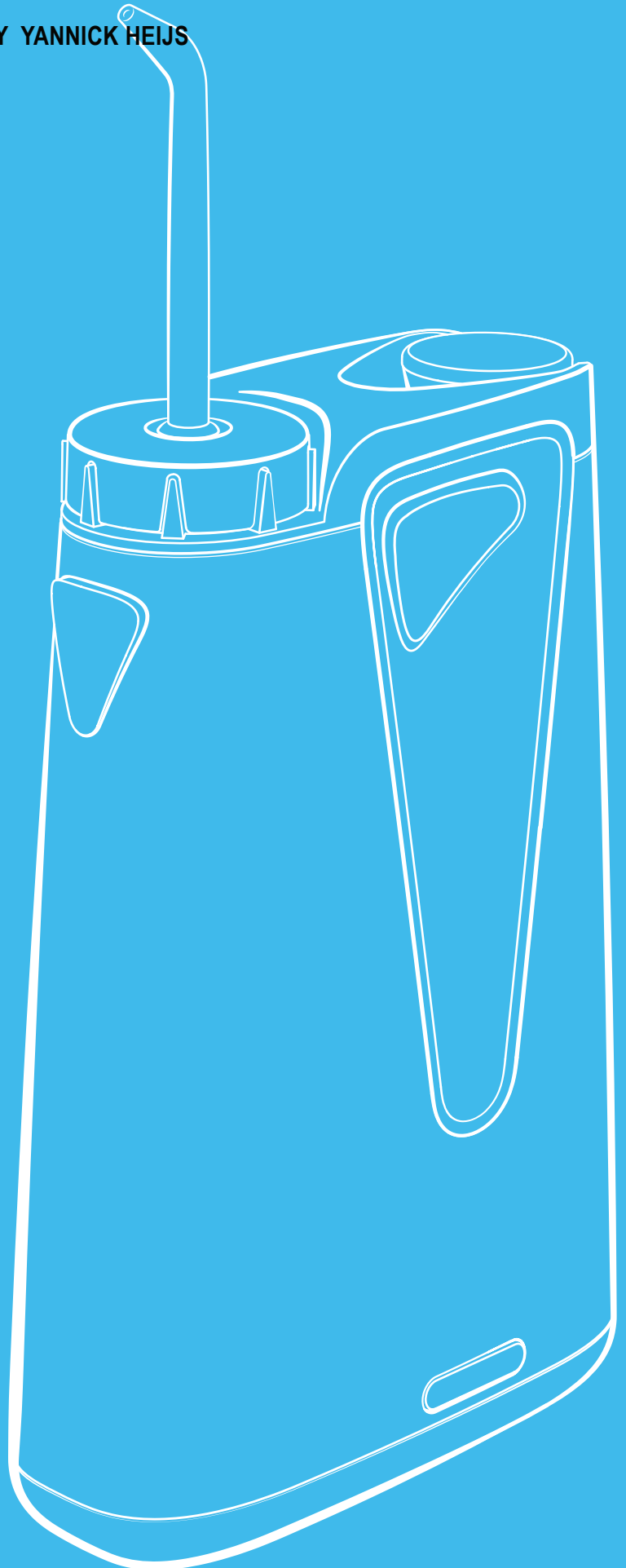


DESIGN REPORT

Design for the Mini Flow

BY YANNICK HEIJS



DESIGN REPORT

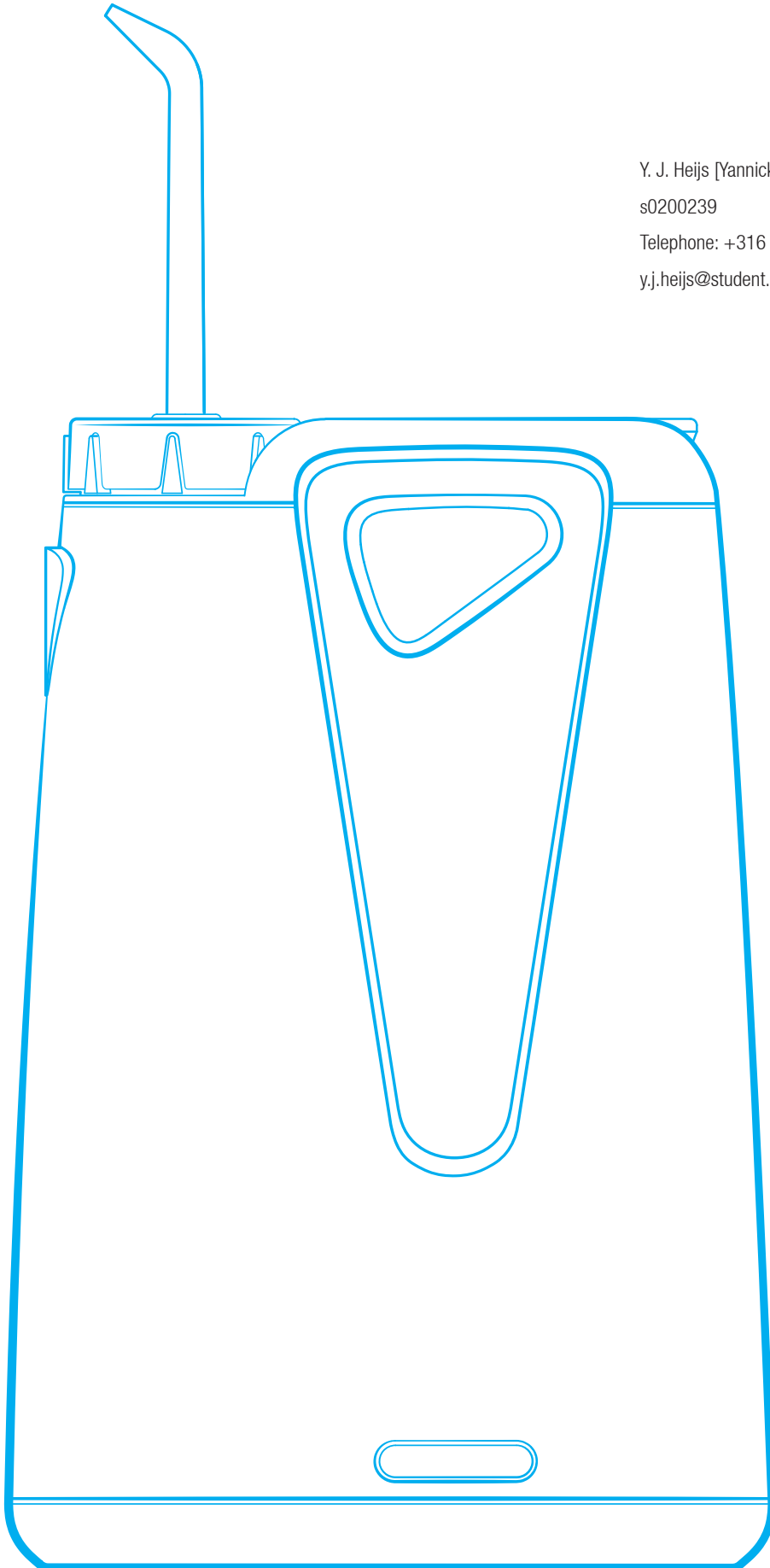
Design for the Mini Flow BY YANNICK HEIJS

Y. J. Heijs [Yannick]

s0200239

Telephone: +316 22 37 90 25

y.j.heijs@student.utwente.nl



Scale 1:1

UNIVERSITY OF TWENTE.

Dr. Ir. D. Lutters [Eric], Assistant professor ME
D. Lutters@utwente.nl

Msc. A.P. van den Beukel [Arie Paul], Assistant professor IDE,
Coordinator Bachelor Final Assignments for Industrial Design Engineering
A.P.vandenBeukel@utwente.nl

University of Twente.
Faculty of Engineering Technology
Industrial Design Engineering
Postbus 217
7500 AE Enschede, Overijssel, The Netherlands
Telephone: +31 5348 99 11 1



C. B. Waahlin [Carsten], Creative director
c.waahlin@made-innovation.com

J. Zhang [Jinglei], General manager
jinglei.zhang@made-innovation.com

MADE Innovation
3402 suite B3 no. 12, Hongda Road,
Beijing Economic & Technology Development Area,
100176, China.
Telephone: +8610 67 87 35 98
contact@made-innovation.com



J.W. Hoftijzer [Jan Willem], PhD researcher
j.w.hoftijzer@TUDelft.nl

Delft University of Technology
Faculty of Industrial Design Engineering
Landbergstraat 15
2628 CE Delft, Zuid Holland, The Netherlands
Telephone: +31 (0) 15 27 89807

Date of publication: 28 September 2012

Print Run: 4

Number of pages: 73

Appendices: 13

Total page count: 108

This design report was written as part of the Bachelor Assignment [280310], and reports on the research, development and verification for portable water flosser conducted at MADE Innovation located in Beijing, China during May till September 2012.

PREFACE

"Truly elegant design incorporates
top-notch functionality into
a simple, uncluttered form."

DAVID LEWIS

This design report discusses the research, development and verification for the Mini Flow; a portable water flosser, at MADE Innovation and commissioned by Endo Exo. It was part of the Bachelor Assignment [280310] and the completion of the bachelor program Industrial Design Engineering at the University of Twente.

People in China have a poor state of their oral cavity. The Mini Flow is a product which offers premium solution which should convince Chinese people why flossing is part of good oral health habits and why brushing the teeth is not just enough. Through a continuous generation and verification process the design for the Mini Flow as presented in this report focused on combining usability and appearance and proposes a system which could meet the desired performance.

There are several people who I want to thank for attributing to the creation of this design report and the design process.

I want to thank Jan Willem Hoftijzer for his support prior to this bachelor assignment by providing me with several opportunities and contacts in China. Also, I want to thank him for his feedback and insight during this process. The discussions we had helped me in reassessing my work as well as offer a fresh perspective. I want to thank Carsten Waahlin and Jinglei Zhang for the opportunity to come to Beijing and provide me with an internship.

I want to also thank Carsten Waahlin for his guidance during this bachelor assignment and for sharing his vision on design. A vision which is very insightful and different from the one taught to me during my bachelor Industrial Design Engineering.

Also, thanks go to the members of MADE Innovation's design team: Nathan Blair, Carson Kan, Alex Xu and Hongtao Zhang, with which I had the pleasure of working during this bachelor assignment. Their help and enthusiasm both, during work hours and outside working hours helped me in quickly finding my place within MADE Innovation. Additionally, sharing their culture and humor helped me to gain a better understanding of China.

Of course, all other members of MADE Innovation: Zhiming Qian, Xinhui Wang, Shanshan Jiang and Wenji Yu who have helped me at some point during my stay in Beijing. Finally, I want to thank William Yang for his awesome photos of the Mini Flow which are showcased in this design report.

TABLE OF CONTENT

	PREFACE	
	TABLE OF CONTENT	
	SUMMARY	8
	SAMENVATTING	9
	摘要 Zhāi Yào	9
1	INTRODUCTION	10
1.1	DESIGN BRIEF	10
1.1.1	PROJECT SCOPE	10
	<i>China's health care system</i>	
	<i>China's oral health</i>	
	<i>Benefits of flossing</i>	
	<i>What is a portable water flosser?</i>	
1.1.2	STAKEHOLDERS	12
	<i>MADE Innovation</i>	
	<i>Endo Exo</i>	
1.1.3	DELIVERABLES	13
1.2	DESIGN APPROACH	13
	<i>Research</i>	
	<i>Design</i>	
	<i>Detailing</i>	
1.3	STRUCTURE OF DESIGN REPORT	14
2	ANALYSIS	16
2.1	MARKET ANALYSIS	17
2.1.1	WATER FLOSSING	18
	<i>System architecture</i>	
2.2	COMPETITOR ANALYSIS	20
2.2.1	WATERPIK	22
2.2.2	PANASONIC	23

2.2.3	CANDEON	24
2.2.4	ASSOCIATIVE TECHNOLOGY	25
2.3	TARGET USERS	26
	<i>People with braces</i>	
	<i>String flossers</i>	
	<i>Non–Flossers</i>	
2.4	DESIGN PROPOSITION	28
2.4.1	BENCHMARKING	28
2.4.2	DESIGN HEADING	30
	<i>Design identity of Endo Exo</i>	
	<i>Product experience</i>	
2.4.3	FUNCTIONAL REQUIREMENTS	32
	<i>System architecture</i>	
	<i>Usability</i>	
3	DESIGN	36
3.1	BROAD IDEATION & CLUSTERING	37
3.2	VERIFICATION	39
3.3	CONCEPTS	41
3.3.1	MINI FLOW X	42
3.3.2	MINI FLOW Y	43
3.3.3	MINI FLOW Z	44
3.4	CONCEPT REVIEW	45
4	DETAILING	48
4.1	FEATURES UNDER DESIGN	49
4.1.1	SHAPE OF DESIGN	49
4.1.2	FEATURES OF DETAIL	54
	<i>Emblem</i>	
	<i>Water Plug</i>	
	<i>Jet tip–related buttons</i>	
4.2	PRODUCT PRESENTATION	56
4.3	FIRST PROTOTYPE	60
4.3.1	PROTOTYPE REVIEW	63

5	CONCLUSION	64
5.1	EVALUATION MINI FLOW	64
5.1.1	PRODUCT FEATURES	64
5.1.2	RECOMMENDATIONS	65
	<i>Charging dock</i>	
5.2	EVALUATION PROCESS	67
5.2.1	RECOMMENDATIONS	68

	REFERENCES	70
--	------------	----

APPENDICES

I	PROJECT BRIEF	
II	PLAN OF APPROACH	(5)
III	TIME SCHEDULE	
IV	EXPERT-USER REVIEWS	(3)
V	HAND MEASUREMENTS	
VI	PRODUCT BENCHMARKING	(5)
VII	MINI FLOW STYLE GUIDE	(3)
VIII	FUNCTIONAL REQUIREMENTS	(3)
IX	INITIAL IDEATION	(2)
X	SHAPE MODELS	
XI	SKETCHES OF DETAILS	(4)
XII	ASSEMBLY:	
	Jet tip rotation button & Water plug	
XIII	IDEATION CHARGING DOCK	

SUMMARY

This design report was written as part of the Bachelor Assignment [280310], and reports on the research, development and verification for the Mini Flow; portable water flosser at MADE Innovation, a design consultancy located in Beijing, China. The client is Endo Exo, a Chinese brand which develops health care and automation products. Endo Exo is looking to expand their Flow water flosser product line by introduction of the Mini Flow. Endo Exo seeks to improve the general oral health and habits of the Chinese consumer by introducing water flossing: The most effective and easiest way of flossing. Flossing in combination with tooth brushing can prevent gum disease, dental caries and bad breath.

Analysis of the market shows that the Mini Flow as a portable water flosser should first and foremost needs to convince the consumer of benefits of water flossing. This can be done by offering a product which offers a good performance with good usability, all for an affordable price. Also, the Mini Flow needs to offer the user a portable water flossing solution so it can both be used at home and while away from home for a vacation or business trip.

Fitting solutions for the Mini Flow would focus on: The combining a compact system with a large enough water reservoir; an appearance which shows premium value of the brand, but with a high regard for ergonomics. The Mini Flow should contribute to the user having a pleasant experience, by making the product accessible, clear and efficient to use. This all contained in a small and portable product which can be taken along in the suitcase of toiletry bag. This will make the product surpass its competitors and gain a foothold on a small and very specific market.

The Mini Flow presented in this report is the result of a generation and verification process, and captured the sense and heading described above. The validation however remains. This product needs to be tested by its potential user, and experts so it can better match the wants and wishes.

SAMEN VATTING

摘要

Zhāi Yào

Dit design rapport is onderdeel van de Bachelor Opdracht [280310] en behandelt het ontwerpproces van de Mini Flow, een portable water flosser. De opdracht is uitgevoerd bij MADE Innovation, een ontwerp bureau in Beijing, China in opdracht van Endo Exo een Chinese producent wat producten ontwikkeld voor health care en automatisering. Endo Exo wil haar Flow water flosser productlijn uitbreiden door het introduceren van de Mini Flow. Endo Exo streeft naar het verbeteren van de algemene gezondheid van Chinese consument. Daarbij behoren ook een goede mondgezondheid en gewoonten. Hiertoe behoort ook flossen en water flossen wat de meest effectieve en gemakkelijkste manier. In combinatie met tandenpoetsen kan water flossen tandvleesaandoeningen, tandbederf en slechte adem voorkomen.

Analyse van de markt toont dat de Mini Flow als een portable water flosser allereerst de consument moet overtuigen van haar voordelen en nut. Dit kan worden gerealiseerd door een product aan te bieden wat een overtuigende functionaliteit levert met een hoge bruikbaarheid gekoppeld aan een betaalbare prijs. De Mini Flow zal tevens de gebruiker een compacte oplossing moeten bieden, zodat het product zowel thuis als op vakantie of zakenreis gebruikt kan worden.

Passende oplossingen voor de Mini Flow zullen zich richten op: Het combineren van compact systeem met een groot genoeg waterreservoir en een ontwerp dat de hoogwaardige kwaliteit van het merk uitstraald, maar ergonomisch niet onderdoet. De Mini Flow moet water flossen toegankelijk maken voor de gebruiker door middel van een duidelijke, efficiënte en frisse ervaring. Dit alles verpakt in een klein en draagbaar product. Wat kan worden meegenomen in de koffer van de toilettas. Dit zal de Mini Flow haar concurrenten doen overschenden en een voet aan de grond weten te krijgen op een kleine en zeer specifieke markt.

Het ontwerp voor de Mini Flow dit rapport wordt gepresenteerd is tot stand gekomen door een constant generatie en verificatie proces en sluit aan bij de hierboven besproken mindset. Wat echter ontbreekt is de validatie. Het product moet nog worden getest door de potentiële gebruiker(s) en deskundigen. Dit om het uiteindelijke product beter te laten overeenkomen met de verwachtingen van de consument.

作为学士毕业论文[280310]的设计报告，记录了美德创新（北京）科技有限公司为Mini Flow便携式水牙线进行的研究，开发和验证。客户端是Endo Exo（安图艾森），一个专门发展健康护理和自动化产品的中国品牌。Endo Exo为寻求扩大其第一代水牙线Flow的产品线，并推出Mini Flow便携式水牙线。为了改善中国消费者的口腔健康和生活习惯，通过引入使用水牙线是最有效和最简单的方法，将使用水牙线与刷牙结合清洁牙齿，可以预防牙周病，龋齿和口臭。

市场的分析表明，Mini Flow，作为一种便携式水牙线，首先说服水牙线的好处及消费者的需求。要做到这一点，就需要可以提供一种产品，具有良好的性能并能提供良好的可用性，以及消费者能够负担的价格。此外，Mini Flow将为用户提供可以同时在家，外出度假或商务旅行等多种场合适用的便携式水牙线。

Mini Flow的侧重点在于：高度集成的系统；容量适宜的蓄水池；彰显品牌价值的高品质设计，同时符合人机工学的外观。Mini Flow应有助于提供用户一个令人愉快的使用体验，使该产品直观有效地使用。这一小而便携的产品，能轻松收纳于梳妆袋和手提箱中。这将使产品超过它的竞争对手在一个小而特别的市场上占据一席之地。

在本报告中记录的是Mini Flow的生成和验证的过程，简要概括上文所述内容。但是仍待验证，产品需要由其潜在的用户和专家测试，以使它可以更好地达到的用户希望的品质。

INTRODUCTION

"We use a design process that emphasizes

usability, manufacturability and marketability.

We share a global perspective and multifaceted approach to product development.

We offer a design partnership; working together to make great products."

MADE INNOVATION

This chapter provides the outline of the bachelor assignment and its deliverables. Also included is background information regarding China's health, flossing and the main stakeholders; MADE Innovation and Endo Exo. In addition, the plan of approach for this project and structure of this design report are presented.

1.1 DESIGN BRIEF

1.1.1 PROJECT SCOPE *China's health care system* Over the last 20 years China has undertaken huge reforms of its health-care system. (Ling, Liu, Lu and Wang, 2010). The Chinese government still faces a giant task in trying to provide medical and welfare services suitable to meet the basic needs of the immense number of citizens spread over a vast area. Although the overall affluence has grown dramatically since the mid-1980s a great many of its people still live at levels far below the national average. China's health facilities remain unevenly distributed, largely being located in the urban areas. In the rural areas, where approximately one-half of the population resides medical and health personal are scarcer and access to higher tier care is severely limited. The biggest limitation on the availability of health services appears to be an absolute lack of resources. Three key policies have by the government namely, to establish rural health insurance; to develop community health centres; and to aspire to universal basic health care coverage by 2020 (Lui, 2009) & (Xinhua News Agency, 2009). Since China's health care system is still being reformed and developed many companies see potential in developing products which will fit in this system.

China's oral health Since the health care system only was barely functional for a long time and only catered to a few people many Chinese people have a poor state of their oral cavity (Lin and Schwarz, 2001). This can be accounted

"High tech, Quality, Ergonomic, Friendly,

Logical and Sustainable,

with a high regard for 'Form follows function'."

ENDO EXO

to three reasons:

- _ A shortage of professional dentists, especially in the rural areas.
- _ The expenses that come with maintaining oral health over a long period of time.
- _ The lack of proper oral health care instructions combined with wrong oral health habits.

In rural areas people with teeth problems often use old family recipes, which include just pulling the rotten teeth. The expenses associated with keeping a good oral health is for many Chinese people in urban areas an issue. In these areas people who do have some money do not visit a dentist to improve the quality of their oral cavity, but instead have their teeth prematurely removed. By opting to remove healthy teeth and replacing them sometimes with fake ones, the expenses in maintaining the teeth are not high. Also, the complications which could occur in the future with the biological teeth are prevented. Poor oral health is also a large problem with young children, because of the lack of proper oral health habits, and a lot of effort is done the government to create public awareness, train dentists, and adopt medical measures to prevent dental diseases among children (Lin, 2010).

Benefits of flossing Why would people need to floss their teeth? Why is it not enough to brush the teeth? Flossing should be part of good oral hygiene habits. With flossing space between the teeth can be reached, and bacteria can be removed which cannot be reached with the toothbrush. Flossing in combination with tooth brushing can prevent gum disease, dental caries and bad breath (American Dental Association, 2006) & (New York Life Insurance Company, 2006). Flossing has also been linked to greater longevity (Paganini-Hill, White & Atchison, 2011), potentially as a result of the preventions of gum inflammation.

Flossing with water or water flossing has mainly been a way to clean the teeth conducted by professional dentists. However, several water flossing products released by different brands that are for home usage. Water flossing is

significantly quicker than wire flossing. Wire flossing is a tedious process and this is usually what prevents many people from flossing consistently. Water flossing offers an easier alternative.

By introducing water flosser that is affordable and delivers a constant quality and performance people can be persuaded to start flossing on a daily basis therefore improving not only their oral health, but also their general health. Also, especially regarding Chinese children and adolescents the water flosser will educate them on good oral health habits.

What is a portable water flosser? A water flosser is a home care product which uses a stream of water to remove plaque and food debris between teeth and below the gum line. A portable water flosser (see Figure 1.1) has the same water flossing functionality as a stationary water flosser, but consists out of a single unit which contains its own power supply and water reservoir and is smaller in size. This makes the water flosser more portable so it can be taken along on journey similar to an electric toothbrush or shaver.



Figure 1.1 Water flossers currently for sale on the market, these include the Panasonic EW-DJ40, Waterpik Cordless Plus and Traveler™.



Figure 1.2 The GolfSense (www.golfsense.me). One of the products in MADE Innovations product portfolio.

1.1.2 STAKEHOLDERS During this bachelor assignment there are two main stakeholders which have a direct stake in this product and which will contribute in making decisions during this assignment as well as provide expert knowledge. MADE Innovation and Endo Exo are these stakeholders. Below short descriptions are given of both companies and their role during this assignment (For other stakeholders also see **Appendix II PLAN OF APPROACH** pp. 1-2).

MADE Innovation This is a firm located in Beijing, China and specialises in design for the Chinese health care industry, acting as a design firm; conducting design activities for clients. The firm also provides additional design consultancy services in the fields of engineering, graphic design, brand identity, UI design, design transfer and production support. During these projects MADE Innovation uses a combination of design and mechanical innovations supported by other industrial design methods to provide brilliant captivating innovative design in line with world leading brands as Siemens, General Electric (GE) and Philips. Several products which make up MADE Innovation's product portfolio are presented in *Figure 1.2*. On their website MADE Innovation's states the following mindset:

"We use a design process that emphasizes usability, manufacturability and marketability. We share a global perspective and multifaceted approach to product development. We offer a design partnership; working together to make great products." (MADE Innovation, 2012)

The main objectives of MADE Innovation are to drive the digital technology application in country or town hospital; improving the health care of the rural population of China; and developing products which provide primary care to patients.

MADE Innovation is to perform the development of a portable dental flosser, for here on called, Mini Flow, for Endo Exo's Flow product line. This includes

conducting different design tasks like: market and competitor analysis, ideation, prototyping and verification in order to generate a product design which meets consumer demands and wishes, as well as relay the demands and values of Endo Exo.

Endo Exo This is an up-and-coming sister company of MADE Innovation developing, producing and selling health care products, laboratory equipment and personal health products among other products related to automation. Endo Exo focussed on improving the capabilities, quality and efficiency of the Chinese health care system as well as the way in which people can improve their health by themselves. This, by offering premium products with good value meaning: Affordable with a high reliability.

Endo Exo is looking to expand their Flow, water flosser product line. This currently exists out of stationary water flosser, which is shown in *Figure 1.3*. But now is innovating dental flossing by introducing the Mini Flow. Based on initial market research conducted by Endo Exo as well as that of MADE Innovation there is possibility to gain market share. Also, many competing portable water flossers have are of inconsistent quality and have several usability related issues. Endo Exo believes that a water flosser with a strong focus on usability, portability and consistent performance of quality can lead to a large market share. The introduction of an affordable with high quality product could also help to improve the Chinese oral health as Chinese dentists are likely to recommend a good dental product to their patients. Since Endo Exo is a young company its identity is still fluid. This product will therefore also help in shaping the identity of Endo Exo as a brand.

During this bachelor assignment Endo Exo will primarily provide expert knowledge on water flossing, water flosser and potential users. They will provide a budget and be part of the decision-making process during development. Finally, they will provide input to several of the functional requirements for the Mini flow. During the remainder of the project Endo Exo will contact suppliers and fabricators for the production of the product, while a team within MADE Innovation will be preparing the product for production.



Figure 1.3 The Flow stationary water flosser of Endo Exo (www.endoexogroup.com).

1.1.3 DELIVERABLES The main objective of the bachelor assignment is to deliver the design of Mini Flow (Also see **Appendix II: Plan of Approach** p. 3). However, within the scope of this bachelor assignment there are several other key deliverables namely:

- A design heading with complementary list of functional requirements. Based on design tasks: like market research, expert and user interviews and benchmarking this list will be generated and discussed with the stakeholders.
- A large array of solutions and ideas for the Mini Flow. Besides using these ideas for this Mini Flow, Endo Exo is also interested in extreme ideas to indicate opportunities for possible future Flow products.
- The design of the Mini Flow. Focussed mainly on the appearance, portability and usability of the product as well as an indication of system architecture.
- Also, this product would also have to contribute to and help define Endo Exo's design identity.
- A CAD model of the design which will serve as both a method of verification, validation and a reference for the mechanical engineers to develop the system of the Mini Flow.
- Several shape and semi-working prototypes of the design. This prototype is tested and verified. Based on the results the design will be further detailed and prepared for production
- A design report of the development process conducted during this bachelor assignment.

1.2 DESIGN APPROACH

This bachelor assignment can be divided into three separate phases and one phase that runs parallel to those. The **ANALYSIS**, **DESIGN** and **DETAILING** phases all focus on the development of the Mini Flow, while the **DOCUMENTATION** phase emphasizes the documentation of the progress of design process and the creation of this design report. The total time span of this assignment will take three months. Below short descriptions are given of the design tasks which are conducted during the respective phases, as well as being shown in *Table 1.1* or **Appendix III TIME SCHEDULE**.

Research During this phase initial research will be done in the market as well as the product. The main tasks will be conducted:

- Analysis of the flossing products currently on the market. Expert reviews and small usability test of competing products.
- Investigate competing portable water flossers utilizing user reviews and conducting product analysis. The goals are to find the issues the current products have. Which aspects of water flosser contribute to a good usability?
- What people are being targeted by the brands as 'would be users'? And what are unique selling points?
- Exploration of portability. Since 'portability' is a key feature of a portable water flosser.
- The design identity Endo Exo is researched: To create a distinctive design or experience by which the Flow products of Endo Exo can be recognized; and create a cohesive design style or experience within the brand.
- Benchmarking of competing portable water flossers and establish the design heading for Endo Exo's products.

At the end of this Analysis phase in concept proposition, this consists out of a design heading and functional requirements. This is presented to, and discussed with stakeholders within MADE Innovation and Endo Exo.

Design The concept proposition serves as input for this phase. During this phase solutions will be generated and concepts for the Mini Flow will be proposed and reviewed. The tasks that will be conducted are:

- Generation of ideations focusing on finding solutions for various aspects and functionality of the Mini Flow.
- Validating the solutions through sketches, shape modelling and small scale, qualitative usability tests.
- Capturing of different solutions in a number of concepts.

Together with the stakeholders and experts a concept review is held. During this concept review the proposed concepts will be discussed and compared

with the functional requirements. The concept which best meets these requirements and the client's wishes will be further detailed and validated.

Detailing During the Detailing phase the selected concept will be further verified and detailed.

- The sketches and shape models of the Mini Flow concept are translated to a CAD model.
- The design style and the product tonality will be further defined. Decisions regarding material usage, surface finish, colour usage, branding, tactile feedback and indicators (like pictograms and lights) are made.
- The design for the Mini Flow is integrated with the system architecture.
More research is done into the production and assembly of the concept which is to be included into the CAD model.
- The CAD model is prototyped with inclusion of some functionality.

At this stage the final deliverables for this bachelor assignment will have been delivered. The design process will be evaluated and recommendations regarding the next step(s) towards production preparation, project documentation and packaging are given.

1.3 STRUCTURE OF DESIGN REPORT

This design report's structure is similar to that of the design process it reports on. After the **INTRODUCTION** in chapter 1 the three main phases as previously appointed; **ANALYSIS**, **DESIGN** and **DETAILING** are treated in respectively chapters 2, 3 and 4. Enclosing is chapter 5 **CONCLUSION**. Here the final result(s) will be evaluated and conclusions and recommendations are given. Each of these chapters starts with a section(s) which give an introduction and the process of design tasks that were conducted in order to come to the results. These results are then discussed in the subsequent sections.

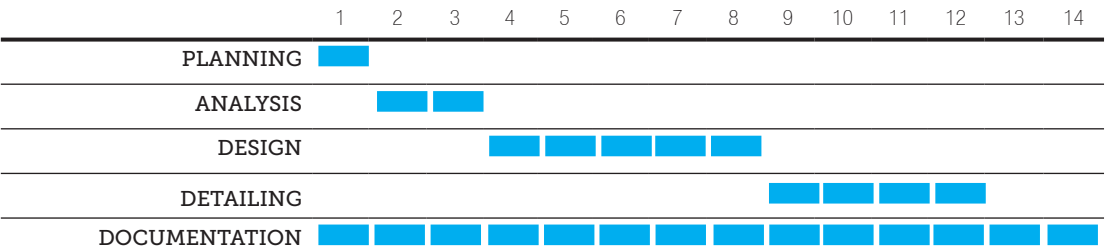


Table 1.1 Time schedule for this bachelor assignment. An extended time schedule including the design tasks is shown in **Appendix III TIME SCHEDULE**.

ANALYSIS

"The consumer isn't a moron; she's your wife." DAVID OGILVY

This chapter discusses the initial research into the market, competition, product and target user in order to determine the design heading and functional requirements for the Mini Flow.

In order to determine what the design heading and functional requirements are for Endo Exo's Mini Flow an analysis approach was formulated to focus generating insight; utilizing three starting points namely: The market (as described as the competition), the user(perceived and actual user), and the brand (in this case Endo Exo and Flow), as is shown in *Figure 2.1*.

The analysis of the competitors on the market was done in on varying levels of depth First; all flossing products were established, followed by narrowing the competitors down to just portable water flossers since these were Endo Exo's direct competitors. Based on this initial analysis of the competition several portable water flossers were acquired and reviewed through two different methods which reinforced each other. This step also involved user and expert reviews.

User reviews which were gained from points of sale, like web shops. The expert reviews were used to verify the problems users had with the portable water flosser(s), as well as investigate possible other usage-related problems. Senior designers provided expert reviews of several products by using them in a home environment for a week. They also provided insights regarding the production and assembly techniques that were used for these products. These insights could serve as a reference for the Mini Flow since Endo Exo expressed a desire to stay close to the main working principle for the water flosser.

The knowledge generated by these reviews gave some insight into the experience that potential users expected and wished for. However, a portable water flosser caters to a very specific user and Endo Exo's intentions are to serve a larger group of users with their product. In order to better understand these different users; they were grouped and shortly analysed, in order to what their demands and wishes were. This helped into further defining the design heading and functional requirements.

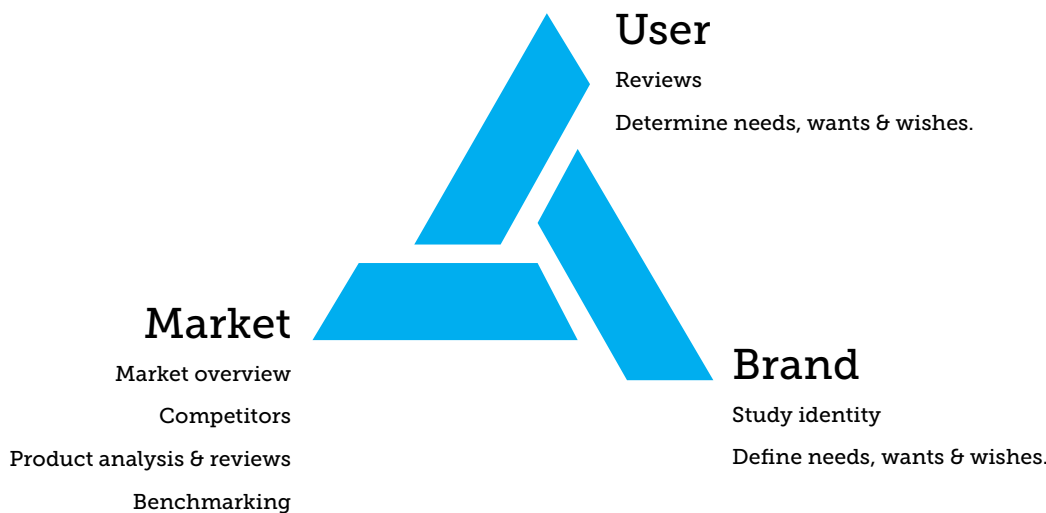


Figure 2.1 The three fields for the analysis approach focussed on gathering knowledge and help determine the design heading and functional requirements for the product.

 = **Design heading & Functional requirements**

Based on this analysis a number of aspects were assigned which are important for a portable water flosser. As the name 'portable water flosser' suggests portability is one of these key aspects. Therefore, some shallow research was done in what was considered portability for a product.

However, to further define the design requirements and determine Endo Exo's position among its competitors a benchmark was conducted. The benchmarking of the competing portable water flossers generated insight into the current performance of these products on several of the key aspects. Besides showing which product was the theoretical best and what was average among all these water flossers. It helped into giving the stakeholders an impression on where its competitors were positioned and where opportunities are present for Endo Exo's product. The benchmark served as a tool to further define and qualify the functional requirements of the product, and give a direction towards how the product was to be distinguished from the rest. These design heading and functional requirements form the design proposition for the Mini Flow.

2.1 MARKET ANALYSIS

Portable water flossers are part of an over arching market, namely that of flossing products. Flossing product in turn can be considered to be small part of two large markets which correlate, namely dental products: Products which help maintain and improve a person's oral cavity, and personal health products: Products which support and improve a person's general health.

The market for flossing products consists out of a wide array of different products, and portable water flossers compete with these products. The

most one important competitor to flossing in general is the tooth brushing.

The main reasons for this are marketing and still-improving effectiveness in functionality of electric toothbrushes. Many brands suggest that their electric toothbrushes offer performance matching that of flossing, therefore making flossing products redundant. However, this is not as the case as stated in *American Dental Association, 2006* and *New York Life Insurance Company, 2006*, and it both flossing and tooth brushing should be done jointly.

As noted earlier in 1.1.1 PROJECT SCOPE (pp.10-11) the consumer does not necessarily see the need to floss. The statistics of the *American Dental Association, 2010* show that only 50,5% of the Americans floss daily, while the remaining, 49,5% floss irregularly or not at all. Although, it not validated for the Chinese market, Chinese consumers can be considered to be lacking in this regard as well. Since, there is a general lack of oral health awareness among a large group of the Chinese consumers.

Figure 2.2 shows the variety of flossing products. There are different methods of flossing and this is how the products differ from each other. The main principles of flossing are utilization of floss wire/string, mechanical vibrations (sonic flossing) or liquids like; mouth rinse or water. All offer either a manual or a powered product. These methods vary in effectiveness (cleaning precision), comfort and price point. However, relations exist. Flossing product like toothpick and flossing wire are cheap, but less effective and generally uncomfortable. High mechanical vibrations provided by flossing products like electric toothbrushes of sonic picks are offer higher cleaning effectiveness and precision, but are more expensive and offer limited comfort, especially the sonic picks which. A water flosser as noted earlier generates a steam of water to remove plaque and food debris between teeth and below the gum

▼ Cleaning effectiveness, ▼ Comfort, ▼ Price.



line. Currently it offers the most effective way and easy way of flossing and the most comfort, but these products are amongst the expensive flossing products, having a similar price point as the electric toothbrushes.

It was concluded that for the market, a flossing product like a water flosser would mean:

The consumer needs to be convinced of the benefits of flossing products more than is needed with the toothbrush. A water flosser must offer the effective method of water flossing, while also focusing of usability and price, in order to provide the consumer an easy accessible product.

2.1.1 WATER FLOSSING Portable water flossers are considered part of the powered, water flossing products. Its shares this group together with stationary water flossers (Also see *Figure 2.2*). The difference is that both products; portable water flosser and stationary water flosser serve another user context.

The main difference in user-context is: A stationary water flosser has as purpose to be used by a family, multiple people using the product. Therefore this water flosser is product that is stationary, able to be placed in the bathroom so it can always be accessed. A portable water flosser is an additional flosser. It only serves one person, which is travelling, but still wants to floss. The portable water flosser offers this person a smaller version, saving the user space. It allows the family members which stay home to continue using the stationary water flosser.

The few key differences in the appearance and between these product types are the following:

- A stationary water flosser needs to be connected to a power socket in order to function. The portable water flosser has an internal battery which can provide power for certain duration without connecting it. However, these flossers have a time of usage and recharging is required.
- With the stationary water flosser the flosser is connected through a coiled water cable to the water reservoir. This requires the pump to be bigger. In the portable water flosser a smaller pump and the water reservoir are inside its own structure.
- A stationary water flosser has a set location in the bathroom and serves a whole family. Typically, the water reservoir can house enough water, around 600mL for one flossing. This is not the case for the portable water flosser. Its water capacity ranges from 150 to 200 mL, therefore refilling is required during each flossing. This is a compromise for keeping the portable water flosser small.

The portable water flossers are very specific product, which provides to only a small number of people and contexts, focusing of other functionality in comparison to the stationary water flosser. Because of the specific context in which the product is used there only a little more than nine products on the market which are advertised as portable water flossers. These are shown in *Figure 2.3*. There are even less brands producing them, with exception of two brands; Panasonic and Waterpik. These brands in general have produced one or two water flossing products, one of which is a portable water flosser. The market for stationary water flossers counts more products and brands, since these products serve a larger market. Many of these brands do not

▲ Cleaning effectiveness, ▲ Comfort, ▲ Price.



operate on the portable water flosser market. The characteristics of these competing brands will be further discussed in the following sections.

Figure 2.2 (Above) A wide array of flossing products offering different methods to the consumer. These product become increasingly more effective and comfortable, but increase in purchase price. The flossing products (from left to right) include: Toothpick; flossing wire; flossing wire in a frame; toothbrush, mouth rinse (and toothpaste); electric toothbrush (Philips Sonicare), sonic pick (Princess & Philippe Starck); portable water flosser (Waterpik) and stationary water flosser (Waterpik).

Figure 2.3 (Below) Portable water flossers currently being sold of the market including (from left to right): Conair Interplak, Panasonic Dentacare EW1211, Panasonic EW176, Oraldent Oraljet, Panasonic Dentacare EW-DJ40, Waterpik Cordless Plus, Candeon and Waterpik Cordless.



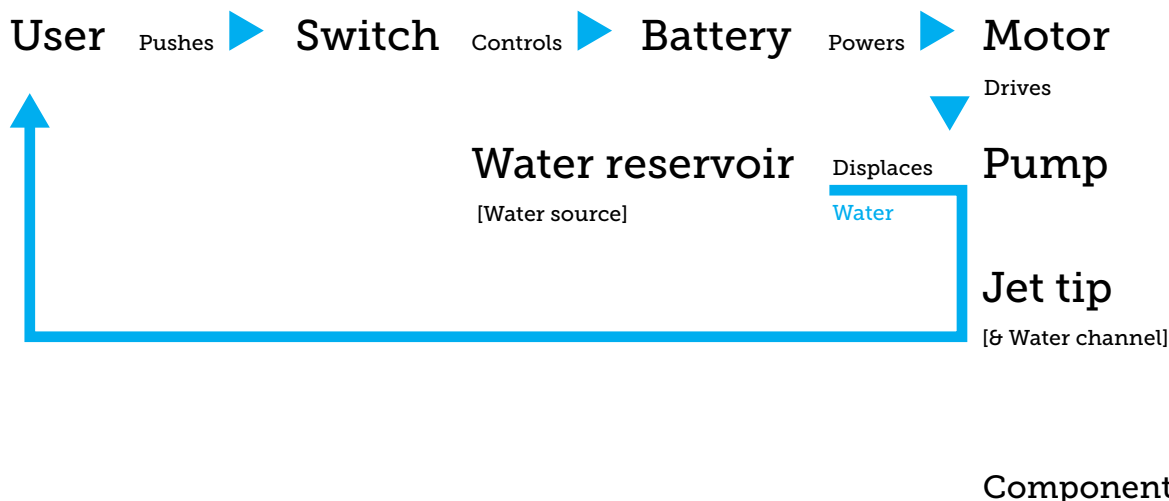


Figure 2.4 Schematic view of the system architecture commonly used in water flossers.

System architecture Figure 2.4 illustrates the various components of the system architecture of a portable water flosser, and how these components interact. The main components which allow for the main function of the product, namely produce a stream of water are: battery, motor, water reservoir, pump and jet tip. Other components of this system architecture are small electronics like PCBs and switches for buttons. These components are all covered by various casing/shell parts.

2.2 COMPETITOR ANALYSIS

As noted in a previous section the market of the portable water flosser counts only a few brands. Many of these brands are small in the sense that they have no longstanding product portfolio and no widely known identity. There are three brands which do possess these two traits and for several reasons are the main competitor's of Endo Exo's Mini Flow. Panasonic, Waterpik and Oral-B are all brands which have operated within the water flossing market (Also see Figure 2.5).

- Panasonic: One of the largest Japanese electronics producers and a big company operating on a global scale. In terms of product variety Panasonic has focused on the optimization of one product type, of which the EW-DJ40 (as also shown in Figure 2.5) is a newest model. In general, Panasonic has a stronger focus on achieving portability in relation to the other brands, and have achieved a better solution. Other key aspects which are seen throughout the product history are improving the aesthetics and performance of the water flosser, as well as lowering the costs associated with the production and assembly.
- Waterpik: An American company which has focused on producing powered sonic and water flossing products. Waterpik has been developing personal and oral healthcare products since 1962. It is a well-known brand on the American and Asian water flossing market. Waterpik has brought to market several sonic toothbrushes and stationary water flossers, but has also

developed portable water flossers. The latest product is The Cordless Plus Water Flosser the successor of their first portable water flosser the Cordless Water flosser.

- Oral-B: A brand of oral hygiene products, including toothbrushes, mouthwashes and dental floss and part of Procter & Gamble. Oral-B is only active on the stationary water flosser market, having developed the ProfessionalCare 7900 OxyJet Center which includes a sonic toothbrush and water flosser. However, Oral-B does not seem to focus this market anymore, but this product is sold on a lot of electronic stores in China.

A handful of brands including Candeon, CosmicSmile and Conair have produced one portable water flosser and are following the market. Of these brands Conair has the most resources and experience in the field of water flosser and personal care products. Interpak, a brand of stationary water flossers is part of Conair that stationary water flosser seems to have Conair's main attention.

Aside from the market movers and market followers another group can be defined. In this case called up-and-comers these brands are characterized by high profile brands which have done some exploration into water flossing and now produce associative technology. If these brands were to start focusing on developing water flossing products they will have a strong influence on this market.

Oral-B has already been mentioned as a strong presence on the flossing market, but Braun is a brand which potentially could work together with Oral-B. Braun is also part of Procter & Gamble. Braun is operating in several product categories like shaving, health and wellness and beauty care. These product categories correlate with a water flosser on several points. Previously, Braun also developed oral care products, but since it and Oral-B are both subsidiaries of Procter & Gamble this was passed over to Oral-B. However, the opportunity exists that Braun will start oral care product anew catering to their target user. Some of Oral-B's and Braun's products are mentioned



in 2.2.4 ASSOCIATIVE TECHNOLOGIES (pp. 24-25) as possible reference for the Mini Flow.

Aside from Oral-B and Braun, Philips's Sonicare brand has released a flosser like product, namely the AirFloss. The product offers a similar experience to water flossing, but uses a different flossing principle. This product will also be discussed more in depth in 2.2.4 ASSOCIATIVE TECHNOLOGIES (pp. 24-25).

In the following paragraphs three different portable water flossers are discussed. Insight was gained into the product structure and key aspects which attribute to the product's functionality and performance. The study of these products has also shown the strengths and weaknesses of the products; what features the products push; and the possible market opportunities for a new product. This information helped to define the design heading of Endo Exo's Mini Flow product. The products that were selected for study were the last launched products: Waterpik Cordless Plus Water Flosser (released in 2008); Panasonic Dentacare Portable Oral Irrigator [EW-DJ40] (released in 2010); and Candeon rechargeable Oral Irrigator [CD300].

Figure 2.5 Panasonic EW-DJ40, Waterpik Cordless Plus and Oral-B ProfessionalCare 7900 OxyJet Center

Figure 2.6 (Below) The Mini Flow will have to compete for space in the toiletry bag with other products.





Figure 2.7 (Left) Waterpik Cordless Plus.

Figure 2.8(Below) System of the Waterpik Cordless Plus.

Figure 2.9 (Right) Assembly of the Waterpik Cordless Plus. The main frame on which the components are mounted is encased by two shell parts. On one of these shell parts the water reservoir is click-connected.

2.2.1 WATERPIK This product (Figure 2.7) is the successor of their first portable water flosser the Cordless Water flosser. The product is not marketed as a portable water flosser, presumably because of its size which is bigger than its competitors (Also see Figure 2.3). Their focus is as noted in section 2.1.1 WATER FLOSSING (pp. 18-20) to provide a additional product aside from their stationary water flossers, but solve two usability related issues.

- A stationary water flosser needs to be connected to the electricity network in order to function. The cordless water flosser has an internal battery which can provide power for certain duration without the need to connect is to power socket.
- With the stationary water flosser the flosser unit is connected through a coiled water cable to the water reservoir. This water cable limits the user movement while flossing. This is solved by the cordless water flosser since it houses the pump and the water reservoir inside its own structure, therefore cancelling the movement restrictions presented by the water cable.

Although these Waterpik products are not called portable water flosser, their functionality does suggest them to be able to be taken along and used on journeys and owners of the product have done so.

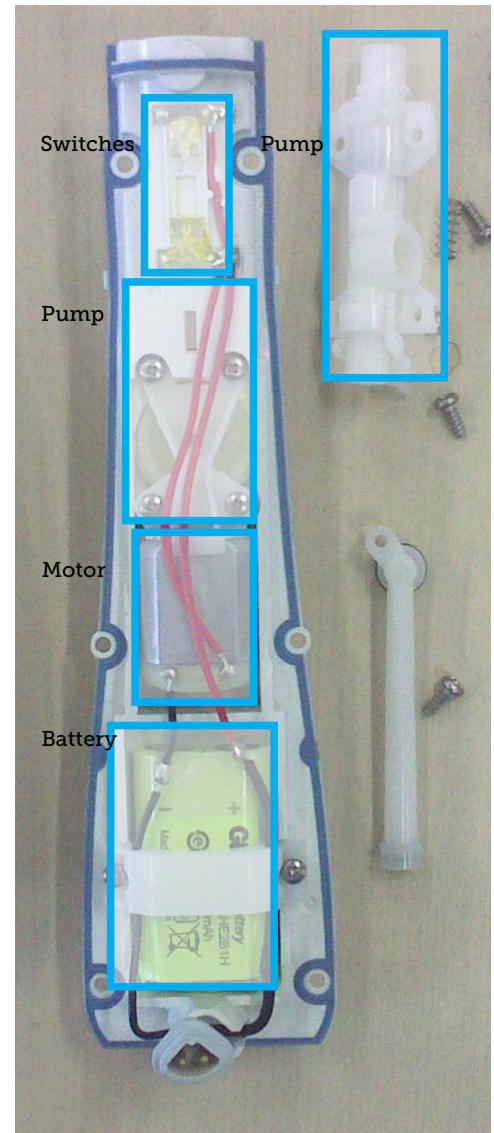
There seems to be a huge gap between users who enjoy the product and those who do not. Based on these user reviews this seems to attributable to the users either being first-time users or more experienced users; having used a Waterpik product or other brand of water flosser in the past.

The first time users often raise positive points about the product and believe the product to effective floss their teeth. The experienced users come up with many of the same the positive points raised by first time users, but review those in a negative perspective. The following aspects of the product are either considered a positive or negative:

- Size of the water reservoir
- Battery life and recharging time.
- Working effect
- Portability of the product

An addition drawback that is mentioned by the experienced users is:

- The noise that the water flosser produces is annoying





Many of the experienced users make the comparison between the two Waterpik products; the Cordless Plus Water Flosser and the Cordless Water Flosser (an predecessor of the 'Plus'). Also, they comment that the 'Plus' has better functionality than its predecessor. However, there is debate between the experienced users if the 'Plus' offers a performance of sufficient quality. Based on these user reviews it can be concluded that Waterpik Plus does not meet the expectations of all it's users.

Figure 2.8 shows the internal system of the Waterpik Cordless Plus. The main components (pump, motor, battery and some electronics which are connected to the on/off switch and the pressure setting switch) are all fitted in a straight line of each other onto a frame by screw connections. This frame (200.0 x 50.0 x 30.0mm) is clamped between two casing parts and also fastened by screws. Figure 2.9 illustrates the method in which the frame, water reservoir and casing parts are assembled. The Waterpik is operated by three buttons; on/off switch, pressure switch (shown in Figure 2.5 and Figure 2.7) and jet tip release button which is located on the back of the product.

2.2.2 PANASONIC The Panasonic Dentacare Portable Oral Irrigator comes from the personal & health care branch of Panasonic. Panasonic has focused on the optimization of one product type, of which the EW-DJ40 is a newest model (Figure 2.10). Key points which is seen throughout the product history is improving the aesthetics an performance of the water flosser, as well as lowering the costs associated with the production and assembly. The main positive points being listed by users are the following:

- The water pressure is high enough to clear debris from the teeth. Users feel fresh after using the product.
- The product can be used in the shower without creating any hazardous situations.
- The product can be collapsed to a more compact product, around 150.0mm in height.
- The reservoir which is sufficient for one usage.

The drawbacks which are listed by users who give the product a lower or bad score are:

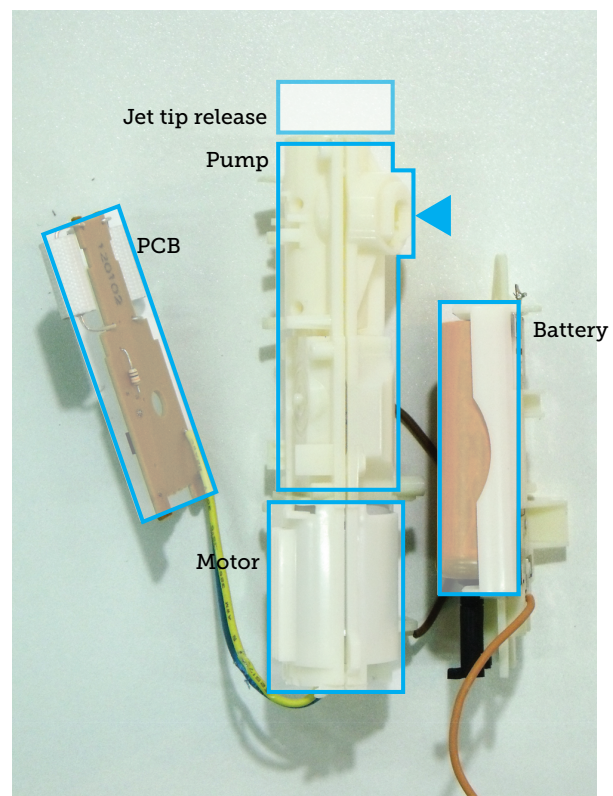
- The closure of the water reservoir cannot be secured tightly. This causes leaks, which is a problem for people who travel with the water flosser.



Figure 2.10 Panasonic Dentacare EW-DJ40



Figure 2.11 System of the Panasonic Dentacare EW-DJ40.



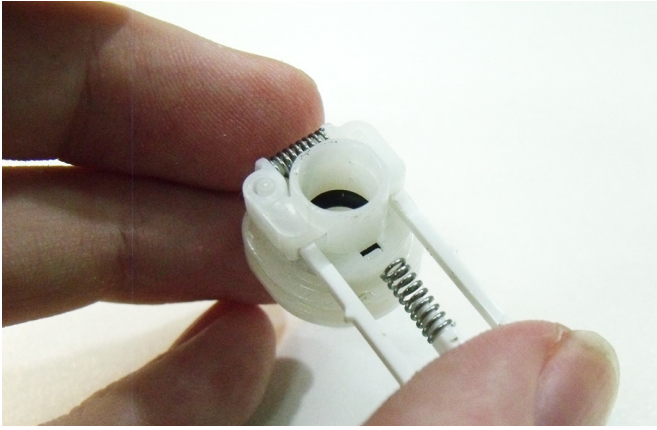
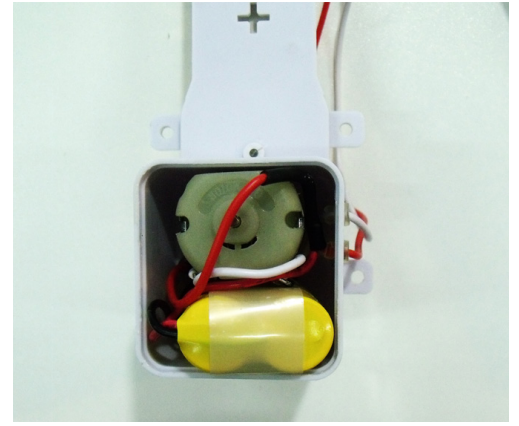


Figure 2.12 (Above) The jet tip release mechanism that is utilized in the Panasonic water flosser. When the button is pressed two clamps are pushed aside so that the jet tip can be removed. When the button is released the spring at the back pushed the clamps back in place.



- The inside of water reservoir is difficult to clean, because of the sharp edge. In some case this has resulted in the formation of mold.
- The quality of the water flosser is inconsistent. Many break down within 12 months, but there are cases in which the product breaks down within a few weeks.
- The quality of the pressure seems to drop over time, therefore influencing the working effect of the water flosser.



Figure 2.13 Candeon CD-300 portable water flosser

The system of the Panasonic is very small and compact. The shell containing the system is 70.0 by 35.0mm and elliptical shaped by a height of 120.0mm. The system is defined into two separate pieces; a bracket/casing which houses the motor and pump; and a bracket for the battery (Also see Figure 2.11). Since the water reservoir is able to collapse around this shell containing the system, the water channel which allows for water to be sucked out the reservoir is flexible. Around this flexible channel a spring is places so that the channel is always straightened and therefore can reach the bottom of the water reservoir. The water channel on the inside however is molded in the shell structure. The Panasonic water flosser has two buttons: One to release the tip jet; and one which is an on/off switch and at the same time controls pressure setting (Figure 2.10). Finally, the product has a compartment which can be utilized to store the jet tip, so the user cannot lose the jet tip while travelling.



Figure 2.14 Close up of the structure for jet tip release button.

2.2.3 CANDEON This product (Figure 2.13) was only studied to gain insight in the quality, assembly and product techniques utilized, and assess the level of a Chinese designed and produced water flosser.

This product seems to lend a lot of features of the Waterpik Cordless water flossers. It is unclear what the intentions are of this product aside from offering a cheaper portable water flosser specifically to the Chinese market. Similar to the Panasonic and Waterpik water flossers the Candeon's internal system architecture consists out of a support frame on which the pump, motor and battery are mounted. This internal system architecture is less complex than those of Panasonic and Waterpik in terms of the amount of components, shape complexity and electronics. It occupies a space of 210.0 x 50.0 x 4.0mm. The Candeon [CD300] has two buttons. The jet tip release button which clamps and holds the jet tip in place and, when pushed,

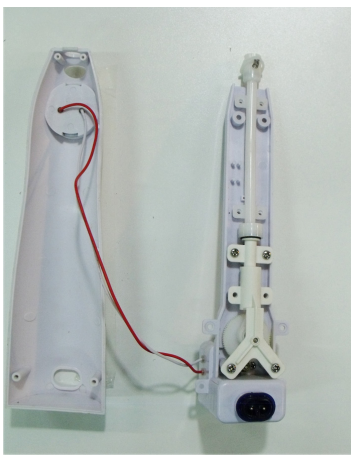


Figure 2.15 (Left) The motor and battery are located inside a separate compartment which is part of the frame.

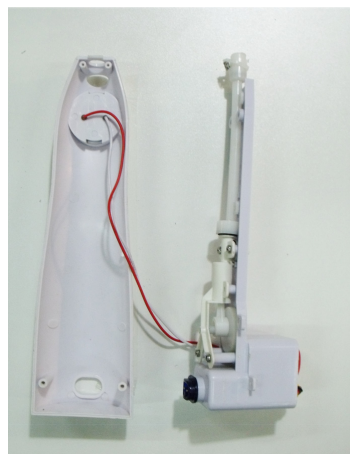


Figure 2.16 (Above) Assembly of the Candeon utilizes hook and screw connections.



releases the jet tip (see Figure 2.14). The On/Off switch is directly connected to the battery and aside from the electric wiring, there are no PCBs present. Figure 2.15 and Figure 2.16 shows the assembly of the exterior casing and water reservoir, which are fixed to each other by usage of screws and hook connections.

2.2.2 ASSOCIATIVE TECHNOLOGIES

Brands like Oral-B, Braun and Philips are some examples of large, global operating brands with a lot of expert knowledge and resources. These named brands have done some examination into the market by releasing water flossing products, but all produce associative products to the water flosser. The products correlate on several areas with a portable water flosser and offer solution for design features which can prove interesting for further investigation.

Shavers, electric toothbrushes and water flosser are all design to be used in the same environment; the bathroom. Design features which are interesting to look at are charging, storage, ergonomics, appearance and size.

- Charging: Most shavers and electric toothbrushes have charging dock by which the products can be charged when not utilized. The main methods of charging are simple charging or induction recharging. The dock provides a stable platform on which the product can always be placed, but also automatically creates a small, open storage for the product. Some of these docks have additional features. Docks of shavers for instance, have capabilities to clean the shaver, while the docks of electric toothbrushes can be expanded with Ultraviolet light cleaners.
- Storage: Many products, especially shavers offer travel cases or bags in which the product can be transported. These are separate from the charging docks.
- Ergonomics: All products are operated by one hand, therefore the buttons are placed on the product so they can be reached and operated by that one hand. Different materials combinations are used to provide more comfort to the user while operating the product.
- Appearance: the appearance is often linked to the brand identity, but also to the gender. Shavers for male are often more straight and have darker colours, like black, grey and dark blue, while female shavers are light and more rounded in shape. Those shavers often have a combination of white, pink, violet and light blue colour tones. Electric toothbrushes for adult are

mostly white with blue coloured accents. A clear archetypical shape has been established within both these product types.

- Size: Another feature of the product is their small size, which contributes to their portability. As will also be shown in Section 2.3 TARGET USERS (pp.26-27), travelling people are among the target users. The portable water flosser will fight for a space inside the toiletry bag, especially the electric toothbrush.

Philips Sonicare AirFloss A device which offers a similar experience to flossing but utilizes bursts of air and water to clean the cavities between teeth is the AirFloss(er) (Figure 2.16).

Philips Sonicare has released one flosser-like product introducing another means of flossing, namely bursts of air and water. The AirFloss(er) has gotten mixed reviews regarding the performance of the new flossing method. However, the product has been designed with user experience in mind paying close attention on aesthetics and ergonomics. Since flossing method works with pulses opposed to the continuous water stream of the water flossers it does not require a large water reservoir. Only two tablespoons (circa 30 mL) of water is enough.

These aspects that the Airflosser offers serve as a good reference for the user experience (Appendix IV EXPERT-USER REVIEWS), ergonomics and aesthetic design for the Mini Flow of Endo Exo. However, its operating system is not within Endo Exo's desired scope, and would also need to be optimised, since it was uncomfortable for most of the users during usage. Also, as is stated in the product manual the AirFloss(er) can only be utilized to clean the front faces of the teeth and cavities, but not the back faces. This limits the cleaning capabilities of the Airflosser.



Figure 2.16 Philips Sonicare AirFloss



Figure 2.17 Several of the target users at which water flossers are aimed.

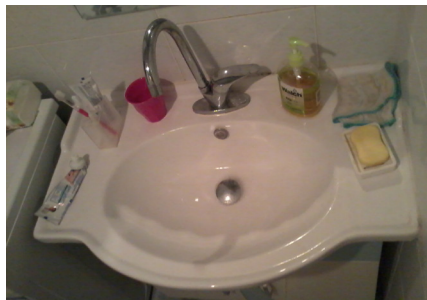


Figure 2.18 Several photographs of bathroom sinks of MADE Innovation employees.

2.3 TARGET USERS

The Mini Flow is targeted for the Chinese market. As stated in the paragraph 1.1.1 PROJECT SCOPE (pp. 10-11) many Chinese people have a bad oral health and many do not have the possibility to regularly see a dentist or well maintain their oral cavity.

Aside from the different needs, demands and wishes which will be discussed in the following sections the target users have physical characteristics and measurements which should be taken into account. Generally, Chinese people have a smaller physical build. In the case of the portable water flosser this means that hand measurements needed to be met, in order for allow for good hold (**Appendix V HAND MEASUREMENTS**). Also, the usage of symbols, pictograms and text must also be understandable for Chinese people who have limited or no understanding of the English language.

The target users, several of which are shown in *Figure 2.17* can be defined by different contexts of usage. In these contexts the user imposes different priorities on the product. These contexts are the following:

- _ In general portable water flossers are targeted to people who want to floss while travelling. These users would normally use a stationary water flosser in their home environment, but while travelling they choose for a more portable, smaller variant. These people floss to maintain a healthy oral cavity and this makes them feel healthy and to some degree live healthier (As noted in 1.1.1 PROJECT SCOPE pp.10-15). Also, flossing after having had a long travel gives them a fresh feeling.
- _ In China many people have a small bathroom as shown in *Figure 2.18*. They have almost no space for stationary water flossers. That is why they rather choose to buy a portable water flosser, since it is smaller in size and easier to store in a bathroom cupboard or sink drawer. In Western countries users do not want to have a big product standing on their bathroom sink and rather take it out of drawer, use it and place it back.
- _ The market analysis showed there are families which buy multiple portable flosser, instead of a single stationary flosser. This, because people value having their own which only they can use. Similar to a toothbrush people have the like feeling of controlling the hygiene.
- _ Some consumer prefers to buy a portable water flosser instead of a stationary, because of the price point and the performance. Many first-time buyers are



still reluctant to believe in the performance of water flossing and the benefits it offers, therefore they buy a portable water flosser in order to verify and experience the product. Also, in Asian countries well-known brands generally costs more money, so buying the portable water flosser is often cheaper than buying the stationary water flosser.

People with braces Another group of users are people who wear braces. People with braces often have troubles with reaching and cleaning their teeth with a conventional toothbrush. In America and China dentists often recommend their braces-wearing clients to use a water flosser. People with braces can range from children to adults. These users mainly look for a product which is cheap and cleans effectively.

Endo Exo wants to reach two additional target groups, namely: People who use different flossing products, commonly string flossers; and people who do not floss. These two groups of users are not directly targeted, but can be persuaded to start water flossing and buy a product based on for instance user review or recommendation of their dentist.

String flossers As noted in Section 2.1 **MARKET ANALYSIS** (pp.17-19) there are a number of ways to floss. Water flossing is the easiest and effective way to floss. The people who floss using other floss products, primarily flossing wire, have to persuade of the benefits water flossing gives them. The main reasons they would prefer water flossing is the effectiveness and lack of sore gums. Also, water flossing is a less complex process and it is easier to be precise. While with wire flossing the user is constantly trying to place the wire between the small gap of two teeth, which takes experience to do effectively and efficiently. While purchase price for floss wire is lower than that a water flosser. However, a water flosser can be used many times longer than floss wire.

Non-flossers Flossing is still a personal health process which is not done by a lot of people. The main reasons for not flossing are:

- They do not want to do an additional teeth cleaning task next to brushing the teeth, because it will cost them time, and flossing with for instance flossing wire is difficult and can cause sore gums.

- Brushing your teeth a number of three times a day seems to be healthy enough for most people. Doing this for many people is already a challenge. So flossing seems to be redundant.
- The costs associated with flossing. Especially, in countries where people have less money to spend, keeping a good oral health is not a priority (As illustrated in 1.1.1 PROJECT SCOPE pp. 10-15).

These people are target user since they still have to be persuaded to buy a water flossing device. A product which would cater to their needs would have to offer a convenient, easy and quick way of flossing, which gives them the impression that flossing works to improve their oral health.

There are a large number of target users Endo Exo wants to cater to with the Mini Flow. In general these users all want a product that works effectively, offers them a high performance and pleasant experience both at home or while travelling.

2.4 DESIGN PROPOSITION

The design proposition is comprised out a design heading supported by functional requirements. The design heading is an abstract of the description of the product and incorporates the feelings, experience and values of the product. These values were gained from the market research, competitor analysis, target users and expert insights. At another point during the development of this product this would have to be validated by user reviews. The functional requirements are the design heading defined in a set of functions and features which are measurable of performance. The benchmarking of competing portable water flosser helped into defined the functional requirements so the Mini Flow was able to compete with its direct competitors.

2.4.1 BENCHMARKING Based the market analysis showed that there are several portable water flossers with which the MiniFlow will compete. Benchmarking helps determine the current performance of these products on several key aspects. The benchmark also shows which product was the theoretical best and what was average among all these products. It also helped into giving Endo Exo an impression on were its competitors were positioned and where opportunities are present for Endo Exo's product.

In *Figure 2.19* and *Figure 2.20* show the benchmarking of the products on the various key aspects like portability (including; weight & height), ergonomics, and water reservoir, and Endo Exo's desired position among them. For more aspects that were benchmarked see **Appendix VI PRODUCT BENCHMARKING**. The benchmarking suggests that there are constraints and compromises among the products as well as opportunities for Endo Exo's Mini Flow to distinguish itself. The conclusions of the benchmarking are listed below.

- 1 The system of the water flosser which provides the water jet stream in similar among all products, and all perform adequate. It is difficult to precisely define what optimal pressure range is. The effect of flossing is only noticeable on the long term and not very optically visible. Some products have an additional feature allowing the user to switch between different pressure settings, but this presence of this feature has gotten mixed reviews. If Endo Exo seeks to gain an advantage regarding the performance of their internal system it should focus on making it smaller in size. This will also influence the size of the product. Another aspect the noise production of the system which can be improved to make it less noticeable to the user.
- 2 Portability is a relative concept among portable water flossers. Based on expert reviews the Panasonic [EW-DJ40] is the most portable products. It has a collapsible water reservoir making the product considerable smaller than its competitors. Most other products range around the same height and footprint differ only several millimeters. This size of the product is limited by the size of

the system and water reservoir. Based on the benchmark it portability would suggest that the product is/can become small and minimizing the space and maximizing the efficiency for the system are key elements into making the product smaller, aside from the water reservoir as is discussed later.

This was the reason the portable water flosser of Flow was chosen to be called Mini Flow since calling it for instance; portable Flow could raise expectations which are possibly not be met. The analysis showed that the consumers had different opinions of portability. By calling the water flosser Mini Flow it would also fit better within the Flow product line as it is a smaller water flosser than the Flow stationary water flosser.

- 3 The size water reservoir greatly influences the usability of the product in two regards. The larger the water capacity of the less times the user needs to refill it while flossing. Many of the bench marked products need at least 2 refills for recommended 60 seconds of flossing. However, a larger water capacity increases the overall size of the portable water flosser and influences the handling of the product as well as the weight.
- 4 For an appearance standpoint there is an established archetype among the portable water flossers. Colours are often a combination of high gloss white with often high gloss blue accents, like buttons. The products are entirely comprised out of plastic. The water reservoirs are almost always made out of a semi-clear or frosted, coloured plastic. The shape language in the design does differ from a more static, mechanical to a dynamic, ergonomic feeling. Most water flossers also do not relay the same premium impression as associated products like shaver or powered toothbrushes, and de styling does not fit in Endo Exo's sense of premium quality.

Aesthetically all products have a 'problem' incorporating the jet tip while maintaining cohesive design. This part has to be removed in order to make the product smaller, thus more portable. However, this user has to provide effort in order to keep the jet tip and flosser together, which is not provided by the product itself. The Panasonic [EW-DJ40] is the only product which solves this issue. By incorporating a special compartment into the design, the jet tip can be stored in the product and not get lost. The usability of the product would benefit from integrating the jet tip into the main design of the product.

- 5 There is one portable water flosser on the market which utilizing a docking station to recharge. Other products either use a power cable or batteries. These types of charging leave an unsafe impression in the eyes of the user. An opportunity is present for the Mini Flow to have a docking station. The added value of this docking station would be that the product always has a location to be stably placed and charged, as well as give a safer impression to the user than utilizing power cable or batteries. The docking station could also serve as a storage container for the flosser, additional jet tips or a toothbrush.

6 The price point of the portable water flossers ranges between ¥200,00 to ¥750,00, respectively €25,00 to €95,00. This price difference is attributable to the brands and quality those relay. Brands like Panasonic and Waterpik are more established in this market as brands which deliver quality and more exclusive products.

- Endo Exo's Mini Flow
- Panasonic
- Waterpik
- Market followers

Figure 2.19 (Right) This radar chart shows the proposed design heading for Endo Exo's Mini Flow based on benchmarking of products.

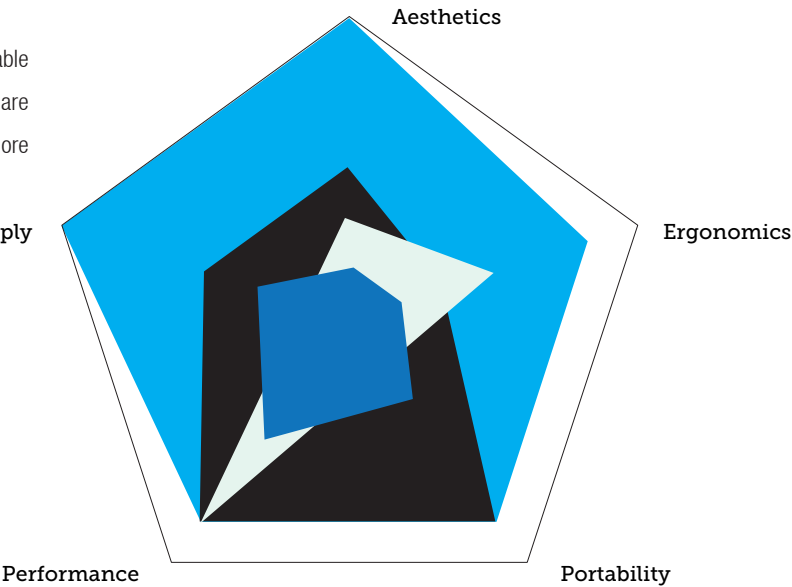


Figure 2.20 (Below) Benchmarking of portable water flossers on portability, which is split into weight, height and footprint; the water capacity and ergonomic impression. For more benchmarking also see **Appendix VI PRODUCT BENCHMARKING**.



Poor ergonomic impression

High regard for ergonomics

High tech, Quality, Ergonomic, Friendly,

Logical and Sustainable,

with a high regard for 'Form follows function'.

ENDO EXO



Figure 2.21 Several images from the styling board.

2.4.2 DESIGN HEADING The form of an object can be more than just “styling”. It can communicate meaning. Product semantics attempt to convey what a product is or does through its form. Following this method, shape, texture, materials, and colour are used to convey meaning. The goal is to make the product intuitive that the user knows how a product works and what it does without instructions. The Mini Flow will have to communicate meaning from three different sources, namely the user, the brand, and the Mini Flow itself.

Design identity of Endo Exo Endo Exo is a young company and has no long line of products; therefore it still has a fluid design identity and style. The Mini Flow will help attribute and solidify the design identity of Endo Exo does possess a number of values wants to convey with their products. Some key values Endo Exo uses to identify itself are:

High tech, Quality, Ergonomic, Friendly, Logical and Sustainable, with a high regard for 'Form follows function'.

Similar to the principle of Form follows function: that the shape of a building or object should be primarily based upon its intended function of purpose. Endo Exo believes a product's functionality should be key point and the aesthetics should support to improve the usability of the product. In the case of the portable Water Flosser besides the aesthetics supporting the usability it should give the product a premium appearance. In Figure 2.21 portrays several impressions and products which Endo Exo would identify itself with and which serve as inspiration and reference for the Mini Flow. Also see Appendix VII MINI FLOW STYLE GUIDE.

The Flow product line currently consists out of a stationary water flosser, as shown in Figure 2.22. This product has several aesthetic features which Endo Exo wants to pursue in the design of the Mini Flow. However, the Flow water flosser has modern, but conservative appearance. The Mini Flow is not bound by the have this appearance. However, several aesthetics it should incorporate features are; the usage of basic shapes like; triangles, circles, rounded rectangles and squares, but also more complex shapes like super elliptical shapes. The design also uses straight lines but uses rounded edges to break them to create a more friendly design. A specific design is the top



face (lid of water reservoir) of the Flow stationary water flosser the shape, also referred to as the 'chamfer-fillet-fillet' is a specific aesthetic feature Endo Exo wants to pursue in their Flow products.

Figure 2.23 (Above) Signatures shapes and lines of Endo Exo's design style.

Product Experience The Mini Flow is a water flosser which offers an easy, usable solution for consumers who want to water floss while away from home for a vacation or business trip. The Mini Flow provide the effective and efficient water flossing functionality as a stationary water flosser, but all in a smaller self contained product . The design is convenient enough to be taken along on travels and takes up almost no space when packed in the suitcase or when set-up in the bathroom. This product allows consumers to keep water flossing while travelling and not have to choose for a less effective and efficient methods of flossing like flossing wire.

The Mini flow is handheld, portable devise, the design must exude maturity, originality and relate to frontier tech in a natural and casual way.

The Mini Flow gives a premium impression, incorporating clean, reliable design that relays clear instructions to the users on the usage of the product.

The interactions between the Mini Flow and the user are consistent. The product supports the user in effectively flossing the teeth, and leaves a fresh feeling in the mouth of the user after each flossing.

ENDOEXO
FLOW



Figure 2.22 The Flow stationary water flosser of Endo Exo (www.endoexogroup.com) and the 'chamfer-fillet-fillet' is a specific aesthetic feature.

2.4.3 FUNCTIONAL REQUIREMENTS The functional demands, as listed below are the product heading translated into measurable values and performances. Each of these main functional demands are further detailed in functional requirements and divided over the main components of the products. For this also see **Appendix VII FUNCTIONAL REQUIREMENTS**.

- 1 The product produces a water jet stream which can clean debris from and between teeth.
- 2 The product contains water and is able to be refilled.
- 3 The product is portable.
- 4 The product contains an own power supply which can be recharged.
- 5 The ergonomics of the product contribute to the usability of the product.
- 6 The product has a premium appearance which convey the image of Endo Exo as well as the Flow product line
- 7 The product may not cause harm to the user or others.

Out of the functional requirements the main ones which should be considered during this design process are shown in *Table 2.1*. Also several remarks regarding function 5 and 6 list several aspects which should be considered during the design process.

System Architecture As noted earlier in this design report competing water flosser all use the same working principle in order to generate a water pressure which can be used to floss the oral cavity (also see **2.2 COMPETITOR ANALYSIS** pp.20-25). Endo Exo's sees that the first Mini Flow does not need to improve this working principle and therefore will use a similar system architecture for the Mini Flow as its competitor Panasonic.

Since portability had been established as an important aspect of the design the architecture and minimization of size of this internal system became important. Therefore Endo Exo is striving to generate an internal system similar to that of the Panasonic Dentacare water flosser, as shown in *Figure 2.24* Also, the water reservoir was part of the internal structure, but was to be considered separate so it could be reinterpreted, in order to improve the portability and usability of the product. At that point in the design process it was also undecided if a pressure setting would be present in the system. Therefore only an on/off switch would be present in the 'to be designed' Mini Flow.

An addition to the internal structure was the induction coil. The Mini Flow has a rechargeable system through induction charging. This system consists out of two induction coils, namely one inside the structure of the Mini Flow and other one inside the docking station. These two coils when connected make a complete transformer, as is illustrated in *Figure 2.25*

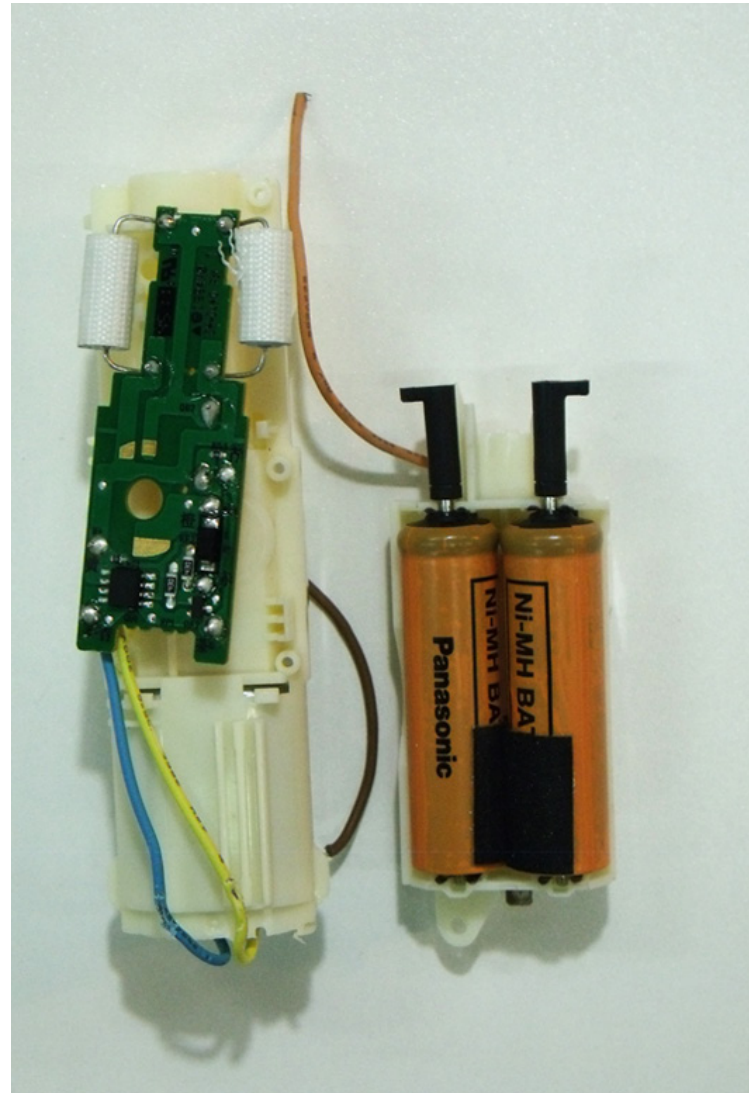
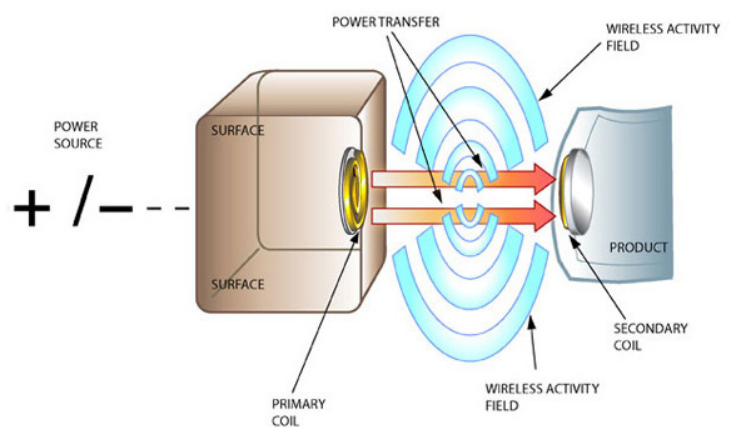


Figure 2.24 (Above) 1: 1 Scale picture of the internal system Panasonic Dentacare EW-DJ40 (partly disassembled). The rough dimensions of this system are: 120.0 x 30.0 x 30.0mm; and the battery 70.0 x 15.0 x 30.0mm

Figure 2.25 (Below) Workings of induction charging.



Function	Requirement & specification	Wishes
2	Capacity of water reservoir 210.0 to 230.0mL: Enough for 30 seconds of flossing.	Around 250.0 mL For 60 seconds of flossing
2	Size of the lid Diameter around 30.0mm: Big enough for water tap to fill. Handling and closing of the lid must be able to be performed by 95% of the target users. Mainly focused on holding with thumb or fingers and applying force on the closing lid with those fingers.	
3	Size dimensions of the product Smaller than 30.0 x 180.0 x 80.0mm (<i>This was altered to 200.0 x 50.0 x 50.0mm to closer matching the competition.</i>)	150.0 x <50.0 x < 50.0mm Minimize 1 size dimension.
3	Internal space needed for system architecture. System architecture is defined to be around 120.0 x 40.0 x 40.0mm	System architecture is defined in the following paragraph.
3	Weight of the product 350.0 gram (<i>Later proven unrealistic weight will be around 500.0 gram, as a set maximum.</i>) Weight distribution should not interfere with the user's handling of the product.	300.0 gram (was proven unrealistic, and was therefore rejected)
5*	Size dimensions of the product Smaller than 30.0 x 180.0 x 80.0mm (<i>This was altered to 200.0 x 50.0 x 50.0mm to closer matching the competition.</i>)	150.0 x <50.0 x < 50.0mm Minimize 1 size dimension.
5	Comfortably rest in the target user's hand and be handles by the user without any discomfort. The product should be able to be handled by 95 percent of the Chinese people, both left- as right-handed users (See Appendix IX: Hand measurements).	
6**	Appearance of the product matches the semantic values. Convey values Endo Exo and Water Flosser Product must contain the 'Endo Exo' logotype. Products must be recognizable as a water flosser.	Product must contain a 'Mini Flow' logotype.

*Remarks regarding Function 5.

- Consideration for different tasks like flossing, recharging and filling of the water reservoir etc.
- Button placement:
On/Off switch: Once pressed on the water pressure will slowly build build-up.
Jet tip rotation button: Operate this button with the same hand with which the product is hold.
Jet tip release button: Make this button able to rotate the jet tip, therefore
- eliminate the necessity of a separate jet tip rotation button.
- Tactile feedback of the buttons.
- Weight distribution.
- Main point of mass will be water reservoir when filled.
- Indicator light for battery recharge.

**Remarks regarding Function 6.

- Aspects to be considered:
- Values of the user
 - Shape of design
 - Utilize shapes common among Endo Exo products.
 - Colour usage
 - Colours commonly used in healthcare and water flossing products.
 - Material usage
 - Surface finish

Table 2.1 List of specified functional requirements retained to the design of Mini Flow.

Usability The Mini Flow was to have a strong focus on usability and would be part of the product's functionality and performance. In general, usability discusses the interaction between the user and the product and the user's ability to perform tasks with the product. ISO defines usability as following:

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use." (*UsabilityNet, 2006*)

Usability is composed out of:

- Effectiveness: The accuracy and completeness with which specified users can achieve specified goals in particular environments.
- Efficiency: The resources expended in relation to the accuracy and completeness of goals achieved.
- Satisfaction: The comfort and acceptability of the work system to its users and other people affected by its use.

Jakob Nielsen offers framework of a system's acceptability, where usability together with utility shape the "usefulness" of a product. Additional components of usability which are presented are:

- Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
- Efficiency: Once users have learned the design, how quickly can they perform tasks?
- Memorability: When users return to the design after a period of not using it, how easily can they re establish proficiency?
- Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
- Satisfaction: How pleasant is it to use the design?

(*Jakob Nielsen, 2012*)

However, the usability of the Mini Flow is hard to define solely based on these abstract terms. A water flosser has several features which strongly influenced the usability and therefore define it. During the remainder of the design process these features were considered to attribute to the usability of the Mini Flow. These features are:

- Ergonomics: a wide array of interfaces the user interacts with like the grip, buttons and switches and water reservoir are among these interfaces.
- Portability: split into size dimensions, footprint and weight. But also the effort and affordance Mini Flow offers the user into bringing it with him/her.

Not all features of usability described can be directly qualified and measured in terms of functional requirements. Therefore, the Mini Flow needs to be reviewed user testing in order to verify the usability of the product.

DESIGN

**"If you can't solve a problem it's because
you're playing by the rules."**

PAUL ARDEN

This chapter discusses the ideation process which was performed to generate fitting solutions for the Mini Flow. The generated solutions were verified and validated in order to generate a concept that embodied proposed user experience as well as meet all functional requirements.

As illustrated in *Figure 3.1* the design phase is characterized as an iterative process, a constant alternating between ideation and validation. During the initial ideation, utilizing techniques like brainstorming, mind mapping and sketching generated a wide range of solutions for functionality and problems. These solutions were clustered based on the key aspects of the Mini Flow's design as were defined in the design proposition. Also solutions for different key aspects were grouped into an idea for the product. The validating of ideas was done by utilizing a combination of various form study prototype varying in detail, as is shown in *Figure 3.2* and discussed in **3.2 VERIFICATION** (pp.39-41) supported by additional sketches. The verification of these ideas was roughly outlined by the following steps:

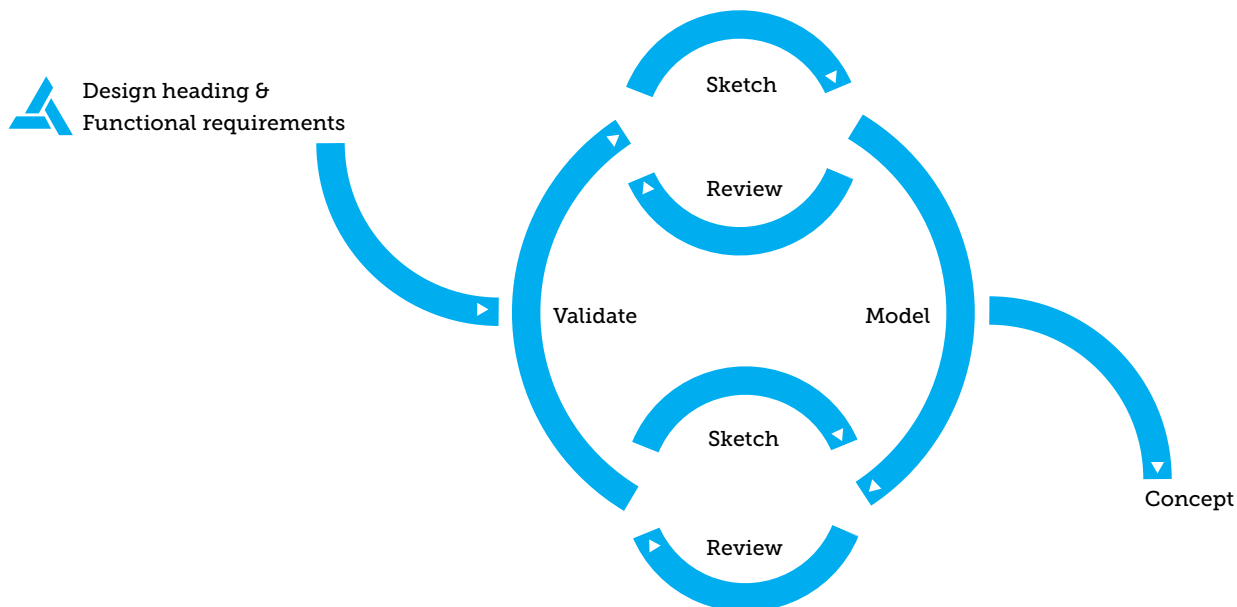
Through shape modelling:

- 1 Assign a rough set of size dimensions and test hold and handling of the product
- 2 Simulated a size of water reservoir and take into account the space needed for the internal system.
- 3 Simulate the weight of the product, as well as the weight en weight distribution of a water flosser fully filled water reservoir.

Through sketching:

- 4 Assess the production and assembly possibilities for the design.
- 5 Check the styling for the premium appearance that fits within the product semantics and assign product tonality.

To illustrate this verification process *Figure 3.2* shows the steps that were conducted in order to verify one of the initial ideas. During this process, through conducting these steps many ideas were found to be unrealistic, but also new possibilities were generated.



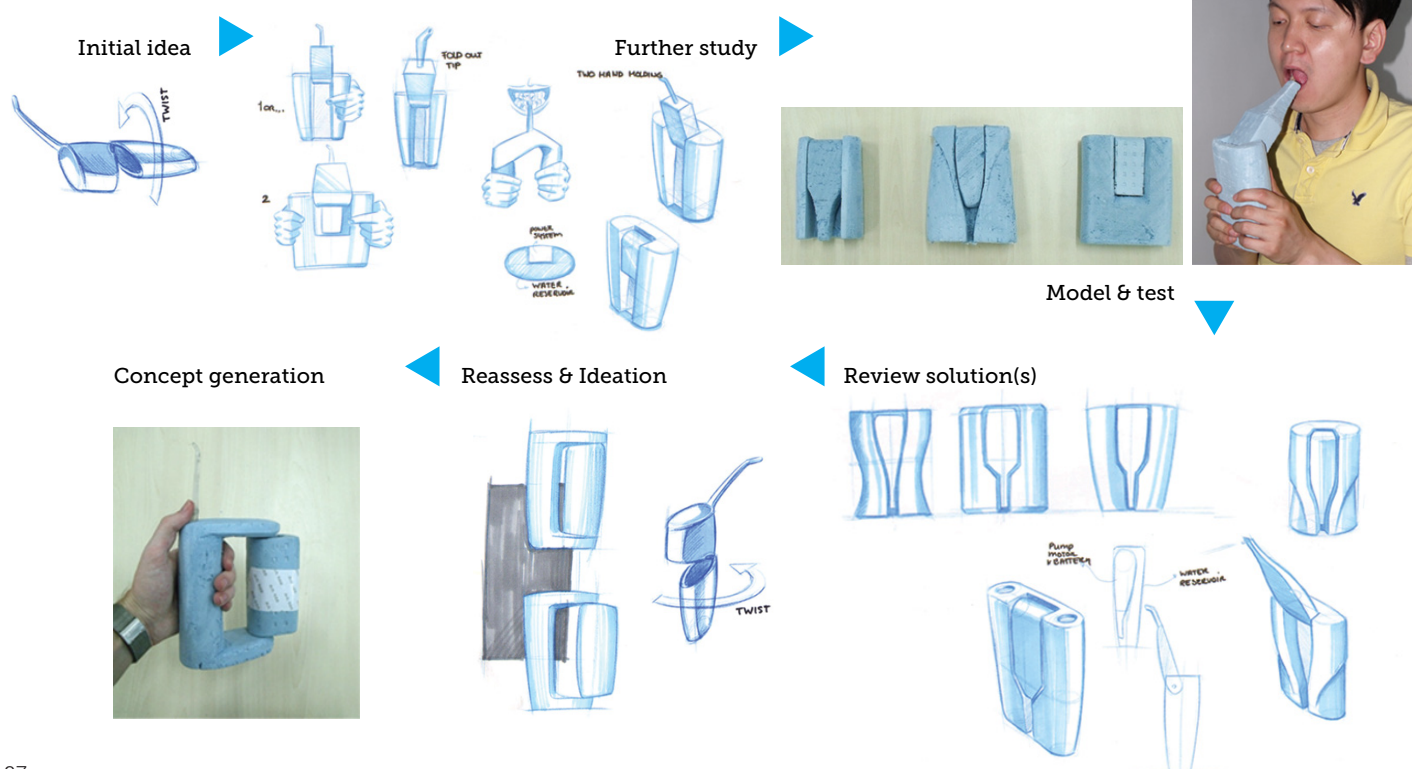
This led to three concepts. These concepts each offered a different approach to solve the various functional requirements. Through a concept reviews pp. 45-46 the performance of each of these concepts was qualified. Together with the stakeholders the concept which best fitted the functional requirements (as are listed in **Appendix VIII FUNCTIONAL REQUIREMENTS**), and heading Endo Exo's values was selected for further development.

Figure 3.1 (Above) Diagram of the design method utilized during this phase of the design process.

3.1 BROAD IDEATION & CLUSTERING

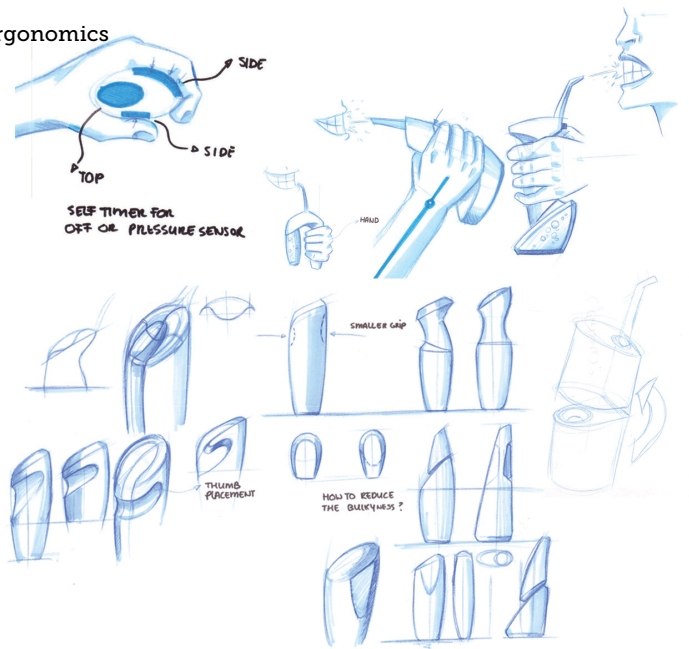
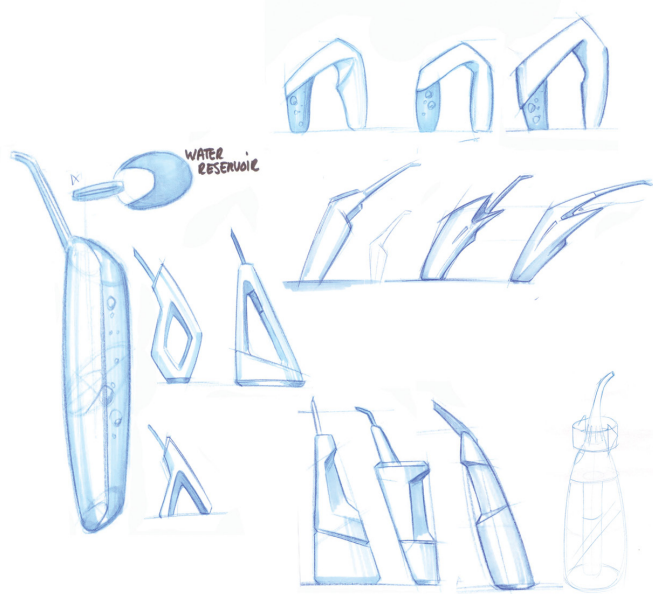
Through several brainstorm sessions, mind mapping and sketching a wide array of solutions was generated. The solutions varied in abstraction; focusing on details or complete concepts for portable water flossing. To get a clear picture of the solution space the generated ideas and solutions were clustered. The ideas were clustered on the key aspects which were defined in the analysis phase. Several of these clustered solutions are shown in *Figure 3.3*. For more ideation sketches see **Appendix IX: Broad Ideation**. Based on this initial ideation the design heading could be more defined. Endo Exo was interested in further investigation several solutions, these are shown in *Figure 3.4*.

Figure 3.2 (Below) Example of the generation and verification process.



Appearance

Ergonomics



Portability

Water containment

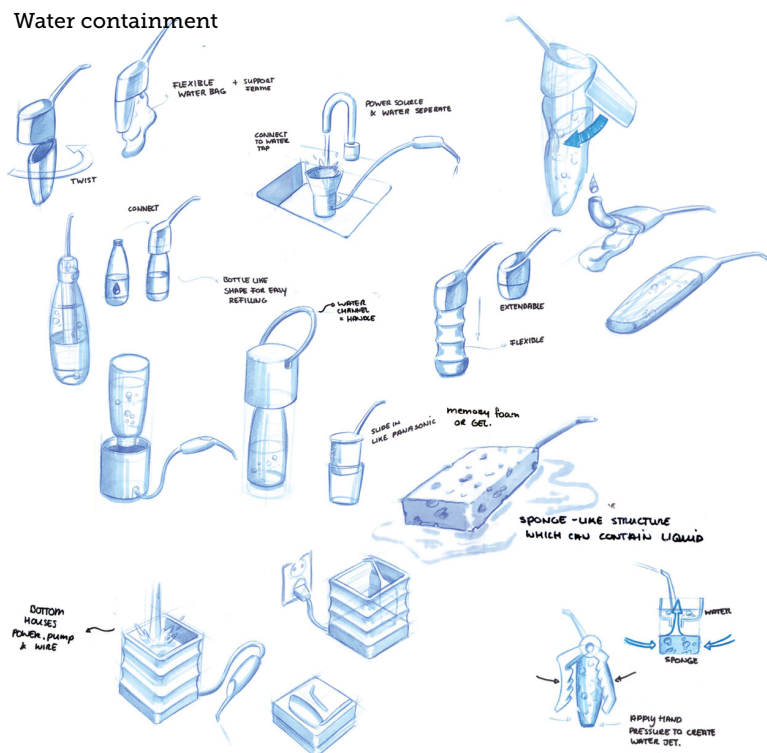
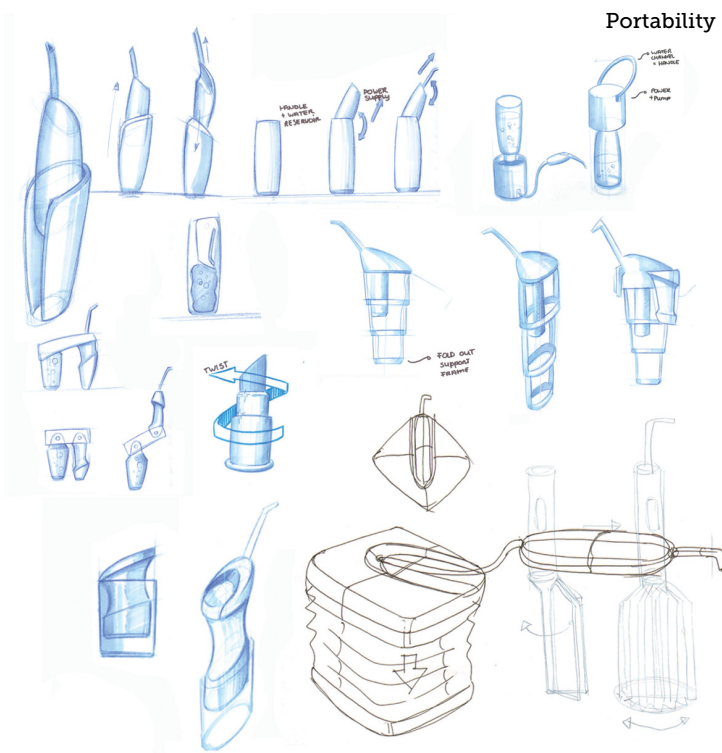


Figure 3.3 (Above) The initial ideation clustered in ideas and solutions for Appearance, Ergonomics, Portability and Water containment.

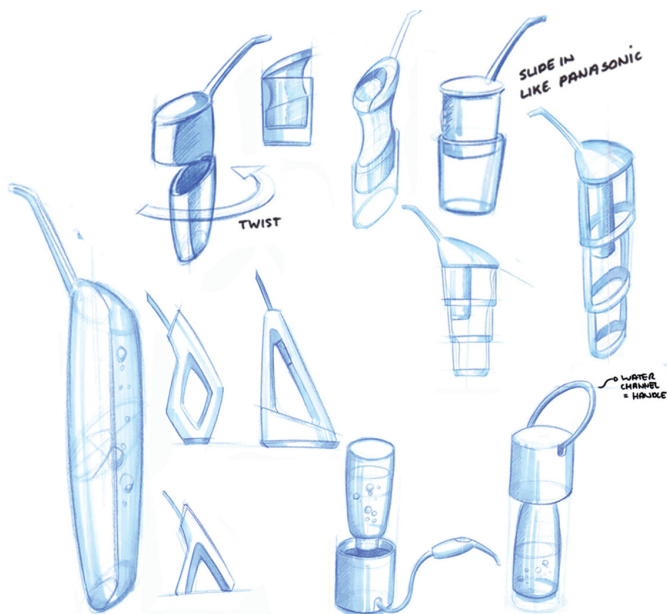


Figure 3.4 (Left) Several ideas Endo Exo and MADE Innovation found interesting and wanted to be pursued further.

non-portable shape



Portable shape

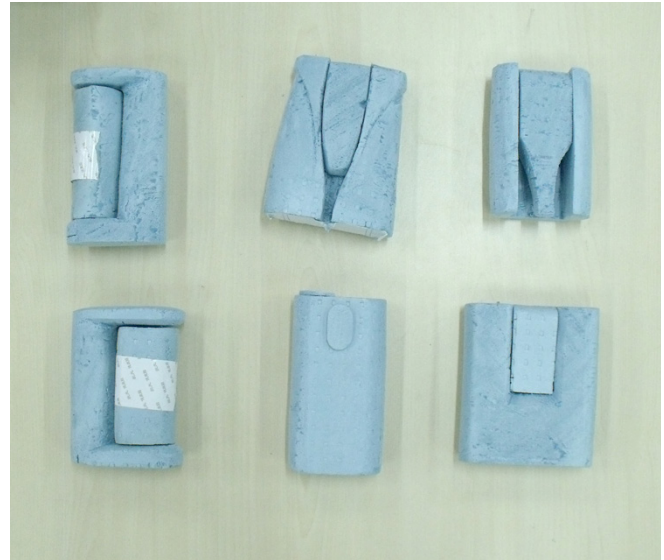


Figure 3.6 Several shape models divided into portable and non/portable shapes.

3.2 VERIFICATION

To test the possibility of the solutions and ideas generated during the broad ideation, validating was required. Form study prototypes aided into getting a realistic understanding of the constraints of the product as well as generate additional ideas. These form study prototypes also aimed at studying different aspects of the product. As mentioned earlier the shape models varied in detail and purpose. *Figure 3.5* shows the process of several models which investigated one shape idea. The validation led to a number of insights regarding the constraints of the design.

- Minimizing one dimension of the product, width, length or height would create a portable impression. In addition, using straight lines and simple, symmetrical shapes, for example a book-like shape or cylindrical would make the product be easily to be packed. Where protruding and asymmetrical shapes create a less portable impression. *Figure 3.6* shows the difference between shape models which are considered portable and which are less/not.
- As noted in 2.4.1 BENCHMARKING the dimensions of the water reservoir and its water capacity have a significant influence on the overall size of the water flosser. Several shape models studied different ways to implement the water reservoir and examine the impact on the design while still keeping the product small and portable. Taking into account the size of the water reservoir caused a lot of the ideas to be discarded since it the product would get too chunking for usage and portability.

Among the solutions generated during the broad ideation are several ideas to give the water reservoir a flexible shape, similar to a water bag. However, this approach for a water reservoir was abandoned, since the stakeholders were in favour of a safer fixed shape.

- Another issue that became apparent during the shape modelling was the weight of a filled water reservoir and position in the product greatly influenced the handling of the product. As stated in the functional requirements the product should weigh not more than 350 grams. Dependant on the water capacity of the design, the weight of a filled water reservoir would be around the 200 to 250 grams, which is close to 200 and 250 millilitres. The incorrect



Figure 3.5 Various shape models which were constructed to verify ideas and gains insight in the constraints of the design.

"Design is thinking made visual." SAUL BASS

placement of the water reservoir would cause strain on the user while flossing and negatively influence the user experience. As illustrated in *Figure 3.7*, the design became unstable, because of the placement and size of the water reservoir. By adding counterweights in the handle or the product this could be negated, however this would have made the product's total weight above the demand, deteriorating the usage of the product. Resting the weight of a filled water reservoir on the top of the hand or wrist as shown in *Figure 3.8*, is a possibility. However, it limits the user movements, making handling harder.

- The optimal positioning of the water reservoir would be as illustrated in *Figure 3.9* and would place the water reservoir directly under the grip/handle or have the water reservoir be the handle. This is similar to the Candeon water flosser where water reservoir and the internal systems are placed parallel from each other, making the water reservoir part of the handle.
- How to hold the water flosser is not necessarily clear by the shape of the handle. Small tests indicated that many shape models had a multi-interpretable way of holding. However, the placement of the on/off button gives a user better indication on how to hold the product (*Figure 3.10*). Still, users held the models in a way that was logical and comfortable to them. During flossing the user has to rotate and twist the water flosser in order to reach the back face of the teeth. This creates the wrist to be in an awkward straining angle. This can be adverted by making the jet tip rotate, which the user can operate with his/her thumb, preferably with the thumb of the hand with which the user is the product holding. The Waterpik and Panasonic offer a semi-optimal solution (*Figure 3.11*): A separate rotating button; and grip on the jet tip itself. These solutions are not very easily reached with the thumb when operating the product.

At this stage several general matters that had to be taken into account when considering the production and assembly of a product.

- 1 The number of parts that is required, where and how these parts are connected and parting lines would have to be placed.
- 2 If and how the parts are removed from a mold, taking into account the part's complexity and draft.
- 3 Grouping the internal components; which make up part of the system architecture, in a single line would offer the optimal solution in term of space and assembly.



Figure 3.7 The strain on the user is less, because the arm (distance) between the point of mass of the water reservoir and the wrist joint is small.

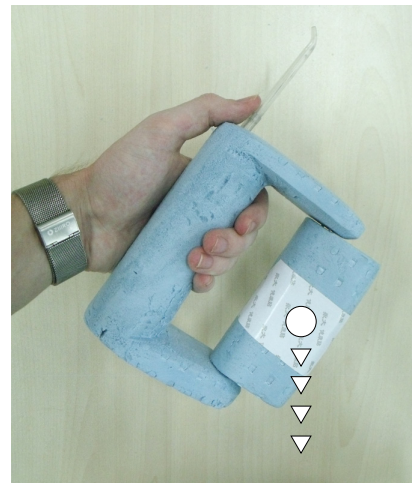


Figure 3.8 The arm (distance) between the point of mass of the water reservoir and the wrist joint is larger, therefore the user is strained more, and the design becomes unstable.



Figure 3.11 The jet tip rotation buttons of the Panasonic and Waterpik water flossers, which both need two hands to be operated since those buttons are hard to reach.



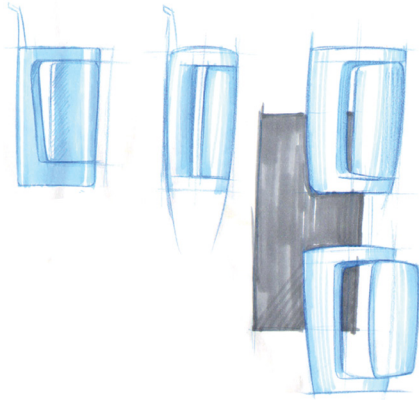
Figure 3.9 The design of this shape model does not instruct the user clearly in how to hold and operate it.

Figure 3.10 Giving some indication into where the activation button was placed made the more understandable how to hold the product. However, the pressure point of thumb still varied between different testing subjects.

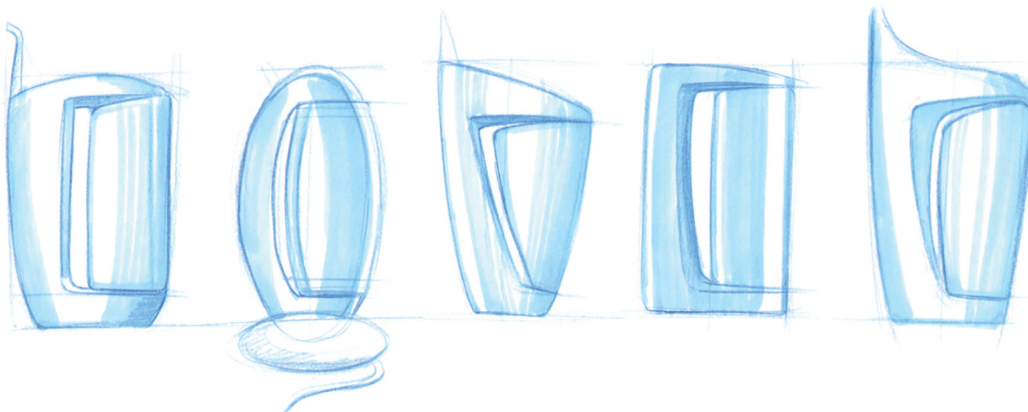
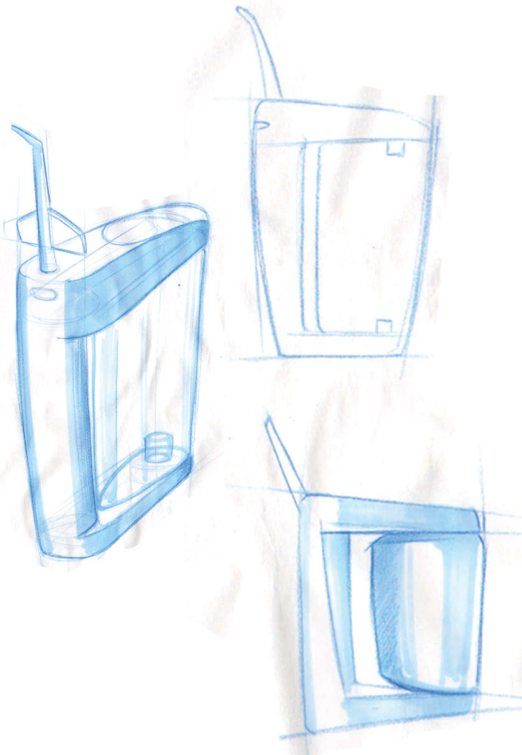
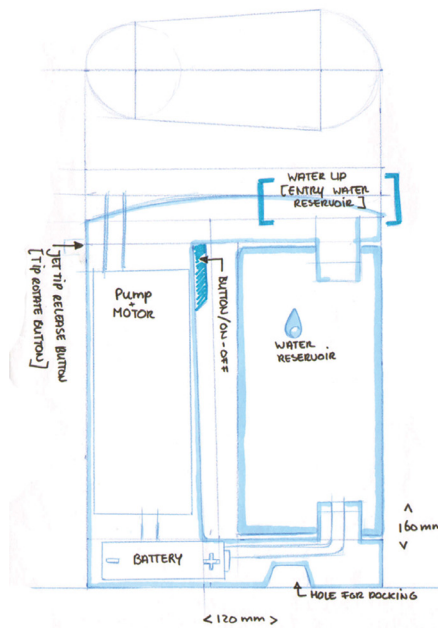


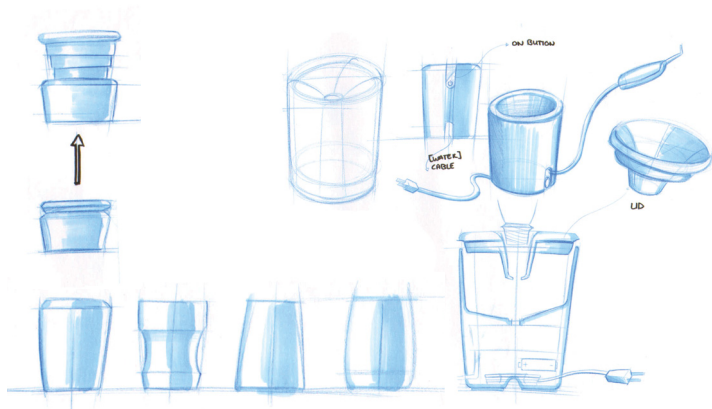
3.3 CONCEPTS

The ideation and validation process resulted in three concepts. These concepts all propose a different idea for size reduction in order to ensure portability, while using a similar structure and components as described in 2.4.3 FUNCTIONAL REQUIREMENTS. These concepts also provide insight into the handling of the product, which is part of achieving a pleasant usability.

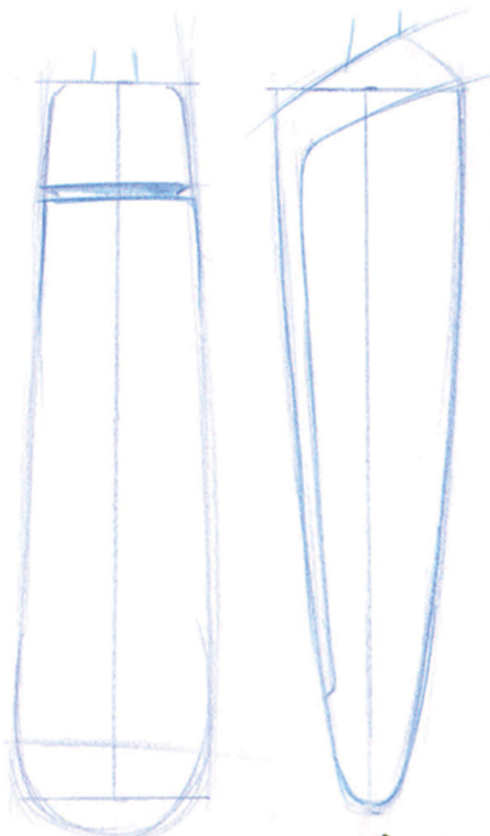
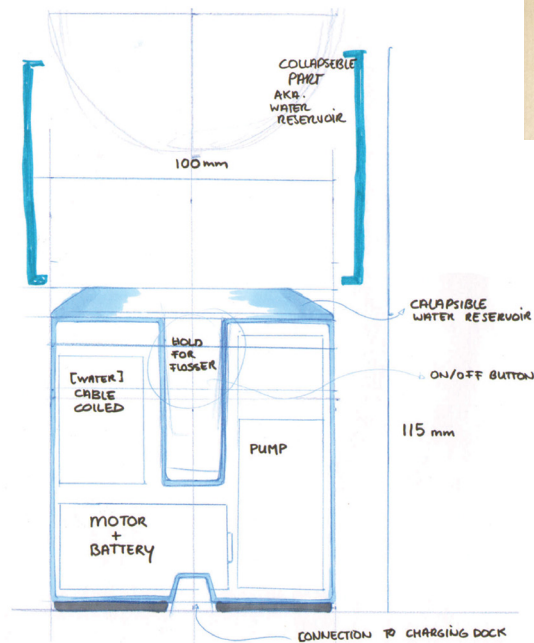


3.3.1 MINI FLOW X 'Water reservoir that can be rotated in order to reduce size.'

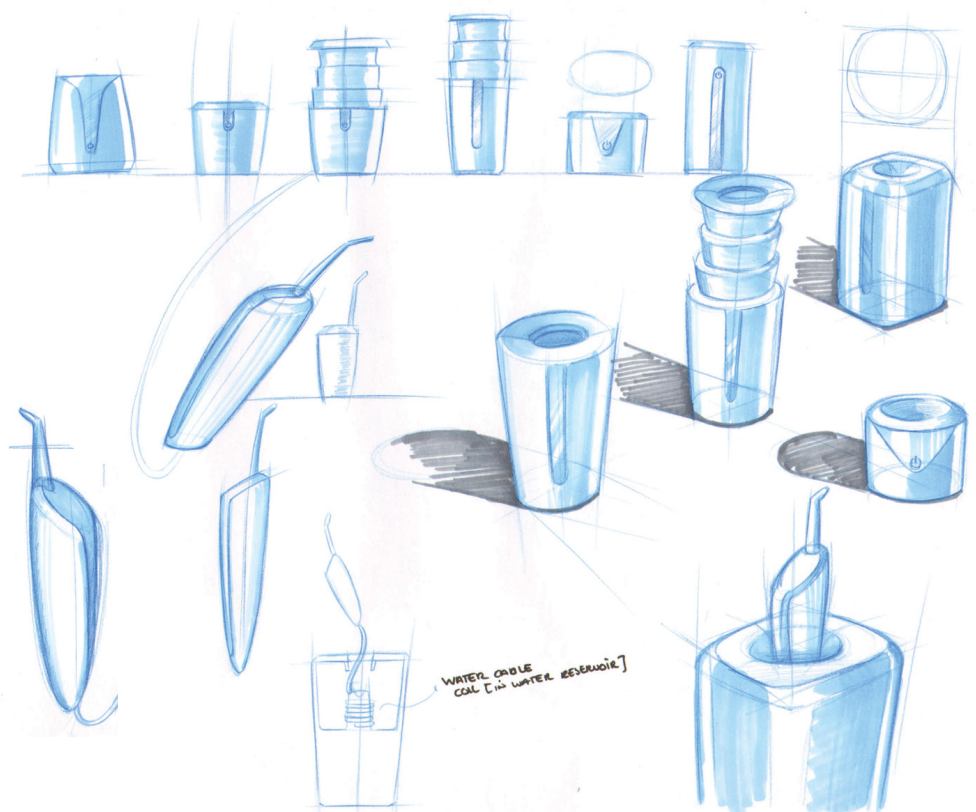


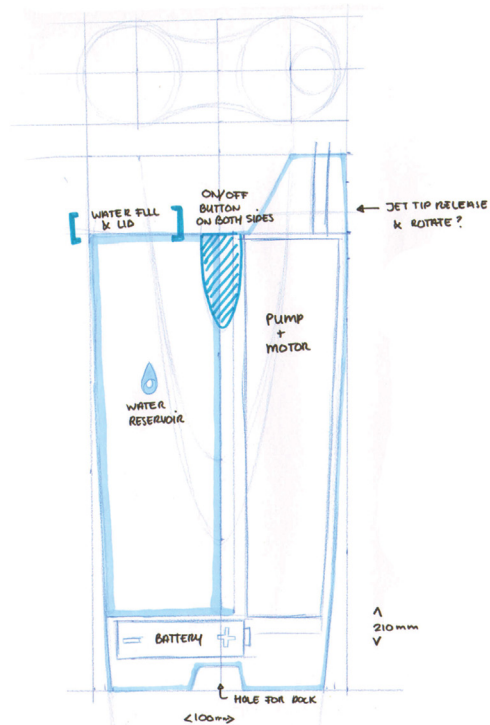


3.3.2 MINI FLOW Y 'A super elliptical structure which eliminates refilling, and offers the same experience as a stationary water flosser.'

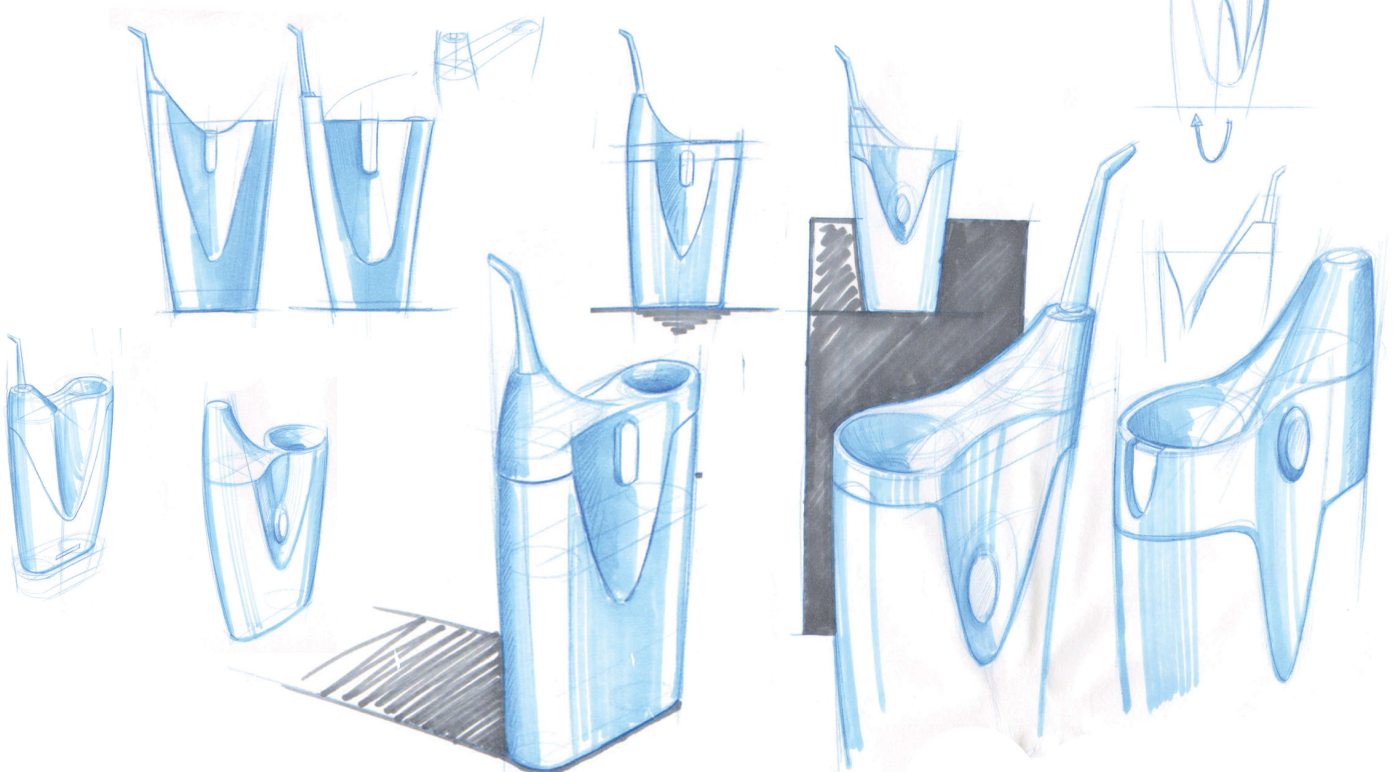
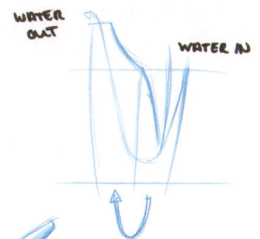


1:1





3.3.3 MINI FLOW Z 'A book proportioned design which offers a distinctive appearance and good ergonomics with multiple options of holding.'



3.5 CONCEPT REVIEW

Together with representatives of Endo Exo and MADE Innovation, the stakeholders scored the concepts on the semantics values and functional requirements, benchmarking the concepts against each other. As *Table 3.1* illustrates how the three concepts perform based on several of the functional requirements, and compared to each other. As noted earlier, Endo Exo expressed the desire to use a similar system as used by its competitors to accomplish the flossing function. Therefore, the functional requirements connected to this function were not reviewed.

In general the concepts met all the functional requirements aside from which were undefined. While at some points one concept would outperform the others. Each of the concepts had still had issues and undefined solutions. However, based on the severity of these issues two concepts, namely Mini Flow X and Mini Flow Y were dropped, in favour of Mini Flow Z. The reasons for the dismissal of these concepts were the following:

X While the size dimensions and usage of space in the Mini Flow X concept were regarded to be optimal by Endo Exo small usability tests conducted during the concept review found that the concept had weight issues. The concept offer the biggest water capacity of any portable water flosser, but this led to the product not being able to be hold with one hand, without straining the user. As was also discussed in section 3.3 VERIFICATION, *Figure 3.10* (p. 40), this was because of the placement and weight of the water. The user had to hold the concept either with two hands or by not rotating the water reservoir outward, in order comfortable use the concept. Eliminating the rotation possibility of the water reservoir, would make the concept look similar to that of the Mini Flow Z, whose appearance was more favored than this concept's.

Additionally, while the appearance of this concept showed similar elements to that of the Flow stationary water flosser, Endo Exo wanted a less contemporary and more exciting design for the Mini Flow.

Y The Mini Flow Y concept's size was too big when compared with the Mini Flow X and Z, but also compared with the competing portable water flossers. This was caused by the bigger motor that was required in order to pump water to the flosser. Also, no solution had been defined for the placement of the flosser, and where it should be connected or housed on the main body. Additionally, it was uncertain whether the way in which water was delivered to the system was technically feasible, without having to change the existed

system architecture.

While Endo Exo was convinced of the premium appearance of the main body and flosser it found that the collapsible water reservoir could not be designed to look premium. Since this was a major part of the design and contributed to the functionality of containing water there were limited options for alteration. The idea of this concept to create a 'mini' version of a stationary water flosser could take away from Endo Exo's existing Flow water flosser market, because the Mini Flow could compete with it.

Z Concept Mini Flow Z was the only concept which did not have similar issues as were present with the other concepts. However, its water capacity was too small and did not meet the functional requirements. This was largely attributable to the shape of this design. Possibilities were present to alter the design into making it have a larger water capacity. Endo Exo and MADE Innovations expressed several other concerns regarding this aspect of the concept, but also wanted the Mini Flow to be better in rivaling its main competitor, namely the Panasonic portable water flosser. Therefore several functional requirements were redefined, mainly included the size dimensions and production related requirements.

Out of the presented concepts the Mini Flow Z was be assumed to be a more complex product to produce. Endo Exo gave the freedom to not be constrained by a set number of parts. While the pricing of the molds was one of Endo Exo's concerns it did accept that the Mini Flow would involve taking (financial) risks, in the sense that the current shape would require more parts to be injection molded, therefore increasing the costs of production. During the further development of this concept the production of the Mini Flow Z had to verified and further detailed.



Figure 3.1 The Mini Flow concepts X, Y and Z compared in size.

	Mini Flow X	Mini Flow Y	Mini Flow Z
Height (including jet tip*)	160.0mm (235.0mm)	140.0mm (flosser part: 170.0mm)	210.0mm (285.0mm)
Footprint	120.0 x 50.0mm	100.0 x 100.0mm	100.0 x 40.0mm
Internal space for system	120.0 x 35.0 x 30.0mm	90.0 x 90.0 x 90.0mm	160.0 x 35.0 x 30.0mm
Water capacity	310 mL	400 mL	180 mL
Weight** filled with water	610.0 g	700.0 g	480.0 g
Production remarks			
Estimated number of parts	9	10	10
Method of producing	Injection molding	Injection molding	Injection molding
Methods of fastening	Ultrasonic welding, screws, flanges, hook connections and adhesive tape	Ultrasonic welding, screws, flanges, hook connections and adhesive tape	Ultrasonic welding, screws, flanges, hook connections and adhesive tape
Features and appearance	<p>1. One dimension has been minimized creating a book-like shape.</p> <p>2. Water reservoir can be rotated to make the product smaller.</p> <p>3. Trigger-like On/Off switch</p>	<p>1. Appearance mimics that of a stationary water flosser.</p> <p>2. The flosser is a separate part, which contains a handle and jet tip</p> <p>3. On/Off switch can be placed on two locations, either on the central unit or flosser.</p>	<p>1. One dimension has been minimized creating a book-like shape.</p> <p>2. The On/Off switch is placed on two sides of the product.</p>

* The length of jet tip is 70mm.

** Weight of the product was estimated to be around 300.0gr.

This is based on the weight of the weight of the Waterpik Cord plus water flosser.

Table 3.1 The Mini Flow concepts X, Y and Z figures on several of the functional requirements.

DETAILING

"The details are not the details,

they make the design."

CHARLES EAMES

This chapter handles the detailing of the Mini Flow concept that was presented paragraph 3.4.3 MINI FLOW Z (P. 44). This concept underwent significant changes in order to better match the functional requirements. The design's features, experience and product tonality were specified. A prototype was fabricated and captured the intended design aesthetic, but also simulated some functionality. This prototype was utilized as another method of validating and verifying the Mini Flow design.

Similar to the process that described the DESIGN phase (pp. 36-47) the Detailing phase was an iterative process. However, this phase was also characterized by working towards finer detailing and the final deliverable, namely a visual and user experience prototype. The main steps that were taken into creating a more realistic design are listed below.

- 1 The concept review (pp. 45-46) pointed out that the selected concept for the Mini Flow had several issues which had to be validated and solved. Therefore, this phase was started with the reassessment of the concept focusing on its overall size, weight and water reservoir.
 - 2 The ergonomics of the Mini Flow were reassessed. A lot of research was spend into design and validating the positioning and feedback of buttons, as well as the hold and grip of the water flosser.
 - 3 Parallel to the previous step, several key features of the Mini Flow, which are also shown in *Figure 4.2* were designed and tested. On/Off switch, Jet Tip
 - 4 rotate button, Jet tip release button and the water plug of the water reservoir were had become the main visible features with which the the user would also have the most interaction.
 - 5 Manufacturing possibilities: Draft, part complexity, and fixtures between parts were more clearly defined. Injection molding was chosen as a main means of fabricate these parts. These points were only considered on a basis level, but would contribute greatly to the manufacturability of the product.
- Product tonality; the selection of materials, colour and surface finish which would attribute to obtaining the desired product semantics.

In this phase the transition was made to Computer Aided Design (CAD), translating the numerous sketches and shape models of selected concept into

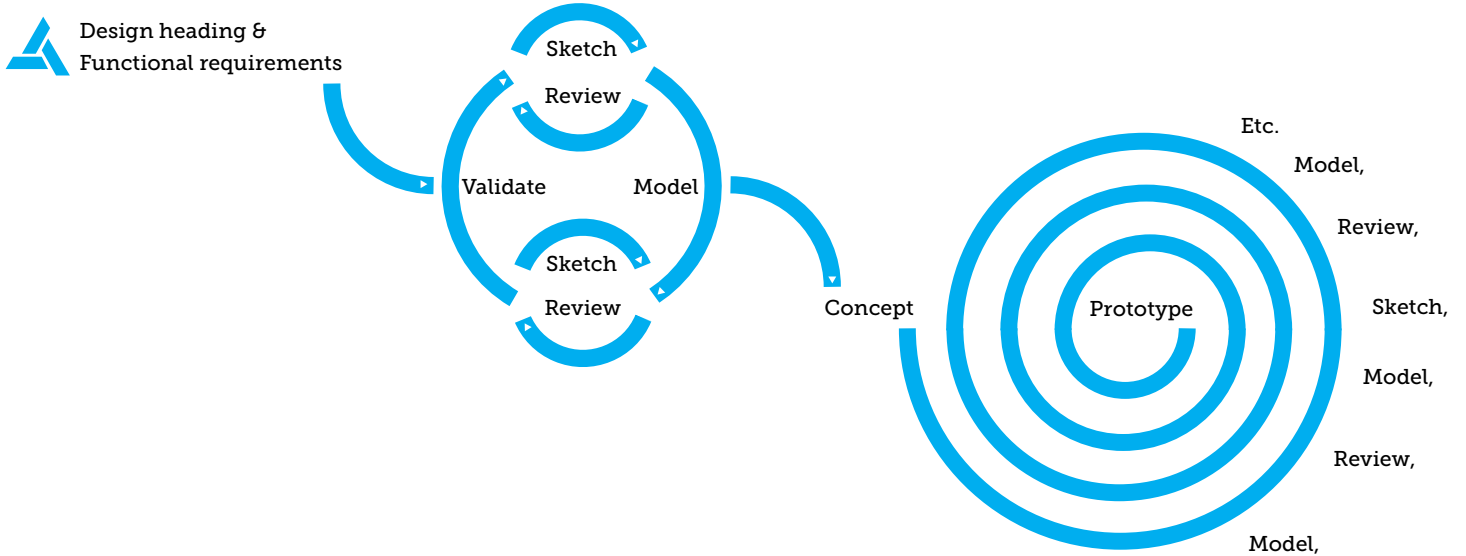


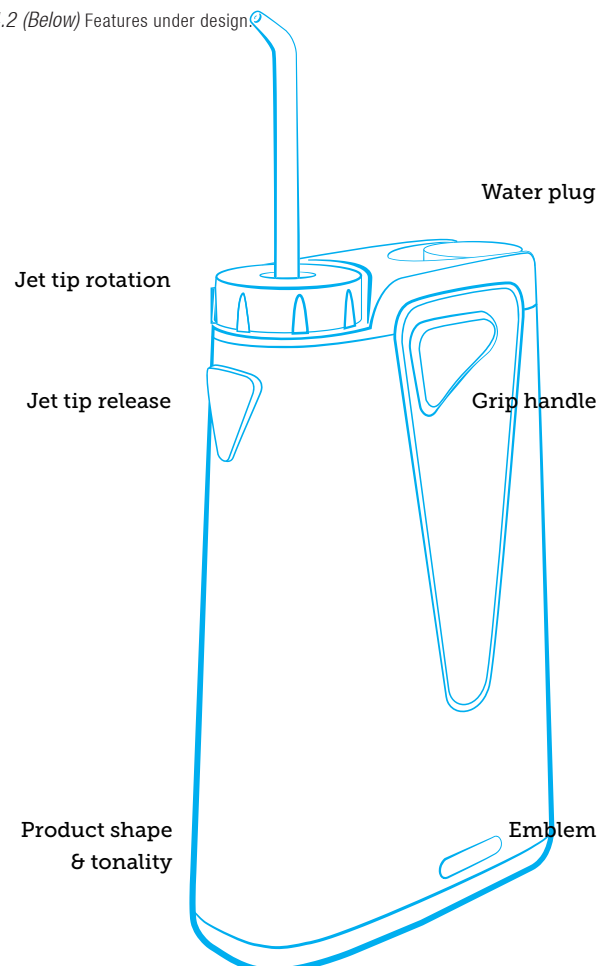
Figure 4.1 (Above) Diagram showing the spiralling generation and verification process conducted during the **DETAILING** phase.

Figure 4.2 (Below) Features under design.

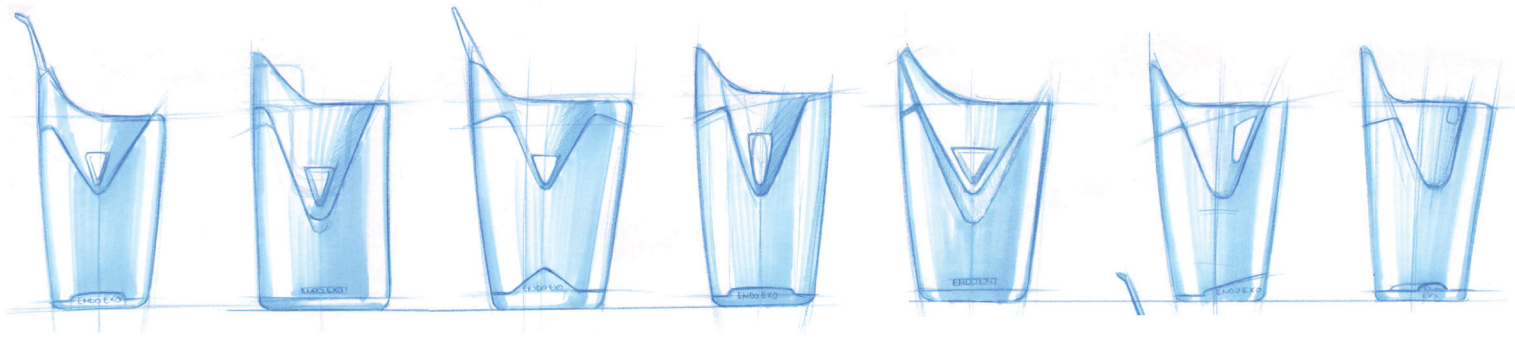
4.1 FEATURES UNDER DESIGN

Figure 4.2 shows the features of the Mini Flow design which were defined during detailing phase, to further optimise the concept and create a realistic design which met the functional requirements. These features are discussed in the following paragraphs and **Appendix XI SKETCHES OF DETAILS**.

4.1.1 SHAPE OF DESIGN As noted earlier the biggest issue coming out of the concept review was that a compromise had to be found between the capacity of the water reservoir and its influence on the size, portability and ergonomics of the product. Figure 4.3 and Figure 4.4 shows several steps in the design process to optimise the design and find the balance. The main shape of the initial Mini Flow underwent a lot of iterations and alterations. The design had to retain its signature handle and switch location as much as possible while increasing the water capacity to 250.0 millilitres. Several significant changes would be visible in this detailed concept in comparison to its initial concept.



- Shape of the profile was mirrored (see Figure 4.6). This shape provided a number of benefits, namely:



- 1 The slimmer shape on the top of the Mini Flow is better to hold, because the top was slimmer.
- 2 The grip shape would have to cut less into the interior space, therefore the water capacity could increase and the interior space for the system could be used more efficiently.
- 3 The larger footprint increased the stability of the product.
- 4 This design alteration did not influence the complexity of the part and the possibility to be produced, since the draft was retained and only small alteration in the interior design would be required.

- Shape of the grip handle a part would be one of the main features on this product, initially caused issues regarding the interior space of the Mini Flow concept. Some new study through shape CAD modeling, sketching and small scale usability testing were done to reassess the hold and feeling of the grip handle. New solutions and shapes were discovered. Several CAD models were made looking at different shapes and their placement on the product and their influence on the interior space.
- It was reaffirmed that the placement of the On/Off switch would be great influence in the comfort and the hold. This investigation also aimed at optimizing the feedback of the button(s) which would be influence the comfort and usability of the Mini Flow. Several shape models where outfitted with a switch in order the test the feedback. While the switch would be covered by a silicone rubber layer in the final design it provided insight in the how accurate and much pressure the user had to apply on the switch and where. The switch itself would have a 'clicking'-like feedback. Clicking it once would start the product and another click would turn it off. It would not matter if the right or left button is pushed.
- To account for production and assembly and Endo Exo's requirements regarding the production the grip was simplified, while keeping the same feeling. This meant the a separate part of silicon rubber would be connected to the main shell of the Mini Flow instead of making the rubber and shell one part, which would require a different production process, like duel injection molding.
- The concept was to organic and 'undefined' in Endo Exo's sense and needed to closer match the design style of Flow. Therefore the design was 'straightened' and the lines were more defined. Also the triangle were used as reoccurring shapes in the design (Also see *Figure 4.10*) and super ellipse was used to optimize space, but still make the design look smooth and not to manly. The manner in which the jet tip 'flowed' into the rest of the product (also

see *Figure 4.3*, *Figure 4.4*) was altered, because it made the product look less portable and big impression. Also the rotation of the jet tip was difficult to incorporate in a way that was desirable, as will be discussed later in this section on p. 63.

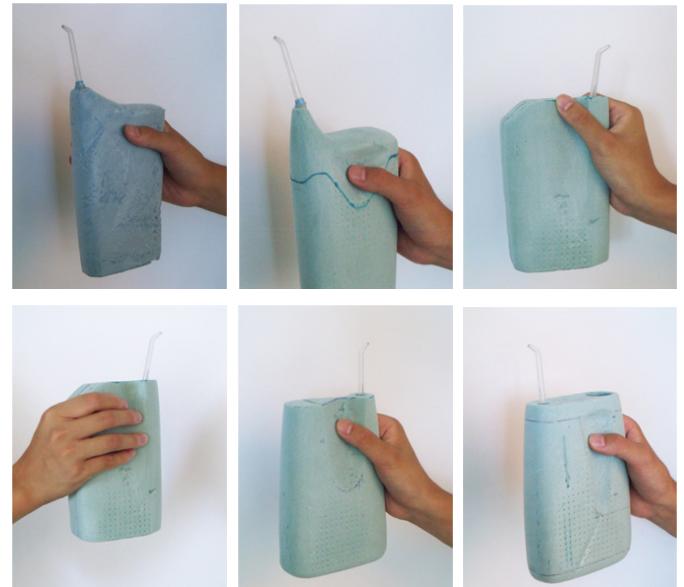


Figure 4.4 Shape models

Figure 4.6 (Right) This picture shows the steps in shape models. From the back to the front, these models led to the final shape of design. The main difference is the profile.

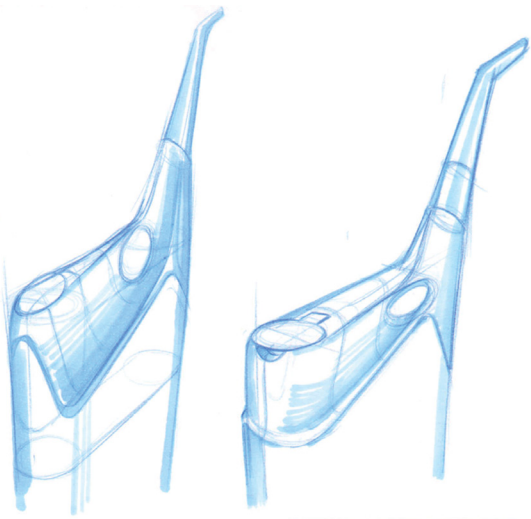


Figure 4.3 (Above) Further shape exploration of the Mini Flow Z concept.

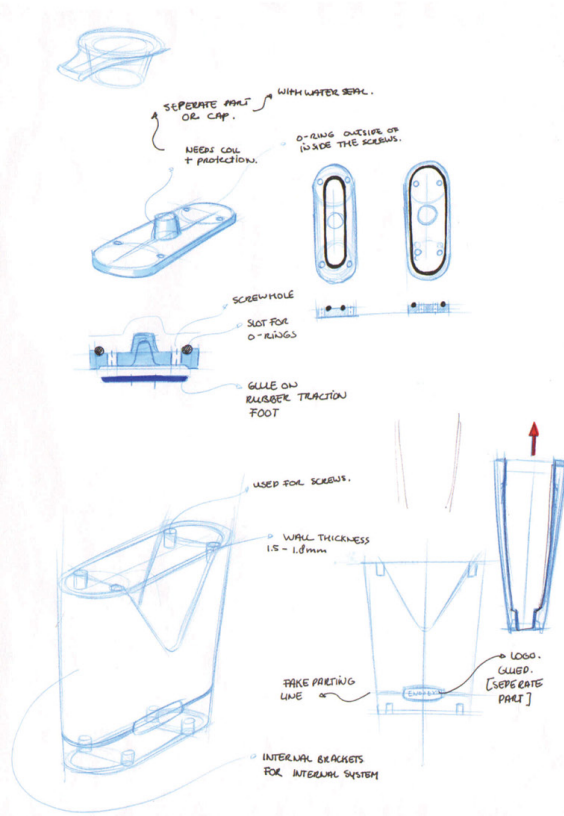
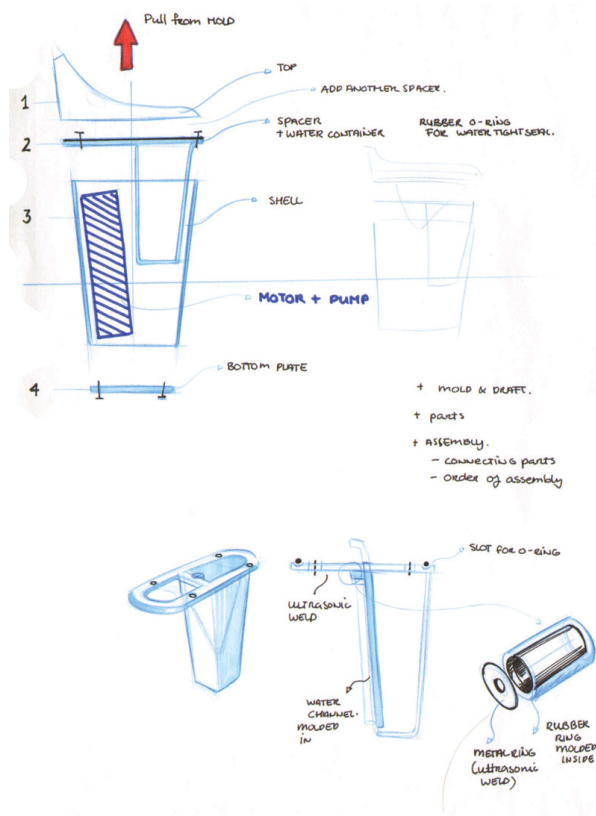
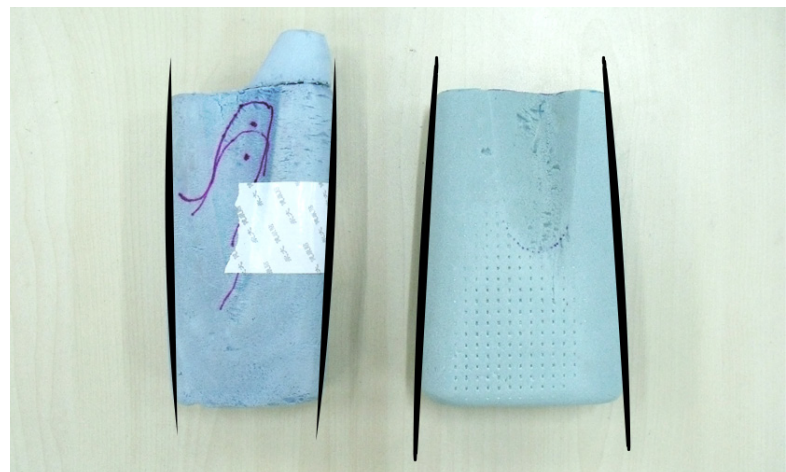
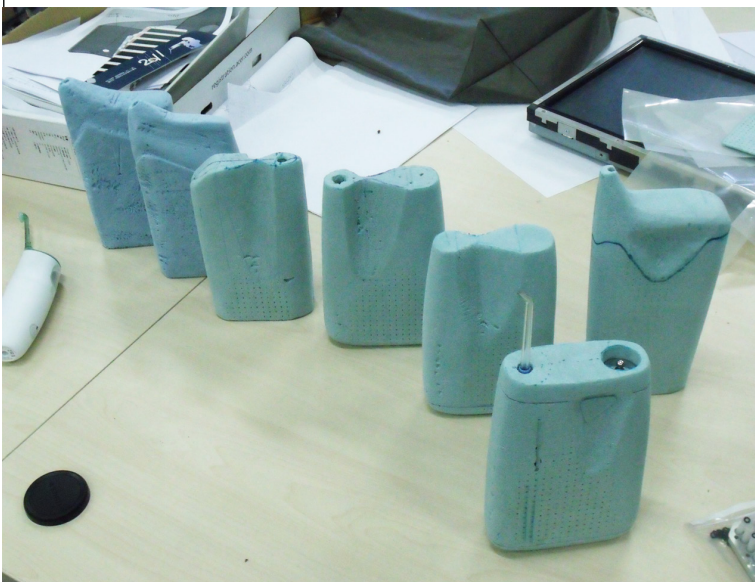


Figure 4.5 Illustrations regarding the manufacturing of the Mini Flow, focussed on number of parts, assembly and draft.



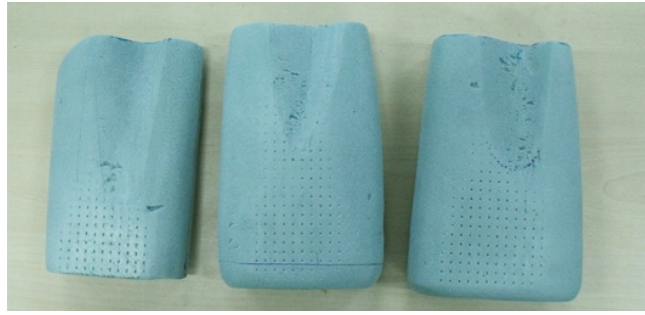
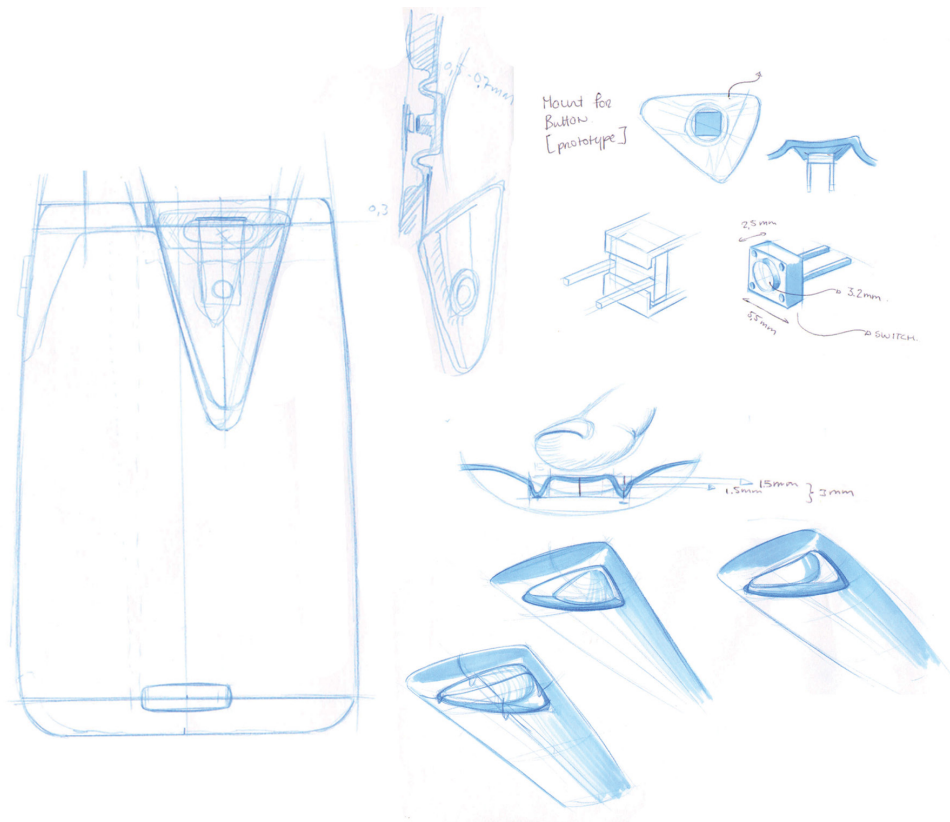


Figure 4.7 Exploration of the 'mirrored' profile shape.



Figure 4.8 Sketches regarding the On/Off switch



Figure(s) 4.9 Renders of the Mini Flow CAD model.



4.1.2 FEATURES OF DETAIL The general feeling with which the different details of this product were designed was Simplistic, original, relaxed, friendly, integrated and seamless. Several reference products are shown in *Figure 4.8* and in **Appendix VII MINI FLOW STYLE GUIDE**.

Jet tip–related buttons Besides the On/Off switches which were incorporated in the grip handle of the Mini Flow two other buttons: the jet tip rotation button and jet tip release button; were incorporated in the design. These buttons have a similar shapes as the On/Off switch (*Figure 4.8* and *Figure 4.10*), creating a coherent design style.

- Jet tip rotation button: In order to keep the symmetrical circumference and the top face level the button was made to look as part of the main shape. A detail of this button is the grip which provides traction to the user fingers while rotating the button.
- Jet tip release button: It was placed in line with the jet tip rotation button and jet tip. When this button would be pushed the jet tip will be released and pop up, so it can be removed. The location of this button is out of reach of the 'holding hand', but still near to the jet tip, since removing the jet tip will require another hand if the user is holding the Mini Flow.

Water plug The water reservoir needs to be accessed in order to be filled. Placing a hole on the top of the Mini Flow allowed the user to place the Mini Flow under the water tap.

Figure 4.11 shows several sketches for a water plug. Its design was inspired by the combination of a sink stopper and a wine stopper of which several different designs.

Some sink stoppers are attached to the sink through a chain in order to prevent misplacement or loss. The water plug is only 30.0mm in diameter and has a similar feature being connected to the bottom of the water reservoir by a rubber line. The surfaces funnel around the water plug and allow for easy access by thumb and index finger. The shape also allows the water plug to be hung over the edge while the water reservoir is filled (see *Figure 4.9*).

Emblem Another feature that contributes to Endo Exo's sense of premium quality as well as establishes the brand is the emblem on both side faces of the product. Several methods of incorporating the emblem into the design of the Mini Flow are shown in *Figure 4.9*. Similar to the images in *Figure 4.12* showing various emblems it would be an eye-catching design feature.



Figure 4.10 (Above) The characteristic triangle shapes are highlighted in this picture of an prototype.

Figure 4.11 (Below) Design sketches for the water plug which was inspired by wine stoppers of Eva Solo and Silit and bathroom sink stoppers.





4.2 PRODUCT PRESENTATION

Endo Exo wanted to provide the consumer with a premium product. Product tonality is a part of the design style that attributes to a sense of quality, as well as incorporates the product's semantic values as stated in paragraph 2.4.2 DESIGN HEADING (pp.30-3) In general the products semantics that the product's appearance should relay the following feeling(s):

“The Mini flow is handheld , portable devise, the design must exude maturity, originality and relate to frontier tech in a natural and casual way. A premium quality product, which is clean, fresh and provide a clear usable experience.”

The product tonality was split into three elements; material, colour and surface finish. The colour tonality was described as following: Tones are light and calm with a splash of colour. Colour shows action points of the product. The different materials were used as a method to increase the readability of the product. An example is the selection for silicon rubber for the grip handle and button.

Figure 4.14 shows several different colour compositions. The 'white and grey' colour scheme was selected for the prototype. This colour scheme was considered the safest choice since it would relate the best to the target user as well as Endo Exo's sense of premium quality. Table 4.1 shows the further detailing of the material, colour and surface finish that were selected for each of the parts for both the prototype as the final product.

In this colour composition pure white was the dominant colour with a rough surface finish similar to that of the Philips Sonicare AirFloss shown in Figure 4.15. There were several reasons for this:

- Is a colour distinctive for oral care products, because is relays a clean and fresh impressions, as well as refinement, this could be linked to premium quality.

- Consumer rather buys a white product than a coloured one and has a commonly used color for products, because it reflects conformity and passivity.
- Endo Exo's Flow stationary water flosser is also available in white and it created consistency in the product line.

Aside from the main colour a supplemental grey-tone was used on several areas. These are the areas where the user interacts with its fingers like the grip, jet tip rotation button, jet tip release button and the water plug. These parts were made off silicon rubber and given the same colour and surface finish. Besides being a visual cue and creating a consistent tactile experience the rubber surfaces also provides extra grip, for when the product or the user's hands are wet.

Fresh, Pure, Clinical





Figure 4.13 Images of products which portray the surface and detail tonality of the Mini Flow.

Figure 4.14 Several colour variations connected to feelings. The white body with the dark grey details was selected for the prototype.

Mature, Neutral, Contrast,

Depth, Mysterious

Deluxe.



Archetype, Young, Cool

Contrast.





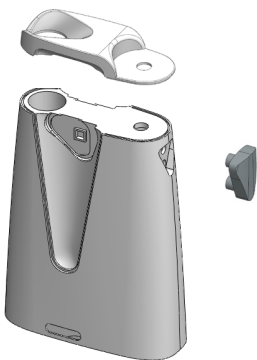






Figure 4.15 Close up pictures of surface treatments which give a clean, calm and ceramic feeling.



Figure 4.16 Shavers of Philips served as reference for the surface treatment of the silicone rubber parts of the Mini Flow among other products.



	Part	Material	Colour	Surface
	1 Jet tip rotation button*	ABS** & Silicone rubber	Pure white*** & Pantone 431 U	n/a
	2 Water plug*	ABS & Silicone rubber	Pure white & Pantone 431 U	n/a
	3 Top cover	ABS	Pure white	Also see Figure 4.15 Dull ceramic feeling
	4 Jet tip release button	Silicone rubber	Pantone 431 U	Also see Figure 4.16
	5 Main shell	ABS	Pure white	Also see Figure 4.15 Dull ceramic feeling
	6 Grip handle (left)	Silicone rubber	Pantone 431 U	Also see Figure 4.16
	7 Grip handle (right)	Silicone rubber	Pantone 431 U	Also see Figure 4.16
	8 Emblem (x2)	Aluminium	n/a	Hand-brushed Laser engraved with 'Endo Exo' logotype
	9 Bottom cover	ABS	Pure white	Also see Figure 4.15 Dull ceramic feeling

*Also see **Appendix XII ASSEMBLY: Jet tip rotation button & Water plug** for more information regarding the components and material, colour, surface treatment selection of these parts.

** Acrylonitrile butadiene styrene

*** Pantone code for pure white was not available.

Table 4.1 Diagram containing the parts of the Mini Flow and the material, colour and surface treatment selection.

4.3. FIRST PROTOTYPE

Figure 4.17 shows several pictures of the prototype of the Mini Flow. The prototype was utilized to capture the intended design aesthetic and simulate the appearance, color and surface finish of the intended product, but did not embody many of the functions of the final product like the system that delivers the water jet stream. The functions which were included were to invite for active human interaction. The model allowed for assessment of how a potential user interacts with various elements, motions, and actions of a concept which defined the initial use scenario and overall user experience. The prototype allowed in identifying any problems and potential risk with the design.

In general the prototype differs from the final production variant on two points.

- 1 As shown in Table 4.1 the prototype was primarily made out ABS and silicon rubber. These materials were initially selected to substitute or simulate the texture of those of the final production design. The selection for these materials was also because of different production processes which were utilized to fabricate the prototype.
- 2 Final production design requires extensive effort to capture high volume manufacturing detail. Such detail was not necessary for prototype as some refinement to the design was to be expected later. Therefore the prototype was built using very limited engineering detail as compared to final production intent, which would require statistical process controls and rigorous testing.

Some features were still under design and not clearly defined, therefore simplified or not fabricated into the prototype.

- Since the internal structure was still under design during the fabrication of the prototype, the internal structure was simplified, and the 'bottom cover' part was made detachable, so it could be fitted which a simple model of the internal system at a later point.
- While the design for the lid for the water reservoir, as shown in Figure 4.18, the exact fixture between the lid and the water reservoir was not designed.
- A simple mechanical fixture was used, which was less exact than that of the production design.
- The 'bottom cover' part was simplified and did not include the connection to the charging dock and the rubber feet.
- The jet tip release button and jet tip rotate button are part of the system architecture. The jet tip release button had no functionality aside from the

appearance, and the jet tip rotate button was made semi-operating.

- Other fixtures between the various parts were simplified and replaced by glue of inaccurate screw connections.



Figure 4.18 (Right) Various size comparisons between the Mini Flow and other water flossers. From left from right± Waterpik, Mini Flow, Flow stationary water flosser, Mini Flow, Waterpik, Candeon, Mini Flow and Philips Sonicare AirFloss.



Figure 4.19 (Above) 1:1 scale picture of the On/Off button.

Figure 4.17 (Below) Several pictures of the Mini Flow prototype.



	Functionality required	Mini Flow Prototype
Height (including jet tip*)	200.0mm (270.0mm)	180.0mm (250.0mm)
Footprint	50.0 x 50.0mm	100.0 x 40.0mm
Internal space for system	120.0 x 30.0 x 30.0mm; and for the battery 70.0 x 15.0 x 30.0mm	140.0 x 40.0 x 35.0mm
Water capacity	230 mL	270 mL
Weight filled with water	500.0 g	Estimated at 570.0 g (Weight of prototype: 300.0 g)
Production remarks		
Estimated number of parts	No requirement(s)	13
Method of producing	Injection molding	Injection molding
Methods of fastening	No requirement(s)	Ultrasonic welding, screws, flanges, hook connections and adhesive tape
Appearance	1. Convey values Endo Exo and Water Flosser 2. Product must contain the 'Endo Exo' logotype. 3. Comfortably rest in the target user's hand and be handles by the user without any discomfort.	1. Appearance conveys the design styling and premium appearance of Endo Exo. 2. The product contains an emblem with the 'Endo Exo' logotype. 3. To be tested on a larger scale.
Features		1. The product has several buttons including: two On/Off switches in each grip handle, and a jet tip rotation and release button. 2. Space is saved for the presence of an induction coil for the induction charging.

* The length of jet tip is 70mm.

Table 4.2 Comparison of between some key functional requirements and the prototype.



4.3.1 PROTOTYPE REVIEW The prototype which resulted from the CAD model was reviewed with the stakeholders. This review led to a series of conclusions which are discussed below. Recommendations based on these conclusions are given in the following chapter.

The appearance of the design fits within the design heading, and the functional requirements regarding the water reservoir, size dimensions are met these figures and measurements of the prototype are listed in *Table 4.2*.

- A size comparison (*Figure 4.19*) shows that the prototype is smaller than the Waterpik and Candeon waterflossers, but bigger than the Panasonic water flosser.
- The weight of the prototype is close to 300 grams taking into account the weight of the system. Adding the water results in total weight of the Mini Flow would be close to 570 grams. This would not strain the user too much.
- The shape of the grip and On/Off switch guides the user to hold the Mini Flow incorrectly. This way of holding strains the user. *Figure 4.20* shows the several unintended ways of holding and the intended hold the product. Holding the
- product as intended does offer the user enough control and feels comfortable, provide the weight is as adequate. The surface textures of these rubber areas should provide more traction to account for wet surfaces. However, the jet tip rotation button is harder to reach by holding it as intended.
- The placement and feedback of the On/Off switch is comfortable. The shape of the button should however be altered to better guide into the way the Mini Flow should be hold.
- The method by which the water plug is implemented into the design seems to work. However, the exact shape of the closure needs to be detailed.
- The jet-tip rotate button as is shown in *Figure 4.21* is hard to reach by the thumb of the hand with which the product is hold. By shifting the hold in some cases the button can be reached with the index or middle finger. The grip pieces on the rotate button are spaced to far apart and protrude too little. The button is unstable and swivels, this is due to the fitting and the method by which the part is mounted. The button is hard to rotate, because the rubber connection of the grip pieces caused friction.
- The front face of the jet-tip release button does not have a smooth curve, as would be more fitting in the design (see *Figure 4.22*).
- The emblem containing the 'Endo Exo' logotype which is shown in *Figure 4.18* does not fit in the rest of the design of the Mini Flow.
- The product lacks a 'Mini Flow' logotype. Endo Exo expressed a desire for this logotype to placed somewhere on the products additional to the 'Endo Exo' logotype.

- The charging dock of the Mini Flow is under design, but the Mini Flow does not have any method of feedback, like a LED light, to indicate to the user that is needed charging or was being charged.

- The initial impression is that the parts are able to be injection molded and safely removed from the mold. Also, while not all connections between the parts have been detailed adequate and realistic solutions are present.

Figure 4.20 (Above) The left picture shows the intended way of holding, while the middle and left image show unintended ways the product was hold by test-users.

Figure 4.21 (Below) The jet tip release button can either be reached with the thumb, index or middle finger .



Figure 4.22 The surface of the jet tip release button is not smoothly curved.

CONCLUSION

"Make it simple, but significant." DON DRAPER, *MADMEN*



Figure 5.1 The Mini Flow.

This chapter gives an overview of the deliverables which resulted from the design process, and these are evaluated. Out of this evaluation several conclusions and recommendations can be presented to Endo Exo and MADE Innovation regarding the current design of Mini Flow water flosser and the further development. Also, several insights are summarized based on the design process for the design of Mini Flow.

5.1 EVALUATION MINI FLOW

5.1.1 PRODUCT FEATURES The Mini Flow as shown in *Figure 5.1* is a water flosser which allows the user to floss his or her teeth with a stream of water that removes plaque and food debris between teeth and below the gum line and features the following features

- A system consisting out of a rechargeable battery, a motor and pump. This system produces a water stream and by sucking water from its 250 mL water reservoir included in the product's design. This is enough for 30 seconds of flossing of the advised 60 seconds of flossing per day.
- A set of ergonomically placed on/off switches on both sides of the Mini Flow. This allows both left- and right-handed users to operate the product.
- Additional to the on/off switch this product has two other buttons, which are used to operate the jet tip, namely: A rotation button which can be used to rotate the jet tip, to better reach space inside the mouth; and a release button, which allows the jet tip to be removed and/or switched for another type of jet tip.
- The Mini Flow also includes sink stopper-style water plug which is located on the top and can be accessed to fill the water reservoir, this water plug is connected to the inside of the water reservoir so that it cannot get lost if removed.
- A premium appearance which incorporates simple and clean lines and shapes to create an ergonomic product, but retain a portable design (175 x 100 x 40 mm).

The design for the Mini Flow as presented in this design report is not ready for production. Several aspects of the product are still under design including the

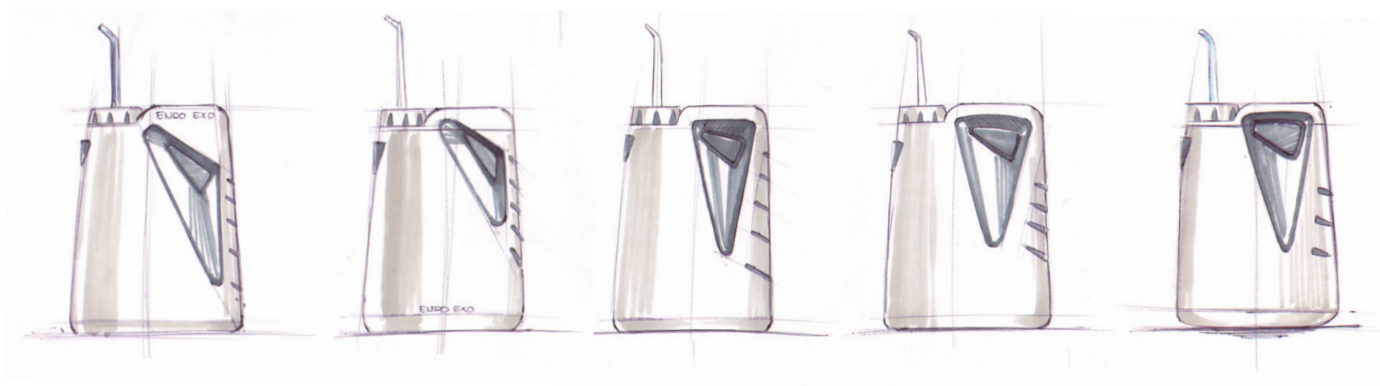


Figure 5.2 Ideation sketches for improving the hold and grip on the Mini Flow, by altering the shape of the grip handle and on/off switch and adding more parts of grip.

integrating of the following functions.

- The product produces a water jet stream which can clean debris from and between teeth.
- The product contains water and be able to be refilled.
- The product contains an own power supply which can be recharged.
- The product may not cause harm to the user or others.

The mechanisms that make these functions possible and make up system architecture have to be designed, selected and tested. This will also lead to several design alterations to be made into the existing structure. Also, the buttons which help in operate the system need to be made fully operational. Other parts of the design were verified through a prototype and these conclusions were discussed in 4.3.1 PROTOTYPE REVIEW (pp. 62-63).

5.1.2 RECOMMENDATIONS Based on the review of the prototype of the Mini Flow several recommendations can be given. These recommendations also suggest how to deal with key issues which were discovered.

In general during this development process the only limited user tests were conducted. Further validation of the product should be conducted, in order to assess the usability of this product on a larger scale. At this stage these tests are confined to several aspects, because of the limited functionality of the prototype. Several other prototypes will be manufacturing the near future, which will be fully operation. Other recommendations specifically focussed on the design of the Mini Flow are mentioned below. Aside from assessing the usability of the Mini Flow these test should also focus on validating the needs, wants and wishes of the consumer or user and which product features they find most important when deciding to buy a portable water flosser.

The current design is unclear for the user where and how the product should be held. The current design is in a sense misleading because it gives the user the impression to hold the product in a way which is straining. This is caused by the weight of the Mini Flow which is close to 700 grams. By altering the shape of the grip and adding extra grip parts on the body of the Mini Flow as is shown in Figure 5.2, the way to hold the product would be more defined and clear to the user. However, these alterations would make the mold more complex, as well as the way the part will have to be removed.

Based on some study of the prototype and the system architecture by an engineer at MADE Innovation, the architecture of Panasonic EW-DJ40 after which that of the Mini Flow is modelled can be made more compact. Possibly, this can lead to a decrease in some of the Mini Flow's dimensions. However, the water capacity should be maintained.

The jet tip rotation button was hard to reach by the thumb of the hand with which the Mini Flow is held. Several things that be altered in the design of this button to make it better to reach and be operated are:

- Make the spacing between the grip pieces smaller by adding two or more pieces.
- Make the grips pieces protrude more around probably 0.5 to 1.0 mm more.
- Increase the spacing between jet tip rotation button and top cover to small by 1.0 to 1.5 mm.
- Make the size of contact surface between the rubber connection of the grip pieces caused friction and the top cover smaller.

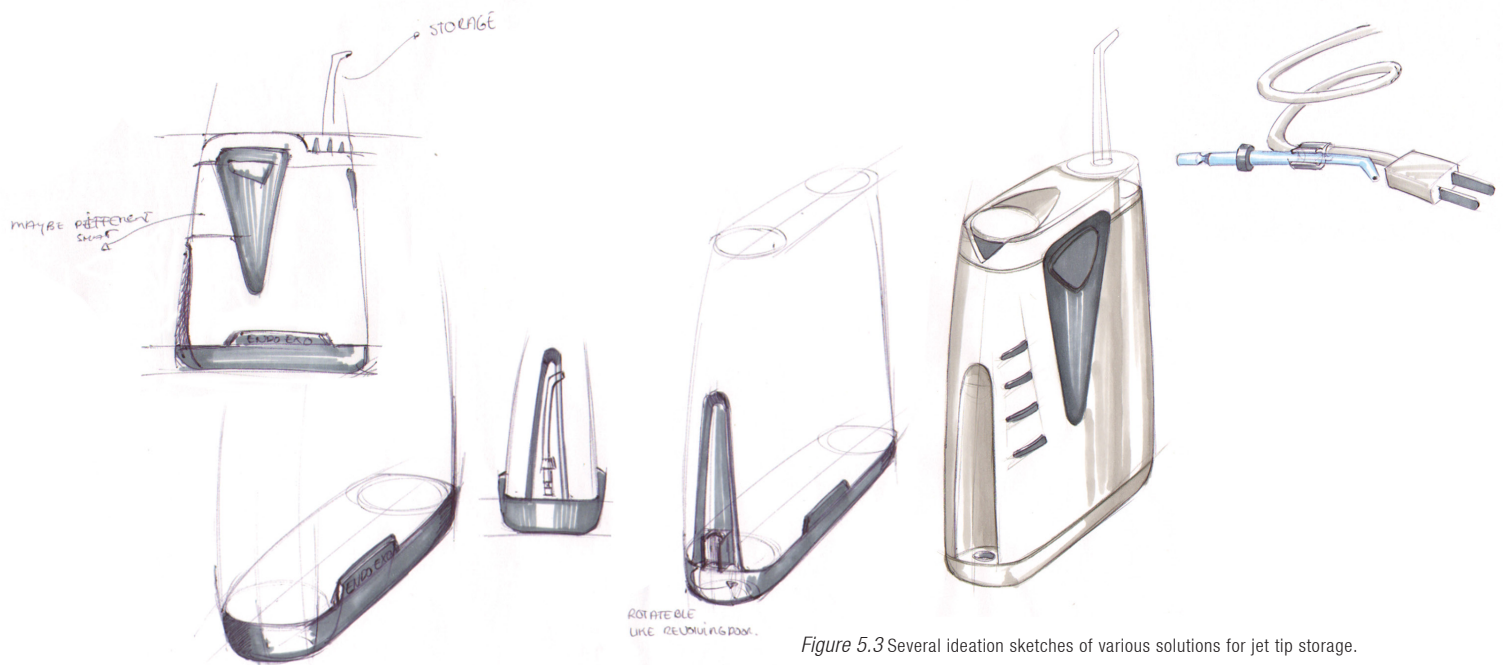


Figure 5.3 Several ideation sketches of various solutions for jet tip storage.

The storage of the jet tip would enhance the usability as well as the portability. The design presented in this report does not offer any solution. However, based on the review of the prototype several options exist to incorporate a storage space in/on the Mini Flow for a jet tip. These solutions, as listed below, are discussed in order of best applicable.

- 1 Create a space in one of the sides of the Mini Flow, as illustrated in Figure 5.3, where the jet tip can be clamped/clicked in. This space will cut into the existing structure and decrease the internal space. This causes the space for the system or the water reservoir to decrease.
- 2 Also shown in Figure 5.3, a clamping connection can be added to the power cable of the charging dock, which has an additional clamp/click connection for a jet tip.
- 3 Provide a storage location in the charging dock instead off on/in the Mini Flow.
- 4 A hollow space can be made inside to water plug. This requires the rubber connect wire between the lid and the water reservoir to have a larger circumference in order to account for the circumference of the jet tip. Also, this solution required an alteration to the jet tip. The angle in the jet tip has to be removed making the jet tip have a straight shape.
- 5 Similar to the previous solution the jet tip can also be housed inside the Mini Flow through jet tip rotation button. This requires the water channel to be lengthened and possibly requires a rearrangement of the system inside the Mini Flow. This solution also requires the same alteration in the jet tip as noted at the previous solution.

The 'Endo Exo' emblem is too clearly visible and that does not fit the styling of the Mini Flow (Figure 5.4). A solution which fits the current design more is embossing the logotype, either raised or sunken in the main body. Shown

in Figure 5.5, the embossed letters could best be raised, it attracts less dirt. The letters could also be coloured. A similar method can be used for the 'Mini Flow' logotype, which is best placed on the top cover of the water reservoir lid. In order to create a consistent brand identity it is advised to choose one way of branding for the Flow products. This means that instead of utilizing 'Mini Flow' on the product, it is better to use 'Flow'. Similar to what is shown in Figure 5.5. Sonicare is the sub-brand and its parent-brand is Philips. Also, it could be better to place 'Flow' and 'Endo Exo', or "Flow by Endo Exo" close together on the product.

Charging dock As was discussed in this design report the Mini Flow is to have a charging dock and functional requirements were listed. However, the design of this charging dock was found too extensive, and was cancelled from this bachelor assignment. Based on the initial investigation that was done during the ideation the following ideas for a charging dock are recommended below. Some sketches illustrating such a charging dock are found in **Appendix XIII IDEATION CHARGING DOCK**.

- The charging dock would charge the Mini Flow through induction charging.
- The design recharging dock should simple and act as a plate for the Mini Flow. It should be a stable platform on which the Mini Flow is easily placed. Adding a suction-cup on the back of the charging dock would be a method which can provide stability on wet surfaces. A silicon rubber could also be foot placed on the bottom of the charging dock.
- Incorporate a means of storage for the jet tips.
- To have no "hassle" with the power cable the charging dock could incorporate a coil up system similar to that of a vacuum cleaner.



Figure 5.4 Close up of the 'Eudo Exo' emblem located on the Mini Flow. Note that the actual logotype should have been 'Endo Exo'.

Figure 5.5 Several examples of logotypes on products including; Jeep, Nikon, Samsung and Philips Sonicare.

5.2 EVALUATION PROCESS

The deliverables of this bachelor assignment were the following:

- A design heading with complementary list of functional requirements. Based on design tasks: like market research, expert and user interviews and benchmarking this list will be generated and discussed with the stakeholders.
- A large array of solutions and ideas for the Mini Flow. Besides using these ideas for this Mini Flow, Endo Exo is also interested in extreme ideas to indicate opportunities for possible future Flow products.

The design of the Mini Flow. Focussed mainly on the appearance, portability and usability of the product as well as an indication of system architecture. Also, this product would also have to contribute to and help define Endo Exo's design identity.

- A CAD model of the design which will serve as both a method of verification, validation and a reference for the mechanical engineers to develop the system of the Mini Flow.
- Several shape and semi-working prototypes of the design. This prototype is tested and verified. Based on the results the design will be further detailed and prepared for production
- A design report of the development process conducted during this bachelor assignment.

These deliverables were all been delivered during this bachelor assignment, the most important of which is the design for the Mini Flow, which was evaluated in the previous section of this chapter.

The design process that led to these deliverables was split into three phases, namely: **ANALYSIS** (pp. 16-35), **DESIGN** (pp. 36-47) and **DETAILING** (pp. 48-63).

The Analysis phase was clearly defined and had a clear end deliverable; the design heading and functional requirements. However, this analysis was conducted into a too short time span to come to any hard substantiated insights and the available resources provided only limited information.

The Design phase would have had a similar clear end deliverable: Several concepts out of which one was selected for further development. While one concept was selected the process that followed during the Detailing phase could and should interpreted as a continuation of the design phase, since several step were taken back, reassessed and redone. This was because the functional requirements at several points failed to quantify into a clear measurable performances and moved more towards suggestive and relative design. Apparent examples of this are the usability and appearance requirements for the Mini Flow. Since the water flossing market is a very specific market recovering "hard" data to create a more objective basis from this design was only partly possible given the time limit and available resources.

Another reason was that the design process itself generated insights which were and could not have been obtained through the Analysis phase. This caused functional requirements to be reconsidered and this bachelor assignment to take longer than the planned three months period.

During the Design phase a lot of solutions and ideas were immediately validated. This was possible because the nature of this design focussed for large parts on the usability, appearance, size and weight. All these aspects could easily be tested by generating shape models.

Detailing phase, as noted earlier, required some backtracking and critically look at the selected concept. Coming to a design compromise and finding a balance between the water reservoir, size and ergonomic and appearance

took the most time during this phase. After this design compromise was resolved the detailing of the smaller features like buttons and water plug followed naturally.

5.2.1 RECOMMENDATIONS During the design process for the Mini Flow several insights were gained which could prove useful in the following phases of the development after the conclusion of this bachelor assignment or in future Flow projects.

Throughout this design process ideas and solutions were generated which were out of scope for this project, but could inspire new Flow products. It is recommended that the sketches and documents are saved and used as inspiration for future flow projects. One idea in particular was the MINI FLOW Y concept discussed on p. 43. While this idea did not meet the functional requirements for the Mini Flow, this concept has potential as a Flow stationary water flosser.

As has been verified during this design process several times is that the design is greatly by the water reservoir and capacity. The Mini Flow X concept sort of eliminated the water reservoir by the possibility to place it under a running water tap. Since the water flosser always needs a water to operate, it will almost often be used near a source of water. A future Flow product could therefore utilize a solution which deletes the necessity for a water reservoir.

As has been mentioned in this design report several times portability is a key feature of a portable water flosser. However, this is a semi-relative concept. Of the competing portable water flosser, the Panasonic EW-DJ40 is a portable product since it can be made to be around the size of an electric toothbrush or shaver. The collapsible structure was found to be the best solution possible within the scope of the project. However, portability alone does not make that the user takes it along on travels. Usability and performance are also important aspects, as well as the desire for the user to floss while away from home. Several components of usability were listed in paragraph 2.4.3 FUNCTIONAL REQUIREMENTS (p. 32).

In order for this product to be successful on the market the Mini Flow needs to be recognized as a health improving product. This means that the Chinese consumer has to be persuaded and convinced that water flossing not only helps in maintaining a good oral health, but also a person's general health. Marketing and product placement will therefore be important aspects to be considered. The Mini Flow needs to be recommended by professionals,

like dentists and orthodontists in order to be taken seriously and gain larger market. This could also mean that these professionals could become Endo Exo's main channel of sales.

The technology and system inside the Mini Flow which provide the stream of water are very simple and in essence the same as most other portable water flossers on the market. To differentiate between the products and still be a unique product, usability and appearance become key aspects to consider when designing a portable water flosser. Also, creating a consistent quality and provide a good customer service would prove meaningful, especially for Endo Exo and Flow as starting brands operating between well-established brands.

Considering the points mentioned above it is advised that Endo Exo should focus on obtaining "hard" data on the market and its users and not pursue the immediate realisation of this design to a market-ready-product. Since Endo Exo is competing with well-established brands like Waterpik, Panasonic and Philips the consumer will be more inclined to buy from these brands and not a new brand. At this point the Mini Flow does not offer enough to differentiate itself from its competitors which would make consumers pick it over other flossing products, as well as the effective means to reaching her target users.

REFERENCES

- 1 *Amazon.com, Inc.* (2012). Customer Reviews Philips Sonicare HX8111/02 Airfloss, Rechargeable Electric Flosser. Retrieved 4 June, 2012 from <http://www.amazon.com/Philips-Sonicare-HX8111-02-Rechargeable/product-reviews/B004Y9AINC>
- 2 *Amazon.com, Inc.* (2012). Customer Reviews Panasonic Oral Irrigator EW-DJ10A. Retrieved 5 June, 2012 from http://www.amazon.com/Panasonic-EW-DJ10-A-Oral-Irrigator/product-reviews/B0027LSEPS/ref=cm_cr_dp_see_all_btm?ie=UTF8&showViewpoints=1&sortBy=bySubmissionDateDescending
- 3 *Amazon.com, Inc.* (2012). Customer Reviews Waterpik Waterflosser Cordless PLUS. Retrieved 5 June, 2012 from http://www.amazon.com/Waterpik-WP-450-20009320-Waterflosser/product-reviews/B000UWAWQU/ref=cm_cr_dp_see_all_btm?ie=UTF8&showViewpoints=1&sortBy=bySubmissionDateDescending
- 4 *American Dental Association.* (2006). Healthy mouth, healthy body. JADA, 137, p.563 Retrieved May 10, 2012, from http://www.ada.org/sections/scienceAndResearch/pdfs/patient_61.pdf
- 5 Beaglehole, R., Banzian, H., Crail, J., Mackay, J. (). The ORAL HEALTH Atlas. Mapping a neglected global health issue. FDI, World dental Federation. *ISSUU*. Retrieved 29 May, 2012 from http://issuu.com/myriadeditions/docs/flipbook_oral_health
- 6 Blijlevens, J., Creusen, M. E. H., Schoormans, J. P.L. (2009). How Consumers Perceive Product Appearance: The Identification of Three Product Appearance Attributes. *International Journal of Design*, 3(3).
- 7 *Candeon Technologies Co., Ltd.* (2008). Products. Retrieved 25 May, 2012 from <http://www-935.ibm.com/services/us/gbs/thoughtleadership/healthcare.html>
- 8 Chamorro-Koc, M., Popovic, V., Emmison, M. (2009). Human experience and product usability: Principles to assist the design of user-product interactions. *Applied Ergonomics*, 40(4), pp. 648-656.

- 9 Eggleston, K. (2012). Health Care for 1.3 Billion: An Overview of China's Health System. *Social Science Electronic Publishing, Inc.* Retrieved March 12, 2012, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2029952.
- 10 Guo, F. (2012). More Than Usability: The Four Elements of User Experience, Part I. *UX matters*. Retrieved 29 June, 2012 from <http://www.uxmatters.com/mt/archives/2012/04/more-than-usability-the-four-elements-of-user-experience-part-i.php>
- 11 *Healthcare4All*. (2012). Water Jet irrigators. Retrieved 30 May, 2012 from http://www.healthcare4all.co.uk/Water_Jet_Irrigators
- 12 IBM Business Consulting Services. (2006). Healthcare in China. Toward greater access, efficiency and quality. *IBM*. Retrieved 21 May, 2012 from <http://www-935.ibm.com/services/us/gbs/thoughtleadership/healthcare.html>
- 13 *Koninklijke Philips Electronics N.V.* (2012). Airfloss. Retrieved 30 May, 2012 from <http://www.usa.philips.com/c/airfloss/287417/cat/en/>
- 14 *Koninklijke Philips Electronics N.V.* (2012). Shavers. Retrieved 30 May, 2012 from <http://www.philips.co.uk/c/mens-shaving/18672/cat/>
- 15 Krippendorff, K., Butter, R. (1984). Product Semantics: Exploring the Symbolic Qualities of Form. Departmental Papers (ASC), University of Pennsylvania. Retrieved 26 June, 2012 from http://repository.upenn.edu/cgi/viewcontent.cgi?article=1040&context=asc_papers
- 16 Lin, H. C., Schwarz, E. (2001). Oral Health and dental care in modern-day China. *Community Dentistry and Oral Epidemiology*, 29(5), pp. 319-328.
- 17 Lin, Z. (2010). China to boost dental health awareness, appoints singer as advocate. *Xinhua, English.news.cn*. Retrieved March 12, 2012, from http://news.xinhuanet.com/english2010/health/2010-09/10/c_13489731.htm
- 18 Ling, R. E., Liu, F., Lu, X. Q., Wang, W. (2010). Emerging issues in public health: A perspective on China's healthcare system. *Public Health*, 125(1), pp. 9-14.
- 19 Lui, D. (2009). Strategic Program of "Health China 2020" Novo Thinking on Science & Technology-based Support (STBS). *Healthy China*. Retrieved May 21, 2012 from http://www.google.com.hk/url?sa=t&rct=j&q=healthy+china+2020&source=web&cd=2&ved=0CGYQFjAB&url=http%3A%2F%2Fwww.chinahealthpolicy.com%2Fupload%2Ftimimg%2F%25E5%2588%2598%25E5%25BE%25B7%25E5%259F%25B9_%25E5%2581%25A5%25E5%25BA%25B7%25E4%25B8%25AD%25E5%259B%25BD2020%25E6%2588%2598%25E7%2595%25A5%25E8%25A7%2584%25E5%2588%2592%25E7%25A7%2591%25E6%258A%2580%25E6%2594%25AF%25E6%2592%2591%25E7%259A%2584%25E6%2596%25B0%25E6%2580%259D%25E8%25B7%25AF%25EF%25BC%2588English%25EF%25BC%2589.ppt&ei=po25T4bwD-iQiAef3o3mCA&usg=AFQjCNFHvbOm b4irxZmW4H5h2zo1y34i5A&cad=rjt
- 20 *MADE Innovation*. (2012). MADE Innovation. Retrieved May 10, 2012, from <http://made-innovation.com/en/pages/>
- 21 New York Life Insurance Company. Medical News: Flossing to Longevity. (2006). *New York Life Insurance Company*. Retrieved May 14, 2012 from <http://www.newyorklife.com/nyl/v/index.jsp?vgnextoid=ed02e62f139d2210a2b3019d221024301cacRCRD>
- 22 Nielsen, J. (2012). Usability 101: Introduction to Usability. Retrieved 26 June, 2012 from <http://www.useit.com/alertbox/20030825.html>
- 23 Nokia. (2012). Benefits of usability. Retrieved 26 June, 2012 from http://www.developer.nokia.com/Resources/Library/Design_and_UX/designing-for-nokia-devices/usability-overview/about-usability/benefits-of-usability.html
- 24 Oraldent Limited. (2006). Powerfloss. Retrieved 25 May, 2012 from <http://www.oraldent.co.uk/powerfloss.html>
- 25 Paganini-Hill, A., White, S. C., Atchison, K. A. (2011). Dental Health Behaviors, Dentition, and Mortality in the Elderly: The Leisure World Cohort Study. *Journal of Aging Research, Volume 2011*. Retrieved May 21, 2012 from <http://www.hindawi.com/journals/jar/2011/156061/>

- 26 *Panasonic UK*. (2012). Products. Retrieved 25 May, 2012 from http://www.panasonic.co.uk/html/en_GB/8526226/module/general/compare/productsCategory.html
- 27 *Procter & Gamble*. (2012). Oral-B ProfessionalCare 8900 DLX OxyJet Center. Retrieved 2 June, 2012 from <http://www.braun.com/us/series-shavers.html>
- 28 *Procter & Gamble*. (2012). Series shavers. Braun Series shavers – Ultimate shaving performance and skin comfort. Retrieved 15 June, 2012 from <http://www.braun.com/us/series-shavers.html>
- 29 *UsabilityNet*. (2006). International standards for HCI and usability. Retrieved 26 June, 2012 from http://www.usabilitynet.org/tools/r_international.htm
- 30 *UsabilityNet*. (2006). Relevant international standards in usability and user-centred design. Retrieved 26 June, 2012 from http://www.usabilitynet.org/management/b_standards.htm
- 31 *Water Pik, Inc.* (2012). Water Flossers. Retrieved 30 May, 2012 from http://en.wikipedia.org/wiki/Oral_irrigator
- 32 *Water Pik, Inc.* (2012). Water Flossers. Cordless Plus Water Flosser. Retrieved 30 May, 2012 from <http://www.waterpik.com/oral-health/products/dental-water-flosser/WP-450/>
- 33 *Water Pik, Inc.* (2012). Water Flossers. Traveler™ Water Flosser. Retrieved 2 June, 2012 from <http://www.waterpik.com/oral-health/products/dental-water-flosser/WP-300/>
- 34 Woodford, C. (2012). Induction chargers. Retrieved 16 July, 2012 from <http://www.explainthatstuff.com/inductionchargers.html>
- 35 Xinhua News Agency. (2009). China unveils health-care reform guidelines. *China.org.cn*. Retrieved May 21, 2012 from http://www.china.org.cn/government/central_government/2009-04/06/content_17559519.htm

APPENDICES

I	PROJECT BRIEF	
II	PLAN OF APPROACH	(5)
III	TIME SCHEDULE	
IV	EXPERT-USER REVIEWS	(3)
V	HAND MEASUREMENTS	
VI	PRODUCT BENCHMARKING	(5)
VII	MINI FLOW STYLE GUIDE	(3)
VIII	FUNCTIONAL REQUIREMENTS	(3)
IX	INITIAL IDEATION	(2)
X	SHAPE MODELS	
XI	SKETCHES OF DETAILS	(4)
XII	ASSEMBLY: Jet tip rotation button & Water plug	
XIII	IDEATION CHARGING DOCK	

I PROJECT BRIEF

Yannick J. Heijs, s0200239

At MADE Innovation, Beijing, China.

Project Brief

10 May, 2012

Design of a portable dental flosser.

Water Flosser is a brand of Endo Exo a American company which develops and produces laboratory equipment, health care products and products for personal health. The Water Flosser brand consists out of a stationary dental flosser for home usage, but the brand is to be expanded her product range by introducing a portable dental flosser. Endo Exo focuses on premium with good value, meaning affordable with a high reliability. They develop for a global market, but manufacture their products locally. Endo Exo is aware today's sustainability problems and the need for a durable mind set. Therefore, Endo Exo is paying critical attentions to the manufacturing of the their products.

This design assignment focuses on designing a portable dental flosser, a product which is uses a combination of air and water in order to remove food and dental plaque form teeth. During the development of this Water Flosser analysis is done in the market and the competitors. This is done to gain insight in the products which are present on the market, their problems and usability. Together with the stakeholder a target group is selected and studied. Based on the noted processes a list of functional requirements several concept will be generated utilizing sketches, shape models as well as CAD. Again together with the stakeholders a decision will be made on the external design of the Water Flosser. Of this external design a first prototype will be made. This prototype will be evaluated to fit the internal mechanics of the Water Flosser. This mechanical system is designed by a separate engineering team. The final deliverables is a semi-working prototype of the out-side design of the Water Flosser, but which can be fitted with the internal mechanism which at one stage being designed by an Engineering team of Endo Exo. This prototype can be combined with the internal systems, evaluated and further developed to come to a market ready consumer product.

II PLAN OF APPROACH

Yannick J. Heijs, s0200239
At MADE Innovation, Beijing, China.

Plan of Approach
14 May, 2012

DESIGN OF THE PORTABLE DENTAL FLOSSER

1 STAKEHOLDERS ANALYSIS (ACTOR ANALYSIS)

MADE Innovation is a firm located in Beijing, China and specialises in design for the health care industry, acting as a design firm; conducting design activities for clients. The firm also provide additional design consultancy services in the fields of Engineering, Graphic Design, Brand Identity, UI Design, Design Transfer and Production Support. During these projects MADE Innovation uses a combination of design and mechanical innovations supported by other industrial design methods. MADE Innovation health care's focus is the delivery of state of the art products for the Chinese health care market. They promise to provide brilliant captivating innovative design in line with world leading brands as Siemens, GE (General Electric) and Philips. On their website MADE Innovation's states the following mind set:

"We use a design process that emphasizes usability, manufacturability and marketability. We share a global perspective and multifaceted approach to product development. We offer a design partnership; working together to make great products." (*MADE Innovation, 2012*)

The main objectives of MADE Innovation is to drive the digital technology application in country or town hospital; improving the health care of the rural population of China, and developing products which provide primary care to patients.

MADE Innovation has been contracted by Endo Exo to perform a research and development for a new portable dental flosser¹ for the Water Flosser product line.

Endo Exo is an up-and-coming sister company of MADE Innovation developing and producing health care products, laboratory equipment and personal health products² and bringing them to market. Endo Exo focuses on premium products with good value, meaning affordable with a high reliability. Endo

Exo's main objective is to launch successful products which can be sold on a global market, but which are being manufactured locally. Endo Exo is looking to expand their Water Flosser product line, and innovate dental flossing as well as improving the usability³ of portable dental flosser for home usage.

Water Flosser is a product line of dental flossers being manufactured and sold by Endo Exo. Besides working on a stationary dental flosser⁴ they also want to expand their product line by introducing a portable dental flosser. Market research and user experiences conducted by Endo Exo, as well as MADE Innovation have shown that there are still a lot of possibilities and innovations⁵ present in order to gain a market share in the field of electrical dental flossers. The research indicates that competing electrical dental flossers have a lot of usability related issues and therefore perform poor. Also, there are few brands which sell them.

Designers are one of the sub teams operating within MADE Innovation. A designer's main responsibility during this project is to conduct design tasks in order to generate a design for the new dental flosser meeting the functional requirements⁶ which emerged from the other stakeholders as well as their own research.

Engineers are another sub team which are part of the MADE Innovation team. This team of engineers have the responsibility of engineering the internal structure of the Water Flosser: the mechanical functionality. Close communication between the engineers and the designers is necessary in order for the design and engineering of the Water Flosser seamless fit together.

Manufacturers are approached during several points during this development process. They will be manufacturing the parts of the Water Flosser like the outside casing. The main goal of a manufacturer is to manufacture and provide a constant stream of parts of a high quality demanded by Endo Exo in order to assure a sustainable relationship and regular purchases.

Providers of components will deliver different standard components for the Water Flosser to Endo Exo. These parts have to be of a constant stream and quality demanded by Endo Exo in order to assure a sustainable relationship and regular purchases.

Dental Clinics will initially be the main place of sales for the Water Flosser. A dentist helps patients in maintaining a healthy oral cavity by the diagnosis, prevention, and treatment of diseases and conditions. The main objective for a dentist is to provide good service and products to patients so they can have healthy teeth. This means that the products which are recommended by the dentist must have good functionality and improve the oral health⁷ of people and help keep them healthy.

Electronic Stores together with Dental Clinics will sell the Water Flosser. However the sales of the Water Flosser at electronic stores will occur on a later stage when the product has gained some foothold on the consumer market. An Electronic store's goals will generally be to relay an image to their customers by providing service and certain products. Therefore the products which are sold at a store should fit their image. Also often successful and popular products are available since they can generate a high income for the store concern.

Consumer Is a person who will buy and/or use the Water Flosser. The consumer's main goal is to have a product which performs functionalities which allow him/her to keep a healthy oral cavity. A consumer would expect a high quality-made product with good usability, within a price range which he/she finds affordable, also taking into account the running costs⁸.

2 PROJECT SETTING

Background of China's health care system Over the last 20 years China has undertaken huge reforms of its health-care system. (Ling, Liu, Lu and Wang, 2010). The Chinese government still faces a giant task in trying to provide medical and welfare services suitable to meet the basic needs of the immense number of citizen spread over a vast area. Although the overall affluence has grown dramatically since the mid-1980s a great many of its people still live at levels far below the national average. China's health facilities remain unevenly distributed. Medical and health personnel work in rural areas, where approximately one-half of the population resides, where access to higher tier care is limited. The severest limitation on the availability of health services, however, appears to be an absolute lack of resources. Improving the health care system is important to raise living standards. The Chinese government clearly understands closing the gaps in the health care sector has to come from a cooperation of the public and private sector.

Many companies see the potential of the Chinese health-care system as

being a major market, and are there developing and selling products. Endo Exo develops and produced their own health care and personal hygiene products focussing on improving the capabilities, quality and efficiency of the healthcare system as well as way in which Chinese people can improve their health by themselves.

Scope of Assignment One product line Endo Exo is currently working to bring to market is the Water Flosser; a brand of dental flossers. Many people in China have a poor health of their oral cavity. (Lin and Schwarz, 2001). There are several reasons for this:

- A shortage of professional dentists. Especially in the rural areas of China dentists are really scarce.
- The lack of proper oral health care instructions combined with wrong oral health habits.
- The expenses that come with maintaining oral health, especially over a long term period.

The expenses associated with keeping a good oral health many Chinese people who have some money do not visit a dentist to improve the quality of their oral cavity, but instead remove their teeth. The thought behind this is that it would save them money. By opting to remove healthy teeth and replacing them with fake ones, the expenses in maintaining the teeth are not high. Also the complications which could occur in the future with the biological teeth are prevented. This poor oral health is also a large problem with young children. And a lot of effort is done the central government to create public awareness, train dentists, and adopt medical measures to prevent dental diseases among children.

It is therefore that Endo Exo is developing dental flossers in the hopes of persuading the Chinese from ceasing to remove their healthy teeth in favour of a product which offers allows them to maintain a healthy dental state. Flossing in combination with tooth brushing can prevent gum disease and dental caries⁹ (American Dental Association, 2006), (New York Life Insurance Company, 2006). Flossing is also linked to reduce incidence of heart disease. Flossing is correlated with greater longevity, potentially as a result of the preventions of gum inflammation¹⁰. Also Endo Exo wants to help educate Chinese children and adolescents on good oral health habits. While mainly paying attention on the Chinese market Endo Exo sees possibilities for its Water Flosser to be sold on a global scale. Since the quality of current dental

flosser leaves room for improvement.

3 OBJECTIVE

Endo Exo is a company producing health care and personal health products the Chinese market. They see potential in expanding their Water Flosser brand by introducing a portable Water Flosser. They have contracted MADE Innovation to conduct the development. This assignment is part of a larger project, and focuses on the analysis, design of the product. The goal is to produce a semi-working prototype¹¹ of the design which can be evaluated and further detailed by an engineering team operating within MADE Innovation as well as serve as a starting point for preparing production.

This assignment is split into three phases namely Analysis, Design and Detailing (also see Time Schedule). The Analysis includes several studies into the market, the potential target group, an analysis of the product and the design identity¹² of Endo Exo. This phase will result in the list of requirements which will be used to evaluate the concepts generated during the Design phase. The resulting concept will be prototyped and again evaluated on usability. After which it will be further integrated with functional mechanisms developed by a separate engineering team, resulting in a second prototype. This will be the final deliverable of this assignment. The assignment is conducted by one person during a time period of three months.

4 RESEARCH QUESTIONS

- 1 What are the Potential Unique Selling Points for a portable dental flosser?
 - 1.1 What flossing products are currently on the market?
 - 1.2 What are the benefits and negatives of flossing?
 - 1.3 How do competing portable dental flossers perform?
 - 1.4 What usability issues does a dental flosser have?
- 2 What are the potential target groups for the portable Water Flosser?
 - 2.1 Who would use a dental flosser? And needs it to be portable?
 - 2.2 What are groups being targeted by other brands?
- 3 What are the functional requirements for the Water Flosser?
 - 3.1 What is the design identity of Endo Exo?
 - 3.2 What are the mechanical restrictions?
 - 3.3 What does the target group want?
 - 3.4 What Unique Selling Points are to be included?

- 4 How can the prototypes be tested on performance listed by the functional requirements?
 - 4.1 What are the main performances that need to be tested?
 - 4.2 What kind of prototype will be produced?
 - 4.3 Which methods are there to test the prototype?
 - 4.4 What kind equipment and budget is available?

6 TIME SCHEDULE

The time schedule (See the **Appendix III: Time Shedule**) displays all the design tasks which are to be conducted during this assignment. These design tasks can be divided into three phases namely; Analysis, Design and Detailing. During the entire assignment information will be recorded. This is the Documentation phase, which runs parallel to the other phases. This, in order to deliver a design report at the end of the assignment.

7 CONSTRAINTS AND BOTTLENECKS

During a design project there are always situations possible which could lengthen the duration of the project. An assessment of these possible issues is given below.

- The project is shortened or put on hold because of executive decisions. To be able to account for the shortening in time, a ranking of the design processes should be done and low priority processes are cancelled.
- The project parameters are changed, due to executive decisions or research results. This results in reformulating the research questions or the possible approach of the assignment.
- Certain information for analysis is not available or hard to come by. This is especially while dealing with internet sources. Since in China parts of the internet are censored, it is harder to get information. Information can be gained by accessing an internet source or contact person outside of China, or based on the available information make estimations (questimations).
- Dependency on others for information, materials, components or prototypes. This is mainly a time related issue; this causes the assignment to take longer than planned. This can be taken into account during the planning of the project.
- Alterations in the budget. During this assignment budget alterations are most notable while building prototypes. A budget reduction can result in a prototype(s) being cancelled. Either by a manufacturing a plainer prototype(s) or one(s) focussing on the main performance or functionality can the budget

5 STRATEGY

The research questions, as mentioned previously, can be answered by following a strategy.

<i>Research Question</i>	<i>Strategy</i>	<i>Material and Sources</i>
1.1	Market Research	Internet
	Competitor Analysis	Internet & products of competitors
	Product Analysis	Internet & products of competitors
1.2	Desktop research	Internet [consumer feedback & academic literature]
	Expert Interviews	Experts within MADE Innovation & Endo Exo
1.3	Competitor Analysis	products of competitors
	Desktop analysis	Internet [consumer feedback]
1.4	Product Analysis	products of competitors
	Expert Interviews	Experts within MADE Innovation & Endo Exo
	User Interviews	Owners of product(s)
2.1	Desktop research	Internet [consumer feedback & academic literature]
	Expert Interviews	Brainstorm with stakeholders [MADE Innovation & Endo Exo]
2.2	Competitor Analysis	Internet & products of competitors
3.1	Interviews	Personnel of Endo Exo
	Brand Analysis	Internal documents
3.2	Expert Interviews	Experts within MADE Innovation & Endo Exo
3.3	Desktop research	Internet [consumer feedback & academic literature]
	Expert Interviews	Experts within MADE Innovation & Endo Exo
3.4	Stakeholder interviews	Brainstorm with stakeholders [MADE Innovation & Endo Exo]
	Desktop research	Results of previous research
4.1	Expert Interviews	Experts within MADE Innovation
	Stakeholder interviews	Interview with stakeholders [MADE Innovation & Endo Exo]
	Prototypes	Prototypes produced by MADE Innovation
4.2	Expert Interviews	Experts within MADE Innovation
4.3	Expert Interviews	Experts within MADE Innovation
	Prototypes	Prototypes produced by MADE Innovation
4.4	Stakeholder interviews	Interview with stakeholders [MADE Innovation & Endo Exo]

8 DEFINITIONS

¹ Portable dental flosser	An electronically flossing device which is has a build-in water reservoir. It is used the clean and maintain a person's oral cavity.
² personal health products	Products which can be used in a home environment to improve or maintain a person's health.
³ Usability	A wide array of interaction which allow the user to have experience with a product.
⁴ Stationary dental flosser	An electronically flossing device which is placed in the bathroom and has a separate water reservoir and flosser. It is often designed to serve a whole family
⁵ Innovation	Introducing new advantages and changes to the product, so it offers better functionality than is counterparts.
⁶ Functional requirements	Set of technical details combined which impose constraints on the design or implementation, such as performance requirements, usability, or reliability.
⁷ Oral health	The state of a person's oral cavity.
⁸ Running costs	Costs that are made in order to maintain or keep operating a product.
⁹ Dental caries	An infection of bacterial in origin that causes damaged to the tooth.
¹⁰ Gum inflammation	A biological response of the vascular tissues, the gums, to harmful plaque-induced stimuli.
¹¹ Semi-working prototype	A prototype with limited functionality so it can be tested on performing its main function as documented in the list of functional requirements.
¹² Design Identity	The design style that is visible in a product line or a set of distinctive design features of brand.

9 LITERATURE

- 1 American Dental Association. (2006). Healthy mouth, healthy body. JADA, 137, p.563 Retrieved May 10, 2012, from http://www.ada.org/sections/scienceAndResearch/pdfs/patient_61.pdf
- 2 Eggleston, K. (2012). Health Care for 1.3 Billion: An Overview of China's Health System. Social Science Electronic Publishing, Inc. Retrieved March 12, 2012, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2029952.
- 3 Lin, H. C., Schwarz, E. (2001). Oral Health and dental care in modern-day China. Community Dentistry and Oral Epidemiology, 29(5), pp. 319-328.
- 4 Lin, Z. (2010). China to boost dental health awareness, appoints singer as advocate. Xinhua, English.news.cn. Retrieved March 12, 2012, from http://news.xinhuanet.com/english2010/health/2010-09/10/c_13489731.htm
- 5 Ling, R. E., Liu, F., Lu, X. Q., Wang, W. (2010). Emerging issues in public health: A perspective on China's healthcare system. Public Health, 125(1), pp. 9-14.
- 6 MADE Innovation. (2012). MADE Innovation. Retrieved May 10, 2012, from <http://made-innovation.com/en/pages/>
- 7 New York Life Insurance Company. Medical News: Flossing to Longevity. (2006). New York Life Insurance Company. Retrieved May 14, 2012 from <http://www.newyorklife.com/nyl/v/index.jsp?vgnextoid=ed02e62f139d2210a2b3019d221024301cacRCRD>
- 8 Wikimedia Foundation, Inc. (2012). Dental Floss. Wikipedia. Retrieved May 10, 2012, from <http://en.wikipedia.org/wiki/Flossing>
- 9 Zhu, L., Peterson, P. E., Wang, H. Y., Bian, J.Y., Zhang, B. X. (2003). Oral Health knowledge, attitudes and behaviour of children and adolescents in China. International Dental Journal, 53(5), pp. 289-298.

III

Planning

Analysis

Design

Detailing

Documentation

IV EXPERT-USER REVIEWS

Name: Carsten Waahlin

Gender: Male

Age: 32 years

Occupation: Design manager and Company owner

Product: Philips Sonicare Airflosser

Use time: 7 days



Day 1

Opening the packaging was a menace, a real workout with special tools needed to get the device out of the 3 part plastic enclosure .

Once out the device is really small and fits nicely in my hand, perfect match! buttons nicely arranged and easy to push. The structure is very solid and made of few part's. Looks like the sonically welded. The surface treatment seems to give more grip. All in all a really nice value.

Using the devise.

The water spray pressure is impressive but compared with a Water Flosser not enough water to give sense freshness that I am used to. I accidentally hit my tongue and it hurt quite a bit for few minutes. Even the button is really nicely arranged I still have to hit it more than 50 times ? hardly seems right. But again the device only hold 2 Tbs of water.

Moving day

To Move my new portable Flosser in my bag I had to use the original packaging to avoid mess and dirt from my bag to join with clean new device. Concern of losing the spraying tip was also considered. Now my bag is filled with large packaging... Now not so portable ?

Evening use

Now familiar with the devise I bravely stuck the device in my mouth and pushed on the trigger! I instantly regretted my lack of common sense, as metal flavor was filling my mouth. This is not a joyful product !!!

I am regretting signing up for the test..

Day 2

Evening use

I Still get's freaked out by the blast on my gums and tongue. Read the manual to be sure I was using it correctly. But I am using the device correct.

Day 3

Morning use

I can taste my old crap in my mouth even before of the Flosser use I brushed with traditional brush. I am Sure the device is doing something.

Day 4

Using the devise is now easier, but Still I blood in my mouth !

Day 5

Getting familiar with the device and no more blood in my mouth

Day 6

It's routine now. The spray on my tongue still is uncomfortable but i guess i can accept it

Day 7

hmmm what to say

Name: Carsten Waahlin

Gender: Male

Age: 32 years

Occupation: Design manager and Company owner

Product: Waterpik Cordless Plus water flosser.

Use time: 7 days

Use & Experience

At first using the product was an interesting experience. Starting the device shot me in the face and water hit the mirror as well, very annoying surprise. I did not realize that this is a high pressure spooler. A small instruction in application and use would be nice... learning experience is short but hey, not all get the device at first.

Sliding the power control up and down is not so convenient! Especially when wet, the force needed to slide the waterproof power switch is big, so regardless of grip the feeling is not good. Especially when moving the tip from left to right side is a challenge, as we have to turn the device off, otherwise shooting you in the throat.

The power control left on high all the time, except for the first few sessions.

Most of the time using the device, it was out of power. I always forgot to hook up the device for power, mostly because I hate fiddling with cables, and wet cables do not make the feeling good. Few of us want to get electrocuted btw – Water Pik Take note! ... Or someone else please!

I had to fill the water tank 3 times per session so not exactly convenient... Water container should be bigger. Two times filling might be OK. But anymore fillings suck.

Design

Void of design, generic styling but follow the brand well. So even it's bad at least it's consistent.

I hate the noise! Does not feel like a premium product because of it. A deeper noise would be better instead of the squeaking pumping sound.

Name: Hongtao Zhang

Gender: Male

Age: 30 years

Occupation: Industrial designer

Product: Panasonic EW-DJ40

Use time: 7 days

Use & Experience

Fill water to the container.

That experience seems very convenient.

Cleaning process

The advantage of this product is that I can adjust the intensity of water steam, it is very important for the users who use this product at the first time, because most of people's gum need some time to accommodate the water pressure, most of people will bleed when they use this product. Users will be scared completely, so they need to use it from very soft gears level and then use the high pressure level step by step.

The product has an very special slipping structure, it can save a lot of space, for travelling it seems very convenient, but lose some capability.

One big disadvantage of this product is the small container, I always refill it three times per cleaning process, it is not very convenient.

The surface of this product has a lot of details (gaps), sometimes I concerned that water can permeate into the product especially there some blood inside.

Recharging process

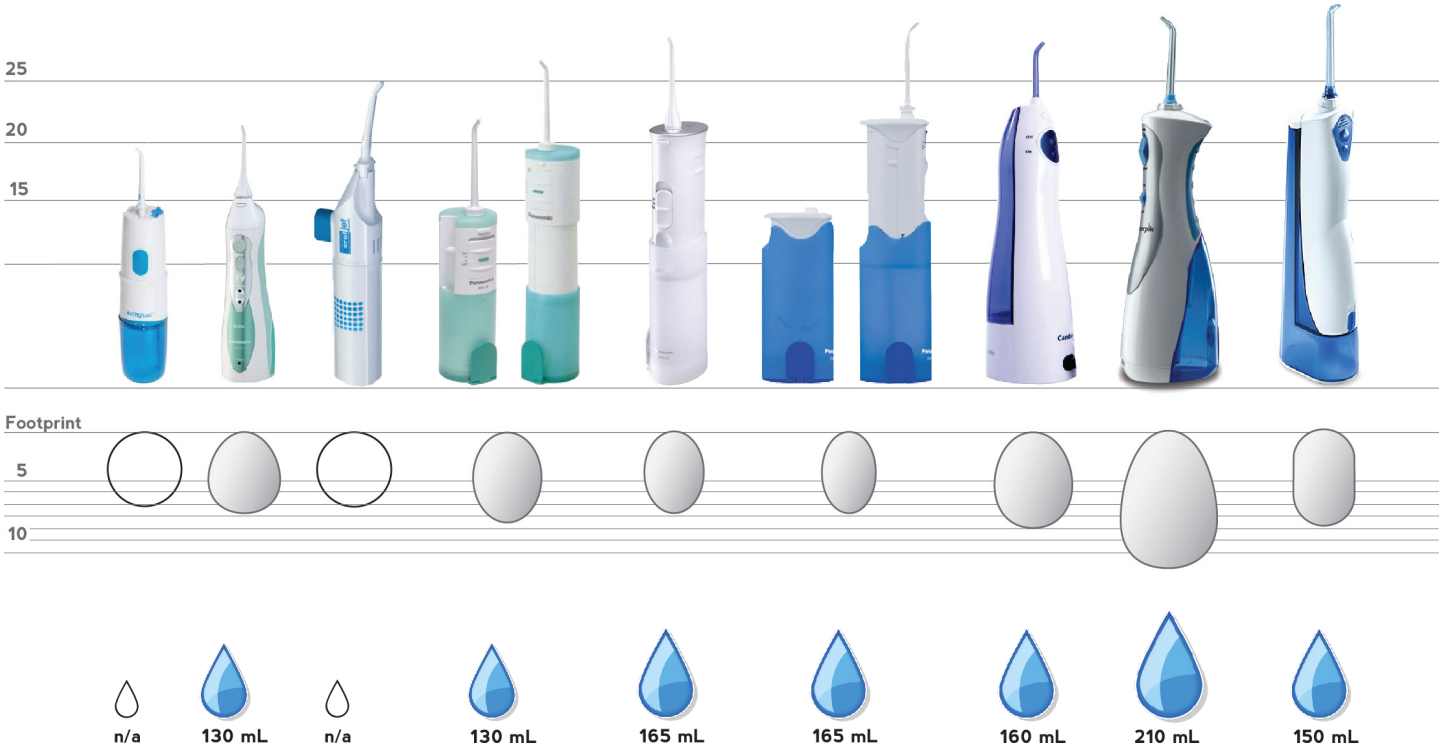
The electrical source joint seems very dangerous, because it is uncovered, water can easily permeate into the plug.



V HAND MEASUREMENTS

	Grip circumference	Hand breath [without thumb]	Hand breath [with thumb]	Forefinger breath	Thumb breath
Dutch					
[20 till 60 years]	Male 135.0mm - 13.0mm Female 122.0mm - 9.0mm	Male 91.0mm - 5.0mm Female 81.0mm - 5.0mm	Male 119.0mm - 5.0mm Female 93.0mm - 6.0mm	Male 19.0mm - 1.0mm Female 16.0mm - 1.0mm	Male 25.0mm - 2.0mm Female 21.0mm - 1.0mm
International					
[20 till 60 years]		Male 100.0mm - 6.0mm Female 75.0mm - 8.0mm			
Asian					
[20 till 60 years]		Male 95.0mm - 3.0mm Female 85.0mm - 5.0mm			

VI PRODUCT BENCHMARKING



	Conair Interplak Rechargeable water jet
Dimensions*	229.0 x 89.0 x 89.0 mm
Weight	400 g
Water capacity	n/a
Power supply	Rechargeable battery & adapter
Recharge time	n/a
Time of usage	n/a
Pressure setting(s)	n/a
Pressure range	n/a
Amount of buttons	1: On/Off switch
Selling price [MSRP**]	¥ 180,00 [€ 18,00]
Features	Rechargeable for convenience. Use with water, mouthwash or antibacterial rinse. Includes 2 jet tips.

* Height includes jet tip length of 70.0mm
**Manufacturer's Suggested Selling Price.



Waterpik Cordless

Dimensions*	305.0 x 76.0 x 48.0 mm
Weight	590 g
Water capacity	150 mL
Power supply	Rechargeable battery
Recharge time	n/a
Time of usage	n/a
Pressure setting(s)	2
Pressure range	30 to 75 psi
Amount of buttons	2: On/Off switch, pressure switch
Selling price [MSRP**]	¥ 330,00 [€ 30,00]
Features	<p>Easy to fill, flip-top reservoir.</p> <p>Low pressure tip for gentle cleaning, high pressure tip for deep cleaning.</p> <p>Tips rotate 360° to reach all areas of the mouth.</p> <p>Use with water or your favorite mouthwash.</p>



Waterpik Cordless Plus

Dimensions*	290.0 x 90.0 x 65.0 mm
Weight	635 g
Water capacity	210 mL [Enough for 45 seconds of flossing]
Power supply	Rechargeable battery & adapter
Recharge time	n/a
Time of usage	n/a
Pressure setting(s)	2
Pressure range	45 to 75 psi
Amount of buttons	3: On/Off switch, pressure switch and jet tip release button
Selling price [MSRP**]	¥ 599,00 [€ 60,00]
Features	<p>Advanced ergonomic design with non-slip grip.</p> <p>One-touch dual pressure control system.</p> <p>Ideal for travel.</p> <p>Four unique tips clean in specialized ways.</p>



Candeon [CD300]

Dimensions*	290.0 x 78.0 x 62.0 mm
Weight	350 g
Water capacity	160 mL
Power supply	Rechargeable battery & adapter
Recharge time	n/a
Time of usage	1 week [60 seconds per day]
Pressure setting(s)	1
Pressure range	60 to 80 psi
Amount of buttons	2: On/Off switch, jet tip release button
Selling price [MSRP**]	¥ 186,00 [€ 20,00]
Features	<p>Waterproof design</p> <p>One-handed operatable</p> <p>Set of three different jet tips</p>



Panasonic Portable Oral Irrigator [EW176]

Dimensions*	290.0 x 78.0 x 62.0 mm
Weight	205 g
Water capacity	130 mL
Power supply	Battery operated [2 AA batteries]
Recharge time	n/a
Time of usage	n/a
Pressure setting(s)	2
Pressure range	n/a
Amount of buttons	n/a
Selling price [MSRP**]	¥ 160,00 [€ 16,00]
Features	Compact for easy travel plus cordless convenience



Panasonic Dentacare EW1211

Dimensions*	197.0 x 75.0 x 55.0 mm
Weight	300 g
Water capacity	130 mL [Enough for 35 seconds of flossing]
Power supply	Rechargeable battery & adapter
Recharge time	n/a
Time of usage	15 minutes
Pressure setting(s)	3
Pressure range	n/a
Amount of buttons	4: On/Off switch, jet tip release button, n/a and n/a
Selling price [MSRP**]	¥ 400,00 [€ 40,00]
Features	Easy to grip & easy to fill with water Waterproof and washable Non-contact recharger - easy to keep clean Equipped with jet tip stand 3 modes: Jet - for removing food particles trapped between teeth; Normal Air In - for removing particles, massaging gums and rinsing between teeth and gums; Soft Air In - for gently massaging the gums.

* Height includes jet tip length of 70.0mm

**Manufacturer's Suggested Selling Price.



Panasonic Dentacare Oral Irrigator [EW-DJ40]

Dimensions*	270.0 x 75.0 x 35.0 mm
Weight	210 g
Water capacity	165 mL
Power supply	Rechargeable battery & adapter
Recharge time	8 hours
Time of usage	15 minutes
Pressure setting(s)	2
Pressure range	n/a
Amount of buttons	2: On/Off switch, pressure switch and jet tip release button
Selling price [MSRP**]	¥ 600,00 [€ 60,00]
Features	<p>Compact for easy travel plus cordless convenience</p> <p>2 mode settings:</p> <p>NORMAL - for removing particles, massaging gums and rinsing between teeth and gums</p> <p>SOFT - for gently massaging the gums or when normal is too strong</p> <p>Powerful waterjet removes food debris and massages gums. Removes the bacteria that cause plaque, but irrigation is not a substitute for brushing</p> <p>Suitable for use with mouthwash</p> <p>Fully waterproof and washable</p> <p>Built-in nozzle storage space</p> <p>Nozzle is hidden when unit is condensed for storage</p> <p>Charge indicator light on top of unit</p>



Philips Sonicare Airflosser

Dimensions*	191.0 x 56.0 x 35.0 mm
Weight	n/a
Water capacity	30 mL
Power supply	Rechargeable battery & adapter
Recharge time	24 hours
Time of usage	2 weeks [60 seconds per day]
Pressure setting(s)	-
Pressure range	n/a
Amount of buttons	2: On/Off switch, activation button
Selling price [MSRP**]	¥ 750,00 [€ 75,00]
Features	<p>Includes Microburst-technology which cleans with only one push on the button.</p> <p>Can be utilized for two weeks without recharging.</p> <p>Guided tip for easy placement</p> <p>Easy to refill the water reservoir</p> <p>Sleek, ergonomic handle</p> <p>Suited for standard Sonicare-rechargers</p>

* Height includes jet tip length of 70.0mm

**Manufacturer's Suggested Selling Price.



ENDOEXO
MINI FLOW

Low portability

High portability



Low value

Premium



Poor power supply

Good power supply



Small water reservoir

Big water reservoir

VI MINI FLOW STYLE GUIDE

Concept

Create a design that compliment Endoexo's product line, The target is a cordless water flosser with empathies on small foot print and easy use. The devise is should be released as a better more styles option that the best on the market.

Mini flow is handheld , portable devise, the design must exude maturity, originality and relate to frontier tech in a natural and casual way.

Items to design

Device , Dock , Carry/Accessories bag.

Semantics

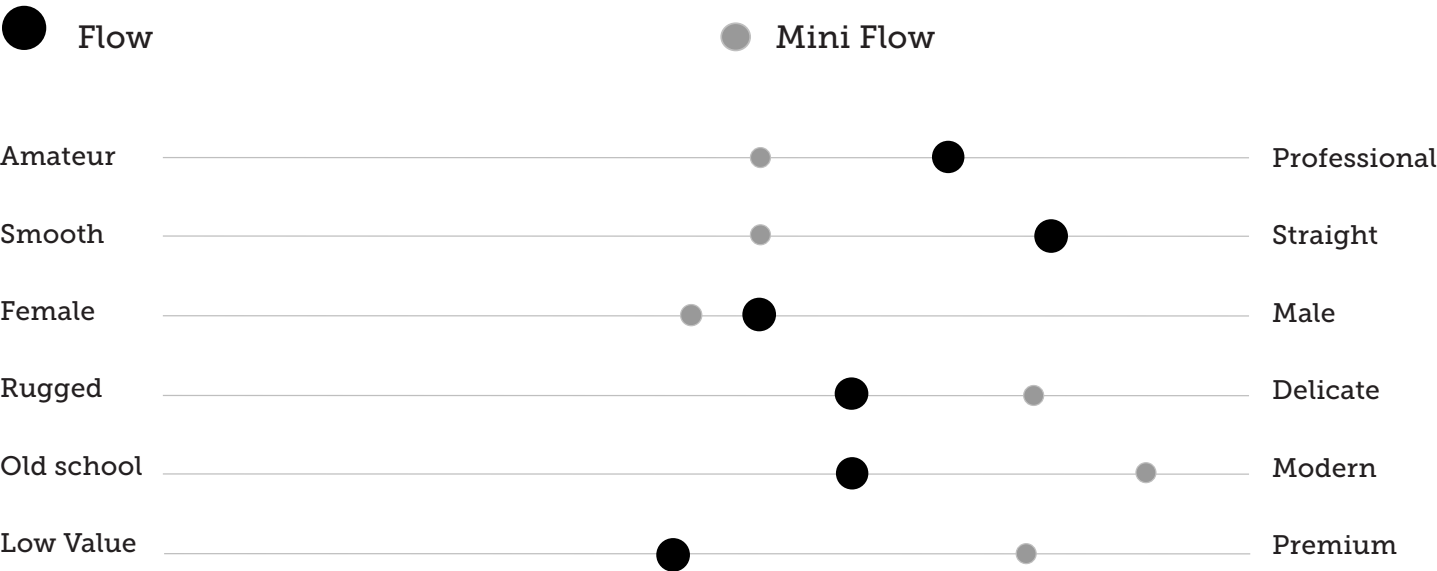
Smooth

Clean

Use geometric shapes (noted that the device must be held by hands and therefore should conform to that)

Premium

Transportable





Environment



Product Tonality



Product Tonality



VII FUNCTIONAL REQUIREMENTS

- 1 The product produces a water jet stream which can clean debris from and between teeth.
- 2 The product contains water and is able to be refilled.
- 3 The product is portable.
- 4 The product contains an own power supply which can be recharged.
- 5 The ergonomics of the product contribute to the usability of the product.
- 6 The product has a premium appearance which convey the image of Endo Exo as well as the Flow product line
- 7 The product may not cause harm to the user or others.

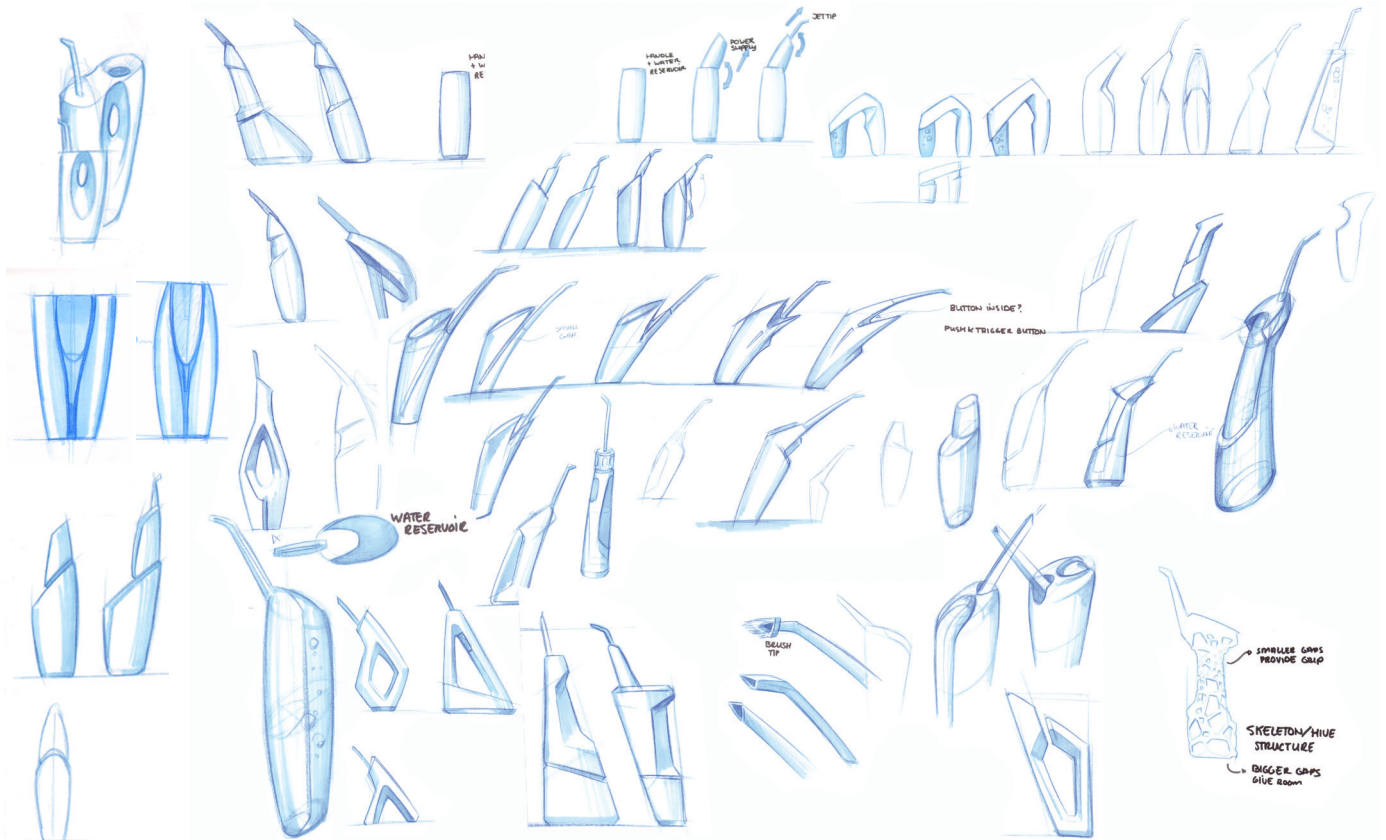
Function	Requirement & specification	Wishes
1	Deliver a water pressure between 45 and 75 psi	
1	Internal space needed for system architecture. System architecture is defined to be around 120.0 x 40.0 x 40.0mm	System architecture is defined in paragraph 2.4.3. Functional requirements (p.??)
Remarks	Noise production of the system Support different types of jet tips. Time of usage Regarding the jet tip <ul style="list-style-type: none">- Additional feature: Adept one jet tip with a detachable brush [similar to a toothbrush]- Jet spray radius- Size of opening in jet tip- The jet tip must be able to be removed or replaced from the product.	
2	Capacity of water reservoir 210.0 to 230.0mL: Enough for 30 seconds of flossing.	Around 250.0 mL For 60 seconds of flossing
2	Size of the lid Diameter around 30.0mm: Big enough for water tap to fill. Handling and closing of the lid must be able to be performed by 95% of the target users. Mainly focused on holding with thumb or fingers and applying force on the closing lid with those fingers.	
3	Size dimensions of the product Smaller than 30.0 x 180.0 x 80.0mm <i>(This was altered to 200.0 x 50.0 x 50.0mm to closer matching the competition.)</i>	150.0 x <50.0 x < 50.0mm Minimize 1 size dimension.
3	Internal space needed for system architecture. System architecture is defined to be around 120.0 x 40.0 x 40.0mm	System architecture is defined in paragraph 2.4.3. Functional requirements (p.??)

3	Weight of the product	350.0 gram <i>(Later proven unrealistic weight will be around 500.0 gram, as a set maximum.)</i>	300.0 gram (was proven unrealistic, and was therefore rejected)
	Weight distribution should not interfere with the user's handling of the product.		
4	Method of charging	Internal rechargeable battery and exterior docking station	Docking station does not require a power cable
	Battery is recharged through induction.		
Charging	Dimensions of Size	Protect the water flosser while being transported.	
Dock	100.0 x 100.0 x 50.0mm	The docking station should have a suction cup.	
	Length of power cable: 1.20m		
	Simple design with some details.		
	Plastic and with some metal details.		
	Provide stability to the water flosser		
	Have a coil-up power cable.		
	Works on induction to recharge.		
5	Size dimensions of the product	Smaller than 30.0 x 180.0 x 80.0mm <i>(This was altered to 200.0 x 50.0 x 50.0mm to closer matching the competition.)</i>	150.0 x <50.0 x < 50.0mm
	Minimize 1 size dimension.		
5	Comfortably rest in the target user's hand and be handles by the user without any discomfort.		
	The product should be able to be handled by 95 percent of the Chinese people, both left- as right-handed users (See Appendix IX: Hand measurements).		
Remarks	<ul style="list-style-type: none">– Consideration for different tasks like flossing, recharging, filling of the water reservoir etc.– Button placement:<ul style="list-style-type: none">On/Off switch: Once pressed on the water pressure will slowly build build-up.Jet tip rotation button: Operate this button with the same hand with which the product is hold.Jet tip release button: Make this button able to rotate the jet tip, there-– fore eliminate the necessaisty of a separate jet tip rotation button.– Tactile feedback of the buttons.– Weight distribution.– Main point of mass will be water reservoir when filled.– Indicator light for battery recharge.		

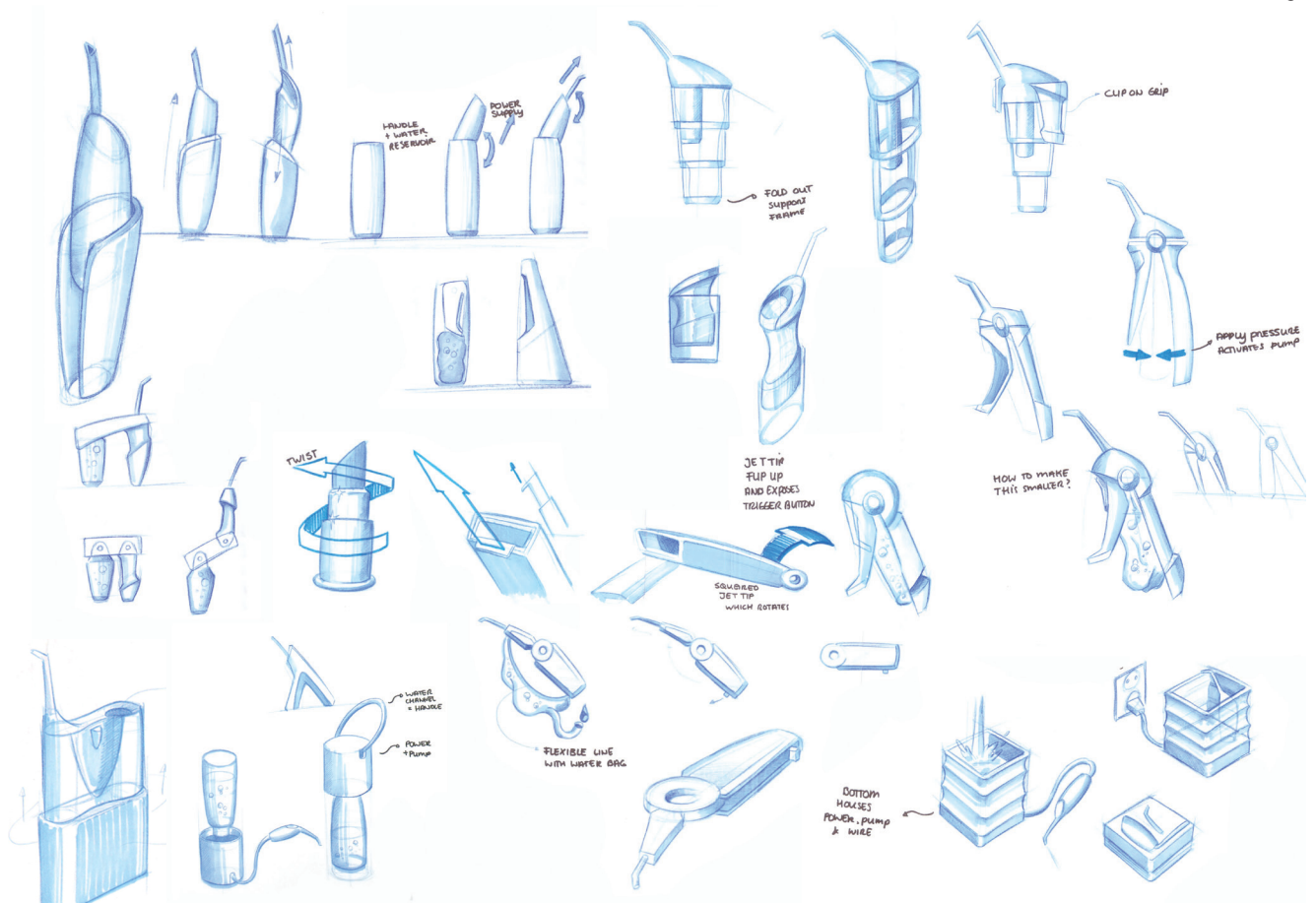
	6	Appearance of the product matches the semantic values. Convey values Endo Exo and Water Flosser Product must contain the 'Endo Exo' logotype. Products must be recognizable as a water flosser.	Product must contain a 'Mini Flow' logotype.
Remarks		Aspects to be considered: Values of the user - Shape of design - Utilize shapes common among Endo Exo products. - Colour usage - Colours commonly used in healthcare and water flossing products. - Material usage - Surface finish	
	7	Water resistibility. The product must be water resistant.	
	7	The product must stand stable on a horizontal plane	
	7	The product must be durable. Survive a drop of 2.0 meters without cracking the exterior or break any internal systems.	
Production		500 units must be produces during the first batch. Structure and shape of the design should be able to be produced by usage of injection molding. The product exterior casing must not need more than a two-part mold.	The product exterior casing can be made out of a single mold. The internal system architecture is pre-assembled before being inserted in the exterior casing of the product.

VIII INITIAL IDEATION

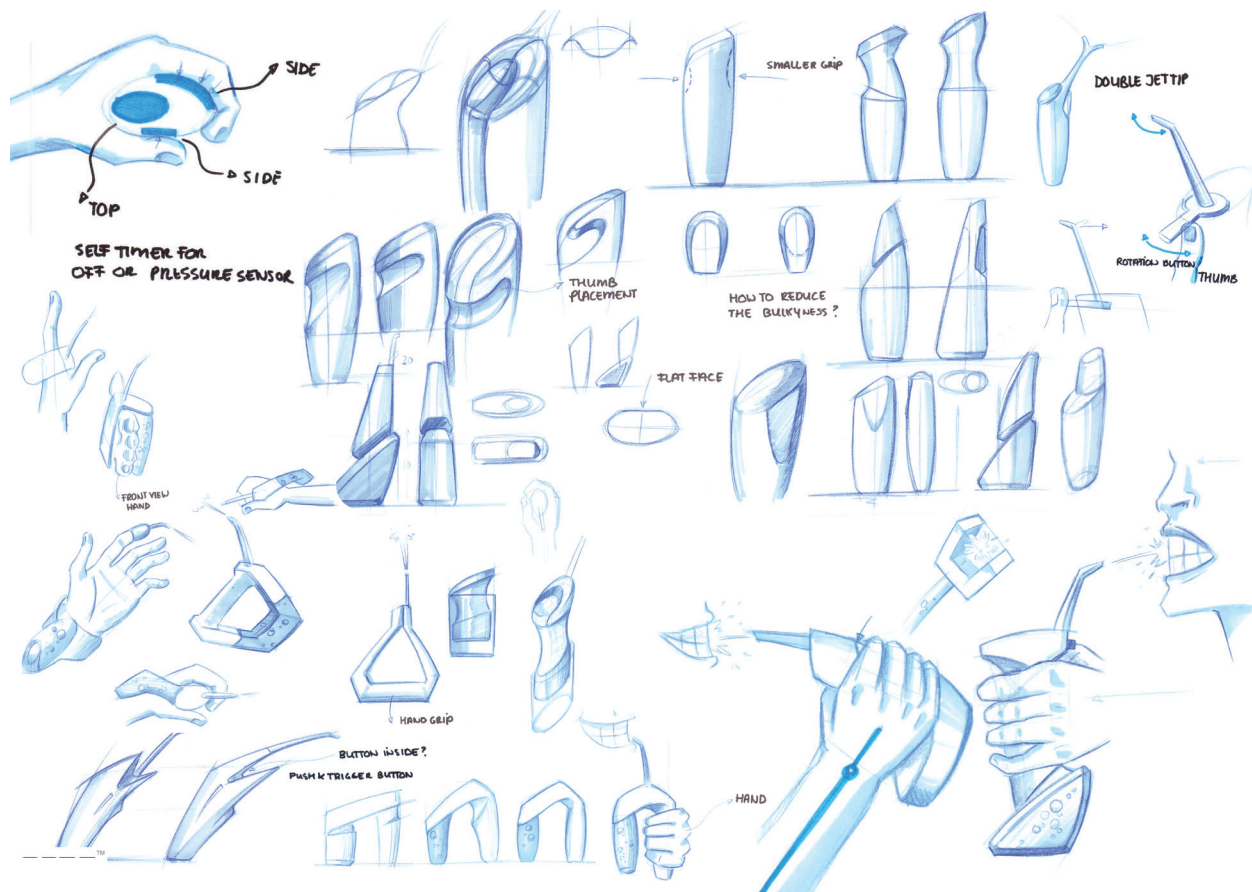
Appearance



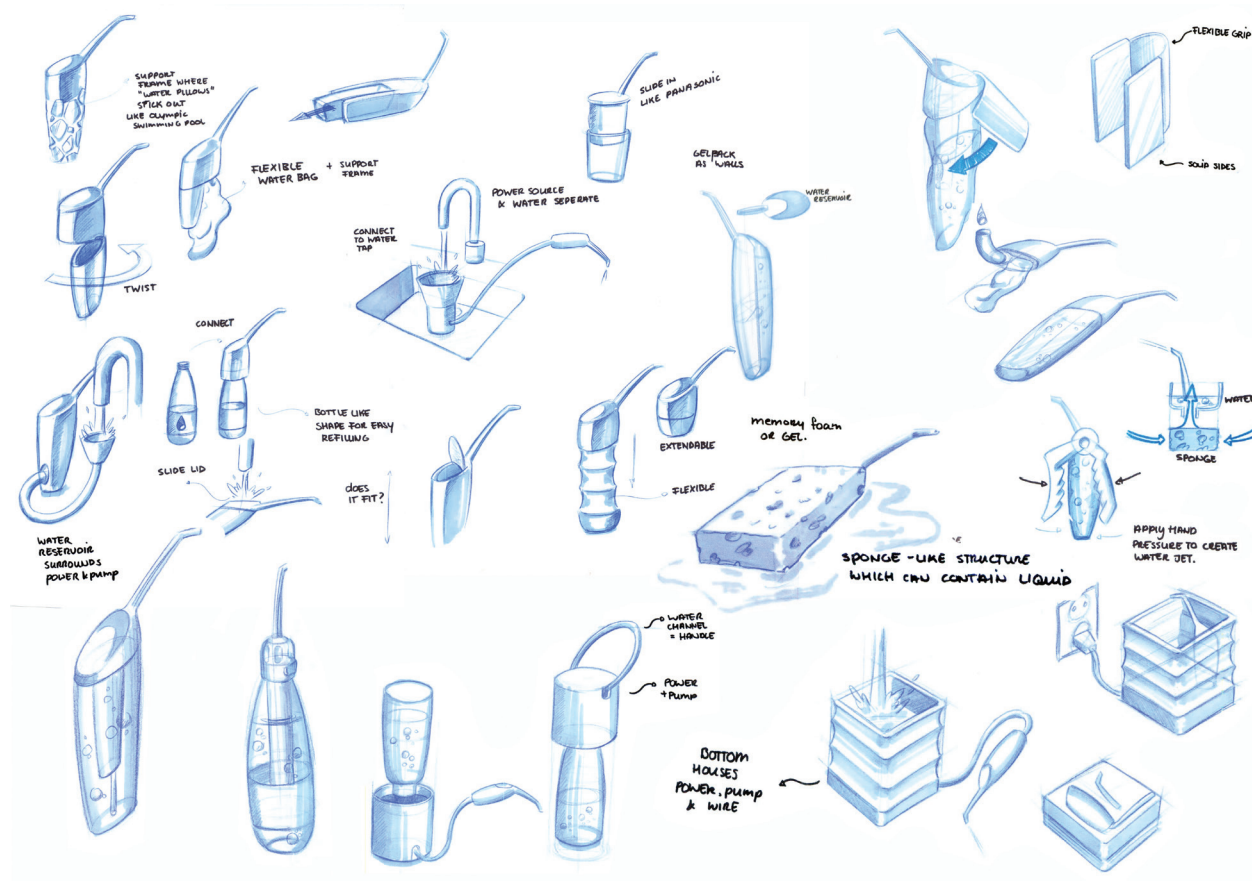
Portability



Ergonomics



Water containment



IX SHAPE MODELS

DESIGN



1



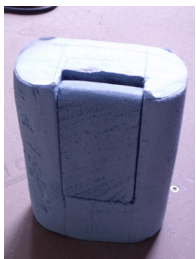
2



3



4



4



5



6



7



8



9



10



11



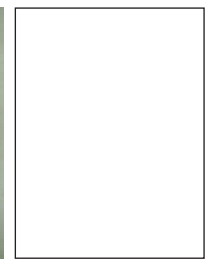
12



13



14



15, 16

DETAILLING



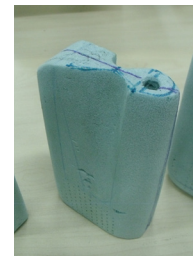
1



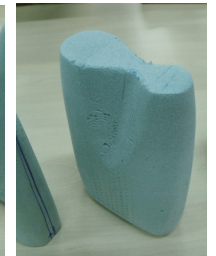
2



3



4



5



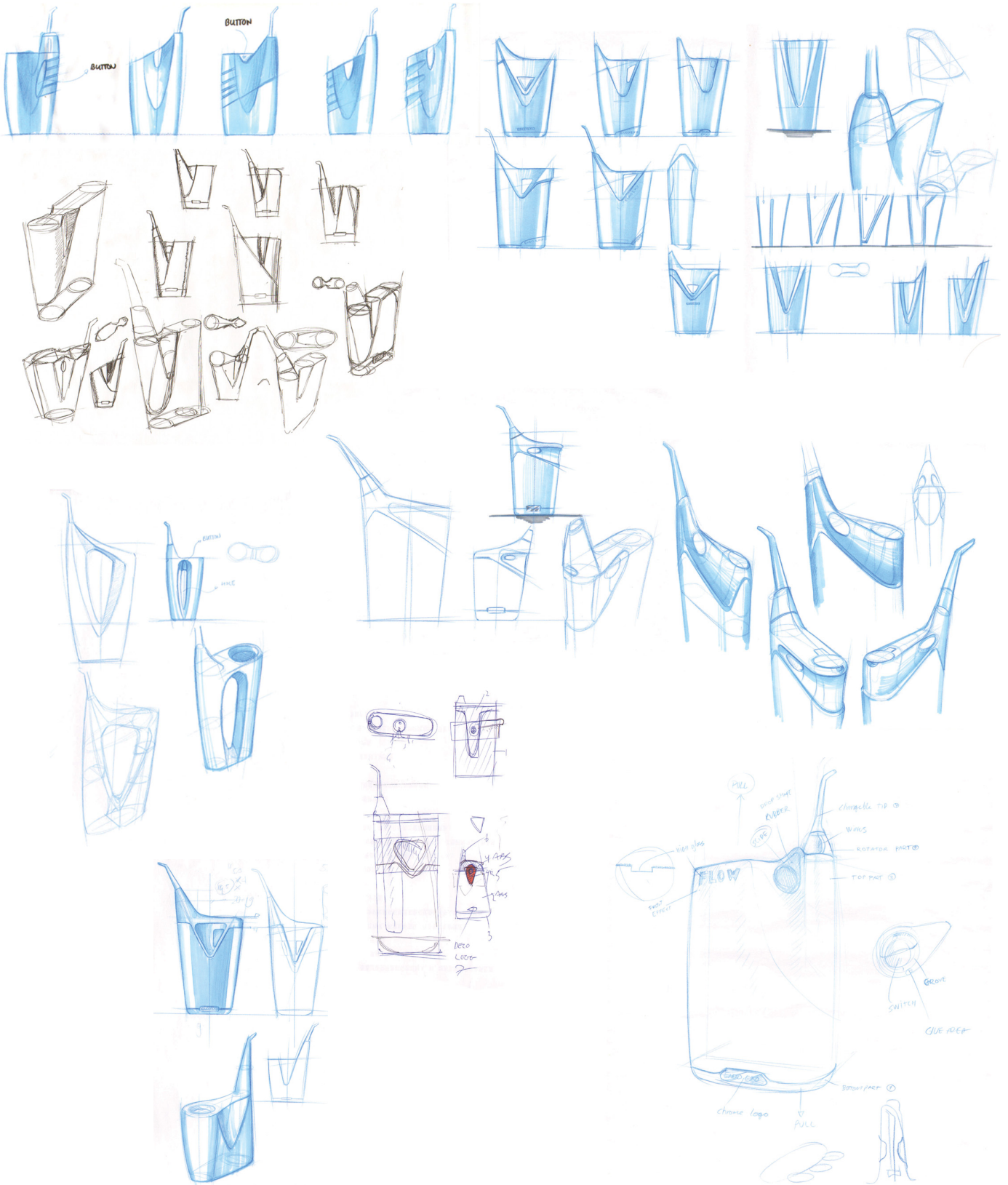
6

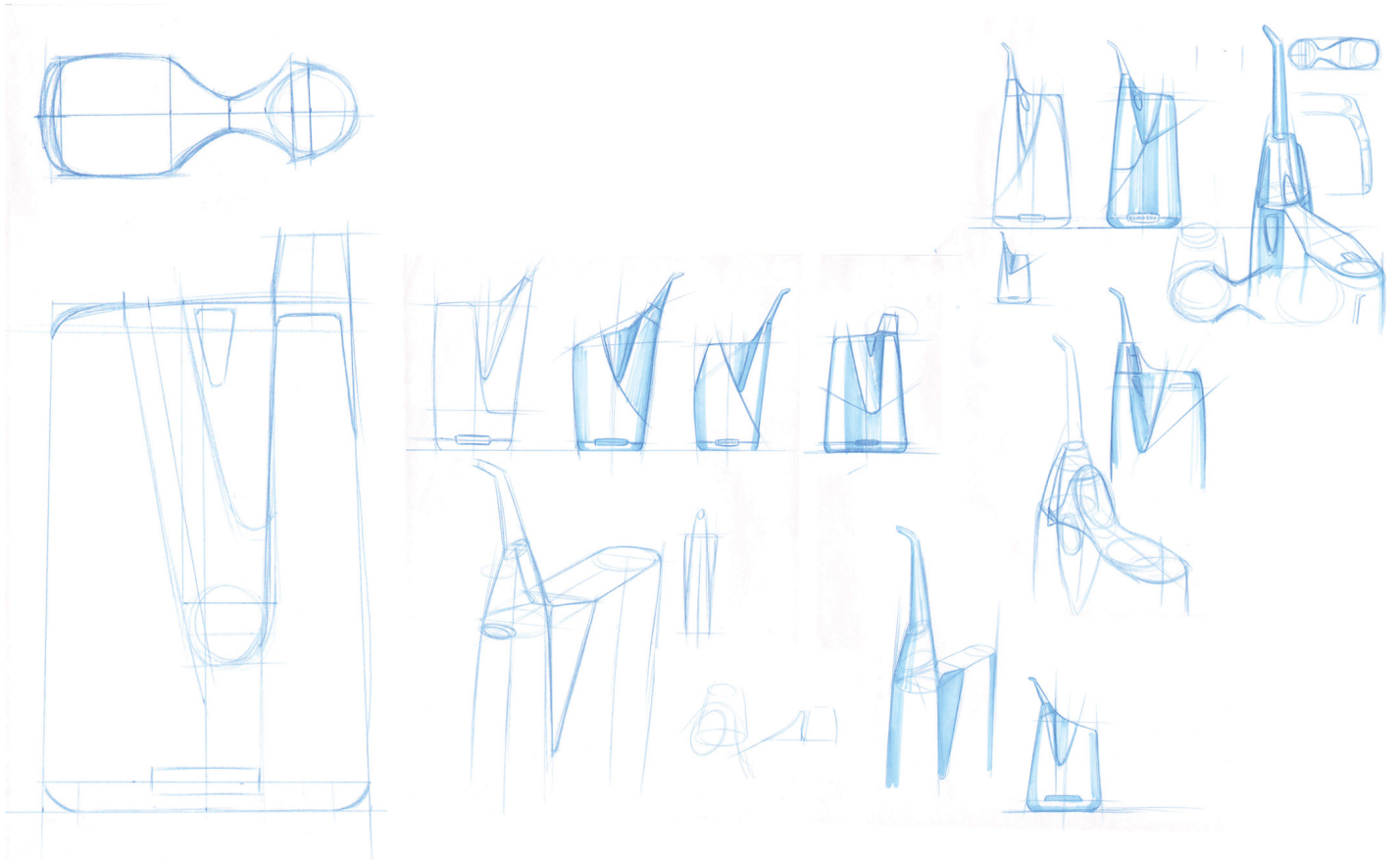


7

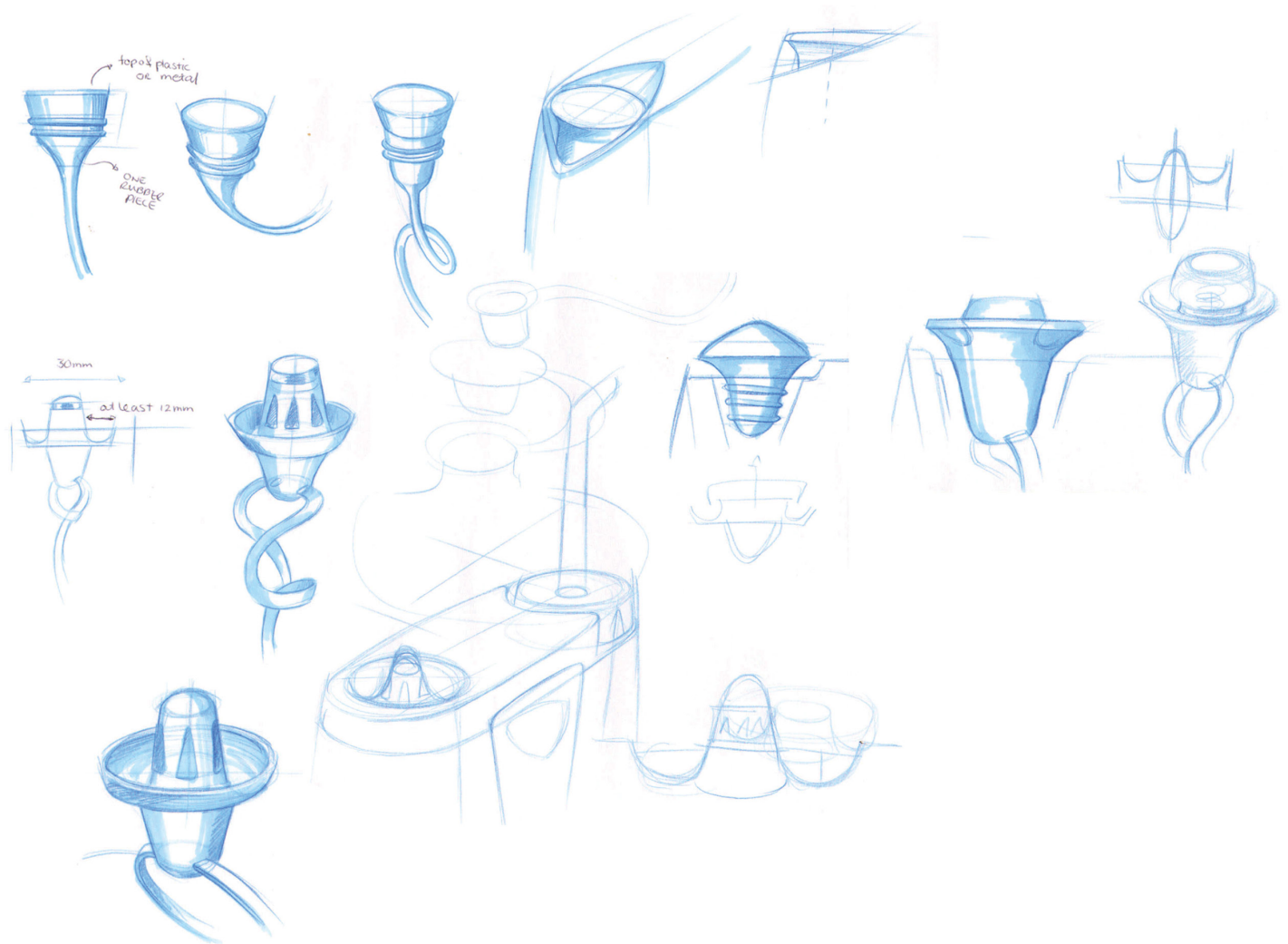
X

Sh

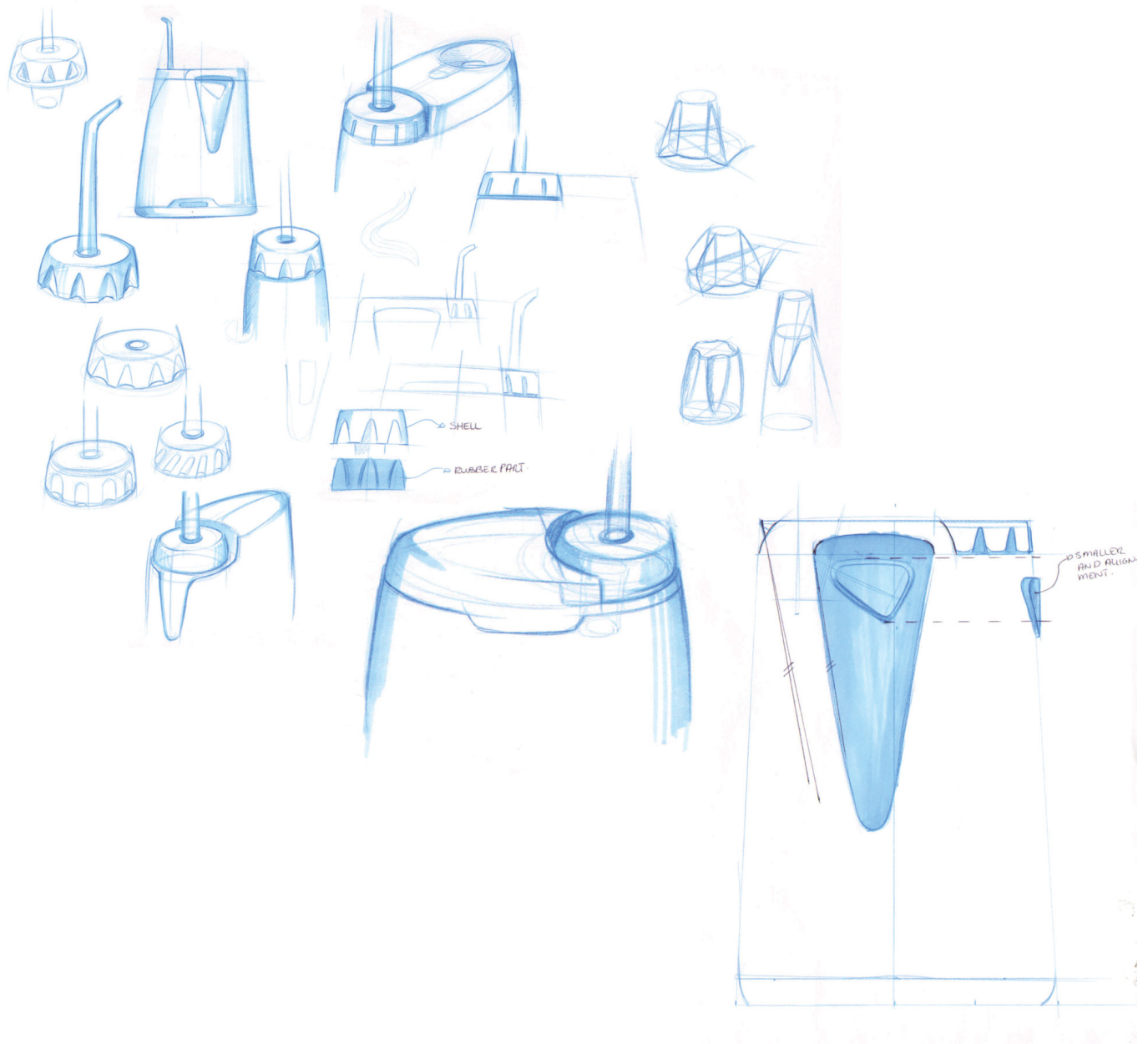




Water plug



Jet tip-related buttons




XI

ASSEMBLY:

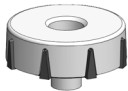
Jet tip rotation button & Water plug

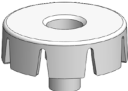


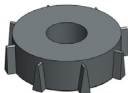
	Part	Material	Colour	Surface
	1 Cover plate	ABS	Pure white	See Figure 1 Dull ceramic feeling



	2 Seal	Silicone rubber	Pantone 431 U	See Figure 2
--	--------	-----------------	---------------	--------------



	Part	Material	Colour	Surface
	1 Shell	ABS	Pure white	See Figure 1 Dull ceramic feeling



	2 Grip ring	Silicone rubber	Pantone 431 U	See Figure 2
--	-------------	-----------------	---------------	--------------



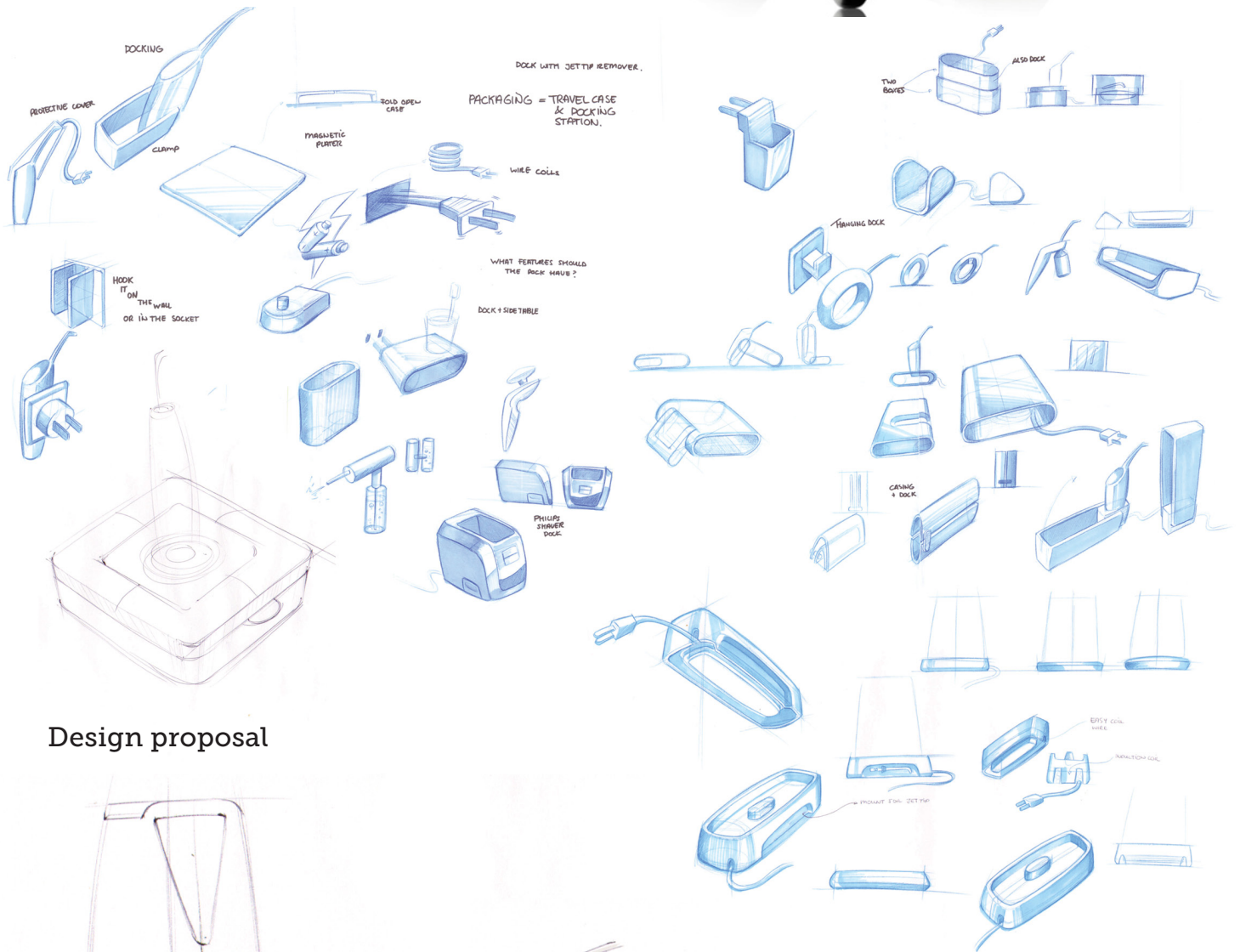
Figure 1 Close up picture of surface of the Philips Sonicare Airflosser.



Figure 2 The Philips (PT860) shaver served as reference for the surface treatment of the silicone rubber parts of the Mini Flow.



XII IDEATION CHARGING DOCK



Design proposal

