on the context, dispensers are used either very often or hardly. The traffic in the main hall of an office building will lie much higher than the washroom hidden in the corner on the fourth floor. More traffic means more use and people that want to be quickly out of the washroom. In this case, it is the difference between a high amount of people standing in line to wash and dry their hands, feeling rushed to give the next person room, and a single employee that does it fast but thorough.

2.2.9. Types of dispensers

There are a lot of different dispensers. Their difference is determined by traffic in the washroom, the frequency of cleaning, and dimensions and design of the washroom; aspects influencing the use scenarios described above. All these aspects result in a product portfolio ranging from a single toilet paper dispenser to the multi mirror of Van Houtum. For instance, a small washroom with a large traffic, requires the towel roll and jumbo toilet roll dispenser. Whereas a low traffic washroom can cope with a regular towel and a single toilet roll dispenser.

An interesting product of Van Houtum is the multi mirror. This is a very convenient product for the newly designed, more exclusive washroom (Figure 14). It facilitates two stacks of paper towels combined with a soap dispenser and a mirror in one box, saving space and increasing hygiene and comfort. However, it needs power for the integrated light and the design of the washroom should be adapted to it. Otherwise the dispenser does not fit. These requirements result in a low amount of sales.

Figure 14: The multi-mirror by Van Houtum

2.2.10. Conclusion

The interaction with dispensers is not divided equally among the more important stakeholders. End customers are looking at the dispensers with the question what they do for their business, wholesalers are occupied with their relation to competitors' dispensers, visitors are more concerned what the dispensers do for themselves, and cleaning staff have a purely functional interaction.

So the end customer is the most important stakeholder as he has to decide whether or not to buy it and is influenced by all aspects of the dispenser (except for the packaging). Figure 13 gives an overview of all the influences per stakeholder with the context as main influencer, followed by the use scenario. The first aspects in this overview are derived from interviews and the bottom from desk research regarding value theory. In here it can be seen clearly that the end customer is the stakeholder to focus on. Not only are they interacting with them like regular visitors, but are also taking their business into consideration. Resulting in a lot of aspects and value types related to dispensers that other stakeholders are not relying on.

The nature of these influences is determined by the use scenario. Which in turn is influenced by the context. So when applying CVD, it is important to determine the according use scenario to discover the requirements and types of dispensers that will be installed most or that perhaps a new kind of dispenser is needed.

2.3. Deconstructing context

In this chapter, the deconstruction of the context of a washroom dispenser will be done. This is done using interviews and presentations given by Van Houtum. This analysis will focus on what customers are willing to pay for their washroom furnishing, where dispensers of Van Houtum are needed and which dispensers this will likely to be.

2.3.1. Prices for a dispenser

Mostly the dispensers are provided on loan. But when single sales do happen, prices vary between 30 and 155 euros for a single Satino Black or White dispenser. The stainless steel line dispensers and multi mirror are considerably more expensive. So much more expensive even, that many end customers are not willing to buy it and opt for the ABS lines or go to a competitor which does deliver cheaper versions. Some wholesalers are even thinking about removing the multi mirror from their catalogue, because it does not sell at this price. But considering a lot of companies have to equip multiple washrooms, it is logical that customers opt for the loan structure.

2.3.2. Target group

Van Houtum is in the B2B business, so there is not a very specific target group. Their current lines are attractive for very sustainable businesses, businesses that have sustainability not on the top of their priorities, businesses that just want a nice look, and businesses that want to have a very exclusive look. This includes hotels, offices, restaurants, etc. Recently, Van Houtum also started offering polish and rub paper with accompanying dispensers including industry in the potential customers.

What end customers look for in dispensers are products that emphasise their company identity and integrate smoothly in the washroom (Kroon, 2017; Visser, 2017). In terms of styling this is still limited, having the option between Black, White, and a very exclusive metal look. But when it comes to sustainability, the Satino Black range cannot be matched.

2.3.3. Most sold dispensers

This is dependent on the wishes of the customer and its washroom. Every washroom is different as well as their needs. There is not a particular dispenser that stands out in sales. But what happens when a contract is signed, it is most of the time the regular hand towel dispenser and the system roll dispenser, along with air fresheners, soap and once in a while toilet seat cleaner(Kroon, 2017). The towel dispenser is always integrated in the washroom, making this a promising candidate for the new product design phase.

2.3.4. Conclusion

The price for a dispenser is mainly important for Van Houtum. With the most often used loan structure, it is Van Houtum that needs to invest in them. This does however only include the Black line, as the stainless steel line and the White are not included in the structure. So the price of the stainless steel line is important for both Van Houtum and the customer. But very often this line is disregarded for its current price, so when produced and offered for a lower price, the sales of this line can go up. As long as this does not become a serious contender for the Black line, which is Van Houtum's prime line to sell as it is the most sustainable. But since the loan structure is applied the most, it is likely that the Black line will always have the upper hand. So when designing a new dispenser range, it is logical to let the dispensers that are included in the loan contract form the basis.

Most often the loan structure is used, making the towel, system roll, air freshener, soap, and waste bin the most important dispensers of the line. Therefore, a small change in the design brief is in place by not focusing on the whole range, but on this selection of dispensers.

2.4. | Conclusion deconstruction

The current dispensers of Satino Black are well fit for recycling. In terms of sustainability, transport might be an interesting aspect to look at, and the packaging can be improved. However, packaging is not a focus point as end customers, which are the most important stakeholders, are not concerned with this aspect. They are however influenced by a lot of other aspects. The nature of these influences is determined by the use scenario and the context. This also counts for the price. While the loan structure is chosen a lot, there are still companies that want to buy them. Mainly small companies with accordingly small washrooms. But when the loan structure is chosen, there is a standardized compilation of dispensers offered, making them the dispensers to focus on. And although they are very sustainable, a further optimization might achieve a more solid competitive advantage with competitors closing in on sustainable thinking. Especially when a styling optimization is included.

The current interaction is one of function. Both for visitors and end customers, the dispenser is something necessary in the washroom and only has a functional reason of being; namely holding and dispensing paper, soap, or scent. It is something necessary to buy instead of being an addition to the washroom. Design is only looked at superficially, but never as an integrated part of the washroom. That is why price plays a very big role for end customers in the decision for which brand to go for. But as with the introduction of black as a colour for dispensers, Van Houtum can set a new trend for a new way of dispenser design. Before this is investigated further, a good look at the future is necessary. The first step for this is discussed and elaborated on in the next phase of the ViP process: future context design.

3. The future contexts

In order to know what the future will look like, some preliminary research is done towards future contexts in 2035. Various trends and developments, or context factors, were investigated according to the DEPEST model. These factors are used to make a representation of the future contextss in 2035. As designing for multiple contexts is sustainable, the Context Variation by Design approach is used and introduced in this phase. However, multiple contexts can be thought of. Therefore, the influence of the factors is used to determine what contexts to design for. This phase starts with the definition of the domain, before going into the factors.

3.1. | The domain

Every ViP process starts with a domain to determine which starting points are relevant. The domain is the start of a whole sentence, that describes what the designer is aiming for. It is a description of the context in which you want to make a contribution. The domain is developed by the designer, but in close collaboration with the client. It is a mutual decision to define the domain. Because CVD will be applied, the domain is defined in such a way that it can relate to more than one context. To define the domain, a subject, demography and timeframe should be given. So for this project, the domain is:

“In the domain of a hygienic and comfortable washroom experience in 2035’s BeNeGeLux,...”

...a hygienic and comfortable washroom experience
ViP is about the interaction between the product and its user. This is where the experience comes into play. The two most important aspects of a washroom, is that it must be hygienic and comfortable. These are not just priorities for the visitor, but also for cleaning staff, business owners and other stakeholders.

...BeNeGeLux
The BeNeGeLux applies to the countries within the 300 km radius from the facility of Van Houtum in Swalmen. Because the delivery of trucks consists of 40% air on a full load of paper and is therefore not sustainable; it collides with the mission of Van Houtum in making the world a better place.
It should be noted that the 300km radius is kept. So any part of germany outside that radius is not taken into account. However, in this respect, also Scandinavia is taken into account.

...2035
To be able to use trends and developments that can be seen today, the timeframe is set at approximately 15 years ahead.

3.2. | Trends & developments

To know what the future will hold, trends and developments are researched according to the DEPEST model. Some important trends are urbanization, experiences, digitization, and automation. The full list of trends and developments can be seen in appendix A. The next step is to combine these trends. Combining trends lead to the following eight clusters, based on human behaviour. This is done because VIP is about the interaction of people with products and services. The factors inside one cluster all point to the same direction, so Common-quality clusters are formed, meaning “a combination of factors that all point to the same direction and together form a ‘metafactor’.” (Hekkert & Van Dijk, 2014).

Hygiene focus

Cities can become the epicentre of bacteria, because of an urbanization trend. Here are a lot of jobs which lure immigrants and refugees, these jobs have flex working spaces and thereby more mingling of bacteria, and anti-vaccinate supporters are mostly rich and religious people, which can be found mostly in cities.

Less boundaries

Boundaries are fading. Through globalization, the increase in migration and products being produced more globally, people, genders, and cultures are being mixed at a growing pace. And more products are being shared instead of owned; think about car sharing. Products to enjoy, but not own.

Self-sustaining

Western societies are characterized by an ageing population, where elderly want to be independent. They have telecare and self-monitoring devices. In fact, automation is going on to help anyone with various tasks. People become producers due to 3D printing, and buildings are becoming smart and sustainable by generating their own energy and collect and use rainwater.

Intimacy

Because of globalization and a growing population, people are looking for more intimacy. They are going out more as smaller households and want to feel more at home; including at work. Because of this employers are investing in workplace wellness and wellbeing. In products, this intimacy can be seen through customization and the popularity in locally produced goods.

Contradictions for convenience

"I want to be sustainable, but only when it's comfortable." A trend towards water scarcity and toilets with faucets to replace toilet paper. A growing health awareness and hospitality cleaning. A natural need for human interaction and digitalization that shifts focus from each other towards screens. Systems and products for convenience, but at a cost that we acknowledge.

Less human interaction

Smartphone addiction is a serious thing. The rise in social media popularity confirms this. And with the developments in virtual and augmented reality, a further loss in human interaction with their direct context is predicted. It is also one of the reasons that loneliness is on the rise and why networking is becoming more professional every day.

Efficiency

As an employee you want to be efficient, but for the employer it is necessary to reduce costs. For this to realize, the usage of robots and automation are a solution. This requires big data. But not everything is carried out by robots. So for the employee to become happier and thereby better at his job, the employer is providing an experience rather than a job.

Living in the moment

People are looking for experiences, which results in more hotel reservations and AirBnB popularity. Especially in the Netherlands' "Leisure Land". And restaurants are pushing this by demanding cell phone free meals. But also less ownership confirms this trend. You don't need a drilling machine every day. You only need it at a specific moment.

3.3. | Cluster matrix

From the clusters a future context structure can be formed (Figure 15). This is done by first discover what kind of relationships exist between them. According to Hekkert and Van Dijk, there are two types of relationships possible: *pattern or storyline*, where a clear pattern is visible that unites the clusters in a narrative, or *Dimension*, where clusters seem to conflict. The latter is the case, so the next step is to form a grid with 2x2 opposite dimensions, representing different futures. In this aspect, two clusters are turned into dimensions and act as the axes on which other clusters represent the extremes. This creates four boxes in which behaviours are defined inside the washroom environment. The last cluster, Living the moment, fits as a behaviour within the box that is determined by Intimacy and Self-sustaining. The other behaviours are derived from this to fit within the three remaining boxes. These are described as Avoiding direct contact with others, Thinking about your direct context, and Living in your own world.

3.3.1. Avoiding direct contact with others

This behaviour describes a behaviour so that hygiene is preserved inside the washroom environment. So no more pat on the backs or nail polish checks. However, the need for interaction is too deeply rooted in the human brain to be changed and people won't actively want to change this.

3.3.2. Thinking about your direct context

This behaviour describes people who are actively thinking about others and think further than just their personal hygiene. They see the bigger picture. It is related to their direct context, so they do not need to do this for everyone; making it digestible.

3.3.3. Living in your own world

In here, people are actively improving what is directly related to them, but don't care anymore when it is related to someone else. For instance the toilet at work, which they want to see clean when they occupy it, but seem to forget this when they leave it. This is a very passive mind-set and should be discouraged.

3.3.4. Living in the moment

This behaviour describes randomness. People are only sometimes placing hygiene high at their list of priorities. This behaviour will result in inconsistent data on a smart washroom, but will also generate complaining and thereby a negative feeling towards washrooms. They want the washroom as hygienic as possible, because they also contribute to it. Sometimes. So finding a "dirty" one is a blow in the face and will ultimately lead to a lack of hygiene as a whole.

3.3.5. The interaction to focus on

To determine which behaviour should be focused on, a closer look to the behaviours is necessary. Looking at the bottom two behaviours, a very selfish attitude can be seen. With selfishness, a more hygienic and comfortable washroom experience cannot be realised.
The top ones are better in that perspective, because they improve the hygienic standard inside the washroom. However, the left one (Avoiding direct contact with others) is very hard to accomplish since humans are naturally social creatures. Therefore, the decision was made to opt for Thinking about your direct context as the basis for the mission statement. In this project, the direct context is situated inside a washroom. But there are many washrooms that can be considered. In the next chapter, this is narrowed down to specific contexts, using the Context Variation by Design approach.

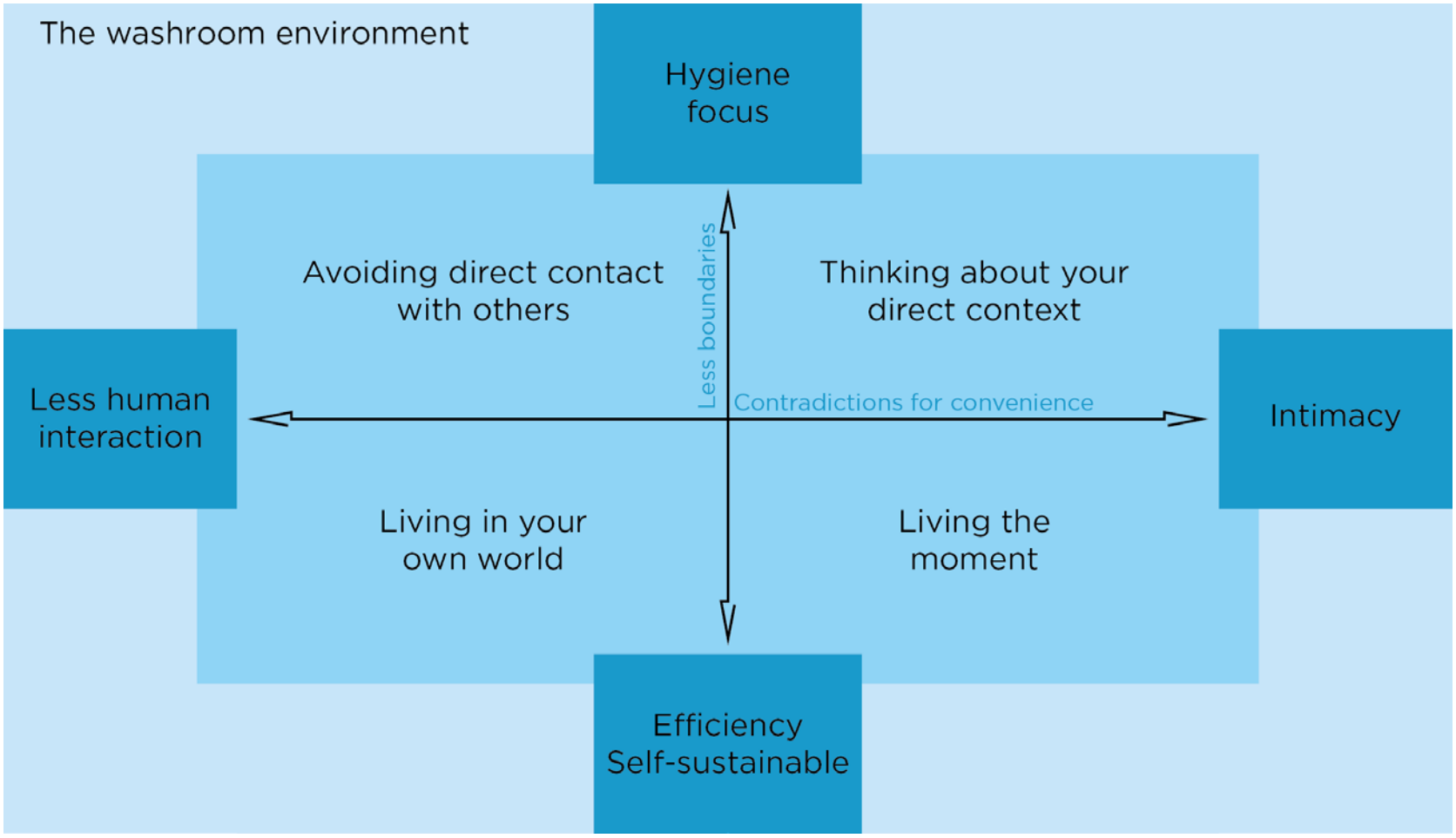


Figure 15: Cluster matrix representing a Dimensional cluster direction

3.4. | CVD

3.4.1. A short introduction into CVD

“CVD (Context Variation by Design) is a product development approach that has as a starting point that the complexity of contemporary society should be acknowledged and worked with to achieve better results.” (Van Engelen, Diehl, & Kersten, 2015). So instead of simplifying the design challenge, CVD uses the complexity of reality to scale the solutions to new contexts like regions, countries, and segments. Integrating CVD in a ViP process is something new, as no records are available that such a combination has been made in previous years.

3.4.2. Why is CVD suitable for this project?

If the product or service is only suitable for one specific context, this means that more similar products need to be designed for other contexts. By designing for multiple contexts, less similar products are necessary, which is more sustainable. Furthermore, the VIP method is used for this project. As a context driven method, the combination with CVD might be interesting.

3.4.3. Project complexity and CVD use

This project focuses on all sorts of washrooms for a variety of people, cultures, and countries. All these variations will inevitably result in various contexts that the vision should comply with and be appropriate for. So first the amount of contexts and the criteria for choosing the contexts need to be determined before making a selection of contexts to design for.

3.4.4. Context choice

With all those variations, different contexts can be thought off (Appendix B). Although Van Houtum does not sell dispensers in Arabic and Asian countries, the amount of immigrants from these countries is large enough to keep into account (Figure 16). Designing for 2 contexts is not rich enough, but designing for too many contexts will be impossible. Therefore, it is opted to combine three contexts. This comes from the power of three (Kalb, 2013). The human brain likes choices, but too many choices causes stress and confusion. To be able to design for every context equally, three is the ideal amount.

3.4.5. Decision criteria

But what contexts to choose? One criterion for this, is diversity or contrast. The richest design and the power of CVD lies within the difference of contexts. So the larger this difference, the stronger the design will be.

The contexts should also have connections to the factors and thus the described domain and mission statement. When the largest amount of context factors is applicable to the combination of contexts, it will be future proof in the best possible way.

The final criterion, is accessibility. Therefore, to choose a Scandinavian retirement home might be difficult to research properly. So all chosen contexts will be situated in the Netherlands.

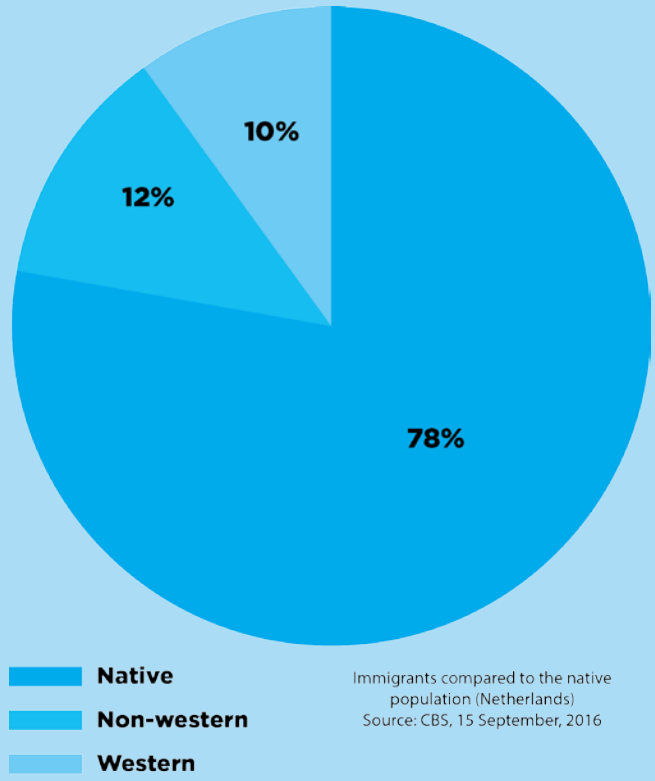
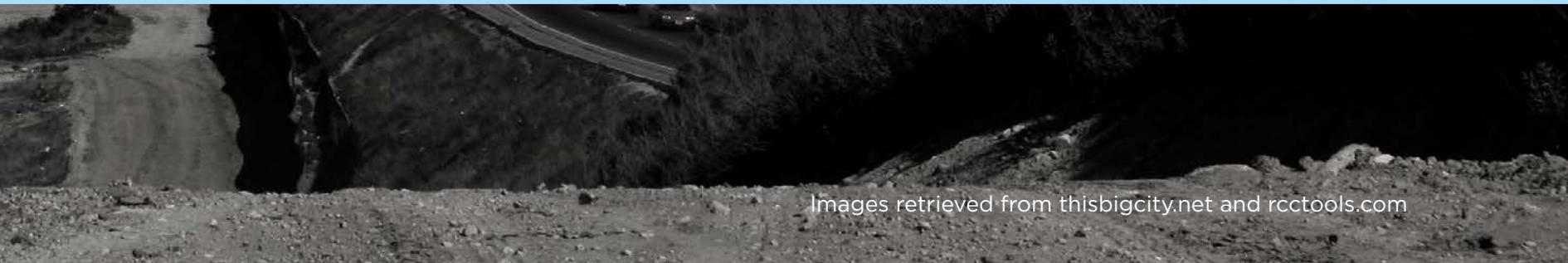


Figure 16: immigrants compared to the native population



Images retrieved from thisbigcity.net and rcctools.com

3.4.6. The decision

Context 1: A small, single person washroom in a retirement home. This context will be influenced a lot by trends and developments. An ageing population, self-monitoring, and telecare are just a few examples. Especially the target group is different from the other two contexts. They have wheelchairs and rollators that should be able to be brought along, as well as one of the staff to help the inhabitant where needed. Besides this, not a lot of people are familiar with this context and therefore need to assume things, which generates a lot of diverse creativity.

Context 2: A large washroom in an international office building, with a lot of culturally different people. The reason for choosing this context, is the amount of factors that are related. Experiences, urbanization, immigrants & refugees, and hospitality cleaning are just a few examples. It proves that this context is likely to change a lot in the future. What this context differentiates from the other two, is the reasonably high traffic with the same people using it daily.

Context 3: A washroom in a hotel. Just like the other two contexts, this is also dependent on a lot of factors, but different ones. Especially in here, the experience of the guest is important. It should be at least up to par with what they expect from the hotel. Also, the washroom breaths the same air. Guests should know that they are in the hotel even when they take a moment for themselves.

3.4.7 Why are these different?

Besides the differences that are already mentioned, there are more aspects that let the individual contexts stand out from the others. It is not like elderly will be unknowing around sensors, as they are catching up quickly with the rest of the population (CBS, 2011). The reason for elderly to visit the washroom is purely functional and a necessity. In contrast to the office washroom, which is often used as a place to socialize and find some rest. The hotel is just in between. For guests it is a necessity, but are not in a hurry since they are on holiday. Hotels are different in terms of people using it. In here, a lot of different people visit the washroom. There is much less control over the preferences of these people. In the office building and retirement home, there is a limited amount of people using it; the employees and the inhabitants respectively. Besides this, an hotel is a high traffic location and need to facilitate a continuous flow of people coming in and out. This is much lower in an office building or retirement home.

3.4.8 Contexts information

To get a picture of the three chosen contexts, this chapter gives some general information regarding those contexts. What are the characteristics of the people visiting them and what are the priorities of the facility managers? Small descriptions of the environments that let them stand out from one another and focus points for those contexts. How are they likely to change in the future? This information is acquired by desk and observational research and interviews with experts.

3.4.9. Retirement home

The traffic in a retirement home washroom is low compared to that in a hotel or office building. But the visitors of those washrooms will take their time and might need some assistance with certain tasks. This makes these washrooms a lot different than those in a hotel or office building. Facility managers will look for dispensers that are user friendly and will not break down easily. But this does not mean that everything inside a retirement home is old-fashioned, robust and plain. Today's elderly are catching up with their younger counterparts. The number of seniors using the internet and related technological devices increases (Larsen, 2017).

However, in contrast to youngsters elderly get more joy out of little things. They are willing to learn new things, but only if it is for enjoyment or if it is useful. Especially in the washroom where they already have to take effort in certain tasks, they will not want very complex products with flashing images while their reflexes are not what they used to be. The washroom is a place for comfort and control and will remain this way. Only the level of complexity shifts. However, simplicity and calmness will always lead in the list of descriptions for a retirement home washroom.

Image retrieved from worldhealthdesign.com

3.4.10. Office

Mostly employees will visit the washroom in an office. They will be increasingly concerned with what is put up in the washroom, want to know why and be satisfied with it. This increases the affinity with the company, which in turn increases efficiency and thereby profits. Facility managers are also concerned with design, but sustainability comes increasingly into play as this becomes a focus point of more and more companies. And with the loan structure, price is pushed more to the background. However, when the design is not appealing, a nice circular story behind it does not matter.

The traffic in these washrooms lies in between that of a retirement home and a hotel. But apart from the core reason for a washroom's existence, the washroom in an office building is used also as a place to take a small break from work and to socialize. Especially with the rise in social media and the decrease in social interaction. But businesses are increasingly looking for ways to personalize their offices and increase the experience for the employee. The washroom can be a big part in that.

Image retrieved from copycamp.ca

3.4.11. Hotel

A hotel is considered as a high-traffic context. A lot of different people visit a hotel, having different backgrounds and values. This will only get higher with the rise in hotel bookings and immigrants and refugees. Most visitors are specifically looking for a comfortable and effortless experience; something they miss in everyday life. The facility managers are looking for a washroom interior that fits the hotel atmosphere. Their priorities are design, user friendliness and price. Aspects like sustainability are only considered if it fits the hotel image.

The experience that visitors have is very important, as annoyances are things they are just escaping from during their holiday. So everything in the hotel should be on the level that visitors are expecting, determined by the price they pay. Favourably this level of comfort and effortless should be a little higher to have a positive review and returning guests. For a washroom this means cleanliness and authenticity. The future washroom of a hotel is therefore general equipped to facilitate all sorts of people and designed for high traffic situations, in which visitors get a comfortable and hygienic experience at least par with what is expected from the hotel.

Image retrieved from zoover.com

3.4.12. Conclusions

This chapter was about the future contexts. Because it is more sustainable to design for multiple contexts, the CVD approach was used. Three contexts were chosen based on the power of three: an office, retirement home, and a hotel which are influenced by the researched trends and developments the most. These contexts are described as how they will change in the future. It can be concluded that the integration of CVD in this project is both wise and suitable. The chosen contexts will change in the period that is set within the domain. So the contribution of a new dispenser range will be valued here the most. But hygiene and comfort will always be at the top of the priorities in washrooms, which is why the domain is very suitable. With the domain set at a hygienic and comfortable washroom experience in 2035, it is now time to look at the future human-product interaction and the mission statement or design goal that is wanted. This will be discussed in the next chapter.

4. The future interaction

The design of the future interaction will be done by constructing a framework that adequately describes the thinking about others' behaviour found in the future contexts. This framework will be constructed, using product qualities, features, and attributes, which are derived from interviews with the more important stakeholders. To come to these product qualities interviews are conducted according to a stipulation of the Zaltman Metaphor Elicitation Technique. From there, the desired interaction is given shape so that product qualities can be formed. These product qualities will be used as a basis for the new product design phase and will ultimately be requirements to evaluate this new product on.

4.1. | Mission statement

The mission statement is derived from the cluster matrix. A combination of intimacy and hygiene focus. This lead to a more global conception, namely: “Thinking about your direct context”. However, VIP is about people, so that is why the final mission statement will be the following:

“..., I want people to actively think about others in their direct environment.”

This statement has a direct connection to individual trends, such as the growing population, smaller households, flex working spaces, and the growth in hotel and AirBnB bookings. So when people think more about the people in their direct surroundings, this will have a positive effect on the overall hygiene without people having the idea that they are raising or educating strangers. These individual trends cause people to have more physical contact with strangers. Additionally, other trends (Appendix X) result in people to live in their own bubble and expect that things are taken care of. This raises the risk of a lack of hygiene and the spread of bacteria. I want to counteract this by stimulating people to think about others. Even though it is only for such a limited time in the washroom.

This will not come easy when even Ignaz Semmelweis could not get medical staff to change their behaviour in a sustainable manner (W.H.O., 2009). But with smart product innovation and interaction-driven design, this might be possible. And it does not need to be as big that people advise strangers. Researchers studying connectedness on social networks have proposed that you only need three other people to get acquainted to anyone else on the planet (Leber, 2013). So spreading knowledge and behaviour is only a small step.

“I want people to actively think about others in their direct environment”

“Like reminding someone of an appointment”

4.1.1. Analogy

An analogy helps to understand what is meant by the mission statement. It creates an image of the behaviour that is expected from the product or service that will be designed, so people can position themselves in this behaviour. It also helps to explain the intentions of the design.

“Like reminding someone of an appointment.”

This analogy is the manifestation of a small gesture that people will remember. It is not that small that people will forget it instantly, but not at all as big that payment is in place. The design of the future product or service must resemble this analogy.

4.1.2. Conclusions

From the cluster matrix, which was derived from the context factor clusters, the mission statement was extracted. So the dispensers should encourage people to actively think about others in their direct context. This context will be either a washroom in a hotel, an office, or retirement home situated in the Netherlands, as these create the largest diversity or contrast and are influenced by upcoming trends and developments the most. So now that the future interaction and context are defined, the product design assignment can be formulated in more detail.

4.1.3. Product design assignment

Usually, a problem definition is built around a particular context. But as said, CVD circles around the believe that real solutions are applicable for more than one context. This means that the context is only defined up to a conceptual level. There are also constraints defined earlier in the process. These constraints contain for instance the sustainability focus of Van Houtum and the demand for a cradle-to-cradle dispenser range for in the future. This also includes the 300km limit for the sale of dispensers. Together with the mission statement as the main goal of this assignment, the right problem definition of this project is the following: *“An innovative and future proof dispenser range that fits a sustainable cradle-to-cradle business model for Western societies that lets people actively think about others in their direct environment.”*

4.2 | Interviews

The four stakeholders that will be interviewed (visitors, cleaning staff, business owners, and wholesalers) are influenced the most when new dispensers are introduced and will therefore also have most insights into the current problems and annoyances of these products. Interviewing them is a direct way to get quality insights into the qualities, features, and attributes that those people want from a washroom dispenser. Therefore, questions are asked regarding comfortable and annoying experiences with these products and a specially designed approach is used to discover the wanted features and attributes and achieve theoretical saturation.

Figure 17: photo of a selection of metaphors used in the interviews

4.2.1. How

The interviews were performed as qualitative research. This was not only because of the limited time available, or the needed access to more than 20 business owners, but also because qualitative data is to explore the range of opinion and diversity of views (Patel, 2015). And it is expected that after 3 to 6 respondents, a theoretical saturation of data is reached (Seale, 1999). For qualitative research to be credible, certain criteria should be met (Tay, 2014). According to Frambach, Van der Vleuten, and Durning (2013), these are credibility, transferability, dependability, and confirmability. Credibility is achieved by interviewing experts with more than 5 years experience in their field. The transferability, or applicability, is in order because it is wanted to explore the range of opinion and diversity of views. But in order to account for this small amount of respondents and achieve dependability, or consistency, a stipulation of ZMET (Zaltman Metaphor Elicitation Technique) is introduced.

4.2.2. ZMET

ZMET is a method used to get insight into the unconscious thinking that drives the behaviour of people (Zaltman & Zaltman, 2008). The original approach is to give people a camera with which they capture images that they think are recognizable for a product or brand (product knowledge structures). These images are metaphors for what people mean by them. After collecting these images and an extended interview, the researcher can transfer the images into data. This ZMET data can then be mapped in different ways to give greater insight into consumers' product knowledge structures. But for this research, this precise approach was too extensive. However, Zaltman proved that with this method not a large number of respondents is needed to get valid outcomes. This was a reason to apply this method in a stipulated version. The use of metaphors is kept, because their strength lies in the large amounts of information and ideas that can be captured and conveyed (Hill & Levenhagen, 1995). So for this research, respondents were presented with various images that function as metaphors. These images were there for the respondents to explain why they think a type of dispenser is fitting for a given context. These metaphors are ideal to represent product attributes (Seidel & O'Mahony, 2014).

A disadvantage of the ZMET is that most respondents are not as familiar with describing product features and attributes, resulting in a lot of the same words that are used to describe different things, making it the interviewers responsibility to ask further and risk irritation from the respondent and/or give his own interpretation of what is meant. An option to prevent the wrong interpretation is to ask exactly what the respondent means by his words, but this can again result in irritation from the respondent as he has the feeling that he is clear.

Another obstacle with the ZMET is the time consuming aspect. Per attribute it can take some time to get a solid description where the interviewer does not need to make is own assumptions of what is meant. So when multiple attributes need to be assessed, along with introducing the respondent to the method, the respondent has to seriously plan the interview in his schedule. This is not possible for everyone.

4.2.3. Contexts

For this research, the Context Variation by Design method is implemented by presenting the respondents the three chosen contexts. Also these are represented by images to give the respondent a feeling for it. There was the option of letting respondents choose their own context, but this would possibly result in a lot of very different contexts, not reaching theoretical saturation. There are no records available online that give an example of a combination of ZMET with CVD. It can therefore be assumed that this combination is made for the very first time.

4.2.4. The metaphors

As said, the respondents are presented with images that represent metaphors for certain product attributes. The amount of metaphors is set to 34 (Figure 18). There is no literature that defines this number. Instead, this number is acquired manually using 4 test respondents. Each of which was presented with an increasing number of images. They had to say stop whenever they thought that the amount was getting too big to be able to take each image into account. By asking the same questions and using the same images for contexts and metaphors, consistency is achieved. By asking what features the dispenser should have and why, product knowledge structures can be obtained by the terms that respondents use.

ZMET original

Step #1
The participant is given a camera, to capture a set of pictures that represent his thoughs and feelings about a specified topic.

Step #2
These images manifest themselves in surface metaphors that the researcher needs to uncover during a 2 hour interview.

Step #3
The researcher groups the found metaphors.

Step #4
The metaphors point to the deeper frames and structures a person is using to understand a topic. A consensus map helps to uncover these.

Step #5
By knowing how people react to certain images/metaphors, the right communication can take place. For instance in commercials.

ZMET stipulation

Step #1
The researcher defines what features and character traits can be applicable to his to be designed product/service.

Step #2
The researcher defines contexts in which he wants the to be designed product should perform.

Step #3
The participant is presented with the chosen contexts and a set of pictures, that represent these features or character traits.

Step #4
The researcher builds consensus maps based on the chosen metaphors, the opinion behind it, and the reason for that opinion.

Step #5
By combining the consensus maps, the most important attributes a product needs to have can be found.

Figure 18: original ZMET method compared to the stipulation

4.2.5. Results

A lot of the respondents used overlapping words compared to other respondents to describe what features the dispensers should have. In order to draw conclusions, these words are put together so the terminology list becomes shorter and preferences towards features and attributes can be seen. This way, reactions become more general and the last criteria for qualitative research (confirmability) is met. These results are put in consensus maps (Figure 19), which show the knowledge structures and represent most of the thinking by most people, most of the time. These consensus maps show the different levels of analysis; the metaphors are on a meta level, the features on macro level, and the attributes on micro level. In the appendices (Appendix E and F), all results can be seen. Because the metaphors are also used to get an image of what respondents mean by the descriptions they give, one particular figure (Figure 19) is important. This is also the best map to base the future design on as the chance that this will differ with an increasing amount of participants is the least likely. By looking at the most used combinations of metaphor – feature - attributes, the first steps towards the future vision can be taken.

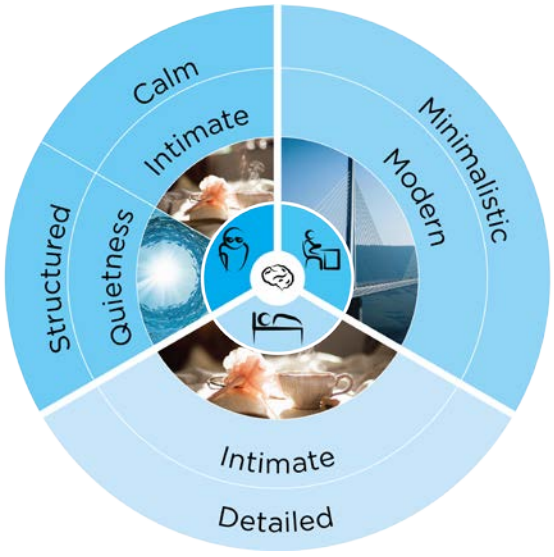


Figure 19: the overall consensus map resulted from the interviews

4.2.6. Sensitivity analysis

In a sensitivity analysis, the results are projected when just one variable is changed in order to test the sensitivity of the overall results. In this project, this is done by adding another respondent. By generating another consensus map, the results can easily be checked. Looking at the changes this extra respondent makes to the results (Figure 20), in can be seen that the conclusions remain the same. This extra respondent only has an influence over the visitor's part of the results and overall results for most used attributes. However, all changes are on such a level that the top three used metaphors, features or attributes does not change in content but only on an orderly level. So in terms of attributes, the original order was structured (19), minimalistic (19), contrast (11), clear (11), and continuous (10). In the new results, continuous gets a value of 11, but other terms also increase in value. Structured becomes a clear number 1 with a value of 20, minimalistic comes in second with an unchanged value of 19, contrast becomes number 3 (value of 13), and clear becomes number 4 with a value of 12. Therefore, it is safe to say that the sensitivity of the results to an extra respondent is low and conclusions can remain the same.

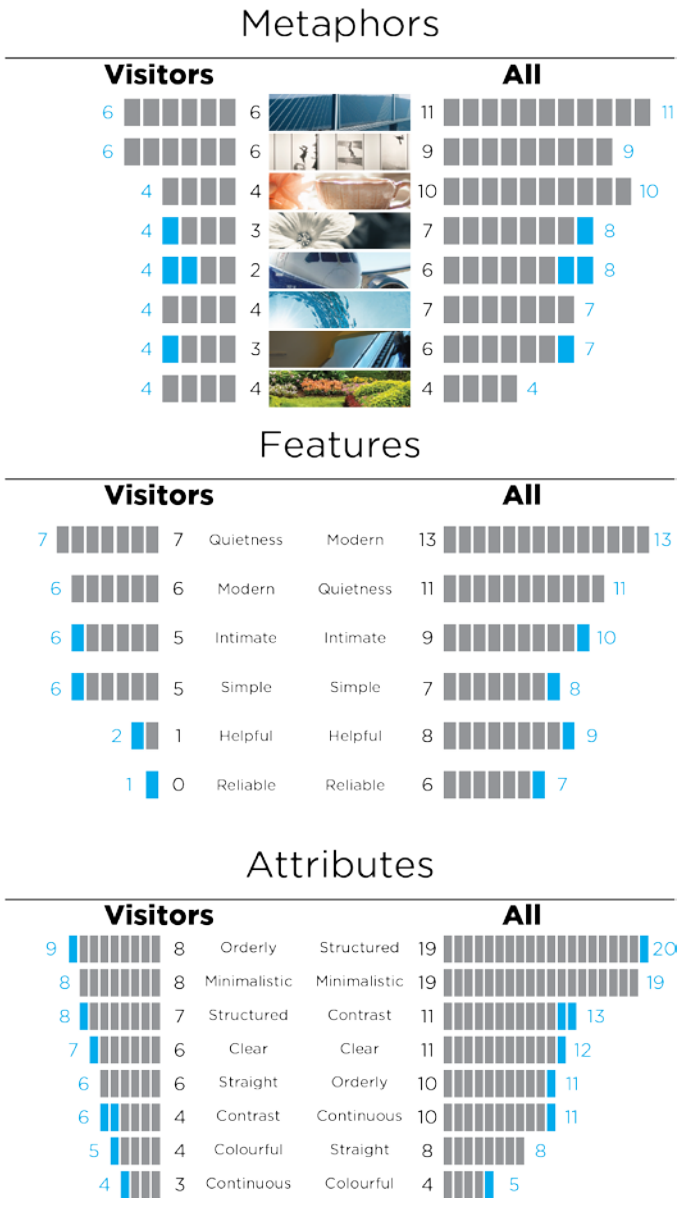


Figure 20: visual results from the sensitivity analysis

4.2.7. Conclusions

Next to the metaphors, questions were asked regarding comforts and annoyances inside the washroom. One general conclusion that can be drawn, is the principle that people want to avoid touching anything. Regardless whether anti-bacterial material is used. This principle is most important in the preference towards paper towels or jet air blowers. It is not so much about the dispenser for paper towels, as it is for the accompanying bin that often needs to be touched to dispose the towel. In terms of hygiene and ease of use, paper towels mostly win, even though jet air blowers require less actions from the visitor.

When it comes to appearance, the jet air blower always wins. It looks more modern and neat, and because it brings a new experience. So a good, modern redesign should increase the popularity towards paper towels.

For end customers and wholesalers, sustainability, design and price are mostly on top of their priorities when choosing a new washroom interior. In here, also the battle is between paper towels and jet air blowers, as the latter are better in terms of design and price. But for hygiene and sustainability, paper towels are preferred. It is in both cases important that users know why these dispensers are chosen. A better and quicker hygiene, more careful use, and a better connection to the company are the result.

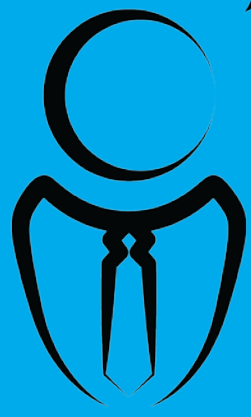
The story behind the dispensers is a very good sales argument. This story can be seen in the keys that are moulded along with the housing. Sustainability can also be applied better for the packaging, as a lot of cardboard is used. Especially in large deliveries.

The metaphors, features, and attributes in the resulting consensus map are wanted by most people, most of the time. So it can be concluded that the future dispenser range should be minimalistic, detailed, structured, and calm in order to have a modern, intimate, and quiet appearance. This can be achieved by design aesthetics that mimic the feeling and appearance of the accompanying metaphoric images.

I want a good view over the amount of toilet paper. It doesn't matter if there is a paper towel dispenser or a jet air blower, as long as I can dry my hands properly. Sufficient amount of paper is for me the ultimate demand when paper towels are offered.
In terms of hygiene, the paper towel dispenser has my preference, but it always looks so dull. If the design was a little more exciting...
The bin is a disadvantage of working with paper towels. It look not hygienic and is often misused.

I quickly want to know the amount of paper and if this needs to be replenished.
Opening the dispensers should be done easy and quickly and refilling shouldn't need to have difficult actions required.
The larger the surfaces the better and less split lines are also good.
The soap dispenser preferably have a sensor. When this is not the case, the handle should be cleaned easily.

It depends what my priorities are if I choose for paper towels or a jet air blower. For hygiene and sustainability, paper towels by Van Houtum are key. For looks, the jet air blower definitely comes first. The personnel needs to know why these dispensers are chosen. Paper towels give a cleaner feeling, but the jet air looks better.
Sensors are often good, but they need to fit within the sustainable focus of Van Houtum and Satino Black



Companies are looking for design and ambiance. Personalizing can achieve this. It can also serve as a means to commuincate the sustainable aspect of Satino Black towards visitors and personnel.
The sustainable story of Satino Black is a winner, as long as the dispensers are nice to look at.
For the installers are all those individual packages a hassle when installing large numbers of dispensers. Locking the dispensers should be done using the same key in an easy and consistent manner.

Figure 21: stakeholder design criteria

4.3. | Interaction design

The interaction design, or desired behaviour, is dependent on the mission statement and the future contexts. This behaviour comes with a desired human-product interaction. In this chapter, this interaction will be further defined by translating the mission statement into product qualities, which will be used as an evaluation tool to determine which ideas will have the best future.

4.3.1. Desired interaction

But what is the desired interaction? Off course, people should think about others in their direct context, but this is very general. It should be translated for the future washroom. One aspect of this desired interaction is that people should want to leave the washroom in a clean state, so the next person also has a hygienic and comfortable experience. That is what they also want themselves. A clean washroom is the most important criteria for both end customers and visitors. This is an important notion, as the dispenser range is the key player for this to happen. The product qualities define this interaction further.

4.3.2. Product qualities

The product qualities are based upon the mission statement. But how can a product let an individual think actively about its direct context? For this to happen, the product needs to have certain qualities that express or provoke that desired interaction. So the real question would be: what qualities should the dispenser range have to facilitate the desired human-product interaction? What should the dispenser range have that encourage people to think about others?
This is where the domain comes into play. The dispenser range should fit inside and facilitate a hygienic and comfortable washroom experience. To determine this, sub questions are asked. What aspects are influencing hygiene or the feeling of hygiene? When is something considered as hygienic? How can a dispenser be experienced as comfortable? In the process of answering these questions, the qualities started to get shape. These questions are rewritten as product qualities that stand below:

The dispenser range should be...
...inviting cleanliness: people should want to use the dispensers so a cleaner washroom is achieved.
...ever inspiring: an inspiring appearance brings up the very best in people, and increases the chance of social responsibility
...unconventionally provocative: when something is unconventional, people want to interact with it. Also end customers will notice something unconventional sooner.
...socially stimulating: by activating people into a social action like a conversation, people automatically become more social and will keep others in mind.

These qualities will be used as a tool to evaluate the ideas that have the best future in becoming a concept. But these are not the only criteria to evaluate the ideas. From the interviews an extra criteria is determined: the intervision.

4.3.3. Intervision

Running through all the interviews again, in combination with the domain and mission statement, led to a general description of what the dispenser range should accomplish. Namely, the dispenser range should look minimalistic, structured, and modern, and bring a new, hygienic, and sustainable experience with it. This is called the intervision. It is a general description of what other people have in mind when they think about others in the context of a hygienic and comfortable washroom experience. It is the washroom-description for when people will remind someone of an appointment.
This vision accounts mainly for the end customer. As interaction deconstruction showed, this is the most important stakeholder to design for. So the dispenser should brign a new, hygienic, and sustainable experience with it.

5. The new product

In this section, the final design will be presented. It shows the vision and the implementation of the work that has been presented in the previous sections. This has been done by first looking at alternative materials, as this can influence the whole production process and the design possibilities. The next step was to develop the next dispenser. This lead to a folding mechanism idea. So this was worked out in Solidworks. After the folding mechanism was developed in its primary form, the aesthetics were developed with the use of moodboards. After the material, the shape and measurements were confirmed, the Solidworks model was finalized and optimized for assembly, hygiene, and sustainability. Finally, the business model behind the wrapping of dispensers was worked out. As a bonus, a website configurator was suggested as a means for the client to personalize the dispensers with live feedback. The final result of this new product design phase can be found at the end of this section, on page 74.

5.1. | Material choice

Currently, Van Houtum as well as other dispenser manufacturers make use of ABS as the main material for their dispensers. It has a couple of interesting strengths that make this material attractive for this application. It facilitates flexible design, while keeping dimensional stability. ABS has excellent surface quality, good colour control, and an attractive feel and touch, which is desirable when you want people to have a comfortable interaction. But maybe the most important properties are the chemical and impact resistance. As these products are used and cleaned frequently, reliability is highly valued. On top of that, recycling is economically attractive, and when blended with virgin ABS, a high quality standard can be preserved. However, ABS is made from oil; a not so sustainable way. Which is the main reason to look for an alternative material. Also, researching alternative materials can open up new opportunities. However, the alternative should have a large upper hand as changes in the production process are very costly. An alternative material also influences the design possibilities, which is the reason why this new product section starts with material research.

5.1.1. Negative aspects ABS

Next to the oil based factor, ABS is also sensitive to humidity during the production process. However, this can be dismissed, since current production is controlled perfectly. The second, is the effect UV has on the material. When ABS is exposed to UV rays, the appearance deteriorates due to micro crack deformation. But since there isn't direct sunlight in washrooms, dispensers are save from UV rays (Dworshak, 2008). The main reason to look for an alternative material, is that ABS is made from oil. This is not at all environmentally friendly.

5.1.2. Approach

First, a selection of materials families is determined, to evaluate a large number of alternatives. Biodegradable, thermoplastics, engineering plastics, metals, woods and wood-like materials, ceramics, and future materials. For each of these families there are general rules that apply. The next step was to determine if any of these families could contain specific materials that perform better than ABS for dispenser application. Most of these families could be dismissed after this step. Only a special section in woods (hardwoods), the future materials, wood-like materials and engineering plastics were considered more in depth as a next step. The final step was only for the engineering plastics, as these come very close to ABS. For comparison and practical reasons, the unfilled, general purpose, injection moulding versions are selected in CES at level 3.

Figure 23 shows if they perform better or worse than ABS with ABS set as the average. Meaning that the emptier the graph, the worse the material performs. These scores are divided in five sections, each representing a range in which the material deviates from ABS. It is important to know that the density is less attractive only in relation to the price. When the density is higher, the dispenser becomes heavier and thereby more expensive. Without a direct increase in price/kg. Figure 22 shows the basis for the scores.

Both thermoplastics and biodegradable plastics are unattractive for recycling, which is one of the core values of Van Houtum. Few metals can withstand the humid conditions in washrooms, and the metals than can cope with these conditions are way too expensive. Furthermore, wood and wood-like materials have been considered. Where bamboo looked promising. But like all other woods, this requires a lot of post-processing operations, making it expensive and thus unattractive. Completely other materials and materials that will be available in the future are also compared. But these are also not as good as ABS for dispenser application.

5.1.3. Conclusion

Although there are a couple of materials that come close to ABS, none are actually better for dispenser application or worth the investments of changing the production process. They are either too expensive, have bad sustainability properties, or need too much post-processing steps. So the best option is to remain with ABS as the main material and focus on other aspects to improve. This is not too bad, as Van Houtum can remain with their current suppliers and storytelling with clear advantages compared to competitors.

Sticking with ABS also results in the satisfaction of a couple of requirements, regarding environment. It can withstand sanitary solutions, an average humidity of 70% (and peaks of 95%) and according temperatures.

Property	Basis
Mechanical	Young's modulus
	Yield strength
	Tensile strength
	Elongation
	Compressive mod.
	Compressive strength
	Fatigue strength
Impact	Fracture toughness
Processing	Injection moulding suitability
Durability	(salt) water resistance
	Weak acids (cleaning agents)
Sustainability	Ability to recycle
	Embodied energy (new)
	Embodied energy (recycled)
	CO2 footprint (new)
	CO2 footprint (recycled)
	Water usage during production

Figure 22: evaluation properties of engineering plastics

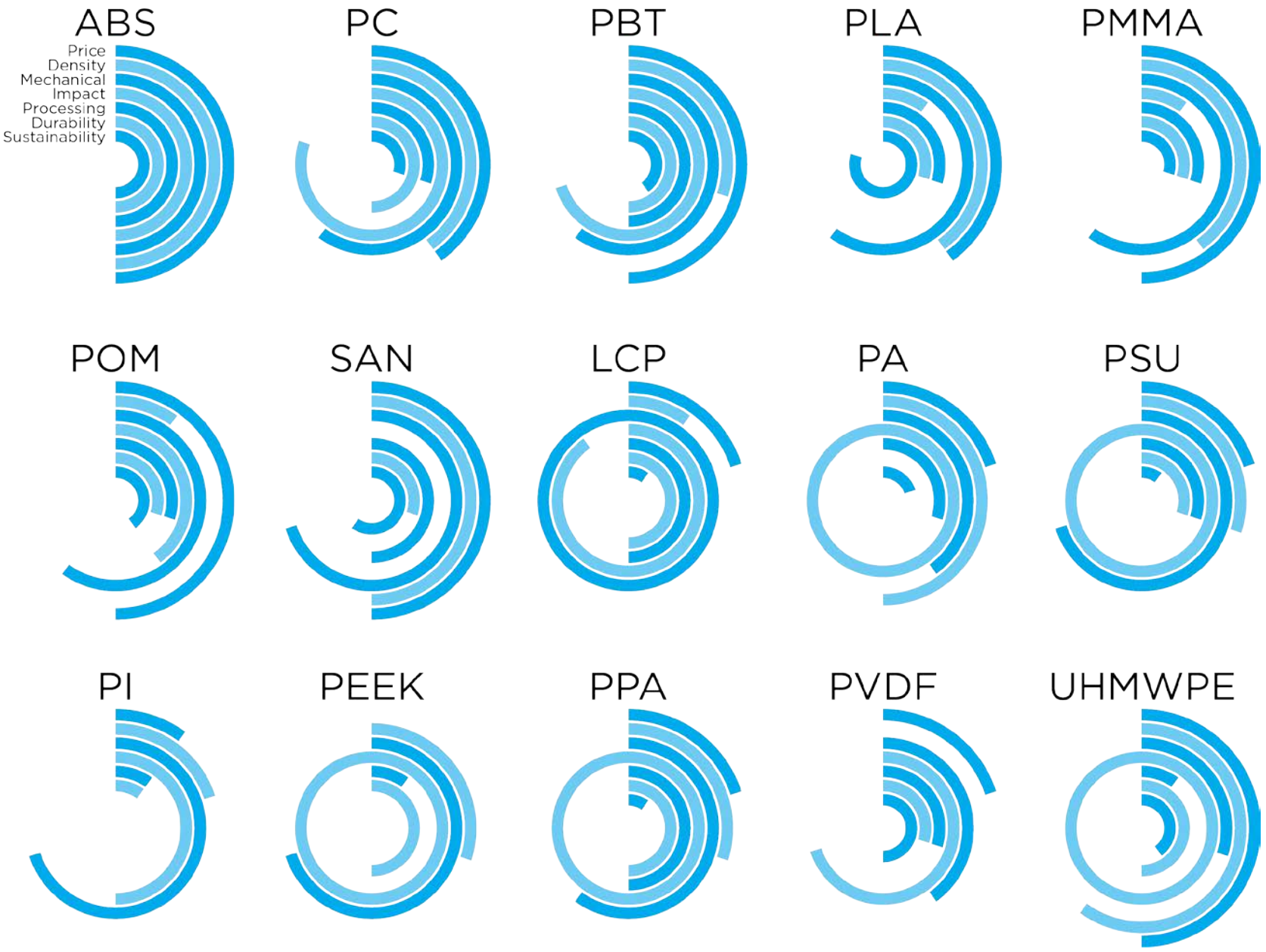


Figure 23: ABS compared to other engineering plastics according to CES 2017 data

5.2. | Which dispenser to focus on?

For practical reasons one single dispenser is focused on in this chapter. This dispenser is selected out of the 5 dispensers from the loan structure, where the focus was on up to this point. But what dispenser to focus on? Van Houtum's core business lies in paper. It is therefore logical to focus on a dispenser that circles around paper. These are the towel and system roll dispenser, and the waste bin. The waste bin is a product that is bought, so Van Houtum does not have a large influence over the design. The system roll dispenser has more requirements than the towel dispenser. To have a more free ideation process, the towel dispenser is chosen as the dispenser to focus on. The context deconstruction also showed this was the most promising candidate to focus the new design on.
Along with this decision, it was also decided not to focus on improving the packaging. Some wholesalers indicated during the interviews that the packaging and their contents could use improvement. But because of time and the quality of work, this is left aside.

Figure 24: photo of the current Satino Black dispenser

5.3. | An unexpected twist

After the period of wild and out-of-the box ideas, more serious ideas were developed, focused on three different directions: hygiene, personalisation, and the interaction between user and dispenser. These directions were derived from the interviews, mission statement, and the first part of ideation. These ideas (Appendix X) appeared promising. They were assessed with regard to the product qualities, the intervision, and their usefulness for the client, using a Harris profile. But after a second consideration, they were not fit to be implemented in certain contexts or were not innovative enough.

But there was a twist. After looking back at the life cycle of the dispenser, it can be seen that there is a lot of transport. First from the manufacturer to Van Houtum, from there to the wholesalers, and after that to the end customer. When the dispenser has reached its end-of-life stage, the dispensers are transported back to Van Houtum and finally to the shredder. From a sustainability point of view, this is not wanted. Especially when most of it is air. It does not rime with a sustainable company like Van Houtum. This notion developed into an idea of foldable dispensers for transport. As this has enhances the storytelling of the dispensers, this idea was focused. Wrapping was still taken into account as this is a stand-alone idea.

5.3.1. An important decision

3D printing was also considered and looked promising at first. But this idea was dismissed careful consideration. The reasons for this are mentioned below.

- 3D printing is a slow process. Implementing it would have a negative impact on delivery times.
- Because it is a slow process, it is best to do it in-house. Outsourcing it will result in a significant increase in price. However, in-house production requires knowledge and time and the investments in 3D printers.
- The surface quality of 3D prints is not on the same level as injection moulded ABS, resulting in a product with two separate surface qualities and an unwanted aesthetic appearance.

The benefits of 3D printing do not outweigh these disadvantages. 3D printing is still not a production method for large quantities. Maybe in the future this might be the case.

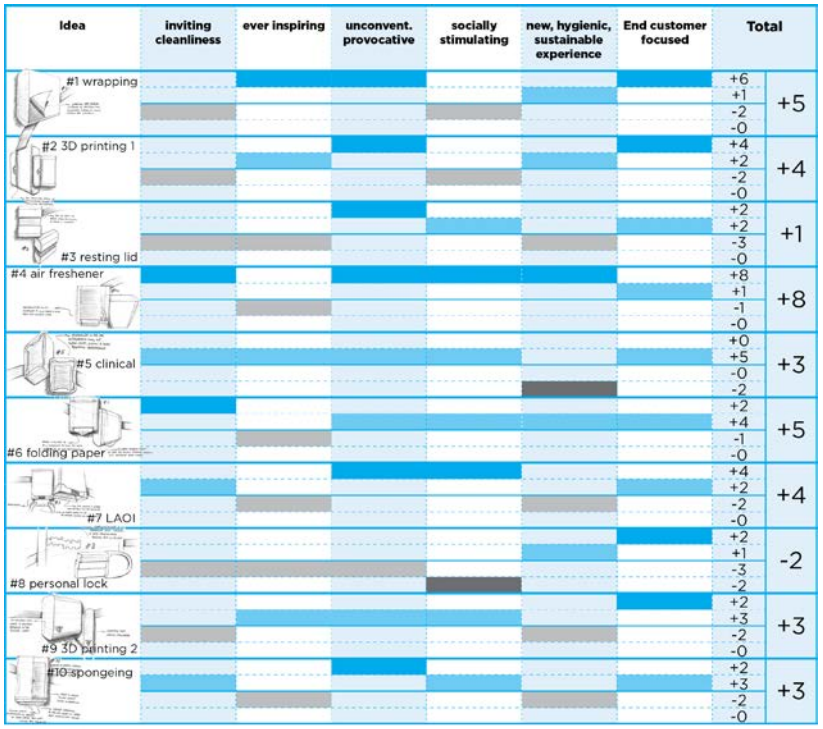


Figure 25: Harris profile of the first promising ideas

Image retrieved from guru.bafta.org

5.4. | No Sensors

But before the actual design is discussed, there has to be made something clear about including sensors in the dispensers. A lot of products are nowadays equipped with sensors and from the interviews, it would be logical to implement them in the dispensers. It would give cleaners and company owners a lot of information about the usage of the washroom and gives possibilities in optimizing cleaning frequencies. However, it is decided not to include sensors in the dispensers. Mainly out of sustainability perspective. An LCA was done according to Vogtländer's LCA data books (Vogtländer, 2011) (Vogtländer, 2012) in order to make this decision.

5.4.1. LCA

The scope of this LCA is to compare a dispenser with electronics and the same dispenser without electronics. The newly designed Satino Fold dispenser is used. The electronics that are discussed here should measure the amount of paper towels in the dispenser and transmitting this data to a server, so all cleaners can keep an eye on it. Elements that are needed: IR distance sensor, battery, and circuit board with integrated Wi-Fi transmitter (such as the Arduino Primo).

The next step is to establish the system, functional unit, and system boundary. The system is already described in the deconstruction phase in "the journey of the dispenser". In this journey, the amount of transport is shown. For the exact locations, Buma/Stemra is used as the client, and A&P as the wholesaler, located in Hoofddorp and Zwijndrecht respectively. The manufacturer is based in Idar-Oberstein (DE). When electronics are implemented, this adds extra transport as these are not manufactured at the same place as the dispensers. The life time is set to 5 years, following requirement 3a.
The functional unit is not taken into account as it is assumed that the amount of paper towels does not change by implementing electronics. Therefore, the amount of paper towels is not included in the LCA.
This is at the same time a system boundary. How the electronics are connected is not defined here, as this might influence the geometry of the dispenser in an unforeseeable way, resulting in vague outcomes. It is assumed that the electronics are made in Shenzhen, China (Selko, 2015) and are transported in a box of 150x150x150 mm.

Step 3 quantifies materials, use of energy, and other aspects in the system. Materials are interesting for their weight. As the complete model is modelled in SolidWorks, the weight can easily be determined. All data on materials are based on the Idematapp2017 excel sheet provided by the Delft University of Technology and data sheets provided with the separate parts by their manufacturer. Following, is an overview of the dispenser with electronics. After that, another LCA overview is given for a dispenser without electronics. Both are visualized in table 1 and table 2. In here, the new approach as described in "A practical guide for students, designers and business managers" (Vogtländer, 2012) is used, meaning that the recycling is put in the processing stage. This includes recycling of recycled ABS. It is called a mixed polymer, since recycling is done in combination with virgin material. This also means that there is no use phase or end-of-life phase for a dispenser without electronics.

Materials	**kg**	**Process step**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
ABS	0,99354	Production	Idematapp2017 recycling mixed polymer	0,399	0,3964		5,92	5,8818	
	0,99354	Injection moulding	Idematapp2017 injection moulding, production site	1,268	1,2598		17,48	17,3671	
						1,6562			23,2488
Transport	**m3**	**km**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Idar-O.-Swalmen	0,00601	287	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0467		0,41	0,7072	
Swalmen-Zwijndrecht	0,00601	151	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0246		0,41	0,3721	
Zwijndrecht-Hoofddorp	0,00601	82.5	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0134		0,41	0,2033	
						0,0848			1,2826
				Total CO_2		**1,7410**	**Total CED**		**24,5314**

Table 1: LCA for the Fold dispenser without electronics

Materials	**kg**	**Process step**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
ABS	0,99354	Production	Idematapp2017 recycling mixed polymer	0,399	0,3964		5,92	5,8818	
	0,99354	Injection moulding	Idematapp2017 injection moulding, production site	1,268	1,2598		17,48	17,3671	
Electronics	0,045		Idematapp2017 AA cell battery (Li-Ion)	0,18	0,0081		2,94	0,1323	
	0,02		Idematapp2017 PCB=Printed Circuit Board (incl. ICs)	339,7	6,794		4680,03	93,6006	
	0,0035		Idematapp2017 PCB=Printed Circuit Board (incl. ICs)*	339,7	1,1890		4680,03	16,3801	
						9,6473			133,3618
Transport	**m3**	**km**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Shenzhen-R'dam	0,003375	18901	Idematapp2017 Container ship (max w/ vol. Ratio 0,41ton/m3)	0,002	0,1276		0,02	1,2758	
R'dam-Idar-O.	0,003375	446	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,04079		0,41	0,6172	
Idar-O.-Swalmen	0,00601	287	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0467		0,41	0,7072	
Swalmen-Zwijndrecht	0,00601	151	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0246		0,41	0,3721	
Zwijndrecht-Hoofddorp	0,00601	82.5	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0134		0,41	0,2033	
						0,2531			3,1755
Use phase	**kg**	**energy (kWh)**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Electricity		6,6E-7**	Idematapp2017 Electricity Low Voltage, domestic use General	0,15	9,9E-8		2,13	1,4058E-6	
						9,9E-8			1,4058E-6
End of life	**kg**	**Process step**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Electronics	0,0685	Landfill***	Idematapp2017 landfill (inert waste, not biodegradable)	0	0		0	0	
						0			0
				Total CO_2		**9,9004**	**Total CED**		**136,5374**

Table 2: LCA for the Fold dispenser with electronics

*The IR distance sensor cannot be found in the Idematapp2017, so another PCB is added as the distance sensor also has a PCB in it.

**The electricity in the use phase is calculated for a Arduino Primo that checks the supply once every hour.

***Most electronics are made for landfill at their end-of-life stage. Only small percentages are subjected to any form of recycling (Goosey & Kellner, 2003)(Li, Zeng, Stevels, 2014)

5.4.2. Conslusion

As can be seen, the impact of implementing electronics in the dispenser is significant. The difference is 8kg of CO2 and 112MJ that is produced, or 5,5 times as much. And this is per dispenser. This means that, when consistency is applied, every dispenser should have an indication of its filling and when they need to be refilled or emptied. For a single, standard office washroom block, this means 24 dispensers, or 192kg CO2 and 2688MJ extra. This was the main reason to not equip every dispenser with electronics.

The other reason is the frustration when they do not function correctly. The frustration when the sensor of a faucet does not work for washing your hands is something to be avoided. It can also happen that the sensor is dirty and is under the impression that there is a hand in front of it. This would result in a lot of waste.

An option would be to include a sensor at the entrance of the washroom that counts visitors. It is known how much toilet paper, how much soap, and how much hand towels are used for every toilet visit. By extrapolating these data, a predictive model can be build that shows when a washroom needs to be cleaned and dispensers need to be refilled. This only asks for one sensor instead of 24 for an average office building washroom. Field research showed that this is a washroom with 3 toilets and 2 sinks. So per block of one men's and one women's washroom requires 4 towel, 6 soap, and 6 toilet paper dispenser, 6 air fresheners, and 2 bins of 43L.

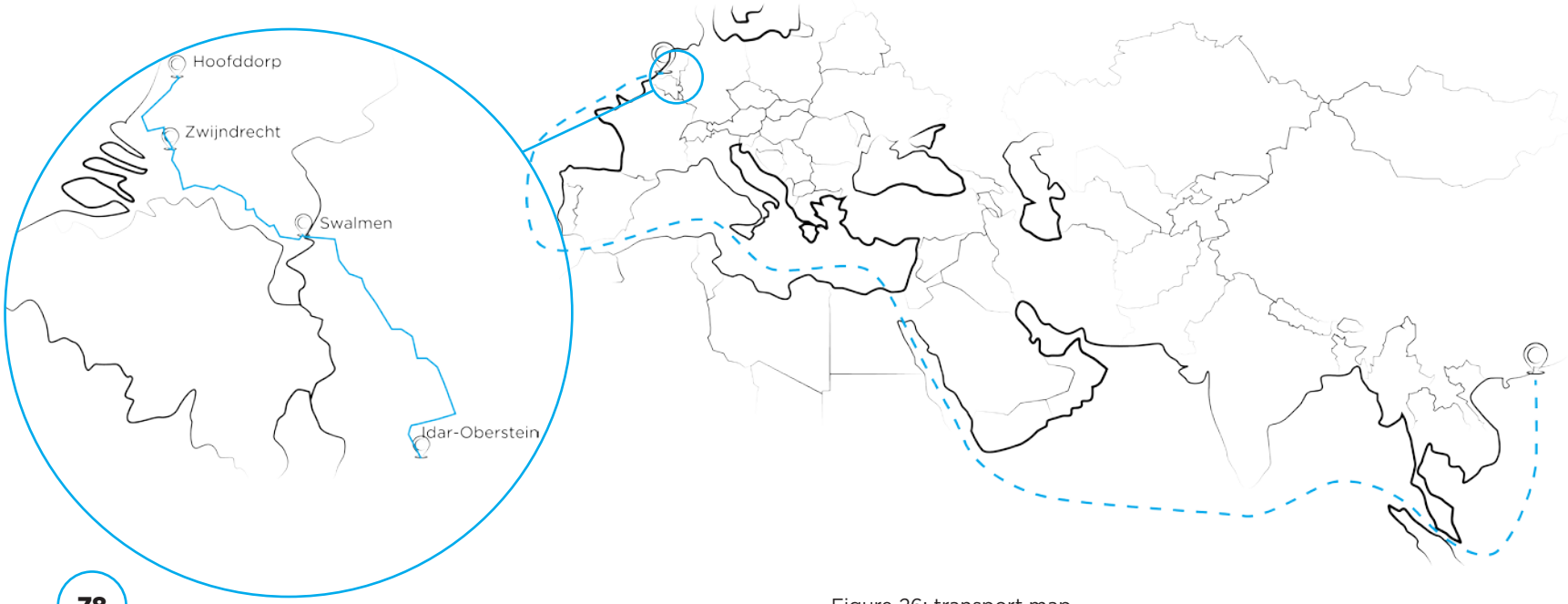


Figure 26: transport map

5.5. | The folding mechanism

The story behind Satino Black dispensers is important as this defines the difference with competitors. But competitors are increasing their sustainable behaviour as well, resulting in a decrease in this difference. To counteract this, the transport within the story is enlightened. As said there is a lot of transport going on in the life of a dispenser and companies, including Van Houtum, have a social responsibility to minimize this and reduce emissions. There are two ways of looking at the ecological burden of road transport: the load's volume of a truck, or its weight. For a truck full of dispensers, it is the volume that determines the burden. Therefore, a folding mechanism has been thought of in order to reduce the volume during transport.

5.5.1. Differences open and folded volume

The hand towel dispenser needs to be able to dispense hand towels of 250 x 114 (207 x 228 in a C-fold position). Therefore, the dispenser has maximum measurements of 273 x 333 x 131 (w x h x d, [mm]). The folding happens in the z-direction, as the x or y-direction would result in split lines across the front surface. Therefore, the minimum measurements are 273 x 333 x 45mm in folded position (Figure 27). With these data, it can be calculated what is saved in transport in ecological burden. Transport also includes the packaging, which adds another 15mm in each direction, resulting in 288 x 348 x 60 mm as final volume. As a comparison, the current dispenser box is used, measuring 295 x 455 x 155 mm. This is also influenced by the changed geometry, so the unfolded dispenser box is also taken into account, measuring 288 x 348 x 146 mm.

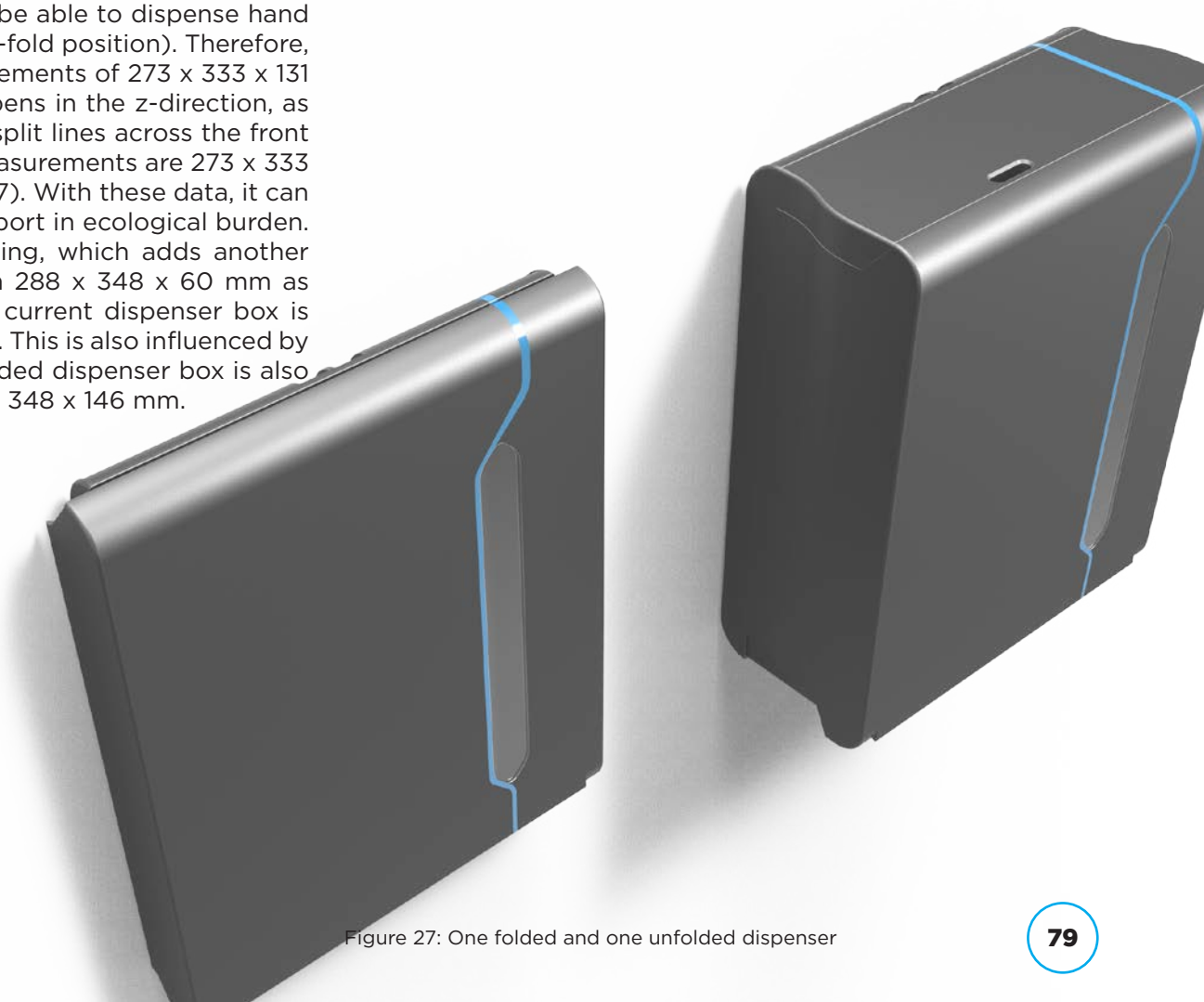


Figure 27: One folded and one unfolded dispenser

5.5.2. Calculations savings

The book "A quick reference guide to LCA data and eco-based materials selection" (Vogtländer, 2011) and Idematapp2017 excel sheet are used to make the following calculations about eco-costs, carbon footprint and CED. The eco-costs are based on a truck+trailer 24 tons net, max. weight/volume = 0,32 ton/m^3 (m^3.km). One trailer is 13,8m long with a volume of 104,04m^3 (Wisnicki & Galor, 2010). On the right are the data for this situation which are paid per cubic metre:

Eco-costs: 0,0096 EUR
Carbon footprint: 0,0271 kg CO_2
CED (Cumulative Energy Demand): 0,41 MJ

Figure 29Data of a truck+trailer 24 tons net, max. weight/vol = 0,32 ton/m^3

Comparison	Current	Folded	Unfolded
Width	0,2950	0,2880	0,2880
Height	0,4550	0,3480	0,3480
Depth	0,1550	0,0600	0,1460
Volume	0,0208	0,0060	0,0146
Trailer volume	104,04	104,04	104,04
Amount/trailer	5001	17301	7110
Dispenser/m^3	48	166	68
Payment/dispenser			
Eco-costs	1,9975E-4	5,7729E-5	1,4047E-4
Carbon footprint	5,6381E-4	1,6296E-4	3,9655E-4
CED	8,5300E-3	2,4655E-3	5,9994E-3
Gain/dispenser (cf. current)			
Eco-costs		1,4200E-4	| 346%
Carbon footprint		4,0085E-4	| 346%
CED		6,0645E-3	| 346%
Gain/dispenser (cf. unfolded)			
Eco-costs		8,2745E-5	| 243%
Carbon footprint		2,3358E-4	| 243%
CED		3,5339E-3	| 243%

Figure 28: Overviews transport savings for folded compared to current and unfolded dispenser

5.5.3. Costs for transport

In this chapter only an impression of the transport costs is made using the amount of dispenser per pallet. Based on the current and the BriQ towel dispenser, this can be estimated for the Fold. A ratio can be found using the amount of dispensers pet pallet and its volume of 1.55 (volume*amount). So by dividing 1,55 by 0,00601 results in 257 dispensers/pallet. Compared to 75/pallet for the current dispenser, results in an increase of 343%. It is assumed that this means a significant decrease in transport costs.

5.5.4. Conclusion

In terms of percentages, the gain can be considered as significant. However, the actual gain is not of such magnitude that this makes an ecological difference. Especially since dispensers are only transported once every 3 years at the most. It is purely part of the storytelling as a push towards even more sustainable dispensers. But it is assumed that the transport costs can decrease significantly, as the amount of dispensers per pallet is increased by almost 3,5 times.

5.6. | Workings

But a folding mechanism can have all sorts of layouts, as a small ideation step indicated (Figure 30). A shopping crate is easily thought of, but this requires a lot of parts. Two requirements determined the choice for mechanism: (1) it should consist of as little parts as possible, and (2) the front surface may not be broken into parts as this influences aesthetics negatively. The amount of parts has not just an economical motivation, but more parts also result in more parting lines, which has a bad influence over hygiene. The chosen mechanism required the least amount of parts and has little influence on surface quality.

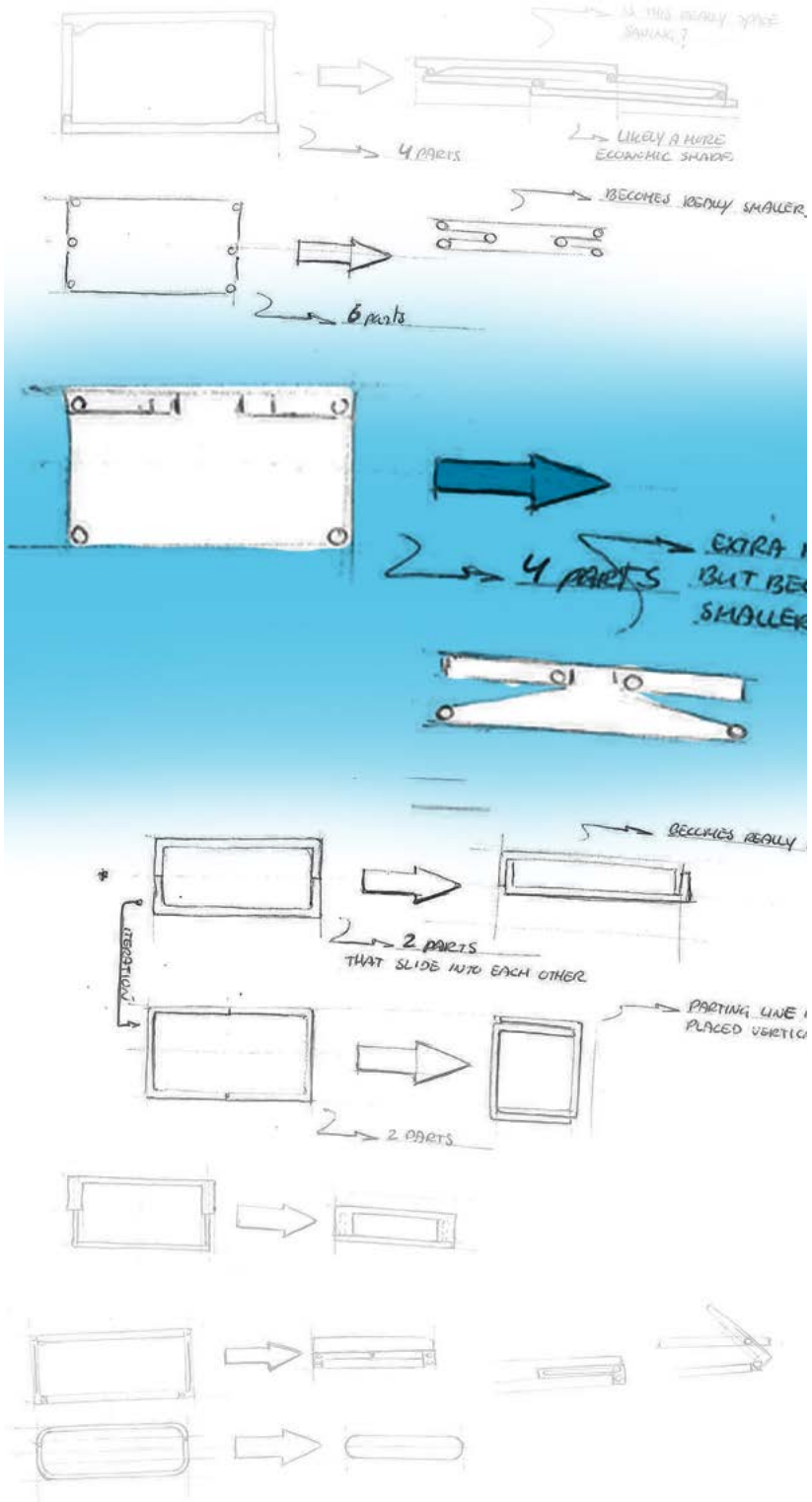


Figure 30: Folding mechanisms ideation

Figure 31 gives a step-by-step visual of how the folding mechanism works. Once this mechanism was chosen, the main requirement described that the side panels should be in the same plane direction as the front and back plate, so the package would be as small as possible. As a result, the front pins are not in the same plane as the back pins, resulting in a width difference between the front and back plate. The main principle, is the use of two pins (back pins) that rotate in slots in the back plate and two pins (front pins) that slide in rails in the front plate, and thereby automatically push the front plate forward or pull it backward.

In folded position, the front pins are in the middle and encased by the sliders from three sides. To unfold, the side panels rotate around the back pins and slide to the outside in the rails. Both the rails and the pins have dimensions that can hold forces related to dispenser installers unfolding it roughly. These forces are set on 50N, which is a lot since the dispenser weighs not even 1kg. These forces result in 1,871mm of displacement and stresses of 12,94MPa (figure 39). This displacement is okay, as long as it bends back. This amount of stress lies well under ABS' maximum Yield stress of 49,6MPa and tensile strength is 51,7MPa. So no break or plastic deformation occurs, and thereby also the displacement is approved. Under normal circumstances, the pin and rails slide smoothly, so hardly any force occurs.

When completely unfolded, the side panels coincide with the back and front plate so the sides are aligned and only small split lines exist.

During turning, the slots of the bottom pins slide into pins at the side of the front plate. This connection allows the front plate to rotate and thereby facilitates opening and refilling.

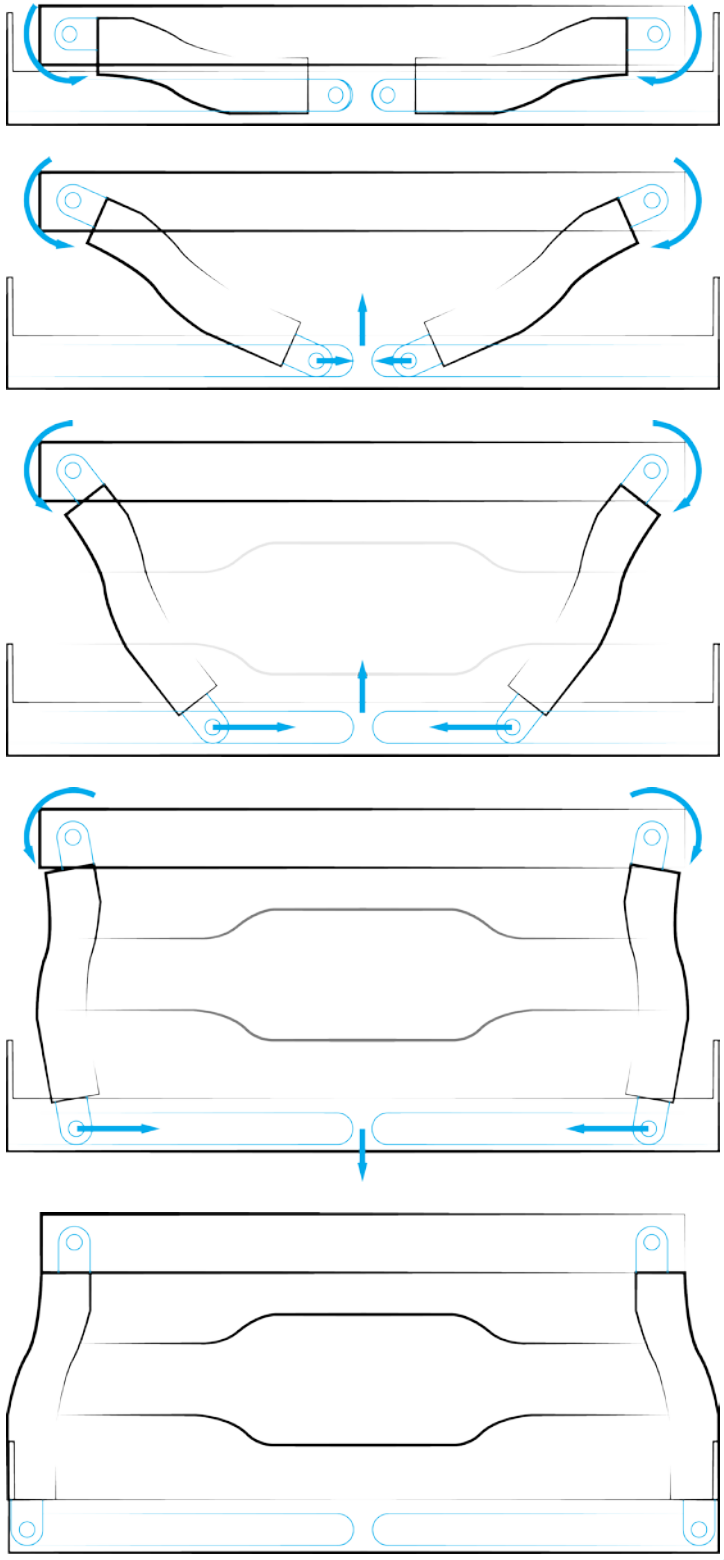


Figure 31: step-by-step workings of the folding mechanism

5.7. | Parts

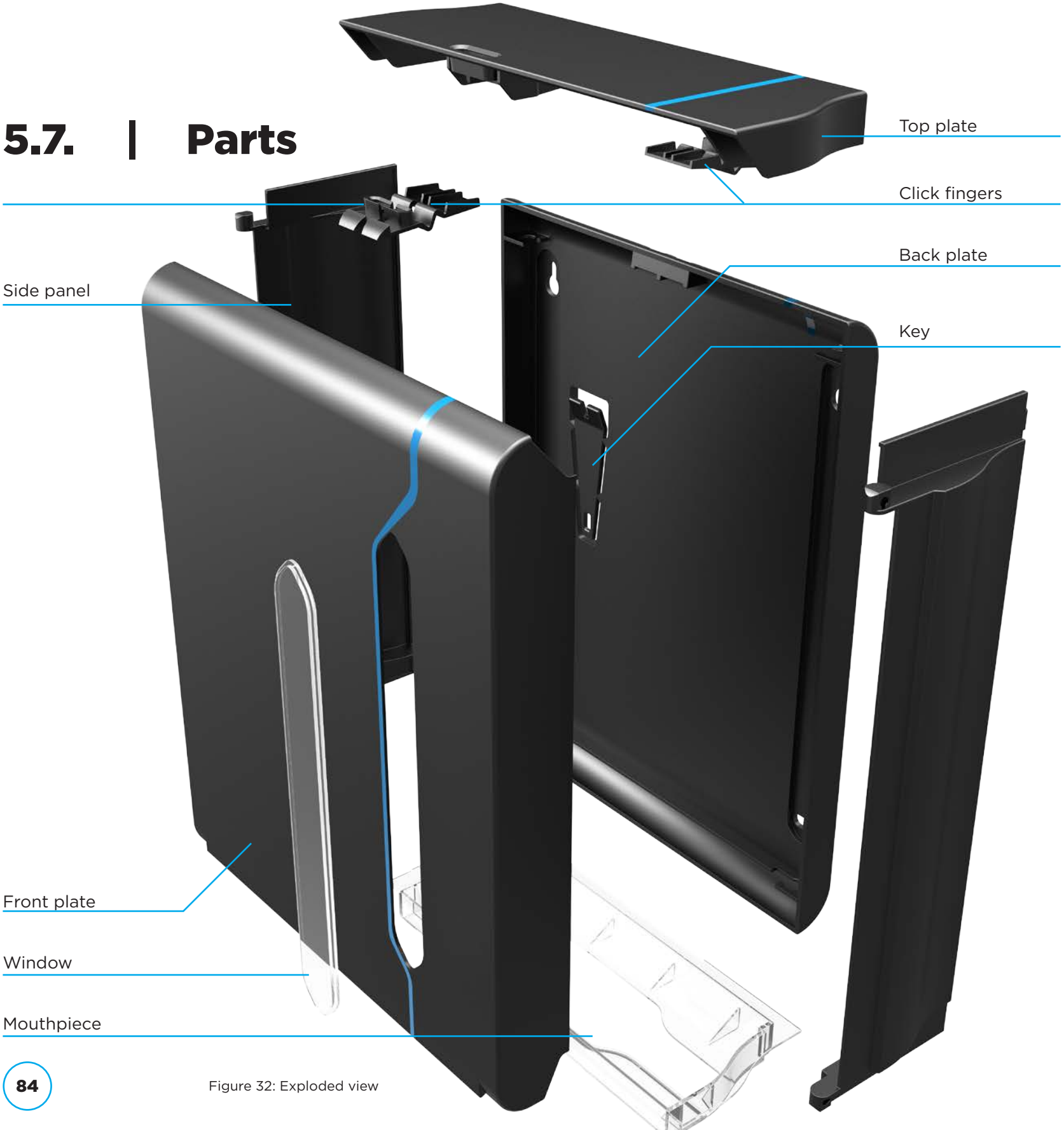


Figure 32: Exploded view

5.7.1. Back plate

The basis is formed by the back plate. This plate is the connection between the dispenser and the wall. The connection points are the same as for the current dispenser, but had to be positioned differently. The mouth of the Fold will be higher up on the wall when the same holes are used, but the top plate lower than the top of the current. The ribs are practically the same apart from the key that will be moulded along. This feature is based on the BriQ line and prevents the need for a separate production for the key.

The back plate facilitates the pivot points for the side panels. They are positioned right above the fillet to let the side panels have a solid foundation. It also provides slots for the click fingers of the top plate (Figure 34). These slots are partly covered, so visitors cannot see or tamper with them.

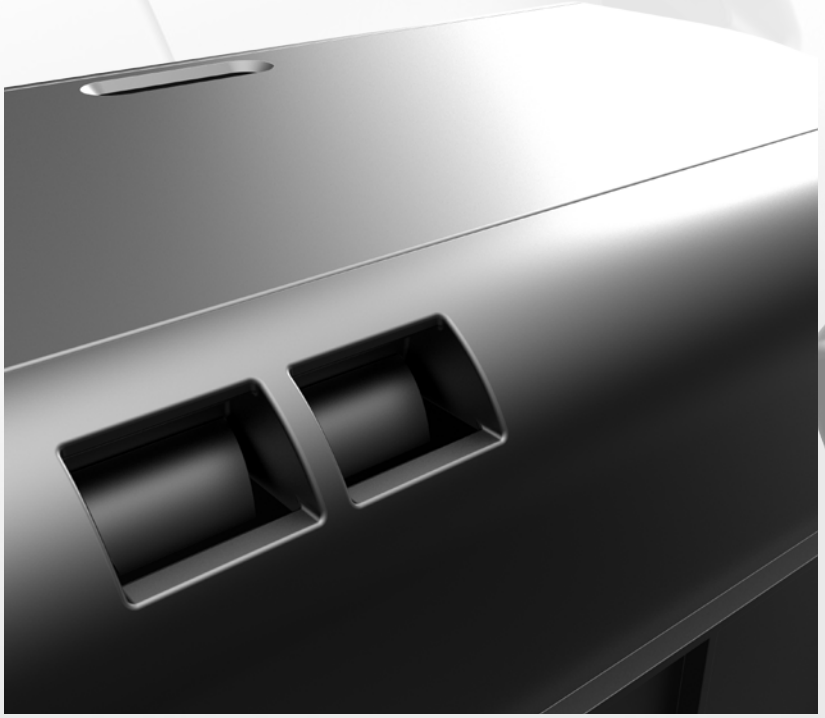


Figure 34: covered click finger slots

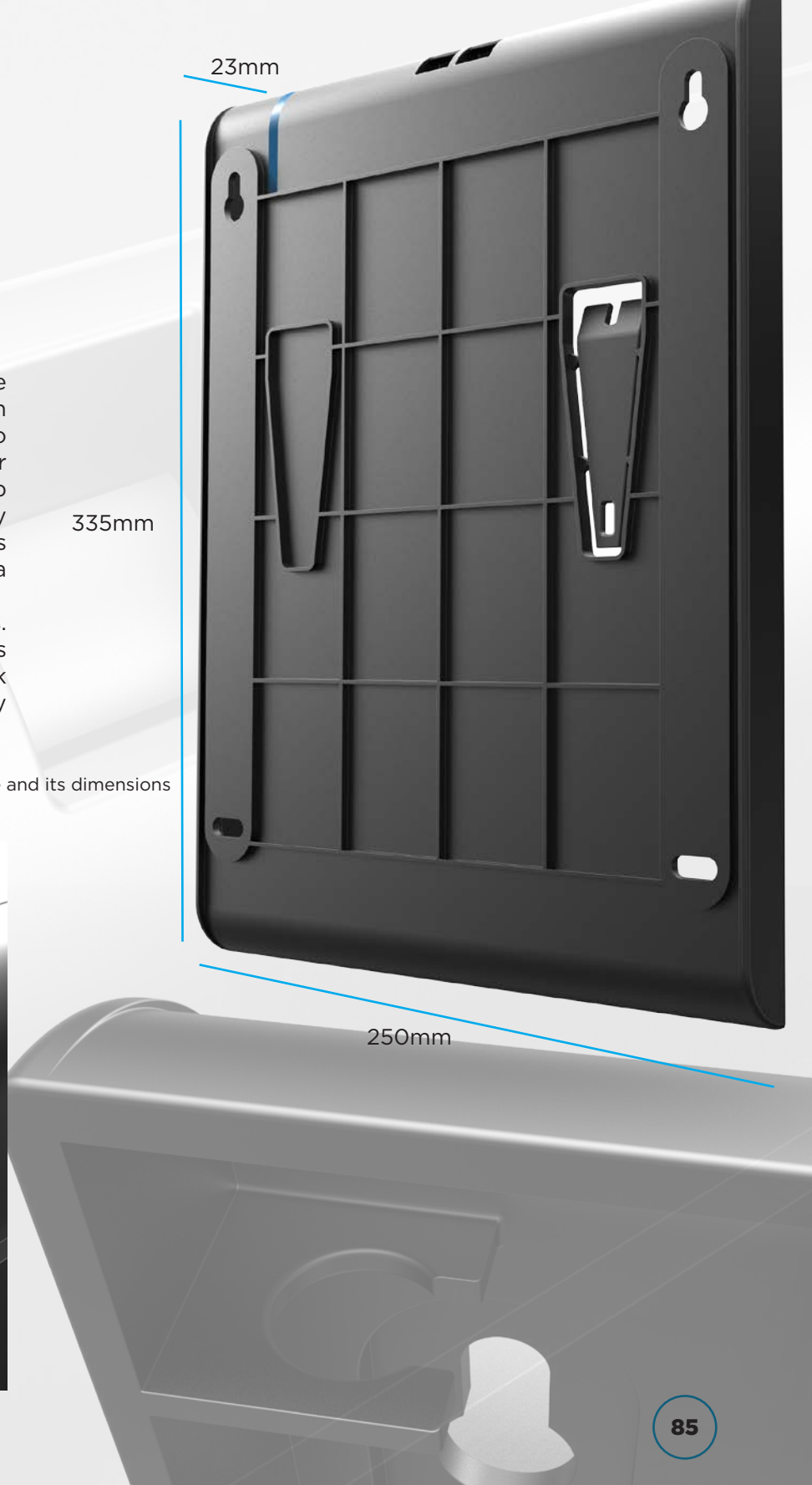


Figure 33: Back plate and its dimensions

5.7.2. Side panels

The side panels are the connection between the back and front plate. The pins at the corners make sure of that, but also facilitate the axis for the front plate to open. Those two front pins (Figure 35) have special slots in them so the pins in the front plate can slide in them, but also in case the front plate need to be disassembled in use. The slots are under an angle, so the front plate can only be disassembled when partly opened.

They are strongly curved to have a smooth transition towards the wider front plate. For aesthetics this is pleasing. When in folded position, it creates room for the top plate and mouthpiece to be placed between the back and front plate. Closer to the top and bottom, the curved surface is replaced by a flat surface, because only then the dispenser can be folded as small as possible and stress at the hinges is prevented.

What is special about them, is that they are identical. They are mirrored in a way like you would turn a page (Figure 36). This has the benefit that one mould less needs to be invested in. A consequence is that the slots for the pins of the front plate (located at the bottom) are also in the top front pins of the side panels.

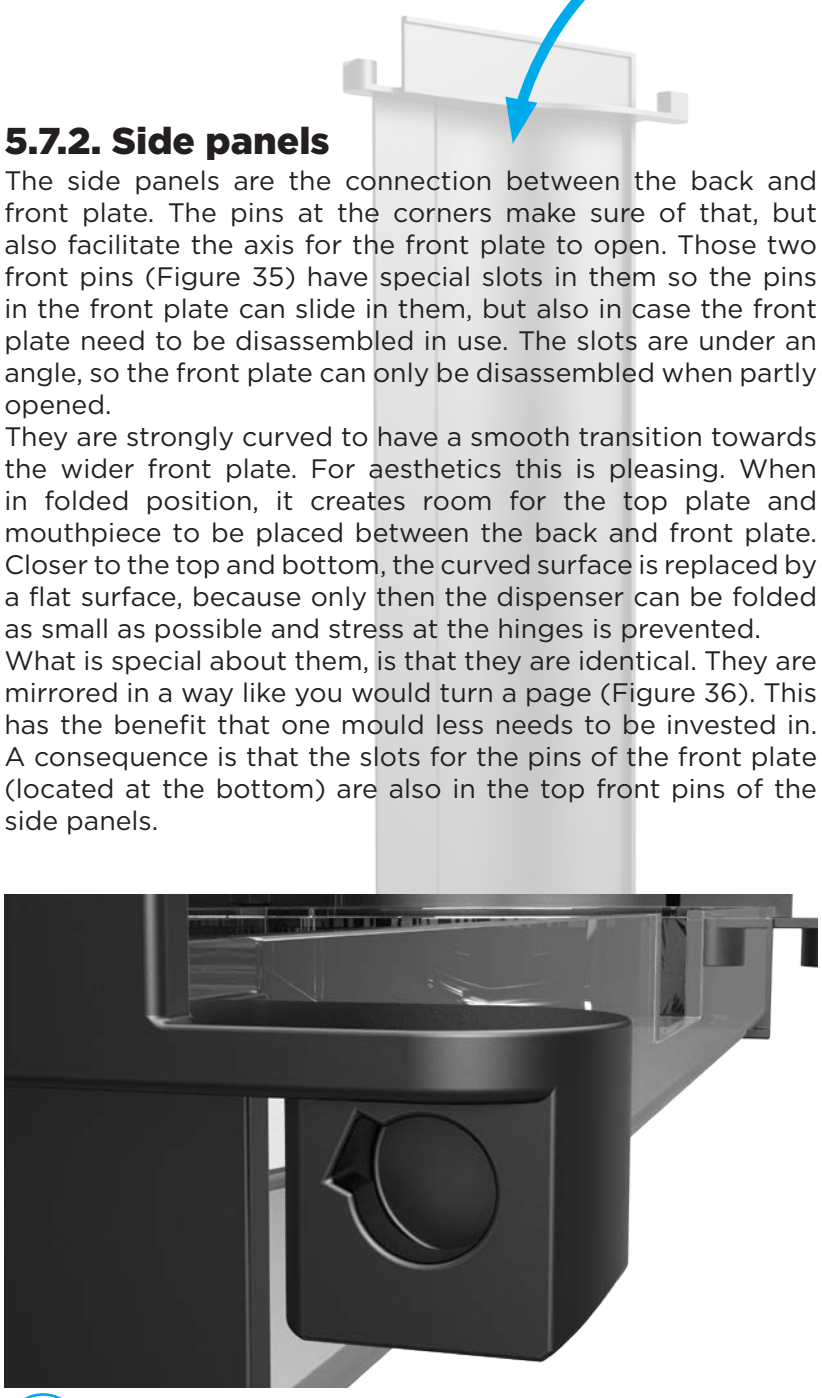


Figure 35: Front pins close-up

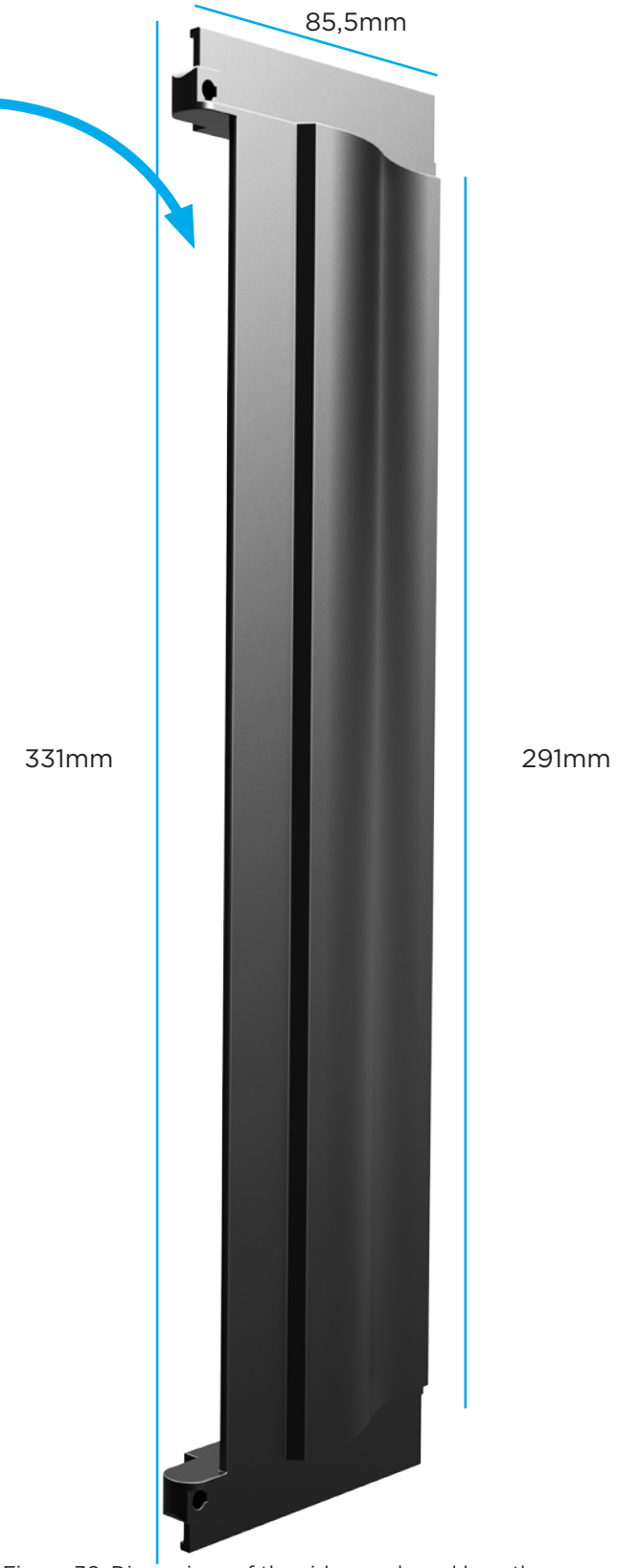


Figure 36: Dimensions of the side panels and how they are mirrored

5.7.3. Front plate

The front plate is the most visible. It needs to be the nicest part of the dispenser, which was the reason for opting for this folding mechanism. It also includes a slot to place the window in. Details about this part are discussed in a later chapter.
Its dimensions (Figure 38) are different from the back plate, as this part is wider. This is because of the folding mechanism and the pins that need to be positioned accordingly. The top and bottom have an equal fillet of 20mm in radius, but the bottom is for the large part straightened to provide a small usecue for the visitor where the paper towels are dispensed. This straight piece also acts as a stop when opening the dispenser. It lets the front plate have a maximum angle of 72° (larger than the current dispenser (Figure 40)) before it comes in contact with the bottom of the side panels.
Looking at the back of the front plate, two sliders are visible in which the pins of the side panels move. In the middle there is a stop provided for the pins, so the side panels stay in place when in folded position. The top slider also provides a place for the click fingers to cling onto. Both sliders have enough support and are dimensioned sufficiently to withstand the forces determined in the programme of requirements (appendix X).
The sides are chamfered as this makes it possible to close the dispenser without any resistance. For both hygienic and aesthetic purposes this is done for both the top and bottom part, with only minor differences in dimensions. It forms the bridge between the front plate and side panel, but more importantly, covers up the holes at the front, created by the pins.

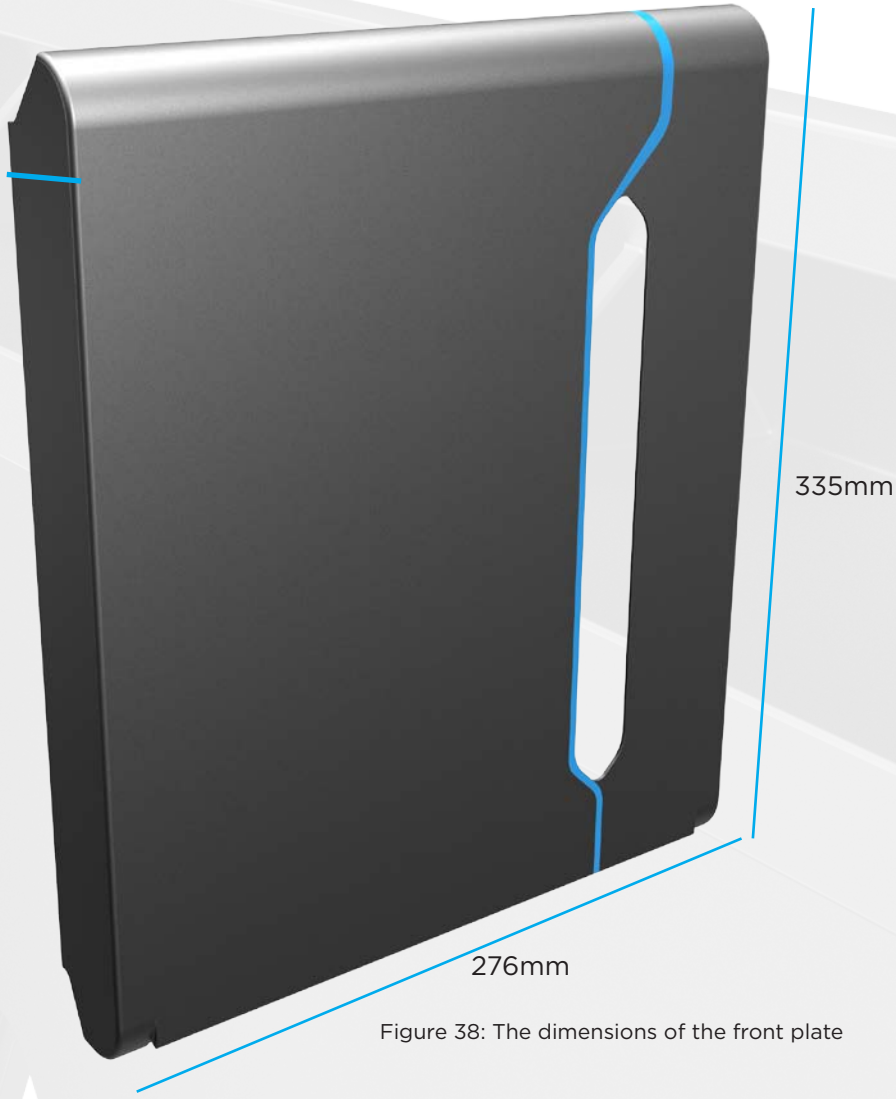


Figure 38: The dimensions of the front plate

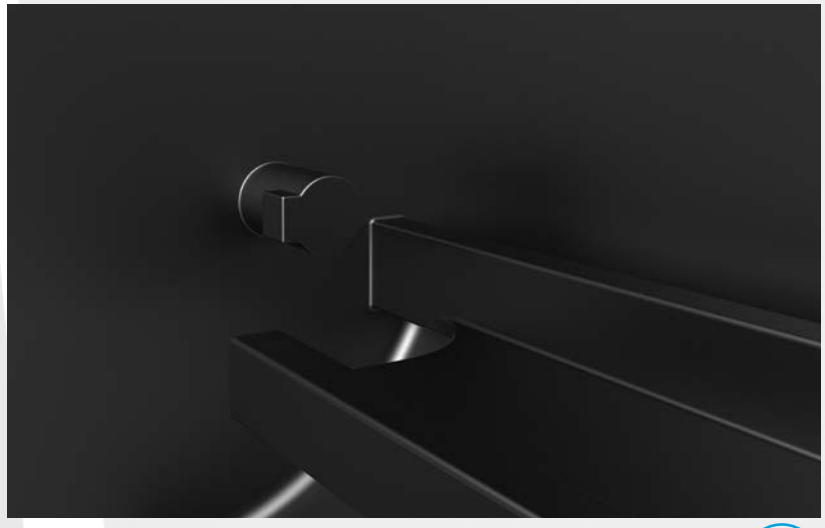


Figure 37: Pins in the sides of the front plate

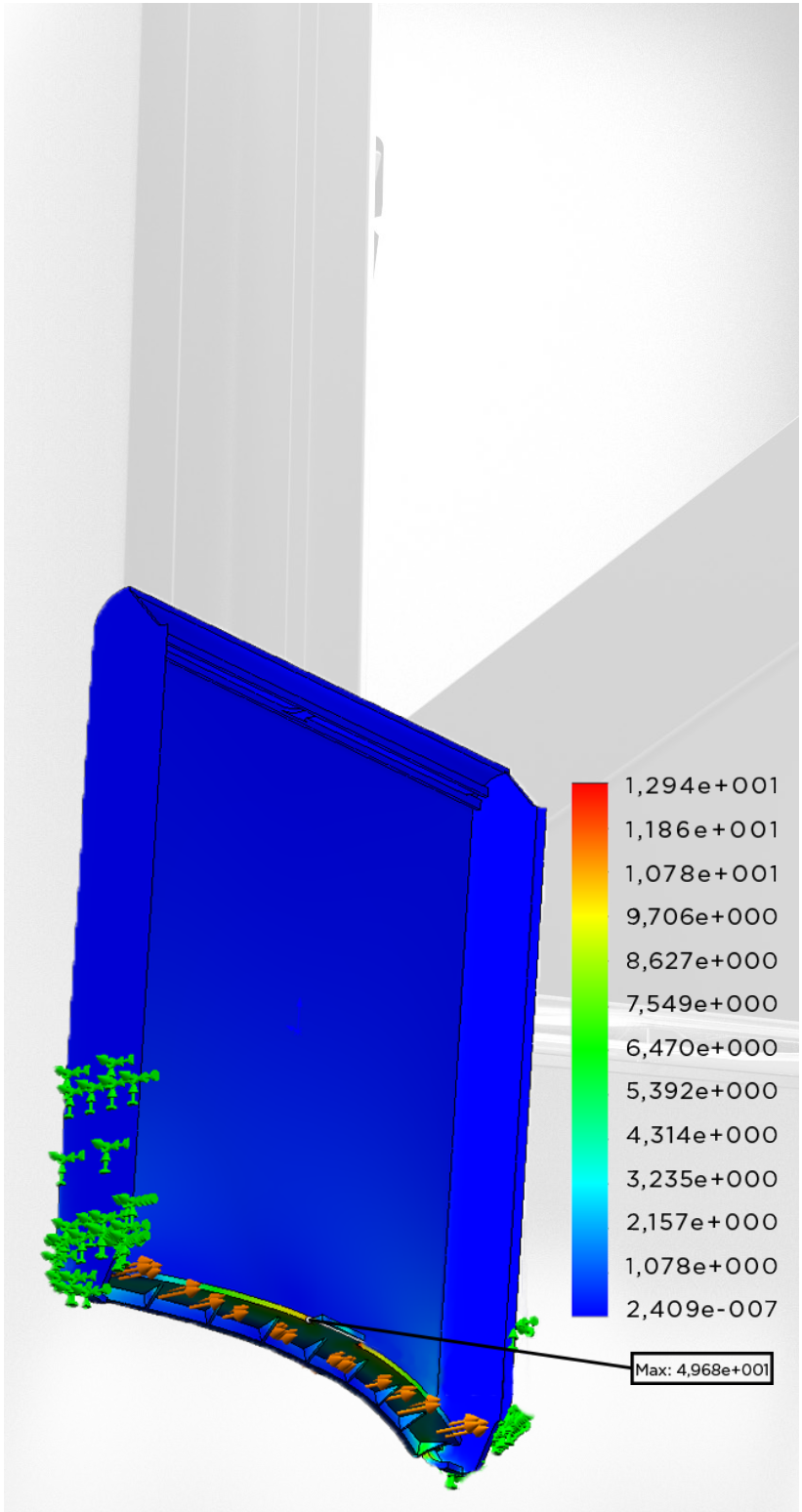


Figure 39: stresses that occur when lifting the assembly by the front plate

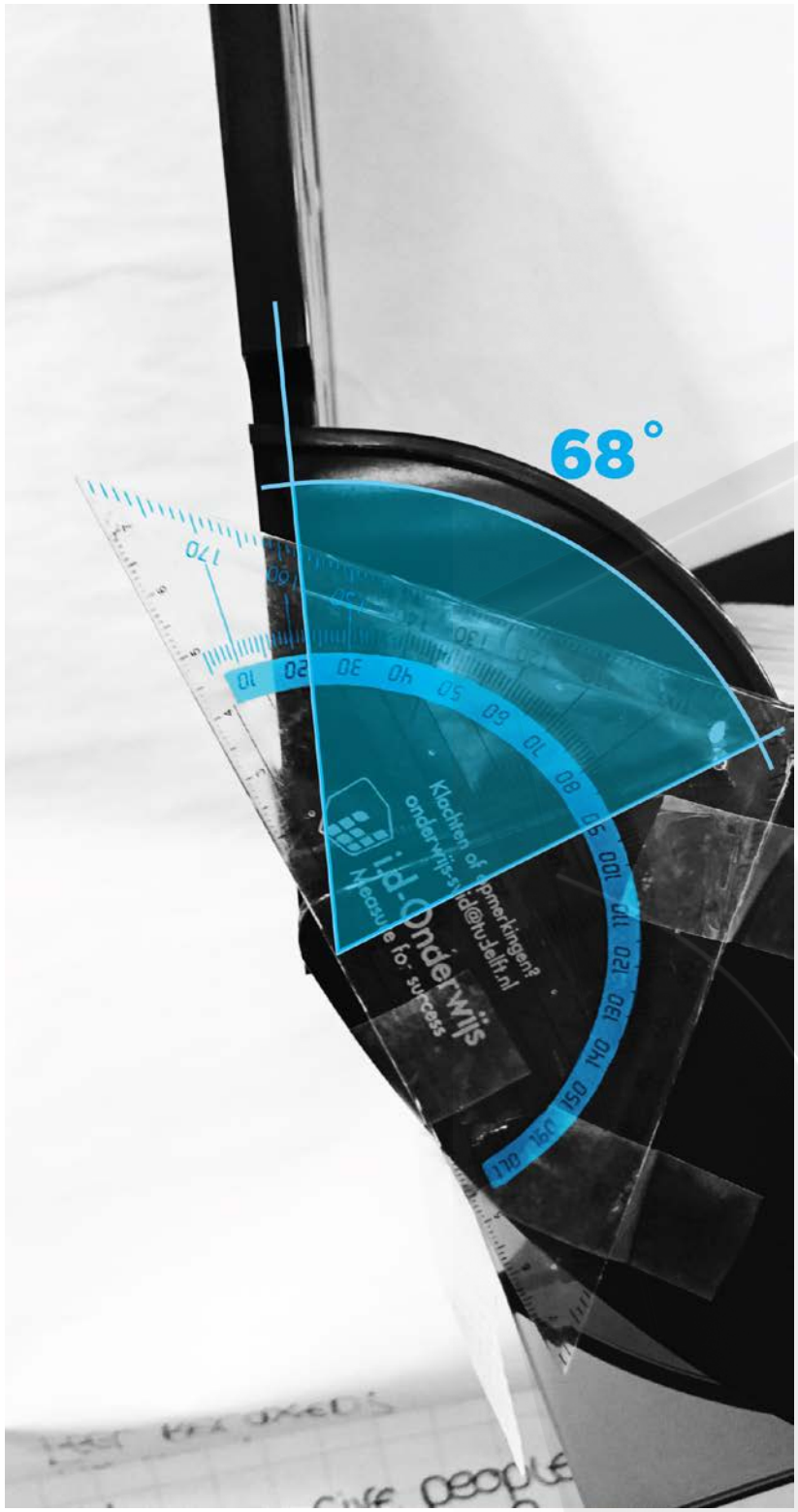


Figure 40: Angle of opening for the current hand towel dispenser

5.7.4. Top plate

The top plate provides the locking mechanism for the front plate. It has two slots to click the click fingers in; one to connect with the back plate and the other for the front plate. These slots are the same as the BriQ line, as the click fingers are also the same. As mentioned, the click finger connecting the front plate should be placed lower so it can cling behind the slider. Therefore, the slot is elevated and extra depth is added to the keyhole.

The inner walls at the sides act as dividers for the side panels, so their position at the top is secured. These walls are also handy for the dispenser installers to quickly have the top plate in the right position before clicking it into the back plate. The outer walls are a translation from the side panels and cover up the holes at the top, left by the side panels. This is beneficial for both hygiene and aesthetics.

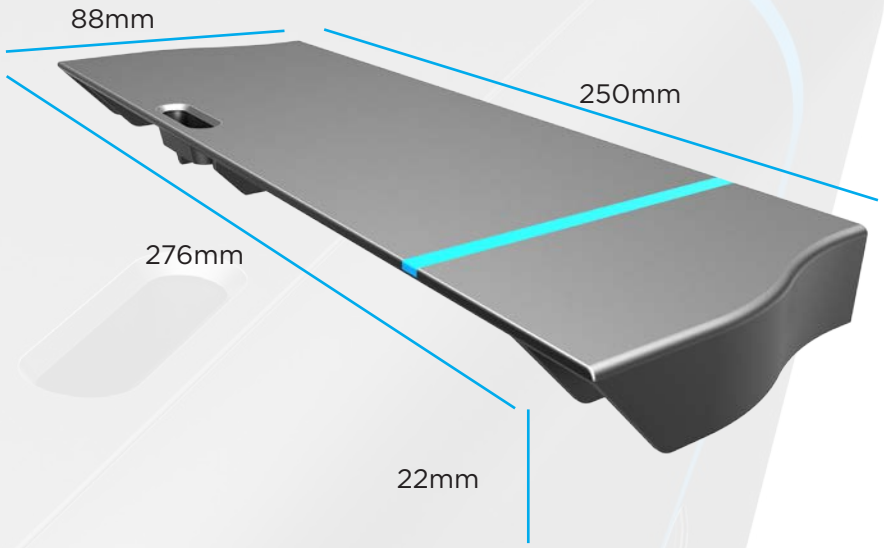


Figure 41: Top plate and its dimensions

5.7.5. Keyhole

The keyhole is positioned in the top plate, so opening the dispenser is always possible, regardless of the placement inside the washroom. So also when placed in a corner. This would not be possible if the keyhole is positioned on the side and would have a larger impact on the production of the side panels and front plate.

Being positioned on top, does have an impact on user friendliness. Especially on small people. Therefore, two user tests were conducted using small female respondents. The first one was with a 28 year old female, measuring 1,56m in height. She had no professional cleaning experience. The BriQ Single dispenser was used, as this has the same locking mechanism. The keyhole was positioned at the same height as the Fold would be (1.73m). The respondent had to find the keyhole with the key, as she did not know where it was and was too short to see it. She did not bother to reach high as she was used to it in her daily life, and she could find the keyhole quickly.

The second respondent was a very friendly 61 year old lady, living in a retirement home. Measuring 1,58m, she was the ideal respondent to represent an elderly cleaner. Again, the BriQ Single was used, however, she found 1,73m just too high to reach. When positioned at 1,70m it was just right.

Desktop research has been conducted next to the user research with the help of Dined's anthropometric database (DINED, 2017). In here, the reach height can be selected, however not directly for elderly. There is data on reach height for Dutch adults of 20-60 years old from 1982. The most recent data on this age group is done in 2004, but there is no reach height data from this period. Therefore, the reach height for Dutch adults in 2004 is extrapolated (Figure 42). The stature data is known for both the 1982 as for the 2004 group. For the 5 percentile in 1982, the stature measured 1544mm. For the same percentile in 2004, this meant a measure of 1558mm, or an increase of 14mm. For the 1982 group, this stature height is put on the 7.64 percentile. They had a reach height of 1798mm. Since there is an increase in stature in 2004, it seems logical there is also an increase in reach height. With the dispenser's keyhole positioned at 1735mm, it is safe to say that even the 5 percentile of this age group can easily reach the keyhole. And with this age group being representative for over 80% of the cleaning structure personnel (Uitert & Aalst, 2013), positioning the keyhole in the top plate can be done.

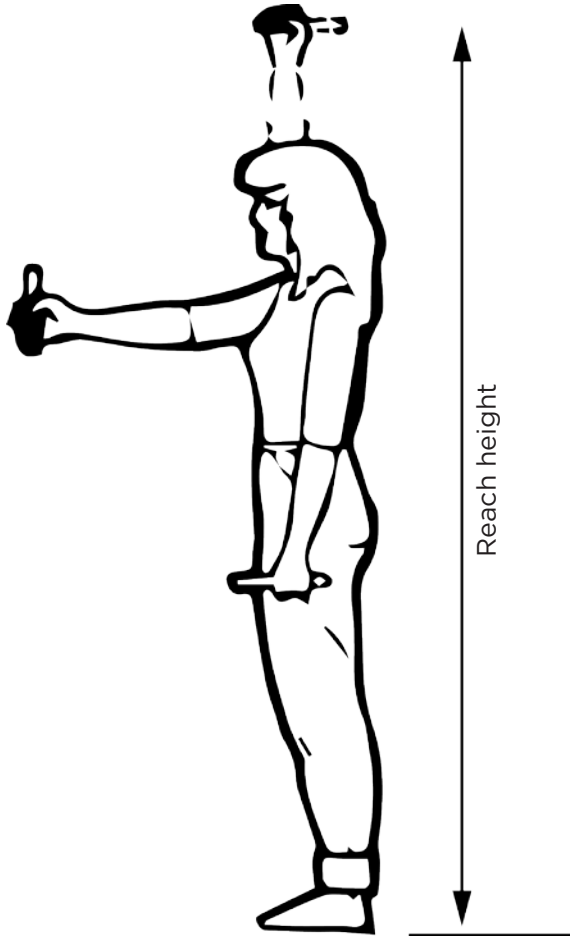


Figure 42: Dined figure visualizing reach height

Figure 43: User test reach height

5.7.6. Off centre

As can be seen, the keyhole is positioned off centre, because the back click finger slot is an obstacle. For the back plate to be produced as easy as possible, the hole for the click finger is in the centre. Thereby, the other slot and the keyhole must be off centre. Another reason for this is that the click finger snaps behind the top rails, which can only be done off centre, since the middle is reserved to sto the pins of the side panels when in folded position.

5.7.7. Conclusion keyhole

The keyhole can be positioned in the top plate. This is the best position considering production and freedom of placement in the washroom. According to Dined and the first user research, placing the dispenser 1,40m above the floor, and so the keyhole at 1,73 above the floor, can be done easily. However, the second user test contradicts this. A position at 1,70 above the floor would be maximum and thereby ideal for short cleaners to be able to open and tall visitors to still grab a paper towel. This matches requirements x,x, and x.

5.7.8. Mouthpiece

Originally, the idea was to let the side panels, the back and front plate together form a mouthpiece for the paper. However, these parts could not come together close enough for the paper to have enough support. Therefore, a mouthpiece was added. Following the dimensions of the three mentioned parts, the mouthpiece also functions as an extra prevention for the lower part of the side panels to slide.

But the main function of the mouthpiece is to give enough support to the paper and allow visitors to easily grab one piece of paper at a time. The mouthpiece is based on that of the BriQ towel dispenser. Compared to the current dispenser, this one dispenses paper a little easier. The dimensions are adjusted for this design and to hold larger paper as described in requirement 14c (appendix x).

To prevent it from moving when in use, it is surrounded by the sides, front, and back in the horizontal plane. The front and back plate have special embossments to prevent the mouthpiece from moving upwards. A movement that can be triggered by a visitor that cannot find the opening.

The mouth's design is adapted to the aesthetics of the overall dispenser, even though this part will hardly be seen.

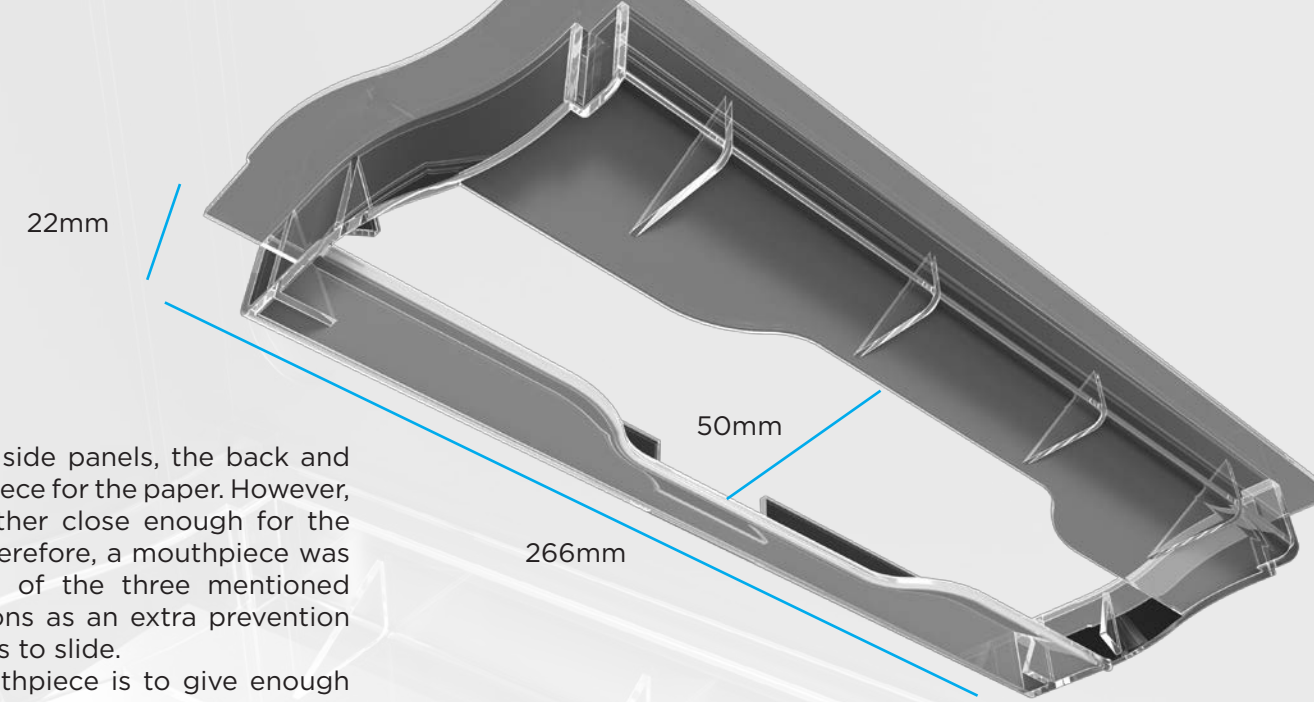
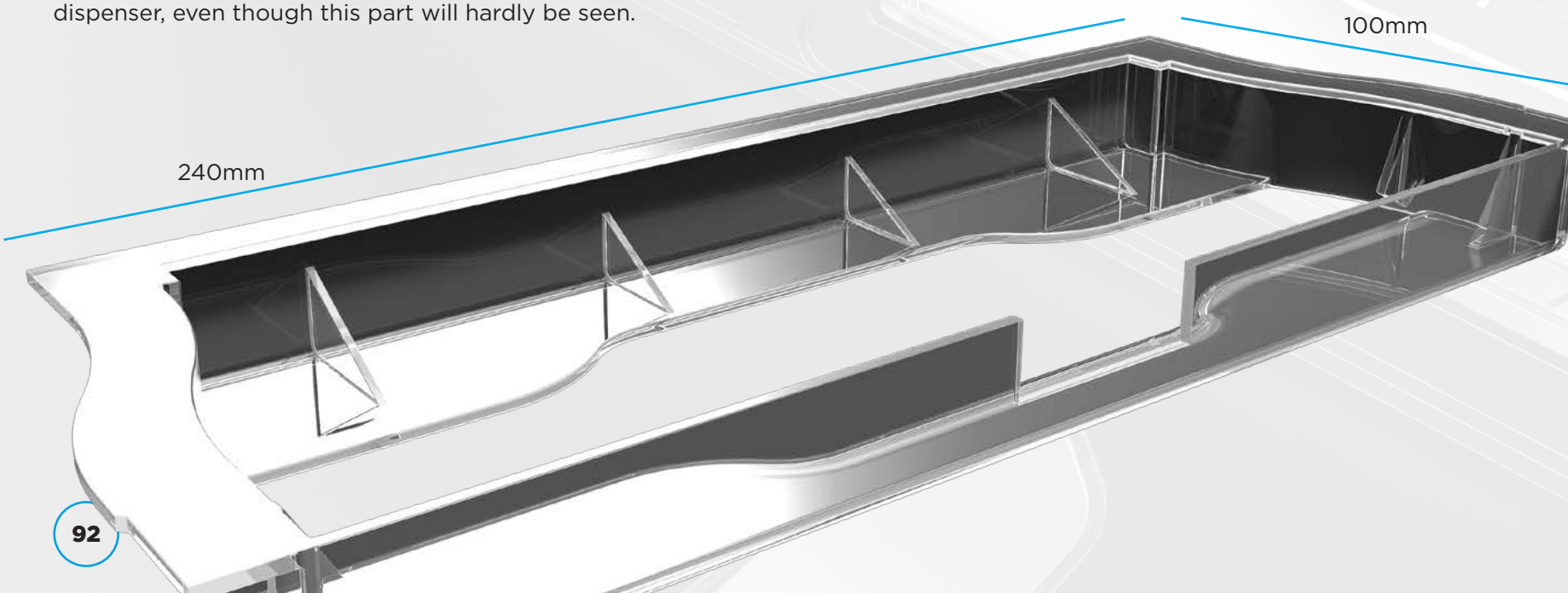


Figure 44: The mouthpiece



5.7.9. Click fingers

The click fingers are a direct translation from the click finger used in the BriQ dispensers, as this reduces the investments of e new mould and do not wear over time. An aspect that can occur on the current dispenser's click fingers (Verberne, 2017).

5.7.10. Window

Visitors want to quickly see if the dispenser still has paper inside it. And if so how much. Therefore, a window is necessary. It is positioned at roughly one fourth of the dispenser's width as this feels natural. The golden ratio was tried to determine the position the position in x-direction, however this looked as if it was random. The height is such that it will not show any of the folding mechanism. It is also in service to the appearance, so the colour strip running parallel to it can have nice dimensions.

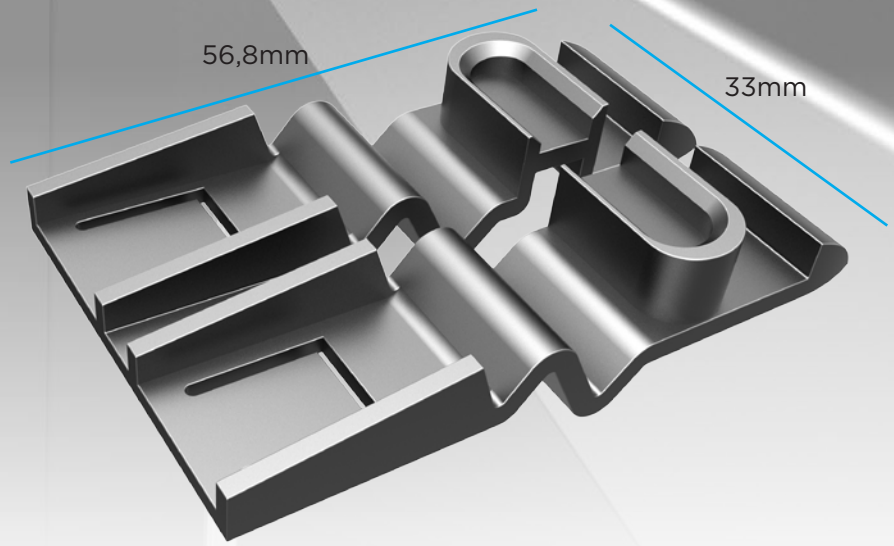


Figure 45: Ergonomic fillets at the opening of the mouthpiece

5.7.11. Conclusion

Despite the fact that more parts are needed for the housing, the amount of unique parts is less than that of the current dispenser. Where the current dispenser requires 10 unique parts, the Fold only uses 7. This is a considerable improvement. And since the click fingers are already in production, there are no investments related to that part.
Also the material use is improved. Compared to the current dispenser, that weighs 1,452kg, the Fold uses almost one third of that. The Fold weighs 0,993kg, which is a reduction of 0,459kg or 32pp (percentage point). This is mostly the result of a smaller dispenser, but the Fold went through a number of optimization steps to acquire such a low weight.
It was necessary to add a mouthpiece. This is an extra part and thus extra investments in a mould, assembly and material. On the other hand, the overall appearance of the dispenser is brought closer to the current dispenser. A transparent mouthpiece can be seen as a signature mark of Satino Black dispensers and distinguishes it from the competition. No other competitive towel dispenser has a fully transparent mouthpiece.
A foldable dispenser cannot do without less parts, while still offering hygiene paper. As hygiene is the most important aspect, this is the minimum amount of parts to offer hygiene paper. What the investments will be, is discussed in chapter x.x. | Costs. Mould design and injection moulding are discussed in chapter x.x | Production.

One of the main focus points of the BriQ line, was to decrease the amount of parts. So as a follow up, the Fold complies with that. However, the BriQ towel dispenser only has 5 unique parts. So it scores a little better on that part. Also in terms of material use, it scores better. With 0,724kg, it is 0,269kg lighter. In chapter x.x | Sustainability, it is analysed whether this difference in material use is compensated by the Fold with its ability to fold.

5.8. | Production

Being made from ABS, it is logical that the parts are made using injection moulding. It is cheap, fast and ideal for large quantities. Injection moulding requires a number of design rules that need to be taken into account (figure x). These rules are applied in the design of the parts. Due to the folding mechanism and the resulting hinges, some difficult moulds are necessary. For each of the parts, the moulds are designed and discussed in this chapter, following the rules given by the book “Manufacturing and Design” (Tempelman, Shercliff & Ninaber van Eyben, 2013), the injection mould standard provided by ABC group (Bollman & Wicknesvaran, 2015), and information from 3dsystems.com.
There is no expert in injection moulding consulted. The moulds follow the general rules, and are partially based on current dispenser moulds.

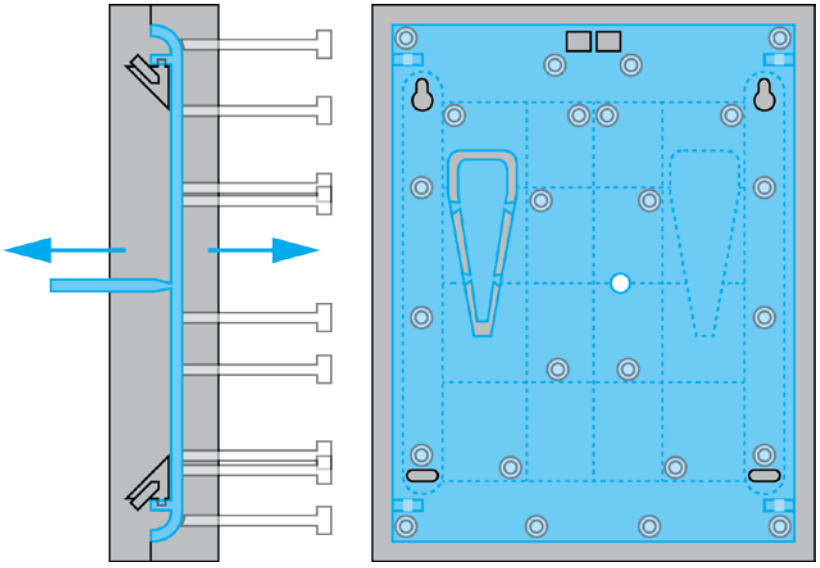


Figure 46: side and front view of the back plate mould

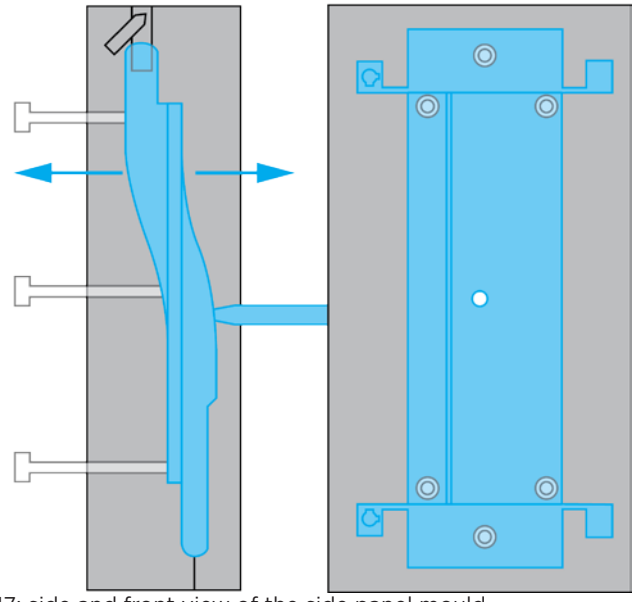


Figure 47: side and front view of the side panel mould

5.8.1. General focus points

Wall thickness is never more than 3,5mm, as this is close to the maximum recommended thickness for ABS. This has an influence over the maximum flow length, as the ratio between these l/d should never be more than 400. So for a thickness of 3mm, this means that the flow length should not exceed 1200mm. The maximum flow length in the front plate (largest part) is around 446mm, so only one gate should suffice for every part.

The biggest challenges in designing the moulds, were the slides. To produce the slots in the back plate, the rails in the front plate and the slots for the click fingers in the top plate and in the pins of the side panels, slides were necessary. Most of them are triangular in shape, so they can slide along one mould plate. Most slides are mechanically driven, as this should be done whenever possible (Bollman & Wicknesvaran, 2015).

Ribs and ejector pins are based on the current Satino Black and BriQ dispensers. Ejector pins are mostly necessary in places where shrinkage appears. This means in corners and the fillets of the back and front plate. The ribs of the rails have the same height/length ratio as used by the current dispenser. Their number and distance is based on maximum forces they need to withstand.

The location of the gate is based on what is ideal for production, as the wrap can cover it completely. Since the wrap cannot be transparent, gate marks will not be visible. One requirement that comes with it, is that the vestige must be machined as smooth as possible so no bumps appear through the wrap.

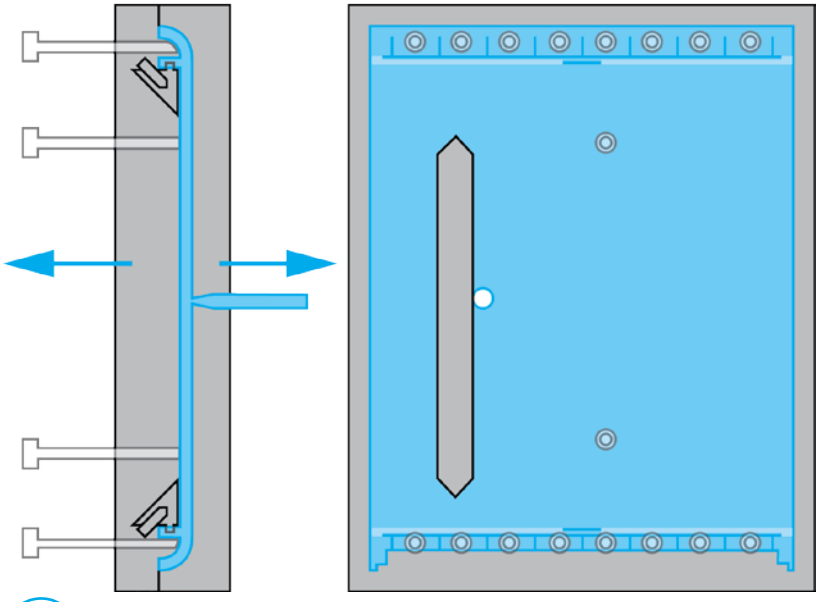


Figure 48: side and front view of the front plate mould

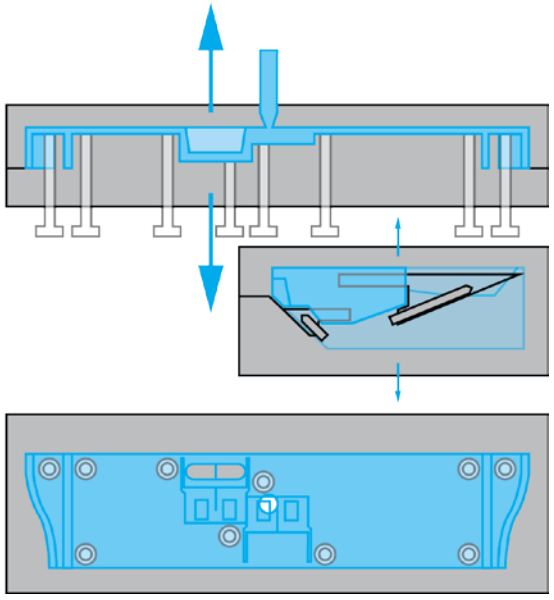


Figure 49: side and front view of the top plate mould

5.8.2. Mould specific aspects

Some moulds require some special attention. For instance the back plate mould. It is not only the back plate, but the key is moulded along with it. This design is also based on the BriQ dispenser, where this method is already applied. With these dimensions, it can be certainly be produced.

The slides in the top plate's mould are driven by a hydraulic cylinder, as its travel is greater than 20 degrees (angle of the slide with the vertical). The other slides can be driven mechanically.

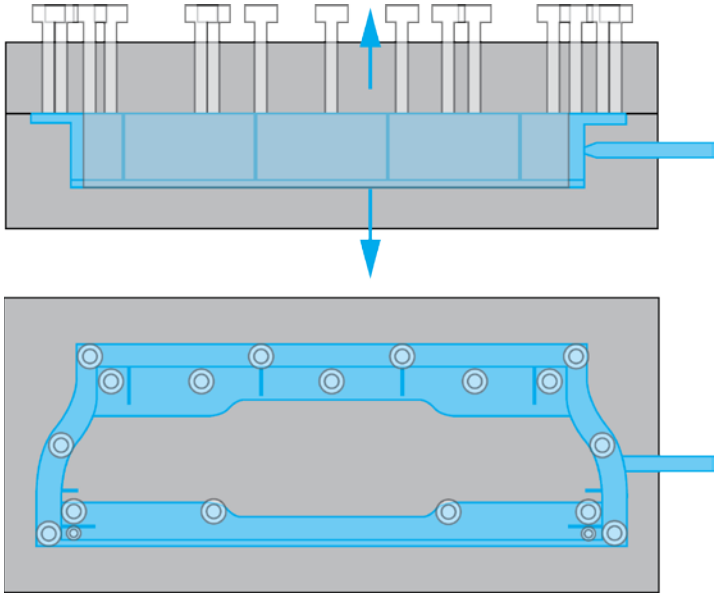


Figure 50: side and front view of the mouthpiece mould

Figure 51: photo of the click finger from the BriQ hand towel dispenser

5.9. | Assembly

The folding mechanism requires a two stage assembly approach. The first stage is at the production facility; the second outside the client's washroom. It doesn't require special tools and hardly any force. Most connections are through form fit and only four connections run through click fingers. Figure 52 shows a technical assembly scheme. In this figure, it is clearly visible that most actions run sequentially. The two stages are indicated by the black line in the middle. Figure 53 gives a visual representation of the assembly. This paragraph discusses this approach step by step beginning with the back plate. Every step in figure 52 is referred to as ("number").

5.9.1. First assembly stage

1. The back plate (1) forms the basis for the main assembly. The first step then to connect the hinges by sliding the two side panels in the slots, so they cannot move up or down (2). By turning them, they are also locked in the horizontal direction and thereby remain in place.
2. The next step is to connect the front plate to the main assembly. It consists of two steps. The first is to turn the side panels in a position, preferably between 85 and 90 degrees (3). Then, the front plate is placed by shoving the bottom axes of the side panels in the sliders of the front plate (4).
3. Now, the side panels can turn to their maximum of 90 degrees (5), so the special axes in the sides of the front plate (Figure 37), slide into the slots in the bottom axes of the side panels. Once this connection is achieved, the front plate can be rotated to a vertical position, so the top axes fall in the top sliders (6).
4. While this is being done, a subassembly of the top plate (8), the mouthpiece (9) and two click fingers (10) is made (7). This subassembly is placed between the front and back plate. The top plate and mouthpiece should be positioned to be able to fit when the dispenser is folded. Aligning is not difficult as this happens automatically when the side panels turn.
5. By closing the assembly (11), this stage is finished and the assembly can be put inside the packaging (12). There is no movement possible except unfolding. Inside the assembly there isn't much movement possible. The subassembly can only move a couple of millimetres in vertical and horizontal direction, before it hits the side panels or back plate. The click fingers can move a lot, but cannot fall out of the assembly when closed. In this step, also mounting equipment (13) and manual (14) is put in the packaging.

5.9.2. Second assembly stage

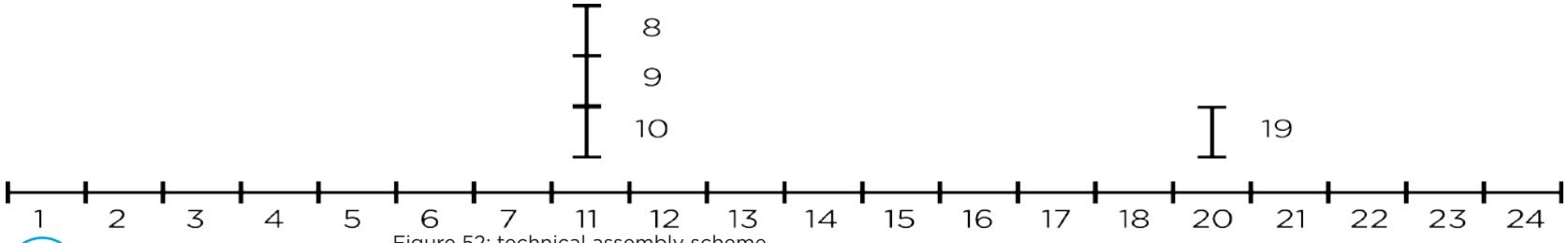


Figure 52: technical assembly scheme

6. Once the installers have unpacked the dispenser (15), the assembly must be unfolded (16). This way, the installers can take out the subassembly (17).
7. The dispenser is opened and the key is pressed out of the back plate (18).
8. If the installers work in pairs, the second can prepare the subassembly by clicking the click fingers inside the top plate (19). This subassembly can then be put on top of the side panels and clicked into the back plate (20). At this stage, wrapping can occur, which leaves the dispenser installer time to prepare wall mounting and other dispensers. Wrapping is discussed in chapter 5.14. | Wrapping.
9. Now the main assembly can easily be mounted to the wall (21).
10. The mouthpiece is shoved into place under an angle and laid on the side panels (22).
11. After this step, all that remains is to put paper inside the dispenser (23) and close it (24). Closing is just like the current dispensers by means of a clicking finger inside the top plate. Now, the dispenser is ready for usage.

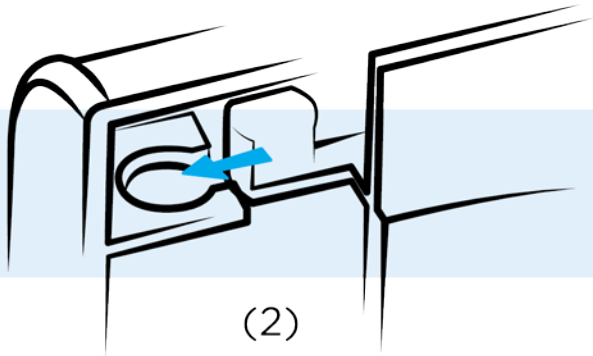
It is assumed that assembly takes place by hand. The required time for each step is divided in grab & align, and assembly by hand. These times are calculated (table 3), based on the tables given in Appendix J.

Step	Grab & align	Assembly by hand	Total time
(2)	1,1s	2,0s	3,1s
(4)	1,1s	8,0s	9,1s
(7)	1,1s	1,5s	2,6s
(19)	1,1s	2,0s	3,1s
(20)	1,1s	2,0s	3,1s
(21)	1,1s	2,0s	3,1s
(22)	1,1s	2,0s	3,1s
			27,2s

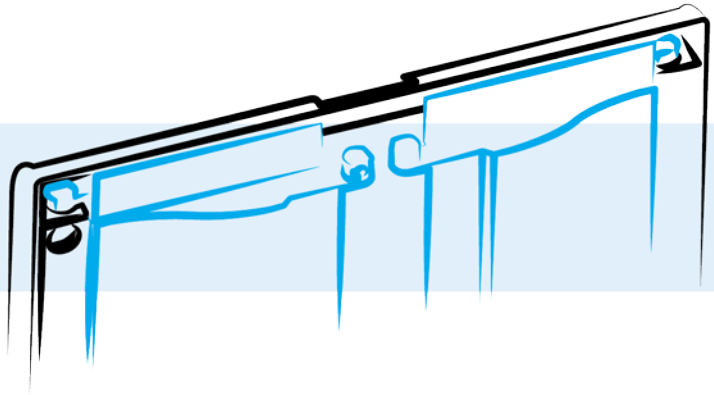
Table 3: assembly time without wrapping time

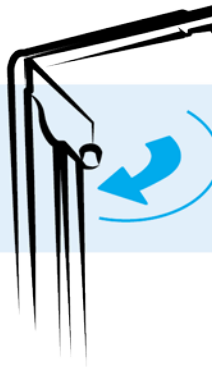
5.9.3. Disassembly

When the dispenser has reached the end of its life, disassembly needs to take place. The order in which this happens can be the exact opposite of the assembly steps.

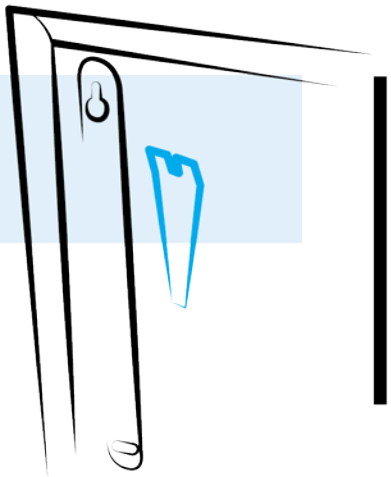


(2)

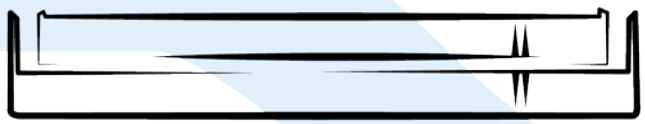




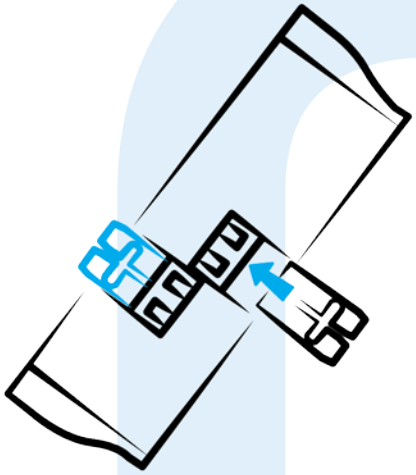
(18)



End of factory essembly stage

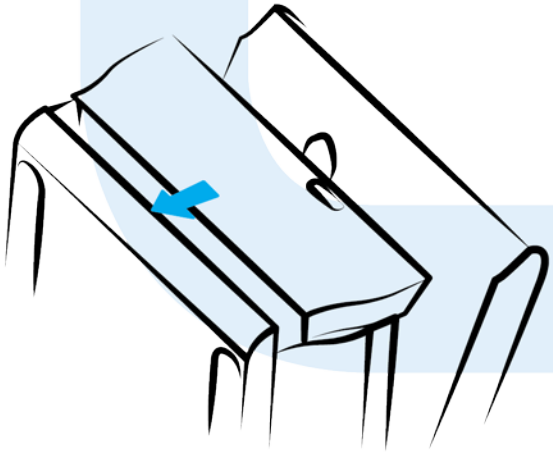


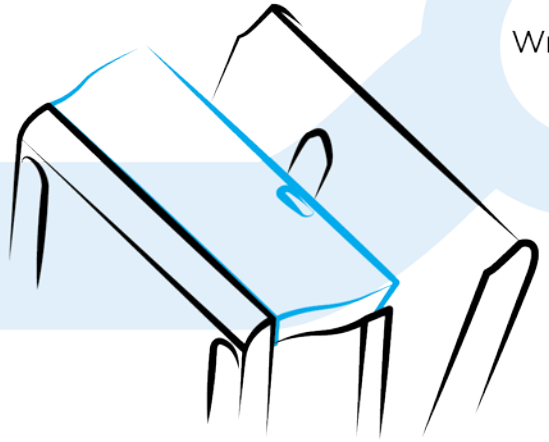
(11)

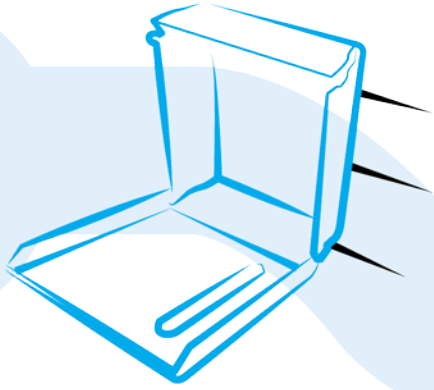


(19)

Wrapping







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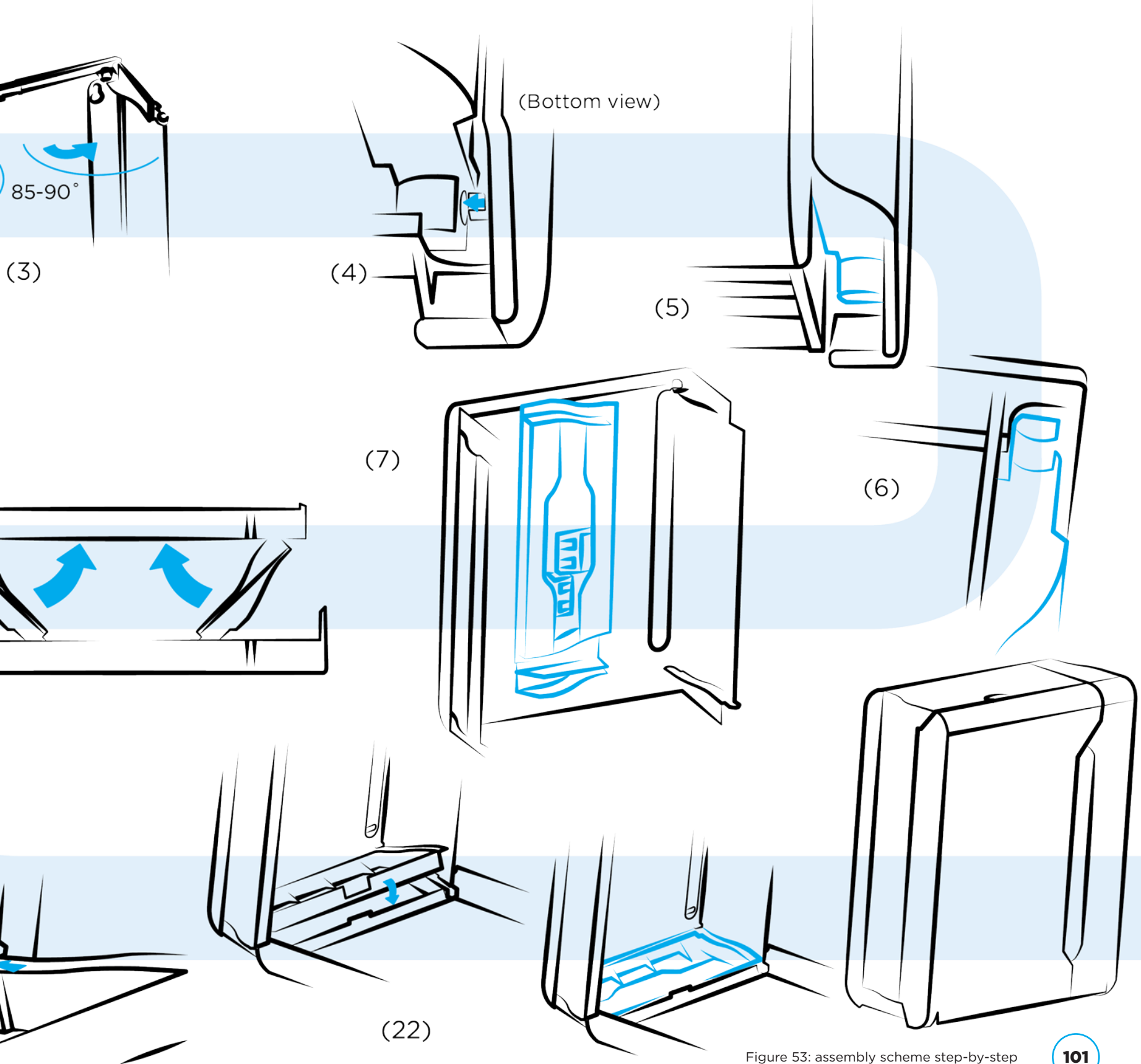


Figure 53: assembly scheme step-by-step

5.10. | Strength analysis

Next to the strength analysis of the separate parts, the complete model was also analysed on its performance using Solidworks. For this analysis, the model needed to be simplified. This is done by removing the slots within the pins of the side panels and most of the fillets from all parts. Various scenarios were analysed. These, along with their results and conclusions are described in this chapter. The properties of ABS according to CES are used and can be seen in table 4.

Young's modulus	|	2,07 - 2,76	GPa
Yield stress	|	34,5 - 49,6	MPa
Tensile strength	|	37,9 - 51,7	MPa

Table 4: properties ABS according to CES

5.10.1. Leaning

The first scenario is described by a person of 150kg leaning against the dispenser (Requirement 1b). This is modelled as a force of 500N acting upon the front plate. This force is calculated according to the sketch in figure 54. This force results in a maximum stress of 25,37MPa and a displacement of 10,47mm. The stress is well beneath the maximum of ABS. The displacement is not disturbing the workings of the dispenser. Especially since no one will be able to use it when someone else is leaning against it. But this amount of displacement can be close to the limit of what people may find reliable.

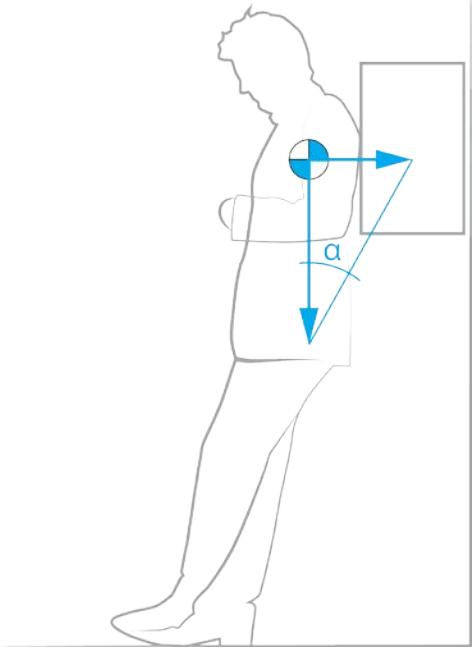


Figure 54: situation sketch of a person leaning against a dispenser

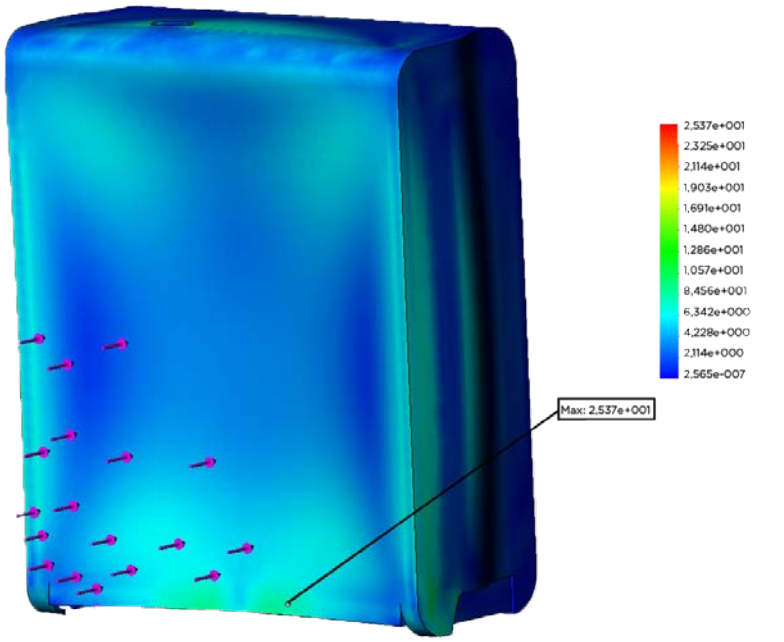


Figure 55: Von Mises results leaning scenario

5.10.2. Pulling

It can happen that a person is not that careful with the dispenser and accidentally pulls on the mouthpiece with a force of 100N. A force pulling on the mouthpiece was modelled to represent such a scenario. As well as with the scenario described in chapter 5.6. | Workings, 100N is pretty much and is not likely to happen. But even in this scenario, a maximum stress of 15,16MPa and a displacement of 4,016mm are the result (Figure 56); both well within the capabilities of ABS.

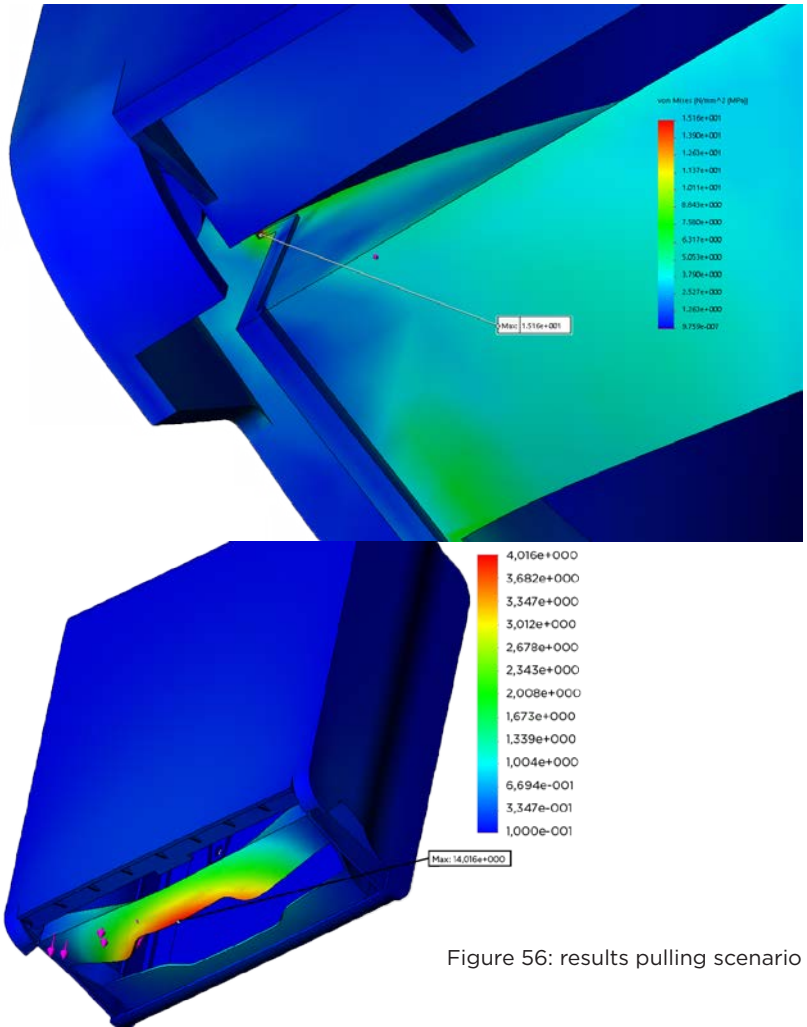


Figure 56: results pulling scenario

5.10.3. Hanging kid

A playful and bored kid on holiday in a hotel might find the dispenser attractive to hang on. For evaluation purposes, this will be a kid of around 70kg, acting a force on the top plate of 700N. The dispenser is fixed at the mounting holes. The maximum stress involved in this scenario is well beneath the Yield and tensile properties, measuring 25,24MPa. The displacement is placed in the centre of the top plate. However, this is not likely, since the child will grab the dispenser at the sides. But even if he managed to stand on top of the dispenser, the displacement will only be 5,256mm. A displacement that will not even be noticed.

When this scenario is modelled as if the back plate is glued to the wall, stresses and displacements become even smaller: 16,28MPa and 3,98mm respectively.

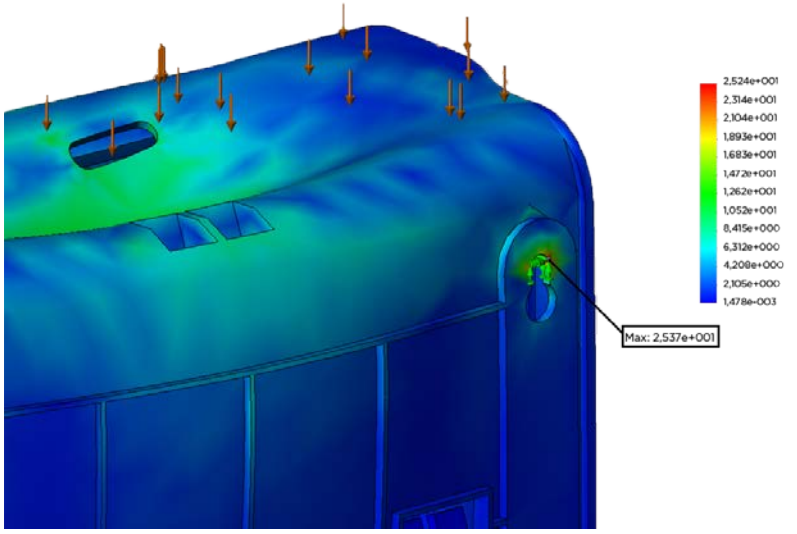


Figure 57: Von Mises results hanging kid scenario

5.10.4. Droptest

A digital drop test was executed with Solidworks to evaluate the amount of stress that is involved when a dispenser falls from the wall. The mounting height was determined with the keyhole at 1700mm above the ground. This means that the bottom of the dispenser is located 1365mm above the ground. To implement a small safety factor of around 9%, the dispenser was dropped from 1500. And when it is dropped, it turns in the air by 20 degrees, so the mouth comes first on the floor. This is modelled by adding a plane under a 20 degree angle that acts as the floor.

This results in a maximum stress of 35,12MPa (Figure 58). This is well below the maximum Yield stress and Tensile strength. It becomes actually critical when dropped from 3000mm, where the stress peaks at 49,68MPa (Figure 59).

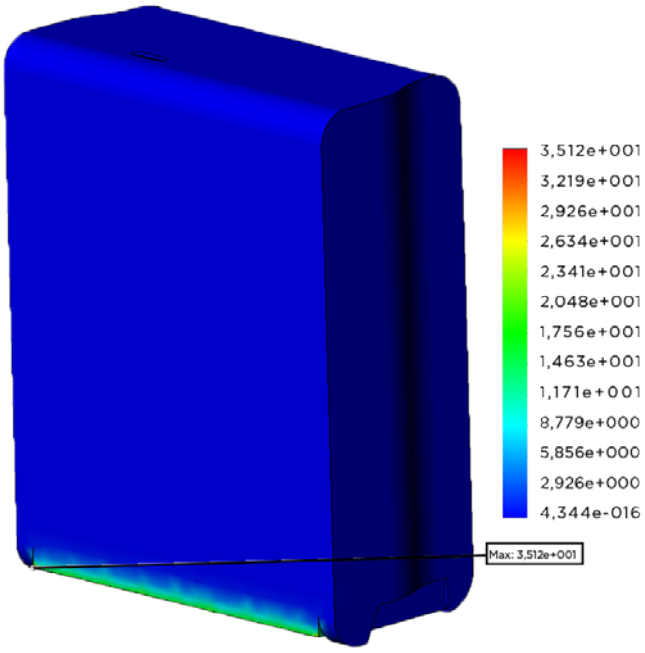


Figure 58: Von Mises results drop test at 1500mm

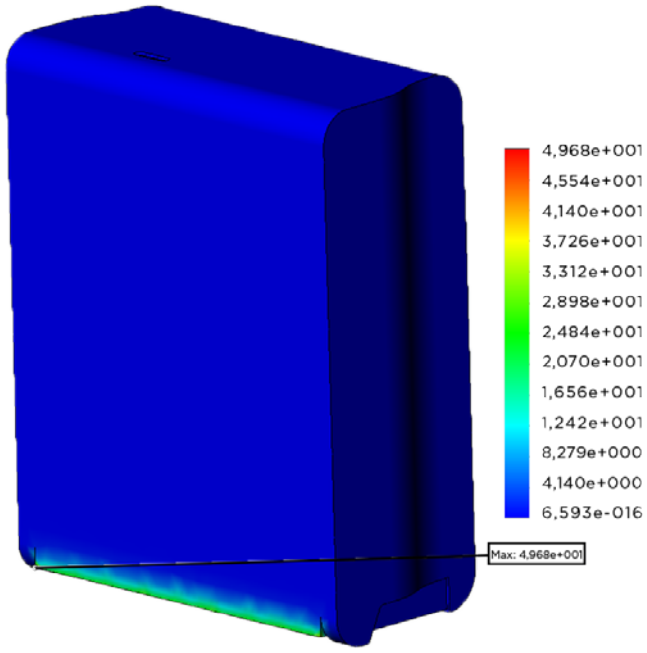


Figure 59: Von Mises results drop test at 3000mm

5.11. | Aesthetics

Some aesthetic elements are determined by design interdependencies (discussed in the next chapter). However, the metaphors used in the ZMET stipulation formed the basis for most of the aesthetics. From the overall consensus map, moodboards were developed based on the features and attributes. The metaphors acted as the main image to look for images and products that breathed the same atmosphere. These images were put in separate moodboards (Appendix K). By looking at what features and attributes connected all these collages, an overall moodboard was developed (Figure 61) that also showed perception and a combination of product and perception. This way, a more thorough understanding of the user and the image of the dispenser was mapped.
The product images are collected, following a minanic appearance. A word that does not exist, but describes a design style that is between minimalistic and organic. Where minimalistic products tend to have straight lines under a lot of tension and hardly any fillets (minimalistic moodboard in Appendix K), a minanic appearance is more loose and curvy. However, not as curvy as organic shapes, where endlessness is the key.

The people that use these products are professional, yet relaxed persons. Their clothing is neat, but casual and they speak informal with a large vocabulary.
The product facilitates them. It is a necessary element in their daily lives, but it is not something that they interact with very closely. So not like a cell phone, but more a cup of coffee or a car. Something they miss deeply when it is not there, but will hardly notice it when it is.
This is what is reflected by the colours. Overall, the dispenser can appear in any colour that people want. However, the basic colours for Satino Black should be professional and somewhat mysterious like the current Satino Black. Therefore, greyish colour tones are used for the main body, while personalization is achieved on a more detailed level. It lets the dispenser blend in with its surroundings; it “thinks” about its direct context. The reason that bright colours are only on a detailed level, is because this is confirmed by the separate moodboards. A completely bright dispenser is not calm. These colours are also no guiding elements, but more have a more supporting role.

Figure 60: Minanic compared to minimalistic (left) and organic (right) (images retrieved from LeManoosh.com)

The main colour palette displays the typical mysterious character of Satino Black by greyish tones. But, the appearance is influenced on a larger scale by new textures and on a detailed level by new colours. For marketing purposes, a red accent is advised for a professional warmth

Go the
extra r
Go for
Satino

Product





Product + perception


Figure 61: Moodboard Satino Black (images retrieved from lemanoosh.com, seriouswheels.com, alamy.com, and videohive.net)

e

mile

Black

Style system

Perception

The overall appearance is characterized by single curved surfaces. Partly they are the result of the folding mechanism (chapter 5.12. | design interdependencies), but for the most part are established by the minanic moodboard. Except for the placement of the fillet on top and at the bottom. This fillet could also be at the sides. But then the design would be too close to the Tork stainless steel dispenser. The mouth of the front plate (figure 62) has the function to signify where to take the paper. But the design can be traced back to the truck and wheel arches of the bottom car.
The window shape is a result of the standard wrap design (chapter 5.15. | wrap design). The colour strip is used, to let the window have a position and shape, so it does not appear random.
The mouthpiece does not have ribs at the front, so this area is completely smooth. Also the opening is equipped with extra-large fillets (Figure 63) to prevent users from hurting themselves.

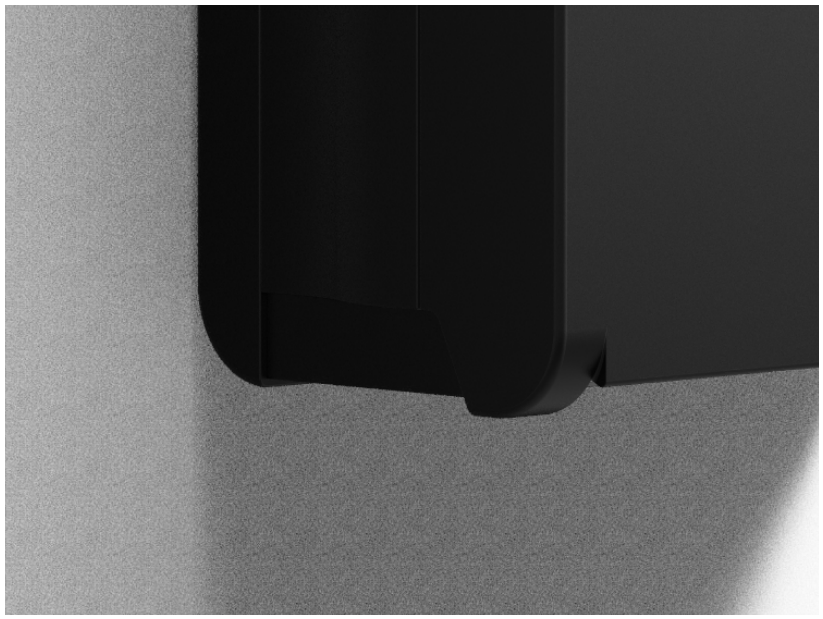


Figure 62: mouth of the front plate

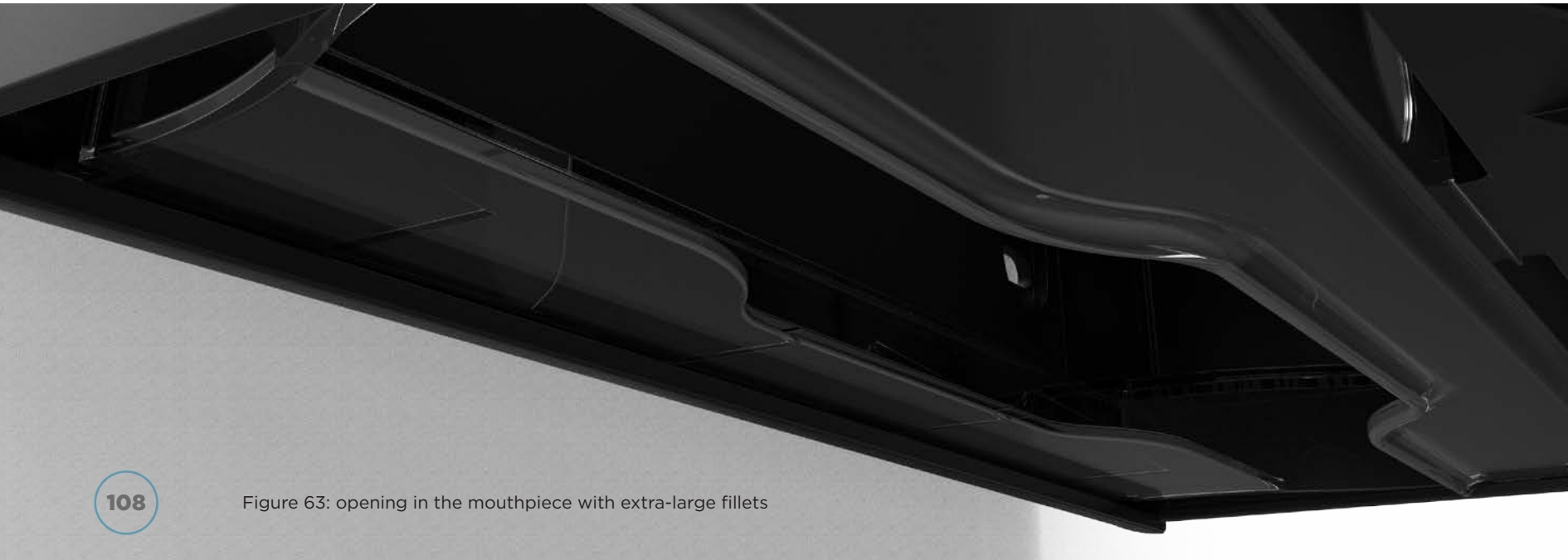


Figure 63: opening in the mouthpiece with extra-large fillets

5.12. | Design interdependencies

Requirements result in a certain design for one part. This part influences another part in its design; i.e. its dimensions, assembly, or position. This chapter discusses what aspects of the design influence other aspects hand how is dealt with them. Figure 67 shows an overview of these design interdependencies.

The top and bottom fillet, as discussed, were a result of the minanic moodboard and partly the folding mechanism. Actually, not so much the folding mechanism, but as how much the volume can be decreased by the folding mechanism. When the fillets become larger, the front and back plate become further apart when folded. So the smaller, the better. But smaller fillets resulted in a minimalistic appearance and not a minanic one. The balance is found with fillets of 20mm in radius.

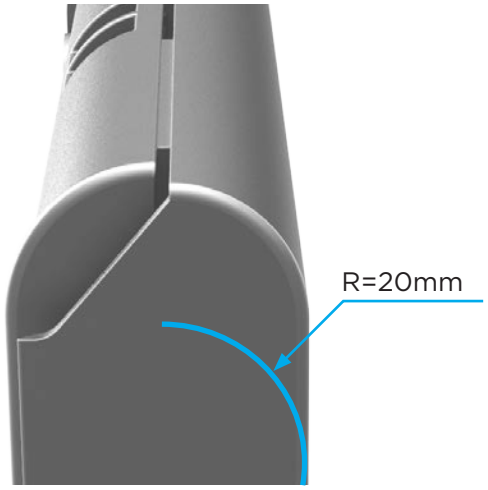


Figure 66: Top fillets with a radius of 20mm

The sliders in the front plate are actually two raised edges that enclose the pin of the side panel. The thickness of these edges, and then primarily the one closest to the inside of the dispenser, determines the geometry of the side panel's pins (Figure 64). If the thickness increases, the pin needs to come more forward. Because it moves forward, the length of the slider needs to increase. And this has influence over the placement of the click finger and thereby over the placement of the keyhole.
And that's not all. Because the pin also needs to move outward, the front plate itself becomes wider. When this happens, the side panel's curvature needs to be adjusted to have a neat connection with the front plate. The same goes for the top plate and mouthpiece. So determining the thickness of the slider was one of the first things that was optimized.

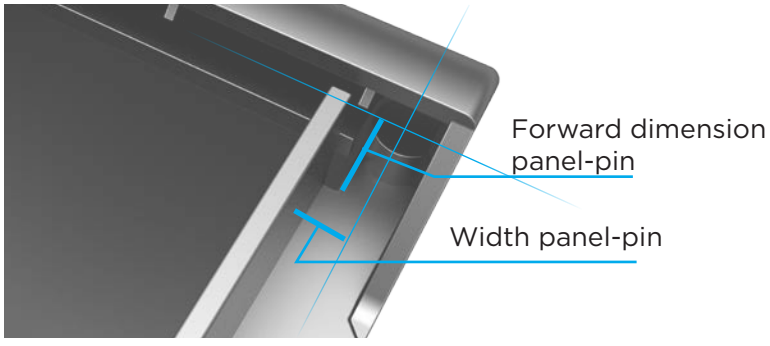


Figure 64: Interdependency between slider and side panel pin

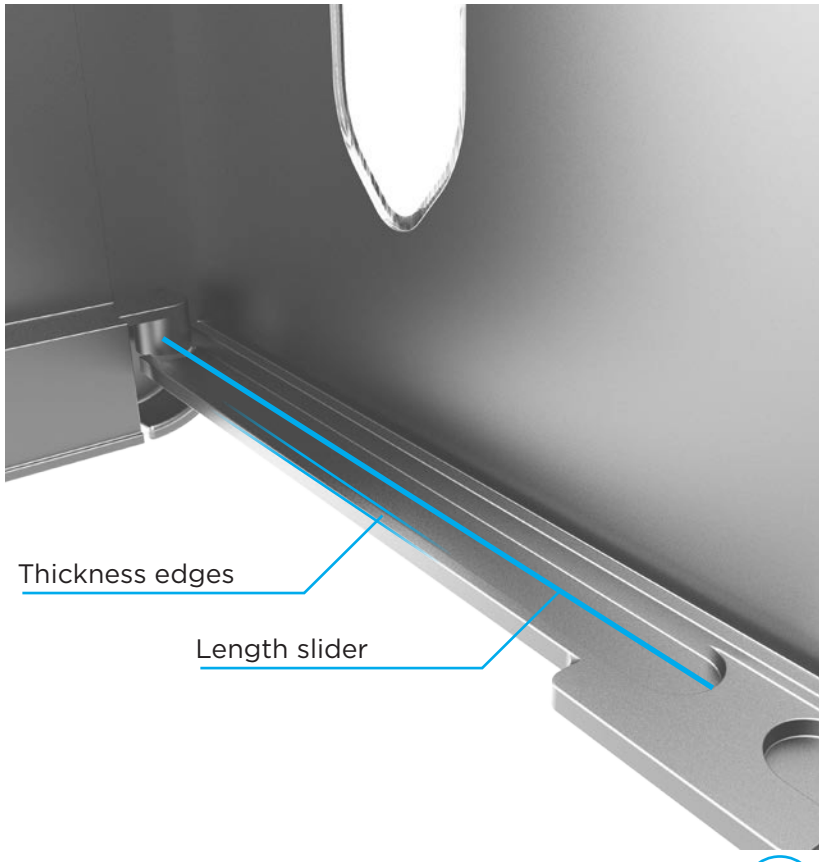
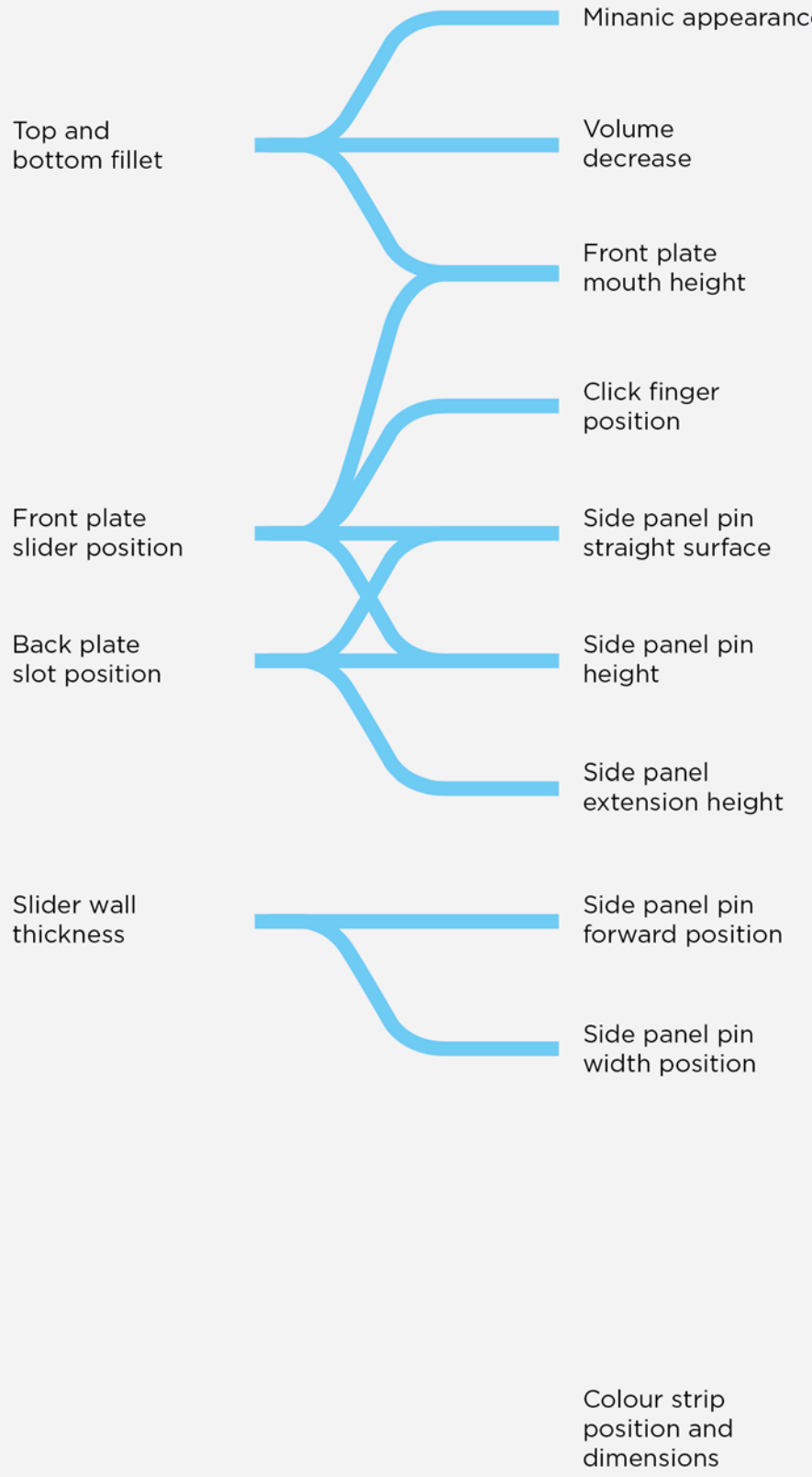


Figure 65: the connection between slider and side panel pin

The position of the sliders and slots in the back plate determine the height of the straight part of the side panels, and thereby the size of the holes in front. When the sliders are moved closer to the fillets, the curved part of the side panel can become larger in comparison to the straight part. But moving the sliders this way, also influences the mouth of the front plate and position of the front plate click finger. The dimensions as they are now, result in a well-defined mouth with sufficient room for ribs to support the bottom slider.
The front plate has a mouth that functions as a usecue, also has a second function: It serves as the stop by opening. It bumps into the side panels, so that it stays under an angle. This angle is determines the freedom of movement of the cleaner. So enlarging the mouth, results in a smaller angle and thus less freedom of movement. The length that is used now, results in an angle of 72 degrees. Compared to a 68 degree angle of the current dispenser (Figure), the freedom is increased.
The length of this mouth also influences the geometry of the ribs that support the slider. When the mouth is smaller, the ribs also need to decrease in size.
The window and wrap design are dependent on each other. The window needs to be at the right position to give sufficient information about the filling. The size and position determine this. The colour strip of the wrap follows the window. So wherever the window goes, the wrap goes. This also goes for the toilet paper dispenser, where the window is placed on the sides.
However, the shape of the window is determined by the colour strip. Because the colour strip will always be there (chapter 5.15 | wrap design), the window can be optimized for the shape of the colour strip.



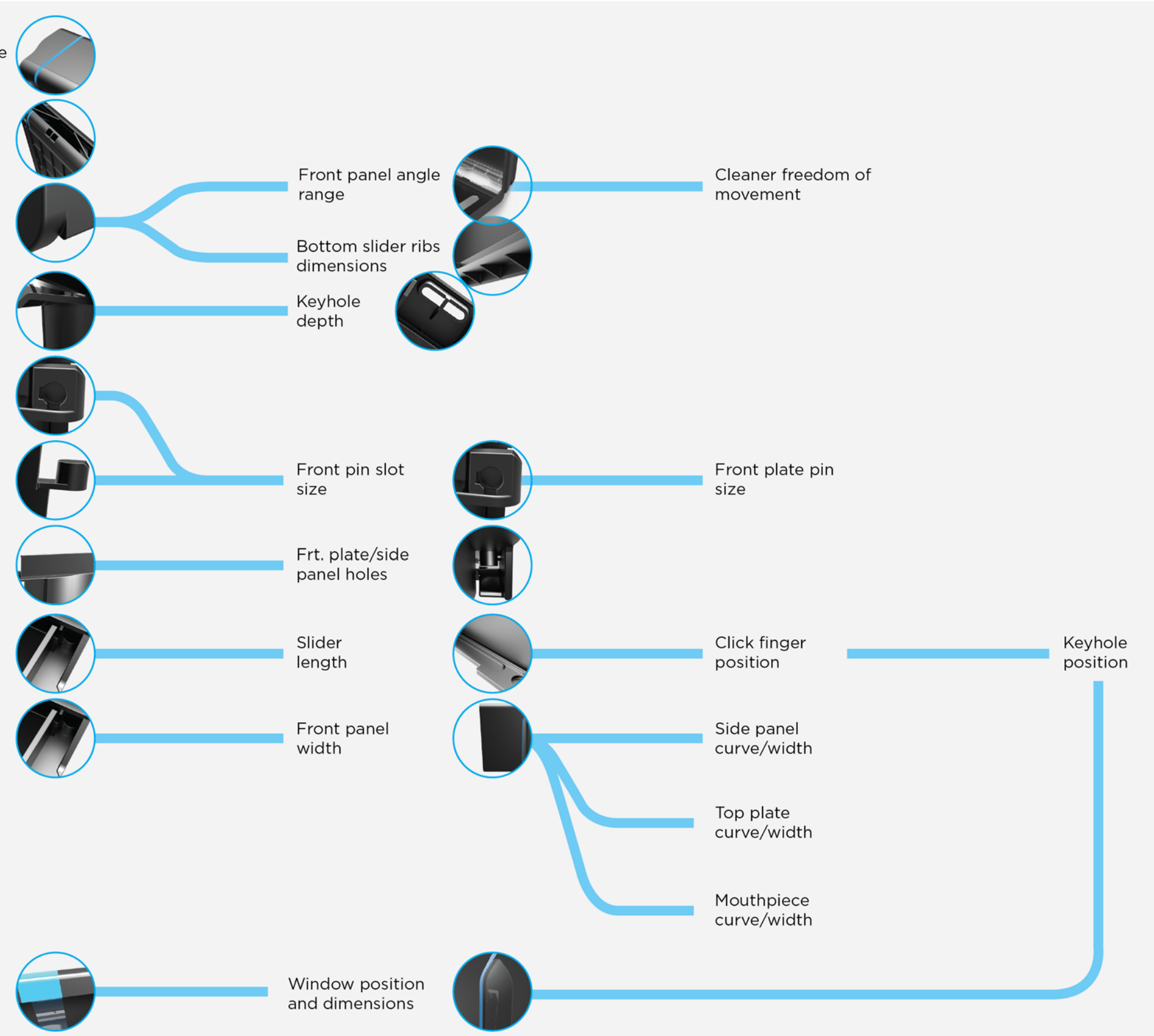


Figure 67: overview of design interdependencies

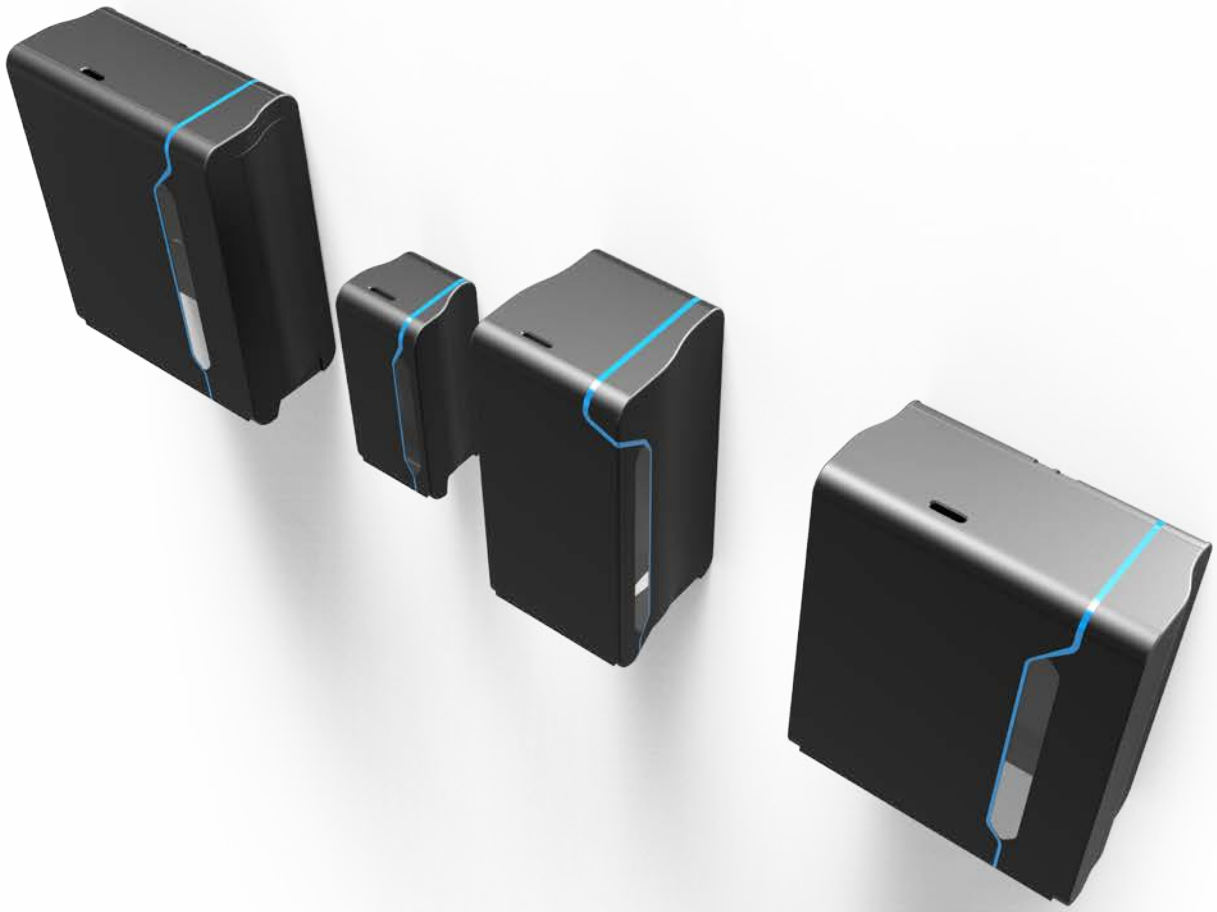


Figure 68: A small selection of how the dispenser range could look like

5.13. | Packaging

5.13.1. Calculations savings

The folding mechanism chapter showed a decrease in volume and the gains that are the result of that. Then, only the transport was taken into account. But the packaging also decreases, so less paper is needed per dispenser. The current dispenser is put in a box of 295 x 455 x 155 mm and thereby requires 0,5191 m^2 of paper. The Fold is put in a box of 288 x 348 x 60 mm, requiring 0,289m^2. This is reduction of 0,2301m^2 or 45pp (percentage point). The sustainability influence of this difference is described in the Sustainability chapter, where the current, the BriQ, and Fold dispensers are compared.

5.13.2. Packaging contents

The dispenser is packaged in the same way as the current dispensers, as the interviews indicated that this is good. The screws and dowels may not of the quality that dispenser installers would like, but since this is different for every dispenser installer, it will be hard to account for everyone. Therefore, the contents of the packaging is not changed and still consists of the folded dispenser wrapped in a plastic back, along with screws and dowels (located inside the dispenser), and a mounting manual.

Not every dispenser installer needs the mounting manual after a while, so this might not be necessary. But the exact timescale for when the manual is not needed anymore is not calculated or analysed as this was put outside the scope of the project. The only small difference with the current packaging is the addition of a small tongue so opening the packaging is clear.

5.14. | Wrapping

Wrapping is applying a plastic film over an object. The most used and well-known application is vehicle wrap. This is popular as it is quicker and cheaper than a custom repaint. Thereby, it also comes in colours and surfaces which are hard or sometimes even impossible to create using paint. Like for instance gold or red carbon fibre. This is advantageous, as competitors only offer a limited colour range. Wrapping can create a competitive advantage, as was concluded at the end of the deconstruction. But applying a wrap can happen on all sorts of objects and products, ranging from vehicles to buildings and kitchens to billboards.

5.14.1. Rules & Equipment

To professionally wrap an object, there are certain rules to obey. The first is that a wrap is best applied under influence of heat. This makes the film pliable, but lets the film shrink. This shrinkage advantageous when wrapped around corners, because then it presses itself to the object's surface causing the adhesive to really activate. Usually there should be between 25mm and 40mm of film bend around the corner to stick. This, in combination with extra pressure from a squeegee results in a perfect adhesion between wrap and object.
Furthermore, there are some tools required for a solid application. First of all, a squeegee or similar tool to press on the wrap and activate the adhesive without making it dirty. An industrial heat gun with an electronic readout, capable of achieving and sustaining temperatures above 500°C and according heat and burn-resistant gloves.

5.14.2. 3M or Avery

For wrapping, there are actually two major brands that immediately pop up: 3M and Avery. Both are very big in wrapping, but 3M is also active in other fields, among others healthcare. This means, they have extended knowledge of hygiene and its focus points. This might help in the future, to develop for instance special hospital dispenser wrapping. 3M also has a lot of overlap with Satino Black when it comes to sustainability. They have a special focus on life cycle management, use recycled packaging and paper material, and believe in a cooperation between companies to reduce environmental impact. Furthermore, they have a constant ambition to reduce the amount of packaging; something that is a critical point for this future vision of Satino Black.

5.14.3. Requirements

There are a lot of different films to choose from. Each with their own specifications. The first requirement is that the film should be PVC free. PVC is not sustainable and would do more damage to the brand Satino Black than customization would do good. Another advantage is that PVC free film is tougher than vinyl, which means less risk of tear and faster, cleaner removal.
The second requirement, is that is can be applied to complicated ABS products. The dispenser has some sharp fillets, so the wrap film must be flexible enough and be able to stretch sufficiently. Also, the ABS application removes a lot of the offering of PVC free films. Another important requirement is the type of adhesive. A pressure sensitive film is desirable, because this can be repositioned before applying pressure, but more important uses a less aggressive adhesive and is easier to remove. But removal may not be too easy to prevent unauthorized people to remove the film from the dispensers. Therefore, a permanent removability is wanted. It needs extra heat to remove, which can be done using a hair dryer or heat gun. Removing the wrapping needs to be done carefully, but when done so, it is also completely gone. Along with the adhesive. Hygiene is yet another important focus point. Although it is not antibacterial, the cleaning agents used in hospital can be used to clean thoroughly (Wim Oostveen, 2017). 3M offers good and widely used cleaning products, so it is logical that the wrapping film can withstand those.

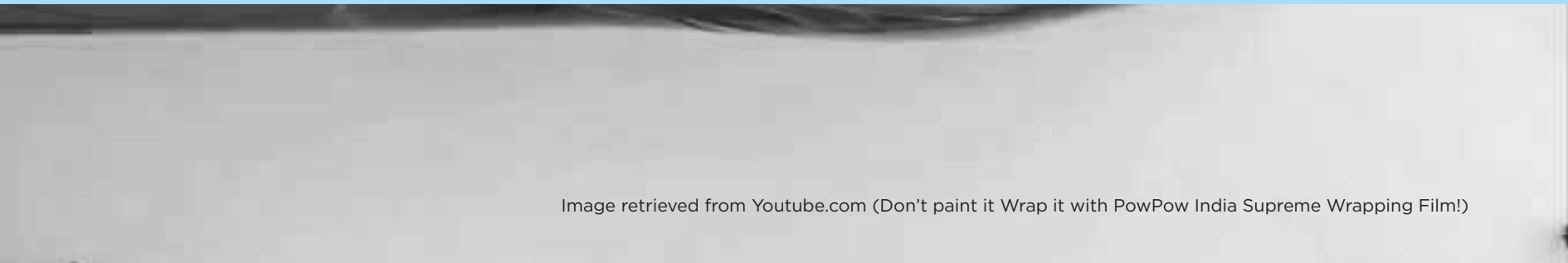


Image retrieved from Youtube.com (Don’t paint it Wrap it with PowPow India Supreme Wrapping Film!)

5.14.4. Envision™ Print Wrap SV480Cv3

So all these requirements result in only one option: the 3MTM EnvisionTM Print Wrap SV480Cv3 (Figure 69). It is a premium quality film, which means it has a lifetime of 12 years and thereby can survive 4 contracts of Satino Black dispensers. Since mission statements are likely to be revisited every 3-5 years (Stuecher, 2016)(Van Eck, 2017), this lifetime is more than enough. It is not unthinkable that companies want a different look after that. Every thinkable image, colour, or texture can be printed on this film. A laminate film is added for surface finishing and protection of the ink. Both the wrap and laminate film are PVC and phthalate free. There are also laminates that mimic stainless steel, which create opportunities to replace the expensive stainless steel dispenser line.
To make sure that this wrap film can be applied over such sharp edges as with this design, two checks were conducted. The first was an opinion from the owner of a professional kitchen wrapping firm (keukensplakken.nl). The second was a small test, by applying a similar wrap over the BriQ Single dispenser. Both were positive and convincing for wrap application on a complex shaped dispenser. Appendix X describes how this came to be. It was discovered how easy, yet complicated wrapping can be. Easy to apply, but with complex shapes, difficult to apply it without any wrinkles.

3M™ Envision™ Print Wrap SV480Cv3

Foil type	PVC and phthalate free
Basis type	ABS, Aluminium, Glass, Paint, PMMA, PC
Applications	indoor and outdoor signs, fleet, vehicles, watercraft, textured walls
Adhesive type	Pressure sensitive
Removability	Permanent
Hygiene	Not anti-bacterial, but can be cleaned thoroughly
Classification	Premium, 50µm
Max. sustainability	12 years
Surface & temp.	Matte, -60˚C to +107˚C
Base colour	White
Application	Exterior and interior
Fire certified	EN13501-1 (buildings)

Figure 69: specifications of the chosen wrap

5.15. | Wrap design

5.15.1. Boundaries

Off course, customers cannot get full freedom in the design of their wrap. Satino Black does not want to be connected to a swastika or something from the red light district. On the other hand, it should really be something personal instead of standard colour variations of the dispenser. This is what competitors do (Figure 71). Satino Black should be the next step in this. So instead of only colours, Satino Black should be offered in a vast array of finishes and textures that present harmony (Figure 70). Although this will be standardized, the amount will be much larger than that of the competition, giving a personal feeling to the client while sufficient control of the appearance of Satino Black is kept. But fully customized prints are possible when desired. However, the design should be then checked by the Satino Black brand manager at Van Houtum to see if the design doesn't conflict with the Satino Black brand image.

Boundaries also need to grow with the requests of the clients. You cannot define everything, but a description of what Satino Black wants to breath as a brand is handy to put on the website and configurator. This way, clients can also decide for themselves if their request is likely to be accepted.

Colour and finish offering should also have some boundaries. This should be done carefully to find a balance between personalization and maintaining the Satino Black brand. The chapter "the configurator" will discuss this in further detail.

Every wholesaler gets a standard spot on the wrap to print their logo on. This spot is defined by Van Houtum in its measurements and position on the dispenser. This way, every wholesaler has an equal opportunity to advertise and consistency is maintained throughout the range. The logo should be offered in a black and white version, so it does not compete with the personal designs of the client, yet is clearly visible, and is in line with the Satino Black logo.

Furthermore, a signature mark should be added to the wrap so visitors and employees can see that the wrap is Satino Black approved. This mark cannot be easily copied as this can result in fake wraps that are not sustainable and thereby damage the brand.

With all these boundaries and rules, good control over the appearance of the dispensers is kept and consistency is achieved; something which is very important to distinguish these dispensers from their competitors.

Figure 70: future colour scheme of Satino Black

BERENDSEN

CWS

KATRIN®

TORK®

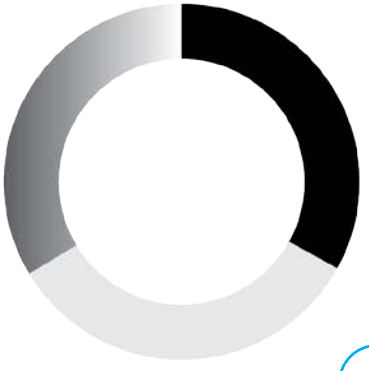


Figure 71: competitor customization overview (images retrieved from the respective companies)

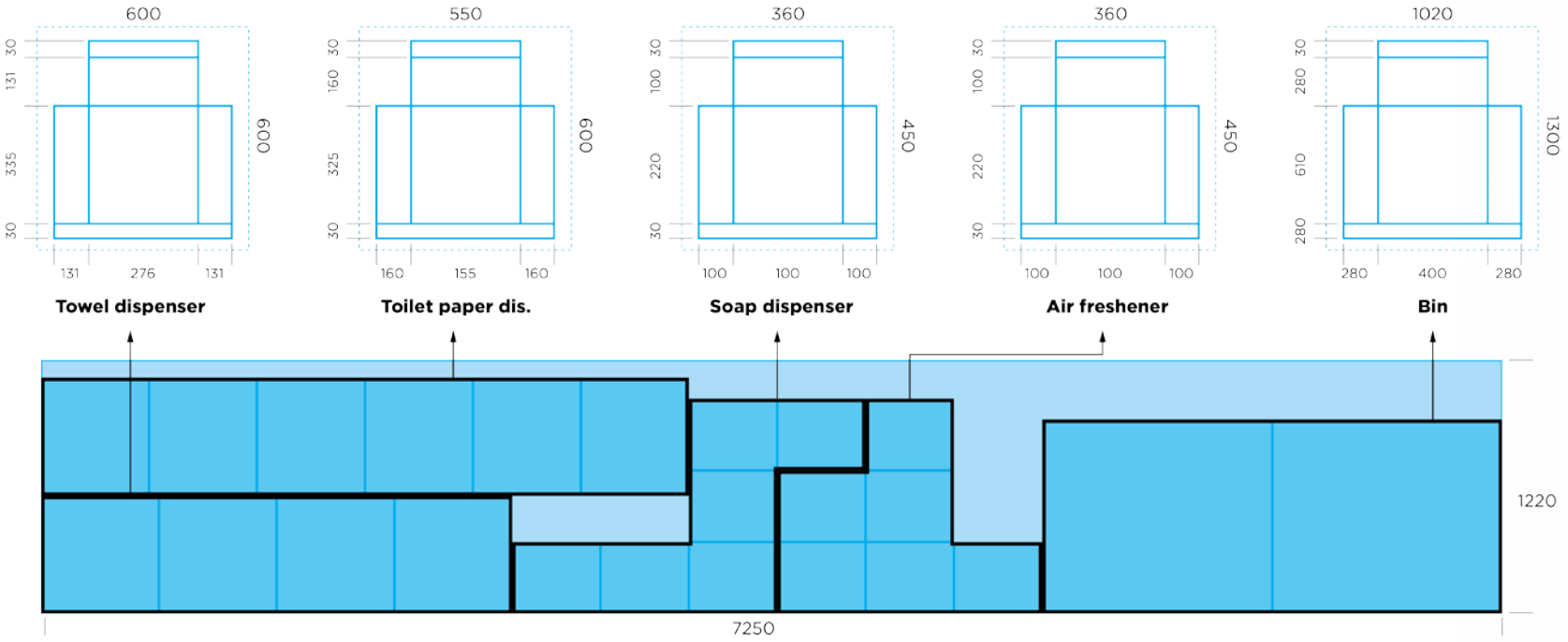


Figure 72: overview of how standard wrap pieces are optimally configured over a film roll of 1,22m wide and max. 50m long.

5.15.2. Pieces and sizes

The SV480Cv3 is produced only in large rolls of 1.22 x 50 metres. However, printing can happen over a smaller area and cut at any given position. In order to fully use these measurements, a particular layout should be thought of depending on the offering. Figure 72 gives an overview of such a layout, determined by a regular sized washroom in an office building. Field research showed that this is a washroom with 3 toilets and 2 sinks for a men's washroom. So per block of one men's and one women's washroom requires 4 towel, 6 soap, and 6 toilet paper dispenser, 6 air fresheners, and 2 bins of 43L. Because not every dispenser and bin is worked out in this project, an estimation of the measurements for the new line is used. This estimation is determined by the relation between the current towel dispenser and the Fold. The Fold measures 76% in height compared to the current. This relation is extrapolated to the rest of the line.

Following this rule of thumb results in certain surface areas. Because the wrap should be bend around corners, an extra 30mm in each direction is added; even though this might not benecessary as the wrap will be stretched a lot during instalment.

It can be seen that the back end is not taken into account, as this is not visible when installed in the washroom. Deleting this section is another optimization step in terms of sustainability. This is also good considering the complexity of the back plate. This is another demonstration that only professionals should apply the wrap. These measurements should be fitted as economically and sustainably over the roll.

Figure 73: standard design across the range with strip focus

5.15.3. Standard design

In order to have an even more consistent dispenser range, a standard design is in place. As said in the Aesthetics chapter, this design is based on the proposed moodboard. The wrap can easily be printed with the desired colour strip that runs across the dispenser. This strip runs differently over the various dispensers, as the window is positioned differently between the dispensers. The colour strip confirms the consistency between dispensers even more (Figure 73).

The colour strip is positioned and has dimensions as small as possible to not let the dispenser be too conspicuous. However, it is big enough to stand out as a clear design feature. Therefore, this strip can be changed in colour and finish just like the rest of the wrap. It is then up to the client which combination suits his washroom best.

This colour strip cannot be removed as this is a key feature of the design. Without it, it becomes a completely different dispenser. In such a difficult market as dispensers, it is hard to be noticed. The colour strip counteracts this and adds to the washroom experience. Removing the strip also has an effect on the shape and position of the window, as the window can either get a different shape, or it becomes a randomly placed object. With a high class dispenser like the Satino Black, this is something to be avoided. If clients do not want the colour strip, they can choose to have it in roughly the same colour and/or finish. But never exactly the same, as this would also result in optical removal. Clients can for instance choose for a matte body and a shiny strip. Figure 74 shows that this can be a suitable solution.

The window and thereby the strip have a fixed position. Therefore, the face on which the window is placed acts as the starting point for the wrap. From there on, the wrap will be applied over the dispenser. Because the wrap needs to stretch a lot to be bend smoothly over the corners, the strip is likely to deviate from the window's dimensions if the starting point is chosen differently.

Figure 74: matte black dispenser body with a gloss black colour strip

5.16. | Business model and opportunities

Adding a wrap to the dispensers requires a new business model. This paragraph advises a business model that looks the most promising to strengthen the Satino Black brand (Figure 74). Other business model approaches are considered and can be found in Appendix X. In this appendix it is also discussed why they didn't make it to the final advise. This chapter discusses how this business model works in real life; what is the starting point and the journey towards the client having wrapped dispensers in its washroom.

5.16.1. The client's order

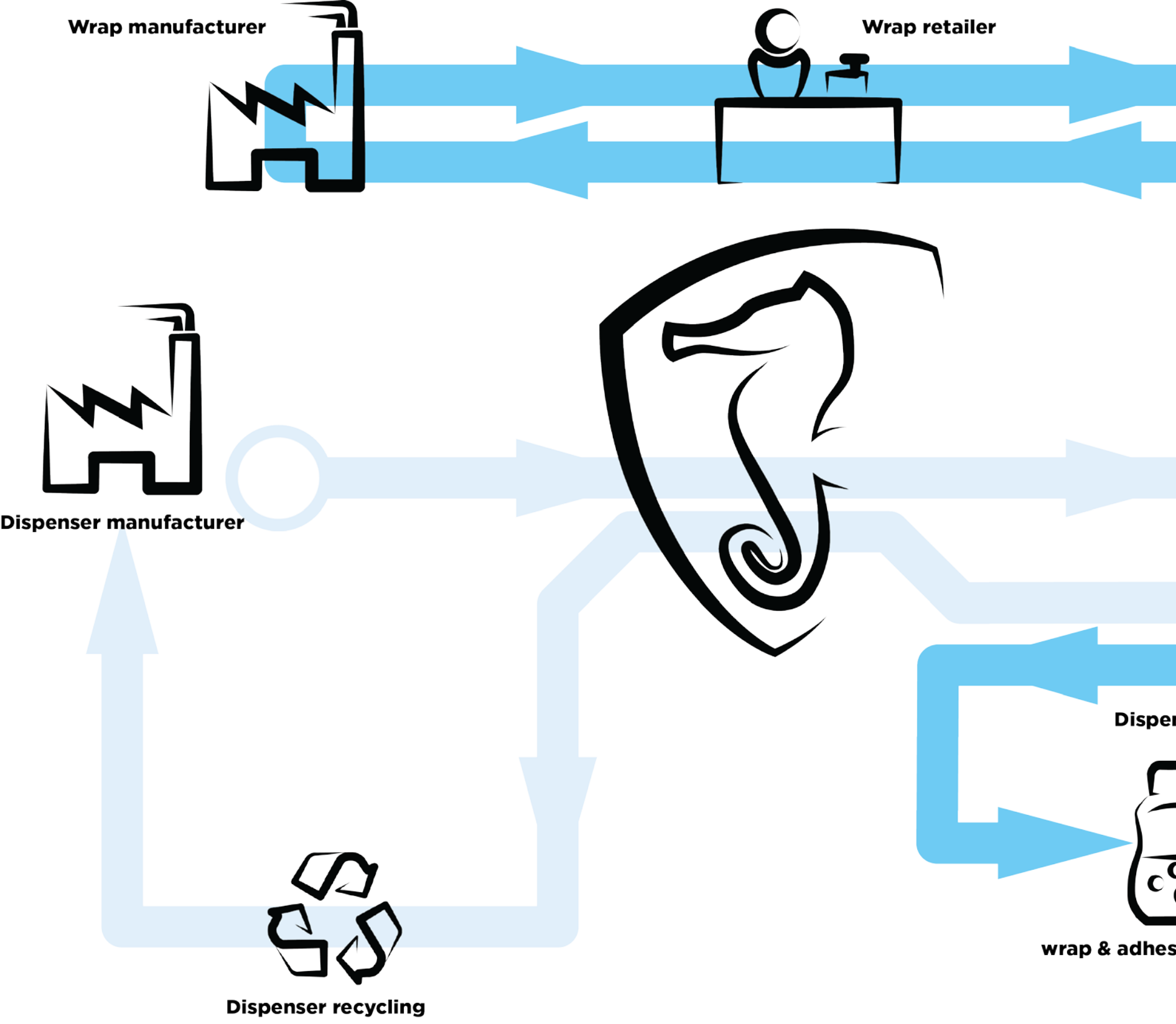
It starts with the client ordering dispensers at the wholesaler. Via a configurator on the site of Van Houtum (discussed in its own chapter), the client has made a selection of the design of the wrap. This design is communicated with the client via a .pdf files where all dispensers and according wrap designs are placed with the help of codes. These files are checked and after that used for ordering the client's wishes.

5.16.2. From order to delivery

The wholesaer orders the dispensers at Van Houtum, just like it is currently done. The wrap film is ordered at a separate company. This is dependent on the wholesaler at which company to order, but there are several professional companies specialized in installing wraps. Such a company orders the wrap at their supplier and 3 to 4 days later (Van der Straaten, 2017), it is printed and returned to the installer. Then, the wholesaler and wrap installer make an appointment with the client to come and install the dispensers.

5.16.3. Installing personalized dispensers

On this date, the dispenser installer and wrap installer work together at the client's to install the dispensers correctly; making use of the wrap expertise of the wrappers and the mounting expertise of the dispenser installers. Only this way the dispensers are installed at the highest possible standard. Because when the dispenser installers wrap the dispensers, this is likely to become sloppy as wrapping requires a lot of practise and knowledge. The most challenging being the influence of the heat gun, because overheating the film damages the film, but under-heating does not permit conformability. However, the wrappers don't know how to install dispensers correctly because of the same reasons. The place for wrapping is outside the washroom as it can only be applied in a dry environment. When all this is done, there is one week of warranty for the client to mention if the wrap is not sticking well. Otherwise, the dispensers can begin with their life in service.


Wrap manufacturer
Wrap retailer
Dispenser manufacturer
Dispenser recycling
wrap & adhes

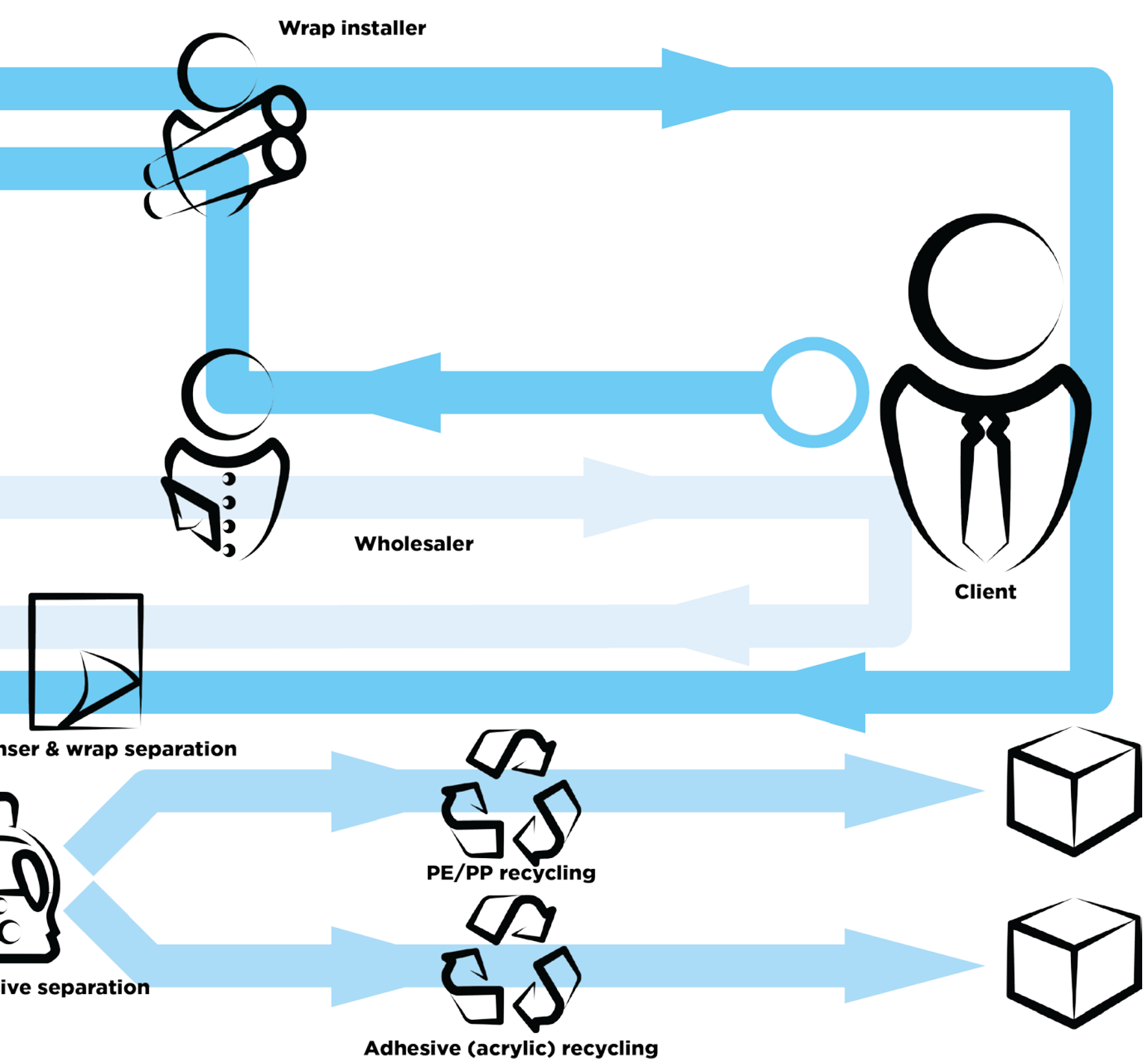


Figure 75: visual representation of the business model

5.16.4. The contract's end

After the first contract expires, the client can choose to prolong the contract for another 3 years. The wrap film has a lifetime of 12 years, so this is not a problem. However, the client gets the option to renew the wrap for a discounted offer. The wholesaler will not advise this for sustainability reasons, but when the client insists, it can be done. Ordering the new wrap will run through the same channels as described above. Removing the wrap will happen at the same time as the new wrap will be applied. This way, the installers only need to come by once as they are also experts in removal. The old wrap needs to be removed when the new wrap is partly transparent. Because of consistency and prevent errors, a fixed removal in this process will be best.

5.16.5. Recycling

But removal can also happen when the contract is not prolonged or the dispensers are broken. This needs to be done by the wrap installers, as removal needs to be done professionally. When this is done so, no adhesive residue is left on the dispensers, so no extra steps in their recycling process need to happen. At this stage, the wrap installers have done their job. Van Gansewinkel collects both the dispensers as well as the wrap film and will be in charge of recycling the latter. The dispensers will be brought back to Van Houtum as they are in charge of recycling those. Since the wrap film is made of polyolefin material and the adhesive is an acrylic solvent, recycling does not form a problem. The first step is to separate those by washing, the rest is done using standard steps which are outside of the business model scope.

5.17. | The Business Model Canvas

To know what this changes for Van Houtum and its current business model of dispensers, the business model canvas, proposed by Alexander Osterwalder, is filled in. Figure 76 shows this business model, with the changes represented by the words printed boldly. It does not only show the changes, but also visualizes the fundamental thought behind creating value for clients. To know for what customers the personalized dispensers are, is the most important information for filling in the canvas. Therefore, defining the customer segments is the place to start.

5.17.1. Customer segments

Satino Black dispensers were mainly for the sustainable entrepreneur: clients with serious sustainable goals. But in terms of design it depended on the taste of the client, of the facility manager to be precise, whether or not he would choose for Satino Black or a competitor. Adding a wrap and being able to personalize, a different customer segment can be identified: the sustainable decorator.

5.17.2.The sustainable decorator

Satino Black was always the example of a sustainable washroom solution. The design was nice, but just like the competition a given standard. It needed to be found attractive to the facility manager or it would not be bought (De Kroon, 2017). The focus was on sustainability, so mainly facility managers with these ambitions were drawn by Satino Black. The wrap adds more design freedom to it. It lets the facility manager think about the possibilities for the design. It becomes a decorator with sustainable dispensers; a sustainable decorator.

5.17.3. Value proposition

Before, the main sales point of Satino Black, was the sustainability story behind it. Satino Black offers a hygienic and complete washroom interior, but this does not stand out from competitors. Some competitors are already offering customizable products. However, their customization is limited to a handful of colours. Wrapping the dispensers and thereby offering almost unlimited colours and finishes results in real personalization; it is the difference between customization and personalization. This is called a qualitative value proposition (Hinterhuber & Snelgroove, 2016), because it focuses on customer experience and not on financial aspects.

5.17.4. Channels

As discussed, the client is only in contact with the wholesaler. This keeps it simple for the client and coordination of dispenser and wrap delivery to the client is more streamlined. The wrap installer is an extra channel. By leaving the wrap instalment completely in the hands of these people, it is applied and removed perfectly and professionally. This gives the client a secure experience and dispenser recycling is not in danger.

5.17.5. Customer relationships

With the dispensers, Satino Black already establishes a long term relationship with its clients. The contracts make sure of that. The wrapping adds some special attention to this. An extra step in the ordering process is added, resulting in a personal touch. The ordering can be done using the configurator on the website, but also via phone with the wholesaler. This way, the client has direct advise and information on the wrap available.

Key partners

Wholesalers
Van Gansewinkel
Dispenser manufacturers
Dispenser design agencies (Van Berlo)

Wrap installer

Key activitites

Recycling dispensers into new dispensers
Marketing B2B

Recycling wrap
Providing custom wraps

Key resources

Recycled ABS

PVC free wrap

Value propositions

Closed loop
Hygienic
Complete

Extended personaliza

Cost structure

Employees
Design and marketing by external parties
Manufacturing dispensers at 3rd parties
Replacing broken (parts of) dispensers
Transportation dispensers

Wrap
Transport + Applying wrap
Wrap removal
Wrap recycling

tion

Customer relationships

Long term

Special attention

Customer segments

Sustainabe entrepreneur

Sustainable decorator

Channels

Wholesalers

Wrap installer

Revenue streams

Asset sale; selling ownership rights of Satino Black to wholesalers
Selling dispensers

Customization of dispensers
Removing and recycling wrap fee

Figure 76: the business model canvas of the chosen business model

5.17.6. Revenue streams

Even though filling in the canvas starts with the customer segments, the revenue streams are just as important and often the most interesting for the company behind the business model. Currently, Van Houtum generates income through asset sale and the selling of dispensers. By offering personalization, Van Houtum can increase the price and add a little margin for this option. Furthermore, a small fee for removing and recycling the wrap can be added, just like is currently done for the dispensers. Prices for special requests can be even higher, as they are not standard and require extra costs for design.

5.17.7. Key resources

Satino Black dispensers are made from recycled ABS. With the new dispensers described in this report, this will remain the same. The second resource is the print wrap. As the adhesive and laminate are part of the wrap, these are not considered separate resources.

5.17.8. Key activities

This new resource requires new key activities in the form of recycling of the wrap. PVC free film is made from polyolefin material. In this case (LD)PE or PP. Both are good to recycle materials, being number 4 and 5 on the plastic recycling scale respectively. But before recycling happens, the films need to be washed to remove the adhesive layer. This adhesive is an acrylic solvent, This is also recyclable. Companies like Eiso Bergsma and Pyrasied already use 100% recycled acrylate as main source of material to create new acrylic products. Van Gansewinkel will be in charge of the recycling process of these materials.

5.17.9. Key partners

Multiple parties are considered to act as key partners, based on the fact that it is best economical to integrate the wrapping in the dispenser's journey as late as possible. This leaves 3M, wrapping retailers, Van Houtum, the wholesaler, or a new external party. However, 3M doesn't deliver wrapping services in the Netherlands, just like most of the wrapping retailers. Van Houtum will not do it, since they do not have the experience or the manpower to cover this. The lack of experience does also apply to the wholesaler. Therefore it is chosen to add a new external party in the wrapping chain, called the wrap installers. These companies are experts in applying and removing wrap film from products. The best companies will be the ones that wrap kitchens or similar products, as these are closely related to washroom dispensers. Car wrapping companies can also be approached, but washroom dispensers may be too far from their core business. An example of such a kitchen wrapping company can be keukensplakken.nl. They have professional knowledge on every wrap and work in the whole Benelux, the area in which Satino Black is also sold. For fast delivery times it is better to have more partners, but keukensplakken.nl is a good starting point.

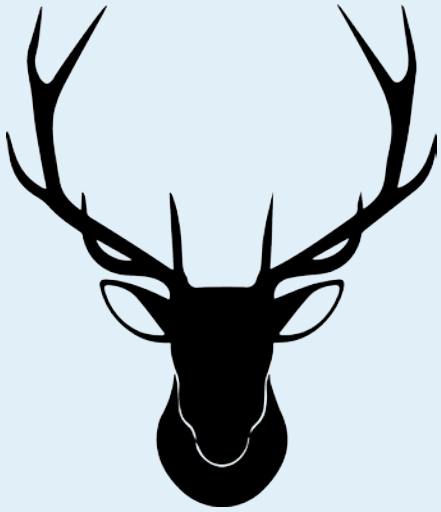
5.17.10. Cost structure

Integrating the wrap in the business model, brings along some costs. Of course the wrap itself will have to be bought. This includes the printing and laminate, but also the transport from 3M to the printing company and from there to the wrap installer. The transport from the installer to the client is counted as separate, as this varies between clients. Applying and removing the wrap will be fixed costs per dispenser, where removing includes also the driving hours of the installers. Finally, the wrap needs to be recycled. A head of expenditure by Van Gansewinkel that also needs to be paid. This all seems a lot, but applying and removing the wrap can be charged by the client by means of a small fee. Clients are willing to pay extra for dispensers that can be personalized (Van Eck, 2017), so this can include the application and removal of the wrap.

5.17.11. Bambi (bmb)

As said, the exact recycling of polyolefin materials is outside the business model scope. But this is not the only boundary, as it is set at the end. The first boundary is the one of production. This wrap is casted, that is known. But how this exact casting takes place is not relevant. All that is relevant, is that the wrap installers order the wrap at their suppliers who also print the design, which in turn order the wrap at 3M. How the exact transport happens is not discussed here.

The exact specifications of washing the wrap is another boundary. Washing is a logical step in removing adhesives. However, the temperature, duration, limitations, etc. are outside the scope.



5.17.12. Pros and cons

Of course there are several pros and cons related to both the wrap as well as the business model behind it. The wrap is chosen because of the requirements; there is no alternative that match those. However, it still has some benefits. It is a printable film, meaning every design can be adopted as long as it supports the Satino Black brand. It enables custom designs for only a small piece of the price of that of painting. And designs can be saved and used later by other companies if they would want to. In comparison to the traditional offering of black, white and stainless steel, this is a huge improvement. What are also possibilities is working with season and limited editions. Although season editions are likely to be changed often and may require a different wrap film, it is still a possibility. Limited editions can work well, when there is good control over the availability. This can be achieved with the configurator and an algorithm to delete limited editions when chosen by a client.

Another benefit over painting is the sustainability. This wrap can be recycled easily, only requiring some minor steps like removal and washing. With the wrap being PVC and phthalate free, the sustainable story is only enhanced.

The wrap also protects the dispenser against scratches and damage. This can prolong the lifetime of a dispenser and thereby another sustainable enhancement. The downside of this, is that there is less transportation going on, which counteracts the usefulness of the foldable element. Therefore, it is even more logical to focus on storytelling considering the folding aspect.

Wrap seals off the split lines between the top plate, side panels and back plate. Because the dispenser still needs to be opened for refill, the split line between the front plate and the rest of the housing has to remain. However, sealing off the others improves a lot in terms of hygiene.

A disadvantage can be seen in the fact that it is a printable film. Everything, even just simple colours and finishes need to be printed first before it can be send. Other wrap series of 3M, like the 1080 version, are already in stock with over a 150 colours and finishes. Having to print everything results in longer delivery times. Even though these times will almost always be the same, it is still a disadvantage.

With endless possibilities it is difficult to define the boundaries of what can be printed on the wrap. It is inevitable that some designs proposed by clients have to be rejected. But this is necessary to maintain the Satino Black brand.

5.17.13. Why this business model?

One of the reasons to opt for this business model (Figure 77), is that the Satino Black brand maintains its professional image. By keeping the wrap installers as close as possible, the wrap is applied and removed as good as possible. Not only is this good for brand building, but also for recycling purposes, as only a professional removal leaves no adhesive residue. Which in turn has a stronger storytelling point. This is done, while the client is still only in contact with the wholesaler. For the client this is very convenient and for the wholesaler not a lot more work. Also maintaining contact with the client is easier done from the wholesaler.

With this being said, it is carefully looked at minimizing the wholesaler's interaction. The wholesaler is their primarily to sell and give information on the dispensers. That is their area of expertise. Their knowledge about wrapping is limited and this should be clearly communicated to the client.

The professions are all kept. So the wrap installers do what they do best and the dispenser installers only install and mount the dispensers. Wrapping requires a lot of knowledge and skill and especially in the beginning, these aspects cannot be asked from the dispenser installers. Resulting in low quality wraps and thereby a decrease in the image of Satino Black. With this amount of competition, having a bad name is fatal.

The extra partner in this cycle can also have an added benefit, because they may have access to possible wrap recyclers, resulting in a wider and more professional network.

One of the negative aspects of this business model, is that the delivery time is now dependent on both the dispenser and the wrap. Depending on the cooperation between the wholesaler and the wrap installer. Which is a con in itself. Plus, it depends on the schedules of three parties when the dispensers can be installed, instead of just two. Making it a lot more difficult to find a suitable date and time.

There is a third party involved, meaning extra margin. The wrap installer will want to make money, meaning extra margin needs to be accounted for, compared to a situation where the wrap is installed by the dispenser installers.

Figure 77: reasons for this business model

5.18. | The new journey

To see how the journey of a wrapped dispenser looks like, the original journey has been updated (Figure 78). In this visual, the production, implementation and disposal of the wrap is added. At the wrapping icon, there are two ways where it can be implemented, since the dispenser might get a second wrapping during its life. This second wrapping is implemented when the dispenser has already passed a number of refills, cleaning and perhaps repair cycles.
With the second wrapping, the first cover is removed and recycled. This is the circle part disassociated from the use cycle and into the acrylic and LDPE cycle after been separated from each other by washing. But this also happens at the end of the dispenser's economic lifespan. Therefore, there are also two ways going to the acrylic and LDPE cycle. In here, the adhesive and film are recycled in separate cycles, hence the split line in the middle.

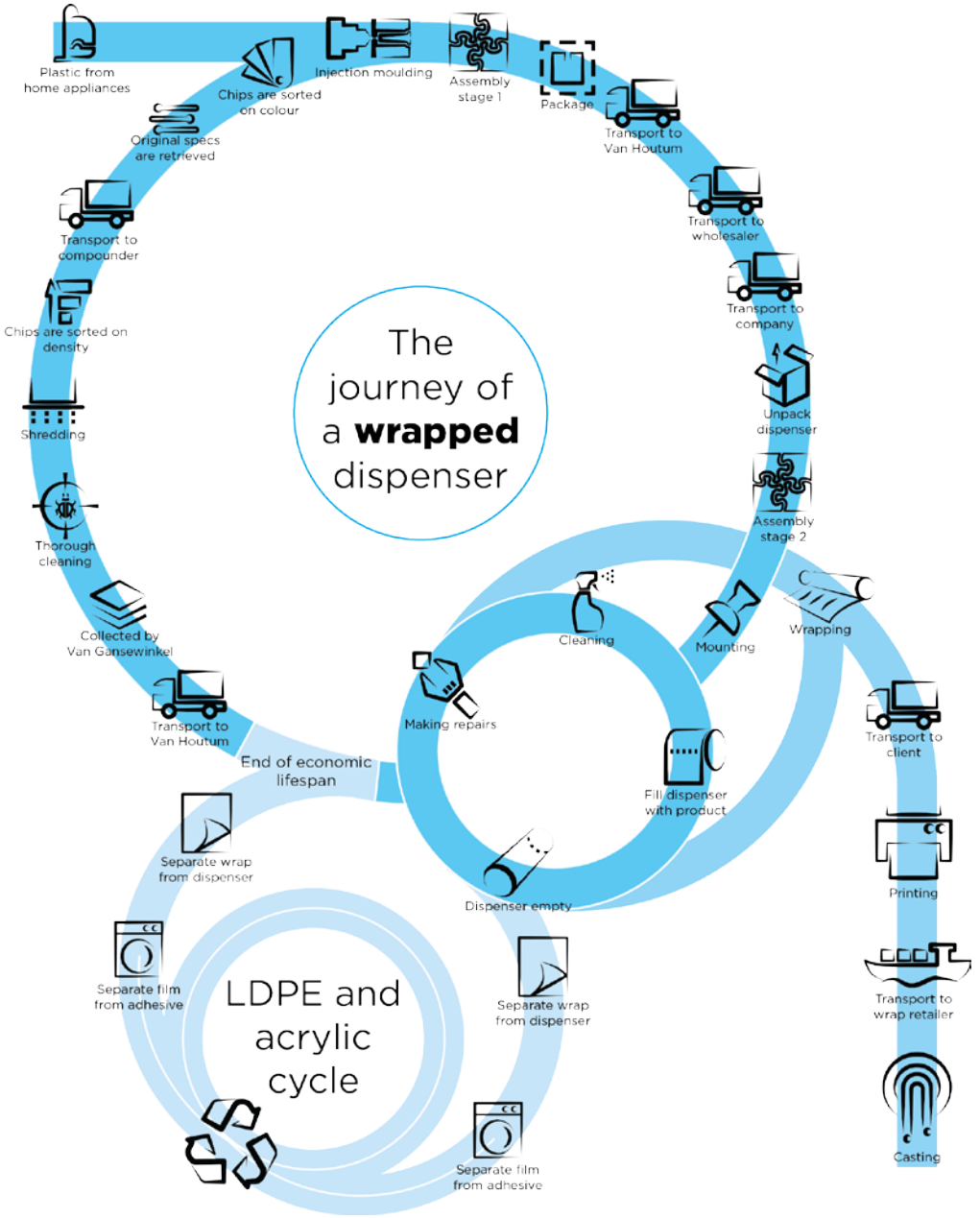


Figure 78: the journey of a wrapped dispenser

5.19. | The configurator

This tool acts as a communicator between the client and the wholesaler. In here, clients can personalize their dispensers with live renders. Figure 79 and 80 shows how the configurator can look like, but is not defined fully as this is not really part of the scope of this project. It acts merely as an example. How this works is explained below. This process can be done by the client individually, but also with guided help from the wholesaler. The client can get on the phone with the wholesaler and they can design the dispensers together, so the client gets live feedback from the wholesaler.

Clients are directed to the configurator either through the wholesaler or through a link on the website of Van Houtum. Before the clients are directed to the actual page, they have to make a choice which wholesaler to choose. This has influence on the design, but also on the contact information shown at the bottom of the screens.

Figure 79: configurator page to make a selection of dispensers

The first page (Figure 79) shows the client all the different dispensers of Satino Black and asks them to make a selection. When clicking on the plus button that is located at a dispenser picture, a dropdown window is opened with information about that specific dispenser (its dimensions, product number, use, certificates, what kind of filling it needs, for what kind of washroom, and downloads explaning why this is the next step in dispensers). This way, the client can get a complete picture. There is also a button to compare dispensers. This way, the client can easily get to know the differences between for instance a toilet roll and a system roll dispenser, and can thereby make a selection easier.
What is also on this page, is a smart button that can be clicked when the client wants a contract. When clicked, the screen shows the standard selection of dispensers (discussed in the context deconstruction). What the client now only needs to do, is to define his washroom, the amount of toilets, sinks, washrooms, and washroom size. With this filled in, the configurator automatically calculates the amount of dispensers the client needs. Of course, the client can contact a wholesaler for advice. If the client wants to have different dispensers, it needs to contact the wholesaler.
When clicking on the button to go to the next page, it first shows an overview of all the selected dispensers and asks if this selection is correct. In this view, some hints and tips are given for the client. It reminds the client that he forgot to a vital product and if he is sure that this is correct. It then also shows some benefits of having that product in the washroom. If everything is correct, the client can move on to the next page.

Figure 80: configurator page to apply a design to the dispenser selection

On this page, the client can choose from different designs. On top of the screen there is a rendered image of one of the dispensers from the selection. There are arrows on both sides of the dispenser, giving the viewer access to different perspective views. The screen shows four different rows. In these rows, different colours and finishes can be chosen. This is not an unlimited offer but defines the balance between personalization and maintaining the Satino Black brand.
There are four circle parts, each representing a different colour element for the wrap. From left to right, these are body colour, strip colour, laminate finish, and custom designs. In the custom designs section, a question mark can be seen. By clicking this, the client can upload a personal image to use on the dispenser. With the first two circle parts, an additional option is possible in the form of a slider (on top). This is to indicate if you want a matte, satin, or gloss finish. The disclaimer at the bottom of the screen shows, that what is visible on the screen is not necessarily how the dispenser will look like when wrapped. In the top right corner there is a button with hints and tips, where the client can get information on what to look for when deciding on a design.
The client can do this for all his dispensers or he can tick off a box to apply this design to every dispenser of his collection. After loading this design on to the collection, the client can click on other dispensers and quickly see how his design looks like on those. Figure 81 shows a couple of possibilities of custom designs. Compared to competitor customization, this is a significant step forward.

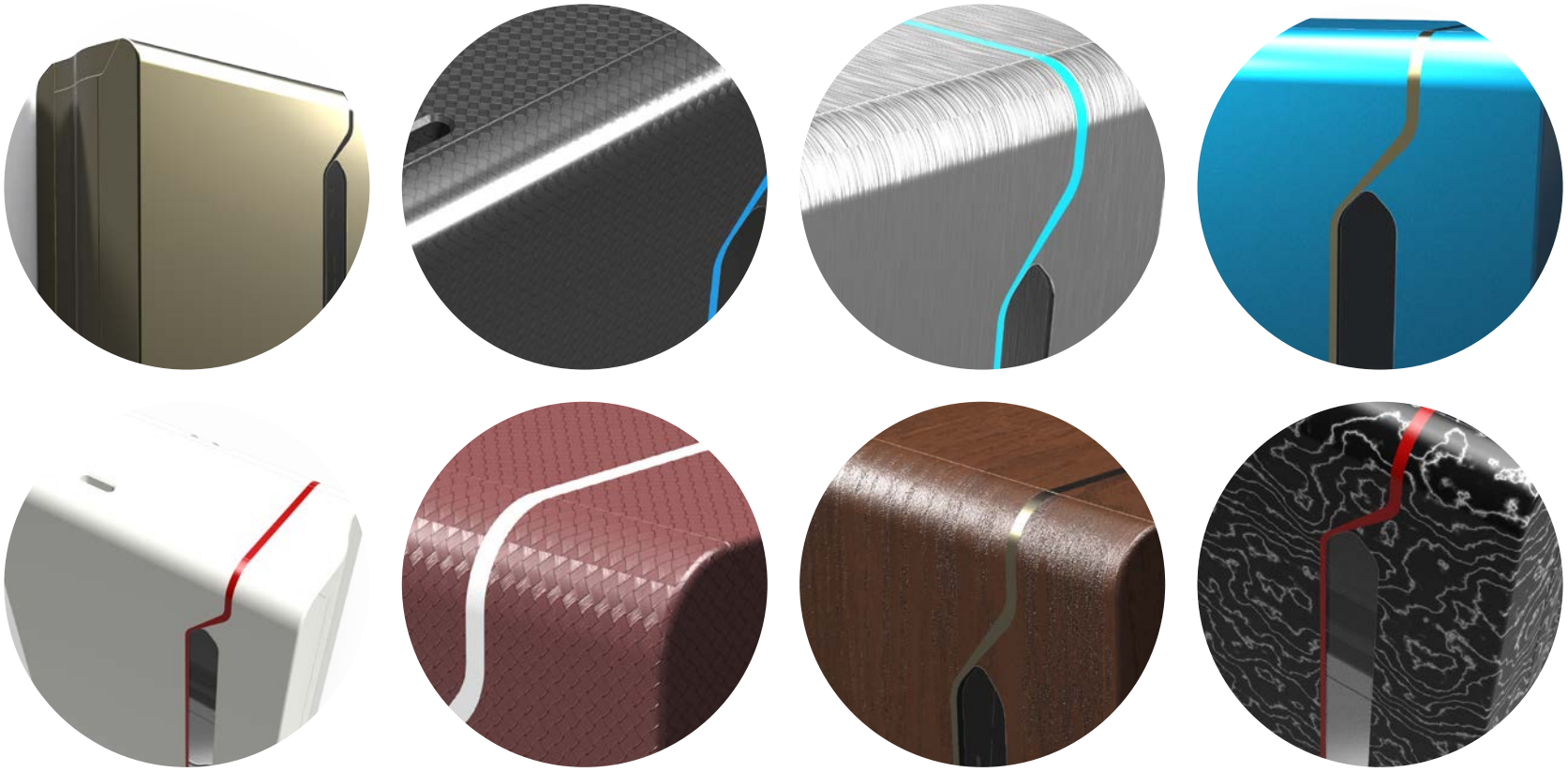


Figure 81: possible designs to show the amount of personalization

The next two pages are overviews. The first gives a complete overview of the selection. Every dispenser is shown separately with its amount and the applied design in both words and thumbnails. Also in here, a small plus button per dispenser is shown that opens the same information box as on page 1. After clicking “accept” the client is directed to the second overview. On this page the delivery time is given along with contact information in respect of the wholesaler is given. Also information on the following steps is given, explaining that the dispensers will be ordered at Van Houtum, that the design will be forwarded to a professional wrap company that prints the client’s personal design, and that the client will be contacted by the wholesaler to find consensus on a date and time for installation. When the client has uploaded an image, it shows that delivery times may deviate because of design checks. Furthermore, an email with both overviews will be send to the client, so he can look forward to getting his personal dispensers installed. By hitting “done” the client gets a final screen, showing that the wholesaler is informed about the selection and will check the design and dispenser selection to make sure everything is in order. A call may occur when the wholesaler sees something missing or the design is not in consensus with the Satino Black brand.

5.20. | Can this be copied?

3M is too large of a company to make agreements on the wrap. Van Houtum is, compared to 3M, a very local company and this will not make it attractive for 3M to let Van Houtum have a monopoly on applying the SV480Cv3 wrap film on their dispensers. But what Van Houtum can do, is to implement a signature mark in the printing that shows that they were the first to wrap their dispensers with a sustainable film. Maybe with formal approval of 3M so other companies cannot claim they were the first. This signature mark can then be placed next to the Satino Black and wholesaler's logo. Or, when it is chosen to do so, next to printed certificates showing the sustainable story of these dispensers (C2C, CO2 neutral, recycled) (Figure 82 and 83).

Figure 82: A possible signature mark next to other sustainable logos

Figure 83: Signature mark example

5.21. | Costs

5.21.1. Dispenser costs

Figure 85 shows the cost summaries of all parts. These are calculated with the help of custompart.net. The exact settings that determine these numbers can be found in appendix X. As the costs at custompart.net are expressed in dollars, a conversion to euros was needed. At the time of writing, 1 dollar equalled 0,85 euro.

Cost summary front plate		Cost summary back plate		Cost summary side panels		Cost summary top plate		Cost summary mouthpiece	
Material:	1,0914EUR	Material:	0,9988EUR	Material:	0,2295EUR	Material:	0,2304EUR	Material:	0,1981EUR
Production:	0,8305EUR	Production:	0,8186EUR	Production:	0,4369EUR	Production:	0,4046EUR	Production:	0,4046EUR
Tooling:	2,3580EUR	Tooling:	4,0596EUR	Tooling:	0,8687EUR	Tooling:	1,4561EUR	Tooling:	1,6303EUR
Total:	**4,2798EUR**	**Total:**	**4,0596EUR**	**Total:**	**1,535EUR**	**Total:**	**2,0919EUR**	**Total:**	**2,2338EUR**

Total paper towel dispenser: 14,21 EUR

Figure 85: cost build-up for all dispenser parts

5.21.2.Wrapping costs

Figure 84 gives an overview of the costs for wrapping the dispensers. The data are retrieved from wrapping experts, desktop analysis, and rijksoverheid.nl. The costs are determined for an average office washroom block (men and women), counting 24 dispensers. The time of applying the wrap is an estimation since dispensers have never been wrapped. These are based on YouTube videos. In total, this will result in 195,42EUR, which is well below requirement 5c that limits these costs at 250EUR (Van Eck, 2017). It is bought in, so production is already calculated in the price per m2. The total wrapping costs per dispenser is calculated by dividing the costs for the washroom block by 24 dispensers.

Wrapping roll (50m): 746EUR
Necessary length: 7,25m
Wrap costs: 108,17EUR
Printing: 15EUR
Wrapping time (per dispenser): 0,1667h
Amount of dispensers: 24
Total wrapping time: 4h
Amount of installers: 2
Installer wage: 72,25EUR/h
Installing costs: 72,25EUR

Total wrapping costs: 195.42EUR
Total wrapping costs (per dispenser): 8,1425 EUR

Figure 84: cost build-up for wrapping a collection of 24 dispensers

5.21.3. Transport and packaging

Because exact data on transport costs is hard to come by, as it depends on numerous variables, the transport costs are based on data retrieved from ecocalc-test.ecotransit.org. In here, transporting per km costs 0,0000125 EUR. So for the scenario used for the LCA comparisons, the total amount of kilometres is 520,5. This means 0,0065 EUR per dispenser.
Packaging costs are estimated based on data from valleybox.com. These data are a tool for companies to estimate a budget for packaging. In here, a durable packaging should cost between 0,01% and 2% of the product costs. So packaging will cost roughly 0,07 EUR.

5.21.4. Results

Together, the dispenser itself will cost 14,21 EUR to produce. The wrapping will add 8,1425 EUR, transport is set to 0,0065 EUR, and the packaging adds another 0,07 EUR. The mounting tools and manual is left out of the costs, as these will add very little and can therefore be neglected. Just as transport, however, transport is a major component in the overall image and the focus point of this project. With all these numbers given, the total costs for a single towel dispenser will be 22,429 EUR.

5.21.5. Conclusions

According to requirement 5a, the total cost price should not exceed the price of the current dispenser, which is set at 37,59 EUR. This is without wrap, as facility managers are prepared to pay more for such an added benefit. It is already established that the wrap is below their maximum for this aspect. So without the wrap, costs will be 14,2865 EUR. Requirement 5b states that a margin of 40% should be made possible. When the dispenser is sold for 37,59 EUR, a margin of almost 62% is achieved. This is well within the requirement.
Even with the wrap, there is some margin to be taken. With 40,3%, requirement 5b is also achieved with the wrap. This means, that an extra profit can be generated from the wrap. As the maximum price for the wrap is set at 250 EUR for the standard 24 dispensers and only 195,42 EUR is needed, an extra margin of 21,83% can be instituted.
So when the price is set at the current price of 37,59 EUR, and the wrap is taken within this price as described above, an absolute profit of 15,16 EUR (40,3%) is made. When the wrap is kept out of the equation and clients pay the minimum for this, the costs will be 45,73 EUR (37,59 + 8,1425) per dispenser. This has an absolute profit of 23,30 EUR, and a margin of 49%. The most profitable scenario will be when for both the dispenser and the wrap the maximum price is invoiced. This is 61,99% for the dispenser and 21,83% for the wrap. All three scenarios comply with the requirements, so no matter what is chosen, these dispensers and wrapping them can be a profitable business model and thereby very attractive. It depends on the scenario how attractive it is for the client.
The total investment costs for the moulds are 157.342,00 EUR. This means that with the most profitable scenario, 6.154 dispensers need to be sold before the break-even point is reached. However, most profit is gained through the sales of paper, hence the loan structure. The profit that is gained from paper is not given in this project, so the exact break-even point is unknown.

5.22. | Sustainability

Another LCA is performed to compare the Fold with both the current as well as the BriQ dispenser. In this LCA, the system boundary is expanded compared to the LCA in chapter 5.4 | No sensors. Since the packaging has decreased with the Fold, it is logical that this is taken into account, as well as the wrap. Tables 5, 6 and 7 show the LCA's from the three dispensers. But again, the amount of paper is not taken into account, as this will not change between dispensers. For the duration, 5 years is chosen as this is the time of one contract. This has influence over the wrap, since it can happen that the wrap will be changed after this period, as the mission statement of companies if revised after 5 years (Stuecher, 2016).This means that when a longer period is chosen, the possibility of a new wrap and thereby new material and transport are involved.
Again, Buma/Stemra (Hoofddorp) is used as the client and A&P (Zwijndrecht) as the wholesaler. Keukensplakken.nl (The Hague) is used as the wrap installer. As a supplier, Stickerland is used, located in Rosmalen. According to the website of 3M, the wrap film is manufactured in Decatur, Alabama, USA.

5.22.1. LCA current Satino Black dispenser

Materials	**kg**	**Process step**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
ABS	1,452	Production	Idematapp2017 recycling mixed polymer	0,399	0,5793		5,92	8,5958	
	1,452	Injection moulding	Idematapp2017 injection moulding, production site	1,268	1,8411		17,48	25,3810	
Packaging dispenser*	0,262	Production	Idematapp2017 Board and recycled paper ("test liner" and wellenstof)	0,5	0,131		0,76	0,1991	
						2,5515			34,1759
Transport	**m3**	**km**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Idar-O.-Swalmen	0,0208	287	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,1618		0,41	2,4475	
Swalmen-Zwijdrecht	0,0208	151	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0851		0,41	1,2877	
Zwijndrecht-Hoofddorp	0,0208	82,5	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0465		0,41	0,7036	
						0,2934			4,4388
Use phase	**kg**	**energy (kWh)**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
						0			0
End of Life	**kg**	**process step**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
				Total CO_2:		**2,8449**			**38,6147**

Table 5: complete LCA of the current Satino Black dispenser

5.22.2. LCA Satino Black Fold dispenser

Materials	**kg**	**Process step**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
ABS	0,9935	Production	Idematapp2017 recycling mixed polymer	0,399	0,3964		5,92	5,8818	
	0,9935	Injection moulding	Idematapp2017 injection moulding, production site	1,268	1,2598		17,48	17,3671	
Packaging dispenser*	0,145	Production	Idematapp2017 Board and recycled paper (“test liner” and wellenstof)	0,5	0,0725		0,76	0,1102	
Wrap film**(*)	0,8845	Production	Idematapp2017 recycling mixed polymer	0,399	0,3529		5,92	5,2362	
	0,8845	Casting	Idematapp2017 blow moulding, machine only****	0,23	0,2034		3,17	2,8039	
Wrap adhesive	0,4423	Production	Idematapp2017 recycling mixed polymer	0,399	0,1765		5,92	2,6181	
Wrap packaging*	0,408	Production	Idematapp2017 Board and recycled paper (“test liner” and wellenstof)	0,5	0,204		0,76	0,3101	
						2,6655			34,3273
Transport	**m3**	**km**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Idar-O.-Swalmen	0,0060	287	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0467		0,41	0,7072	
Swalmen-Zwijdrecht	0,0060	151	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0246		0,41	0,3721	
Zwijndrecht-Hoofddorp	0,0060	82,5	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0134		0,41	0,2033	
Decatur-Savannah	0,0281	650	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,4954		0,41	7,4953	
Savannah-R’dam	0,0281	7086	Idematapp2017 Container ship (max w/ vol. Ratio 0,41ton/m3)	0,002	0,3986		0,02	3,9859	
R’dam-Rosmalen	0,0281	84,8	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0646		0,41	0,9779	
Rosmalen-The Hague*****	0,0281	50	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0381		0,41	0,5766	
The Hague-Hoofddorp	0,0281	62,4	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0476		0,41	0,7196	
						1,1291			15,0377
Use phase	**kg**	**energy (kWh)**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
						0			0
End of Life	**kg**	**process step**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
				Total CO_2:		**3,7946**			**49,3651**

Table 6: complete LCA of the Fold dispenser

5.22.3. LCA Satino Black BriQ dispenser

Materials	**kg**	**Process step**	**data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
ABS	0,724	Production	Idematapp2017 recycling mixed polymer	0,399	0,2889		5,92	4,2861	
	0,724	Injection moulding	Idematapp2017 injection moulding, production site	1,268	0,9180		17,48	12,6555	
Packaging dispenser*	0,145	Production	Idematapp2017 Board and recycled paper (“test liner” and wellenstof)	0,5	0,0725		0,76	0,1102	
						1,2794			17,0518
Transport	**m3**	**km**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
Idar-O.-Swalmen	0,0086	287	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0668		0,41	1,0103	
Swalmen-Zwijdrecht	0,0086	151	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0351		0,41	0,5316	
Zwijndrecht-Hoofddorp	0,0086	82,5	Idematapp2017 Truck+trailer 24t net (max w/vol. ratio 0,32ton/m3)	0,0271	0,0192		0,41	0,2904	
						0,1211			1,8323
Use phase	**kg**	**energy (kWh)**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
						0			0
End of Life	**kg**	**process step**	**eco-costs data**	**CO_2**	**CO_2 result**	**CO_2 total**	**CED**	**CED result**	**CED total**
						0			0
				Total CO_2:		**1,4005**			**18,8841**

Table 7: complete LCA of the BriQ dispenser

*the weight of the packaging for the Fold is calculated by the ratio between weight/surface area of 0,5047kg/m2, determined by the packaging of the current and BriQ dispensers. Requiring 0,289m2 of paper, results in 0,145kg.

**the weight of the wrap is determined by the estimate value of 150g/sqm given in the data sheet of 3M’s Wrap Film Series 1080, provided by 3MTM. It is assumed that 2/3 of that weight is for the film and 1/3 for the adhesive. The surface area needed for the wrap is 8,845m2.

***this also includes the laminate film

****the wrap film is casted. “Idematapp2017 blow moulding, machine only” is the closest in terms of process and result.

*****the wrap is transported in rolled state, requiring a box of approximately 150 x 150 x 1250mm. These dimensions are based on the box that was used for the test wrap (Appendix M | Proof of wrapping application). The total surface area is 0,8085m2.

5.22.4. Conclusions

As can be seen from the tables, the Fold dispenser performs worse than the current dispenser. This is mainly because of the wrap that is added. If the wrap is not added, the values are 0,3439 (eco-costs), 1,8135 (CO_2), and 24,6416 (MJ). So the folding mechanism results in a beneficial difference of roughly 35%. Adding the wrap is not more sustainable, but it is the price for giving clients the option of personalization.

The biggest contribution to the performance of the wrap, is the transport from Decatur to Savannah (the closest harbour). Transport by air is not an option, as this requires intercontinental flight. The closest airport capable of intercontinental flights is in Huntsville (23,6km away, but these planes land in Amsterdam (Schiphol). Which means another road transport element.

Compared to the BriQ, the Fold performs also worse; even without wrap. However, the BriQ uses smaller towels and is not designed for high traffic washrooms as well as the current dispenser. When the BriQ is dimensioned in order to handle the same quantity paper as the current or the Fold, more ABS and packaging material need to be used. It is assumed that the outcomes will then come closer to the current dispenser than the Fold. But again, the wrapping adds too much CO_2 and energy for it to be more sustainable than the BriQ.

The BriQ and current dispenser are also hard to compare, because of the same reason: the context in which is can be applied is not the same. However, looking at just the results, the BriQ performs more than twice as good in all fields. So the focus of the BriQ (less parts and less material) really improves its sustainable performance.

5.23. | Clean-ability

Hygiene is a serious subject in dispensers offering hygiene paper. Dispensers are one of the primary hot spots for germs and bacteria, according to Dr. Charles Gerba (Garrett, 2009). Dispensers need to be mounted everywhere, including hospital washrooms. The Fold has experienced several optimization steps to be able to be cleaned quickly and thoroughly. In general, dispensers are or should be cleaned with a damp wet microfiber cloth, so there are no worries of still water that can cause mould. The same goes for hospitals (Garrett, 2009), only there are other, more thorough disinfectants used to focus on the protection against Salmonella, Staphylococcus aureus, and Pseudomonas aeruginosa.

There is a minimum amount of openings. Where one of the first concepts had large holes as a result of the folding mechanism, this final version only has two (Figure 86). And those are located right next to the mouthpiece, so no decrease in hygiene can be found there.

Those holes are protected from both sight and touch. Being located at the side and people reaching for paper at the centre, touching would happen practically never. The chamfered bottom covers the holes from sight (Figure 87).

All visible surfaces and transition between those surfaces are smooth and thereby can be cleaned thoroughly.

Split lines are as small as possible and are for the most part removed by the wrap. Because the wrap is applied when the dispenser is assembled, split lines between the back plate, top plate, and side panels are erased. The only split line is caused in relation to the front plate. Opening it would otherwise be impossible.

The wrap is able to cope with all kinds of disinfectants, even those that are used in hospitals.

Figure 86: the holes located at the side

Figure 87: chamfered bottom covers the holes from sight

5.24. | Challenges

During the project, there were a some challenges to overcome. This chapter enlightens the most challenging of those.

Minimizing the amount of parts: decreasing the amount of parts is not only sufficient for rigidness, but also decreases the amount of injection moulds. Choosing a folding mechanism that works in such a way that it is not under stress during transport or in use, was a challenge. This has everything to do with the interaction between parts and the dimensions, which was the next challenge.
The right dimensions: as the design interdependencies chapter showed, the dimensions of the sliders have influence over a number of dimensions. Finding a balance between overall size and slider strength was the challenge here.
Implementing the top plate and mouthpiece: one of the requirements was that the envelope during transport should be determined by the front and back plate, with the side panels in between. Meaning that the top plate and mouthpiece had to fit in between these parts. After several optimization steps, a margin of 2mm was achieved.
As hygienic as possible: with a folding mechanism, chances are that there will be gaps somewhere. As with this mechanism. The challenge was to limit the amount of gaps and find a hygienic solution. Letting all parts work together was the solution to this challenge.
Fasten the mouthpiece: when a user wants to grab a towel, he can accidentally push against the mouthpiece. To prevent movement and thereby an unreliable feeling, the mouthpiece should be fixed. It could not slide in horizontally as the rails of the front plate prevented this. But the aim was to make the fixing just as easy as the BriQ. By finding a combination of sliding and fixing, this challenge was overcome.
A suitable rails: the rails could not have large dimensions, as this would hinder the folding mechanism and paper dispensing. But it had to be strong enough for injection moulding. Therefore, the rails was repositioned and ribs were added.
Clicking-in the front plate: the click finger for the front plate and the rails are close together, so a separate bump for the click finger to cling on to was not an option. For production optimization, the click finger clings to the rails (Figure 88). This does result in a lowered click finger and a deeper and thereby larger hole for the key. A larger keyhole can be beneficial for short cleaners, as they can find it quicker without seeing it.
Find the right wrap: there are not much PVC free wraps available. And since most of them are not very pliable, it was a challenge to find one that could be bend around tight corners. With some help form an expert in wrapping, the right one was found.

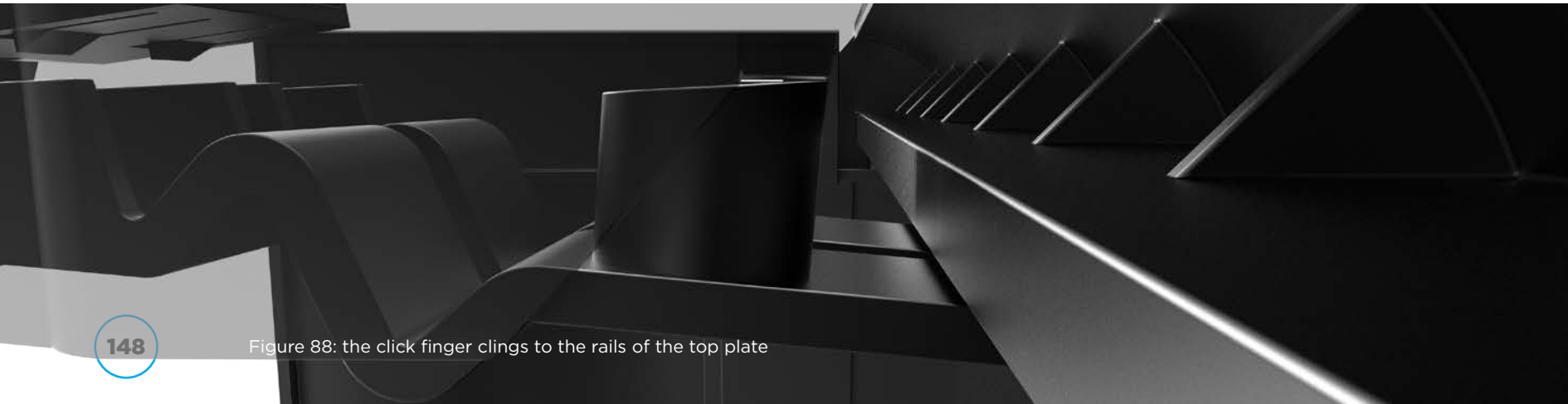


Figure 88: the click finger clings to the rails of the top plate

5.25. | Physical models

Two physical models were produced by means of 3D printing. The first model (Figure 89) was printed merely for illustrating the folding mechanism. It was a 1:2 scale model (of the concept that was then valid) and took in total three days to produce. However, on such a small scale the folding mechanism did not work. However, it could still be used as an illustrator to people without a technical background.
Another element that was tried with this prototype, was the ability to wrap. Even though the wrap couldn't stay in place without regular attention due to the rough surface, the easiness of applying a wrap was discovered.

Figure 89: first scale model

The second model (Figure 91 and 90) was printed as a check model, to see if the folding mechanism worked and if everything could be assembled as was envisioned. The mechanism worked, but it was discovered that the mouthpiece could not pass the bottom rail of the front plate to slide in. This became a challenge as described in the previous chapter.
This model was printed on a scale of 1:6 as this were the maximum dimensions that could be printed by an Ultimaker2. It took 4 days to produce this model.

Figure 90: second scale model

A third and final model was planned to be printed. This should be 1:1 model, requiring breaking up plates in order to fit inside an Ultimaker2 printer. This could not be fitted inside the planning and was done after this report was generated.

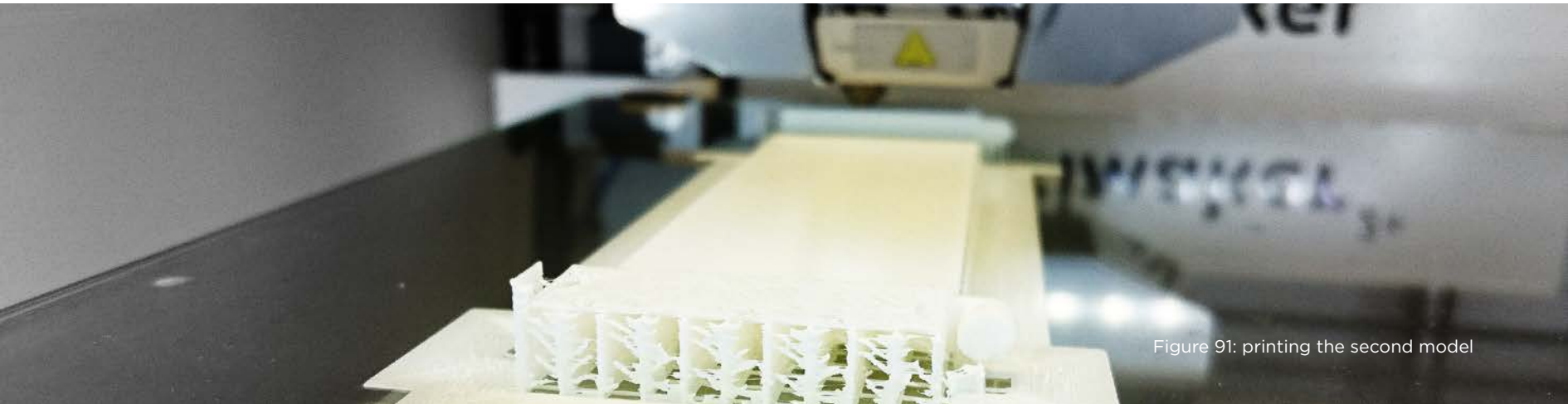


Figure 91: printing the second model

5.26. | Strategic direction

Sustainability vision

This report shows a new way of constructing a dispenser to reduce the environmental impact through transport. But this is not the vision. It is a way of setting the next step in sustainable dispensers. Satino Black has been in the forefront of sustainability, but competitors are catching up. Which is also according to the trend that more companies are thinking about the environment. The vision for Satino Black is to set another step in sustainable dispensers. Competitors might catch up. The result will be that Satino Black loses its competitive advantage. By implementing another sustainable step, Satino Black gets another leg to stand on.

Appearance vision

The other part of the vision is the actual wrapping. Competitors are implementing a range of colours in their product portfolio. Trends support this decision, so Satino Black cannot stay behind. But it should be more than what competitors do. Adding a customizable wrap, gives a solid edge over competitors with their limited colour range. This sustainable wrap (so also part of the sustainability vision) really personalizes dispensers; something end customers will be looking for in their designed washroom.

Adding a wrap is also the key in changing people's interaction and how they look at dispensers. Currently, the interaction is functional. The wrap can change this interaction when done right. Figure 93 (next chapter) gives an example that makes use of the dispenser in a funny way.

Styling vision

The minanic moodboard provides the road in which to go to in terms of styling and design. It is based on the current Satino Black, but determines more in depth what kind of character it should have. When looking at styling, the BriQ is leaning too much towards a minimalistic appearance. This might work for hotels and offices, but in retirement homes it might look too neat. Its reasonably tight fillets will look weird in a spaciously set up washroom. The Fold has a more loose appearance, so also retirement homes are fit for this design.

Figure 92: setting the next step in sustainability. Image retrieved from o.canada.com

6. | Evaluation

6.1. General requirements

Previous chapters already mentioned when a requirement was met. In this chapter, a little more detail to the Fold's requirements is given. The requirements as described in Appendix X, are structured according to the Delft Design Guide. Looking at the requirements, it can be concluded that the Fold complies with all of them. Below are some requirements discussed in more detail.

All the requirements from the environment apply to both the dispenser as well as the wrap. The dispenser is made from ABS, just like currently is done. So this cannot form any problems. The wrap is new to the dispenser, but not to harsh conditions. This wrap is designed to be applied to vehicles driving through rain and standing in the sun. So the wrap can withstand all kinds of humidity and temperatures.

Requirement 7d is not met, in the sense that this project did not focus on that topic. These requirements came from the interviews with wholesalers, but were never further developed. However, requirement 7d is not hard to comply with and only require minor alterations to the current packaging.

Requirement 11b determines that the dispenser should come in at least black. The recycling part of Satino Black is kept, so the dispenser will have the same colour as a basis. The wrapping just adds a whole gamut of colours to it.

Besides the dispenser, the wrap can also be recycled. Both the film as well as the adhesive. Which means that all materials can be recycled and requirement 12a is met.

Requirement 16a defines that the dispenser may only be opened with the special key. The keyhole is equipped with a small rib in the middle. Not just for strength, but this prevents people from putting things in the keyhole and thereby opening the dispenser.

6.2. Van Houtum requirements

With a long history of experience with dispensers and washrooms, Van Houtum has its own list of requirements and wishes. To know whether this new design proposal is future proof and an enhancement on the current dispenser, an evaluation based on this list is essential. Figure 94 shows this list for the paper towel dispenser.

Starting with the requirements, shows paper that is folded wider. Although this model is based on the current dispenser towels, it can be made wider easily. A captive system means that the dispenser should only be used with products of Satino Black. This was not a focus point of this project. However, clients that want to have a dispenser that is focused so much around sustainability, are expected to also use paper as sustainable as they can find it. Meaning Satino Black paper. The universal key is definitely present, and the dispensers cannot be opened without this specific key. The window in front of the dispenser enables the visitor and cleaning staff to check the supply of paper easily.

Another requirement is to be able to open the dispenser from the side instead from above. This requirement is not followed explicitly, because this has influence over the placement in especially small washrooms where there might only be one specific spot. The key is preferably a real key instead of a tool. But this requires a metal addition to the dispenser, making it a lot more expensive. Instead it is made impossible to open the dispenser without this specific tool, which has the same result. With a small user test it is made clear that this dispenser is also suitable for small cleaners for both opening and refilling.

Material use

Lesser unique parts the better

Sustainability (CO_2, CED)

Applicability low-high traffic washrooms (capacity)

6.3. Van Houtum wishes

The first wish on the list is that the dispenser should have a slim appearance. This is tried to accomplish by optimizing the shape running to the back. The sides use as little material as possible. The transition from the front plate to the back plate is done smooth but sudden, so the back end is less visible and the dispenser looks thinner.
The surface treatment is aimed at hygiene and the ability to clean. With the wrap to seal off seams, this wish is fulfilled perfectly. It is the next step in hygiene focus. The wrap also gives endless opportunities in applying different colours and as basis for communicating personal messages.

6.4. Timeline

The timeline can give directions in what way dispensers might or should evolve. What can be seen from the timeline, is that everything from the past 60 years is black or white with an occasional blue cleaning paper. There was a short time where it was fashionable to have a green colour in the bathroom, but currently grey tones and especially white is the main colour inside the washroom. This gives a hygienic feeling, but does appear very plain. The Satino Black counteracts this by its colour. However, a black dispenser is quite common. So it might be time for offering multiple colours. Looking at the competition this is already going on. Therefore, to be future proof, offering a personalized dispenser is the direction to go in.

6.5. Product qualities

Inviting cleanliness: people should want to use the dispenser. This is the first quality the dispenser should have in order to comply with the mission statement. It's the wrap that needs to activate this. Only colours might not work that well, but with a printable design, the dispenser can create an interaction with people, that can trigger this quality (Figure 93).
An inspiring appearance is something that can also be achieved with the wrap. It comes close to what is visualized in figure 93. However, the folding mechanism and the thought behind it can also help achieving this. If people know the effort that Satino Black takes in being more sustainable, they might be triggered to change their behaviour. Even though it may just be slightly.
The folding mechanism is definitely unconventional. The wrap can enhance this even more, resulting in people wanting to interact instead of needing to interact. The mind-set changes. By having personalized dispensers or a personalized environment, activated people to talk about them. It is the design and what is printed on the wrap how stimulating this works.

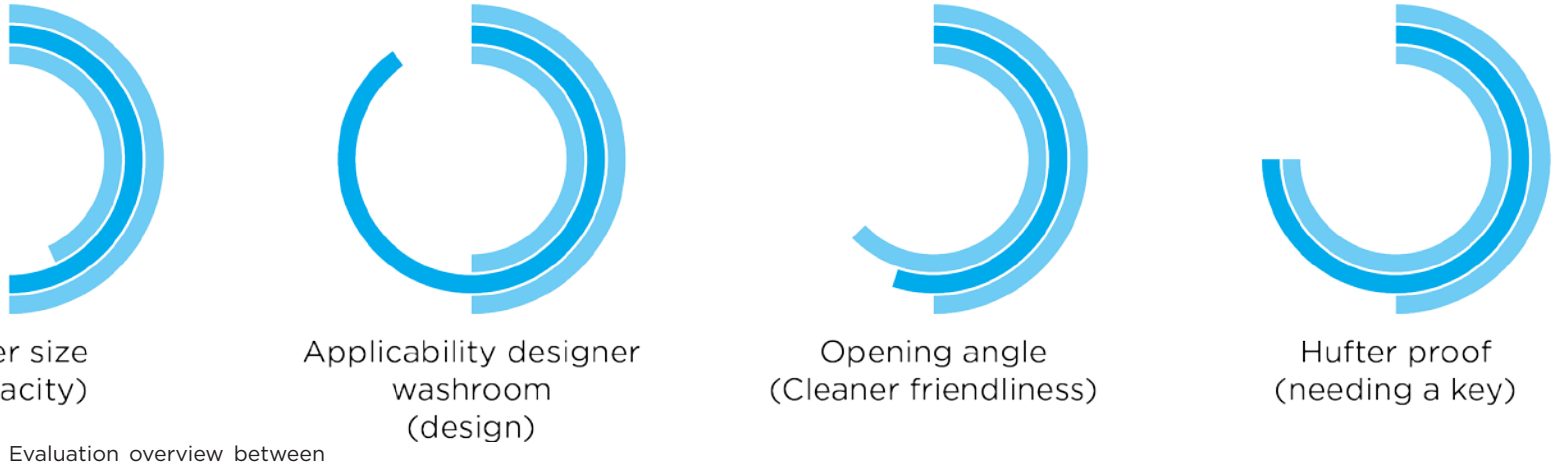


Figure 94: Evaluation overview between dispensers (the current is the average)

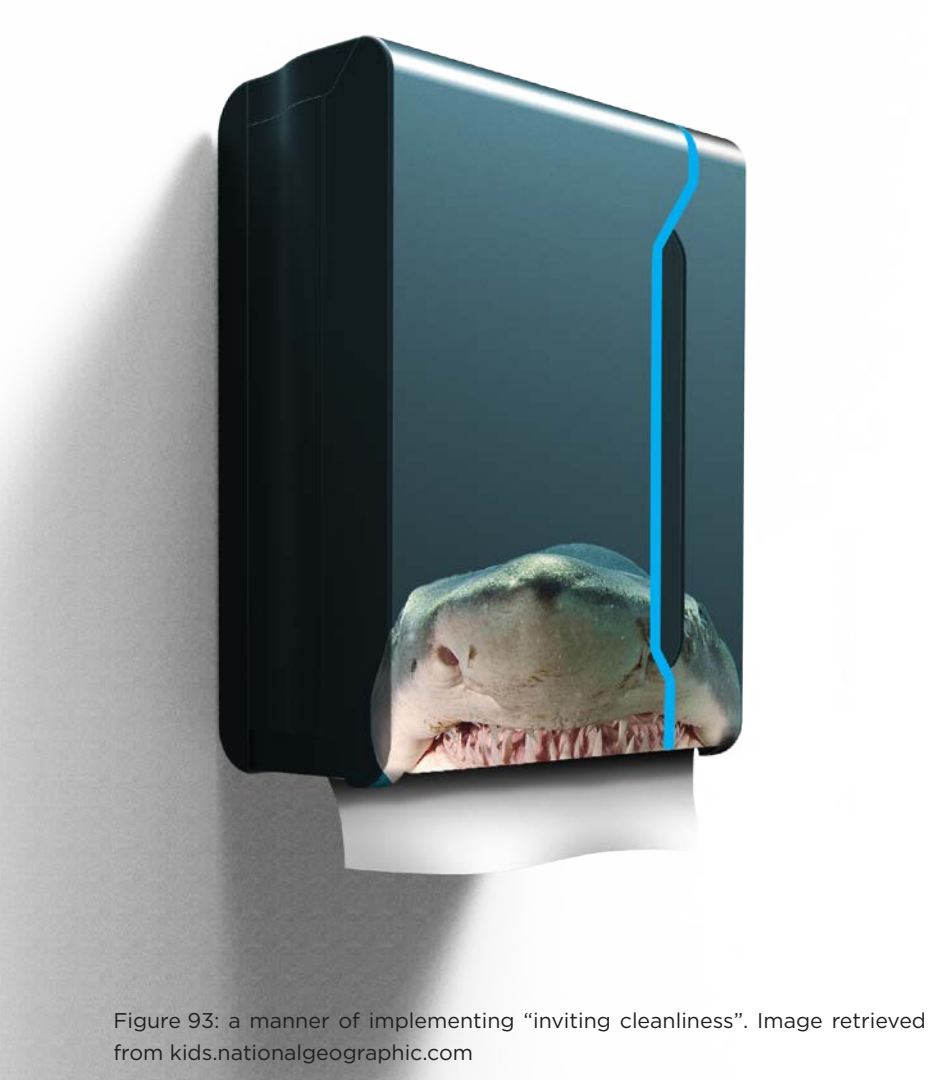


Figure 93: a manner of implementing “inviting cleanliness”. Image retrieved from kids.nationalgeographic.com

6.6. Within the changing contexts

The CVD chapter gave descriptions of the changing contexts. The washroom in a retirement home will keep a simple and calm appearance. These were two leading words in the resulting consensus maps and moodboard. As well as a robust appearance, which is an attribute of the minanic moodboard.
The office does not require much, except for a clear focus on design and an increased experience. Wrapping can cause this, but also the folding mechanism can add some experience when this is communicated well.
Hotels are even more focused on design and the suitability to the rest of the hotel atmosphere. Apart from that, it should be user friendly, which is achieved by implementing the little more comfortable mouthpiece. Cleanliness is also highly valued due to the high traffic inside such a washroom. The design leaves hardly any holes and the wrap covers split lines.
But what all contexts have in common, is that they are changing to more personalization. They want everything to match their environment and send a message that suits theirs. Wrapping enables this. It assures that the dispenser can be kept up-to-date without changing its dimensions. Which results in a dispenser that can last long without getting out-of-date; it becomes future proof.

6.7. Compared to competition

When products are being personalized, they become fashion objects. One of the aspects of fashion is colour. It is a million dollar market. People that can predict which colours will be found attractive in the future get paid a significant sum. Wrapping the dispensers is future proof in this sense. When colour preferences change, the wrapping can easily change with it. Competitors also offer different colours, however, they become useless when these colours are no longer wanted.

The folding mechanism is an illustration of how a more sustainable dispenser can look like. Competitors are increasingly implementing sustainable factors in their dispensers and sales talks. Satino Black should always be on the front line in terms of sustainability. The folding mechanism does this. By adding more complexity to it, competition needs to take extra effort in beating this.

6.8. Compared to the current

The current dispenser is not bad at all. Its design is attractive and the quality is good. But it is time for something different. Something even better. The Fold brings down the amount of parts and material use, without compromising on performance. In terms of CO_2 and CED, the dispenser itself performs better, but the wrap takes this down (Figure 94). So the sustainable story behind it becomes even more important.

6.9. Van Houtum's vision (BriQ)

Van Houtum has its own vision: the BriQ. This is also an improvement with regards to the current dispenser in terms of sustainability (FIgure 94). However, it performs a not the same, as not the same amount of paper fits within it. But even on a larger scale, it can be seen that less material is needed. The amount of parts will remain the same, so this will also be an improvement. The vision of the extra step for sustainability is therefore also suitable for the BriQ. But when it comes to actual sustainability figures, the BriQ will not score as good as the Fold. It is already a close call between the Fold and the BriQ, even when the BriQ has not got the correct dimensions for the same paper towels. This will add volume and thereby considerable eco-costs and carbon emission for transport. The BriQ does score better when it comes to the opening angle. It has an angle of 77, while the Fold reaches 72. This could still be changed easily for the Fold, by changing the dimensions of the mouth of the front plate.

6.10. ZMET suitability

This technique proved itself to be useful when not a lot of respondents are available or can be interviewed. In this project, where not a lot of wholesalers could be interviewed because of time and location, ZMET was a good choice to base the interviews on.
In terms of results and conclusions, ZMET formed the basis for all aesthetics (shape, colour, interaction and details), which are essential for a dispenser to stand out from its competitors. The technique had moodboards as a result, from which these aspects were derived. Although the interaction and colour was a combination of these results with the current Satino Black range, the difference and next step was determined by the results and conclusions from ZMET.

6.11. ZMET implementation

The technique from Zaltman proved itself by limiting the amount of participants needed for the outcomes. In this project, ZMET was incorporated deeply in terms of appearance and design. It was the foundation for the design of the wrap. But it could be implemented even more, by implementing it with more questions regarding interaction. The results from this stipulation are satisfactory and really made a difference, but it could have been stronger.

6.12. The cost build-up

Currently, the cost build-up is done using primarily websites. However, these costs might be different in real life, as websites can only give estimations. And no matter how reliable that site might be, definite cost calculations still need to be determined by an expert as the design of the mould is also not done by a professional.

7. | Conclusions

The project started with the question to develop an innovative and future proof dispenser range. But what is an innovative dispenser? Looking back at the introduction, Van Houtum is 60% everyman and 40% creator. Which means that it would be typically Van Houtum to solve the most obvious sustainability problem. According to the deconstruction, this would likely be transport. Finding a solution to this problem would therefore be innovative.
This seemed also smart when looking at competitors, who are catching up in their sustainability. Van Houtum's main selling point is their sustainable thinking, as the deconstruction showed. So finding a next sustainable step would be wise to maintain this competitive advantage; even though it is only on a storytelling basis. But the deconstruction showed more: the interaction between a dispenser and its stakeholders is purely functional. Since the client or business owner is the most important stakeholder, it is focused on that interaction. So an innovation was searched for to change the interaction between dispensers and facility managers.
Which is the onset to the second question from the project: when will a dispenser be future proof? To tackle this, the ViP method was applied, which looks at the future interaction of people with products. The future context phase describes this, by the research into future trends and developments in the domain of a hygienic and comfortable washroom experience in 2035's BeNeGeLux. It showed four directions in which people could be heading towards. Of which only one was wanted: people should think about their direct context.
But what context? This question was handled by the CVD approach to let dispenser range be innovative and future proof in a wide range of contexts. This is sustainable thinking. The further away these context lay from each other, the wider the dispenser could be applied. So it was decided that a hotel, a retirement home and an office were covering a wide range of contexts.
So with these decisions and discoveries, it was looked for a dispenser range that will be innovative by reducing the impact from transport and be future proof for multiple contexts, while changing the interaction with primarily facility managers. To know the direction of this future interaction, interviews were conducted according to a stipulation of ZMET. This proved to be helpful, since it decreased the amount of respondents needed, helped defining the desired interaction and gave a push towards the design. The future interaction design phase ended with the definition of the qualities that the dispenser should have to let people think about their direct context.
The new product design phase gave these qualities a shape in the form of a foldable system as an answer to the transport impact. Also, it showed a method to keep a future proof advantage over competitors in terms of sustainability; a second leg to stand on. As a proof of concept, the paper towel dispenser was chosen to develop this folding mechanism. It is part of the loan structure package and best suitable to incorporate innovation. Concerning the interaction, wrapping was introduced. Wrapping can fully personalize dispensers. Compared to competitors, who only provide a limited range of colours, this is a major step forward. It is not only changing the interaction between facility managers and dispensers, but also gives an edge over competitors. Although it lets the dispenser score worse on carbon footprint and CED, it is the most sustainable way of personalizing. Which is a clear trend (discovered in the future context phase). It is also a simple solution, which again suits Van Houtum's everyday man and creator signature.
All in all, both the mechanism and wrapping add something to the innovativeness and future focus of the dispenser range. Every aspect of the research that was done has helped to develop this future vision and determine its possible success. Even though the folding mechanism is likely to become only a storytelling aspect, it does reduce the environmental impact. About the way of approaching this in terms of research is hard to say as this is (to the current knowledge) the first time that a combination of ZMET with CVD and CVD with ViP are applied. However, the results from both combinations are satisfactory and were useful in this project.

8. | Recommendations

With the currently chosen business model, removal is also done before applying another wrap. However, it costs time. And with only 50 um, a second or third layer may not have significant impact on the dispensers operational service. This needs to be checked to be sure. Also the effect of having to remove two layers of film and what it does to adhesive residue and recyclability is unclear at this stage.
The exact boundaries of designs and colours need to be determined by the marketing team behind Satino Black. They have an advanced feeling for the brand, in contrast to the outside knowledge acquired in a short period of time.
The first few times of wrapping a dispenser will be challenging. So it is recommended to let the installers first do a couple of practise runs with wrapping dispensers, to optimize the amount of wrap material and application time, before actual sale.
The user tests that were done to establish the positioning height of the keyhole were done with only two respondents, representing different user groups. So these conclusions are not scientifically proven. Even though the participants were highly reliable, having more respondents can result in even more insights.
As said in the evaluation, the packaging is not closely looked at. The wholesalers are under the impression that this can be designed significantly better. However, the BriQ packaging already comes close to the wholesalers' demands.
The moulds are designed with as much knowledge as there was available, but experts will have deeper insights into design solutions.
When implementing the configurator, also consulting an expert in web-design is a good idea. There are numerous possibilities to incorporate in such an application and this project only gives an example of how it could be worked out.
The system roll dispenser for instance favours a window on the side, since this is the side in sight. But wrapping needs to start where the window starts, so it is favourably to not have two windows. This can be solved by producing two side panels with a hole for the window in them and produce two windows; one opaque, one transparent. The other option is to have two separate moulds for both side panels, with little difference in one mould plate.
It is recommended that dispensers that are placed next to the toilet have windows on the side panels. But this can cause inconsistency throughout the range, when the paper towel dispenser has the window in front. Therefore, the wrap should be designed to make it coherent again.
Have a second look at the method of implementing CVD in the ZMET stipulation. In this stipulation, the contexts were shown by means of an image of those contexts. These images influence the way the respondent think about the context. This is another influence on top of the list of Ben Emans (Figure 95) (Emans, 2002). But without references, the participant might be too free and consistency is not achieved. A balance need to be defined for this problem.

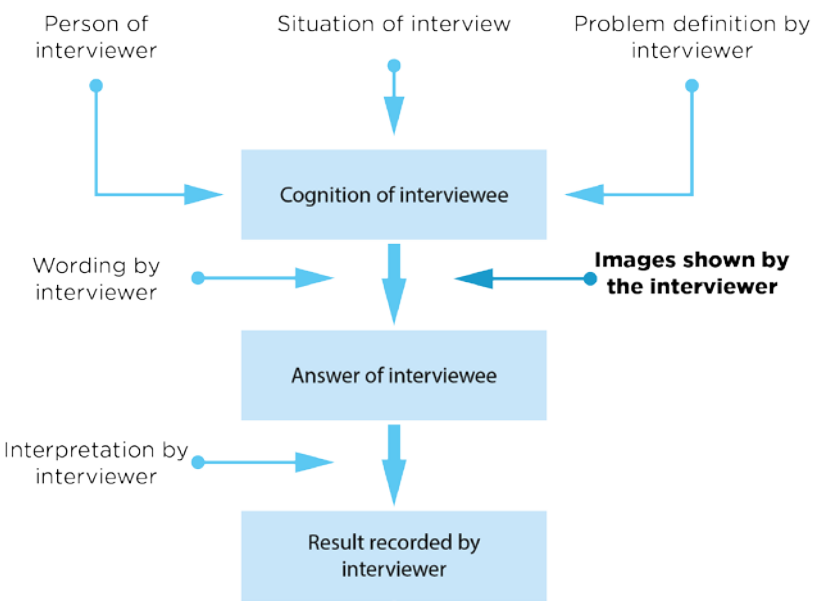


Figure 95: Ben Emans figure of how the interviewer influences the interviewee

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