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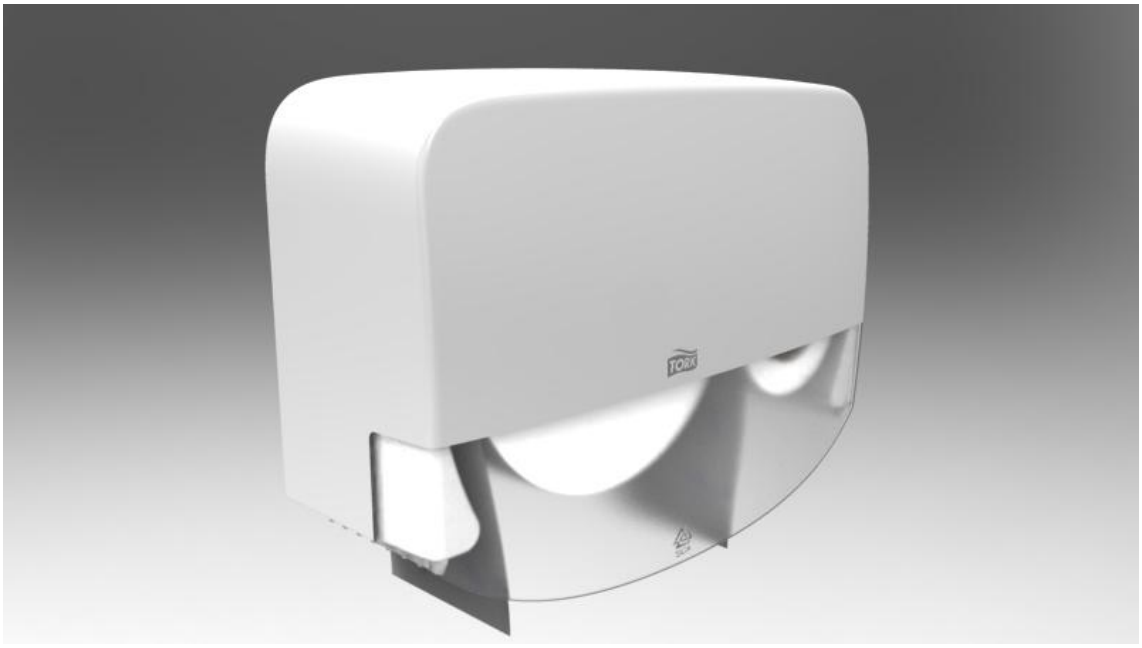

Hygienic Dispenser Design for Public Washrooms

Master of Science Thesis in Industrial Design Engineering

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Preface

This report is the result of a master's thesis for the master's programme Industrial Design Engineering at Chalmers University of Technology. It was made for SCA (Svenska Cellulosa Aktiebolaget) and consisted in developing a hygienically improved dispenser series for public washrooms. Many people helped us during the project, and we want to thank everyone we have interviewed or received help from in other ways. We would like to thank Björn Larsson, Ulrika Husmark, Anna Karlgren and Maria Marklund at SCA, who have contributed with their knowledge on dispenser design, hygiene and microbial matters. We are also indebted to Mats Lind, Thomas Persson and Christian Söderlund at Creator, for their help with making the concept ready for producing a prototype, and finally to Ulrike Rahe, our supervisor and examiner at Chalmers, who have guided us through this process.

Göteborg 2011

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Abstract

This thesis was carried out for SCA, at their Away From Home-department, which produces tissue and dispensers for public washrooms under the brand Tork. The purpose was to investigate what hygienic issues there are in public washrooms in general and for dispensers specifically, and to develop a new, hygienically improved dispenser. At the same time guidelines for hygienic dispenser design were to be collected and outlined. This was done through phases of literature study, interviews with caretakers and experts, observations at public washrooms, surveys and focus groups. This was then followed by idea generation, consisting of brainstorming through sketching, combination of ideas and making a number of concepts. These concepts were evaluated and developed further, until a final concept was chosen, which was then developed in detail, resulting in a physical prototype in the end. The result of the thesis is a new toilet paper dispenser, designed to be more hygienic to use and easier to clean. Part of the result is also a document of guidelines for hygienic dispenser design.

Sammanfattning

Det här examensarbetet genomfördes för SCA, vid deras Away From Home-avdelning, vilken producerar papper och dispensrar för allmänna toaletter under varumärket Tork. Syftet var att undersöka vilka hygieniska problem som existerar på allmänna toaletter och då framför allt för dispensrar, samt att utveckla en ny, hygieniskt förbättrad dispenser. Samtidigt skulle även riktlinjer för hygienisk dispenserdesign tas fram. Detta gjordes genom faser av litteraturstudier, intervjuer med städpersonal och experter, observationer på allmänna toaletter, undersökningar och fokusgrupper. Efter detta vidtog idégenerering, bestående av brainstorming och skissning, kombinerande av idéer och sammanställning av ett antal koncept. Dessa koncept utvärderades och vidareutvecklades, tills dess att ett slutgiltigt koncept valdes, utvecklades i detalj, och slutligen resulterade i en fysisk prototyp. Resultatet av arbetet är en ny toalettpappersdispenser, designad för att vara mer hygienisk att använda och enklare att rengöra. Som en del av resultatet har även ett dokument med riktlinjer för hygienisk dispenserdesign tagits fram.

Contents

1. INTRODUCTION

1.1 Background

SCA (Svenska Cellulosa Aktiebolaget) is a global hygiene and paper company that produces and markets tissue, personal care products, packaging, publication papers and solid-wood products (SCA, 2011)

Tork is a leading global brand of tissue within SCA, which produces a wide range of products, including toilet tissue, hand-wiping products, napkins and wipers for cleaning in industry and offices as well as various hygienic dispensing systems (Tork, 2011).

Tork thus provide hygiene solutions for their customers, mainly by providing products like tissue, along with dispensers containing these products. However, the question was raised whether the dispensers themselves were sufficiently hygienic and how they could be improved.

1.2 Objective

The objective of this master's thesis is to develop a dispenser series with a clear hygiene profile for high traffic public washrooms. The main task of the project is creating a series of products that provide and improve hygiene for their users.

1.3 Problem Statement

To improve hygienic conditions around the world is one of the greatest issues confronting humanity these days (SCA Hygiene Matters, 2011). A way of improving human sanitary conditions is to apply hygiene guidelines and design in related products such as dispensers in public washrooms. To make it possible to improve the hygienic design of a dispenser series, such guidelines must be defined. This thesis will strive to find and structure both factual and perceptual basis for these guidelines, and the result will be applied in a concept for a new dispenser, which will be developed sufficiently far to result in a functional prototype at the end of the project.

1.4 Work Structure

This thesis work is a 30 ECTC credits projects that is based upon 20 weeks of work for the Industrial Design Engineering programme at Chalmers University of Technology. The project started on January 17, 2011 at SCA (Göteborg, Sweden) and lasted to the final delivery in the end of June. The main phases planned for the project were information gathering, idea generation, concept development and product development (see Appendix A).

1.5 Delimitations

The broad aim of the project is to develop a dispenser series for high traffic public washrooms with focus on the hygienic aspects. However, due to limited time, the focus of the project was set on developing a hygienically improved toilet paper dispenser. In addition, the target group for the new product includes both the European and the American markets, but focus will be on the European market. This is due to the fact that the project will be carried out in Europe and so this market is easier to access.

Part of the pre-study phase of the project will concern subjects such as microbiology, which lie outside the area of expertise of the students carrying out this thesis. This part will then rely to some extent on guidance from experts in the field. Also, since time is always limited, the core of the thesis will naturally be in matters directly related to the proficiency of a Master of Industrial Design Engineering.

Though some parts of the hygienic design of a dispenser, like the access to material (e.g. tissue) clearly relates to the disciplines of usability and physical ergonomics, these two will not be the main focus of the project. Therefore these aspects will be secondary compared to the main goal of creating a more hygienic dispenser design. For the same reasons, no analysis of the products environmental impact or production cost estimation will be made.

2. INFORMATION GATHERING

The project was started off with a phase of information gathering and research. This was a two-folded process, concerning on the one hand facts about how to improve hygiene in a publish washroom situation and on the other how hygiene is perceived in product design and what the Tork design language consists of.

A literature study was undertaken, to get a basic understanding of the importance of hand hygiene. The aim was to see what hygienic dangers there were in a public washroom and how these could be avoided. What problems were there and what solutions could be feasible? Existing rules and legislation for other areas, like the food industry, were also studied, to see what could be applied to washrooms as well. This was complemented by field-studies in actual public washrooms, where observations, interviews and hygienic measurements were carried out.

The other part of this phase focused on visual design. For one thing, it was important to analyse the Tork visual brand identity, to be able to design a new product which would fit into the Tork product line. This was done by studying the Tork brand values and performing a Design Format Analysis on the existing product line. It was also necessary to explore how the users perceive hygiene and product design, to understand how to design a product that, apart from being factually hygienic, is also perceived as being more hygienic. To achieve this, surveys and focus groups were used. The collected information from this phase was then used to put together a demand specification.

2.1 Literature Study

The literature used was mainly scientific articles. A few of these concerned public washrooms, in schools e.g., but most of them were related to hand hygiene in the daily work in food handling businesses and hospitals. Though hospitals and kitchens might seem different from public washrooms in many ways, it is still the same kind of hygienic issues that has to be dealt with. Therefore, studying research in this area proved informative and useful.

2.1.1 Hand Hygiene

For preventing the spread of disease-causing organisms in washrooms, the first step is to facilitate these washrooms with hygiene products and dispensers. Moreover, toilet and sanitation conditions should be improved in general. Encouraging people to use toilets and wash their hands are crucial issues that can be taken care of with the help of practical and easy to use hygiene products. A simple hand washing program followed by hand drying with paper towels can prevent the transfer of pathogenic microorganism according to Snyder (1998), amongst others. He refers to Pether and Gilbert "[who 1971] reported results of research showing that hand washing with soap and water, followed by hand drying with paper towels, reduces the risk of transient skin carriage of salmonella."

Generally, not washing one's hands after visiting a washroom, not using soap and not drying one's hands is a big problem. A recent study of public washroom visitors in Europe showed that 71 % always washed their hands with soap and water, 68 % always washed their hands with warm water and only 47 % claimed to always dry their hands with paper towels (Katrin, 2010). Education, information and accessibility are important ways to deal with this problem (Guinan et al, 2002). Additionally, proper design and material choices are key factors in designing hygienic washrooms (Giambrone, 2010).

2.1.2 Hand Washing

Hand-washing is the single most effective method of preventing spread of infectious diseases, according to Hammond et al. (2000), since the hands are the primary mode of transmission of many diseases. Much research has gone into proving connections between better hand hygiene and improved health. An example is Mott et al. (2007), who showed that mandatory hand-washing five times per day in a military training centre decreased the frequency of outpatient respiratory illness by 40 %. White et al. (2003) mention that appropriate hand-washing have been shown to reduce URI (Upper-Respiratory Illness) and diarrhoea rates among children in day-care settings.

It would seem, then, that hand washing is a very effective and easy way of keeping healthy. Still, compliance with hand washing directives is often low. Studies have shown that compliance levels as low as 10 % for soap usage and 25 % for hand-drying have been noted in British schools, though hand-washing compliance is generally much higher (Guinan et al, 2002). It has been suggested that washing your hands is too simple a measure to seem as effective as it really is. This problem could perhaps be solved by design, by making hand washing more glamorous or tempting (Duberg, 2010).

2.1.3 Hand Drying

Hand drying is the last part of the hygiene procedure in a public washroom, and if the washroom is designed in a good way, the user should not touch anything in there after the drying is finished. It is also a fact that wet hands transfer bacteria to a higher extent than dry hands. Wet hands can spread up to 1000 times more bacteria than dry hands (Smith, 2009). Partly this is because water itself transfers easily between two surfaces and partly it is because bacteria thrive in damp environments (Redway & Fawdar, 2008). Therefore, it is critical that hands are not contaminated during the process of drying (Harrison et al., 2003).

The most common means of hand drying in public washrooms are paper towels, hot air dryers, jet air dryers and cloth towels. Snyder (1998) claimed that hot air dryers should not be used, as they accumulate aerosols from the toilets and contaminate the hands. He refers to studies were paper towels were shown to decrease the amount of bacteria on the hands, while hot-air dryers increased some bacteria with 436 %. Whether or not hot air dryers actually are worse than paper towels in this aspect is not an undisputed matter (Holah, 2011), but what seems clear is that hot

air dryers are often slow and inefficient, leaving the user's hands moist and possibly still contaminated. Redway & Fawdar (2008) reported a notable increase of bacteria when using hot air dryers compared to using paper towels, which decreased the amount of bacteria. They stated that one reason for this could be precisely the fact that hot air dryers do not leave the hands as dry as paper towels. The same study showed that though jet air dryers dry the hands equally fast as paper towels, they still increase the amount of bacteria on the hands. Cloth roller towels are not recommended either, because they are low in capacity, and when a roll is finished, it becomes a common use towel which many people touch and is therefore spreading pathogens (Snyder, 1998). Smith (2009) refers to a recent study in which European respondents overwhelmingly (96 %) considered hand paper towels to be the most hygienic way of hand drying.

Compared to the alternatives, paper towels provide a high level of hygiene. However, the paper dispensers can be contaminated themselves, especially if they are located within a splash zone. It has been shown that cross-contamination between dispensers and hands occurs in both directions. In a quite recent study, transfer rates from hands to dispensers were up to 0.64 % and from dispensers to hands 13.1 % (Harrison et al., 2003). It thus seems crucial to avoid either having the dispenser contaminated in the first place, or touching it if it is contaminated.

2.1.4 Antimicrobial Surface Material

As a means of automatically disinfecting dispenser surfaces, antimicrobial surface materials were studied. SCA's competitor Kimberly-Clark is using this type of technology in some of their dispensers (see 2.5). Three commonly used antibacterial agents were studied in more detail: Triclosan, silver and copper.

Triclosan is widely used in products ranging from toothpaste to kitchen utensils and toys (FDA, 2010). It acts as a biocide at higher concentrations (Russell, 2004) while biostatic at lower concentrations (Heath et al, 1999). Its effectiveness is however a subject of debate, at least when used in solid materials (FDA, 2010). Furthermore, it has been warned that overuse of triclosan could lead to bacteria becoming resistant (McMurry et al, 1998). Studies have also indicated that children exposed to triclosan are more likely to develop allergies (Clayton et al, 2010).

Silver has been used as an antibacterial for centuries, and even though it is still not entirely understood how it works, it has a toxic effect against bacteria, viruses, etc., and is used in many common applications like clothes and water filters (Lansdown, 2006). It is a debated issue whether there are any significant side-effects of using silver as an antibacterial. There have been concerns raised regarding the possibility of it causing bacteria to become resistant, not only to silver but also to antibiotics, over time (Melhus, 2007). The great increase in silver enhanced products seen in recent years has been generally criticised both for being unnecessary and possibly dangerous (SVT, 2007).

Copper is another metal that shows antibacterial properties. These properties have been used for centuries, even though, as with silver, it is not yet known exactly how it works (Dollwet & Sorenson, 1985).

These additives have their strengths and weaknesses, and it is possible that e.g. silver or copper ions could be used without any major side effects, but their level of effectiveness is too low to be interesting for applications in a public washroom. Even the most effective substances available today take at least some hours to kill the bacteria on a surface. In a reasonably frequented public washroom, a dispenser surface is touched several times per hour, meaning that the substance used must kill bacteria in 10-20 minutes. This means that there are no feasible alternatives at the time being (Holah, 2011). Furthermore, bacteria normally cannot grow on solid surfaces such as dispenser surfaces or doorknobs. This environment is too dry. The bacteria can persist for a couple of days but will eventually die off. An internal study done at SCA showed that bacteria died off just as quickly on a normal plastic surface as on one with antimicrobial additives (SCA, 2010). Therefore the need for antimicrobial surfaces seems limited.

2.2 Public Washroom Field Studies

In the next step of the project, to get information on the layout of public washrooms and how the dispensers are being used in them, investigations and observations in public washrooms as well as several interviews was carried out in Sweden (Gothenburg), Germany (Frankfurt) and England (Birmingham).

The main aim of the investigations was to find out

critical hygienically related parts on Tork dispensers in order to look into which parts of the existing products should be revised in the project. These results helped in choosing critical areas of each dispenser for bacteria tests which were performed later in the project (see Appendix B). In addition, the investigations provided the opportunity to study competitors' products that exist on the market. Moreover, investigating three different countries provided a rough picture of what public washrooms look like in Europe.

In total, 27 investigations were performed for this project; 11 in Sweden, 10 in Germany and 6 in England. For investigating the public washrooms a table was prepared. The items considered were the general cleanness of the products as well as material availability, function and the cleanness of the split-lines (see Appendix C).

In addition, to find out the pros and cons of the existing Tork dispensers, considering hygienic aspects, most of the current product line was investigated. In Appendix D, the result of this investigation is shown.

Besides investigating several different dispenser brands that are used in different countries, some interesting issues were found out. Generally, very few problems related to material availability have been noted in the washrooms. Collected soap drippings have been seen on the bottom of some soap dispensers, and visible dirt could be seen in split-lines on almost all different kinds of dispensers.

Some older hand paper dispensers were equipped with a wheel, which the user was to rotate to dispense new paper. In a similar fashion, dispensers with cranks and levers are used in the U.S. Having to touch a surface like this after hand-washing is obviously unhygienic, and should be avoided. In some cases, however, mechanisms like these can be used for sensor dispensers, to get them going if they should jam.

2.2.2 Observations

To find out what users touch in public washrooms, observations were carried out during the first two months of the project. The result of this part showed that although washing and drying your hands after using the toilet is of the highest importance to keep up good hygiene, many users omit washing and/or drying their hands. Encouraging users to wash their hands with soap, and drying their hands afterwards, is something that could be a goal for hygienic design.

Moreover, another issue that was observed was how the dispenser communicates its function. Poor dispenser design could lead to the user's not understanding the function, and so she might touch unnecessary surfaces of the dispenser when attempting to access the material. There were, e.g., a sensor on a hand paper dispenser that the users perceived to be a button. They were therefore pushing it, even though it was unnecessary, and thus contaminating their hands (see Figure 2.1).

Figure 2.1. Poor design could lead to the user's not understanding the function

Another matter that was noticed was that in some countries, such as Germany, toilet paper dispensers are used to a lesser extent and users are removing paper directly from the roll. The reason for this may be that the users prefer to have easy access to the toilet paper. Therefore, having the tail of the toilet paper visible and reachable should be borne in mind in the design process.

Generally the users seemed to touch only the surfaces that they had to touch. They did not touch walls, benches or mirrors. Neither did they touch any other part of the dispensers than push-buttons, levers etc. Apart from this, they touched things like door-handles, water taps and flush-buttons. The users just went about with their business and then left. They did not linger in the washroom.

2.2.3 Interviews

In order to find out what users expect in a high traffic washroom in the matter of hygiene issues, a number of interviews were performed (see Appendix E). Although the questions were prepared in a way so that answers would be short and clear, the answers still turned out too general to draw any real conclusions from.

In addition, to get information about how often the caretakers clean the inside and/or outside of the dispensers, a questionnaire was prepared (see Appendix F). The results showed that the outside of the dispensers were cleaned more frequently and the inside got cleaned only when refilling the dispenser. To make the day-to-day cleaning of swiping off dust and splash easier and more effective, dispensers should be designed with large and open surfaces, without any narrow corners or edges.

The food research institution Campden BRI was visited, to discuss hygiene and hygienic materials with John Holah, the head of their food hygiene research. Even though the visit itself was made after the pre-study was more or less finished, it provided a valuable opportunity for reconfirming ideas and information, and also made it clear what directions could be fruitful when considering the material choice later on in the project.

It was e.g. decided that antimicrobial surface coatings was not a viable prospect, since in a typical public washroom, each dispenser is used at least five times per hour. This means that for an antimicrobial coating to be effective, it needs to kill bacteria in roughly 12 minutes, and such materials simply do not exist today, according to Holah.

Another topic of discussion was how large an amount of bacteria a surface could contain and still be considered hygienic. The reason was that the bacteria tests previously carried out in the project lacked a good point of reference. Holah claimed that no such limit in absolute numbers could be given. He pointed out that the only type of bacteria that are interesting from a hygienic point are pathogens (disease-transmitting microbes), and for a surface to be called hygienic, there can be no pathogens whatsoever. In reality this means that a hygienic surface cannot contain any bacteria at all, and that is not feasible in a washroom.

2.3 Hygienic Design in Food Industry

In order to find out guidelines to be applied in the design process, the existing legislation in food industry was studied. The written material studied focused on hygienic aspects of food industry equipment. A summary of what can be used from that area in the current project is discussed in the following.

Lawley (2007) stated that such components that cannot be properly cleaned can cause contamination problems. For cleaning the surfaces effectively, the choice of surface material is important. Product (food) contact surfaces must be made in non-absorbent materials. In guidelines issued by the EHEDG (European Hygienic Engineering & Design Group) it is discussed that all surfaces must be either easily accessible for visual inspection and manual cleaning or it must be demonstrated that routine cleaning completely removes all soil (EHEDG, 2004). Generally, if the equipment is of poor hygienic design, it will be difficult to clean.

For designing the equipment, it is pointed out that projections, edges and recesses should be kept to a minimum (HSE, 2001), the reason being that dust and aerosols may be retained in crevices and dead areas, allowing the micro-organisms which they harbour to survive and multiply. These might then cross-contaminate subsequent batches from the product.

Besides the above discussion, we should bear in mind

that a design with excellent hygienic characteristics but lacking the ability to perform its functional duties is of no use; hence a designer may have to compromise (EHEDG, 2004).

2.4 Hygienic Measurements

In order to find out how much the critical areas, which had been identified on the different kinds of dispensers previously in the project, were contaminated and which areas were more in demand of redesigning, a couple of tests were performed. The critical areas included surfaces that were often touched, surfaces that collected visible dust, etc. The tests were held in two stages: first ATP tests and then bacteria tests.

The ATP tests were carried out to get a quick notion of the amount of organic matter on the dispensers. This was done because bacteria tests are impractical, as you have to decide on beforehand what pathogens you are looking for. ATP stands for adenosine triphosphate, which is a molecule that can be found in and around living cells (Knowles, 1980). ATP tests are commonly used in the food industry. Thus, the tests were performed under the assumption that a high ATP level generally also indicates a high bacteria level. After the ATP-tests, a few bacteria tests were done as well, to see if this assumption was reasonable or not. The result indicates that a high ATP level is indeed a sign of a high bacteria level, though the low number of performed tests naturally means that the result is not to be considered conclusive. In either case, though, low ATP-levels should correspond to high cleanliness (Smith, 2009).

Both tests were performed by swabbing a selected surface. The area swabbed was approximately 10 cm^2. For the first round of tests, the swabs were then inserted into a portable ATP-meter, to get the ATP-value. In Table 2.1-2.4 the result of the tests can be found.

Soap Dispenser	V Building - Chalmers (medium traffic)	Library - Chalmers (medium traffic)	Bergakungen (Cinema - high traffic)
	Tork - Metal	Tork Elevation	Tork Aluminium Series
Push Button	904	1144	-
Bottom Part (surface around push button)	2889	5384	781
Split-line	903	189	7738

Table 2.1. Result of ATP tests - Soap dispenser

Paper Towel Dispenser	HB Building - Chalmers (low traffic)	Vasa Building - Chalmers (medium traffic)	Library - Chalmers (medium traffic)
	Tork Elevation	Tork Elevation	Tork Elevation
Exit (the mouth)	58	334	1258
Split-line (top)	104	426	666
Top (the niche part)	339	1144	1671

Table 2.2. Result of ATP tests - Paper Towel Dispenser

Toilet Paper Dispenser	SCA (low traffic)	Le Pain Francais (Café - medium traffic)	Biopalatset (Cinema - high traffic)
	Tork Elevation	Tork Aluminium Series	Tork Elevation
Exit	178	460	502
Body (inside)	52	354	419
Split-line	375	817	2030
The bottom edge	317	7738	10341

Table 2.3. Result of ATP tests - Toilet paper dispenser

Waste Bin	Le Pain Francais (Café - medium traffic)	Condeco (Café - medium traffic)	SCA (low traffic)
	Tork Aluminium	Brabantia (Competitor)	Tork Elevation
Split-line	365	1295	342
Around the opening	104	-	1817
On top of the lid	-	250	-
Under the lid	-	2503	-
Foot pedal	-	-	-

Notes: Water was used as a reference value, and its ATP-value was 11.
The restrooms chosen for using ATP test are defined as low, medium or high traffic washrooms.

Table 2.4. Result of ATP tests - Waste bin

For the bacteria test, two of the dispensers from the previous test were swabbed again, and brought back to the laboratory at SCA, for analysis. The swab samples were spread out on agar plates which were then incubated in 35° C for five days, before the colonies were counted (see Figure 2.2). The result of the bacteria test can be seen in Table 2.5.

The results generally seem to suggest that surfaces that collect dust and water are those that contain the most bacteria. This would include split-lines and crevices, among other things. Push buttons and dispenser exists did not show significantly higher values than other surfaces. The bacteria tests also indicated that there could be higher concentrations of certain pathogens around the exits of toilet paper dispensers. These results were valuable for the project, but to know whether or not the overall amount of bacteria is acceptable or not, further tests would need to be done (see 2.2.3).

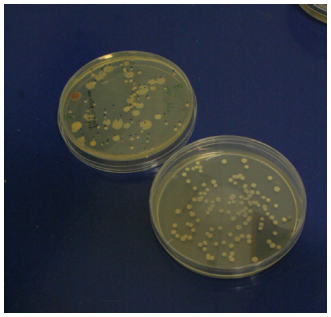


Figure 2.2. Bacteria colonies growing on agar plates

A recent study of bacteria on washroom surfaces (Middleton et al, 2010) showed similar results. They found relatively low amounts of bacteria generally, but higher levels on wet surfaces, like e.g. the soap dispenser. Those results seem to confirm what was seen is this project. The level of micro-organisms ranged from <0.70 to 4.12 logs in that study. The mean level of micro-organisms on these surfaces was between 1.68 and 2.36 logs. A study measuring bacteria levels on Tork H3 showed similar results: Mean micro-organism levels were between 1.70 and 2.11 logs (Holah et al, 2010). These levels were considered comparatively low, which is perhaps not surprising in a well-maintained washroom. In comparison, the bacteria tests performed in this thesis showed levels between 1.00 and 3.43 logs.

Figure 2.3 shows a logarithmic scale, ranging from "clean" to "contaminated." In this scale two of the bacteria test values are placed: The split-line of the toilet paper dispenser and the part around the nozzle of the soap dispenser. As points of reference, two other measurements have been included: A hot air hand dryer from a similar study (Middleton et al, 2010) and the interior of a car (Mail Online, 2011). These two reference values are actually the mean values of several measurements. The controversial part about a scale like this is that it is very hard to decide what should be called "clean" and "contaminated". The numbers in this scale are CFU (Colony Forming Units) of bacteria per specific area unit, but the number of actual pathogens is what is really important, and that is much harder to measure. A surface which contains even very few pathogens should be considered contaminated and not clean, so the numbers in this scale are just a very general indication. However, as high a number as 10 000 CFU/10 cm^2 is clearly to be considered contaminated and not a very hygienic environment. The lower reference point included here, the hot air hand dryer, had 30 CFU/cm^2 which is more or less what could be expected from a surface that people seldom touch and that probably is cleaned regularly.

Place/Dispenser/Surface	Tot. CFU* aerobe bacteria/area**	E. coli/area	S. aureus/area
Biopalatset/Toilet paper/Bottom edge	250	20	50
Biopalatset/Toilet paper/Split-line	1030	<10	<10
Library - Chalmers/Soap dispenser/Split-line	90	<10	<10
Library - Chalmers/Soap dispenser/Push button	10	<10	<10
Library - Chalmers/Soap dispenser/Underneath	2690	<10	<10

* CFU = Colony Forming Unit
** Area = 10 cm^2

Table 2.5. The result of the bacteria test

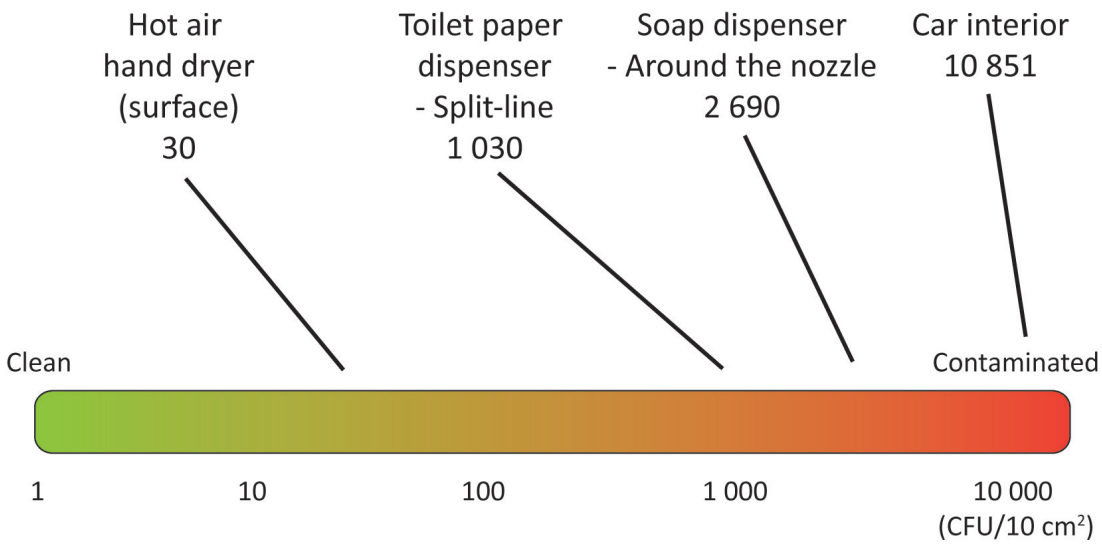


Figure 2.3. Logarithmic scale ranging from clean to contaminated

2.5 Benchmarking

To understand what the market of hygiene dispensers looks like and in which way the present dispensers are fulfilling the users' demands concerning hygiene aspects, the existing dispensers on the market were studied. The studies started with analysing what hygienic products different companies already were providing. These studies showed that the products produced by SCA's competitors focus mostly on using antibacterial materials, and to a certain extent on hygienic design and function. In the following, the main products for each kind of dispenser (soap, hand paper, toilet paper and waste bin) are being presented.

2.5.1 Soap Dispenser

Figure 2.4. Steiner - Soap dispenser

Steiner, with the slogan "hygiene on hand", (Steinersystem, 2009) is a Swiss-American company that produce dispensers for public washrooms. They present their products as offering "certainly impeccable hygiene", "reliable dispensing systems" and "ease of maintenance". A soap dispenser which has an elbow lever function (see Figure 2.4) is offered as a hygienic product.

Cannon is a hygiene company that works with a wider range of hygiene products. The company offers products and services focusing on washroom and healthcare service as well as pest control and textile care. In washroom service, Cannon manufactures a soap dispenser which is made in Polygiene®, an antimicrobial material (Cannon, 2011). The material, which is used for the dispensing lever, allegedly kills microbes on contact. It is also designed in such a way that you get a new nozzle with every refill, which prevents clogs and drips and thereby prevents cross-contamination (see Figure 2.5).

Figure 2.5. Cannon - Soap dispenser

2.5.2 Hand Paper Dispenser

PHS is a British company that claims to have the most hygienic paper dispenser on the market (PHS, 2009). Their dispensers are manufactured with Steri-Touch® antibacterial surface protection. The surfaces are allegedly smooth and easy to clean, and each paper towel is "self-presenting" to prevent cross-contamination (see Figure 2.6).

Figure 2.6. PHS - Hand paper dispenser

Georgia-Pacific is one of the world's leading manufacturers of tissue, pulp, paper, packaging and related products, and has its facilities across North America, South America and Europe (Georgia-Pacific, 2011). Georgia-Pacific's enMotion product line consists of completely touch-less, sensor-equipped dispensers. Some of their paper dispensers are water resistant, which means that they have rubber seals protecting the paper from water splash. In this way, the dispenser can actually be cleaned with a hose, which may be mostly interesting in the food handling business (see Figure 2.7).

Figure 2.7. Georgia-Pacific - Hand paper dispenser

2.5.3 Toilet Paper Dispenser

The North American company Kimberly-Clark is a well-known company with distinctive products in health and hygiene. Kimberly-Clark has a series of toilet paper dispensers with Microban® technology (Microban, 2011). This means that the dispensers are made out of a material that prevents odour- and stain-causing bacteria to grow (see Figure 2.8).

Figure 2.8. Kimberly-Clark - Toilet paper dispenser

Kimberly Clark also offers an electric toilet paper dispenser which automatically dispenses a pre-measured amount of toilet paper when users place their hand under the dispenser (see Figure 2.9)

Figure 2.9. Kimberly-Clark - Electric toilet paper dispenser

In addition, Kimberly-Clark's Aqua series consists of soap, hand paper and toilet paper dispensers, designed in a way that eliminates dirt and dust traps (see Figure 2.10).

Figure 2.10. Kimberly-Clark - Aqua series

2.5.4 Waste Bin

Smart Can® is a technology used by the thrash container company HOSPECO (Nextag, 2011). Their trash containers are equipped with infrared sensors that automatically open the lid when a person's hand is within about 20 cm from the top. It also closes the lid when the person walks away. In this way, the user never has to touch any part of the trash container (see Figure 2.11).

Figure 2.11. HOSPECO - Waste bin

2.5.5 Comments

Many companies on the market apparently have products that claim hygienic benefits through antimicrobial surface materials. As discussed in 2.1.4, the effectiveness of such materials is very limited. From the result of this thesis, it seems likely that more design focused solutions like Kimberly-Clarke's Aqua-series is a better way to improve the hygiene.

2.6 Visual Brand Analysis

In product development and design, it is always important to be aware of the brand the product is going to represent and the product family it is going to be a part of. The new product should express the same values as the brand itself, and carry the visual design heritage of the brand.

2.6.1 Tork Core Values

The Tork core values are not explicitly stated anywhere, not on their website and not in internal branding material either. However, that a brand's core values are not stated clearly does not mean that they do not exist. Through studying Tork's brand

manual and guidelines, the following key words were extracted and used as core values: Hygiene, Nature, Function, Caring and "Everyday & Beyond". Two mood boards were made in order to visualise these core values (see Figure 2.12 and 2.13). One was made using Tork's own promotional images, and the other one using other images not relating directly to the Tork brand. These were then presented to and discussed with company representatives.

SCA's core values as a company are Respect, Excellence and Responsibility (SCA, 2011). These are quite broad terms, as might be preferable for a company with such varied business areas as SCA. The core values were kept as guiding words for the project, but were not analysed in the same detail as the Tork values, as Tork was the brand under which the product would be marketed.

Figure 2.12. Mood board - Tork core values

Figure 2.13. Mood board - Expressing Tork core values

2.6.2 Design Format Analysis

A Design Format Analysis (DFA) is a method used to analyse what design cues are typical for a certain brand (Warell, 2001). This is done by first studying all of the brand's current products (or a relevant subset of products) and listing every design feature that can be found. This generally results in a long list of features. The products are placed on the x-axis of a matrix and the features on the y-axis. Then every product is checked against every feature. If a product clearly has the feature, two points are assigned at the corresponding point in the matrix. If it has it to some extent, then one point is assigned. If it does not have it at all, zero is assigned. In the end the total score for each product and each feature is calculated, and so two results are achieved: The products with the highest scores are the most typical products for the brand, and the features with the highest scores are the most typical features for the brand.

The latter was more interesting for this project, as it was valuable to see what the Tork design cues were, and whether they could be considered as hygienic or not. It would be beneficial to make a new dispenser design that draws on the strong (hygienic) sides of Tork's design language, while fading down or avoiding the not so hygienic design features.

The most typical design features for Tork are indicated in Figure 2.14. The full DFA can be found in Appendix G. Included are the products from Tork's product line for public washrooms.

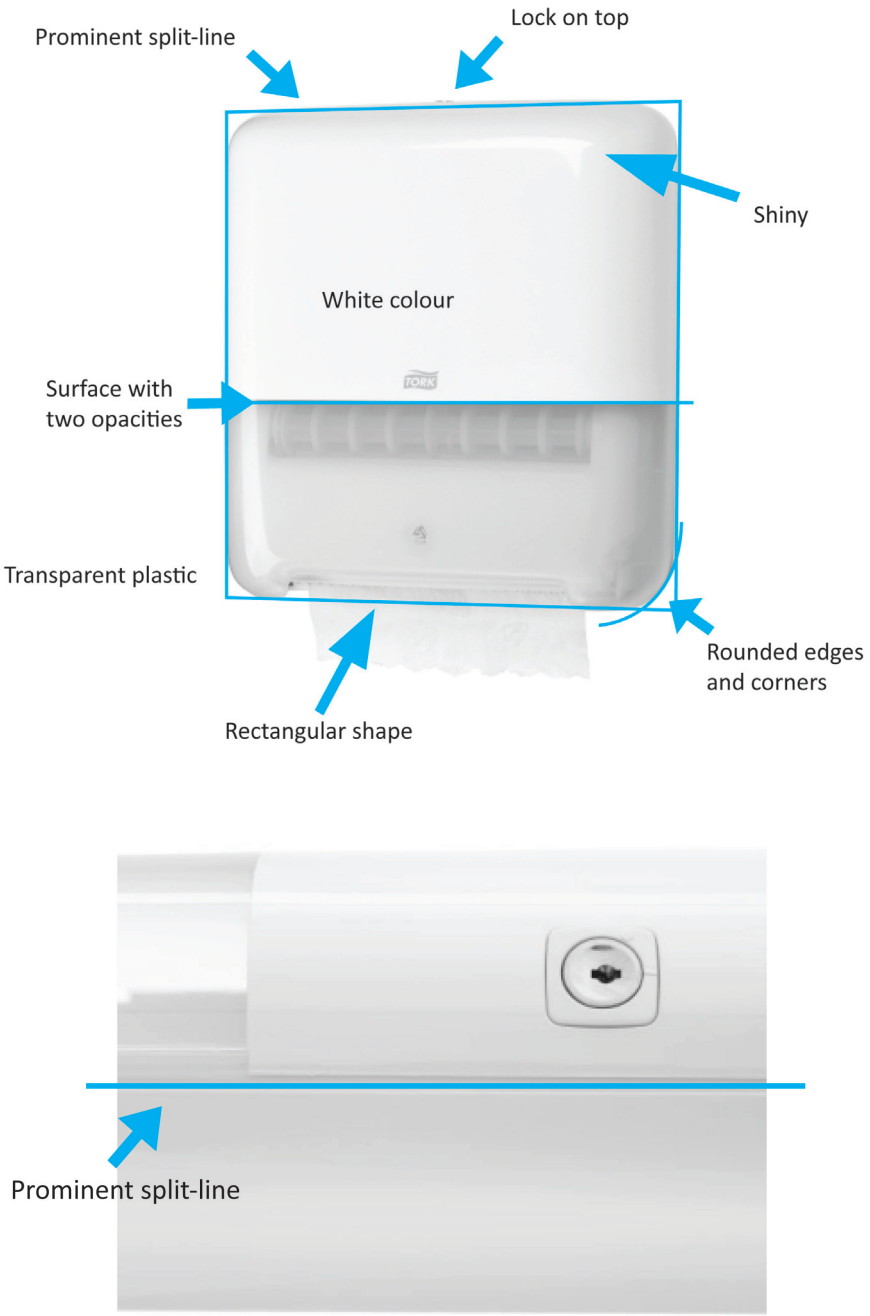


Figure 2.14. The most typical Tork design features

2.7 Hygiene Perception

One online survey, two focus groups and one more detailed survey were used to explore how users perceived design in terms of hygiene. The central question was which design elements were considered hygienic and which were not.

2.7.1 Online Survey

The online survey was done internally at SCA. The respondents were thus employees at SCA, from different parts of the world. A link to the survey was posted on SCA's internal website, for their packaging branch in Europe and for SCA Americas. These branches of the company were chosen as the market for the new product was to be Europe and America. People working with away-from-home products were excluded, to avoid bias. There were 102 respondents in total. The questionnaire consisted of questions about material, colour, transparency, shape, existing dispensers from SCA as well as from competitors, and antibacterial additives. The survey can be found in Appendix H.

Materials of different kind and surface finish were presented, and the result goes to show that surface finish is more important than material kind. Generally, glossy, shiny and polished materials seemed to be considered more hygienic. Rough materials were perceived as unhygienic and matt materials were somewhere in between. It would have been good to be able to see if there were any notable differences between the American and the European respondents, but unfortunately, the survey was made in a way that excluded this possibility. Transparency also seemed an important factor, as clear glass was the material perceived most hygienic. Metal was generally perceived as fairly hygienic, in all the varieties of it presented in this questionnaire (see Figure 2.15).

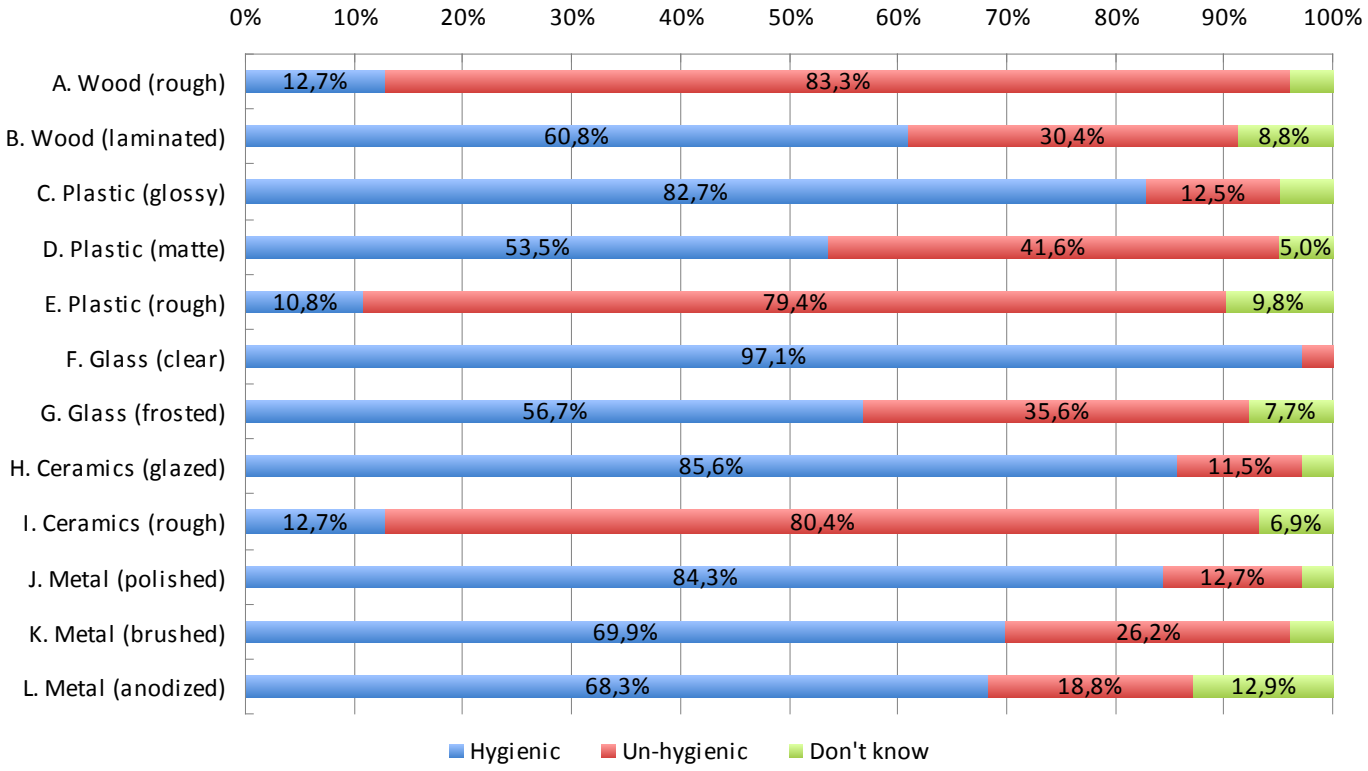


Figure 2.15. Hygiene perception - Materials

Concerning colours, white was perceived as clearly the most hygienic choice, though it should be noted that this question was quite rough, with only a number of primary colours represented. Turquoise, blue and green got moderately good ratings, as did grey. Colours in the red-violet area were perceived as unhygienic and brown was as well (see Figure 2.16).

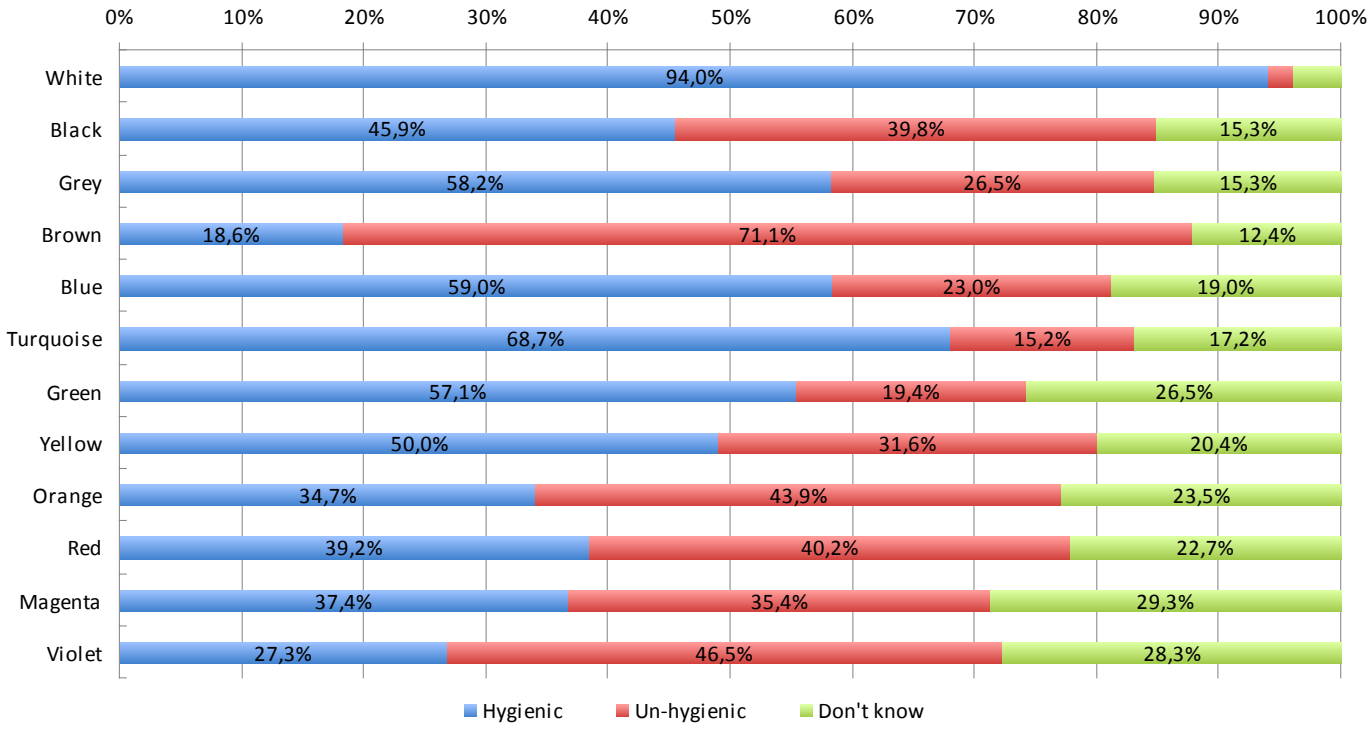


Figure 2.16. Hygiene perception - Colours

The respondents were asked how they perceived the hygienic qualities of a number of basic shapes, to see if there were any broad conclusions to be drawn about shape. Though no single shape stood out, it was obvious that round shapes with large surfaces were perceived more hygienic (see Figure 2.17).

When asked about transparency, the respondents noticeably preferred completely transparent material compared to both semi-transparent and opaque. However, no picture was provided for this question, so it might be reasonable to doubt the accuracy of the result. Without visual examples, the question could have been too abstract (see Figure 2.18).

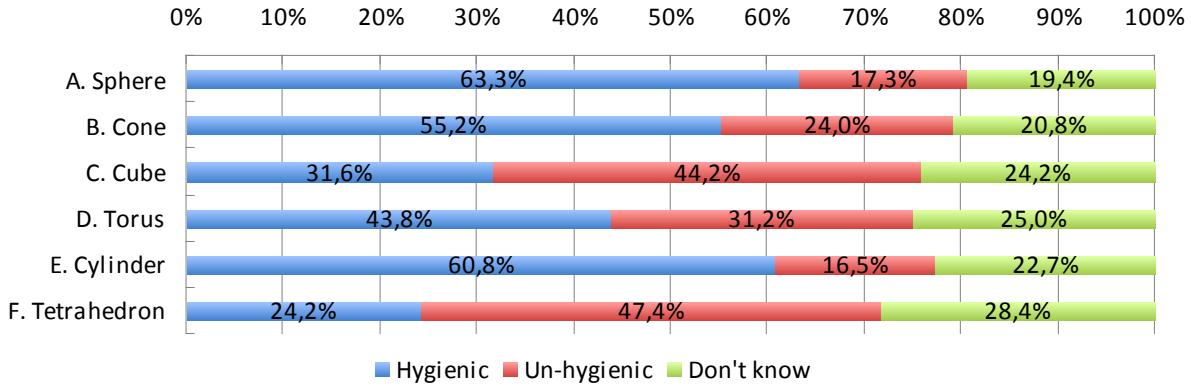


Figure 2.17. Hygiene perception - Shapes

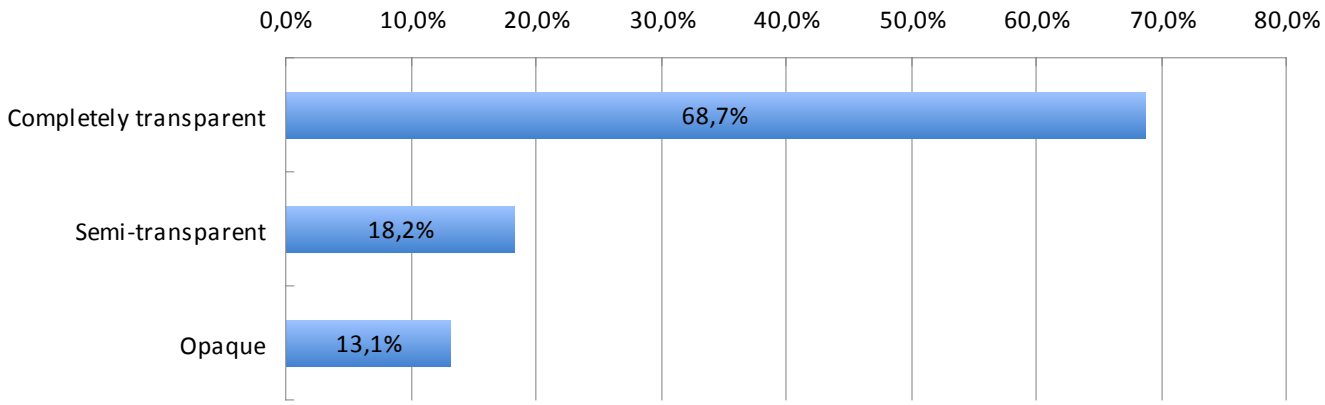


Figure 2.18. Hygiene perception - Transparency

To compare how different ways of operation was perceived, the respondents were presented with SCA dispensers from the product categories hand paper dispensers, soap dispensers, toilet paper dispensers and waste bins. They were asked how hygienic they perceived the function of each dispenser to be (see Figure 2.19-2.22).

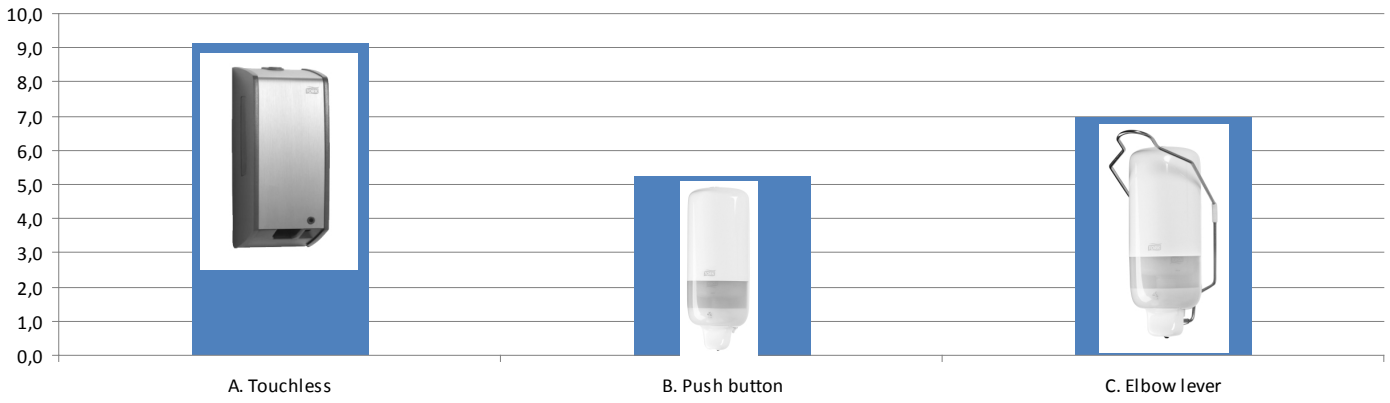


Figure 2.19. Hygiene perception - Function - Soap dispenser

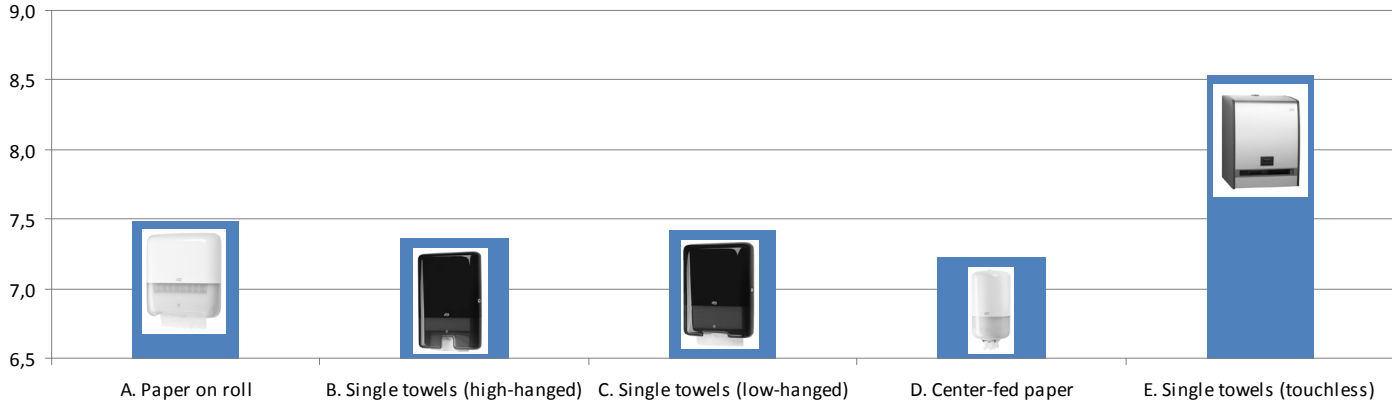


Figure 2.20. Hygiene perception - Function - Hand paper dispenser

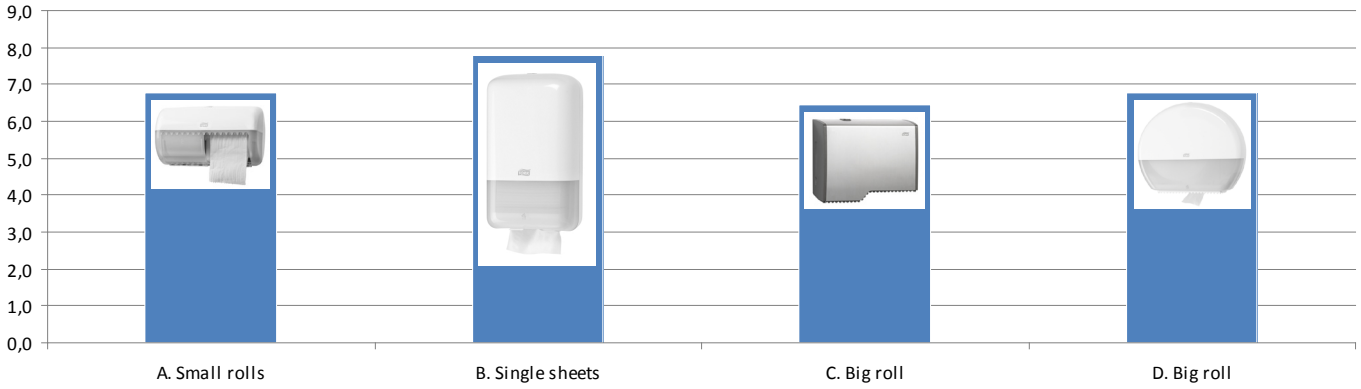


Figure 2.21. Hygiene perception - Function - Toilet paper dispenser

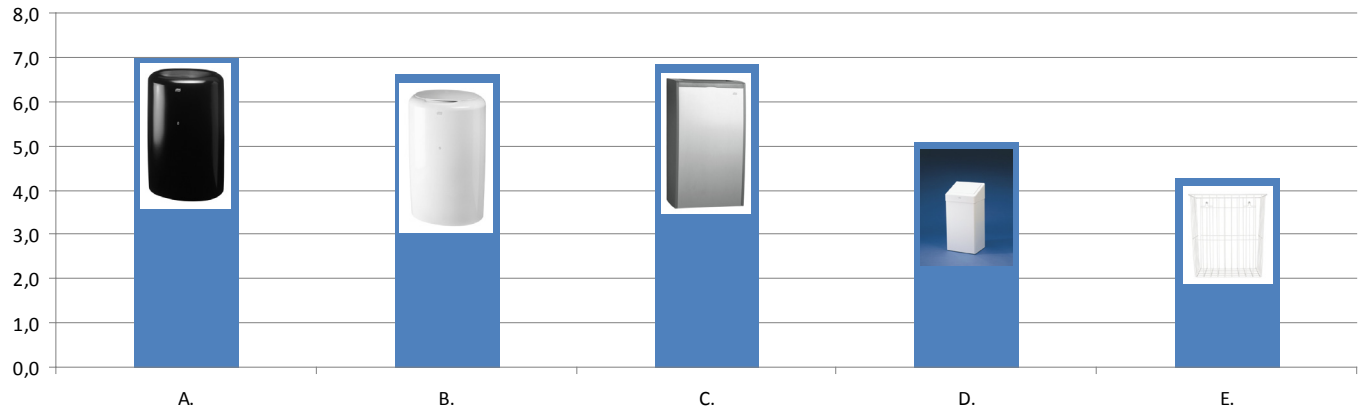


Figure 2.22. Hygiene perception - Function - Waste bin

For soap dispensers, the result seemed to show that the less the users had to touch the dispenser with their hands, the better.

The general trend for hand paper dispensers was that touch-less dispensers were preferred

Though all four toilet paper dispensers scored somewhat equally, it could perhaps be noted that a single sheet system of dispensing seemed to be perceived more hygienic than a roll system.

For waste bins it is perhaps more telling to consider what was perceived unhygienic than hygienic. Waste bin E, a very open wire construction, scored the lowest, and D, with a plastic tilt lid was not far behind. A conclusion that seems plausible is that the users want the litter to be hidden away from sight and that they might have had bad experiences with the tilt lid.

The respondents were also asked to judge how hygienic the visual design of a number of dispensers was. The two dispensers clearly perceived more hygienic were Georgia-Pacific's blue, sensor-equipped enMotion hand paper dispenser and SCA's aluminium, sensor-equipped hand paper dispenser. The Georgia-Pacific dispenser holds many of the traits that seem to be perceived as hygienic, as e.g. transparent plastic, blue colour and rounded shapes, while the SCA dispenser does not. A possible source of error here is that both of these dispensers are touch-less, using sensors. It had been revealed in an earlier question that the SCA dispenser was sensor-equipped, so that might explain why it scored so high. The Georgia-Pacific dispenser, on the other hand, is quite common in the U.S., and seeing as about half of the respondents were from North America, they may already be familiar with it and its function (see Figure 2.23 and 2.24).

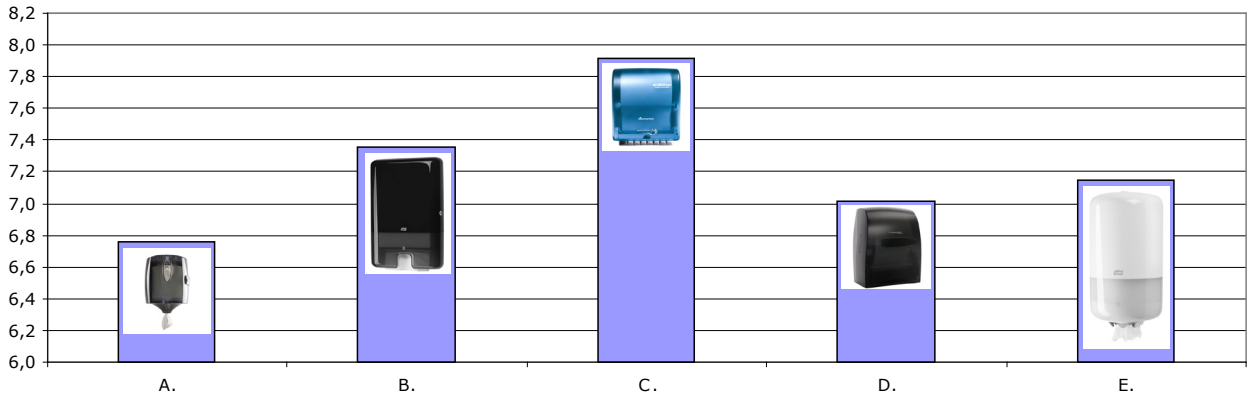


Figure 2.23. Hygiene perception - Visual design (A - E)

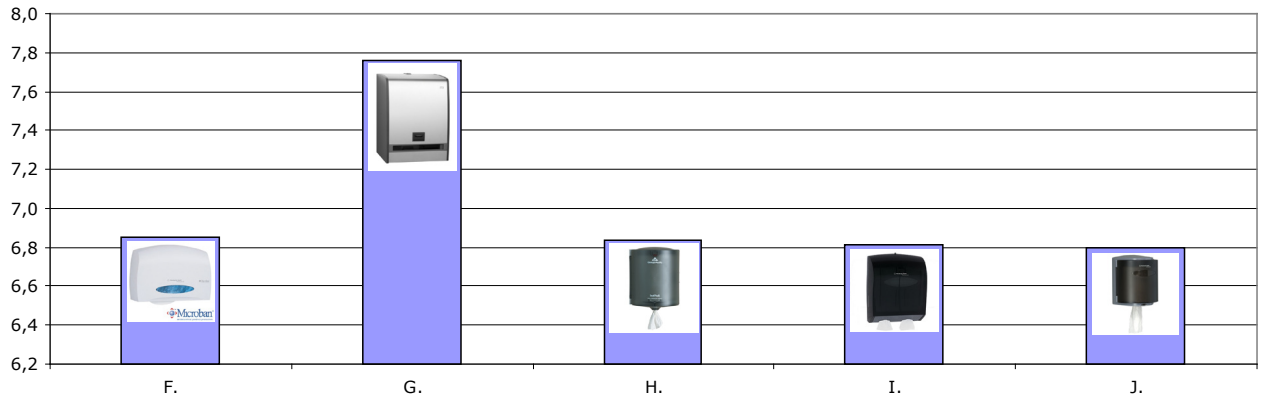


Figure 2.24. Hygiene perception - Visual design (F - G)

Finally, a question about the respondents' attitudes towards antibacterial additives was included. Neither a clearly positive nor negative opinion could be noted (see Figure 2.25).

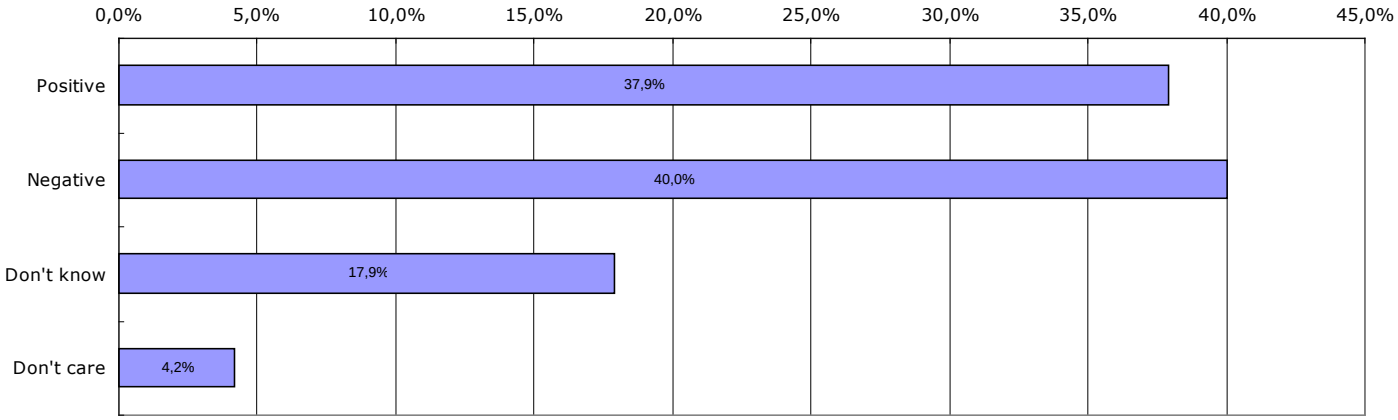


Figure 2.25. Hygiene perception - Antibacterial additives

2.7.2 Focus Groups

As a complement to the questionnaire, two focus groups were carried out, to elicit more quality information about hygiene perception. In a focus group, a small number of people get together to discuss a given topic, in this case hygiene perception (Osvalder, 2009). These people are selected to represent the users of the product. For this project, the target group was very wide, consisting of adults and adolescents living in Europe or North America. One focus group was held with employees at SCA and one with students at Chalmers University of Technology. The one at Chalmers had four participants and the one at SCA only one. It was unfortunate to have only one participant, as the strength of focus groups lies in having a discussion between the participants, but some valuable information was elicited in spite of this. The participants were of both genders and between the ages 20 and 55. All participants were from Sweden except one, who was from Turkey.

One of the thesis workers acted as moderator in the discussions and a slide-show displaying examples of materials, colours, shapes, dispensers, other kinds of products etc. was used to catalyse the discussion. The focus groups were recorded and later transcribed and structured by using the method of KJ-analysis. The transcripts can be found in Appendix I.

KJ-analysis is a method to structure information, which is especially useful dealing with interviews and focus groups (IPU product development, 2010) . All relevant statements from the focus group were written on separate pieces of paper, which were spread out over a big board. These statements were then moved around, being tentatively organised in clusters. Each cluster consists of statements concerning the same general problem or issue. The clusters themselves are also organised, so that problem areas that relate to each other are closer together on the board. In this way, a "big picture" is gradually forming, where a number of problematic areas are defined. Table 2.6 shows a listing of what was found being clearly hygienic and unhygienic from the focus groups.

Hygienic	**Unhygienic**
White	Black
White and blue in combination	Dark colours
Large and open surfaces	Split-line
Rounded shapes	Too much complexity and details
Transparent materials	Hidden surfaces
Shiny materials	Edgy shapes
Foot pedals	Matt material
Material accessibility	Dirt and scratches
Sensor solutions	Touching the lid
	Seeing the contents of the waste bin
	Seeing the plastic bag of the waste bin
	Poor accessibility
	Unprotected paper
	Touching dispensers
	General messiness

Table 2.6. Result of KJ analysis

2.7.3 Detailed Study

The results from the online survey and the focus groups were useful and interesting, but at the same time mostly confirmed what was already suspected. To deepen the study and hopefully elicit more detailed information about hygiene perception in dispenser design, a second questionnaire was created. This delved deeper into the subjects of colour, shape and material. The questionnaire can be found in Appendix J. The nature of the questions in this survey made it more suitable to be carried out as a paper survey than an online survey. The respondents where studying either at Aston University in Birmingham or Chalmers University of Technology in Göteborg, though care was taken to get respondents with as varied national background as possible. There were in total 45 respondents (see Figure 2.26).

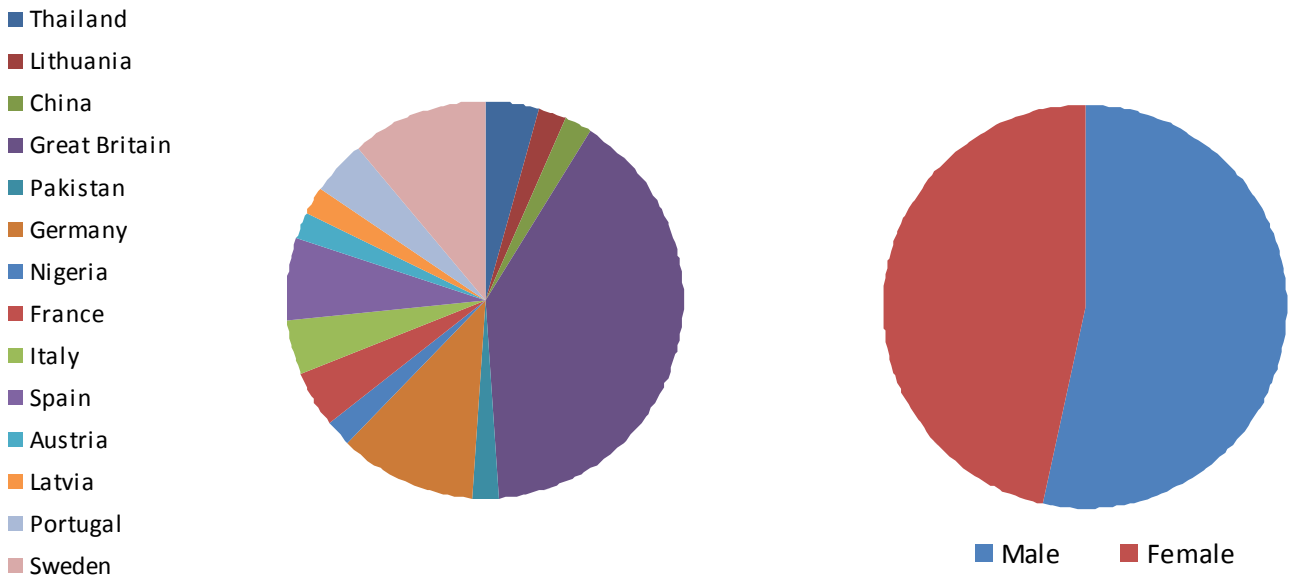


Figure 2.26. Nationality and gender distribution of the respondents

The first question consisted of a colour chart, with 13 x 17 colour swatches. The colours where chosen with the result from the first survey in mind. Since light colours seemed to be considered more hygienic, only the spectrum from primary colour to white was included. All primary colours where not included, as some had been deemed clearly unhygienic in the first survey. The respondents were asked to first circle the five colours they perceived as most hygienic, and then to mark ten more that they also considered quite hygienic. When calculating the score, the circles counted as 2 points and the marks as 1 point.

Perhaps not unexpectedly, white was once again considered the most hygienic colour. Blue was also more hygienic than the average, and in general lighter hues seemed to be preferred (see Figure 2.27).

The second question was similar to the first, but focused on how hygienic colours were perceived to be when contrasted to white. This could be interesting for having white products with details in other colours. The respondents were presented with a chart of 11 x 15 white squares with outlines in various colours, and asked to choose the five colours that they perceived to be the most hygienic. The selection of colours was the same as for question one, though some colours were excluded to make room in the chart.

Colours in the blue spectrum seem to be favoured here as well, and some green shades too. The big difference here is probably that the darker, more primary hues were considered hygienic, as opposed to the lighter ones in the first question (see Figure 2.28).

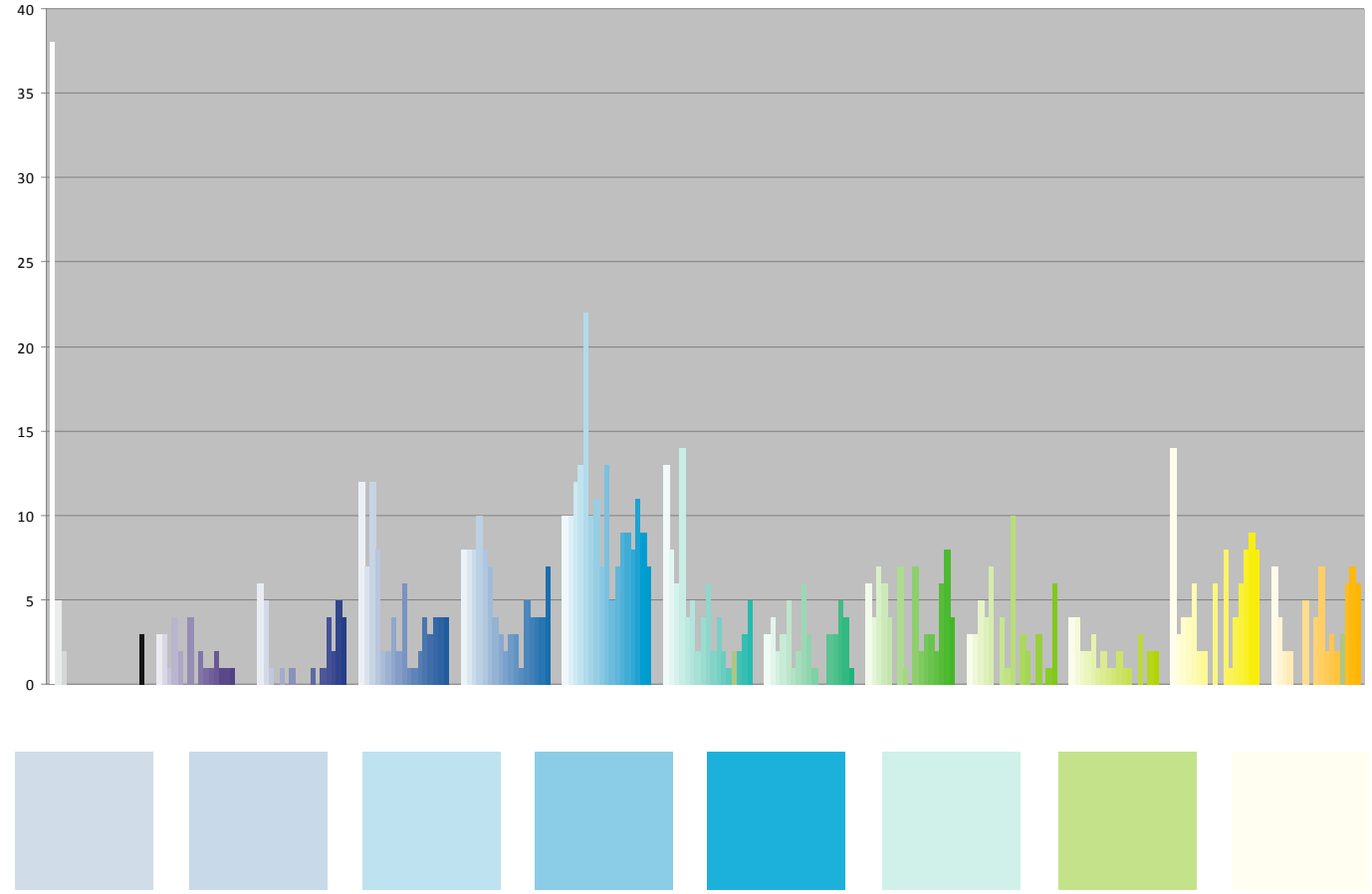


Figure 2.27. Detailed study of hygiene perception - Colours

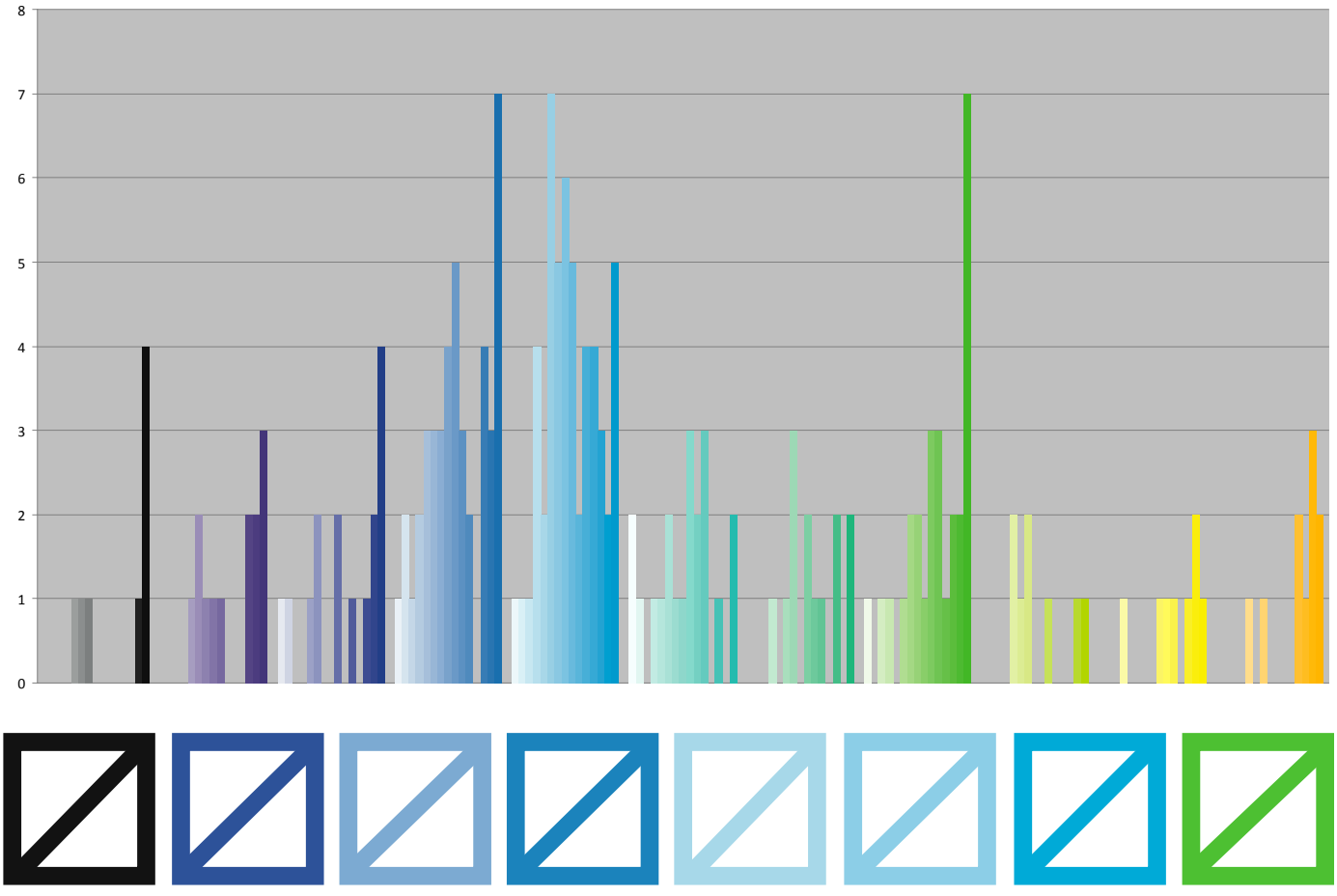


Figure 2.28. Detailed study of hygiene perception - Colours in contrast with white

The third question concerned shape, and presented a generic object shaped vaguely like a dispenser. This object was then transformed by gradually increasing the radius on one edge at a time, and finally on all edges at the same time. The respondents were then asked to consider the closest corner of the object and mark the three most hygienic (see Figure 2.29).

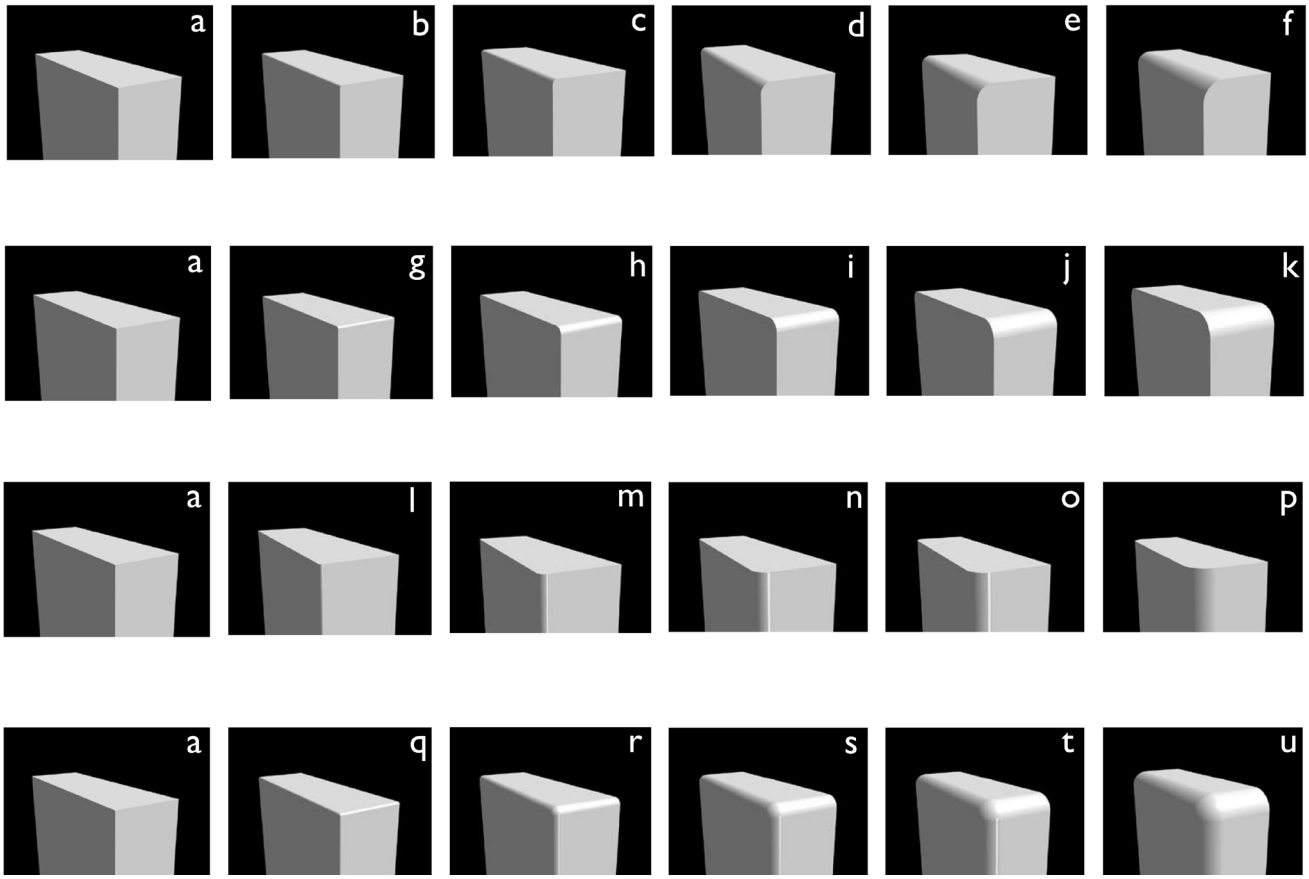


Figure 2.29. Shapes presented in detailed study

It is obvious that the forth series of transformations, where all edges are rounded, is perceived the most hygienic, and the bigger the radii, the more hygienic, it seems. The second series also scores quite high. Corner n is perceived as surprisingly hygienic compared to the other corners in the third series. It could be that the proportions happen to be excellent in that picture, but it seems more likely that it is a coincidence. Perhaps the central placement of the picture made it catch many people's eyes, e.g (see Figure 2.30). This kind of question has its limitations. Ideally, the number of transformations should have been many more, to explore different combinations of rounded edges, different proportions in the basic object, curvature instead of radii, etc. To keep the length of the questionnaire down, though, the number of transformations had to be narrowed.

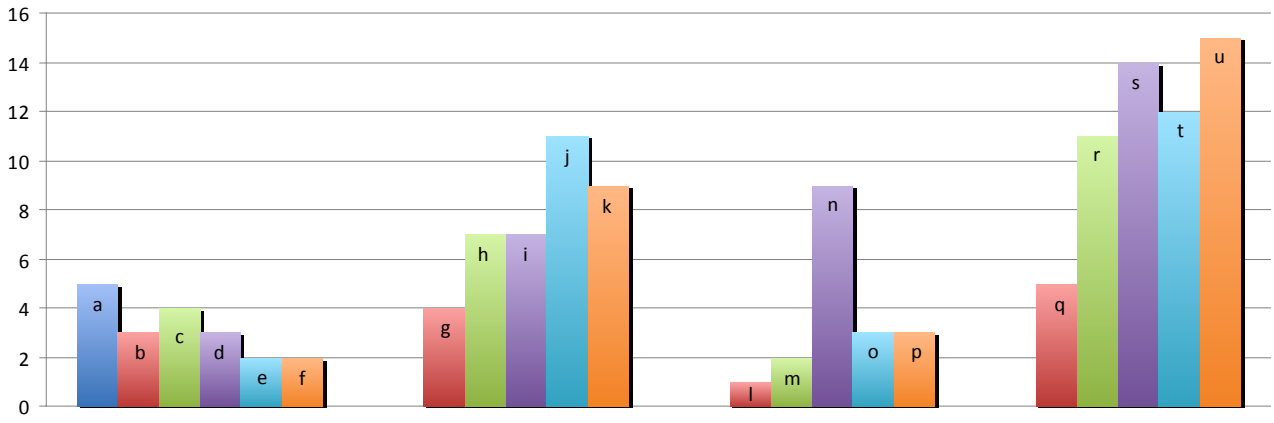


Figure 2.30. Detailed study of hygiene perception - Shapes

The last question dealt with material combinations, surface finishes and transparency. The nature of this question was more that of a discussion question, where the respondents were presented with a number of images displaying products and material samples. They were then asked to mark any feature in the images that they found especially hygienic, and explain why. One of the images presented depicted five sheets of glass ranging from completely transparent to more and more translucent. In this image (see Figure 2.31) all respondents were asked to mark the degree of translucency they perceived as most hygienic. It seems safe to say that the two most transparent sheets were considered more hygienic. This means that the preferred range is between completely transparent material and semi-transparent material through which it is still possible to make out rough contours of objects on the other side of the sheet. This seems like a reasonable range to stay in for applications as well, as it would allow the user to see what is behind the surface (see Figure 2.32).

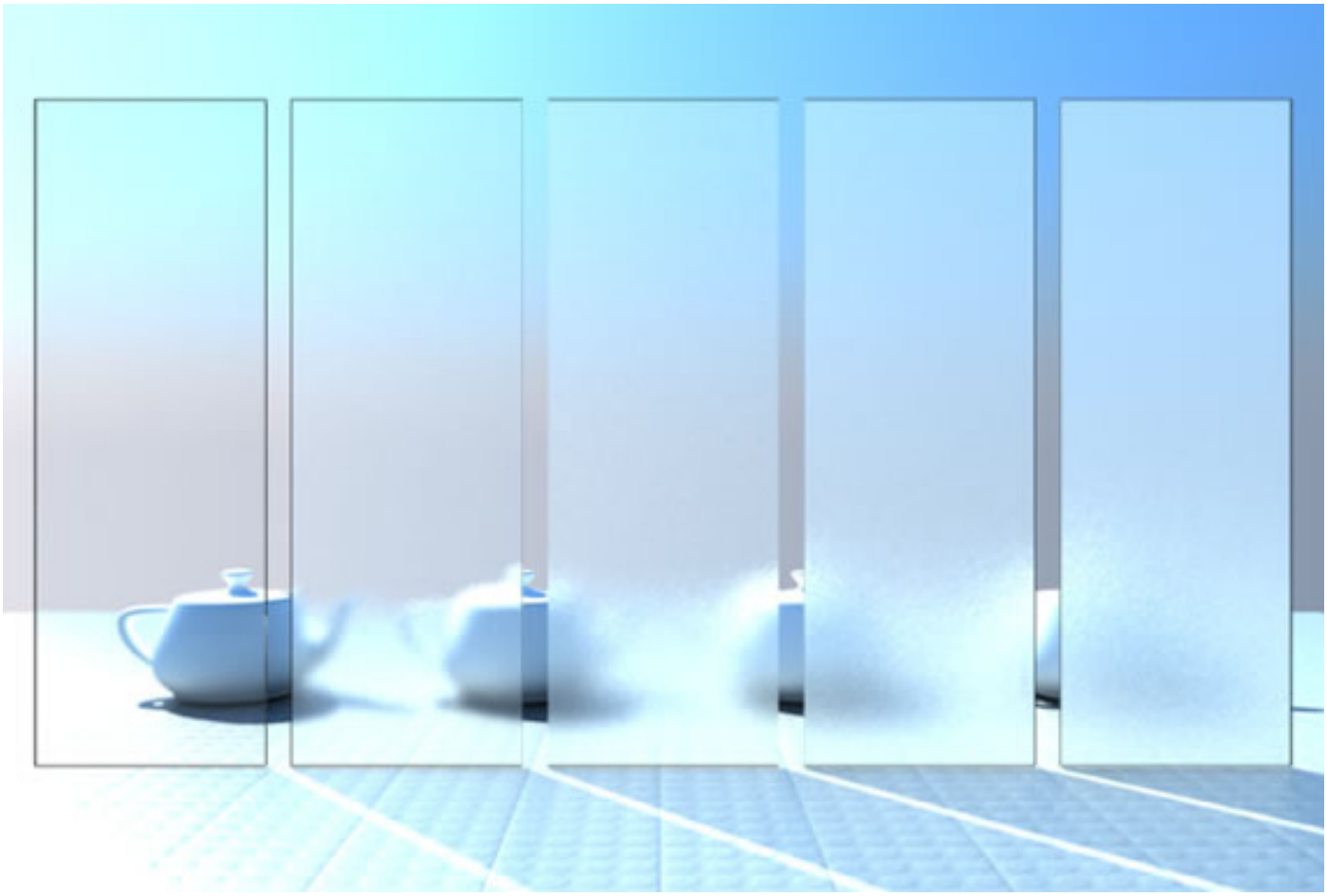


Figure 2.31. Detailed study of hygiene perception - Sheets with different degree of transparency

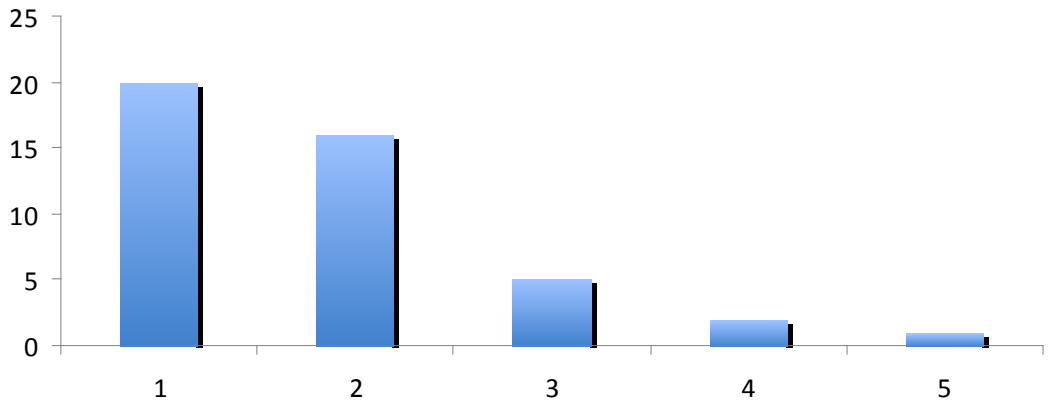


Figure 2.32. Detailed study of hygiene perception - Transparency

Products with different material combinations are shown in Figure 2.33. Figure 2.34 is a graph showing an attempt to organise the result of the material combination part of the fourth question. Because of the question's discussion-based nature, the result might need somewhat more interpretation than the previous ones. All of the features listed in Figure 2.33 where considered hygienic by some people, which means that all of them could be interesting to pursue further. It was also the case that some of the respondents were not quite sure what it was about a certain product that made them perceive it as hygienic. However, some features seem to stand out from the others; e.g very glossy materials are perceived hygienic by more than 50 % of the respondents. At least four categories in the graph involve transparency in some way: "Frosted glass", "Translucent/Transparent" (meaning a combination of translucent and transparent material), "Transparent" and "Semi-transparent and steel." This means that at least some degree of transparency is generally considered hygienic, especially in combination with other materials.

Figure 2.33. Detailed study of hygiene perception - Products with different material combinations

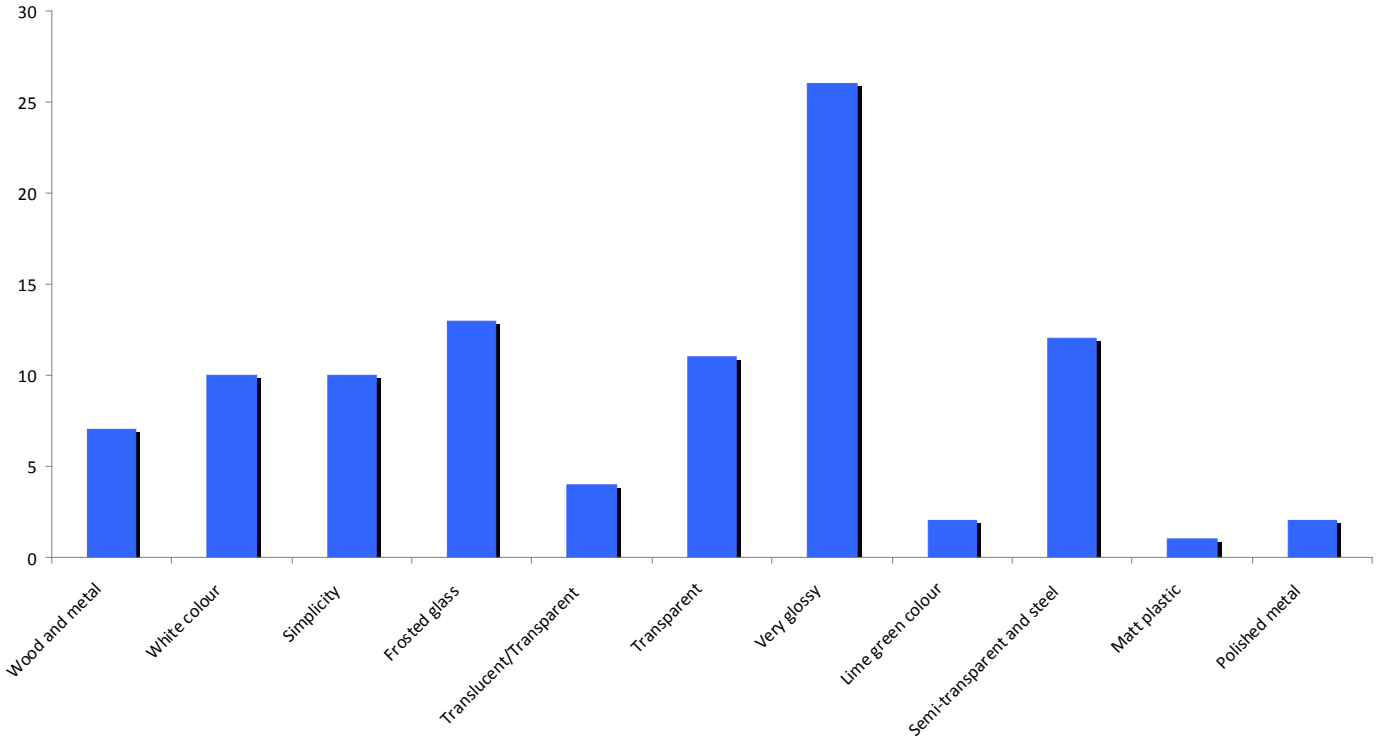


Figure 2.34. Detailed study of hygiene perception - Material combinations

2.8 Conclusions

The result of the information gathering phase was boiled down into a demand specification for a new dispenser and a set of guidelines for hygienic design. An analysis was also made concerning Tork's current brand expression and how it could be adjusted be perceived more hygienic

2.8.1 Demand Specification

Table 2.7 shows a general demand specification for dispensers at public washrooms as well as specific requirements for each dispenser. Some of the demands do not originate directly from the hygiene research performed, but rather from general demands that always should be considered in developing this kind of product. This goes e.g for "Prevent material waste." Most of such general demands are excluded from this list, however, as they are demands that are already fulfilled by most dispensers on the market. It should also be noted that whenever the term "touch-less" is used in this report, it simply refers to the property of not having to be touched when used. A touch-less dispenser in this context does not mean anything else than that in the normal operation of the dispenser, the user only touches the material that is dispensed, and not the dispenser itself. It does not mean that there is any sensor technology involved, even though the term "touch-less", when used in other contexts, usually implies that.

General	Must	Wish
Be easy to clean	✓	
Avoid edges, recesses, split-lines, etc.	✓	
Have smooth surface finish	✓	
Avoid areas where water could collect	✓	
Avoid areas where dust could collect	✓	
Show amount of material left	✓	
Express Tork core values	✓	
Express SCA core values	✓	
Appear hygienic	✓	
Communicate function clearly	✓	
Prevent cross-contamination	✓	
Be touch-less	✓	
Prevent material waste		✓
Soap Dispenser		
Show if dispenser is out of soap	✓	
Encourage use		✓
Prevent leak or drip	✓	
Hand Towel Dispenser		
Protect paper against water splash		✓
Ensure user only touches those towels she takes	✓	
Ensure paper does not touch foreign surfaces	✓	
Toilet Paper Dispenser		
Tissue should always be visible	✓	
Tissue should always be reachable	✓	
Waste Bin		
Hide waste	✓	
Hide plastic bag		✓
Prevent waste falling outside bin		✓

Table 2.7. Demand specification

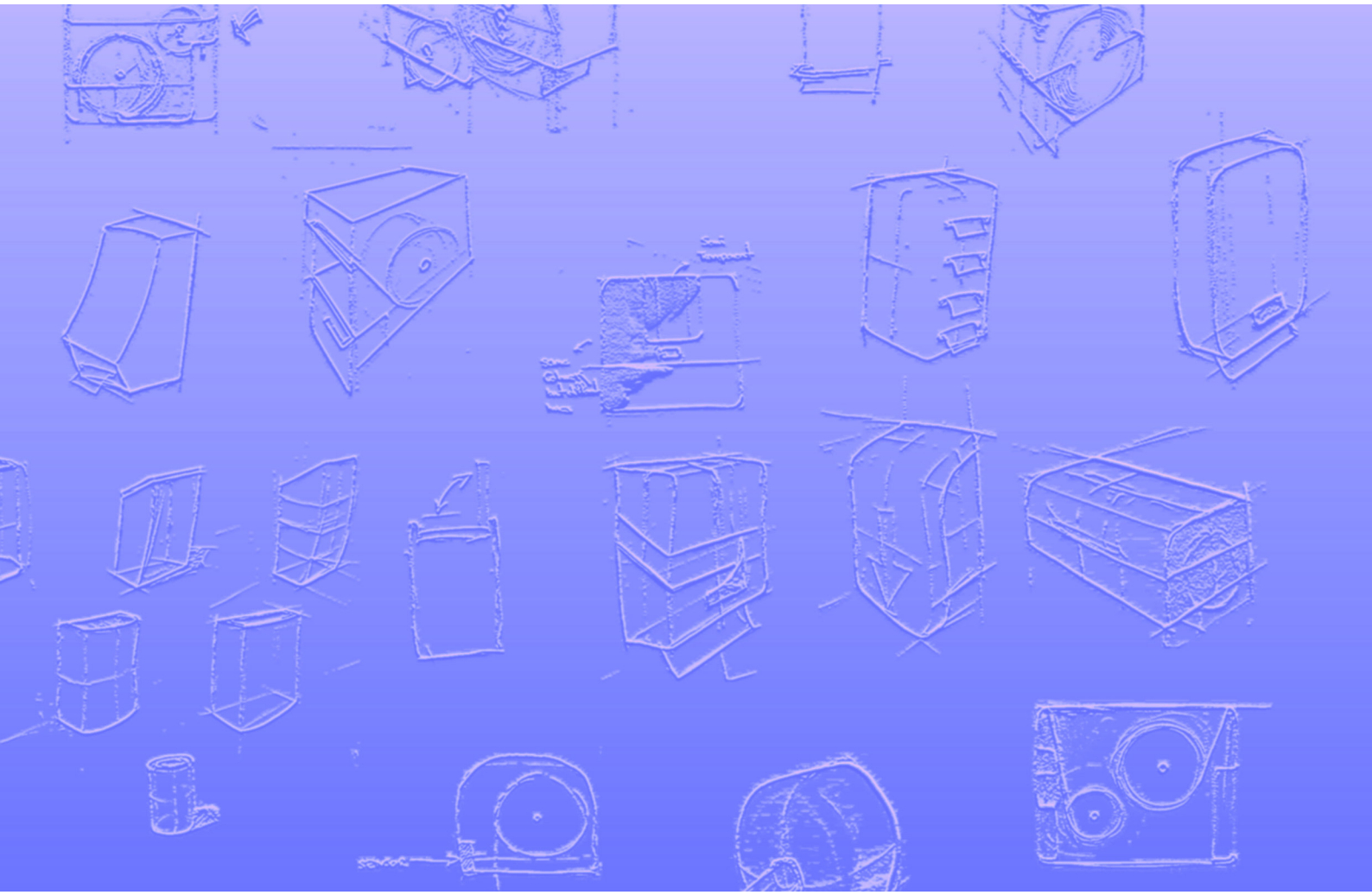
In Table 2.8, the most typical features for the Tork brand are shown in the left column while the right column shows the hygienic elements which were derived from the KJ analysis. As can be seen in the table, Tork has some design features that are already hygienic. These features are shown in dark blue colour. In addition, there are some elements such as transparent plastic and surfaces with two opacities (indicated with light blue colour) that are perceived hygienic but should be redesigned to induce the hygiene impression in an even better way. On the other hand, some of Tork's design features are unhygienic and should therefore be excluded or modified.

Tork	**Hygiene**
Rounded edges	
Prominent split- line	Large and open surfaces
Lock on top	Rounded shapes
Shiny material	Transparent materials
Niche to the wall	Shiny materials
Transparent plastic	Accessibility
Surface with two opacities	Sensor solutions
Rectangular shape	
White colour	
Cylindrical shape	

Table 2.8. Left column: the most typical Tork design features - Right column: hygiene elements which were derived from KJ analysis

3. IDEA GENERATION

The next stage in the project was to start visualizing ideas and thoughts, based on the information that had been gathered in the first phase. Visions were expressed by preparing image boards, sketching different ideas as well as using computer modelling and paper mock-ups in order to examine the three-dimensional aspects of different shapes. A lot of focus went into brainstorming functional solutions for the most important hygienic problems. The idea generation started out as a broad process, considering all the dispensers in a public washroom. This process was then gradually narrowed, in the end amounting to three concepts for new toilet paper dispensers, which are discussed in the next chapter.



3.1 Image Board

To start the design phase and define the expression and context of the product, two image boards were put together. The first image board was made to express hygiene whereas the second one shows a selection of products that have succeeded well in expressing hygiene.

The keywords used to express hygiene were simplicity, round shapes, transparency and white and/or cold colours (see Figure 3.1). The products were chosen because of their overall expression of hygiene, but when analysed afterwards, it turned out that they actually incorporated the very elements that were chosen for the previous image board. So e.g. the roundness in the shape of the soap can also be seen in the mouse design as well as the handle of the knife or even the plate's curvature. In addition, the products give a hygienic impression by their simple design, light and cold colour scheme and shiny surfaces. The image board can be seen in Figure 3.2.

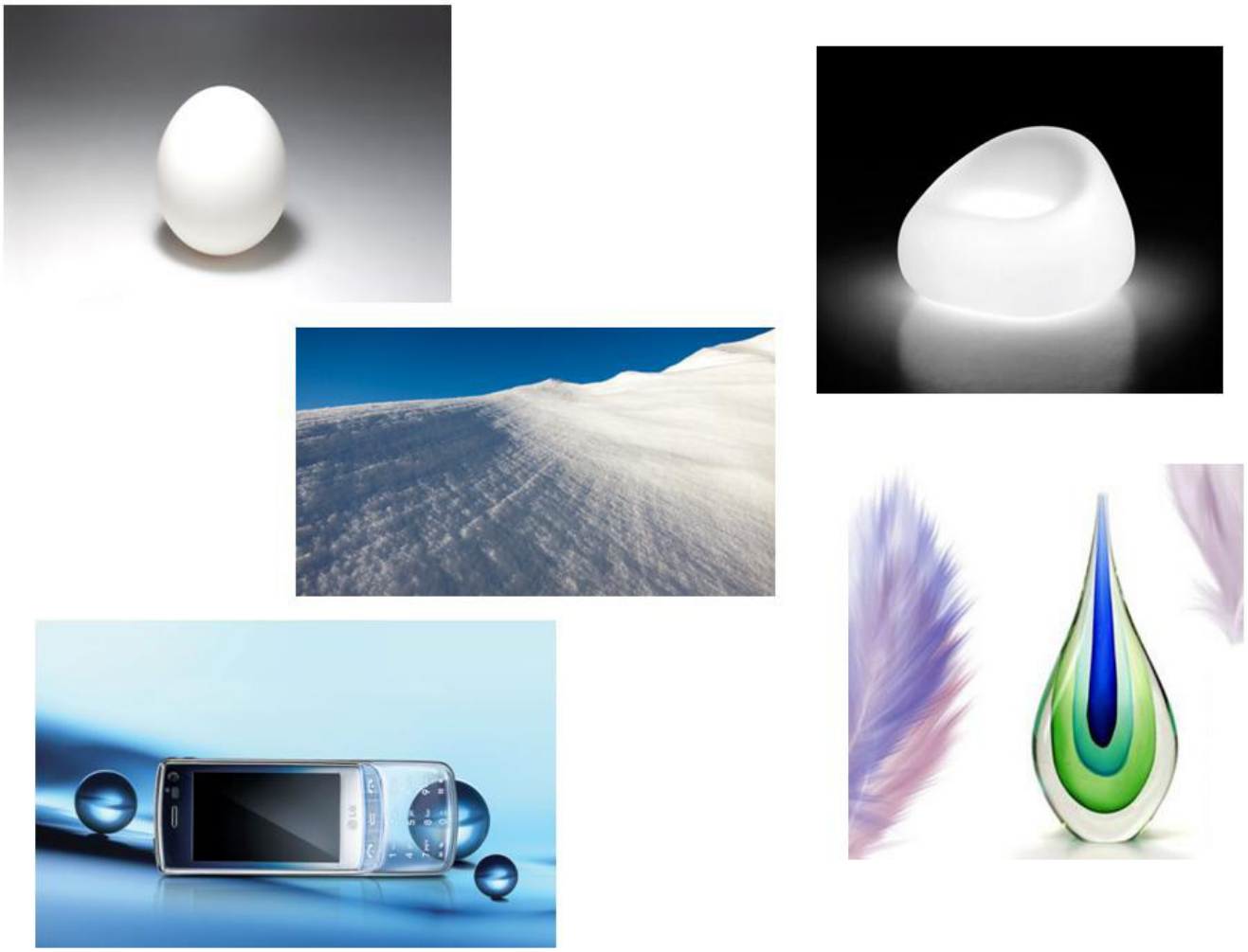


Figure 3.1. Image board expressing hygiene

Figure 3.2. Image board with products expressing hygiene

3.2 Sketching and Brainstorming

The brainstorming sessions were started off by general sketching of dispenser ideas. The dispensers were gone through one at a time, to try to get every idea on paper that might have surfaced during the information gathering phase. When these initial ideas had been exhausted, efforts were instead put into finding solutions to specific functions. These functions were drawn from the demand specification. In between these brainstorming sessions, pure form design sketching session were held, to find a suitable, hygienic expression for the dispensers (see Figure 3.3). This was complimented by 3D-modelling, using computer software as well as clay, to explore the shapes in three dimensions.

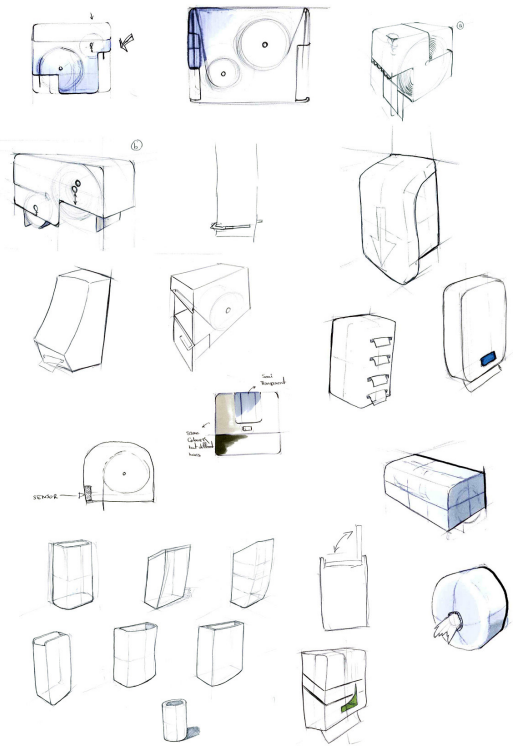


Figure 3.3. Sketches expressing hygiene

After a period of extensive sketching and brainstorming, a workshop was held with students from the master's programme Industrial Design Engineering at Chalmers University of Technology. The ambition was to elicit new ideas that might have been overlooked before, and hopefully also confirming certain ideas as especially promising. The first half of the workshop was reminiscent of the focus groups held earlier. This time the discussion was focused solely on how to express hygiene in product design, though. The second half was a free sketching session, where the participants were told to brainstorm on how to design a more hygienic toilet paper dispenser. Each person sketched on her own at first, and they then discussed their ideas in the whole group. For the most part, ideas were mostly confirmed and strengthened during this session, but there were also some interesting new suggestions, like incorporating a protection against splash from below, an automatic cutting of the paper and a centre-feed solution.

In discussions with SCA representatives, it was decided to focus mainly on one of the public washroom products, namely the toilet paper dispenser. Since the project was to result in a high quality prototype, there was not time enough to develop a whole dispenser series. The toilet paper dispenser was chosen because it presented some interesting hygienic problems, and had potential to be improved. The ideas for the remaining products were kept and presented in a rougher, less developed way (see Figures 3.4- 3.6).

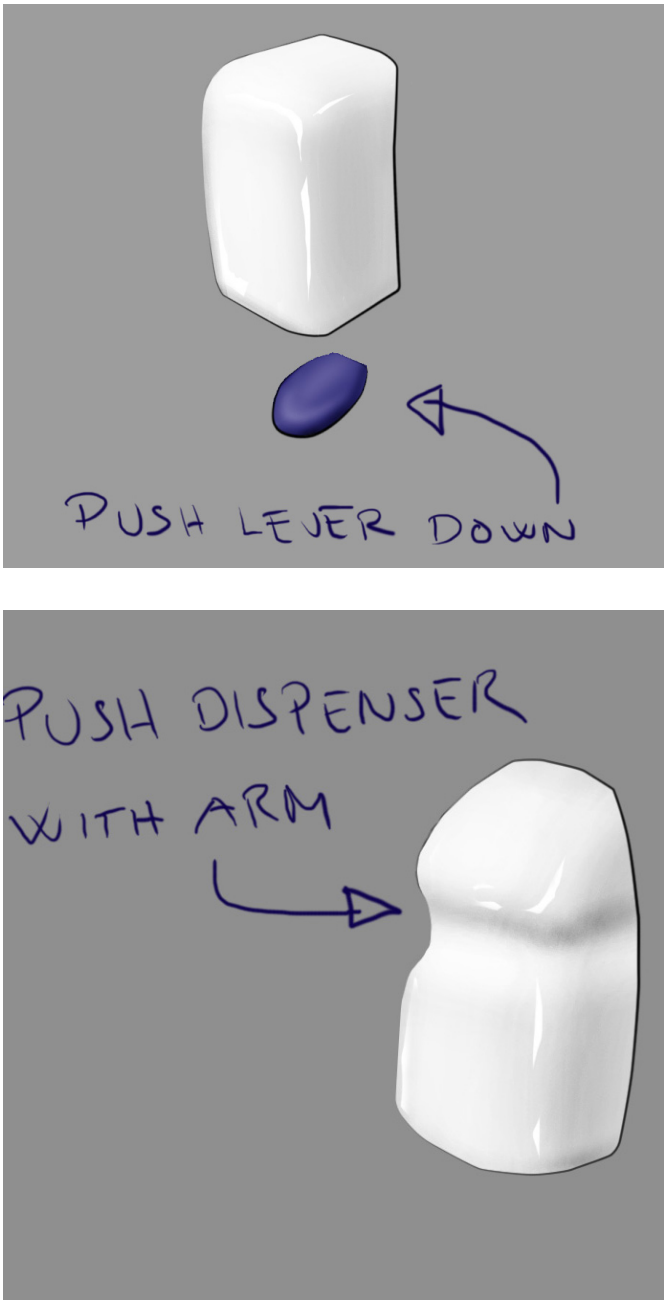
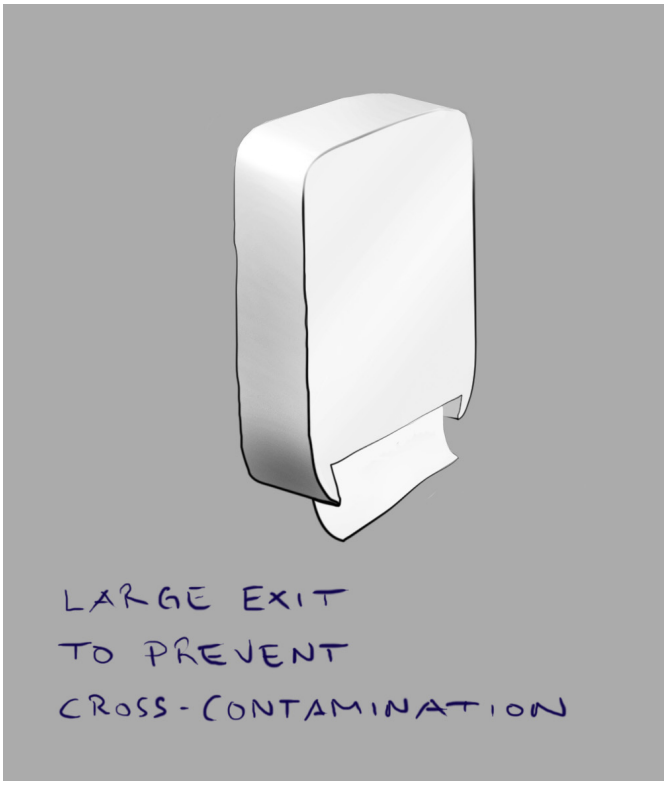
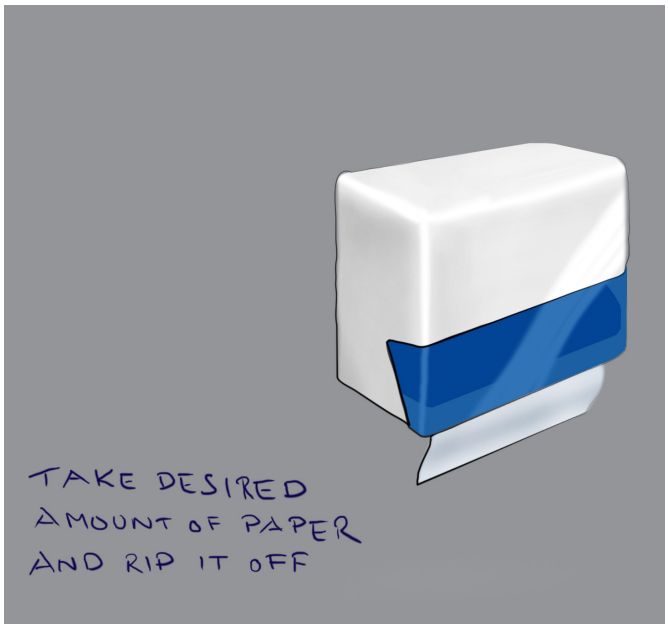


Figure 3.4. Ideas for soap dispenser

It was also commonly agreed that even though sensor solutions were a very promising way of handling problems with cross-contamination, the project would not focus on that kind of solutions. The reason was mainly that the use of sensors is well-known and also presents drawbacks like the need of a power source. The length and desired depth of this project made it more suitable to explore other means of hygienic design instead.





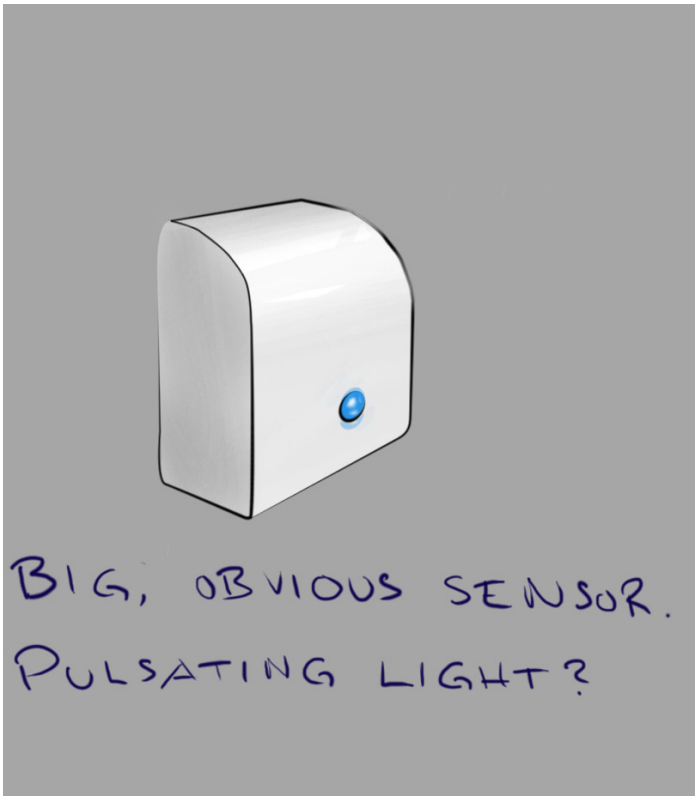
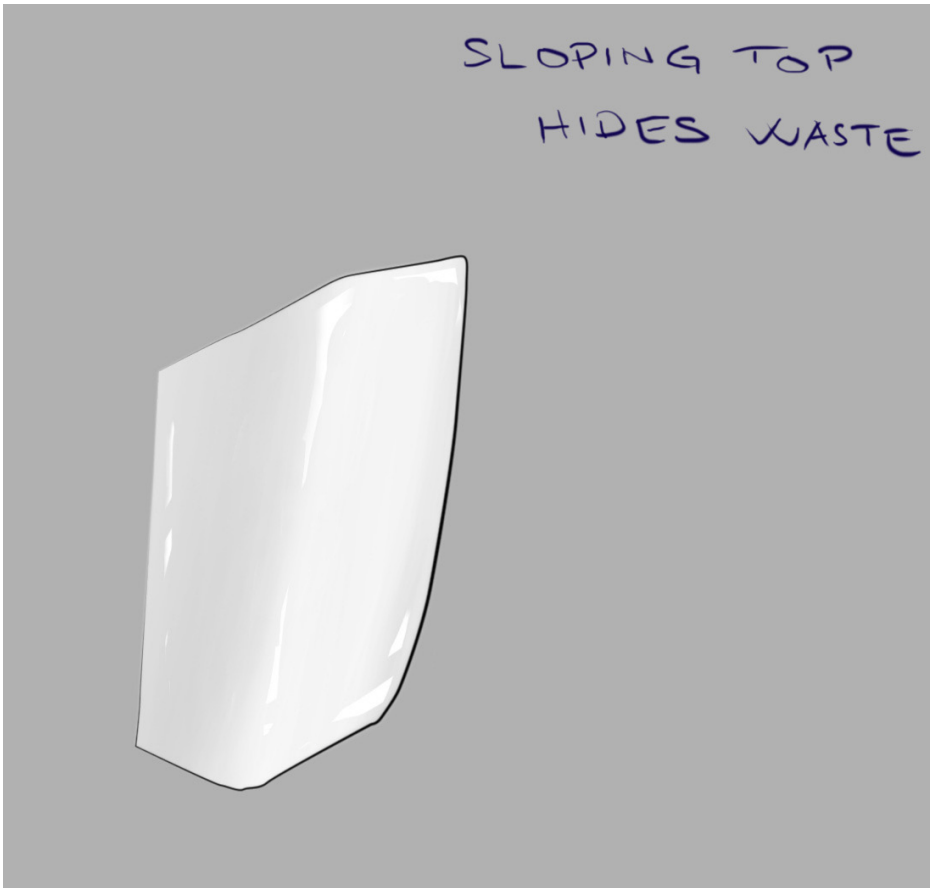


Figure 3.5 Ideas for paper towel dispenser



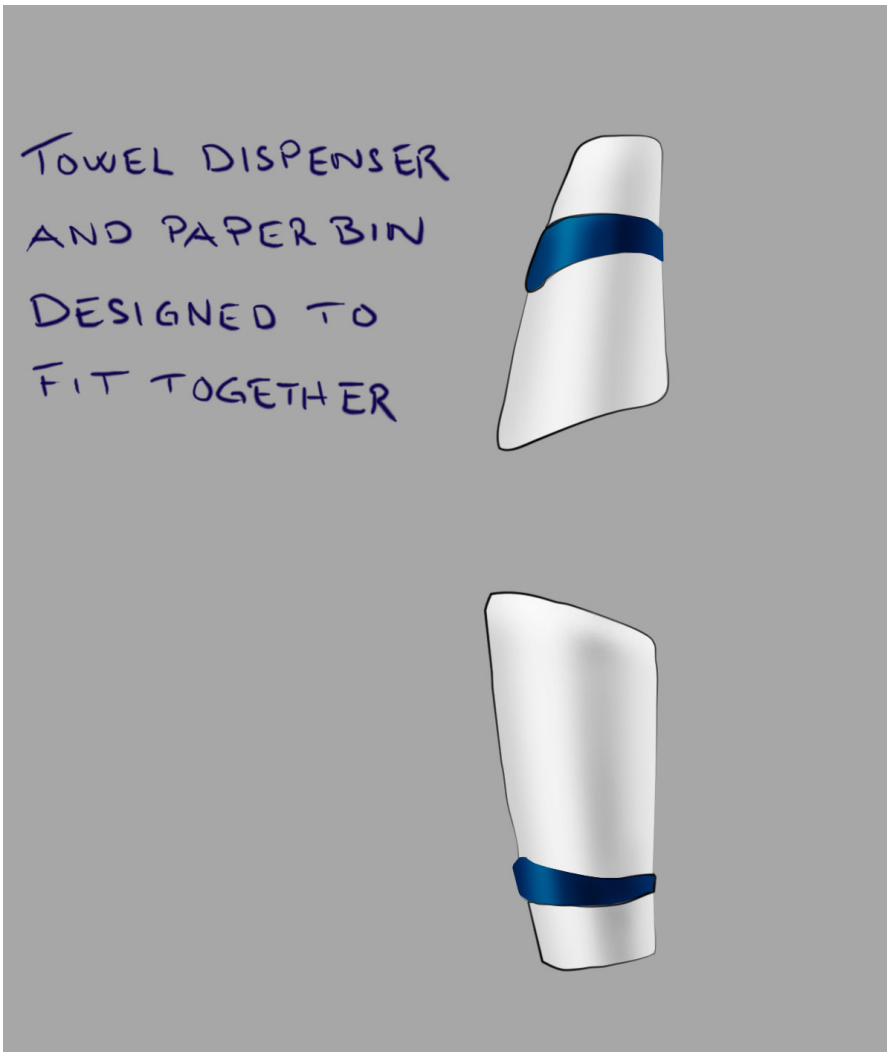


Figure 3.6. Ideas for waste bin

4. CONCEPT DEVELOPMENT

As previously stated, it was decided to go forth with the ideas for a toilet paper dispenser, and to develop these into concepts and finally choosing one for making a prototype. As a complement to these, a document of guidelines for hygienic dispenser design would also be compiled, for future use in redesigning other parts of the dispenser series.

4.1 Concept Generation

In the previous studies, the importance of the toilet paper dispenser's functionality and paper accessibility had been noted. It was seen, and included in the demand specification, that the loose paper tail should be visible and reachable at all times. Consequently, the issue of paper accessibility became the main focus in this part, and much work went into finding a way of dispensing toilet paper in a clean and easy way, avoiding jamming and tangling in the system (see Figure 4.1).

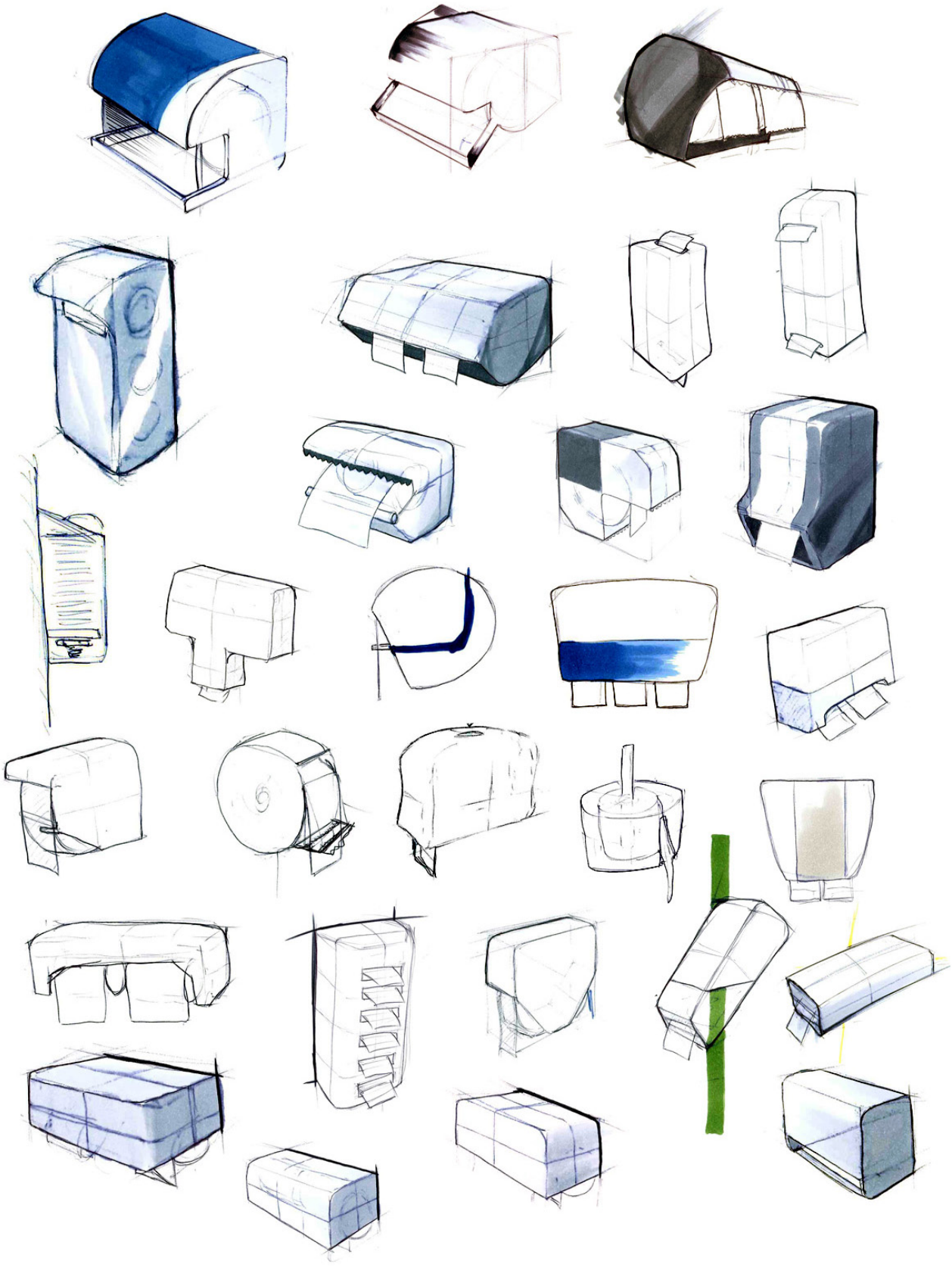


Figure 4.1. Function ideas for toilet paper dispenser

Two function concepts seemed especially promising, and so these were developed further. The one focused on having the teeth far away from roll, to get a longer paper tail, thus ensuring that it hangs down sufficiently low. The other was inspired by tape dispensers, and the idea was to move the tear-off point way from the roll and making the paper stay there after tear-off. To ensure that the function would work in the way intended, mock-ups were made for both concepts (see Figure 4.2).

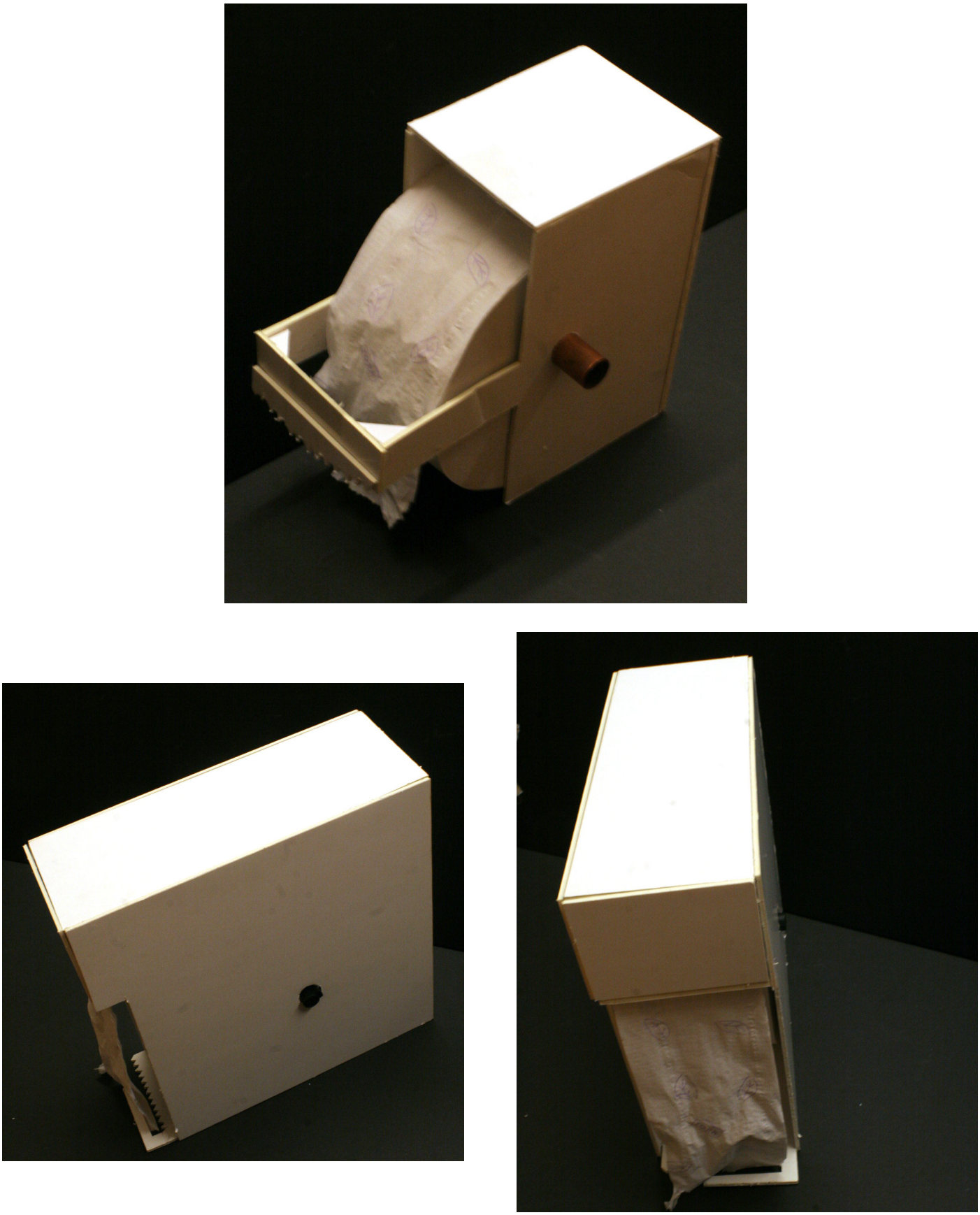


Figure 4.2. Function mockups for toilet paper dispenser

4.2 Morphological Analysis

Besides having the tail of the paper visible and reachable, there were naturally other functions to consider when developing the toilet paper dispenser. These functions included mounting to the wall, avoiding split-lines and crevices, refilling the dispenser, protecting the paper from theft, etc.

Based on the different functions that the toilet paper dispenser should incorporate, different solutions were defined, through sketching and brainstorming. These were then combined into concepts, using a morphological matrix (see Table 4.1). This is a method in which a number of solutions are listed for each function. The solutions can then be combined in a large number of ways, each new way being a possible concept. Some part solutions will fit better together with others, however, meaning that certain combinations will be more feasible than others (Swedish Morphological Society, 2011).

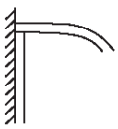
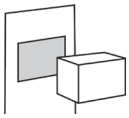
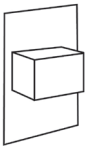
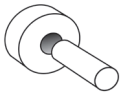
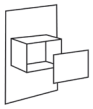
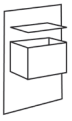
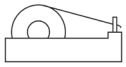
Function	**Solution**						
Allow right and left positioning	Symmetry	Rotatable	Two versions				
Avoid visible split-lines	Split-lines to wall 	Split-lines underneath 	Overlap 	Chamfered split-lines 	Gaskets		
Mounting	Seperate Console 	Dispenser directly to wall 					
Opening	Hinges on side	Hinges on top	Slide	Removable axis 	Removable front 	Lid 	Magnet lock
Ensure paper tail is visible	Teeth far away from roll	Expose large part of roll					
Ensure paper tail is reachable	Teeth far away from roll	"Tape dispenser" 	Folded paper	Sensor and engine	Completely open		
Protect paper from theft	Lock on outside	Code lock	Lock under cover	Tag 	Card reader		
Ensure paper availability	Big size roll	Small rolls vertical	Small rolls lateral	Stub-roll holder	Big volume		

Table 4.1. Morphological matrix - Function & solution

4.3 Three Initial Concepts

Based on the two main function concepts mentioned above, three concepts were developed and presented to SCA in order to select a concept to develop further.

4.3.1 Function Concept 1

The principle of the first concept was based on the fact that if the teeth were located further away from the toilet paper, the paper tail hanging down after tear-off would be longer and therefore also easier to reach. A chief aim of the visual design was to let the users see the paper availability easily (see Figure 4.3).

Even though the dispenser is asymmetric, it still can be mounted on both the right and the left side without alteration. This is because it has teeth on both sides of the opening. A dispenser mounted on a left side wall is then rotated 90° compared to one mounted on a right side wall. The design of the dispenser is however quite open, leaving virtually the whole side of the paper roll exposed to splash. In addition, the teeth which are not in use are redundant. Table 4.2 shows the functions that have been considered for the concept based on the morphological matrix.

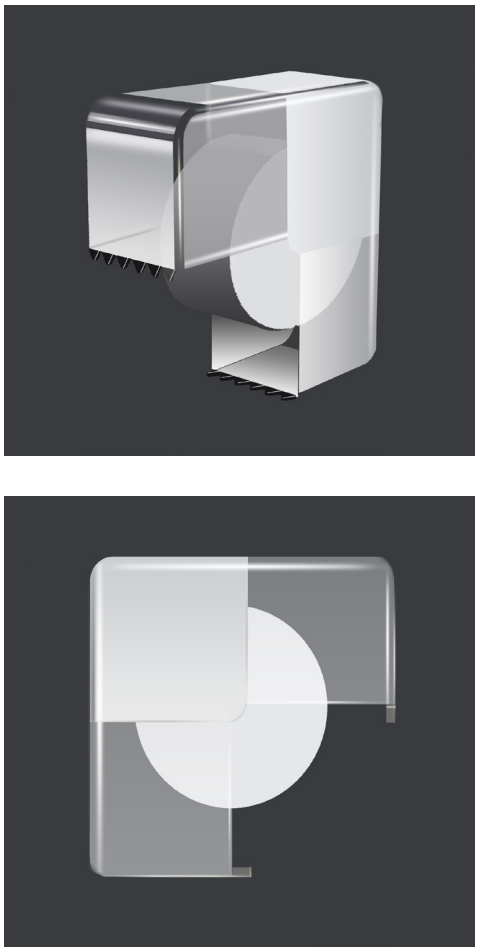


Figure 4.3. Function Concept 1

Function	**Solution**
Allow right and left positioning	Rotatable
Avoid visible split-lines	Split-lines to wall
Mounting	Seperate console
Opening	Slide
Ensure paper tail is visible	Teeth far away from roll
Ensure paper tail is reachable	Teeth far way from roll
Protect paper from theft	Lock under cover
Ensure paper availability	Big size roll

Table 4.2. Morphological matrix - Function Concept 1

4.3.2 Function Concept 2

The function of the dispenser was inspired by a common type of tape dispenser. The paper is led through an opening at the top of the dispenser and then down to the teeth at the bottom of the dispenser (see Figure 4.4). This arrangement also has some similarities to the threading of a sewing machine. The teeth are mounted in a hook-like fashion, providing a slit for the paper to be torn off in. This means that the tail of the toilet paper will stick in the slit and be visible and reachable after tear-off. The design of the dispenser protects the toilet paper dispenser against splash and aerosols, since it is well encapsulated. Since the design of the dispenser is symmetric, it is easily possible to mount it on both left and right side walls. The functions that were considered for the concept are shown in Table 4.3.

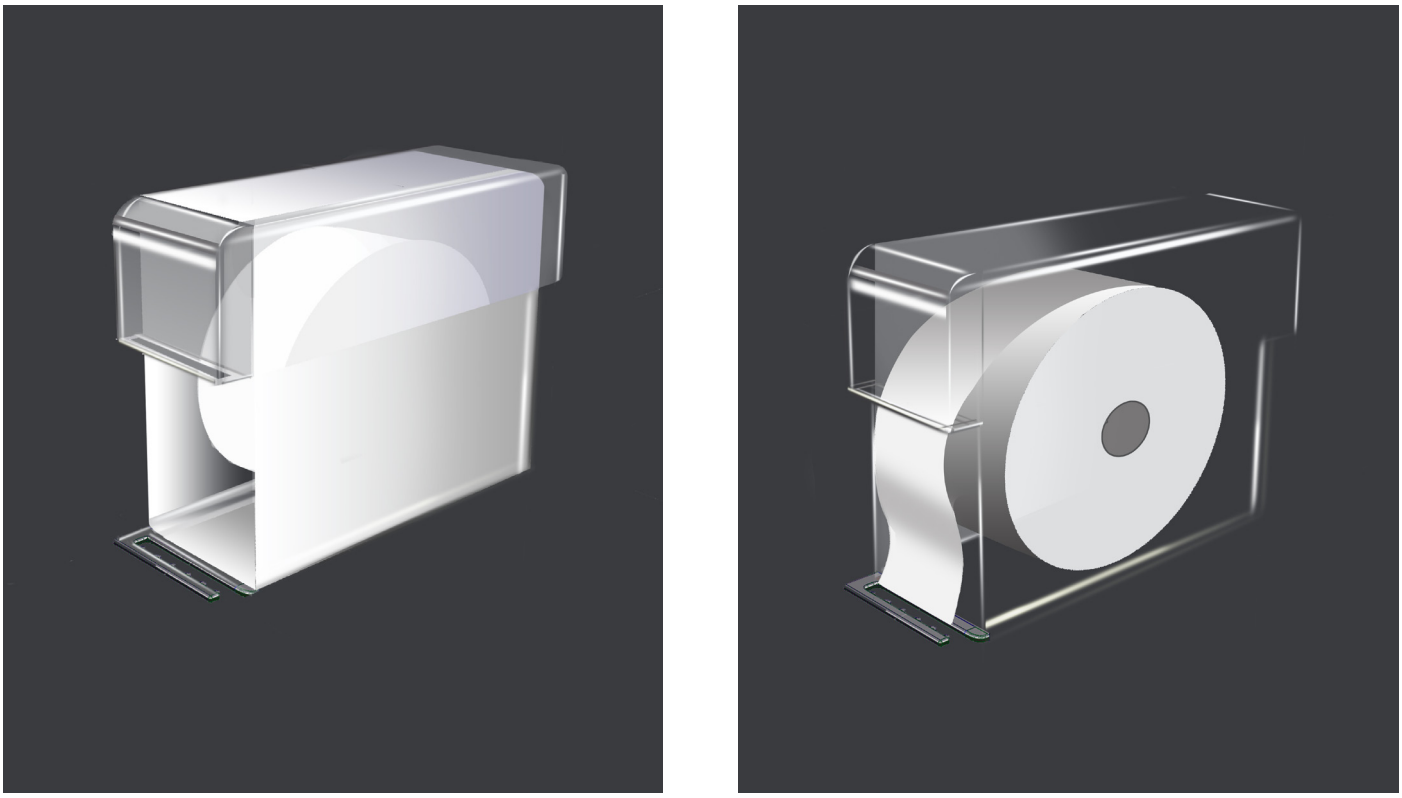


Figure 4.4. Function Concept 2

Function	**Solution**
Allow right and left positioning	Symmetry
Avoid visible split-lines	Split-lines to wall
Mounting	Dispensers directly to wall
Opening	Hinges on bottom
Ensure paper tail is visible	“Tape dispenser”
Ensure paper tail is reachable	“Tape dispenser”
Protect paper from theft	Lock under cover
Ensure paper availability	Big size roll

Table 4.3. Morphological matrix - Function Concept 2

4.3.3 Function Concept 3

While the two other concepts were designed for the mini jumbo toilet system (Tork T2), the third concept was designed for the conventional toilet system (Tork T4) which is for two smaller toilet paper rolls. The principle of the dispenser is quite similar to Function Concept 1 (see Figure 4.5). The bar that is placed in front of the paper prevents the tail from falling back against the roll. The transparent design of the concept helps the paper to be visible and reachable. As is shown in Table 4.4, the lock is located on the axis which results in having a split-line around the lock. Another disadvantage of this dispenser design is its closed design which makes the cleaning harder.

After discussions with SCA, the first two function concepts (Concept 1 & 2) were selected for further development. The third concept was eliminated due to its similarity to an existing product in the Tork toilet paper dispenser series (The Tork Elevation T4). The lock and the cleaning of the dispenser were other problematic areas, which however could have been overcome through further development. Still, as Concept 3 provided more or less the same functional solution as Concept 1 and there is a bigger market for larger rolls, it seemed reasonable to eliminate Concept 3.

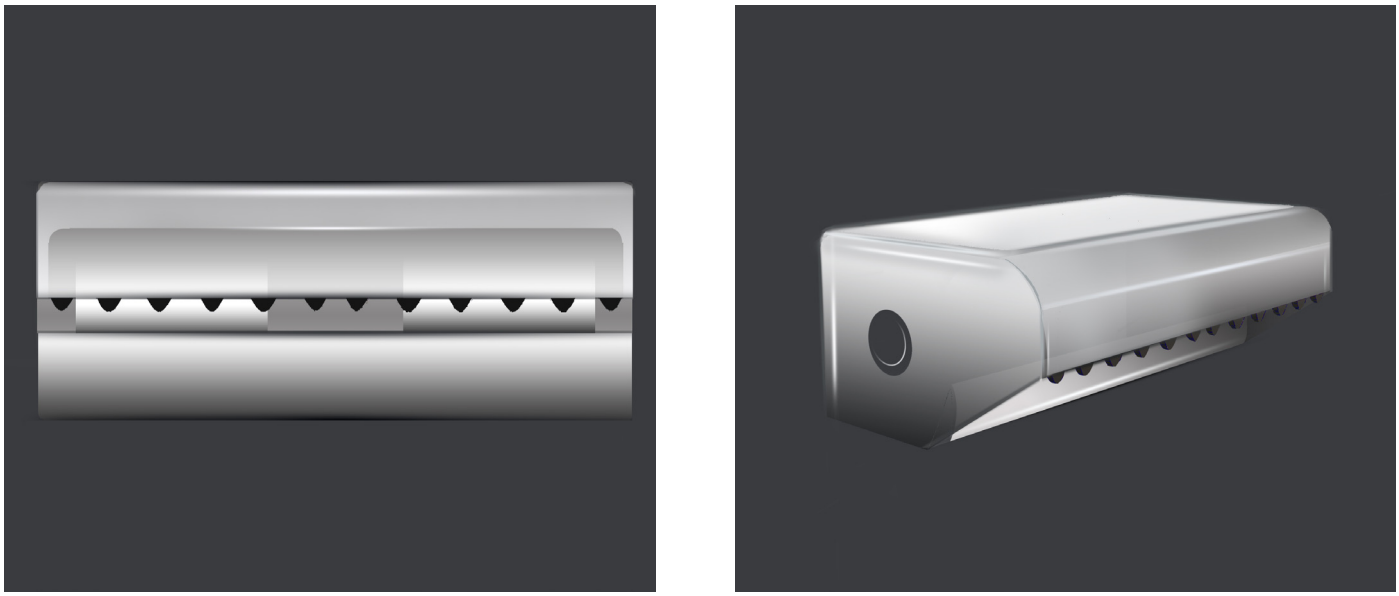


Figure 4.5. Function Concept 3

Function	**Solution**
Allow right and left positioning	Symmetry
Avoid visible split-lines	Split-lines to wall
Mounting	Dispensers directly to wall
Opening	Removable axis
Ensure paper tail is visible	Teeth far away from roll
Ensure paper tail is reachable	Teeth far away from roll
Protect paper from theft	Lock on outside
Ensure paper availability	Small rolls vertical

Table 4.4. Morphological matrix - Function Concept 3

4.4 Further Concept Development

In the time that followed, the design of the two concepts with their respective problems and prospects were reworked and refined. There were many practical details about e.g. mounting and refilling that had initially been overlooked, but now had to be dealt with. In the following, the improved concepts are presented.

4.4.1 Concept 1

During the process of concept development, the problems mentioned in 4.3.1 were looked into. The main function of this concept was to move the teeth further away from the paper roll than what was orthodox. This aspect was desirable to keep then, as it was the heart of the concept. Some changes thus had to be applied to the concept in order to solve the problems related to its having redundant teeth as well as an asymmetric shape which could make it hard for caretakers to open and refill the dispenser. The idea behind the asymmetry was to make a compact solution with an unconventional visual appearance. Even though the simple measure of an extra set of teeth made it possible to mount the dispenser on both right- and left-sided walls, it did mean that it had to be opened in different ways depending on which side it was mounted on. This was seen as undesirable, as it could cause confusion and furthermore could be logistically inconvenient, depending on the washroom design. In addition, it was a pronounced goal to avoid any visible split-lines in the design, and this would prove to be very hard if the bottom of the dispenser in one configuration would be the side of it in another.

The new design of the dispenser therefore had a symmetric shape, and was transparent on the sides and on the top, with a white front. The size of the dispenser was 400×240×140 mm (see Figure 4.6). As illustrated in Figure 4.7, the lock is hidden under the cover and the suggestion for an opening function is sliding the cover upward.

Figure 4.6. Concept 1 - Front view

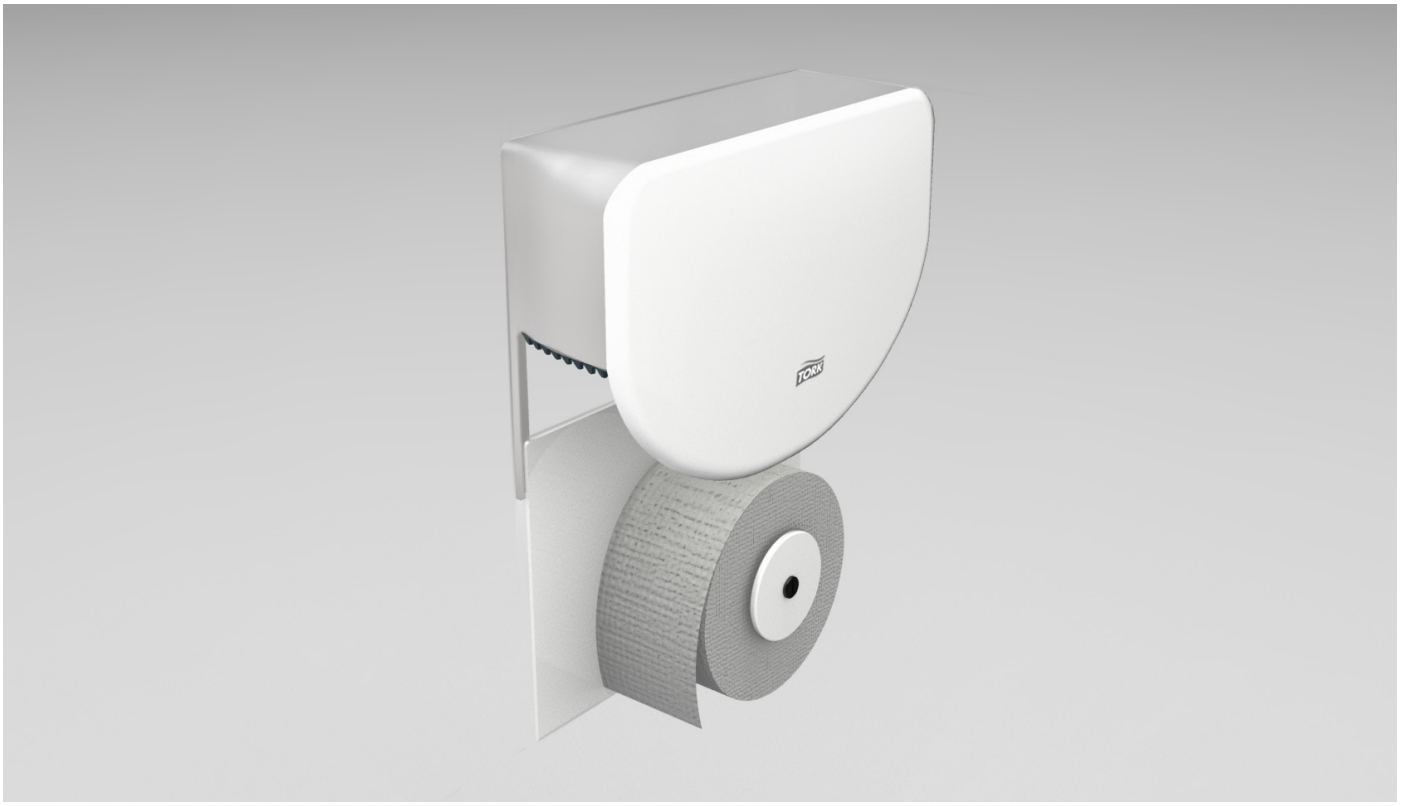


Figure 4.7. Concept 1 - Lock & opening function

The visual design of the concept was presented in two versions, one having the wall console continuing down in a straight fashion, and the other one having the console following the contour of the cover's bottom part (see Figure 4.8).

Figure 4.8. Concept 1a & 1b

4.4.2 Concept 2

For developing Concept 2, different shapes with the same function were experimented with. In Figure 4.9, two versions of the concept, having the same function but with some differences in their visual design are shown.

The size of the dispenser is 300×240×140 mm. The transparent part of the dispenser lets the user see the paper availability. The teeth are designed to make the paper stay at the tear-off point, so that it is easily reachable for the user. Moreover, there is no surface behind were the paper tail hangs down, meaning that the user's hand will not have to touch the dispenser, and so the risk of cross-contamination is minimised.

Hinges are used to open the dispenser, and the lock is hidden under the cover (see Figure 4.10).

Figure 4.9. Concept 2a & 2b

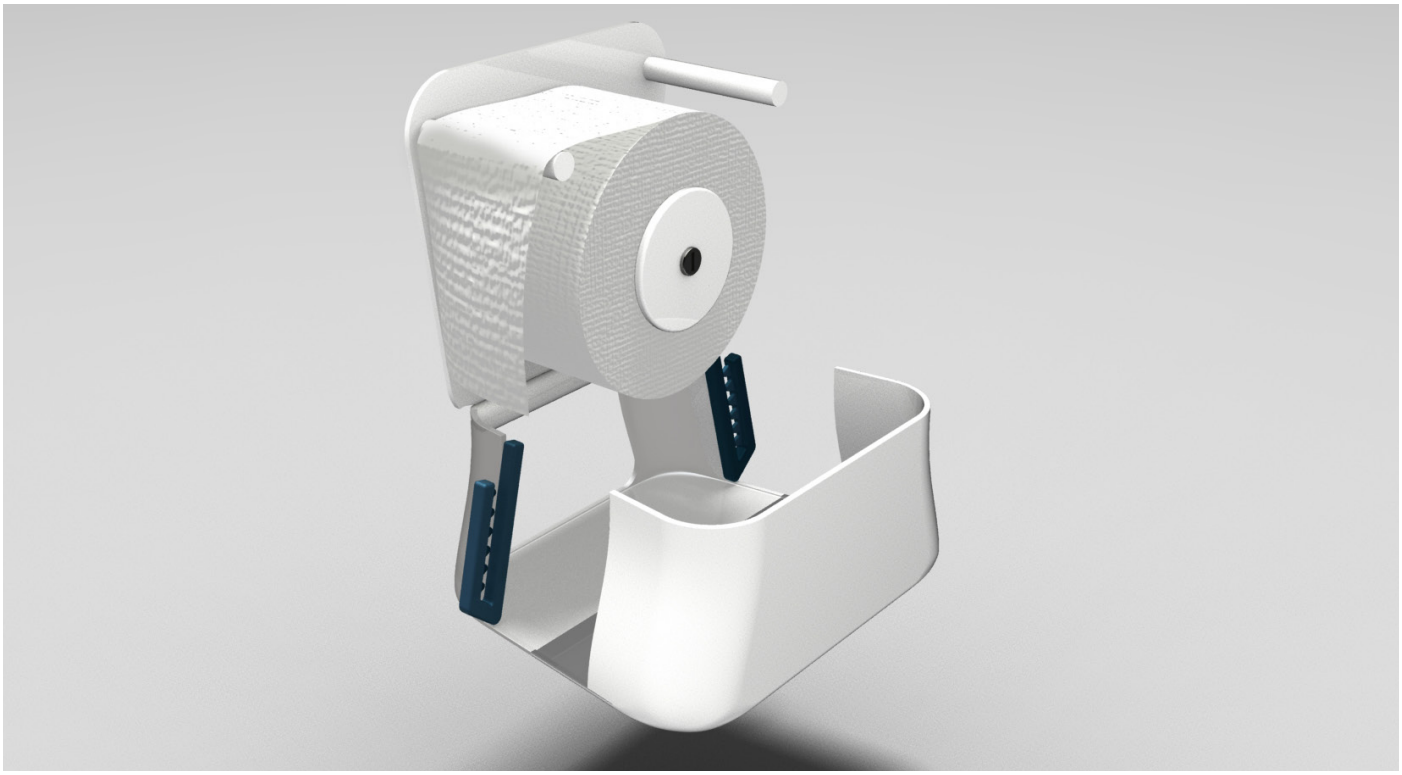


Figure 4.10. Concept 2 - Lock & opening

4.5 Concept Selection

The final concept was selected in a meeting with company representatives from SCA, and with the guidance of a Pugh analysis, which had been performed in connection to this.

4.5.1 Pugh Analysis

Pugh analysis is a method which is used for comparing multiple options against each other (The Quality Portal, 2007). It was here used to compare the four concepts (1a, 1b, 2a and 2b) in terms of how well they fulfilled the demands that had been set for the product. One concept is chosen as a reference, and this concept automatically gets the score 0. For each listed demand or function, the other concepts are then either assigned a '+' or a '-', depending on whether they solve the function in a better or worse way than the reference concept. If it is neither better nor worse than the reference, it gets 0. The score is then calculated and the concept with the highest score is the best one. The process can then be iterated by choosing the concept with the highest score as a new reference and see if there is another concept that scores even higher, when compared to this one.

The analysis was iterated several times for this concept selection, and the result was that Concept 1b got the highest score in total. Concept 2b also seemed like a promising prospect (see Table 4.5-4.8).

	1a	1b	2a	2b
Size	0	+	+	+
Avoid visible split-lines	0	0	+	+
Avoid touching	0	0	0	0
Refilling	0	0	+	+
Ensure paper tail is visible	0	0	+	+
Ensure paper tail is reachable	0	0	-	-
Protect paper from theft	0	0	0	0
Appear hygienic	0	+	-	0
Easy to clean	0	0	+	+
Avoid dust/water collection	0	0	-	-
Communicate function	0	0	-	-
Reliability	0	0	-	-
Paper protection	0	0	+	+
	0	**2**	**1**	**2**

Table 4.5. Pugh analysis - Concept 1a is the reference

	1a	1b	2a	2b
Size	-	0	+	+
Avoid visible split-lines	0	0	+	+
Avoid touching	0	0	-	-
Refilling	0	0	+	+
Ensure paper tail is visible	0	0	+	+
Ensure paper tail is reachable	0	0	-	-
Protect paper from theft	0	0	0	0
Appear hygienic	-	0	-	-
Easy to clean	0	0	+	+
Avoid dust/water collection	0	0	-	-
Communicate function	0	0	-	-
Reliability	0	0	-	-
Paper protection	0	0	+	+
	-2	**0**	**0**	**0**

Table 4.6 . Pugh analysis - Concept 1b is the reference

	1a	1b	2a	2b
Size	-	-	0	0
Avoid visible split-lines	-	-	0	0
Avoid touching	+	+	0	0
Refilling	-	-	0	0
Ensure paper tail is visible	-	-	0	0
Ensure paper tail is reachable	+	+	0	0
Protect paper from theft	0	0	0	0
Appear hygienic	0	+	0	+
Easy to clean	-	-	0	0
Avoid dust/water collection	+	+	0	0
Communicate function	+	+	0	0
Reliability	+	+	0	0
Paper protection	-	-	0	0
	-1	**0**	**0**	**1**

Table 4.7. Pugh analysis - Concept 2a is the reference

	1a	1b	2a	2b
Size	-	-	0	0
Avoid visible split-lines	-	-	0	0
Avoid touching	+	+	0	0
Refilling	-	-	0	0
Ensure paper tail is visible	-	-	0	0
Ensure paper tail is reachable	+	+	0	0
Protect paper from theft	0	0	0	0
Appear hygienic	0	+	-	0
Easy to clean	-	-	0	0
Avoid dust/water collection	+	+	0	0
Communicate function	+	+	0	0
Reliability	+	+	0	0
Paper protection	-	-	0	0
	-1	**0**	**-1**	**0**

Table 4.8. Pugh analysis - Concept 2b is the reference

4.5.2 Result of the Selection Process

After carrying out the Pugh analysis, a presentation at SCA with company representatives and a separate meeting with the academic project supervisor were held, during which the two main concepts and their variations were shown. After discussing the different aspects of the concepts, Concept 1 was chosen to develop further in the project.

Concept 2 was eliminated much because of its visual appearance. The function of the dispenser influenced its appearance to a high degree, which made the possibilities of changing it limited. The special design of the teeth which also affected the look of the concept was another feature which was not giving a good impression generally. Had this concept been developed further, the teeth definitely could have been given a more worked-through visual design, but it would not have changed their protruding nature. It was doubted whether the bars located on the sides of the dispenser would communicate how it should be refilled. The dispenser could be refilled in the wrong way, leaving its function gravely impaired. Even if it was refilled correctly, there would be problems every time the paper would snap somewhere else than at the teeth. The paper tail would then get lost inside the dispenser, and even though it could still be reached, it would be difficult getting it out through the correct hole again. Perforated paper will always run the risk of breaking at an undesirable point, so the dispenser should be designed to handle this kind of situation well.

The simple design of Concept 1, both in function and appearance, was another reason for choosing it for further development. It provided easy access to the toilet paper and in this way improved the hygiene. The lock was also moved inside the dispenser, and all outer split-lines were done away with. In addition, although the look of the dispenser was offering something new, you could still find the Tork features in it. Core values such as hygiene, function and caring are noticeable in the design. Additionally, while the concept incorporates some traits of the Tork brand, such as rounded edges and transparency, some elements that were recognized as unhygienic were eliminated, e.g. the prominent split-line, having a lock on the top and a niche to the wall.

On the other hand the size of the concept was bigger than the existing products with the same toilet paper size (mini jumbo roll), especially in width. This was naturally undesirable, and so reducing the dispenser's size was prioritized for the next step of the project. It was also expressly desired for the dispenser to be equipped with a stub roll holder. A stub roll is a roll which is almost out of paper, and to avoid paper waste, it is beneficial to be able to refill a dispenser without throwing away a roll which may still contain some paper. Thus the need of a stub roll holder. This was something that had not yet been considered in the concepts, and therefore had to be given some thought.

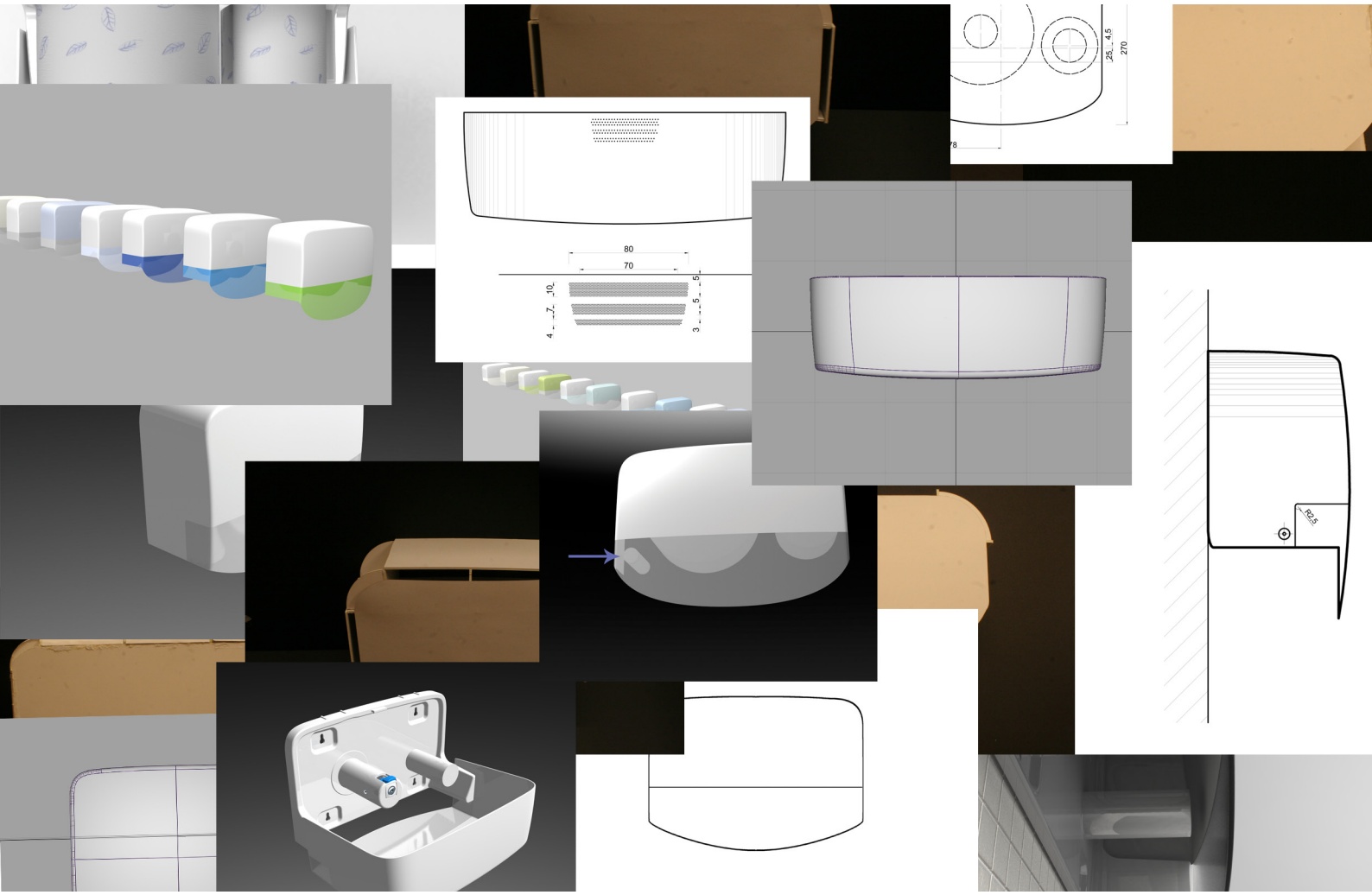
Even though the other functions mentioned in the morphological matrix (Table 4.1) have been regarded in the concept development process, their detailed design was something which would be considered more specifically in the final part of the product development process.

5. PRODUCT DEVELOPMENT

The concept that was chosen for further development had some problems that had to be solved. The first step was to provide the concept with a stub-roll holder. The size of the concept was also an aspect that needed attention, as it was perceived as being too wide. Additionally, it was important to improve the visual appearance of the dispenser, as the main focus up to this point had been on functional aspects.

Another challenge was to design the opening and locking mechanisms of the dispenser. The solutions had to neither interfere with the hygiene aspects of the project, nor provide any difficulties for the caretakers refilling and cleaning the product. The exact placement of the teeth and the roll holders turned out to demand some thought as well.

Finally, the product material was selected, together with the placement of the transparent part. As the concept was going to be produced in eight prototypes, it was decided to make these in a number of different colour combinations. The colours were selected based on the previous surveys.



5.1 Functions

5.1.1 Basic Functions

The big size of the concept made it possible to have two stub-roll holders, one on either side of the big roll holder. Making a mock-up based on this design and exploring how the product was going to look (see Figure 5.1), led to a new solution that decreased the total size of the dispenser.

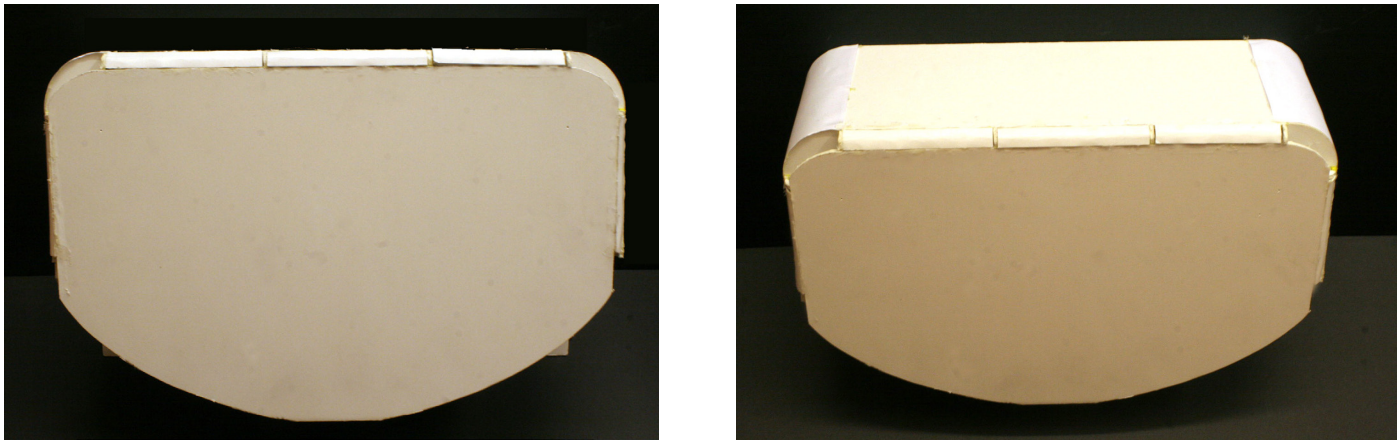


Figure 5.1. Mock-up for trying out size and shape

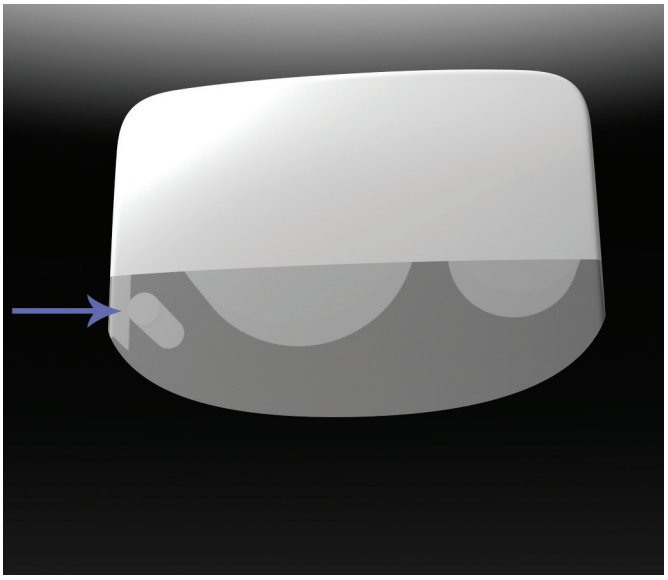


Figure 5.2. Product development - Having a bar next to the teeth, thus making the paper tail longer

The aim of positioning the teeth far from the toilet paper was to ensure that the tail of the toilet paper was long enough for the users to reach it. However, the tail can be elongated by other means than just moving the teeth further away. The idea from Concept 2 (see 4.4.2) of having a bar leading the tail, inspired a solution in which a bar is placed next to the teeth, thus making the paper tail longer (see Figure 5.2). Calculations were made to verify that the minimum length of the tail hanging down after tear-off would be sufficient. The positioning of the big roll holder and the stub-roll holder was checked in a computer model (see Figure 5.3). The new solution decreased the width of the dispenser with approximately 36 mm. The final concept has one stub-roll holder that is positioned on the right side of the big roll holder. The positioning of both holders was important in making sure that the tear-off would be clean and easy. How well the teeth work in tearing off the paper depends to a high extent on the angle with which the paper meets the teeth.

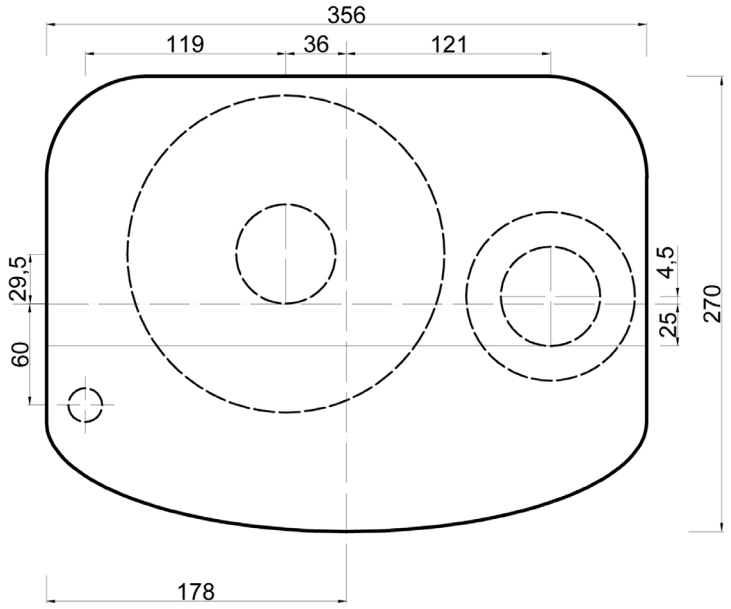


Figure 5.3. Positioning of the big roll holder and the stub-roll holder

5.1.2 Opening

The dispenser had to be possible to open and close, naturally. Because of the hygienic demands which e.g. involved avoiding split-lines, it became critical to have a well thought-through opening mechanism. The different solutions that were proposed for the opening are shown in Figure 5.4.

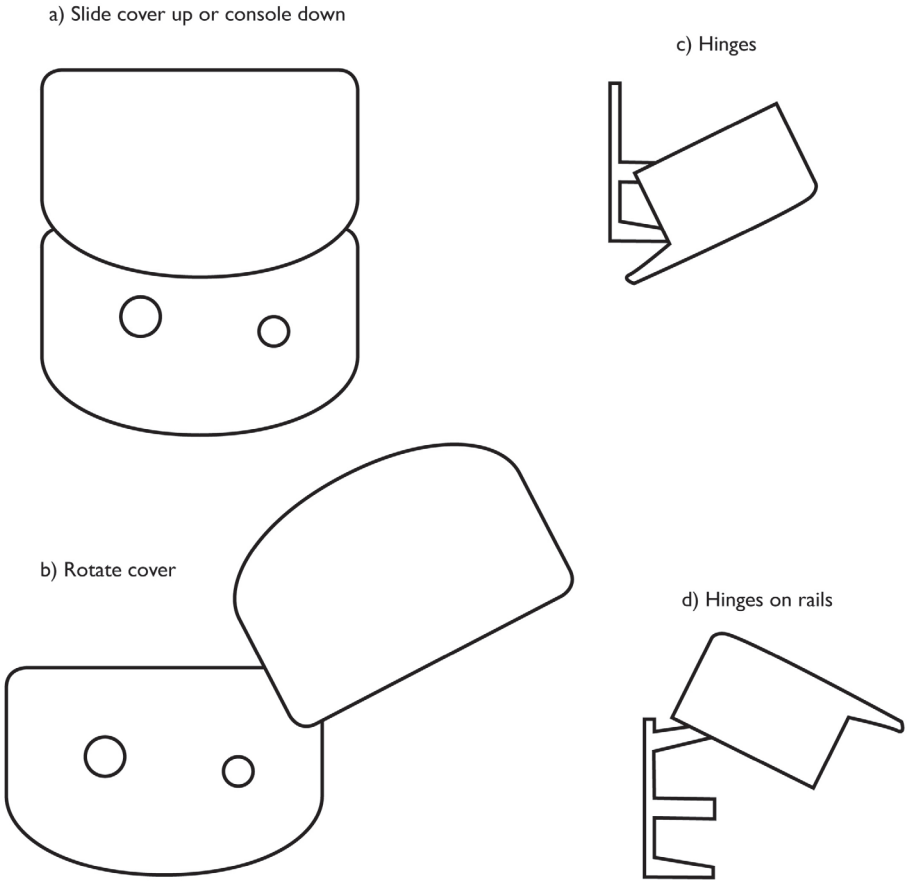


Figure 5.4. Solutions for opening the dispenser

Using slides as opening mechanism led to some problems, such as requiring enough space in the surroundings. It was also difficult to ensure sufficient stability for the cover when in its opened position, and fixing it in its place while refilling the dispenser.

The second solution was rotating the cover around an axis, and in this way opening up the dispenser. Though this idea had its advantages, e.g. there was no risk of the dispenser opening if someone would lean on it, it seemed unfeasible for other reasons. In particular it was the fact that if the cover was going to continue all the way to the wall, thus avoiding split-lines, it would actually not be possible to rotate the cover at all.

Other solutions considered were hinges or a combination of rails and hinges. Since hinges were used for opening most Tork dispensers at the time of the project, the function seemed quite promising. It also seemed to be the easiest and most reliable solution. However, there were some problems to overcome, relating partly to the challenge of avoiding split-lines and partly to the fact that the cover should not open too easily.

For opening the dispenser, the cover should be pushed down and then pulled towards the user. There is a plastic snap hook under the top of the cover, which is released when the cover is pushed down. The degree to which the way of opening the dispenser should be communicated through the design was not easy to decide. Preferably, the caretakers should easily understand how to open it, but it should not be too obvious for the users. To achieve this, a grip area was located on top of the cover (see figure 5.5). It was discussed whether this visual and tactile indication was really necessary, especially as it affects the impression of hygiene. For this reason, prototypes were made both with and without this grip area. Tests were then performed with caretakers to see if they understood the function without the grip area and how much the area really helped.

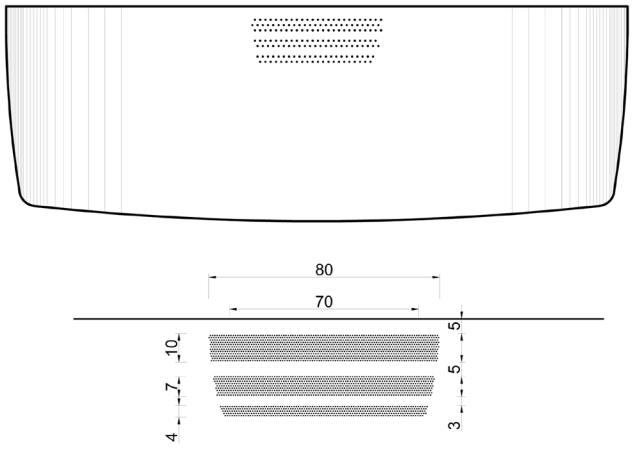


Figure 5.5. The grip area for opening the dispenser

5.1.3 Lock

The concept of having a hidden lock under the cover was embraced at an early stage, but it was at this point in the project that the exact function of it was developed. Five different solutions were suggested (see Figure 5.6). The original idea had been to have a detachable disc on the roll holder, with a built-in lock. Though this solution seemed easy to incorporate in the dispenser, it had a major drawback in that this disc was a loose part that could easily be displaced. Therefore, a solution where the lock mechanism never left the dispenser was preferred. After conferring with the consulting company Creator, Concept 3 was chosen.

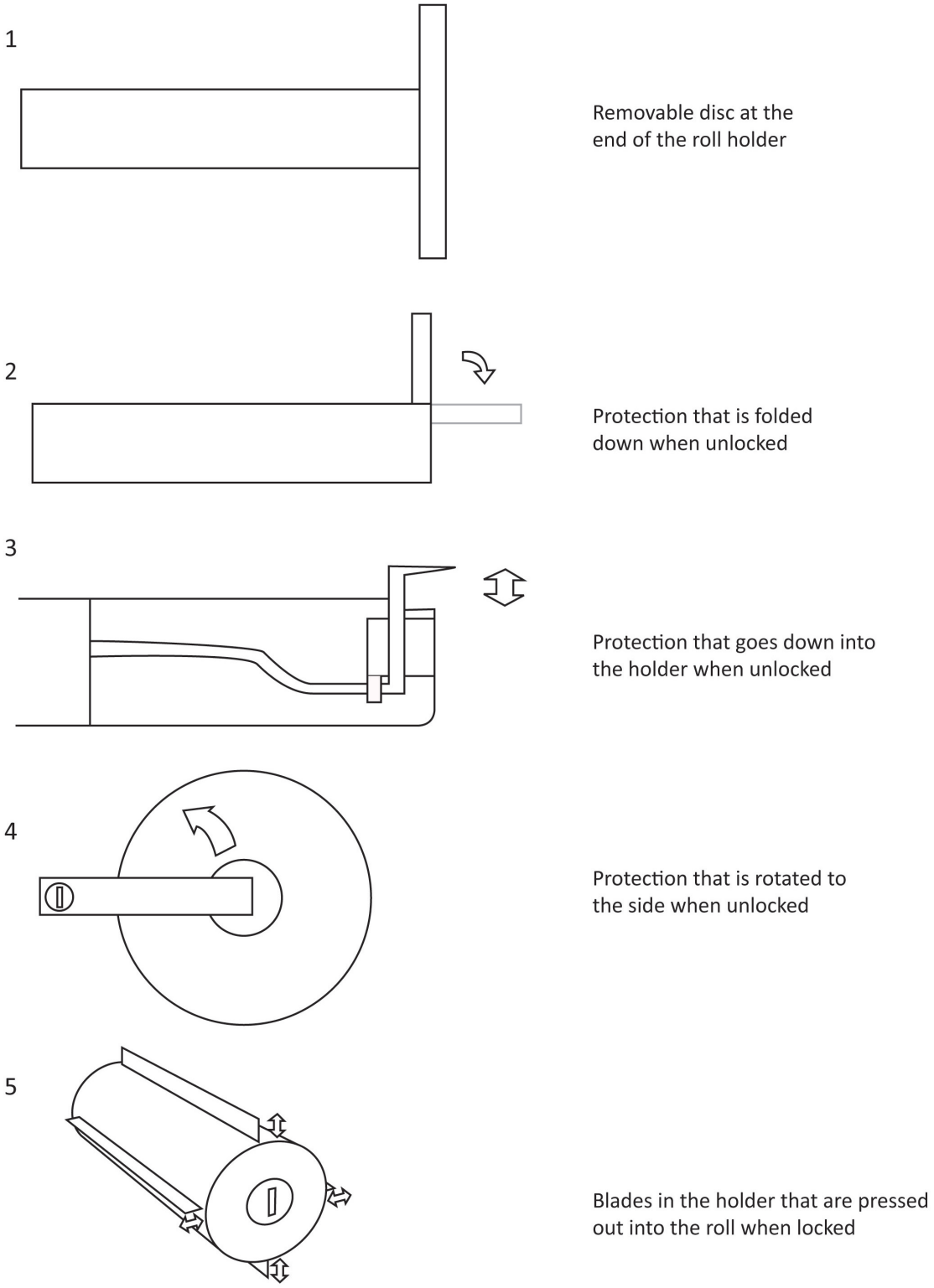


Figure 5.6. Concepts for having a hidden lock under the cover

The locking mechanism had to be easy to understand for the caretaker, while also using the same type of lock that SCA are currently using in their dispensers. This put some demands and constraints on the concept, which had to be considered. The key lock that was to be used consisted simply of a plastic hook that rotated to the side when the key was turned. The locking concept that was developed consists of a spring-loaded plastic bar which is being released when the lock gets unlocked. The pin then moves downward, making it possible to refill the dispenser. For locking the dispenser, the pin must be moved upward manually and then get locked (see Figure 5.7). The choice of colour for the pin is discussed in 5.3.

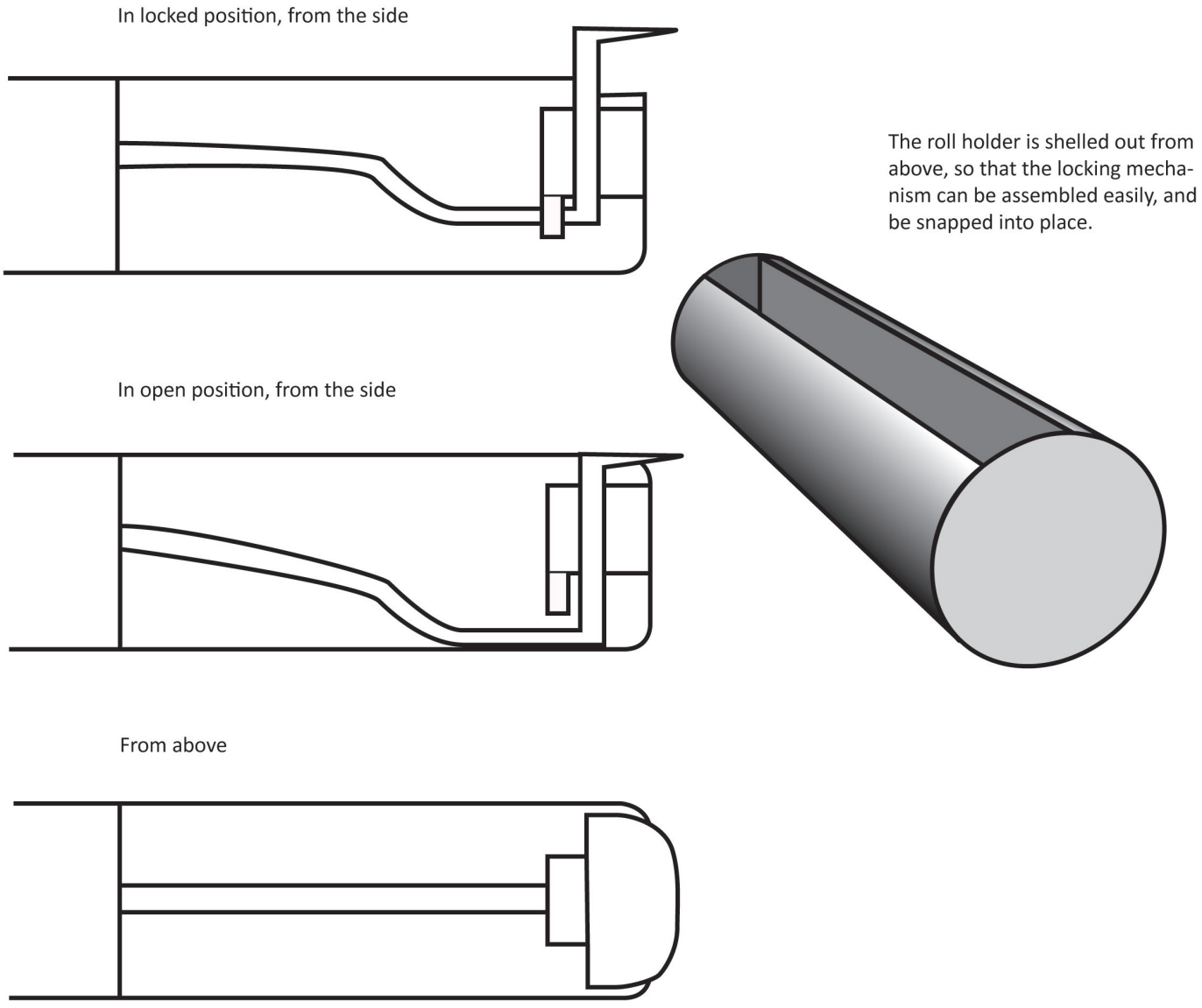


Figure 5.7. Different steps of unlocking and locking the dispenser

5.1.4 Teeth Placement

The placement of the teeth was crucial for several reasons. SCA had previously had problems with toilet paper dispensers making a lot of noise when tearing off paper. The reason had been that the teeth were attached to the cover. When attached to the console instead, this problem was solved. Therefore, it was decided to attach the teeth to the console. It was also important to have the teeth positioned in an appropriate height in relation to the roll holders, as this affects the quality of the tear-off. Ideally, the paper should break cleanly at the perforations, and not be torn off in a random, untidy way.

5.2 Visual Design

The next items to define were the shape, edges and curvatures. In this phase, first computer models were made, followed by a mock-up for the chosen shape which had bigger radii on the edges than the original concept. Experiments were also made with curvature, exchanging the old flat surfaces for slightly convex ones. This meant that all previous radii on the cover were replaced with curvature surfaces. The effect on the visual design was that it got a bolder, more appealing expression. These design changes were also to a certain extent necessary for making the dispenser possible to manufacture (see Figure 5.8).

5.3 Final Colour Selection and Transparency

The colours that were perceived most hygienic in the survey in 2.7.3 were tried out on computer models of the dispenser. Approximately 20 colour combinations were tried at first, and then those that looked better were chosen for the prototypes. This amounted to a total of eight colours (including white) in different combinations (see Table 5.1).

The plastic detail locking the toilet paper roll in place is a separate part and could thus be made in another colour than the rest of the console. This was preferable, as it should be easy for the caretakers to understand which part they are supposed to pull. A quite bright hue of blue was chosen for this purpose as it could be seen easily against the in most cases white console and fits with the hygienic profile of the dispenser as a whole. The fact that this part is not visible as long as the dispenser is closed meant that focus could be put mainly on the functional, communicational aspects of the colour. However, the result of the contrast colour part of the survey also spoke in favour of the choice of this hue. All prototypes were made with this detail in blue, but if the dispenser is taken into regular production it might be worth considering different colours depending on the colour of the dispenser cover.

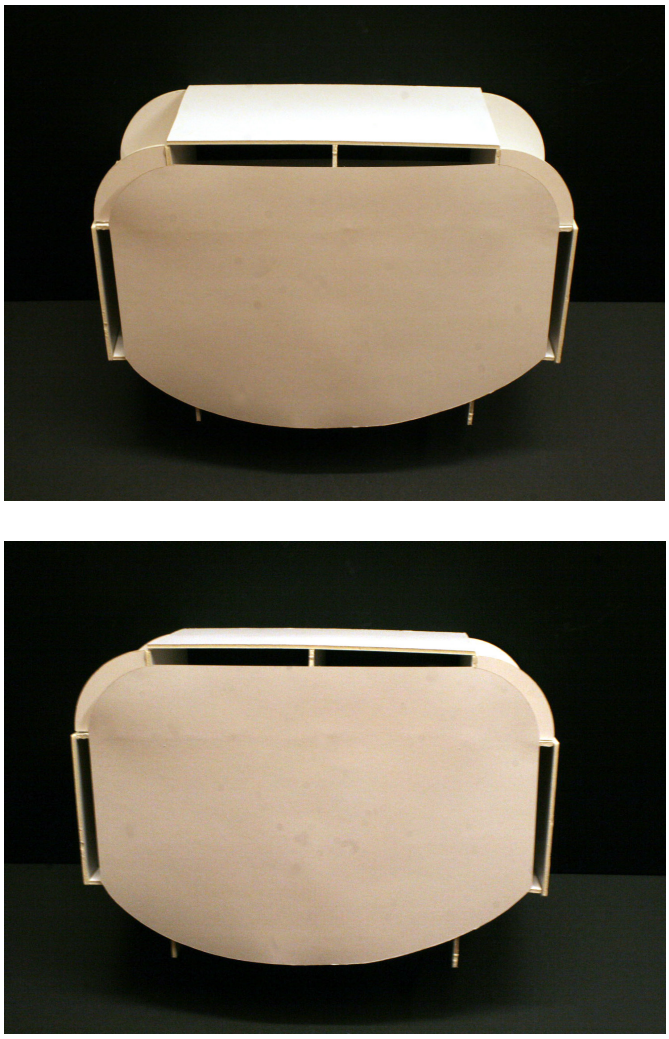


Figure 5.8. Mock-up for trying out shape, edges and curvatures

The colour of the teeth follows the same colour as the console. For the prototype, this was the only option, as they are made as one single part. In real production, however, they would be made as separate parts, as the teeth need to be in a different material to last longer. Their colour would then be an off-white hue, because of the difference in material, but preferably as close to the console colour as possible.

Moreover, the transparent part of the cover is positioned in a level so that it provides a good view of the toilet paper and gives the user a feeling for what is inside the dispenser.

Prototype	Console	Cover (top)	Cover (bottom)
Prototype 1	NCS S 0505-Y	NCS S 0505-Y	Clear
Prototype 2	NCS S 0520-R80B	NCS S 0520-R80B	Clear
Prototype 3	White	White	NCS S 0520-R80B
Prototype 4	White	White	NCS S 4040-R80B
Prototype 5	White	White	NCS S 2050-R80B
Prototype 6	White	White	NCS S 2570-G30Y
Prototype 7	White	White	NCS S 2570-G30Y
Prototype 8	White	White	NCS S 0505-Y

Table 5.1. Final colours for the prototypes

5.4 Final Material Selection and Surface Finish

During the initial phase of information gathering, antibacterial properties of materials were studied. This focused on mainly two aspects: 1) What feasible additives there are to make solid surfaces kill bacteria and 2) Which common material parameters affects the growing and survival capabilities of bacteria on solid surfaces. As seen in 2.1.4, additives were eventually ruled out, at least from this project. What remained was then to decide upon a material that was both practical for design purposes and providing as poor a surviving surface for bacteria as possible. Interviews with experts in the field (Hulander, 2011) indicated that what makes bacteria stick to a surface is a difficult field indeed. However, it is mostly a question of surface finish, where an as smooth a surface as possible is desired. Bumps and pits in the surface topology provide places where bacteria and organic matter can get stuck. It turns out that the smoother a surface, the glossier it normally is (Mateen, 1986). It is also preferable for the surface to be hard, as this prevents scratches and dents that could damage the surface structure.

Furthermore, it was seen in 2.7 that materials are perceived as hygienic if they are glossy, at least partly transparent and of white or certain other, previously mentioned colours. These qualities, together with the kind of rounded shapes that were generally also perceived as hygienic, seemed possible to combine most easily in a polymer. Polymers can be used for complex shapes, they can be coloured easily, they can have a range of surface qualities and they can be both opaque, transparent and mostly everything in between.

Because of these reasons, the final choice of material came to be ABS (acrylonitrile-butadiene-styrene). This plastic material is somewhat of a standard material in the dispenser industry, because of its favourable properties and reasonable price. It possesses all the qualities that were mentioned above, except for transparency. This can be overcome, however, by using the modified material M-ABS for transparent parts of the design (MatWeb Material Property Data, 2011).

The surface finish of the cover is high-gloss, for reasons mentioned previously. This goes for everything except the semi-transparent window at the lower part of the cover. This part is made in frosted plastic, being transparent but with a fine texture on the outer surface, making it matt. This was done to provide a fresh and hygienic feel to the product, as well as giving the user just enough insight to see the toilet paper and the teeth, but not much more. Having this surface matt is also beneficial since this is the part of the cover that the user might happen to touch. A problem with glossy surfaces is that they easily collect fingerprints, but this can be overcome by using a matt surface in this manner. In a similar way and for the same reason, the grip area on top of the dispenser is of the same colour as the rest of the cover top, but with a matt texture, indicating where the user should place her hand to open the dispenser.

5.5 Logotypes

Two logotypes were to be place on the cover: the Tork logotype and the SCA logotype. These were decided to be placed in a similar fashion as on the Tork Elevation series, as the new dispenser was made with a resembling, though modified design. Different placements, sizes and colours were tried out (see Figure 5.9), but finally version ‘a’ was chosen for the conceptigure 5.10).

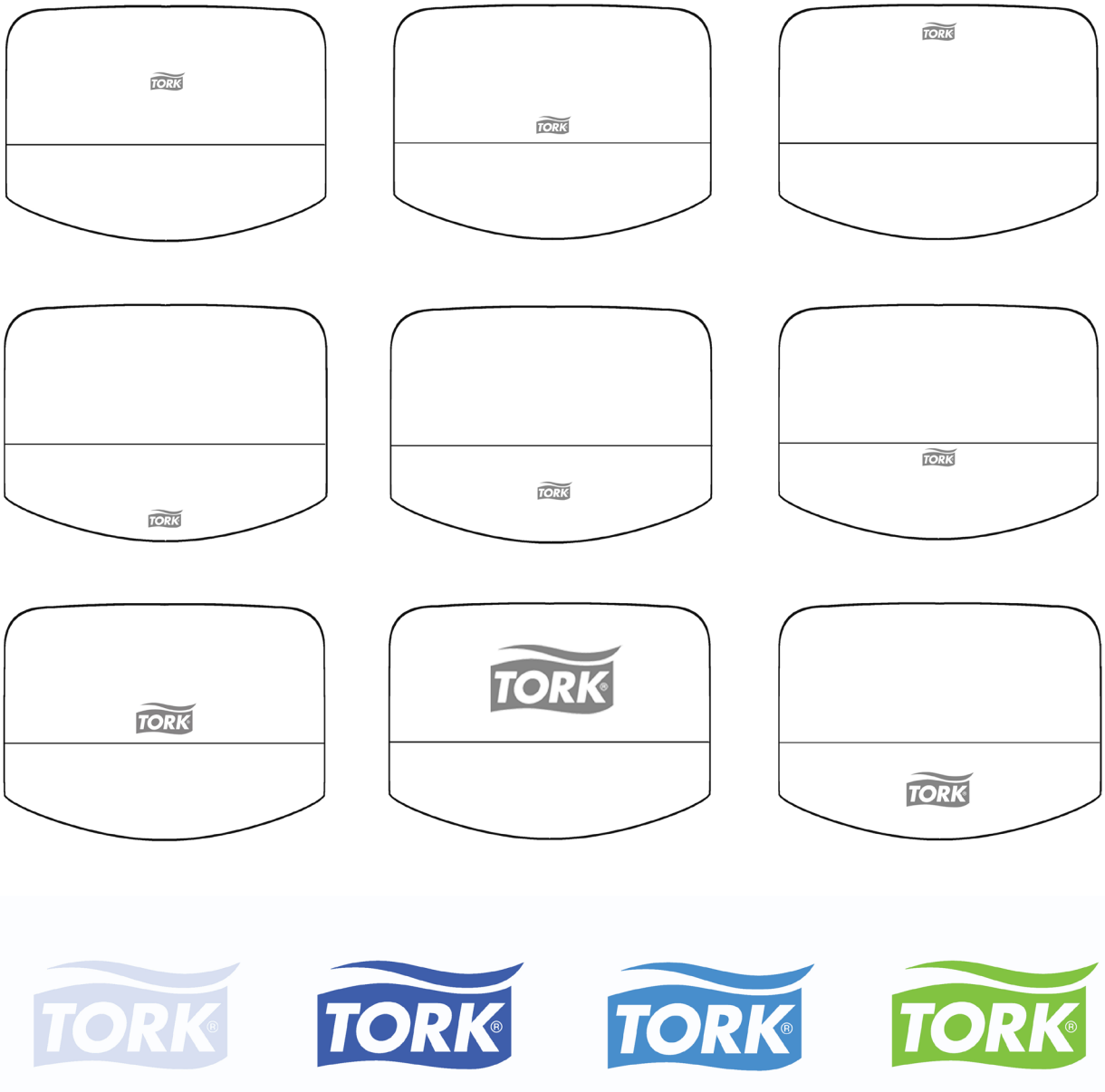


Figure 5.9. Different placements, sizes and colours for Tork logotype

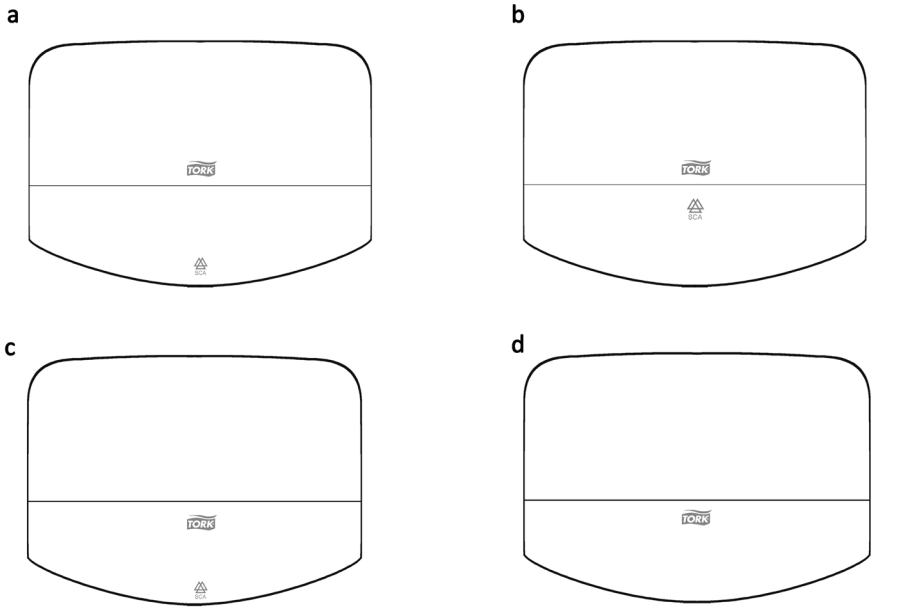


Figure 5.10. Concepts for SCA and Tork logotype placements - Version 'a' was chosen for the prototype

5.6 Final Concept

The final concept is presented in Figure 5.11-5.20. Most of these renderings present the white version of the dispenser, though Figure 5.19 shows dispensers in a variety of colours. All colour combinations are chosen to communicate a hygienic expression, while at the same time being suitable for different environments and tastes.

Figure 5.11. Front view of closed dispenser

Figure 5.12. Front view of open dispenser

Figure 5.13. Perspective view of open dispenser

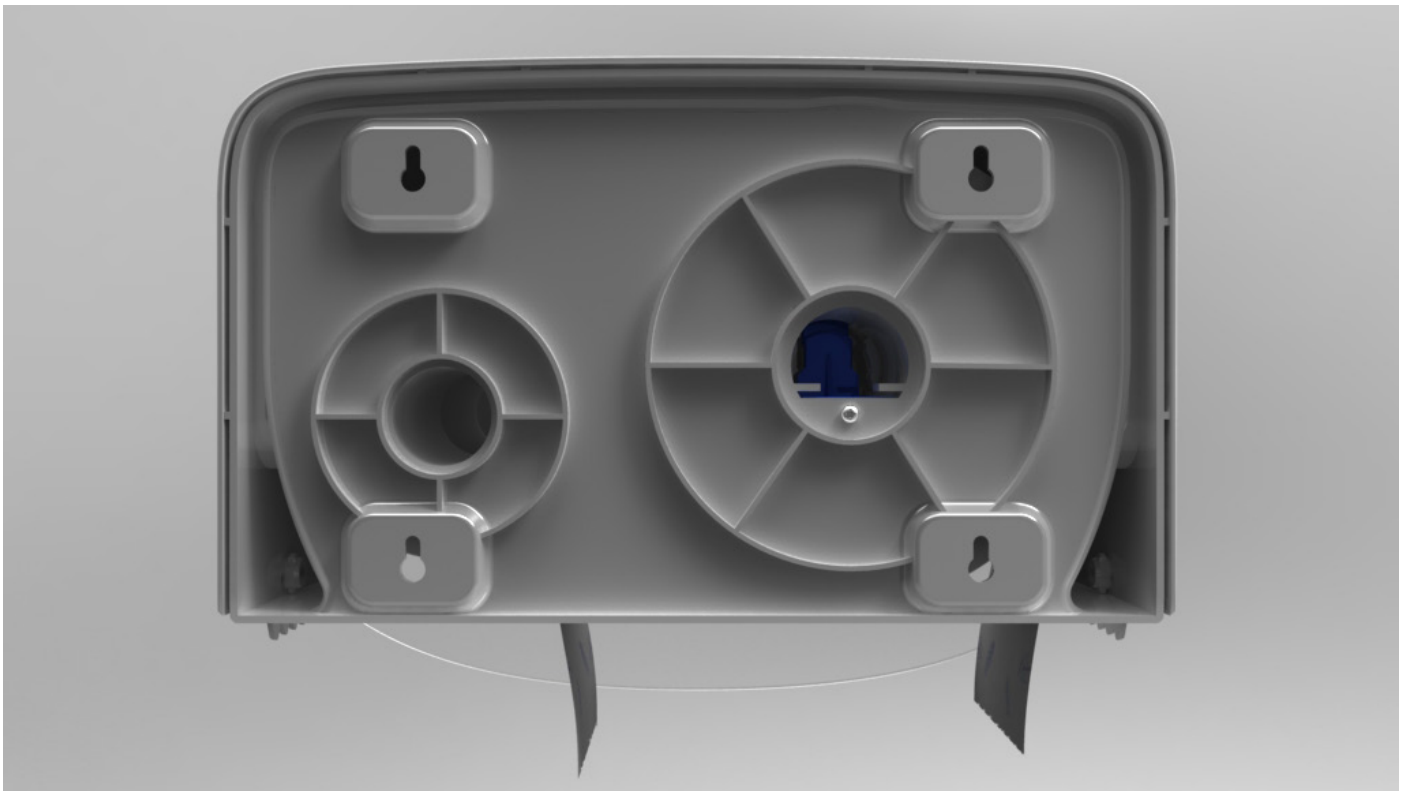


Figure 5.14. The dispenser is mounted to the wall with four screws

Figure 5.15. Side view of closed dispenser

Figure 5.16. Detail of teeth placement

Figure 5.17. Detail of lock function

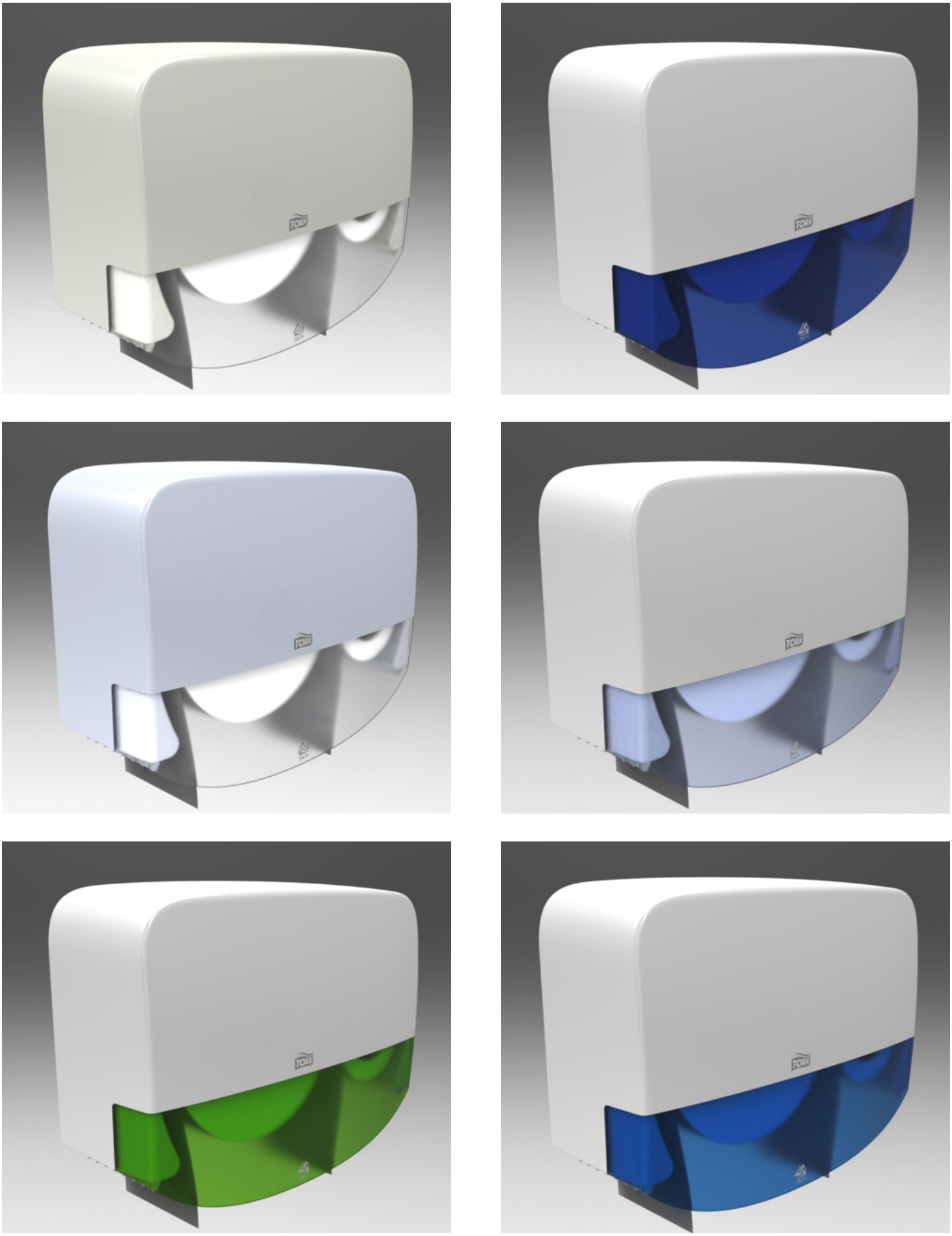


Figure 5.18. Colour variations

Figure 5.19. The dispenser mounted in public washroom

Figure 5.20. The dispenser mounted in public washroom

6. DISCUSSION

The objective of the thesis work was to develop a dispenser series with a clear hygiene profile. The first part of the project was devoted to finding guidelines for what hygienic design can be and how it can be implemented in a dispenser series. The project was continued with idea generation and brain storming, which ended up in choosing one dispenser (the toilet paper dispenser) for further development. In addition to this, a set of guidelines for improving the hygiene aspects of public washroom dispensers was compiled. The main reason for limiting the product development to one dispenser was the time restraint. Developing a whole dispenser series and taking each dispenser to the stage of actually making a prototype would take much more time than the 20 weeks allocated for a master's thesis.

Moreover, in order to get more conclusive results from the hygiene tests, more bacteria tests could have been performed. Again, time was a constraint, but also the fact that a master's thesis should reflect the area studied during the master's programme, in this case product development and design. However, the results from the tests carried out were sufficient to use as guidelines for hygienic improvements, as they could be compared to other, similar studies performed previously.

Though the study of factual hygienic issues in public washrooms could be expanded, perhaps not so much in literature review as in performing more tests and analyses, the study of hygiene perception seems quite exhaustive. It would, however, have been of interest to include more non-European respondents for the surveys and focus groups, had this been possible.

Ergonomic and environmental aspects were not the focus of the thesis and were therefore not looked into in depth in the project, except for the extent to which they were related to hygienic issues. One of the main hygienic issues with the toilet paper dispenser turned out to be accessibility to the tissue e.g., which is also an ergonomic aspect.

To sum up, the thesis's aim was reached in the product development process and the compiling of the guidelines. The final concept fulfils the demands that were specified for it. The dispenser is designed to prevent cross-contamination, and critical areas such as prominent split-lines and edges have been eliminated in the new design. This provides easy cleaning for the caretakers as well. The new solution for the lock is another major improvement. Having the lock under the cover instead of on the cover not only helps the product from a hygienic point of view but also improves its visual appearance. The dispenser could possibly have been made even more hygienic, if e.g. electronic sensors mechanisms had been used, but this was ruled out because of the environmental, economic and logistic problems involved with this kind of technology. The focus was instead on making a more hygienic "regular" dispenser. In conclusion then, the new dispenser avoids all unnecessary and unhygienic features and instead provides a more hygienic and easy-to-use solution.

7. FURTHER RECOMMENDATIONS

For further development of the product, some aspects should be considered in particular. If the goal is produce a complete series of hygienic dispensers for public washrooms, then the rest of the dispensers should be designed to adopt the design language of the presented concept. The guidelines that have been prepared in the project can be used for the developing process. As the toilet paper dispenser developed in this project is visually quite closely related to SCA's current Elevation-series, a further development of that series could perhaps incorporate some of the elements of this new dispenser.

As there was very little time for performing user tests with the manufactured prototypes, this is an obvious area to look into. These tests could range from usability tests to hygienic measurements and perception surveys. As mentioned previously in this report, there were also several different solutions both for opening the dispenser and locking the roll in place. Most of these solutions had some merit, and should be tried out in simple models, to see if they could offer some improvement compared to the current solution. Furthermore, it was not clear whether it was preferable to have some indication of how the dispenser was to be opened or not. Some user tests were carried out at the very end of the project, but this is something that definitely could be investigated further.

To get a better understanding of the microbial aspects of hygienic design, more comprehensive tests should be performed. These could also serve to put the hygienic dangers of public washrooms into a wider context.

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9. APPENDICES

Designing Dispenser Series

Month	January				February			March			April					May				June
Week	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Information gathering																				
Literature study																				
Web research																				
Competitor analysis																				
Visual brand analysis																				
Legal demands																				
Material study																				
Observations																				
Interviews																				
Lab tests																				
Demand specification																				
Idea generation																				
Brainstorming																				
Sketching																				
Concept development																				
Mock-ups																				
Computer 3D modelling																				
Form analysis																				
Material selection																				
Concept selection																				
Product development																				
Solving concept problems																				
Visual design																				
Finalising concept																				
Final material selection																				
CAD modelling																				
Finalising project																				
Computer renderings																				
Manufacture prototype																				
Presentation material																				
Written report								Structure												

Appendix B - Study of Dispensers in Public Washrooms

SL= Split-line

L= Low M= Medium H= High

Chalmers University of Technology	**Soap Dispenser**							
	Brand	Cleanness	Split-line	SL cleannes	Material availibility	Function	User observation	Notes
V Building	Tork / S1	M- Some spots on the surface. Dust on top of the dispenser.	Yes	M	Yes	Liquid soap system- Easy	-	Dirt could be seen around the lock. Material availibility could not be observed from outside.
Mechanical Engineering Building	Katrin	L- Exit part of the dispenser was covered with dirt and dried soap.	No	-	Yes	Easy	-	Material availibility could not be observed from outside.
	Tork / S1 (inside the cubicles)	M- Dirt on the top surafce.	Yes	M	Yes	Easy	-	Dirt could be seen around the lock. Material availibility could not be observed from outside.
HB Building	Tork / S1	M- Dirt on the top surface.	Yes	M- Visible dirt on the bottom surface.	Yes	The button was stiff.	-	Material availibility could not be observed from outside.
Library - Basement	Tork / S1	M- The exit part of it was covered with dirt and dried soap.The main body was clean.	Yes	H	Yes	Easy	-	Dirt on the bottom can not be seen if you don't bend.
Library - Ground floor	Tork / S1	L- The bottom part was dirty.	Yes	L- There was visible dirt on split-line which looked quite old and hard to get cleaned.	Yes	Easy	-	Material availibility could not be observed from outside.

Chalmers University of Technology	**Soap Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Chemical Engineering Building - First floor	Tork / S1 (white)	L- Exit part of the dispenser was covered with dirt and dried soap.	Yes	H	Yes	Easy	-	Material availibility could not be observed from outside.
Chemical Engineering Building - Ground floor	Tork / ?	H- No visible dirt had been seen.	Yes	L- Visible dirt could not been seen on the bottom because of the dark colour.	Yes	The button was stiff.	-	Material availibility could be observed from outside.
Vasa Building	Tork/S1 (white)	H- No visible dirt had been seen.	Yes	H	Yes	Easy	-	Material availibility could be observed from outside.

Movie Theatre	**Soap Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Biopalatset - Göteborg	Tork / S1 (black)	L- Visible dust on the body.	Yes	L- Very dusty and dirty.	Yes	Easy	-	The black colour of the dispenser showed dust and dirt.But less of the dried soap.
Bergakungen - Göteborg	Tork / S3 (aluminium)	M- Visible dust on the top and dirt around the exit had been seen.	Yes	M	Yes	Sensor	-	There was a small tray under the dispenser in case of dripping.

Germany - Frankfurt	**Soap Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Göteborg City Airport	Initial	M	No	-	Yes	Pull lever	-	-
Frankfurt-Hahn Airport	Uticom	H	No	-	Yes	Sensor	Some users could nor get the function and tried to push the sensor button.	There was a small plate under each dispenser in case of dripping.
Göthe University - Library	CWS	L- Looked old and worn	Yes	H	Some were empty	Pull lever	-	The open design on the bottom helped to show the dirt easily.
Starbucks Cafe´	Initial	H	No	-	Yes	Pull lever	-	Good design without split lines.
Galeria Kaufhof - Basement	Tork/Elevation	M	Yes	H	Yes	Push button	-	The dispensers on the left side are not easy for right hand persons and other way around for left hand.
Galeria Kaufhof - Top floor	?	M	Yes	L	Yes	Push button	-	Strange brand
Zeil Galerie	CWS	L- Dirty and scratchy	Yes	M	No	Pull lever	-	Tried to use it in many different ways, but didn't suceed.

Germany - Frankfurt	**Soap Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
My Zeil	? (aluminium)	L- Wet and didn't look fresh	No	-	Yes	Push lever	There were many who did not use the soap dispenser.	-
Karstadt	? (metal and plastic)	L	No	-	Yes	Push lever	-	If you didn't know the function you could place your arm on the bottom of exit part.
Cafe´Libretto	ille	H	No	-	Yes	Sensor	-	Soap dripping had been seen.
Design Musium	? (built in wash basin)	H	Yes	L	Yes	Push button	-	-
Cafe Liebfrauenberg	Tork	M	Yes	M	Yes	Push button	-	-

England - Birmingham	**Soap Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Pallasades	Lotus	H	No	-	Yes	Push button	-	-
Pavilions	? (steel)	H	No	-	Yes	Push button	-	-
Bull-ring	? (recessed, steel)	M	No	-	-	Push button	-	-
University of Aston	Lotus	H	No	-	Yes	Push button	-	-
The Mailbox	? (recessed, steel)	M	No	-	Yes	Push button	-	-
Birmingham Airport	-	-	-	-	-	-	-	-

Chalmers University of Technology	**Hand Paper Dispenser**							
	Brand	Cleanness	Split-line	SL cleannes	Material availibility	Function	User observation	Notes
V Building	Tork / H3	L- Stickers and dirt on front surface. The bottom surface was dirty as well.	Yes	M	Yes	Dispensing one at a time.	The paper could be torned out and fell on the floor.	Material availibility could not be observed from outside.
Mechanical Engineering Building	Katrin	L- The chosen material and design of the dispenser was perceived dirty.	Yes	L	Yes	Infolded hand papers-dispensing one at a time.	-	The exit of the dispenser was too wide which was relulting to hanged paper touching wall.
HB building	Tork / H2	H	Yes	H	Yes	Infolded hand papers-dispensing one at a time.	The exit of the dispenser is too wide which was resulting to take more papers.	The design of the dispenser was helping to hygiene perception.
Library - Basement	Tork / H2	H	Yes	H	Yes	Infoldes hand papers-dispensing one at a time.	-	The design of the dispenser was helping to hygiene perception.
Library - Ground floor	Tork /H2	H	Yes	H	Yes	Infoldes hand papers-dispensing one at a time.	-	
Chemical Engineering Building - First floor	Tork / H2	H	Yes	H	Yes	Infoldes hand papers-dispensing one at a time.	-	
Chemical Engineering Building - Ground floor	Tork / H2 (white)	H	Yes	H	Yes	Infoldes hand papers-dispensing one at a time.	-	

Chalmers University of Technology	Hand Paper Dispenser							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Vasa Building	Tork / H2 (white)	H	Yes	H	Yes	Infolded hand papers-dispensing one at a time.	The exit of the dispenser is too wide which was resulting to take more papers.	-

Movie Theatre	Hand Paper Dispenser							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Biopalatset - Göteborg	Tork / H1 (black)	M- The esxit was not as dirty as toilet paper dispenser but there was visible dust on top of it.	Yes	M	Yes	Hand paper rolls.	-	The black colour of the dispenser showed dust and dirt.But less of the dried soap.
Bergakungen - Göteborg	-	-	-	-	-	-	-	There were hand air dryers in the washroom.

Germany - Frankfurt	Hand Paper Dispenser							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Göteborg City Airport	Ínitial	L	-	-	Yes	Roller towel dispenser	-	The dispenser did not roll up itself and the paper looked disgusting.
Frankfurt-Hahn Airport	Uticom	H	-	-	-	Sensor-one at a time	Most of the users were pressing the sensor as a button for paper dispensing.	There was written info for the function of dispenser.

Germany - Frankfurt	**Hand Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Göthe University - Library	CWS	L	Yes	M	Out of paper	Roller towel dispenser	The towel was at the end, therefore users were using a common part for drying their hands.	Stickers on the dispensers.
Starbucks Cafe´	Initial	H	No	-	Yes	Single folded sheet	-	Material avilibilty could be seen from.
Galeria Kaufhof - Basement	Tork	L- Looked old and worn	No	-	Some were empty	-	-	There was a wheel for dispensing the paper.
Galeria Kaufhof - Top floor	Tork	L- Looked old and worn. Scratces on surface.	Yes	M	Yes	Single folded sheet	Easy- Users preferred to use the hand paper dispensers.	There were both hand paper dispensers and hand air dryers.
Zeil Galerie	? (inside wall, metal)	M	-	-	Yes	Folded papers	Easy	-
My Zeil	? (white, painted metal)	H	No	-	Yes	Folded single sheet	Some users preferred to use hand papers located on top of the dispensers.	-
Karstadt	?	L	Yes	L	Yes	Folded papers.	Users were taking several sheets at once.	-

Germany - Frankfurt	**Hand Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Cafe´Libretto	ille	H	No	-	Yes	Sensor	Some users tried to push the sensor button.	-
Design Musium	Apura	L- Scratches and dust	No	-	Yes	Single folded sheet	-	-
Cafe Liebfrauenberg	?	M	Yes	M	Yes	Lever- User should pull lever down, then there is a blade for cutting the paper.	-	-

England - Birmingham	**Hand Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Pallasades	-	-	-	-	-	Hot air dryer	-	-
Pavilions	-	-	-	-	-	Hot air dryer	-	-
Bull-ring	-	-	-	-	-	-	-	A hole to put yoour hands inside- recessed, steel

England - Birmingham	**Hand Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User ob-servation	Notes
University of Aston	XLERATOR	-	-	-	-	Hot air dryer	-	It was blewing really hard.
The Mailbox	? (recessed, steel)	H	No	-	Yes	Single folded sheet	-	-
Birmingham Airport	AIRDRI	-	-	-	-	Hot air dryer	-	-

Chalmers University of Technology	**Toilet Paper Dispenser**							
	Brand	Cleanness	Split-line	SL cleannes	Material availibility	Function	User observation	Notes
V Building	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-
Mechanical Engineering Building	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-
HB Building	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-
Library - Basement	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-
Library - Ground floor	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	Dispenser was open.
Chemical Engineering Building - First floor	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-
Chemical Engineering Building - Ground floor	Tork / T1	M- Dust on top of the dispenser.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-

Chalmers University of Technology	Toilet Paper Dispenser							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Vasa Building	Tork / T1	M	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-

Movie Theatre	Toilet Paper Dispenser							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Biopalatset - Göteborg	Tork / T1	L- There was visible dirt on body and bottom edge of the dispenser.	Yes	L	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	For solving material availibility, there were two dispensers on top of each other.
Bergakungen - Göteborg	Katrin	M- Dust on top of the dispenser. Sticker's track on surface.	Yes	M	Yes	If the tail of the toilet paper is not out from exit, the users should take their hand inside.	-	-

Germany - Frankfurt	Toilet Paper Dispenser							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Göteborg City Airport	Initial	M	-	-	Yes	Small rolls	-	The dispenser was mounted on higher level which could help to see the paper.
Frankfurt-Hahn Airport	Katrin	H	-	-	Adequate	Small rolls	-	-

Germany - Frankfurt	**Toilet Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User observation	Notes
Göthe University - Library	Paper-stream	-	-	-	Yes	-	-	There was not any dispenser in the toilets.
Starbucks Cafe´	Initial	H	No	-	Yes	Small rolls	-	-
Galeria Kaufhof - Basement	Tork	L- Scratches, cigarett marks and dirty	Yes	L	Yes	Big rolls	-	-
Galeria Kaufhof - Top floor	Tork (aluminium)	L- Visible stains	Yes	L	Yes	Big rolls	-	-
Zeil Galerie	? (metal)	L- Scratches	-	-	Yes	Small roll	-	-
My Zeil	?	H	No	-	Yes	The ordinary dispensers which are being used at home.	-	The extra toilet papers were in the corner of the cubicle.
Karstadt	?	H	No	-	Yes	Big rolls	-	-

Germany - Frankfurt	**Toilet Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User ob-servation	Notes
Cafe´Libretto	ille	M-Scratches	No	-	Yes	Big roll	-	-
Design Musium	?	H	No	-	Yes	Small roll, "at home"	-	-
Cafe Liebfrauenberg	-	-	-	-	-	-	-	-

England - Birmingham	**Toilet Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User ob-servation	Notes
Pallasades	Lotus	L	Yes	M	Yes	big and small roll	-	-
Pavilions	?	M	No	-	-	Big roll	-	-
Bull-ring	Andarta	L	Yes	L	Yes	One mini jumbo roll.	-	-

England - Birmingham	**Toilet Paper Dispenser**							
	Brand	Cleanness	Split-line	SL* cleannes	Material availibility	Function	User ob-servation	Notes
University of Aston	Da Vinci	H	No	-	Yes	Two small rolls	-	-
The Mailbox	Katrin	Stained	Yes	M	Yes	Two small rolls	-	-
Birmingham Airport	Kimberly-Clark	H	No	-	Yes	Big roll	-	-

Chalmers University of Technology	**Waste Bin**							
	Brand	Cleanness	Split-line	SL cleannes	Overfilling	Function	User observation	Notes
V Building	?	M- Due to its quality.	No	-	No	On a four-wheel base.	-	No lid
Mechanical Engineering Building	?	L	No	-	No	Ordinary plastic one	-	No lid
HB building	?	-	No	-	No	Big plastic bag which is fixed on a metal base.	-	It was located under the hand paper dispenser.
Library - Basement	?	-	No	-	No	Net pattern	-	-
Library - Ground floor	?	-	No	-	No	Net pattern	-	-
Chemical Engineering Building - First floor	?	-	No	-	No	Net pattern	-	-
Chemical Engineering Building - Ground floor	?	-	No	-	No	Net pattern	-	Used papers had sticked to the corner of the waste bin.

Chalmers University of Technology	**Waste BIn**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User observation	Notes
Vasa Building	?	L	No	-	No- But the hand papers could be seen around it.	Net pattern	-	-

Movie Theatre	**Waste Bin**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User observation	Notes
Biopalatset - Göteborg	?	M	No	-	No	-	-	There was a big and bulgy waste bin out of the washroom.
Bergakungen - Göteborg	?	M- The metal was corroded.	No	-	No	-	-	Since the waste bin was big, it can be hard to move it inorder to clean underneath.

Germany - Frankfurt	**Waste Bin**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User observation	Notes
Göteborg City Airport	?	-	No	-	No	-	-	The dispenser was mounted on higher level which could help to see the paper.
Frankfurt-Hahn Airport	?	-	No	-	No	Net pattern	The waste bins were located under hand paper dispensers.	-

Germany - Frankfurt	**Waste Bin**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User observation	Notes
Göthe University - Library	?	L	No	-	No	Ordinary plastic one	-	There was not any dispenser in the toilets.
Starbucks Cafe´	?	H	No	-	No	Big and open made of plastic.	-	-
Galeria Kaufhof - Basement	?	-	No	-	No	-	-	-
Galeria Kaufhof - Top floor	?	-	No	-	No	Big, plastic	-	-
Zeil Galerie	?	H	No	-	No	Inside the wall, right under the hand paper dispenser.	-	-
My Zeil	?	M	No	-	No	Big,metal, net pattern, no lid	-	-
Karstadt	?	M	No	-	No	Slide-up lid	-	-

Germany - Frankfurt	**Waste Bin**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User ob-servation	Notes
Cafe´Libretto	?	-	No	-	No	No lid	-	-
Design Musium	?	L	No	-	No	Net pat-tern	-	-
Cafe Liebfrauenberg	?	-	No	-	No	-	-	-

England - Birmingham	**Waste Bin**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User ob-servation	Notes
Pallasades	?	-	No	-	No	-	-	-
Pavilions	?	-	No	-	No	-	-	-
Bull-ring	?	-	No	-	No	-	-	-

England - Birmingham	**Waste Bin**							
	Brand	Cleanness	Split-line	SL* cleannes	Overfilling	Function	User ob-servation	Notes
University of Aston	?	-	No	-	-	-	-	-
The Mailbox	?	Recessed, steel	No	-	-	No lid	-	-
Birmingham Airport	?	H	No	-	-	-	-	-

Appendix C - Pictures of Dispensers in Public Washrooms

Appendix D - Study of Dispensers Tork Dispensers

Dispenser	Comments
Tork Dispenser Soap Liquid 	Bottom part has narrow corners that are difficult to clean. Push button is easy to clean.
Tork Dispenser Soap Liquid Aluminium 	Sloping surfaces that might prevent contamination. Push button appears easy to clean.
Tork Dispenser Soap Liquid Metal White 	Sloping surfaces - good. Quite easy to clean.
Tork Dispenser Soap Liquid Arm Lever 	Arm lever provides good hygiene, but might be hard to use?
Tork Dispenser Soap Foam Aluminium 	The same as other products in this series. Rough plastic. Touch-free, so no cross-contamination. Not hard to clean inside.

Tork Dispenser Hand Towel Interfold Aluminium

Window on side is good, but maybe hard to see? If you can't see it, you don't know if dispenser is empty and so you have to feel with hands. Easy to touch it while taking paper towel. No fingerprints, but oil-stains. Scratches. Rough microstructure? Plastic details have rough finish. Easy to load in incorrect way.

Tork Dispenser Hand Towel Interfold

Big split-lines collect dirt. Easy to clean interiour. Easy to load in incorrect way. Key hole is susceptible to contamination, but users are not supposed to touch it. The niche at the opening is perhaps too small.

Tork Dispenser Hand Towel Roll Easy Load

Touch-free in a sense. Push lever when paper gets stuck - Seldom touch, which is good. Splitline will collect dirt. Dirt might fall down on paper when opening dispenser.

Tork Dispenser Hand Towel Roll Aluminium

Touch-free (sensor). Possibly confusion if paper gets stuck.

Tork Dispenser Wiper Mini Centerfeed Roll

Limited risk of cross-contamination, since you never touch the same piece of paper as anyone else. Cross-contamination could occur via the exit, though.

Tork Dispenser Wiper Mini Centerfeed Roll

Big split-lines collect dirt. Easy to touch exit.

Tork Performance Dispenser Wiper Mini Centerfeed Roll

A lot of bad split-lines. Transparent plastic, but hard to see through when it's black. Quite easy to clean interior.

Tork Dispenser Wiper Centerfeed Roll

Easy to clean, generally. Will look bad if not cleaned, though.

Tork Dispenser Toilet Paper Jumbo Roll

The small hole is a smart idea. The small teeth are easy to clean, compared to bigger ones. Easy to clean interiour. The paper is not well protected.

Tork Dispenser Toilet Paper Jumbo Roll

The teeth are hard to clean. The same problems as the whole Elevation-series.

Tork Dispenser Toilet Paper Mini Jumbo Roll Aluminium

Cross-contamination at teeth. Easy to clean the interior. No fingerprints. Can be cleaned with any detergent.

Tork Dispenser Toilet Paper Folded

Good with small hole, showing how much paper is left, but it only shows a small segment in the middle of the stack. Single-sheet paper may be more hygienic than a roll.

Tork Dispenser Toilet Paper Folded Aluminium

The advantages of single-sheet and aluminum. Quite good window on side.

Tork Dispenser Toilet Paper Folded

Advantages of single-sheet, disadvantages of Elevation.

Tork Dispenser Toilet Paper Roll Twin

Easy to reach paper end?

Tork Dispenser Toilet Paper Jumbo Roll Maxi

Window that shows if there's paper left. Could be hard to reach paper end.

Tork Dispenser Toilet Paper Compact Roll Auto Shift

Risk of cross-contamination at teeth? Elevation-problems.

Tork Bin 50 Ltr

Tilt-lid - unhygienic, since you need to touch it. Good that it hides the contents.

Tork Bin 40 Ltr Aluminium

Same problems as for the whole series. Too small size? Dirt might get stuck in the frame. Good that the bag is hidden.

Tork Bin 50 Ltr

Quite easy to open and close (the whole bin). Lid makes it less hygienic, if you have to touch it. Good with hidden bag.

Tork Bin 20 Ltr

Difficult to clean.

Appendix E - Interview with Users

Sex

Age

1) Do you perceive this restroom as a hygienic one?

2) Why/ Why not?

3) What dispensers have you used today? What parts do you touch?

- Toilet paper (paper, body, exit)
- Soap dispenser
- Hand dryer
- Paper towel
- Disinfectant
- Waste bin

4) What is your hygiene perception about above dispensers?

- low-medium-high

5) Why?

6) Do you touch the water tap?

7) Do you touch door and door knob?

8) How has been the availability of the following materiel :

- Toilet paper (jamming)
- Soap
- Paper towel (jamming)

9) In your opinion which above situation is the most unhygienic?

10) How much do you pay attention to written information?

- Never-sometimes- always

11) Which do you prefer?

- Written info
- Symbols/ pictures

12) What are your attitudes towards antibacterial additives to dispenser material? (Triclosan, Silver ions)

- don’t know
- negative
- positive
- don’t care

13) Any suggestion for having more hygienic public restroom (focusing on dispensers)?

Appendix F - Interview with Caretakers

1) Which surfaces do you clean? How often?

2) Do you clean inside the dispenser(s)? How often?

3) When and how do you refill the dispenser(s)?

4) Is it hard to clean the dispenser(s)? Split-lines?

5) How often do you clean the waste bins? How?

Appendix G - Design Format Analysis

																			
Round corners	2	2	0	2	2	0	2	2	2	2	2	2	2	0	0	2	0	0	2
Surface with two opacities	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**2**	**2**	**0**
Black colour	2	0	1	2	0	0	2	0	1	0	2	2	0	0	2	1	0	2	1
Rectangular shape	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**2**	**0**	**0**	**2**
Shiny	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**0**
Prominent splitline	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**
Niche at exit	1	1	0	2	2	2	2	2	0	1	1	1	1	0	0	0	0	0	0
Trapezoid push button	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rounded edges	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
Niche to the wall	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**2**	**2**	**0**
White colour	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**2**	**2**	**2**	**0**	**0**	**2**	**2**	**0**	**2**	**2**	**0**	**0**
Brushed surface	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Sharp edges	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0
Rectangular exit on front	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mixed materials	0	0	2	0	0	2	0	0	0	0	0	0	0	2	2	0	2	2	0
Metallic gray	0	0	2	0	0	2	0	0	2	0	0	0	0	1	1	2	1	1	2
Rectangular sensor	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Square shape	2	2	1	0	0	0	2	2	0	0	0	1	1	0	0	0	0	0	0
Lock on top	**2**	**2**	**2**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**	**2**	**2**	**2**	**2**	**2**
Lock on side	0	0	0	2	2	0	2	2	0	2	2	2	2	0	0	0	0	0	0
Vertical open window on front	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Sloping top	0	0	1	0	0	1	0	0	2	0	0	0	0	0	0	2	0	0	2
Cylindrical shape	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**2**	**2**	**0**
Tooth-shaped exit	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2
Spherical exit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Turquoise colour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
More than two colours	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
Prominent hinges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Circle on top	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transparent plastic	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**0**	**2**	**2**	**2**	**2**	**2**	**2**	**0**	**2**	**2**	**0**
Red colour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Circular shape	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	2	2	0
Protruding rectangular exit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Two-leveled bottom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sloped bottom	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Transparent window on side	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Visible hub	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wire lever	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diode	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Matte plastic	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Lid lip	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wire construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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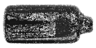	0	2	2	0	2	2	0	2	2	2	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	22
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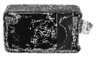	2	2	2	2	2	2	2	0	2	2	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	24
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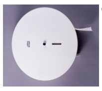	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	2	0	2	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	14
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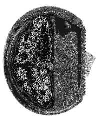	0	2	2	0	2	2	0	0	2	2	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	23
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0	0	0	0	0	0	0	0	0	0	1	0	0	45
0	**2**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**60**
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2	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**2**	**0**	**2**	**0**	**0**	**58**
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0	0	0	0	0	2	0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	0	1	0	1	0	0	13
2	**2**	**2**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**74**
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0	0	0	0	0	0	0	0	0	0	0	0	0	10
2	0	0	0	0	2	1	0	2	0	0	0	0	23
0	**2**	**2**	**2**	**2**	**0**	**0**	**2**	**0**	**2**	**0**	**2**	**2**	**50**
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0	0	0	0	0	0	0	0	0	0	0	0	0	10
0	0	0	0	0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	0	0	0	11
0	0	0	0	0	0	0	0	0	0	0	0	0	4
0	0	0	0	0	0	0	2	0	2	0	2	2	12
0	**2**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**64**
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0	2	2	0	0	0	0	0	0	0	0	0	0	4
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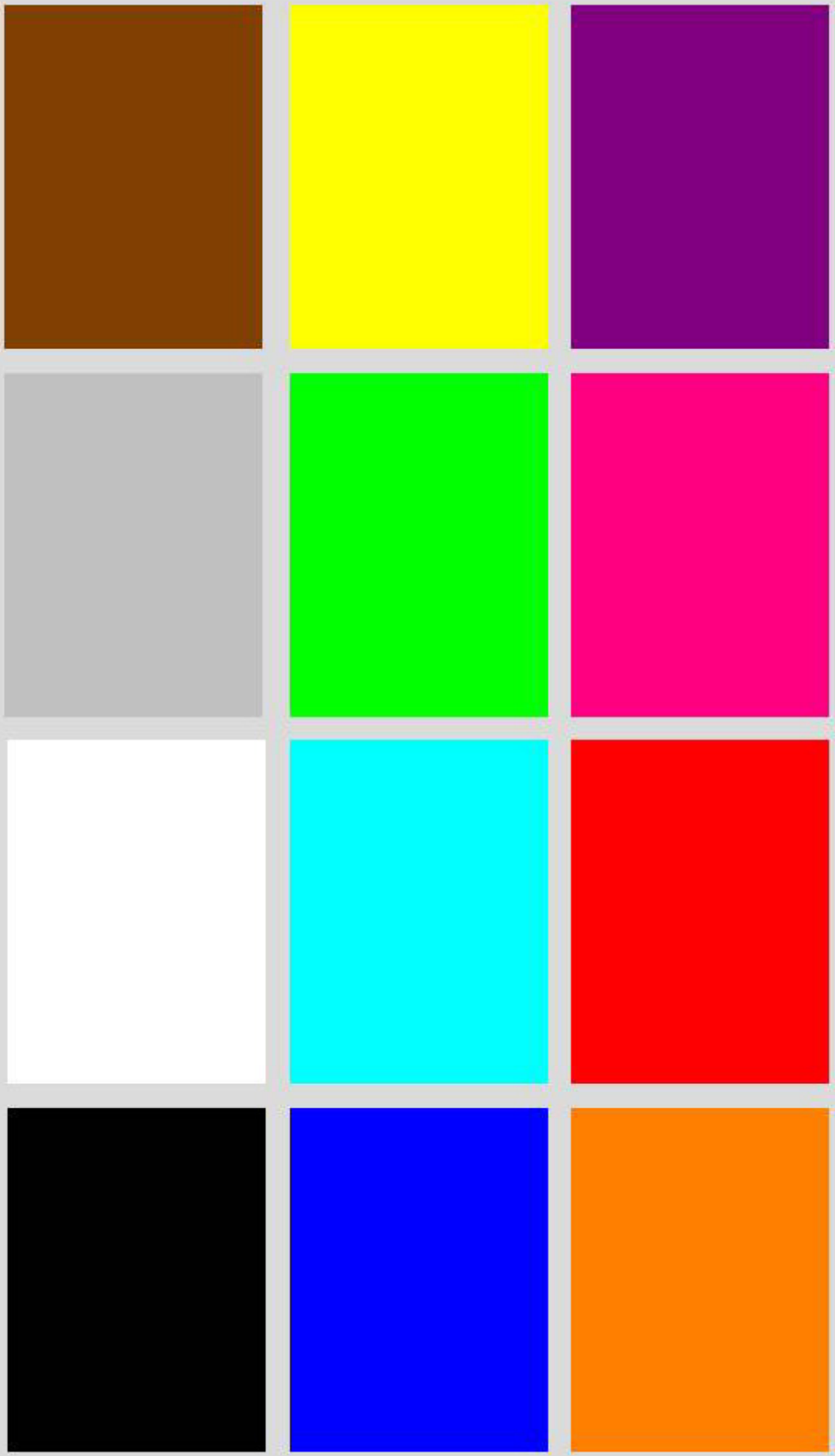
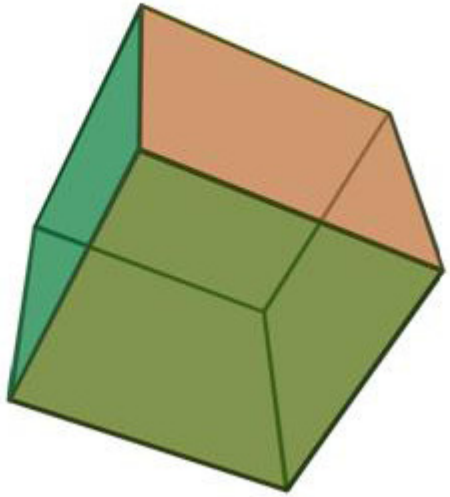
Appendix H - Hygiene Perception



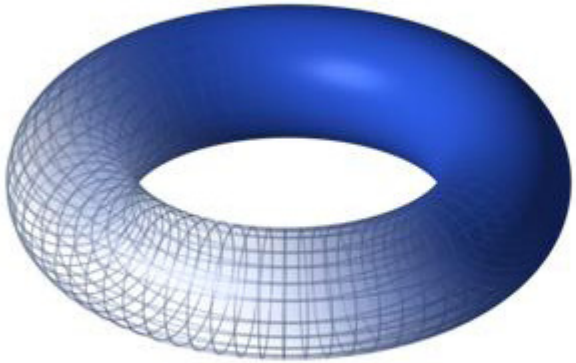
A

B

C

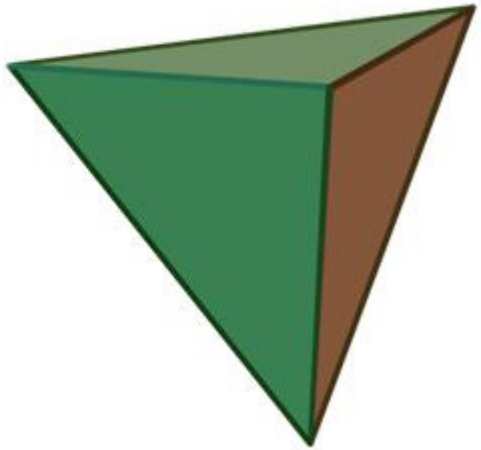


D



E

F



A

B

C

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D

E

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H

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J

Appendix I - Focus Group Transcripts

Focus Group – SCA – 9th Februari 2011

Number of participants: 1 woman, 50-60 years of age, Swedish

Material

Glass seems the most hygienic, and polished metal as well. They feel like the easiest materials to keep clean, and you can see if they are clean. At the first glance… matte plastic is a bit hard to see whether it's clean or not. The same goes for ceramics. Shiny materials are hygienic, matte materials are not.

[Showing material samples did not help with eliciting more detailed responses]

Colours

Hygienic colours to me are blue and white. It is the contrasts. It's this thing when you have white and blue… light blue… I like the contrasts. Both the colours together. I don't like black and dark colours. It's just a feeling.

Shapes

[Basic shapes]

It's very hard to answer. You easily think about the dispensers that are on the market now. They are pretty rounded. Elevation is boxy but there are no sharp edges. A lot is rounded, and that feels positive. Something with sharp edges feels cold and sterile. But something sterile is also hygienic, yes, that's true. I think of interior design for kitchens. There they have a lot of sharp edges, and that often looks really good. I can't really answer, it depends. There's something about it being soft. It probably has got do to with other things than hygiene.

[Examples of products]

The one down to the right [Apple's Mighty Mouse], which is simple without any graphics. That one is the most hygienic. I don't know why, but it just feels that way. Simple shapes. [Next slide] The bottles are the most hygienic. The watch has got too many details, edges and lines. The same thing goes for the radio. There's too much details. Between the two bottles, the one made of glass feels more hygienic, since it is transparent. You can see what's inside. There's a feeling of safety when you can see what's inside, no matter what's inside. If it's a brand you don't recognize or if you're in a washroom you've never been in, it feels better if you can see what's inside.

Size

It doesn't matter, except that the size of the dispenser should be congruent with the size of the room.

Light

It is very important. There should be a lot of light, so that it's really bright. Colour and temperature of the light is not as important as the amount of light. It's good to have light in touch-less devices. Isn't there something like that for water today? With a ray? I prefer the same colours of light (blue and white). Red light would be strange.

Dispensers

[Paper towels] E [Touch-less aluminium] is probably the most hygienic, because the paper is inside the dispenser until you take it. A [Elevation roll, H1] is also similar, but in that case the paper is exposed. Between B and C, B is better [B is single sheet with high niche and C is single sheet with low niche]. It feels more enclosed, and it looks easier to pick a towel. The problem with E is that if it gets jammed, then I can't get any towel. With all the others, I can take a towel with force. Even A is worse in that respect. It's not hygienic to have a button. You have it on soap dispensers, but in that case you wash your hands afterwards.

[Soap] A [Touch-less aluminium] is the best one. Not good if you see old soap around the exit. You often see C [Elevation with arm lever] in hospitals, and I think it is really good. But it doesn't look so nice. But the solution is very good. It could work at work as well, but not at a nice restaurant. Then you would think "Am I supposed to be that frightened?". It looks so technical. It's as if there was a law, and suddenly they had to adjust the product. It looks like it belongs in a hospital.

[Toilet paper] B [Single sheet] is the most hygienic one, even though we don't have it here in Sweden. There's always problems with D [Elevation big roll], when trying to reach the paper, when it's not hanging down the way it should. It's good that you can see through the transparent part. A [Elevation, two small rolls] is good, because it's easy to roll down some fresh paper. It depends on how sensitive you are. B is probably more common here because of historical reasons. When the toilet paper gets stuck, the placement of the dispenser is sometimes too low. But I don't know, there's probably some standard about how far it should be placed from the water closet.

[Bins] I think D [Bin with push lid] is the best one, even though I have to touch it. I realize what I'm doing, so I use the thing I'm throwing away so that I don't have to touch the lid with my hand. If you're at a place where you know the people, like this work-place, then it's not necessary with a lid, but if you're out at a public place, there should be a lid. It's not hygienic when you can see the plastic bag, because then you can also see some of the contents.

[Dispenser design] If B [Black Elevation H2] was white, then that would definitely be the most hygienic one. Otherwise I think E [Elevation centre-feed] is the best. C [G-P enMotion] is blue, but it doesn't work in this case. It's matte plastic. There's too much details. Too much curves and circles and shapes. B is so slim, and that's like positive.

[Next slide] I like white, so it has to be F [K-C Microban]. The blue part I think should have been transparent, so that you could see through. It's got a nice shape. I [K-C Double Single-sheet] has also got a nice shape, but it's black, unfortunately. It would have been really good, had it been white.

[Situations] What's the matter with the blue one [Soap dispenser with splash stains]? That's just fine, isn't it? Oh, there are stains on it? I didn't see that. I thought that was maybe from the camera. But okay, it's worn. I think about these things, but I don't re-late it to the brand, but rather to the caretakers. If it looks messy, sometimes I don't use it. That one you don't really see [about the Katrin dispenser with old soap on lever]. It's more important whether it's dry or wet. If paper hangs down, touching the wall or something, then you remove some papers, before you dry your hands. Now I remember something I said before, that shiny materials feel hygienic… But it's really hard to keep it that way in public places. So that's a challenge, keeping it that way. Because you see here that it very soon looks unhygienic. Splitlines, yeah right… You don't think so much about that. But one think I have been thinking about is the placement of the lock. On the new towel dispensers, it is very visible; it's on the side of the front. I don't understand it, because that's not what you want to show, and it's disturbing. It's a pity that they've placed it there. It doesn't matter to the person refilling the dispenser. It's not good when the lock is on the top either, especially when it's black. It should be somewhere where you can't see it.

[The Tissue Issue] The one where it hangs down is the easiest to take paper, because you can see what you are doing. It's better when the paper hangs down to the floor than when you can't see the paper at all. You just throw away the

Focus group 10th of February, Chalmers 4th floor

Participants: Three Swedish women, 20-25 years of age and one Turkish man, 20-25 years of age.

Materials

At first wood seems to be quite hygienic, maybe because of the texture, or the surface quality. But the surface may contain dust or small particles, so maybe the glossy plastic or the metal instead, because they have smooth surfaces, and that means they can't contain any different particles inside it. Shiny plastic is much more hygienic for me.

I agree that wood feels hygienic, but maybe that's because of it's associations, like in the forest… You're not afraid to touch wood objects, even if a hundred people have touched them before, because you don't associate it with bacteria and viruses. But this brushed aluminium on the other hand, I think of big fingerprints and public toilets, so that feels less hygienic. But it's probably not true, because it's easier to clean it.

I'm not sure about the wood, if it's in a wet environment.

Wood gives the feeling of warmth, like you're at home. But when you're using it, it doesn't feel hygienic, because of the surface quality or the texture, I don't know.

Do you have any porcelain there? Because maybe porcelain is like… hygienic? I think it's because of the shiny surface, and the hardness of it as well.

I also think porcelain is hygienic, maybe because of the way it's used today.

You don't get fingerprints so easily on porcelain. I think there's a difference between porcelain and glass, because you have glass in the shower, for example, and when it gets wet you get these small water drops that you can see very easily, and it's not like that with porcelain.

It's more important that you don't see that the material is dirty than that you easily see if it's dirty or clean. We should not see fingerprints or other effects of usage.

Especially in public environments. At home maybe I would like to see the stains.

Colour

Blue and green are hygienic.

And white.

Light grey… But it's like hospital if it's only white.

They commonly use green and some hues of blue in hospital for hygienic materiel and stuff like that. Clothes… I don't know why, but green and blue and white, in between there, it gives the feeling of healthiness, I think. It should be light hues.

Isn't it because if it's black, you see the dirt easier?

But in hospitals they have white colour to see when it needs washing. It depends on the kind of dirt.

Isn't black also the colour of sadness and illness? Because in ancient times they used it to cross sick peoples doors?

It still looks quite clean if it's shiny and black and new.

Maybe combinations with white is much better. White and another colour. For me it's like that.

Shapes

Large surfaces feel more hygienic. Like the sphere has a very large surface and is easy to clean, compared to the torus.

It [the torus] has more hidden surfaces.

Rounded shapes are better than edgy.

Just going on feeling I would say that the sphere, the cylinder and the cone feels more hygienic, because of the open surfaces.

I think tetrahedron as well, because you have no hidden surfaces.

I think we don't like the sharp edges, for this kind of product. I don't want to use this kind of product in the bathroom [if they have sharp edges]. Just a feeling.

[Next slide]

Of course Magic Mouse.

I like the plates, and it looks like good stuff, like it's easy to clean, and there are no split-lines. It's just one surface. There's no lines where dust can stay.

But maybe it's not so hygienic, because of the colour of the white, because it's not total white.

But I get the feeling about this porcelain that maybe it's not the best quality, so it will get scratch in like maybe one year. But when it's new it looks hygienic, but I don't expect it to look new for very long.

But shiny white colour gives the feeling of "new", I think. If you colour it with shiny white, you will get the same feeling as with this mouse.

But I feel that the mouse looks hygienic when you only look at the white part, but when you look at the product as a whole, you see the split-lines and the bottom part, and it doesn't look so hygienic.

[Next slide]

I don't think the perfume bottle looks hygienic, because of the edges.

I would say the water bottle, because of the colour, and we can see the inside of it.

And it's water…

I think the watch looks hygienic, because of the associations. I think of going swimming with it. Maybe because of the blue.

I don't like the surface of it, because it looks like it will collect dirt, day by day.

It looks like it's possible to wash it in water, so in that way I would say it's really hygienic.

The outside of the radio looks hygienic to me, but I'm not sure about this part, with the split-line.

Maybe it's because of the dark colour in the centre.

But I wouldn't be afraid to touch it, because it feels more like an old object, which maybe collects dirt, but not bacteria, and it feels more okay to touch dirt. I would rather touch the radio than the perfume bottle, if I saw it in a public restroom, covered with fingerprints. It's a different feeling of dirt.

I also feel like the wood absorbs the dirt, but the metal just reflects the dirt to the next person who touches it.

It's like the table – it's a little dirty, but you can touch it.

Size

I think that bigger surfaces gives a more clean expression.

But sometimes, if it's too big, it feels like they have to clean the room everyday, but if it's small it feels like there's someone taking care of the place.

I also think that it's good with a bid surfaces, because it shows when it's dirty and then you have to clean it, unlike with a smaller surface, where you might not notice it.

I agree with the big surface. It's like there's less risk that you touch somewhere where it's dirty. It's less risk when it's large.

I think that bigger surfaces look more expensive and smaller look cheaper. You can trust the big one, easily.

Light

I feel like this one, with the green light, that they only focus on making something nice, and don't focus on the hygiene.

Maybe if it's too dark, you feel like they're trying to hide the dirt.

If it's a good light, I feel it's more honest. If it's well lit.

I don't like the blue light they often have in restrooms, which makes you look sick. Maybe the products look good, but I don't feel good.

Dispensers

[Hand towel]

I would say E [Touch-less aluminium] and A [Elevation roll H1], because you only get one paper at a time, and you don't have to touch it.

I think C [Elevation folded, low niche] is less effort than A. I like this one, as long as there is a paper there. Maybe hygienically, I would say E as well, because you don't have to touch it, but I don't think the form tells you how it functions, so I don't like it because of that.

I like those that are not electric, because if there isn't a paper there, I can always get it out.

I think that C is more hygienic than B [Elevation folded, with high niche], because you are not so likely to have to touch the dispenser.

I don't like D [Elevation centre-feed], because that is the only one I've scratched myself on.

I don't like E, because I don't want to have to wave my hand every time I want a new towel.

[Soap]

Maybe there should be one that you use with your foot.

I would say that A [Touch-less aluminium] is the most hygienic, if the sensor is functioning, because then you don't have to touch anything.

When it comes to soap, it doesn't matter if you touch it, because you wash your hands afterwards, but they're usually out of soap, and then it is better if you don't have to touch it.

I also feel like when you touch the soap dispenser, you are often dirty, and then it's not hygienic, because there are bacteria on the product. So that's why I like the sensor one with the soap, but not with the towels.

[Toilet paper]

I like B [Elevation, folded], where you don't have to tear it off.

I like the D [Elevation, roll], because you can see the inside of it. And I don't like A [Elevation, two small rolls], because it's quite open. It should be closed.

I don't like these [Big roll dispensers] because you have to turn the roll to find the end of the paper.

I definitely don't like C [Aluminium, big roll] because you can't see anything.

It looks dangerous, with the teeth.

And you can't see what you're doing.

[Bins]

D [Tilt-lid] is the worst one, because people don't want to touch the lid, so they just drop the garbage and hope that the lid will move from the weight of the garbage, but it doesn't so the lid gets really dirty.

I definitely prefer A [Elevation without lid].

If it's in a public toilet, you don't need a lid, since it's only paper in the bin. If there were a lot of disgusting things in it, then a lid would be good.

I don't want to touch the lid in these places. I'd rather not have a lid at all.

There should be a lid that opens without using your hands, like with your foot or something.

That's the most important part, because once you have washed your hands, you are clean, and then you don't want to touch a lid or the door handle.

It doesn't matter to me if I see the plastic bag.

I think it's more hygienic if you don't see it.

I think these feels better, where you don't see the bag. I'm not sure why.

Dispenser design

B [Elevation H2] and E [Elevation M1] looks more hygienic, maybe because of the material.

I think E, because of colour, material and shape.

I don't know what's wrong with C [G-P enMotion]. I think it is the design. Maybe the curves.

But it's not the worst one. A [G-P centre-feed] is the worst one. Too much details, it destroys the large surfaces.

We want to see simple and curved surfaces. We don't want to see so much parts and different materials at the same time.

When a thing like this is too complex, it gives me the feeling that they have forgotten the real purpose. Maybe they want to do something that looks really nice, but they forget that it should be hygienic and this stuff.

For bigger top-surfaces, like these ones [G-P and K-C], I can often see the dust. On this one [Elevation H2], you can't see the dust as easily.

H [G-P centre-feed] or G [Touch-free aluminium] is more hygienic. Because this one [I – K-C double single-sheet] is totally stupid for me. You will touch this paper when you reach for the other one.

H look quite hygienic, but the edges are too sharp. I would have preferred if they had a larger radius.

I don't like the feeding part of it. It looks like it's squeezing the paper. It looks hard to get the paper.

F [] also looks hygienic, when it's new, I think, because it's white. White and blue looks fresh. I'm not sure what it would look like when it's in use.

It looks like it's quite bad quality.

In general, it looks more hygienic if it's really white, if it stays white.

It looks more fresh.

I don't relate smoky plastic to hygiene at all.

But that seems cool.

But it's nice, because you get a feeling for what's inside, and you can see how much is left, but you don't have to see the paper. You just get a feeling that the inside is what you want it to be.

Situations

I don’t care so much about splash stains on the dispenser, but I don’t like when the soap is dripping. And if I see a little drop in here, I don’t want to touch that dispenser. I don’t know why.

You don’t pay attention to these products when they’re working. But if it’s a new model that works really well, or if it’s the opposite, that it’s broken or out of order, then you notice it. But otherwise, if you get your paper or soap, you don’t really remember them afterwards.

[About split-lines] This is not nice. I think about these things if they are dirty, or if I have to touch them.

It depends on where they are.

The Tissue Issue

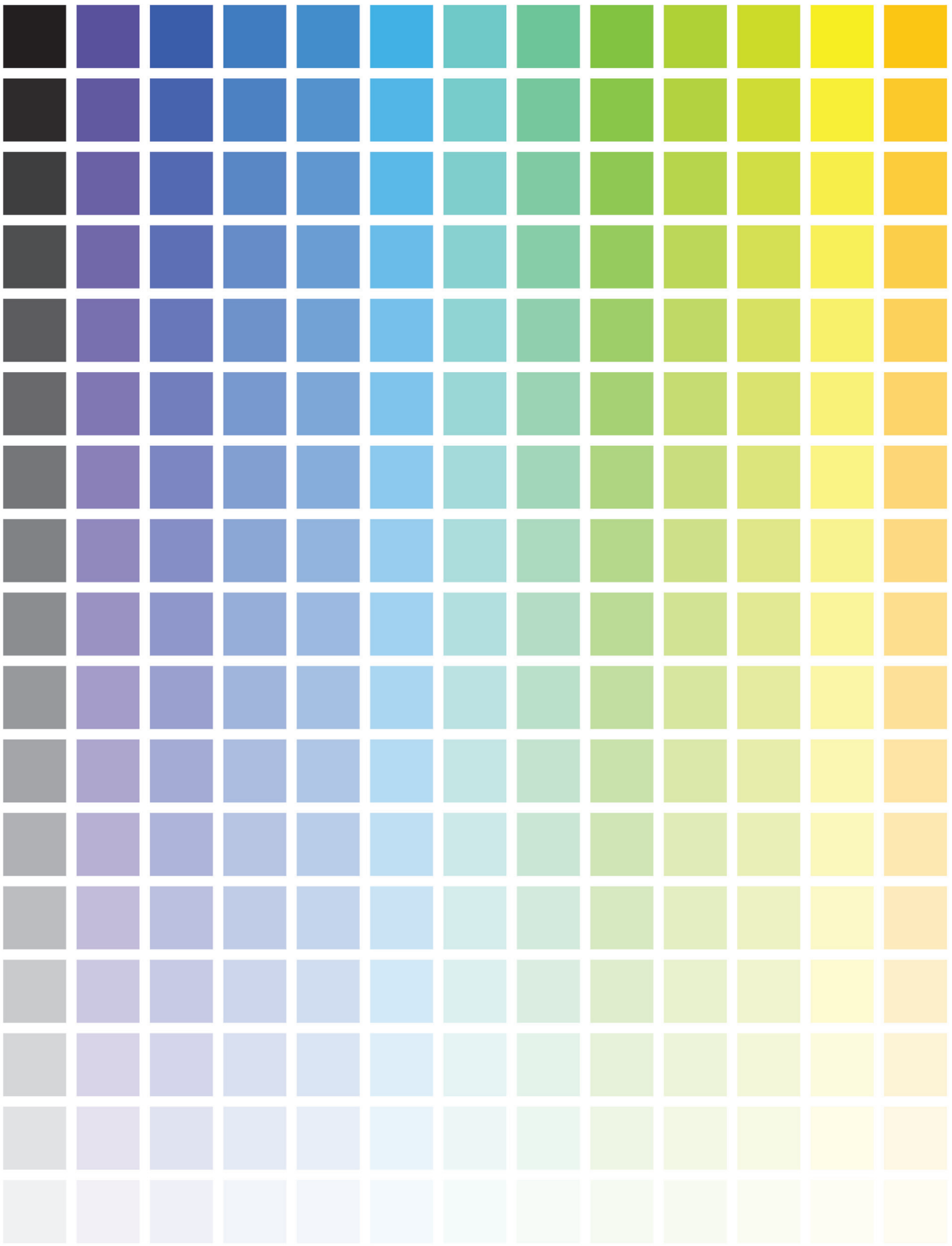
I prefer the left one [where the paper hangs down to the floor].

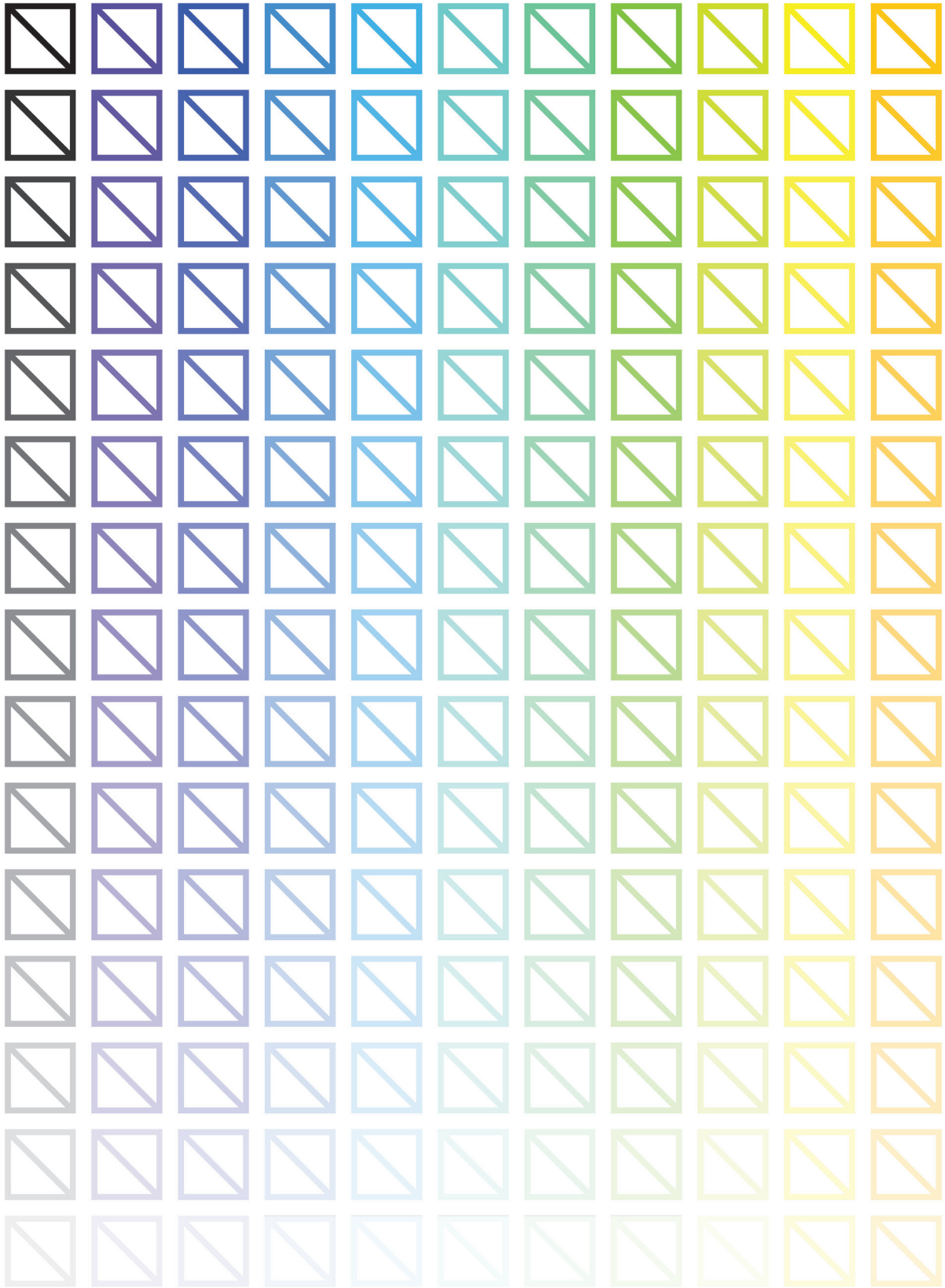
It’s more honest, I think. I don’t like guessing games.

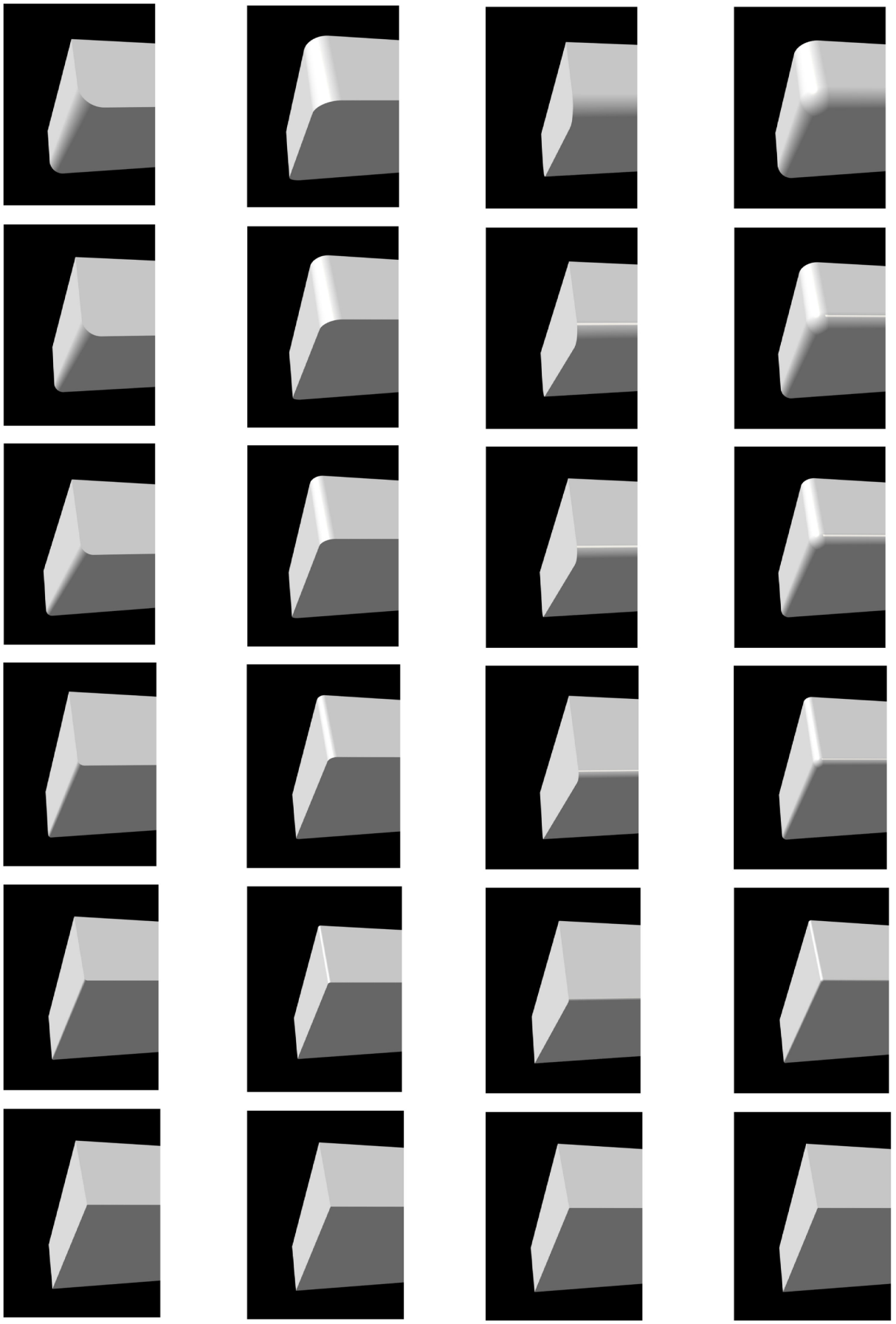
It’s not easy to reach inside of these.

If there’s already a lot of paper on the floor, then I would leave it there, but if the room is clean, I would throw it in the bin.

Appendix J - Detailed Survey





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