Appendix

“An Internet of Things vision for Quooker”

By Marie-Jeanne de Groot

Delft, August 2019
Delft University of Technology,
Faculty Industrial Design Engineering,
Master Strategic Product Design

Disclaimer
This report was written to fulfil the graduation requirements of the master Strategic Product Design at the faculty of Industrial Design Engineering at the Delft University of Technology.

August, 2019

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Supervisory team
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Mentor: Ir. Berghuis, G.H.
Client mentor: Ir. Loois, R.P.

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Contents

Appendix A - Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: de Groot
initials: M.H.V. given name: Marie-Jeanne
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Your master programme (only select the options that apply to you):
IDE master(s): ( ) IPD ( ) DfI (★) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Jacky Bourgeois dept. / section: DE - Internet of Things
** mentor: Gert Hans Berghuis dept. / section: PIM - MCB
2nd mentor: Robbin Loois, Product Manager
organisation: Quooker
city: Ridderkerk country: Netherlands
comments (optional): Martijn Punt (Marketing Manager) may be replacing Robbin's role from May.

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Jacky Bourgeois date - - signature

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

( ) YES all 1st year master courses passed
( ) NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ( ) APPROVED ( ) NOT APPROVED
Procedure: ( ) APPROVED ( ) NOT APPROVED
comments

name date - - signature

Initials & Name M.H.V. de Groot Student number 4289676
Title of Project The IoT as a tool for improving the communication with Cube users

The IoT as a tool for improving the communication with Cube users — project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 14 - 03 - 2019 — - - — end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

The assignment is commissioned by Quooker: the inventors of the boiling-water tap. For many years the Dutch company has been educating customers about the benefits and safety of the boiling-water tap. Since 2012 the concept became more broadly known and the market left the introduction stage for the growth stage. New competitors are tapping in (Grohe, Franke) which are happily welcomed to help in educating the customer. Quooker's strategy is geographically market development, their mission is 'To take over the world'. Quooker products are for the most part sold to kitchen dealers who in turn resell it to customers. The only interaction Quooker has with the customer is when the product breaks and a service mechanic is needed to repair it. This does not happen often because the product is durable and designed to last for 10 years. In September 2019 Quooker has launched a new product: the Cube (see figure 1). It is an extra module for the Quooker tap to offer the customer, next to boiling water, cold - filtered and sparkling water (€1000). The customer needs to order, receive, install, replace and return CO2 bottles for the sparkling water and therefore the customer interaction with Quooker increases. Suddenly Quooker sells a consumable.

The external stakeholders in this context are the company, users, university, me, suppliers, wholesalers and kitchen dealers (see figure 2). - The company wants three different aspects: To deliver high-quality products and good service to justify its premium pricing. To stay frontrunner in the boiling-water tap market. To grow geographically to enable continuous growth. - The users want four aspects: To have quick access to boiling, sparkling or filtered water to spend as little time as possible waiting in the kitchen. By doing so, they have more time for social interactions with family or guest and thus better social connections and pleasant get-togethers, or they have more time for relaxation and peace of mind. Users also want to convey a certain image to others for status or to themselves for self-reflection (e.g. being innovative, modern, family-loving, sustainable, in control, innovative, popular or showing the ability to incur costs). Lastly, users want no hassle with carrying, storing and returning bottles in order to drink filtered or sparkling water. - The university wants to evaluate students based upon the rubric criteria. - What I want will be elaborated in the last paragraph 'Motivation and personal ambitions'. - Suppliers of parts for Quooker products want the following three aspects: To maximise their revenue by selling more parts. To keep Quooker as a customer. To decrease production costs. - Wholesalers want three aspects: To maximise sales for revenue. To increase the revenue with 25% margin on sold Quooker products. To have as little or no contact with customers after purchase. - Kitchen dealers want the next four aspects: To maximise their kitchen sales for revenue. To keep a good reputation (e.g. of high quality, service, design or the lowest price). To increase the revenue with a 35% margin on sold Quooker products. To decrease the after-sale issues to minimise the costs. Most Quooker products are sold via kitchen dealers (68%) who prefer selling Quooker products over competing brands because of the high quality of the products result in less after-sale issues.

The first internal stakeholder is the product manager Robbin Loois who is accountable for the project outcome and key in the realisation of the project. The second stakeholder is the electronic product development (EPD) manager Bart Hermanns. His department could be developing the electronics of the project outcome and his department may be able to support the project with electronic test set-ups. The third stakeholder is the research & development (R&D) manager, Ivo Legel, who is not accountable for the project outcome but needs to be convinced in order to realise the project. The last stakeholder is the marketing manager Martijn Punt. He is piloting a consumer application and he needs to be convinced of the project outcome as well.

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: Left: The Cube reservoir and CO2 bottle. Right: The Quooker and Cube in a kitchen cabinet.

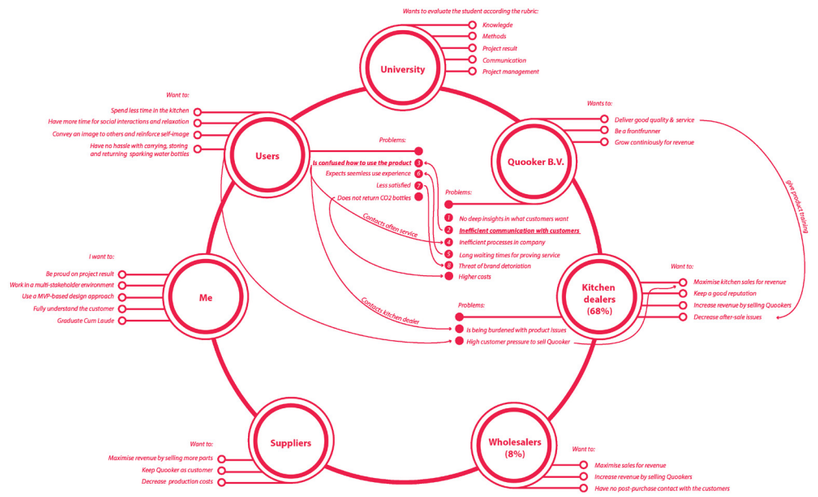

image / figure 2: Stakeholder map

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

In the past, Quooker has almost no interaction or communication tools with the customer. Therefore, the company does not have deep insights into what customers want (see figure 2). With the launch of the Cube, customers need to order, receive, install, replace and return CO2 bottles for the sparkling and filtered water and therefore the communication between Quooker and the customer increases. Quooker does not know how to communicate effectively to the customer and therefore the customer is confused about how to use the Cube. For example, they do not know when a bottle of CO2 is (almost) empty, if the bottle is installed correctly (this is often not the case and then the bottle is empty too quickly) or that they have to return the bottles. They do not know if the amount of effervescence in the sparkling water is normal (they expect it is too low) or if the stream of the different types of water is normal (cold filtered is a weak stream, boiling is a steaming stream). They do not understand what is wrong with the product nor when the product needs maintenance. Due to this confusion, the customer satisfaction is lower and the customer reaches out to service more often. This leads to inefficient processes in the company, for example, the service must visit the customer more often and the call center is overloaded. This results in longer waiting times for providing service and the customer expects a seamless user experience (because of the premium price). As a result, customer satisfaction is lower and brand damage is at risk. In addition, CO2 bottles are not sent back, which increases costs.
At the same time, competitors are developing Internet of Things (IoT) applications. There is a substantial threat that competitors develop better communication with the customer and/or better service with IoT and outperform Quooker. Therefore the company must be one step ahead and look into the possibilities of IoT to improve communication with the customer. However, the design solution must have real and validated added value for the customer. The lack of deep insights in what the customer wants within the company has resulted already in the occurrence of many technological developments without a clear vision or purpose on what the real value is behind it for the customer. The solution cannot be another aimless development.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

To create a feasible, desirable and viable concept that improves the communication between Quooker and Cube users through IoT by looking at the validated user needs. The ultimate goal is to increase customer satisfaction and to improve internal processes in the company to enable continuous growth without brand deterioration.

The following problems I am going to solve:

1. The lack of deep insights in what the customer wants within the company and having no purpose for current technologically developments.

2. Inefficient communication with the customer

3. The confusion the customer experiences while using the Cube

3. The inefficient processes within the company causing high pressure on service (and sales) and longer waiting times for the customer

4. The lower customer satisfaction

5. The risk of brand deterioration and being outperformed by competitors

Initials & Name M.H.V. de Groot Student number 4289676

Title of Project The IoT as a tool for improving the communication with Cube users

Personal Project Brief - IDE Master Graduation

TU Delft

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 14 - 3 - 2019 - - end date

Calendar week	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Project week	1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Monday	Kick-off	Trend Analysis	White business Case	Wrap up Report		Meeting Supervisory team	Test	Idea generation	Test	Prepare mid-term	Process Feedback	Test	MVP4/ Detailing	Detailing	Strategic Roadmap	Report	Prepare Green Light	Prepare Green Light	Report/ Presentation	Report/ Presentation	Report/ Presentation
Tuesday	Technology Analysis	SWOT Analysis	Redefine Assignment			Process feedback	Test	Build MVP2	Wrap up	Prepare mid-term	Process Feedback	Test	MVP4/ Detailing	Detailing	Strategic Roadmap	Report	Prepare Green Light	Prepare Green Light	Report/ Presentation	Report/ Presentation	Report/ Presentation
Wednesday	4C Analysis	SWOT Analysis	Redefine Assignment	BREAK		Set up research	Process feedback	Test	Test	Reflect process Report	Prepare mid-term	Process Feedback	Test	MVP4/ Detailing	Detailing	Costs / USP's	Report	Prepare Green Light	Prepare Green Light	Report/ Presentation	Report/ Presentation	Report/ Presentation
Thursday	4C Analysis	SWOT Analysis	Redefine Assignment			Flowsh out CPM	Idea generation	Test	Test	Reflect process Report	Prepare mid-term	Reach out CRM	Test	MVP4/ Detailing	Detailing	Costs / USP'S	Report	Prepare Green Light	Prepare Green Light	Report/ Presentation	Report/ Presentation	Report/ Presentation
Friday	4C Analysis	White business Case	Wrap up Report			Prepare meeting	Build MVP1	Wrap up	Test	Reflect process Report	MGS term	Build MVP3	Wrap up	Detailing	Future Vision	Report	Prepare Green Light	Green Light	Report/ Presentation	Report/ Presentation	Evaluation Day 2-8-2019
Comment	Analysis	Analysis	Choose focus	Holiday		Preparation	Cycle 1	Cycle 2	Reflection	Mid-term	Preparation	Cycle 3	Buffer week : Either MPV 4 or Detailing	Detailing	Businessplan	Lay-out Visuals	Preparation	Green Light			Graduation Week

I want to perform a Minimal Viable Products (MVP's) design approach to obtain deep user insights. The MVP's are kept basic and contain just as much information to measure the desirability and to acquire insights. For example, if the MVP represents an app, the MVP could be a card box Ipad with paper text-balloons. I plan on keeping these MVP's basic because of the following reasons.

A basic concept will...

- Encourage participants to respond honest and critical.
A fully developed concept gives participants the perception that I have invested a lot of time in it.

- Avoid going too much into depth in the details
Especially in the first two cycles, I do not want to discuss too many details and layout issues and rather focus on depth.

- Save developing time

I want to do at least three cycles with 5 participants each. In total, I would need +/- 15 participants for 0,5-2 hour sessions. I can contact Cube users for these tests with the CRM-system, but only the ones that registered their product online and those who gave permission for contact. This group contains about 100 Cube users which I can contact by e-mail. If the response rate is too low (n<15) I would have a problem. Travelling to participants is going to be time demanding as well and Quooker expects a detailed final concept. So quite some time is needed for the detailing phase.

Initials & Name M.H.V. de Groot Student number 4289676

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Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS
Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

1. I want to be proud on the end result
I want to gain in-depth insights into customers and turn it into strategic design. I want to make something truly desirable for the customer, but at the same time, I want to understand the brand Quooker and offer them a new and fitting strategic concept. By doing so, I want the company, my mentor, chair and myself to be proud of the final solution.

2. I want to learn how to work in a multi-stakeholder environment
Many people in the company are involved in my project and at a high speed, new IoT developments are pioneering at EPD, Service, and Marketing. I need to stay informed and keep up with what is already happening and grab opportunities to collaborate. The company also tends to be critical at the final presentation (which I think is a good thing) so I need to be prepared for that.

3. I want to use a MVP-based design approach
I want to add real value to the company by giving them deep insights into what the customer wants. I want to use a MVP-based design approach which they have not used before. I will offer them in-depth qualitative customer research instead of the current superficial quantitative research (online surveys).

4. I want to fully understand the customer
My biggest personal interest is consumer behavior and decision-making. I followed a minor in this field I enjoyed reading the study books so much that I decided I want to deepen my knowledge in this field. I followed several electives in this field and I plan on doing a second master in Consumer Psychology after SPD.

5. I want to graduate Cum Laude.
After my second master, I want to pursue a career in persuasive design: design based on psychological insights to influence human behaviour through a product's or service's characteristics. In order to persue my career in persuasive design, I need to follow that second master. However, I did not follow a psychology bachelor and therefore I need to graduate Cum Laude to raise my chance to be admitted.

I realise my goals are ambitious, but I am looking forward to doing the best I can in this project!

FINAL COMMENTS
In case your project brief needs final comments, please add any information you think is relevant.

Appendix B. - Company Culture

The historical background of Quooker reflects in the current innovation strategy and created three important company values.

The current innovation strategy is influenced by the company's history. Years of development in a basement made the company to a success. The company owes it success to a technology-driven innovation and therefore most innovations are still technology-driven. These innovations derive from the R&D department instead of normally the marketing department taking the lead. As a result of the technology-driven innovation strategy, most innovations are incremental and focused on improving the quality of the product.

The company values quality and safety. If the founders made a low-quality or an unsafe boiling-water tap in the first place, the company would not have been as successful as they are today.

The company also values autonomy. When Henri invented the tap he could not count on support from third parties. He had no accesss to external capital and suppliers. This autonomous mindset is still present, because Quooker wants to produce as much as possible in-house.

The company is proud to be the inventor of the boiling-water tap and for that reason they want to sustain market leader in the market they have created.

Appendix C - Product Portfolio

The product portfolio is shown below.

Quooker offers taps in the following finishes: chrome, stainless steel, nickel, black, and gold. The company offers the following kettles: a three-litre boiling-water kettle (Pro3), a kettle that either offers seven litres of boiling water or 15 litres of warm water (Combi), a kettle that either offers seven litres of boiling water or unlimited warm water (Combi+). Quooker also sells accessories: a soap dispenser, bracets to hold to kettle and a filter for limescale.

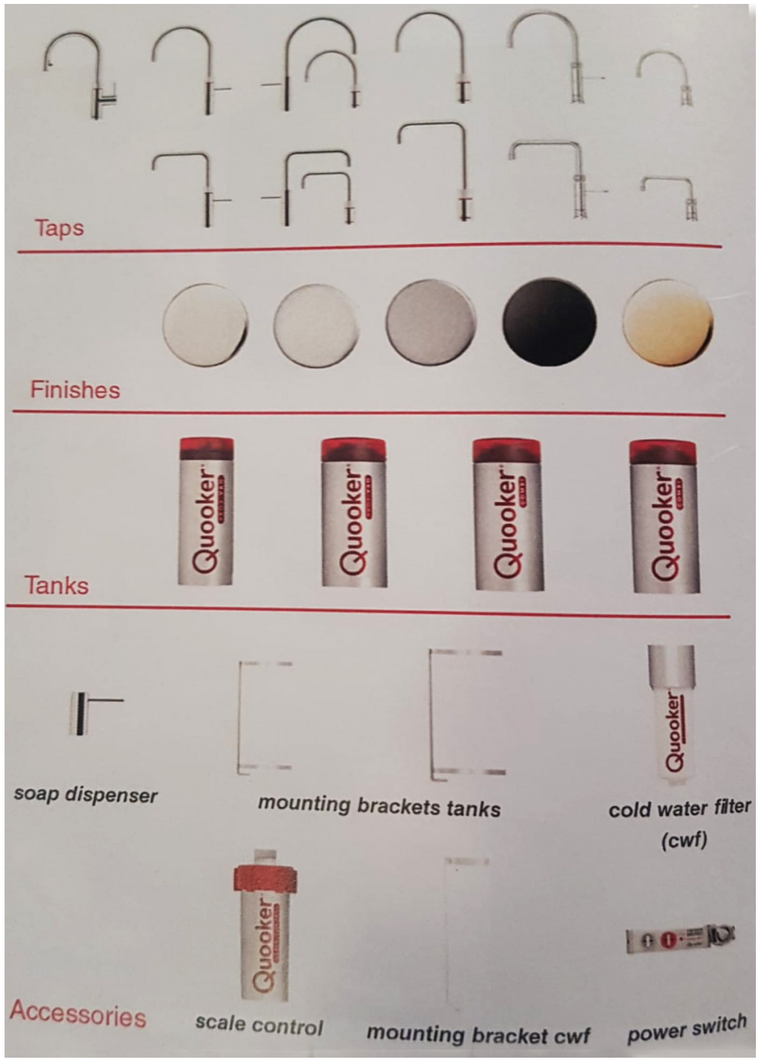
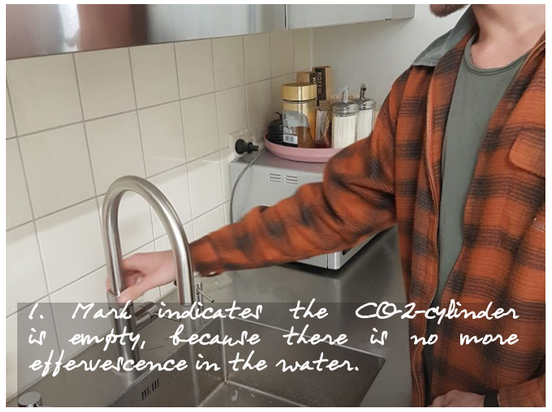
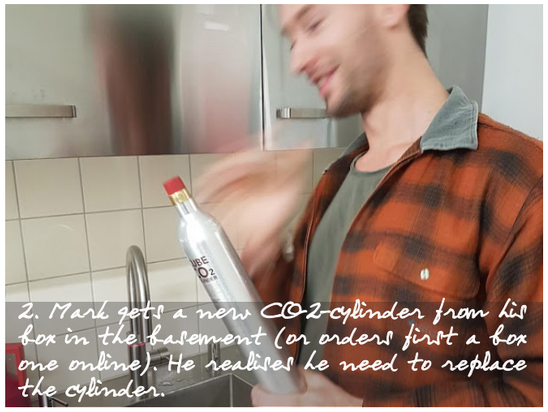


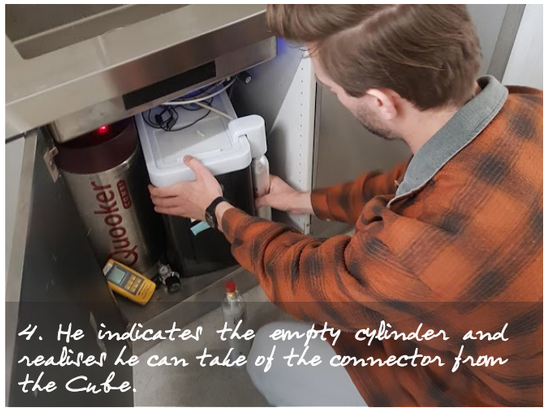
Figure 1. A visual of the product portfolio. Reprinted from Quooker's Modular Kitchen Cabinet (Heemskerk, 2018).

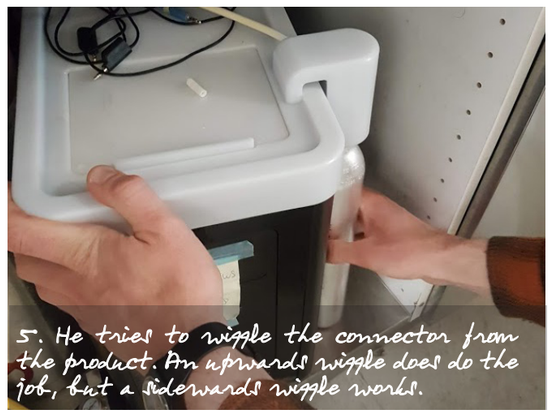
Appendix D - Usage steps of the Cube

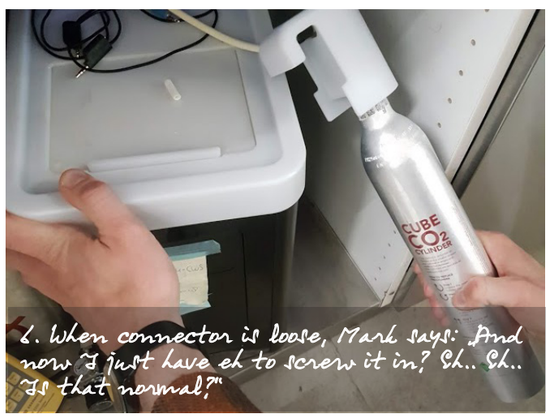
Replacing the CO2-cylinder (3 minutes)



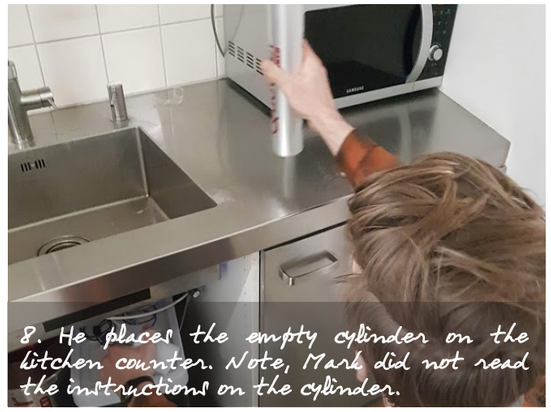








7. He screws counter clockwise. He fungles a bit and switches hands to hold the cylinder.



8. He places the empty cylinder on the kitchen counter. Note, Mark did not read the instructions on the cylinder.

9. He takes the plastic wrapper and red cap of the new cylinder.

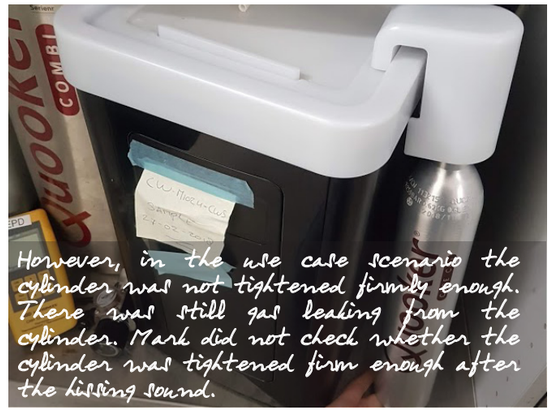
10. He screws the cylinder clockwise in the connector.

11. He hears a hissing sound and shouts nervously: „Oeh I startled!"

12. He hangs the connector and new cylinder back on the side of the Cube.

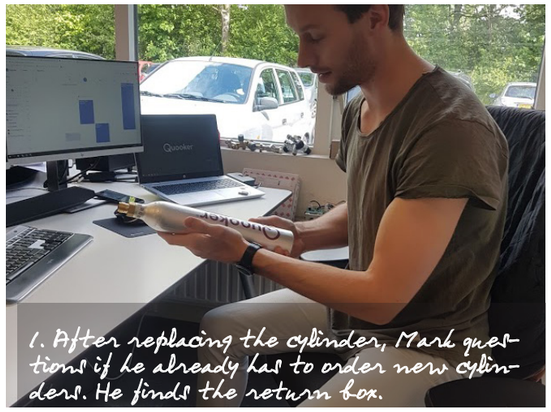
13. He closes the kitchen cabinet.

14. Finally, he checks if the tap dispenses sparkling water.



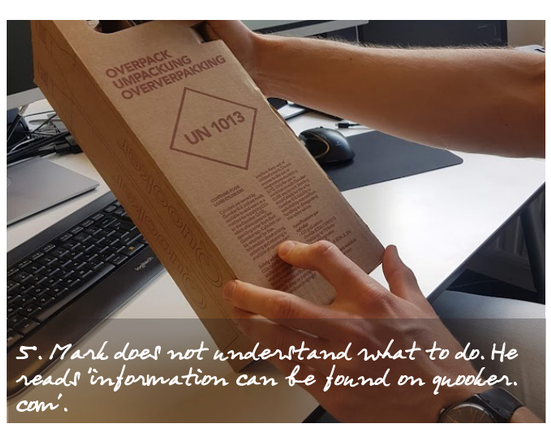
However, in the use case scenario the cylinder was not tightened firmly enough. There was still gas leaking from the cylinder. Mark did not check whether the cylinder was tightened firm enough after the hissing sound.

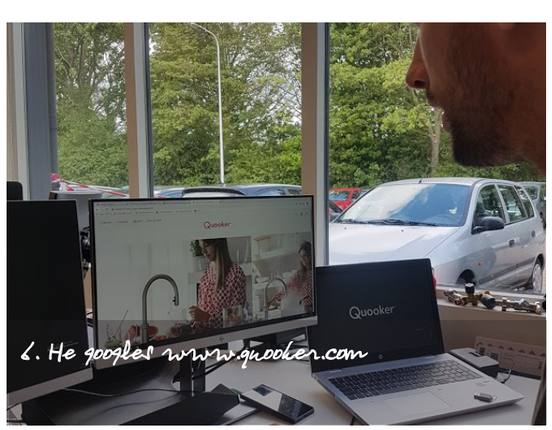
Returning of the CO2-cylinder (12 minutes)



1. After replacing the cylinder, Mark questions if he already has to order new cylinders. He finds the return box.


2. Mark opens the box.

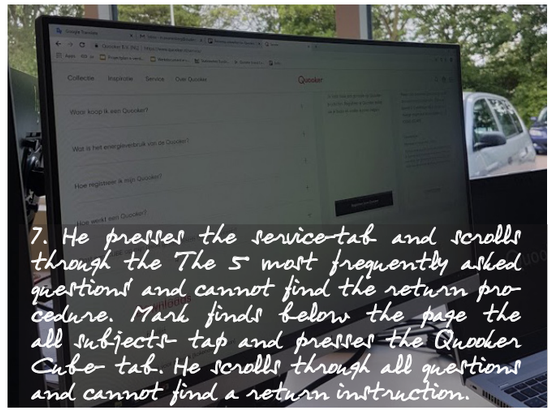

3. He realises all cylinders are used, because all cylinders do not contain a red cap and plastic wrappers.



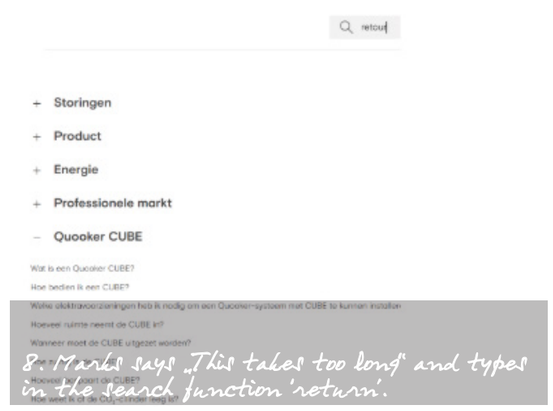
4. He reads the return box for instructions on ordering and returning.

5. Mark does not understand what to do. He reads 'information can be found on quooker.com'.

6. He googles www.quooker.com

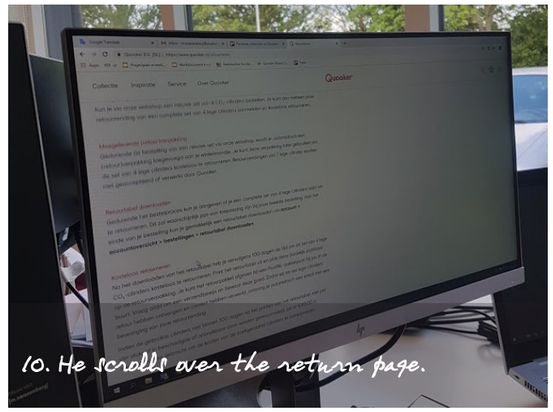


7. He presses the service-tab and scrolls through the The 5 most frequently asked questions and cannot find the return procedure. Mark finds below the page the all subjects- tap and presses the Quooker Cube- tab. He scrolls through all questions and cannot find a return instruction.

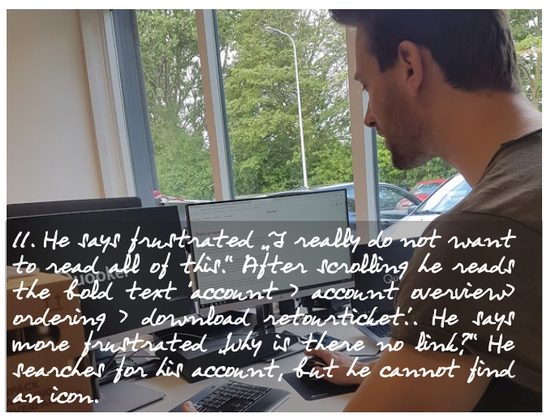


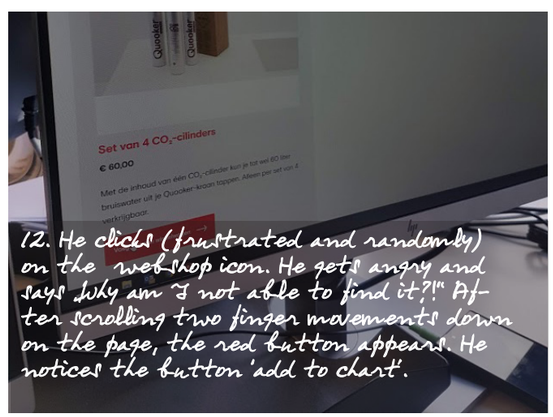
8. Mark says „This takes too long" and types in the search function 'return'.

9. He presses the read more-button at the return-tab

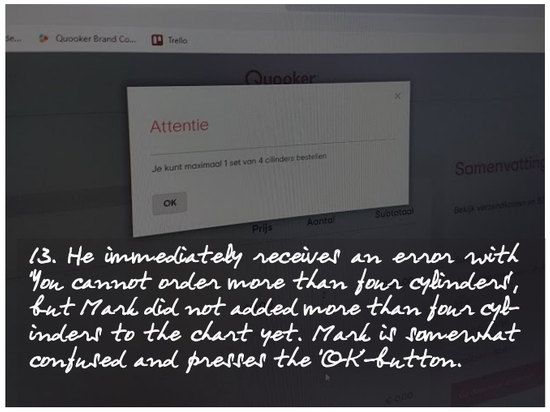


10. He scrolls over the return page.

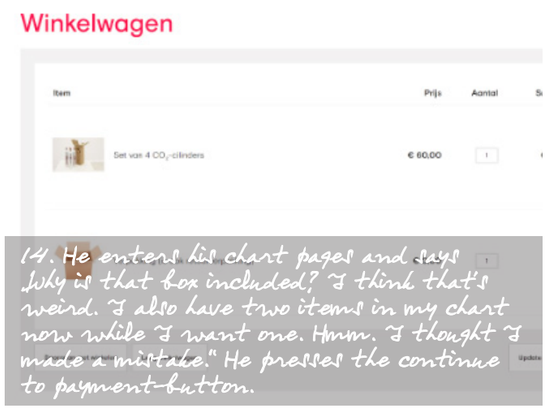

11. He says frustrated „I really do not want to read all of this." After scrolling he reads the bold text 'account > account overview ordering > download retourticket'. He says more frustrated „Why is there no link?" He searches for his account, but he cannot find an icon.



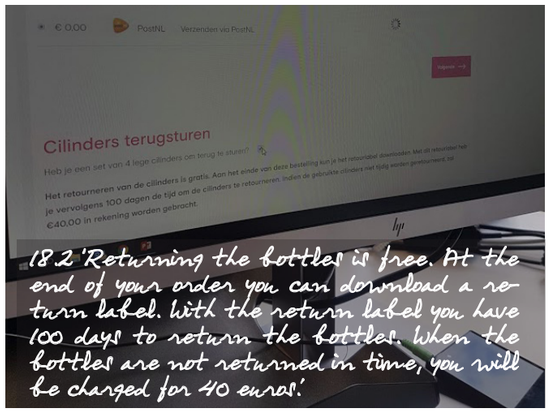
12. He clicks (frustrated and randomly) on the webshop icon. He gets angry and says „Why am I not able to find it?!" After scrolling two finger movements down on the page, the red button appears. He notices the button 'add to chart'.



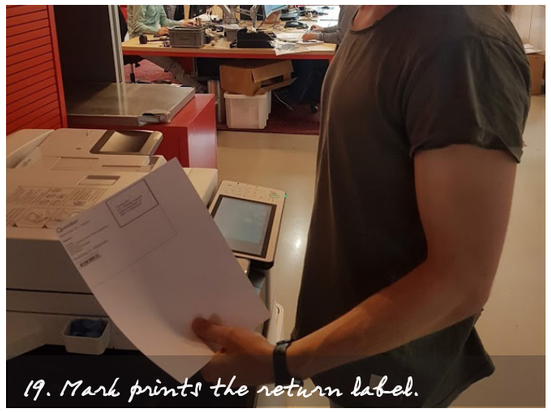
13. He immediately receives an error with 'You cannot order more than four cylinders', but Mark did not added more than four cylinders to the chart yet. Mark is somewhat confused and presses the 'OK'-button.



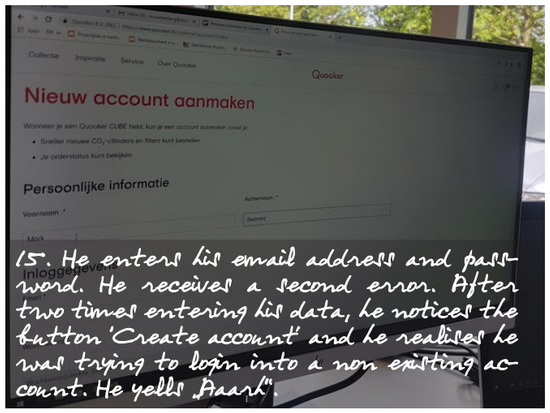
14. He enters his chart pages and says „Why is that box included? I think that's weird. I also have two items in my chart now while I want one. Hmm. I thought I made a mistake." He presses the continue to payment-button.



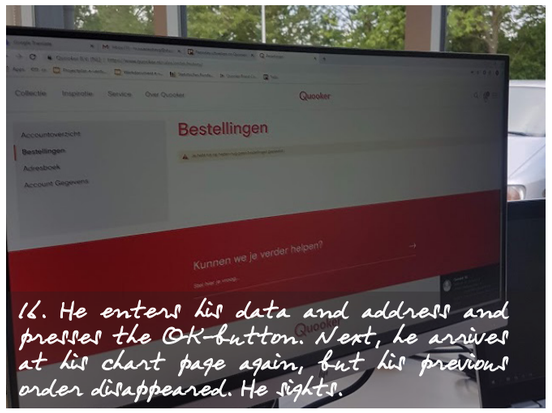
18.2 'Returning the bottles is free. At the end of your order you can download a return label. With the return label you have 100 days to return the bottles. When the bottles are not returned in time, you will be charged for 40 euros.'



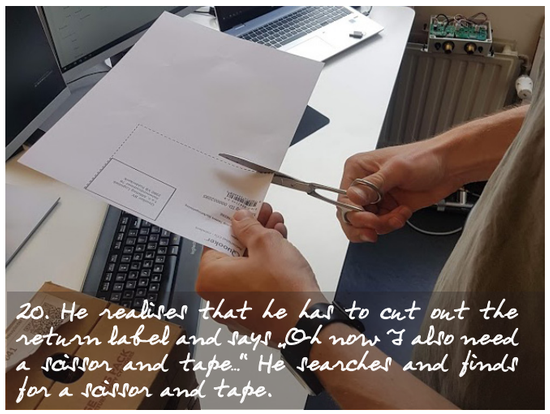
19. Mark prints the return label.



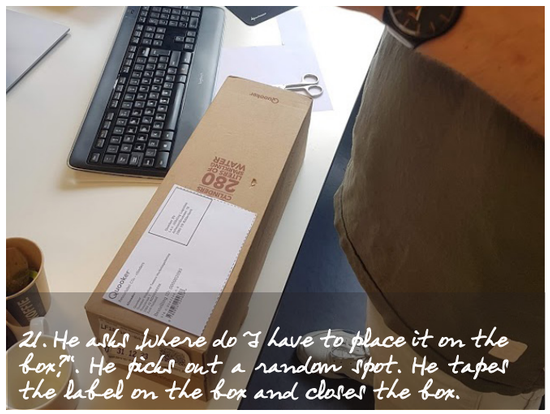
15. He enters his email address and password. He receives a second error. After two times entering his data, he notices the button 'Create account' and he realises he was trying to login into a non existing account. He yells „Aaark".



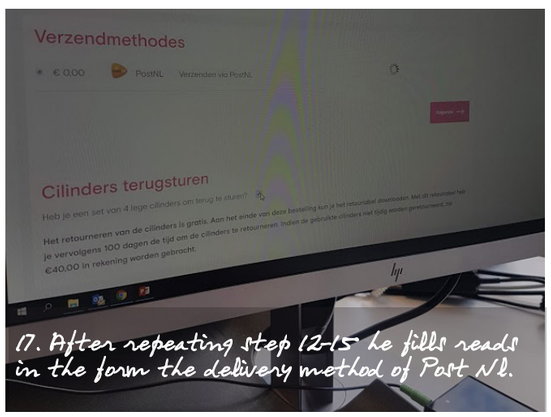
16. He enters his data and address and presses the OK-button. Next, he arrives at his chart page again, but his previous order disappeared. He sighs.



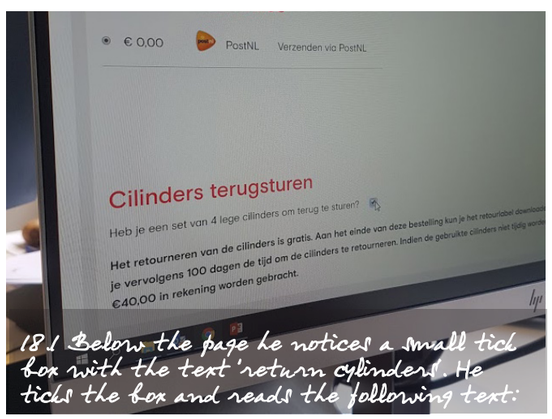
20. He realises that he has to cut out the return label and says „Oh now I also need a scissor and tape..." He searches and finds for a scissor and tape.



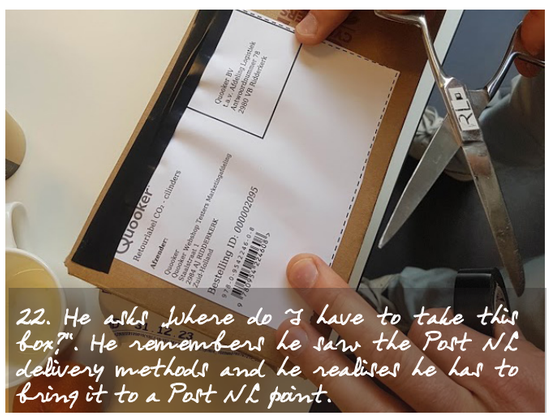
21. He asks „Where do I have to place it on the box?". He picks out a random spot. He tapes the label on the box and closes the box.



17. After repeating step 12-15 he fills reads in the form the delivery method of Post NL.



18.1 Below the page he notices a small tick box with the text 'return cylinders'. He ticks the box and reads the following text:



22. He asks „Where do I have to take this box?". He remembers he saw the Post NL delivery methods and he realises he has to bring it to a Post NL point.

Reflection
Mark thinks the process takes too long: "There are a lot of unnecessary steps. I got frustrated. The instructions are unclear and incomplete. I was confused many times. For example, I wanted to know what to do with the return box but I could not find the instructions. I had to make an account first, but I did not want to make an account first. I want the instructions and I want to order bottles." „Oh and I did not notice the text 'Use this pack' on the box. There is a lot of unnecessary text and there is no roadmap somewhere."

Appendix E - Working principle of the Tap, Kettle and Cube

The working principle of the tap, kettle and Cube are analysed below.

Tap

Figure 3 illustrates an overview of the three main interaction components in the tap. The knurl-knob activates a certain water-type. A double-push-turn motion activates boiling water, a single-push-turn motion activates sparkling water and a single-push-wait-turn motion activates filtered water. The LED light communicates which water type is being activated and the handle activates the water temperature regulation.

Kettle

The kettle is an energy-efficient high-vacuum insulation boiler which contains a reservoir, a heating element (1), two temperature sensors (2), a hood (3), and a circuit board (4) (see figure 3). The cold water enters the reservoir from below with a hose (5). Then, the water is heated with the element and floats upwards. It leaves the kettle from a pipe (6) when the tap is opened and new cold water is entered again.

The tank is hard-coded to recognise product malfunctioning and to shut itself down. There are three product malfunctioning types: tap, kettle or both. The kettle sends out a certain type of LED blinking signal to indicate the malfunctioning type. The consumer can report the signal to the customer service.

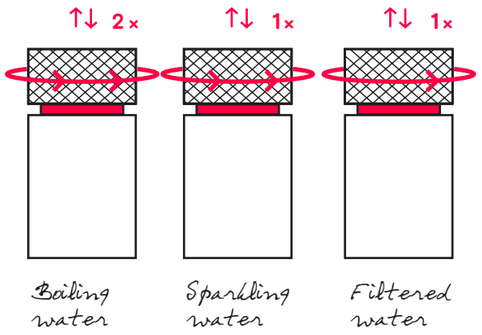


Figure 2. The outside work of the kettle.

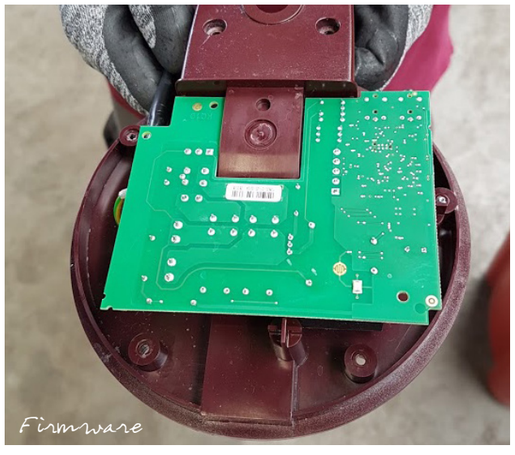


Figure 3. The working principles of the tap and kettle.

Cube

Figure 4 shows the inside work of the Cube. It consists of a reservoir (1), a filter (2) and a water pump (3).

Figure 4. The inside work of the Cube.

Cylinder

The CO2-cylinder is shown in figure 6 . Each cylinder contains 0,425 kg of carbon dioxide and is provided with replacement and return instructions. The cylinder is equipped with a special type of screw thread to make competitive CO2-cylinders incompatible with the Cube. The delivery box functions as the return box and needs to be saved (see figure 5).

Figure 5. The return box.

Figure 6. The CO2 cylinder.

Appendix F - Working principle of the Product Data

In this appendix the working principle of the product data is elaborated.

The data from a Quooker product is manually extracted via the set-up (see figure 7). A cable is connected to the hood of the kettle and plugged into a Bluetooth device. The device sends data to an application on an Ipad that simplifies it in order for mechanics use on spot to find out what the malfunctioning in the product is. The extensive data file is sent to a computer at the Electronic Development Department (EPD) wherein some of the cases the file is manually uploaded to a server.

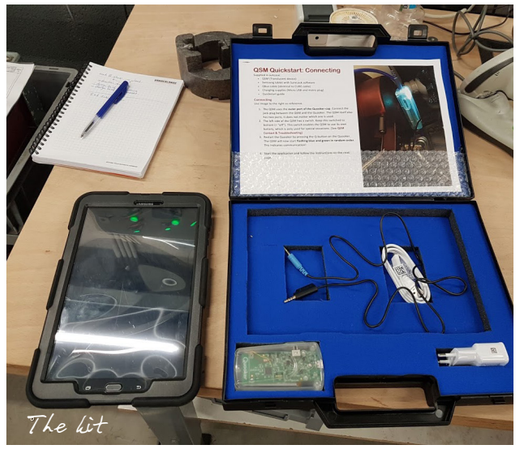
At EDP department the extensive M.C.H. data file is manually uploaded to a server via a graphics tool of Atom Apps by entering the product's barcode, kettle barcode and kettle type. The server is currently +/- 1 year in maintenance and not all data files are uploaded to it. The file contains the data shown below. Unfortunately, the product does not have a timestamp and therefore it is not possible to analyse when and how much water consumers tap during the day. The product measures the total operating time, yet when the device is unplugged the timer resets.

Developments

Currently, EPD is developing a Wi-Fi demo to connect Quooker products to the internet and a tracking device for the Cube to log consumer data (see figure 7). The company plans on producing 50 devices to manually track user data. However, the device still needs to convert the time from milliseconds to time/day and it needs a battery that is able to last long enough for research.

Conclusion

It is not (yet) possible to wirelessly collect (realtime) data from Quooker products. The current proccess not realtime and time consuming.



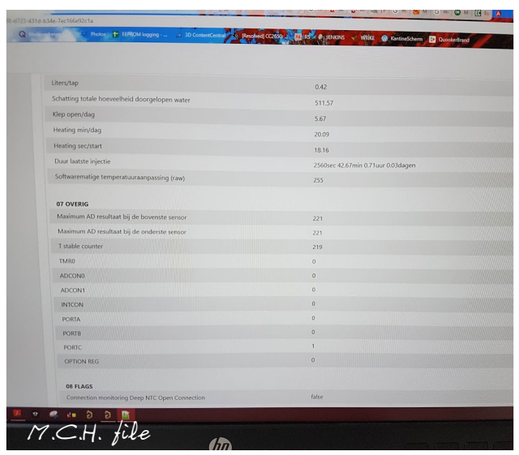


Figure 7. Manual data substraction.

Appendix G - Service Analysis

This appendix shows the extended service analysis based upon three site surveys (21 service appointments).

Site surveys with service mechanics showed that for a number of years the service department runs at under-capacity. The pressure on the service department is high as result of four factors (see figure 8). Firstly, the number of products sold has grown enormously and simultaneously the amount of service notifications. Secondly, it is difficult to attract new service mechanics due to a tight labour market. Thirdly, the company produces batches with a trial-and-error mentality. Production malfunctioning occurs from time to time, forcing the company to recall products. The batches are ten times larger than before and therefore product recall is more time-consuming. Fourthly, internal service processes are mostly manual and inefficient.

The service interaction with the consumer is mapped in figure 9.

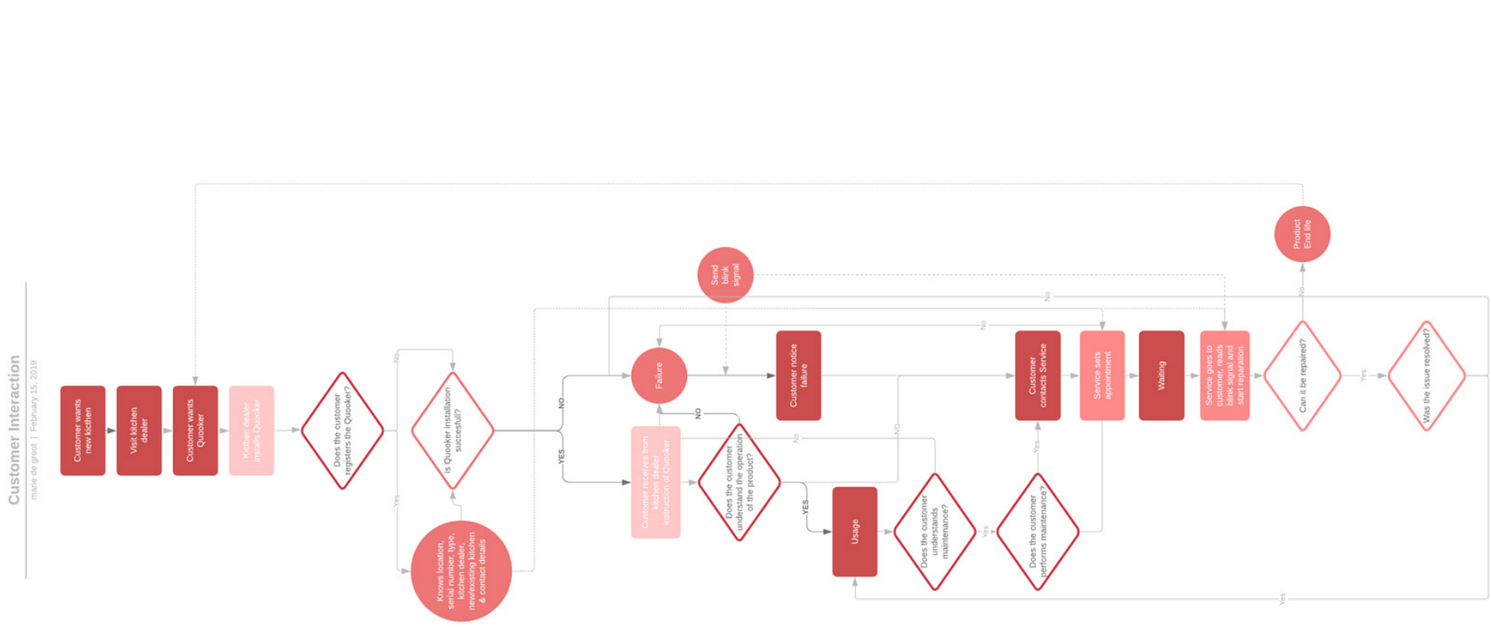


Figure 8. The cause for a high pressure on the service department.

Figure 9. A map of the service interaction with the consumer.

Appendix H - Service Notifications of the Cube

In this appendix the service notifications for the Cube are analysed.

The service notifications of the Cube are analysed with several factors in data analytics-tool, Click, with the ultimate goal to improve the quality of production batches.

Most frequent service notifications

The three most frequently occuring service notifications are caused by consumers incorrectly using the product and teething troubles.

1. 'No filtered or CO2 water'
The most frequently occuring service notification is 'No filtered or CO2 water'. This problem is not solved yet and it occurs at 33 out of 1.000 Cubes (Aghina, 2018). The following causes are indicated:

- The consumer thought the product was broken, but in fact the CO2-cylinder was empty
- The consumer did not turned the CO2-cylinder firmly enough
- The filter is not properly mounted

2. 'Little output of CO2- or filtered water'
The second frequently occuring service notification is 'Little output of CO2- or filtered water'. This problem occurs in 21 out of 1.000 Cubes and is also not yet solved. The following causes are listed:

- The consumer did not turned the CO2-cylinder firmly enough
- The consumer is was not well informed of CO2-cylinder replacements
- The consumer did not have a Cube user manual
- The hose off the CO2 bottle holder was not mounted right
- The supply hose was not in the right position

3. 'Leakage'
The third most frequently occuring service notification is that the Cube is leaking due to a teething trouble. The problem is already solved by a development from the R&D department.

Interviews Service Providers

The causes for the service notifications are not quanitified. In order to find the most important cause, two interviews are conducted with key service providers.

Service coördinator
Q1: "What is the most important problem for service providers?"
Van Hooff: "The installation. We have to find our way still with indicating what the problem is, because the Cube is a new product. Pulling one cable out, turning a valve [...]. We are not that used to it compared to the other Quooker products. We still have to get that flowchart."

Q2: "What is the most frequently occuring problem consumers indicate?"
Van Hoof: "That there is no sparkling water or the sparkling water is empty too soon."

Q3: "What is the main reason for this issue?
Van Hooff: "The bottle was not tightened hard enough. Consumers really have to force the bottle into the connector. I think they do not dare to exert so much force. (...) Because the connector is made of plastic and they think it will break."

Q: "Not because of the 40 bar pressure inside the CO2 cylinder?"
Van Hooff: "No I do not think they realise that. They really have to tighten the bottle so hard. It happens many times that they fail. Especially elderly can't extert that force."

Q4: "What are the steps you perform when someone calls with the no CO2 problem?"
Van Hooff: "A flowchart. First I ask them whether they registered the product. They probably did not and then we have to enter the service number. Then I get how old it is etc. Then I check whether the light works or if there is a sound (check power or issues). Then I ask them if they tightened the bottle hard enough and if they could check if there is CO2 from the tap. If not I ask them to replace the bottle with a new one. If it does not work I'll send a service mechanic."

Q5: "What is the most severe problem for consumers?"
Van Hooff: "Leakage. It is oké if the product just doesn't work. Then we come by and repair it, but if a new product instantly starts leaking. It causes damage and we have to handle quickly. I think that is the most important problem which needs to be solved first."

Q: The Cube already contains a leakage detection feature right?

Van Hooff: "Yes, but it does not seem to work properly."

Q6: "Is there anything else I should know?"
Van Hooff: "Yes sound is an upcoming issue. The Cube makes noise when cooling." (van Hooff, E., personal communication, May 1 2019).

E-commerce and CRM employee
Q1: What do consumers ask you most frequently?
Huisman: "They indicate that there is no sparkling water, just normal water. I am responsible for the webshop and consumers often reach out to me with these problems."

Q2: "What do you think is the most important problem for consumers?"
Huisman: "Not tightening the cylinder. Consumers do not tighten it firm enough and then think that the bottle was empty in the first place. But we know these bottles are filled always. It happens definitly frequently."

Q: "You are sure they are filled?"
Huisman: "Yes, 100%. We research the bottles and indicate the cause, and we know that there was CO2 in there. It happens I think for about 1/10 consumers that call me that they think that the bottles were empty from the beginning."

Q3: "What do you tell consumers when they think the bottle was empty from the beginning?"
Huisman: "We will tell them that we send a new one to them and that it probably was because they did not tighten the bottle hard enough. They mostly do not want to believe this and then we will say, 'make sure you tighten it hard enough just in case and we will send you a new one'." (Huisman, J., personal communication, May 1 2019).

Conclusion

The two most frequently occurring service notifications with regard to the Cube are moslty caused by consumers incorrectly using the product. The most frequently occurring problem is caused by consumers that do not tighten the CO2-cylinder firm enough. Consequently, the cylinder leaks CO2 gas and is suddenly empty within a few days. The second most frequently occurring problem is that consumers think the Cube is broken, but in fact the CO2-cylinder is empty and needs replacement. The third most frequently occurring problem is that the Cube is leaking as a result of one of the many teething troubles.

Appendix I - Explorative Creative Session

In this appendix shows a creative session to explore ideas to solve the unclear replacing and returning the cylinders. Online surveys show that replacing and returning the cylinders are the biggest customer satisfaction bottlenecks. Consumers rate both usage steps in the online survey as unclear.

It is assumed that the unclarity is related to the following problems:

- Consumers do not tighten the cylinder firm enough.
- Consumers unexpectedly have an empty CO2 cylinder.
- Consumers do not know how to return cylinders.

The goal of the session was to generate ideas to solve the problems.

Set-up

The creative session is held at the Industrial Design Engineering faculty with four students and two colleagues and the session lasted for two hours. There was purposely a high diversity in the group: 50% male, 50% female, ranging from a first year student till master students, studying industrial design engineering, architecture, molecular science & technology and strategic product design. The colleagues were a senior design engineer working for five years at the R&D department and a design intern at Quooker from the university of Twente. The session plan is shown in figure 10.

Time	Global task	Functional task	Materials	Duration	Remarks
12:30		Walkin		15 min	
12:45	"Introduction"	Explanation product & problems	- lunch - 3x problem wallpapers - products (cube, kettle, fusion, empty co2 cylinder manuals, boxes)	10min	
		Rules			1) iedereen uitpraten 2) domme ideeen bestaan niet 3) gek te denken 4) zet alles op papier 5) tekenen ipv schrijven
12:55		Icebreaker	- 6 a4tjes - stiften	5 min	Blind drawing. Words = de leeuwerkoning, flasticks, Famke Louise, bushalte, gorilla, disneyworld (extra's: kauwgom onder het bureau, mario kart, horoger, linkedin)
13:00	"(Long) Idea Generation 1"	Dynamic brainwriting	- 6 a3tjes - vragen HKJ's opschrijven	30 min	2x Problem 1 "Hoe kan je klanten de fles beter laten aandraaien", = 6min, 5min 2x Problem 2 "Hoe kan je ervoor zorgen dat klanten niet meerls zonder CO2 zitten7 5min, 5min 2x Problem 3 "Hoe kan je het retourneren makkelijker maken7 5min, 5min evt. 1x Problem 4 "Hoe kan je met de klant communiceren7 5min
13:30		Omcirkel je 3 beste ideeen		5 min	random woorden: drones, supermarkt, sharknado, verbeelding, ananas, foto van het eerste zwarte gat, carnaval, paint, MSN, augurk, ADE, ikkbad, ramadan)
13:35	Break			10min	
13:45	"(Short) Idea Generation 2"	Reverse brainstorm	- 3 flipover vellen	10min	per tweetal 1 probleem. 3min per probleem
13:55		Omcirkel je 3 beste ideeen		5 min	
14:00	Klaar				

Figure 10. The session plan.

1) Introduction

The brainstorm session started with a brief explanation of the Cube, introduction to the problems and the goal of the session. IoT was explicitly not mentioned in the session because it could limit the participants creativity.

Next the creative rules for the session are explained to encourage out of the box thinking and a prosocial environment. Afterwards, a warm-up game was played to force each participant to get over drawing insecurity and to get more comfortable with drawing instead of writing.

2) Idea generation 1

This idea generation lasted on purpose quite long to purge all superficial ideas and then to get to 'a deeper layer'. The method used was dynamic brainwriting. Three problems were written on six papers and each participant brainstormed five minutes per problem. Each participant encountered every problems twice, yet the second time with input from their fellow participants. By doing so, they can build upon preceding ideas. The last five minutes the participants received 'random' words (e.g. a black hole, the supermarkt, drones) for idea inspiration. Next, the participants circled their three best ideas on the paper in front of them. After the session there was a ten minute break.

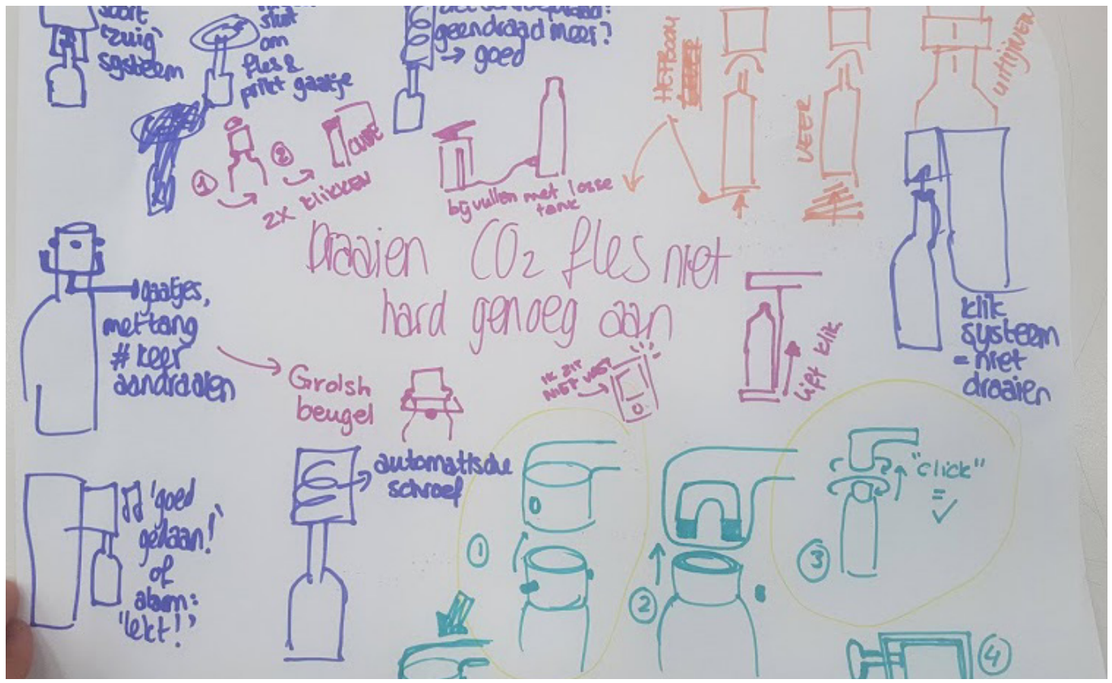


Figure 11. Dynamic brainwriting on tightening the cylinder.

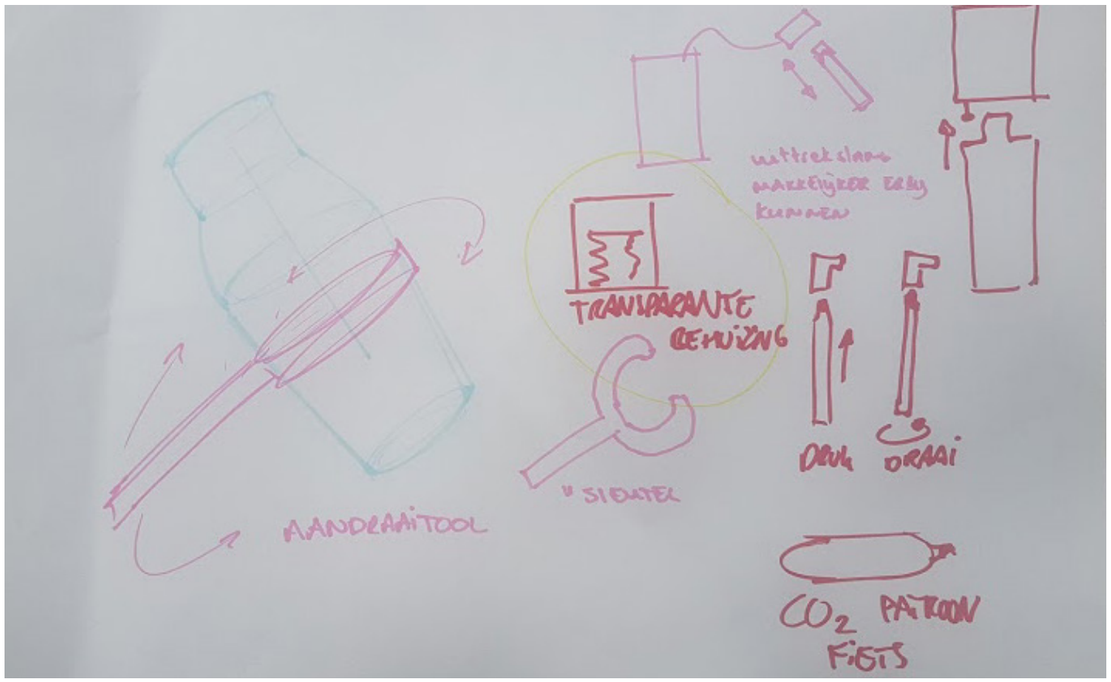


Figure 12. Dynamic brainwriting on tightening the cylinder.

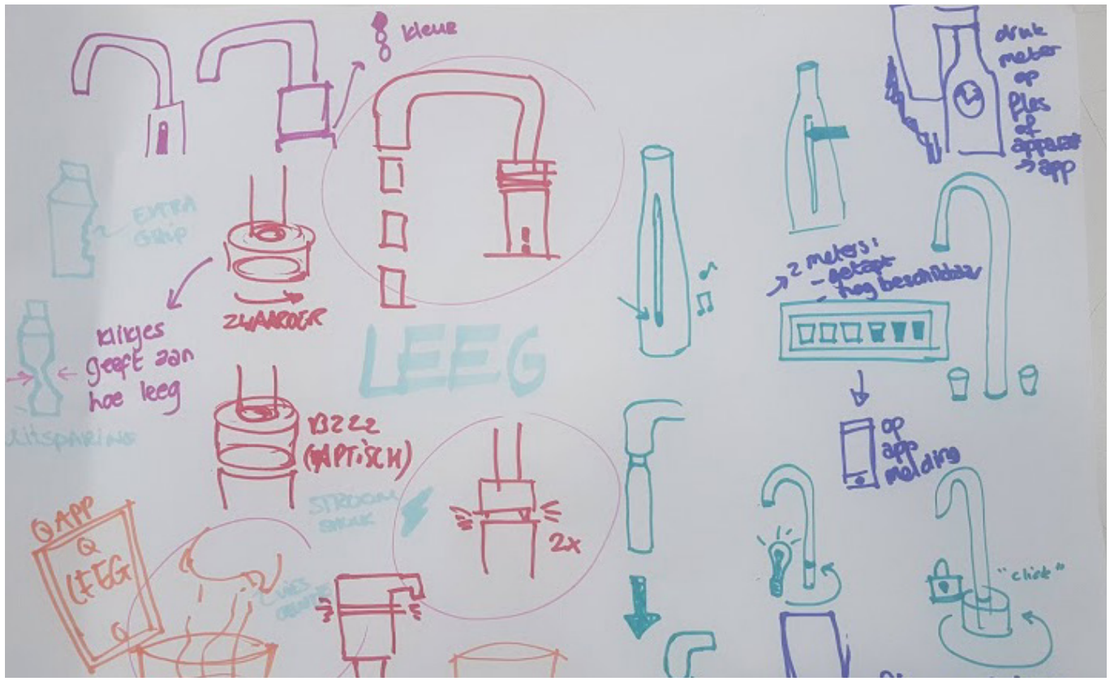
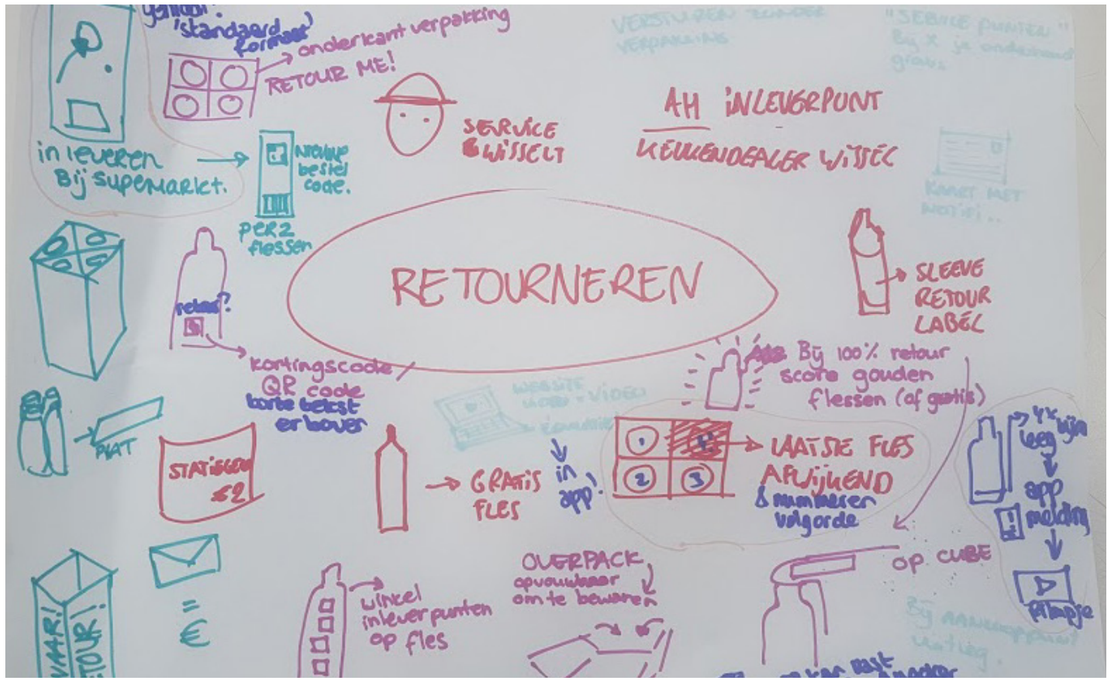


Figure 13. Dynamic brainwriting on indicating the volume of the CO2 inside the cylinder.



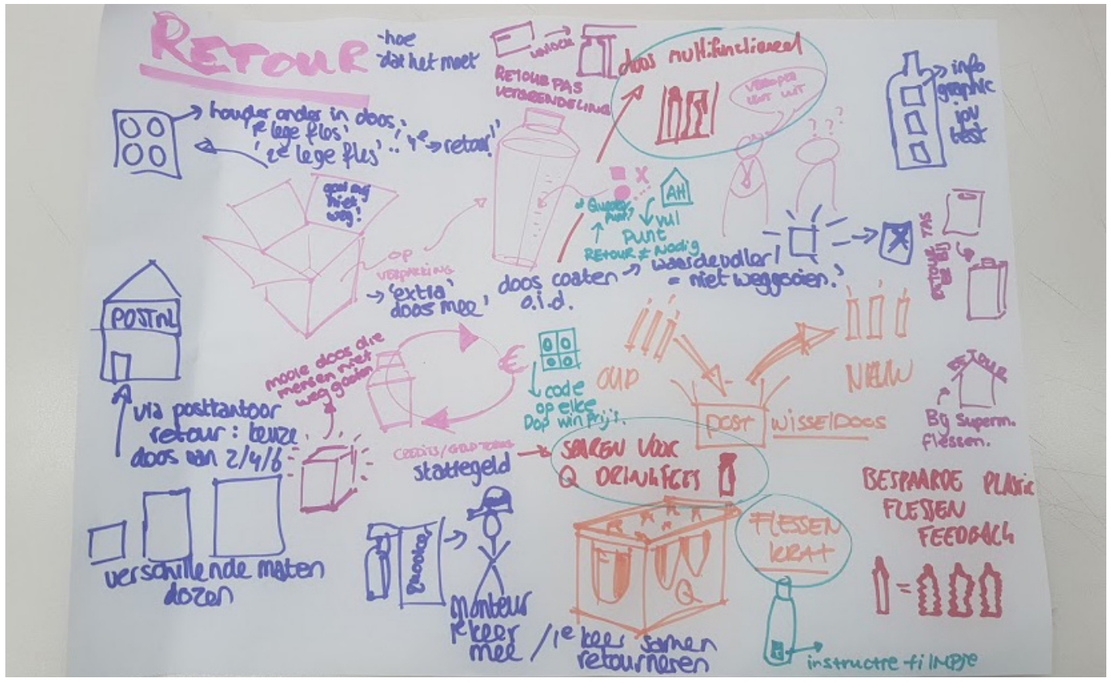


Figure 14. Dynamic brainwriting on returning the cylinders.

3) Idea generation 2
The second idea generation was short, because participants already have given all their ideas in the first round. A reverse-brainstorm method was used. Participants splitted up in teams and took one problem and made it worse. For example, 'How can you make sure consumers always have unexpectedly an empty cylinder (always at the wrong moment)?'. Afterwards the participants circled their three best ideas.

4) Reflection
The last ten minutes the participants reflected on the process and their ideas. The participants discussed great or funny ideas with each other and the researcher took notes. The participants indicated it was a very creative and fun brainstorm with lots of great ideas to be implement immediately.

Conclusion
During the creative session many ideas were generated to indicate the volume of CO2 inside the cylinder, to tighten cylinders and to return them. The session also showed that the working principle of the IoT (the technical driver) is not interesting for the consumer and does not drive consumer value, because almost no ideas showed the technical working principle (e.g. sensors, connectivity, software). On contrary, the ideas focused on the value the IoT brings and on how this value feeds back to the consumer. Two interaction types were noticed: online and physical feedback (e.g. light, sound). During the session the following question arised: What interaction type do consumers prefer with an IoT feature?

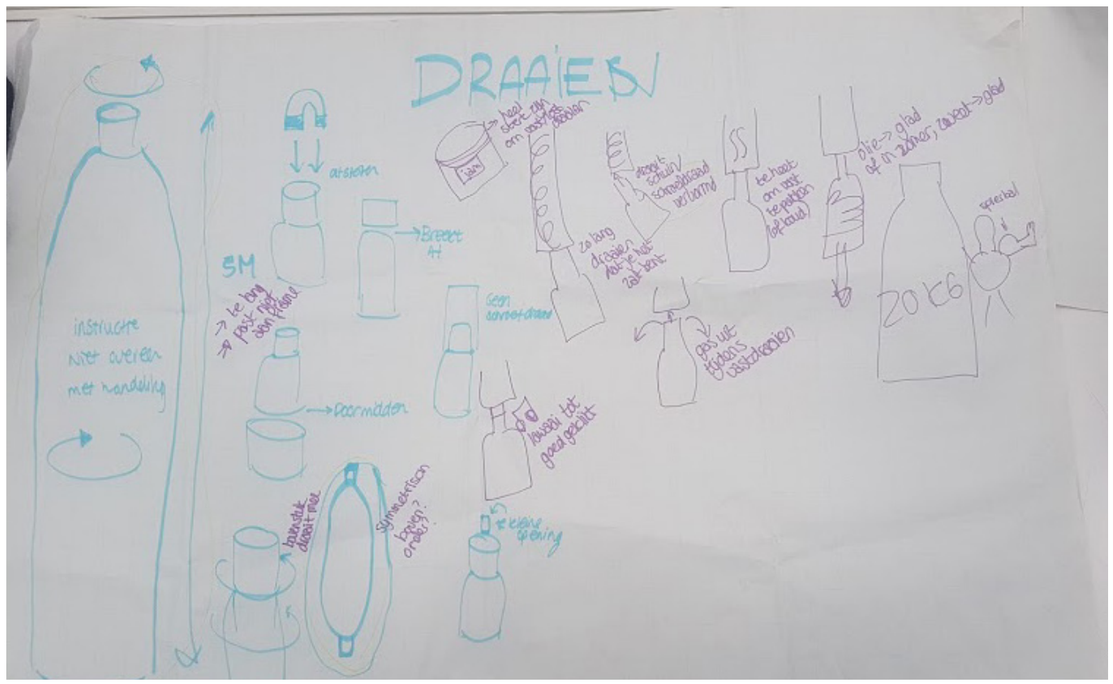


Figure 15. Reverse-brainstorm on tightening the cylinder.

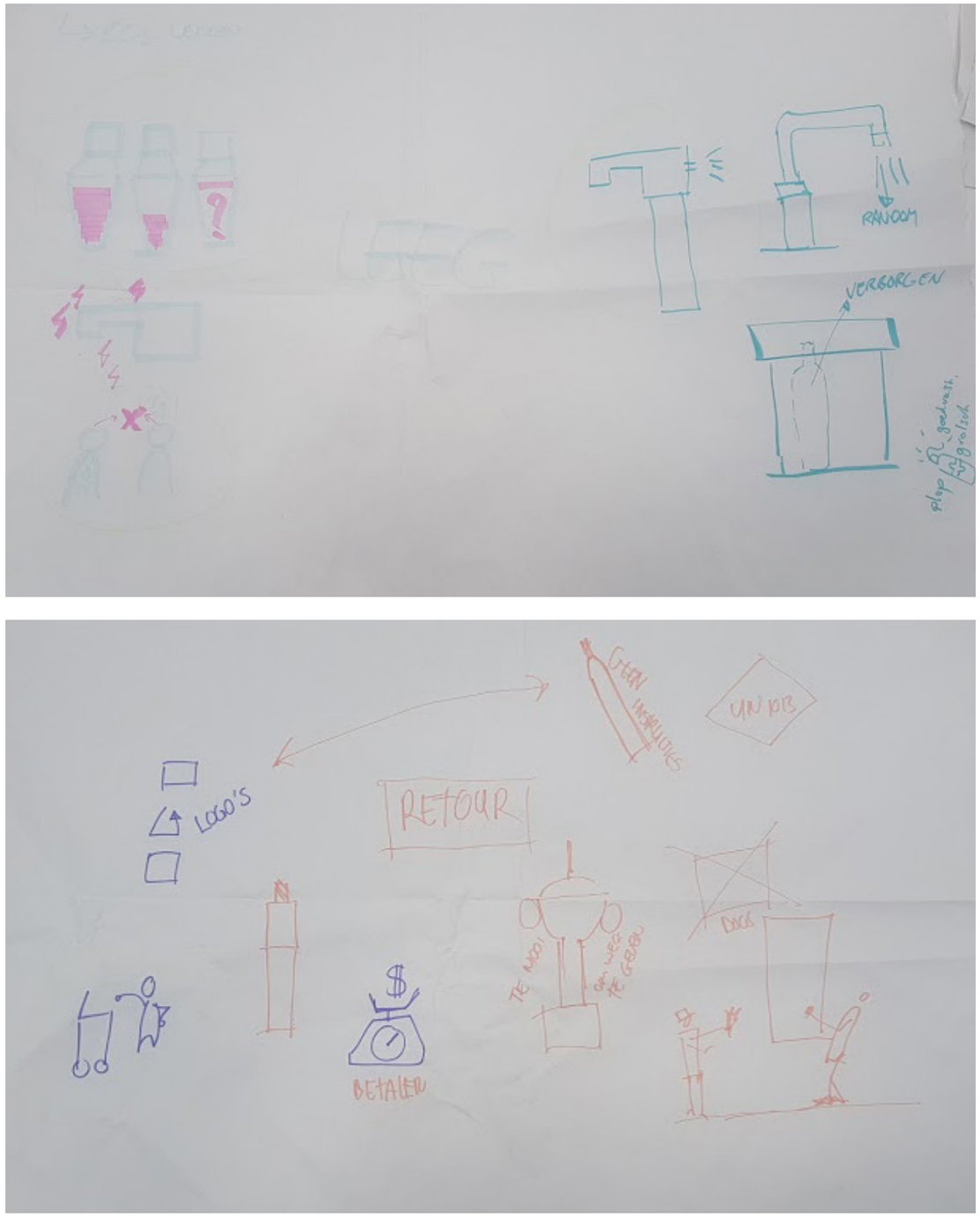


Figure 16. Reverse-brainstorm on indicating the volume of the CO2 inside the cylinder & returning the cylinders.

Appendix J - Customer Journey Research

Quooker has researched the customer journey of boiling-water tap and Cube consumers. The main insights are summarised below.

Figure 17 shows the functions of a boiling-water tap. The figure shows that the tap is multifunctional and many consumers use the tap for more than five purposes. Consumers also use the tap for less obvious purposes. For example, to warm up a spoon to cut icecream, to remove candle wax, steralising baby bottles etcetera (Quooker, 2016). Most of the consumers use the tap 1-6 times per day (67%), use it more than expected (54%) and think the product is indispensable in the kitchen (41%)

The most important reason for purchasing is convenience (fewer actions, time saving) and second the multiple usage options. Consumers use the Quooker mostly for tea (95%), the filling of a cooking pan (84%), and making soup (63%) (see figure I). The overall grade they rate the boiling-water tap is 8,2 out of 10.0 and 92% would recommend it to friends or family. Only 8% have ever had a product malfunction and most of these users rate (84%) the service level as '(very) good' (TSN Technology, 2014).

Figure 18 shows the seven main touch points of the customer journey and the percentages per option consumers choose per touch point (Quooker, 2016).

1. Awareness
First, the customer receives awareness about the product mostly via family, peers and colleagues (26%).

2. Discovery
Next, the customer starts with the orientation of the product mostly via the internet (43%).

3. Decision
The customer makes the decision to purchase the Quooker for convenience (33%).

4. Purchase
The customer is most likely to purchases the product at a kitchen dealer (29%).

5. Service delivery
Next, the product is likely installed by a kitchen dealer (36%) because most respondents want the certainty of a correct installation (27%), or they were unable to do it themselves (20%) or the the installation costs were included in the price (20%). During the purchase and installation phase, 50% of the consumers have had a negative experience. Most negative experiences are caused by an incorrect installation, but the high quality service delivery of Quooker compromises (partly) for the negative experiences.

6. Relationship strengthening
After the product installation, the last part of the customer journey is the customer relationship. Most consumers indicate that they would like to be informed by Quooker in the future about maintenance (74%). From this group, 87% wants to stay informed by email, 10% via Facebook, postmail (3%), a mobile application (2%) and Twitter (2%). The biggest part of the group wants to be informed once per quarter (46%), 23% ones per half year, 13% ones a year, and 12% ones a month.

With the installation, the customer receives an information package with an energy label, an installation manual for the kettle, an installation manual for the tap, a handout with tips for usage, and a registration folder (see figure 19). Quooker wants the consumer to register the product to provide service more quickly and to gain demographic user data. Most customers do not register the Quooker (77%) and do not view and /or save the documents, because the majority purchased a new kitchen and is overloaded with documents of other electronic kitchen appliances. The chance of all documents being viewed and saved is small. In many cases, all the waste ends up including various documents in the trash.

Cube

There are six customer journey steps for the Cube.

1. Purchase
The most important purchase reasons are convenience (no hassle of carrying of water bottles) and sustainability (less waste of plastic bottles). The CSAT-score is 88% (Quooker, 2019).

2. Order & delivery CO2-cylinders
Research indicates consumers find the ordering of the cylinders simple. Most consumers will order new CO2-cylinders when the last bottle is installed (60%), because they want to maintain a sparkling water supply. An acceptable delivery time for the cylinders is 2-3 days. Young consumers prefer delivery in the evenings and 65+ consumers rather during the day. The CSAT-score is 88%.

Figure 19. All the documents a consumer receives when a Quooker product is installed.

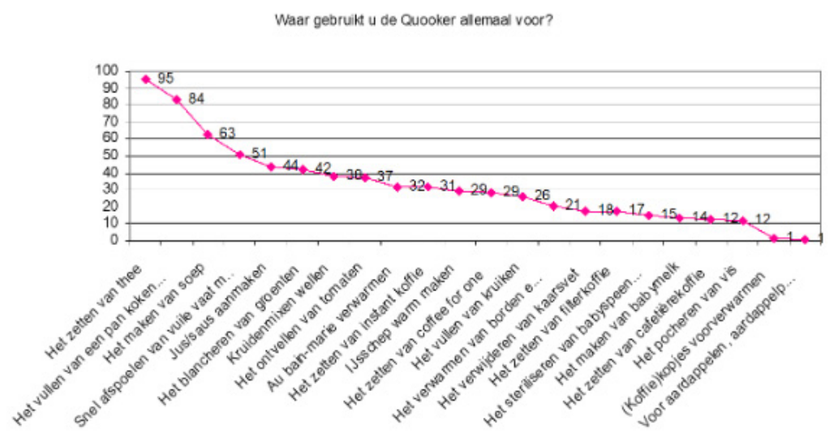


Figure 17. The usage purpose of a boiling-water tap. Adapted from Quooker, 25 March 2019.

Figure 18. Manual data substraction.

3. Returning CO2-cylinders
For 31% of the consumers, it is (absolutely) not clear how to return the bottles (e.g. consumers could not find instructions, instructions were unclear, did not receive a return box or expected a return label in the box / find printing the return label unclear). In addition, 16% of the users are not aware of the fact that the CO2 bottles remain property of Quooker and need to be returned. As a result, 15% of the bottles are not returned which increases the costs (Punt, 2018). The CSAT-score is 49%, significantly below the 80% thresholds and this indicates consumers are probably not satisfied with the returning procedure.

4. Replacing CO2-cylinder
32% the users do not rate the procedure of the replacing CO2-cylinders as clear. For example, consumers could not find instructions, did not understand how to remove (half) empty cylinders or think that the cylinder must be tightened too firmly. Customers indicated that sometimes the cylinder is empty too quickly, because it was not tightened firmly enough. “After two days the sparkling water was already empty. Not much fun if you have friends over to check out your new kitchen”. The CSAT-score is 67% significantly below the 80% thresholds and this indicates consumers are probably not satisfied with the cylinder replacement procedure.

5. Usage
User are satisfied with the overall usage of the Cube (CSAT 89%), but less satisfied with the Cube compared to the boiling-water tap. Some consumers bring up some disappointing aspects in usage of the product. For example, they mention multiple times that the water pressure of cold filtered and sparkling water is too low, that they expected a higher effervescence level in the sparkling water (CSAT 78%), that the Cube makes more noise than expected, that the device is too big or that waterjet stops too slowly.

6. Registrating
A market study shows the registration rate in the Netherlands is 25% (Punt, 2018). Most customers do not register the Quooker and do not view and / or save the documents, because they purchased a new kitchen and are overloaded with documents of other electronic kitchen appliances. The chance of all documents being viewed and saved is smaller. In many cases, all the waste ends up including various documents in the trash. A comment from a customer was that finding the serialnumber was a lot of effort.

Conclusion
Consumers use the tap often and for many purposes. Most of the consumers use the tap 1-6 times per day use it more than expected and think the product is indispensable in the kitchen. Furtermore, the high quality service Quooker offers seems to make up for the negative experience caused by a product failure. This may indicate that product failures are not a big pain point for consumers.

Finally, consumers do not seem the read to documents or registrate the products. Most consumers also receive documents from other kitchen appliances (if they bought a new kitchen and most consumer do) and Quooker already provides the consumer with six documents at installation. Therefore, the communication/introduction of a design cannot be dependent on a installation document and it cannot be assumed that the consumer will share its personal details with Quooker (e.g. adress, name, serialnumber).

The two biggest bottlenecks for the Cube are returning and replacing of CO2 cylinders, because the CSAT scores are below the threshold of 80% (Quooker, 2019). Consumers rate both steps as unclear, yet the term ‘unclear’ is preset in the online survey.

Appendix K - Consumer Analysis

This appendix provides more demographic information of the consumer and consumer trends.

Demographic information
The company’s consumer research shows that consumers are mainly represented in the higher social class (A and B1: 76%) and aged between 25 t/m 44 years old (48%) or over 45 years old (47%). Most consumers live in the Randstad (54%) and come from a three or more person household (58%). Women most frequently initiate the idea to purchase a Quooker (69%), but the decision for actual purchase is often taken together (66%) within the same day (40%) (TSN Technology, 2014).

Consumer trends
The consumer trends are summarised below.

1. Consumers are more informed.
Most consumers want information beyond the product explanation. They want to know what other users have discovered about the product, they want to check the prices of competitors and most of them are used to discounts and deals throughout the whole year. In the past six months, 91% of the consumers have relied on product reviews (KIBO, 2018).

2. Consumers want the most seamless, friction-free buying experience.
Personalized recommendations (at the home page, product page or shopping cart) enables more convenient shopping experiences (KIBO, 2018).

3.(Young) consumers want ‘onmilocal’.
Onmilocal is a digital brand experience that gives a local community feeling. Sharing the same interest and mindset allows consumers to have a local experience (digitally) anywhere (Bradley, 2018).

4. Consumers want brands to share their values.
Consumers do not want to be associated to brands that do not share their values, because it threatens their identity-claim (Prins, 2017). Consumers use their purchasing behavior to convey a positive image to others to ultimately increase in status, but if a brand does not share their values it may damage the image.

5. Longing for the past.
Today, time is a scarcity and information is coming from everywhere. Consumers want peace of mind and long to the past and the familiar (Bouman, 2019).

6. The importance of quick delivery has increased
The importance of quick deliveries has increased. When a tracking number is provided to the delivery, consumers express more leeway in their quick delivery expectations (KIBO, 2018)

Figure 20. Site surveys at eight kitchen dealers.

Appendix L - Value Proposition Canvas

A value proposition canvas method is used to get a better understanding of the boiling-water tap and Cube consumer. No consumers have been interviewed for the method. Therefore, aspects cannot be prioritised or quantified and consequently the method is used for exploration only.

The boiling-water tap

The jobs consumers have to do to use the product:

Functional (yellow):
Wash hands, stay healthy, clean kitchen, decorate kitchen, drink water, fill bottle, sterilizing objects, clean up dirt, clean dishes, warm up plates, cut ice cream with warm spoon, serve meals, keep food warm, feed children, cook dinner, find dinner inspiration, find recipes, do groceries, store food, make tea, relax, invite guests, serve guests, work, cut costs, pay kids tuition, pay rent.

Emotional (pink):
Feel proud of clean/ aesthetic kitchen.

Social (blue):
Look sophisticated to guests, show off, have a pleasant social interaction with guests or family.

The pains consumers experience from doing the job

Functional (yellow):
Not understanding the installation procedure, being home late from work, eat late, no time to cook, too tired to cook, no tasty dinner, have to move stuff for space in the kitchen counter, expensive, maintenance costs, installation costs, descaler costs, less money for other things, effort to activate holiday mode, splashing / steaming water jet, makes alot of noise, (afraid to) burn hands, children get hurt, go to hospital, wait for hours, product is broken, wait for service appointment, stay home for service appointment, cancel work for appointment, less free days off work, did not know about maintenance, damage by leakage.

Emotional (pink):
Feel cramped up, hangry, unhappy, grumpy, feel annoyed, feel guilt, stress.

Social (blue):
Feel stupid, feel scammed, bad social interactions, people judging you for being a bad parent.

The gains consumers experience from doing the job.

Functional (yellow):
Tap works for many years, save money/energy/ water, less devices on the kitchen worktop, easier to clean worktop, more space to cook dinner, more space for items on the worktop, kitchen looks more aesthetically pleasing, less time spent on searching, less time needed in the kitchen, less waiting, more leisure time, more time to relax, more time to spent with family/ peers/ guests/ partner, more time to spent with guests at the dinner table instead of being in the kitchen, having a good time.

Emotional (pink):
Green to be seen, look sophisticated, reïnforce positive self-image, show ability to incur costs, increase in status/popularity, status, having a pleasant social interaction, feel happy, feel more free, feel in control, feel proud, feel relaxed, less bored/annoyed, enjoy cooking more.

Social (blue):
Better engagements with guests, convey positive self-image to others, feel appreciated, feel good about investment.

Ideas to create gains and relieve pains:
Make more compact product, augmented reality video instructions, do-it-yourself repairments, predictive maintenance, automatic holiday mode, protective hand detection, object recognition, automatic boiling-water lock feature, danger detection, online installation support, scan room, include maintenance costs in purchase costs, send maintenance notifications, detect leakages, night appointments service, automatic service appointment planners, energy peak monitor, hide tap under object, recommend recipes, service design pay/liter, quick nice recipes, predict quantities, measure if user drinks enough water, recommend to drink water, self cleaning feature, measure water savings, show money/water/ energy savings.

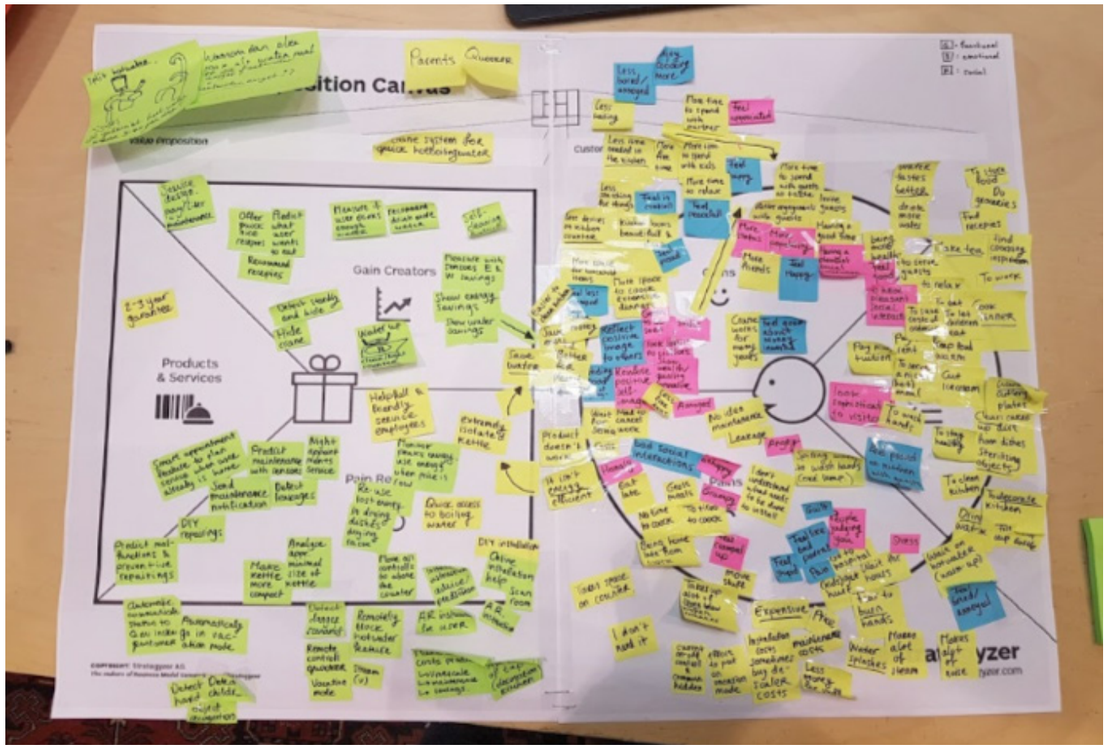


Figure 21. The value proposition canvas for the boiling-water tap.

The Cube

The jobs consumers have to do to use the product

Functional (yellow):
Fill carafe, drink, serve drinks, make lemonade/ cocktails, do groceries, return empty cylinders, stay healthy, order cylinders, store the cylinder, get cylinder from basement, replace cylinder, sport, wash hands, surprise guests with sparkling water from a tap.

Social (pink):
Feeling like a happy family, feel belonging, impress guests, feel in control, feel peaceful.

Emotional (blue):
Feel like a good parent, feel happy.

The pains consumers experience from doing the job

Functional (yellow):
Spend money on cylinders, unsustainable, costs, leakage, kitchen damage, cylinder is empty, bending down to replace cylinder, cannot reach cylinder in kitchen cabinet, move stuff to reach the cube, remove kitchen drawer to reach Cube, do not know how much CO2 left inside the cylinder, product is broken, the cup/carafe fills up too slowly, waiting, cannot find serial number for registering product, sparkling water tastes weird, print return ticket, cover a long distance to get household detergents because they did not fit in the cabinet anymore, place detergents on worktop, too large size, too much noise, too high/low water temperature, too high/low effervescence level, water jet stops slowly, water jet is too weak.

Social (pink):
Lose opportunity to impress guests, being embarrassed, guests are not impressed.

Emotional (blue):
Feel dirty, feel annoyed, feel unhealthy, feel powerless, feel disappointed.

The gains consumers experience from doing the job.

Functional (yellow):
Having better tasting water (filtered water), having a large stock of sparkling water, quickly tapping water without unscrewing a cap, quick access to sparkling water, more space in the fridge, get a restaurant experience at home, happier children.

Social (pink):
Feel trendy/ innovative/hip, show ability to incur costs, status, popularity, nice get togethers, feel proud.

Emotional (blue):
Feel healthy, feel like a fun/good parent, be attractive to opposite sex.

Ideas to create gains and relieve pains

Detect leakage, make smaller, efficient size, easy to clean, hidden next in the basement, show money savings, show CO2 in a mobile application, measure usage behaviour, make water jet/temperature/ effervescence adaptable, make detergent holder, make vitamin water, make a very large cylinder tank, make a show off Quooker Cube water bottle, show all Cube users in the neighbourhood, make Cube noticeable above kitchen counter for status.

Conclusion

Many jobs, gains and pains related to the boiling-water tap and Cube are explored. Yet, the aspects cannot be prioritised or quanitified because the method is based upon assumptions. To truly understand the consumer, qualitative research is required to validate which aspects are important for a consumer.

Figure 22. The value proposition canvas for the Cube.

Appendix M - Competitor Analysis

This appendix documents the extensive competitor analysis. The competitors can be divided into four categories.

1. Product form competition

Product form competitors offer boiling-water taps with similar characteristics (listed in figure 23). Quooker is currently able to distinguish itself well from other boiling-water tap competitors due to their innovative frontrunner brand image, due to offering the highest quality products with the longest lifespan and due to the premium brand image. The figure also shows that Quooker is perceived as innovative, but their products do not include more features than competitors (boiling- filtered and sparkling). Therefore, the innovative brand perception seems a result of the first mover advantage. Compared to its form competitors, Quooker offers a better service delivery. Competitors charge consumers more easily with repairing costs and the waiting times for appointments are longer. Altogether, it is difficult to compete with the company's strong brand position and therefore competitors seek another way of differentiation.

IoT differentiation

Currently, a way to differentiate is by adding IoT features to the taps. The following IoT features were spotted on the ISH fair:

- Mobile applications for customising tap settings (Grohe)
- Mobile applications to support service mechanics in installing taps (HansGrohe)
- Sync features to activate the warming up function simultaneously with the wake-up alarm (Summum)
- Intelligent water mixers to dispense water immediately at the right temperature (Artize)
- Water and energy-saving features (e.g. detection of non-usage to cut off the water supply, re-using energy-loss) (Inman)
- View energy/water consumption features (Summum, Digitap, Grohe)
- Wireless buttons (Hywise, Artize) (see figure 24).
- Touchscreens (Digitap, Artize, Aqua Elite)
- Voice control (Smartap, Treemme)
- Buttons to close the bowl drains (Gugliemi)
- Water temperature indication features (Grohe)
- Smart leakage detection features (Summum, Grohe)
- Child safety mode features (Summum)
- Predictive maintenance features (Grohe, Digitap)
- Remote troubleshooting features (Summum, Digitap)
- Self-cleaning programs (Summum, Das Schell)
- Auto dispensing preset features (e.g. teeth brushing, glass-filling, bath-filling) (Digitap)
- Hands free tap activation features (e.g. with foot
- Sensor or motion sensing) (Dornbracht, Hydrion).

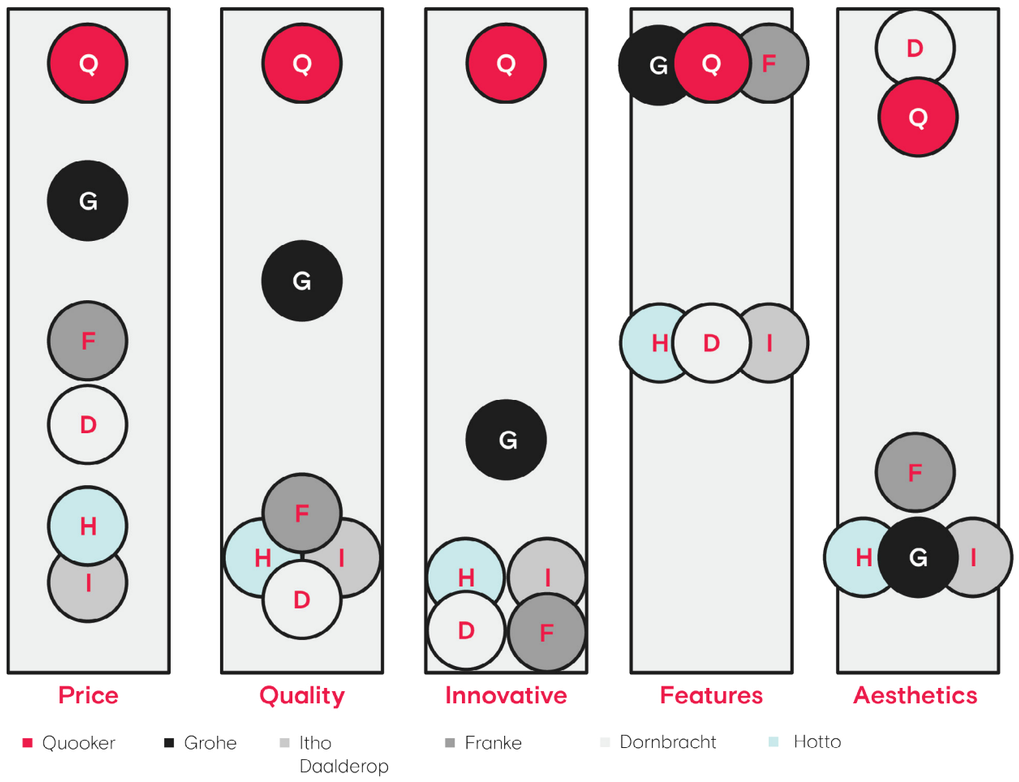


Figure 23. The value curve for Quooker and five form competitors based upon market research and the brand tracker (Quooker, 2018).

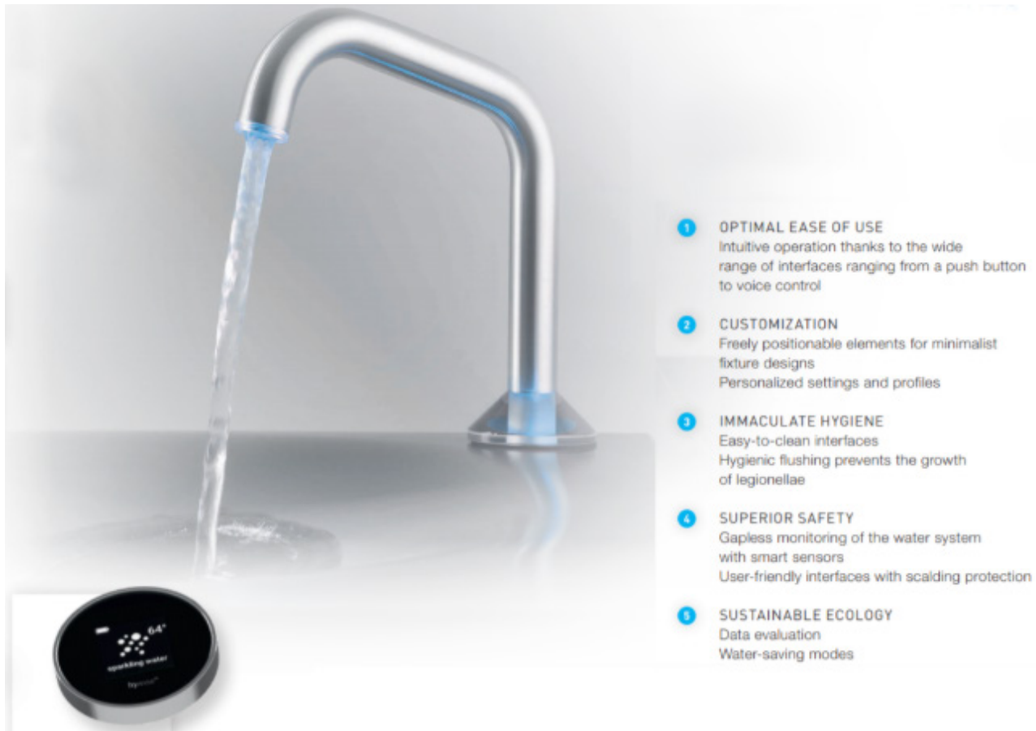


Figure 24. A kitchen tap with a wireless button. Reprinted from Hywise, 31 March 2019.

2. Product category competition

Quooker is a hybrid product and competes in both the overcrowded kitchen taps category and in the close-in boiler category, against, for example, Grohe, Franke, and Itho Daalderop. These category competitors were forced to enter the boiling-water tap market after kitchen taps and boilers sales decreased. The 'premium price' of a Quooker (€1.200) is put more into perspective if the cost of a kitchen tap (€300) is added up to the cost of a boiler (€300). Despite the fact that consumers are often not aware of this add-up, kitchen dealers frequently use it as a pitch to sell the product (Harkema, R., personal communication March 4, 2019). Competitors in the kitchen tap category differentiate also by adding IoT features or by design differentiation. The following design differentiation trends are spotted at the ISH fair: bright colors, pull out hoses, bar-shaped hand showers, separate back and forth handles and playful knobs (see figure 25, 26 and 27).

Competitors in the close-in boiler category differentiate mostly on volume, price, energy usage and warranty duration. Quooker is relatively expensive, but in return consumes less energy. The relatively low energy consumption is difficult for consumers to notice. All competitors have an A-energy label and consumers have to carefully read through user manuals to discover the standby energy usage per brand.

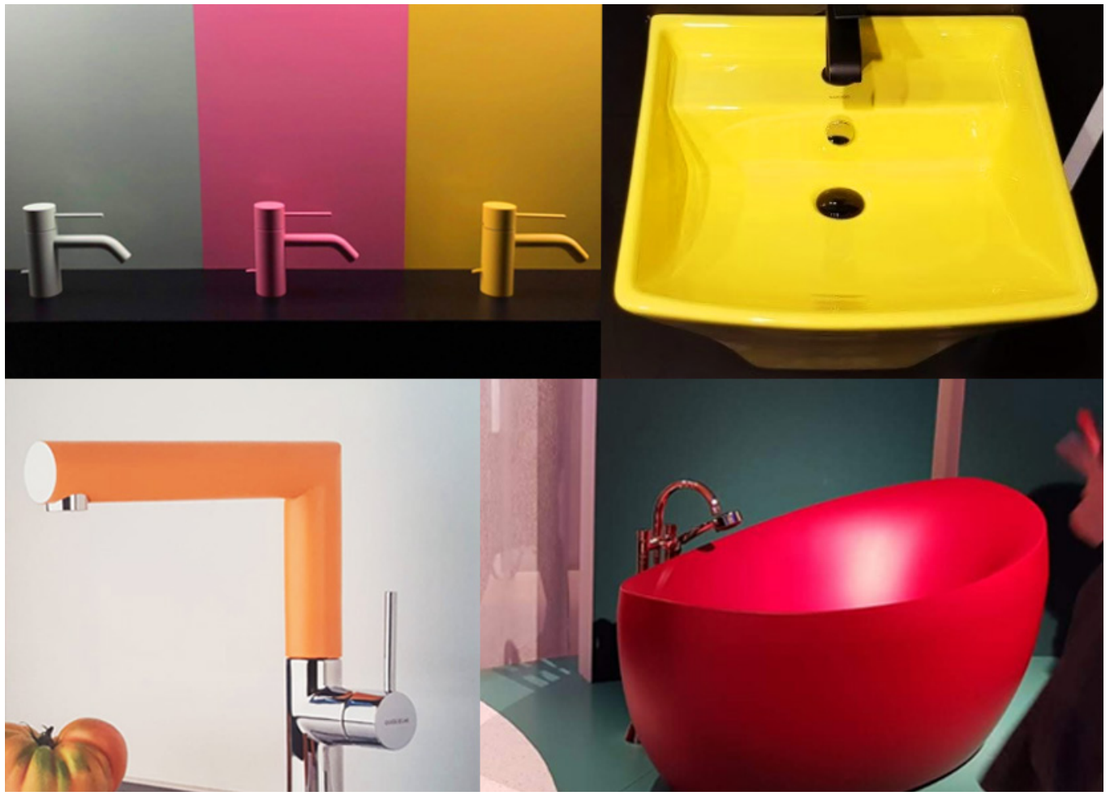


Figure 25. Bright colors.

Figure 26. Pull out hoses and bar-shaped hand showers.

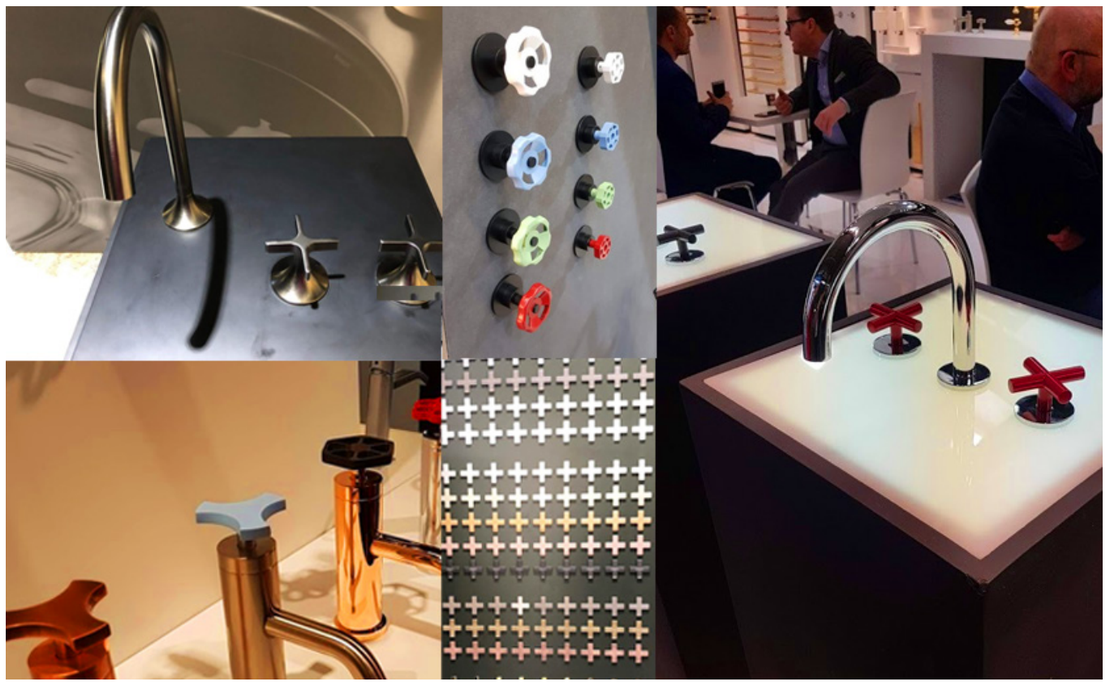


Figure 27. Separate back and forth handles and playful knobs.

3. Generic competition

Generic competitors fulfil the same need for boiling water. The competing products are water kettles, hot water dispensers, a pan on the stove, a (fast) induction stove and a microwave. In comparison to the water kettle, the boiling-water tap is fixed on top of the counter and for that reason more safe despite being perceived as exactly the opposite by the general consumer. A water kettle that can be tipped over by accidentally pulling the cord (Quooker, 2018). Nevertheless, the safety aspect of the kurl-knob interaction is well-tested. A boiling-water tap is also more water and energy efficient, compared to a water kettle, because smaller quantities of water are heated. Again, the opposite is perceived, because the product constantly preserves water at 110 degrees (Quooker, 2018). The hot water dispenser is also able to deliver hot water within three seconds, however the device is quite big and requires the consumer to replenish the water reservoir. No generic competitor is able to answer to all disadvantages into one holistic design. .

Altogether, a boiling-water tap is by far the most expensive item compared to the generic competition, but it is also faster, requires less effort to use, it's 'more clean on the countertop' and more water and energy-efficient.

4. Budget competition

Budget competitors offer products within the price segment of boiling-water taps. Instead of purchasing a boiling-water tap, the consumer can also choose to spend its budget on a more luxurious kitchen appliance. For example, a stove, oven, extractor hood, dishwasher, and fridge. Competition is hard, specially in low-budget kitchens, because consumers cannot afford to buy all options.

Cube competitors

The Cube offers more convenience in maintaining a sparkling water supply compared to bottled sparkling water. Bottled water requires the consumer to buy, carry, store, cool, and return bottles to the supermarket on a weekly basis. The Cube requires the consumer buy, store, and replace cylinders on a half year basis. In addition, the Cube is more sustainable, because it does not contribute to plastic waste. However, bottled water is less expensive than the Cube. The price per liter for bottled water is €0,62. The price per liter of the Cube is €0,25 and requires a one-time purchase of €1.200.

Sodastream is more convenient in maintaining a sparkling water supply and less expensive compared to the Cube. Sodastream CO2-cylinders can be purchased at the Blokker and at the same time consumers can drop of the empty cylinders without having to put extra effort in it. The Cube requires the consumer to buy new cylinders on the Quooker website. To order and return cylinders, consumers first need to create an account and then to print, cut and tape a label on the return box. Next, consumers have to bring the return box to a Post NL point and stay home to receive the new cylinders. See an elaborate customer journey of the return procedure in appendix D. The price per liter of the Sodastream is € 0,22 and requires a one-time purchase of €63. However, Sodastream does require an extra device on the kitchen counter and the product exists for longer than the Cube and may be perceived as less innovative.

Altogether, the Cube is relatively expensive compared to bottled sparkling water and Sodastream. The Cube does offer some advantages in return, but if these advantages justify the high price requires investigation in qualitative research.

Appendix N - Context Analysis

This appendix documents the macro, kitchen and technology trends.

Macro trends

Demographic trends

The population is aging
A strong growth in the number of people over 65 as a result of the post-war baby boom.
People over 65 are sporty
People have been going for the past 25 years more often on holiday abroad (157%) (CBS, 2017).

Economic trends

The economy is growing steadily with 2,2% since the crisis in 2008.
The average age of home buyers increased (39 years) since 2010. The new mortgage regulation in 2013 made it more difficult for starters to buy a home.
The amount of new build homes increases since 2012 and grew in 2017 with 15% (CBS, 2018).
Construction is the fastest growing sector and grew since 2016 with 5.6%.
The number of passenger cars is still increasing (CBS, 2017).

Social trends

Elderly live longer indepently and less often in a nursing home.
33% has daily contact with non-inhabitant family, 33% has daily contact with with friends.
15% of the people has daily contact with their neighbours and 12% has rarely or never contact.
In 2017, almost 9 in 10 adults said they were happy.
A person's degree of happiness is partly related to marital status. Among adults who are married, more than 9 out of 10 state they are happy, which is the highest share.
25-44 year olds are the least satisfied with the amount of leisure time (14% dissatisfied, 22% neutral) (CBS, 2018).

Technological trends

The amount of households with one or more smartphones grew from 2017-2018 with 5% (85%) and laptops with 2% (78%). (CBS, 2017; CBS, 2018)
In four years time, the amount of people ordering online increased with 9%. Clothes, sports equipment, vacations and tickets for events are purchased. Online purchasing of household articles increased with 23%. The amount of webshops in the past ten years has increased fivefold.
The sharpest increase in recent years was seen in online purchases of food and other (daily) groceries.
Older adults (65 - 74) are increasingly active on social media (64%) ang people aged over 75 33%.
In younger age groups virtually everyone uses social media. (CBS, 2018).

Ecological trends

Since 2000 the volume of household waste per inhabitant remained stable (560 kg / year).
Between 2016 and 2017, the amount of energy from renewable sources increased with 10%.

Political trends

Men are more often interested in politics (57%) than women (42%)
There is a political fragmentation in the parliament between left and right. The populist party, Forum of Democracy, has for the first time the majority in the first parliament. The party has an anti-Europe position.

Kitchen trends

The identified clusters in the kitchen context are: minimalism (e.g. under-the-counter-appliances, smooth stoves), automation (e.g. self-cleaning ovens), automation (e.g. projective interfaces), healthy food (e.g. organic), Sustainability (e.g. eco-friendly water kettles), green to be seen (e.g. Marqt), exploring food (e.g.jackfruit), social food (e.g. shared dining) and authentic food (e.g. homemade pasta, slow-cooking). Other more concrete trends are: subscription box models, object recognition for food, tap quantities and heartketing (having a genuine positive attitude towards the consumer to do what is right for the consumer even if it is at the expense of the company's business case to increase brand loyalty).

Technology trends

The identified clusters in the technology context are: cyber security (e.g. akita), automation (e.g. clothes folding machine, self-lacing shoes), technology for sustainability (e.g. smart shower), pattern recognition and prediction technologies (e.g. predictive maintenance, object recognition), intuitive or remote control (e.g. hand tracking, voice control, remote apps), visually dominant IoT gimmicks (e.g. smart watches, tile), do-it-yourself automation (e.g. IoT development kits, smartians), social connectivity (e.g. good night lamp, IoT birdhouse) and digital becomes human (e.g. heartketing, online communities, chatbots).

Other more concrete trends are: online communities, object recognition, smart leakage detectors, postal stamp codes for returning packages instead of labels, automatic paying, hand tracking, child-safety mode and connectors (NFC / Wifi / QR / Snaptag). A threat is the under-the-counter appliances trend, because consumers may no longer have space beneath the counter for a Quooker reservoir.

Appendix O - Product vs. Outcome Analysis

This appendix explains what certain type of products are likely to be replaced by outcomes and what other type of needs may play a role when considering an outcome instead of a product.

Product type

Durables with high upfront costs, a burden of ownership and acceptance for shared use are more likely to be replaced by a pay-per-use model, because this model offers more benefits (Hagel, Brown, Wool, & de Maar, 2016). The Cube (with CO2-cylinders) and boiling-water tap both fit the product profile.

First, a durable deteriorates slower compared to a low-cost physical good and thus the expenses and effort for a company to maintain the product is lower.

Second, a pay-per-use reduces the high up-front costs. It expands the market from consumers that could afford the high up-front costs, to consumers that can afford the use of a product. It also makes the product more affordable to low-frequency consumers, without affecting high-frequency users (on contrary to subscription models that offer a prices based upon average usage). Sometimes consumers want to get rid of a financial pain as quickly as possible by using a one-time purchase. By doing so, they are no longer reminded of the pain. However, in a pay-per-use model, consumers do want to be periodically reminded of paying, because the model is able to offer significant cost savings to the consumer. In a pay-per-use model a company is often able to set a more beneficial pricing, because the company is better at maintaining the product and optimising the product usage (by the use of sensors) than a consumer is and a company can re-use broken products.

Third, a pay-per-use model is relevant for products that have a burden of ownership. Consumers buy the outcome to diminish the burden of ownership with products that, for example, require maintenance and installation.

Fourth, when the products do not lack of acceptance for shared use. For example, sport clothing is not a suited product because of hygiene.

In a pay-per-use model the supplies (e.g. detergens, ink, CO2) are also offered included the price.

Additional needs

Consumers have additional needs in their pursuit to satisfy the need for the outcome and these may serve as a reason to value a product over an outcome. An outcome model can (somewhat) satisfy these needs in different ways as shown in the examples below.

Paying

Consumers may prefer a one-time purchase over multiple periodically payments, because it seems less effort to pay something at onces instead of paying periodically or because they fear to lose overview of the costs when they have multiple periodically payments services (e.g. a washing machine, fridge). The first can be solved with an automatic payment system. The second can be solved with smart contracts. A smart contract is a local program in a device that automatically applies its rules. A smart contract can store the executed outcomes, send payments and can communicate with other smart contracts in a secure way (with the use of blockchain) without needing a service provider as middleman. By doing so the user does not necessarily has to pay every use individually, but is able to pay multiple usages all at onces (Rabobank, 2016). Or the consumer can transfer a certain amount of digital money to a smart contract and the contract stores the money until the service provider charges for a delivered service. If the service is not delivered the money is returned to the consumer (Fotiou & Polyzos, 2019).

In both cases, consumers gives up a part of their control over paying. In order to recover some control, a design can offer a consent first option. Personally, I do not think that many consumers will have difficulties with giving up a part of this control as long as there is enough customer value for it in return. How many debits on your last credit card bill were made without you ever having to pull out your credit card?

Possession

Consumers also have needs for possession. Take a car as an example. Most consumers purchase a car to get around and thus the outcome is mobility. In theory, a (shared)-car system with a pay-per-kilometer service would be a solution. Three example reasons are given why consumers like to possess a car over paying per use of a shared car system.

First, some consumers feel to need for routine. Some consumers would like to drive the same car every day. This need can be satisfied with offering an option in the system to preference a particular car (if it still remains a viable business case to the company).

Second, consumers preference a certain type of car to reïnforce their self-image or to convey a certain image to others. For example, some consumers want an expensive car to show the ability to incur costs and to increase in status. Some consumers want an colorful car to convey their bright personality. A part of the consumer preferences could also be solved with a car preference option in the system (if it still remains a viable business case to the company).

Third, consumers want to possess their own car, because they want to be certain that the car is always available when they need it. However, if the car is not available in the outcome model it is an error in the system. In the long term, the system should assure consumers that the system is reliable. In fact, the system should be even more reliable than if a consumer possesses and maintains a car on its own (e.g. prevent breakdowns).

The example solutions are probably not sufficient enough for all consumers. Some consumers will still want their ‘own car’. These consumers can also choose for a pay-per-kilometer service for their own car in order to increase the feeling of possession.

Yet, even with this service, the consumer still does not feel like he/she is completely possessing the car. Consumers may feel restricted to certain terms and conditions of the service provider. Consumers that, for example, want to customise the car or smoke while driving. Maybe they feel restricted, because if they cancel the service they have to return the car. So some consumers still want to possess a car completely on their own to have their own terms and conditions and experience ‘freedom’. In order to ask consumers to give up a part of their freedom there must be, of course, great customer value in return.

Conclusion

Durables with high upfront costs, a burden of ownership and acceptance for shared use are more likely to be replaced by a pay-per-use model because the model offers four significant benefits to both the consumer and company.

Furtermore, the examples show that consumers have additional needs in their pursuit to satisfy the need for the outcome and that there are opportunities to satisfy these needs (probably) for the majority of consumers.

Yet, there will always remain consumers that prefer a one-time purchase over a pay-per-use to experience maximum control and there will remain consumers that want to completely possess a product to experience maximum freedom. In order to persuade consumers to give up this control and/or freedom, there must be great customer value in return. Therefore, it is recommended to validate if an outcome generates enough customer value to make consumers willing to give up a part of their control and freedom (viability requirements).

Appendix P - List of Requirements

Throughout the graduation project several requirements for a digitally connected service and strategy were identified. The list of requirements is documented in this appendix. In the evaluation chapter the design and strategy will be evaluated on the list of requirements.

Cluster	Requirement / Wish	Keyword	Specification	Reference	Evaluation
1. Assignment / Strategy	R	Satisfaction	The product must improve the customer satisfaction of the Cube	Design brief	Achieved
	R	Return rate	The product must improve the return rate of CO2 cylinders	Design brief	Achieved
	R	Initial assignment	The design must include IoT technology.	Design brief	Achieved
	R	Industrial Design	The design should converge feasibility, desirability and viability	Design brief	Achieved
	R	Strategic Design	The focus in the graduation project should be on the strategic part of the design	Design brief	Achieved
	R	Strategic Design	The design must be a design for the future	Design brief	Achieved
	R	Company goals	The product must increase the revenu and/or strenghten the Quooker brand.	Compay analysis	Achieved
	R	Strategy	The product cannot reïnforce the luxury perception of Quooker products.	Compay analysis	Achieved
	R	Strategy	The design should provide a new source of growth after market saturation	Compay analysis	Achieved
	R	Strategy	The design should provide a new source for sustainable competitive advantage	Compay analysis	Achieved
	W	Resources	The design should require as little machinery, facility space and R&D employees as possible.	Compay analysis	Achieved
	R	Outcome	The design should contribute to the shift towards an outcome-based business model	Design direction	Achieved
	R	Service	The strategy demonstration should be a digitally connected service	Design direction	Achieved
	R	Brand	The strategy and design should fit with the brand	Company analysis	Achieved
	R	Implementation	The implementation roadmap cannot exceed an eight year time frame	Context analysis	Achieved
2. Consumer value					
	R	Consumer value	The design should generate consumer value or the strategy is unfounded	Context analysis	Achieved
	R	Viability requirement	The design should make consumers willing to share their data	Internal analysis	Not achieved
	R	Viability requirement	The design should make consumers willing to download	Synthesis	Not achieved
	R	Viability requirement	The design should make consumers willing to pay	Synthesis	Not achieved
	R	Viability requirement	The design should report a retention-rate of 90%	Synthesis	Not achieved
	R	Pain point	The design should solve a large pain point for a consumer	Ries, 2011	Achieved
	R	Biggest pain point	The design should decreases the (cognitive) effort to recognise an empty cylinder, to realise it needs replacement, to order a new one and to return the empty one	Synthesis	Achieved
	W	Price-convenience	The design should reduce the price of the Cube	Synthesis	Achieved
3. Service					
	W	Pressure service	The pressure on the service department should be minimalised	Product/service analysi	Somewhat achieve
4. Sales channel					
	W	Kitchen dealers	The design should be retailed via kitchen dealers	Consumer analysis	Achieved
	W	Kitchen dealers	The correct usage and customer satisfaction of the design cannot be dependent on the role of kitchen dealers	Consumer analysis	Achieved
	R	Communication tool	The design must be communicated to the customer without the help of a kitchen dealer	Synthesis	Achieved
	R	Documents	The design cannot be communicated via the information package/ manual of the product	Consumer analysis	Achieved
5. Consumer					
	R	Profile	The design should fit with a higher social class homeowner that lives in the Randstad	Consumer analysis	Achieved
	R	Persona	The design should attract both the innovative and conservative consumer	Synthesis	Not achieved
	R	Subscription	The design cannot contain the word 'subscription'.	Synthesis	Achieved
	R	Duration	The design cannot restrict consumers to a certain time-frame for subscribing	Product/service analysi	Achieved
6. Competition					
	R	Innovativeness	The design must improve the competitive advantage with competitors that apply IoT in their taps	Design brief	Achieved
	R	Imitation	The design solution should be difficult to imitate	Competition analysis	Somewhat achieve
	R	Compatibility	The product cannot be compatible with non Quooker products	Product/service analysi	Achieved
	R	Bottled	The product should improve the brand position of the Cube against bottled sparkling water	Synthesis	Achieved
	R	Sodastream	The product should improve the brand position of the Cube against Sodastream	Synthesis	Achieved
7. Lean					
	R	Minimum	The MVP must be minimum	Synthesis	Achieved
	R	Credibility	The MVP must be perceived as credible	Synthesis	Achieved
	R	Self-explanatory	The MVP must be self-explanatory (without the use of instructions from the researcher)	Synthesis	Achieved
	R	Nudge	Consumers cannot be nudged	Synthesis	Achieved
	R	Sample	The used sample must be representative for the regular consumer	Synthesis	Somewhat achieve
	R	Future promises	Validation cannot be based on future promises	Synthesis	Achieved
8. Performance					
	R	Garantee	The products should last for at least 5 years.	Product/service analysi	Unknown
	R	Inaccuracy	The inaccuracy of the CO2 measurement cannot exceed 3,3% (200 ml/one glass)	Simulation	Achieved
	W	Metric	The time consumers are out of CO2 should be minimised	Simulation	Achieved
	W	Metric	The time consumers have an empty cylinder connected to the Cube should be minimised	Simulation	Achieved
	W	Range	The conectivity range between the consumer and the design should be maximised	Simulation	Achieved
	R	Realtime	The design should feed realtime data back to the consumer	Simulation	Achieved
	R	Penetration	The connectivity should be able to penetrate a kitchen cabinet	Simulation	Achieved
	W	Support	A cloud service should be userfriendly/ offer support plans	Simulation	Achieved
	R	Integration	A cloud service should support the integration with Magento, Exact and the service database	Simulation	Achieved
	W	Disconnection	Consumers need to receive a notification if the product has been disconnected from the internet for a while.	Simulation	Not achieved
	R	API-key	Quooker's API -key cannot be publicly distributed.	Simulation	Non relevant yet
	W	Breakdown	The consumer needs to receive message when the product breaks	Simulation	Non relevant yet
	R	Data sharing	Data sharing should be justified with providing real consumer value (convenience)	Simulation	Non relevant yet
	W	External data	The design could be connected with external data sources.	Simulation	Non relevant yet
	W	Incoming API's	The design could integrate incoming API's	Simulation	Non relevant yet
9. Surrounding					
	R	Closed	The products should function in a closed kitchen cabinet.	Product/service analysi	Achieved
10. Materials					
	R	Pressure cylinder	Compontents that come in touch with the CO2 cylinder and connector must withstand a pressure of 40 bar.	Norm study Quooker	Achieved
11. Product usage					
	R	Novice users	Non familiar users should understand the product usage within 30 seconds	Synthesis	Achieved
	R	Vertical	The CO2 cilinder must be positioned vertical	Synthesis	Achieved
	R	Empty	The user must be able to indicate whether they have used a CO2 cylinders already before or not.	Synthesis	Achieved
	W	Instructions	The amount of instructions required should be minimalised	Synthesis	Achieved
	W	Customer Journey	The customer journey for the usage should be as short as possible (time)	Synthesis	Achieved
	W	Actions	The customer journey for the usage should be as short as possible (minimise amount of actions).	Synthesis	Achieved
	W	Text	A crate or cylinder must contain as little text as possible	Synthesis	Achieved
	W	Connection	The design should obstruct the consumer in connecting the cylinder as little as possible	Simulation	Achieved
	W	Return	A design should prone the return procedure	Synthesis	Achieved
12. Interaction					
	R	Features	The user must be able to identify different features.		Achieved
	W	Sound alarm	If a physical interaction on the product is used it should contain a speaker	Synthesis	Non relevant yet
	R	Algorythm	The design should instantly work the first time a consumer uses it	Simulation	Achieved
13. Payments					
	R	Consent	The consumer wants to consent first before automatically paying	Synthesis & Appendix c	Achieved
	R	Authorisation	The bankaccount of a consumer must be authorised with a small payment	Internal analysis	Achieved
14. Maintenance					
	R	Maintenance	Maintenance should be due on average at 5 years or longer.	Product/service analysi	Uknown

Figure 28. The first page of the list of requirements.

	R	Accessible	The Quooker and Cube must be easily accessible for service and maintenance.	Product/service analysi	Achieved
15. Production					
	R	Price	The price of the Cube cannot exceed €1.200	Accountmanager	Achieved
	R	Scalable	The production must be scalable to 20.000 units/parts anually.	Internal Analysis	Achieved
	W	In-house	The majority of parts of the products must be produced in-house.	Internal Analysis	Achieved
	R	Time to market	The time to market cannot exceed two years	Product/service analysi	Achieved
	W	Cost of development	The cost of development must as low as possible.	Company analysis	Achieved
	W	Time to market	The time to market must be as short as possible.	Company analysis	Achieved
	W	International	The product must be scalable to other countries.	Company analysis	Not achieved
	W	Resources	The design should resources as little resources as possible	Company analysis	Achieved
	W	Invasion	A change in the design of the Cube should be as little invasive as possible	Simulation	Achieved
	R	Shape cylinder	The overall shape of the cylinder cannot be altered because of the 40 bar pressure inside	Simulation	Achieved
	R	Feasibility	The technical development of the design should be feasible	Simulation	Achieved
	W	Feasibility	The technical development of the design should be optimal	Simulation	Achieved
16. Transport					
	R	Size cylinder	Shape of the cylinder cannot exceed the maximum size of (176 x 78 x 58 cm)	Post NL	Achieved
	R	Delivery time	The delivery of CO2 cylinders cannot exceed two days.	Customer research	Achieved
	R	Weight cylinders	The maximum weight of the cylinder or other parts cannot overseed 30kg	Post NL	Achieved
	R	Packaging	The packaging must protect the product from damage of bumping into other products	Product/service analysi	Achieved
	W	Delivery time	The delivery time of CO2 cylinders should be as short as possible	Product/service analysi	Achieved
17. Design					
	R	Form	The product or service should have a geometric shape.	Product/service analysi	Achieved
	R	Colors	The overruling colors of the product should be red (), white () and/or metal.	Product/service analysi	Achieved
	R	Font	The only font being used should be Basic Groteque Pro.	Product/service analysi	Achieved
18. Portfolio					
	W	Boiling-water	The product should stick to the core business of the boiling/-water tap or Cube	Company analysis	Achieved
	R	Magento	A webshop feature should function with the platform-tool Magnento due to sunk costs	Product/service analysi	Achieved
	W	Holistic	The design must be applicable to as many products as possible in the product portfolio	Product/service analysi	Not achieved (yet)
19. Security					
	R	ADP	The collection of user data must conform to the Dutch Data Protection Authority	Autoriteitpersoonsgege	Not achieved
	R	Data transparancy	The design must provide data security and transparency of how the data is collected and utilised.		Not achieved
	R	User control	The design must give the user an option to not share data	Consumer, & synthesis	Achieved
	R	Security label	The design should be protected with a data security label	Simulation	Achieved
19. Liability					
	R	Garantee	The guarantee covers manufacturing defects for the products untill two years after the installation date.	Internal analysis	Not relevant
	R	Thefts	The cylinders should be theft-proof	Synthesis	Achieved
20. Installation					
	R	Cabinet	Consumers must be able to store the Cube and Quooker inside a standard kitchen cabinet (60 x 60 x 90 cm).	Product/service analysi	Achieved
	R	Store	Users must be able to store at least one CO2 cylinder right next to the Cube	Product/service analysi	Achieved
	R	Intervention	The installation may not require a physical intervention in the kitchen of a customer.	Product/service analysi	Achieved
	R	Welcome package	A set of cylinders cannot be handed out at installation	Synthesis	Achieved
	R	Flyer	The communication tool cannot break at the installation	Synthesis	Not achieved

Figure 29. The second page of the list of requirements.

Appendix Q - Interviews Cycle 1.0.

This appendix documents the sub-hypothesis, additional quotes and other mentioned problems from the interviews of cycle 1.0.

Sub-hypothesis

H1: The biggest pain point for consumers is the unclear replace and return procedure of CO2-cylinders.
H2: The biggest pain point for consumers are the teething troubles of the Cube.
H3: The biggest pain point for consumers are longer waiting times for service appointments.

Additional quotes

Cylinder replacement problems:

IV4: “I think that one specific bottle was not filled. It was empty after one day. Then I called Quooker and we’ve got a new bottle. That was totally fine.”

IV5: “When the bottle was empty I called Van Dijk (kitchen dealer). He said look on the Quooker website and so I did. That was very simple.”

IV9: “Oh the changing was fine. After a mechanic came over and said; turn it very tight. It was fine!”

Teething troubles:

IV2: “We got a new one and then it simply worked. And now everything works just fine and we’re happy with it.”

IV4: “It didn’t work in the beginning. Something with a wrong nod in the tube. A wrong connection or so, but that was fine. [Name] repaired it.”

IV9: “It is the third time now. I don’t mind. But the fourth time is a bit much. So, if it happens again I would find annoying. So I hope it works now haha.”

Non representative sample:

V1: “Then we called service. Yes not entirely via the regular route of course, because my husband could take him (the Cube) to Quooker.”
V1: “The delivery (of cylinders) was my husband’s desk so it was fine.”
V1: “My husband just takes the bottles to the office.”
V2: “I don’t send the bottles back. No.. He just takes them whenevers they are empty and he’s here.”
V3: “Oh yes, I get those (cylinders) from [employee]. When he visits he brings new ones. He orders them for me.”
V3: “He (employee) replaces them.”
V4: “My son brings new bottles and the old ones.”
V1: “Especially in terms of price, we of course received a discount, but when you consider that this thing costs €2.000. Then I say to the neighbors ...”
V2: “We are happy with it, but very honest if you have to pay the full price ... I would never do it. ”
V3: “No I would never buy it. It was just for the discount you know.”
V4: “... we did not pay full price of course, because we were the first test group.”

Other mentioned problems

IV1, IV2 : low effervescence level of sparkling water
IV1, IV4: (suddenly) an empty CO2-cylinder
IV2, IV4: splashing water jet
IV1: weak water jet
IV1: too large size
IV1: water jet quits too slowly
IV1: not comfortable with replacing cylinders
IV2: low quality knurl knob
IV2: too much noise
IV3: there’s always one empty bottle you cannot return.
IV3: replaced cylinder wrong screw thread
IV4: cylinder is empty too soon
IV4: have to take out kitchen drawer to replace cylinder
IV4: not sure if one cylinder provides 60L water
IV4: ordering cylinders online is not sustainable, prefers a physical store

Appendix R - Interviews Cycle 2.0.

This appendix documents the sub-hypothesis and additional quotes from the interviews of cycle 2.0.

Sub-hypothesis

H1: The biggest pain point for consumers is the splashing water jet
H2: The biggest pain point for consumers is a low effervescence level of sparkling water
H3: The biggest pain point for consumers is a (suddenly) empty CO2-cylinder

Additional quotes

Reasoning behind these feature proposals:

IV2: “Then (with a subscription) of course you unburden. Now you buy the expensive device and you also buy worries. For a company (owner) you also have to ensure that you take care of everything. (...) You stick it on it and then take it to Post NL anyway. Somebody also needs to take care of that or course!! * annoyed *. Just such a sticker in the box, no hassle and reading.

IV2: “Well it actually is just an expensive product. The bottom line is convenience. That you always have sparkling water, provided you have patterns (cylinders). That would be the only thing.”

IV2: “We only have one bottle now. It is parsimonious that you only get one. I would have expected more.”

IV3: “Hmm no, but I when they place something like that, then add a spare and explain how it should all be done. I mean the device is expensive enough, I believe it costs 2.000 euros or something, or whatever, then they can easily just add a spare bottle.”

IV3: “You buy an expensive device so then it (CO2 volume) must be visible all at once. (...)

IV3: “I would think it is normal that there is a label included for returning it. So you have to do that. Then you solve everything at once I think. Those are small things, but very important!”

IV3: Yes look, if I buy a device of 300 400 euros, yes that is something else. But if you buy a device of more than 2.000, then you have to add that bottle. That should be easy. So I look forward to receiving a the bottle (of yours) here hahaha. (...)

IV3: “Always when you place it, add a spare bottle. Then you will never be without it (CO2) and you will order them. And that actually costs nothing for the manufacturer, but it is a very good service. That’s part of it of course.”

IV6: “Because you give a new (spare) bottle, you also provide service. I think that is part of it. Because I thought that you pay quite a lot of money for it.”

IV7: “You order something like that from a kitchen dealer and those people just don’t know what it is and how it works. And ultimately when you order something like that and you have to find out yourself how the replacing and ordering works... You pay a lot of money for it...”

IV7: “I think it is that strange that there is no spare bottle with it (...). Well I just expect that. Certainly for that price.”

Price comparison:

IV2: “Hmm.. 60L per bottle, 60 euros for 4 bottles. * calculates* It is 29 cents per liter. Well, I think it’s expensive. Compared with the Aldi or Lidl.”

IV2: “Yes, you could say sustainability I guess... with plastic. But the thing uses power as well right?... And plastic.”

IV3: “Just a bottle from the supermarket is much cheaper.”

IV4: “We still find the capsules very expensive, but they will become cheaper at some point right? (...) Well compared to spa bottles of course.”

Dissatisfaction:

IV6: “Now you have to go to Post NL, and you need that box, and you need to tape the box, and you need to write an address on it... It’s just an awful lot of work.”

IV3: “Printing it yourself is just so annoying!!”

Discovery of the biggest pain point:
The consumers from the first cycle do not replace, order and return CO2-cylinder as regular consumers do. Their relative or peer from Quooker does it for them or explains it to them. So, these Cube users do not experience the same inconvenience of maintaining a sparkling water supply. In addition, these consumers received a peer or family price discount for the Cube. Altogether, these consumers experience an entirely different the price-convenience-ratio.

Quooker acquires consumer feedback from two sources: online surveys and peers/relatives of colleagues. Online surveys do not support discovering this pain point, because of three reasons. Firstly, the researcher cannot ask for reasoning and explanations in an online survey. Secondly, the answers in the surveys are pre-set and nudging. Lastly, most of the respondents that put effort into responding to a survey are likely to be the more engaged and positive consumers. Why peers/ and relatives are not a trustworthy source for consumer feedback is mentioned above.

Appendix S - Quooker IoT Features

As mentioned before, Quooker has already identified IoT features for the hypothesis which require validation to prove if they generate enough customer value to make consumers committed. Along with the validation of the hypothesis, the IoT features are tested as well

The IoT features that were tested are the features Quooker previously defined that respond to a problem (see table 1), and not the ones seen on the market, because a consumer only buys a product when it solves a problem (Fitzpatrick, 2013).

I believe that...
Consumers will indicate that their are likely to use [insert IoT feature table 1] for the Cube.

To verify that, I will...
Ask consumers if they are likely to use the feature. (Note it is recognised that positive answers are commitless future-promises, but negative feedback could be valuable). Yet the features lack of context and thus probes are used to help consumers imagen how these features would look like. During an explorative creative session two ways to interact with an IoT feature were identified: online (mobile application, QR-code, e-mails) and physical (light / screen / sound from the product) (see appendix T). For each type an example probe is designed (see figure 30).

And measure....
How many participants indicate that they are not likely to use the feature and find out the reasoning behind it.

Result
When the features are explicitly brought up, and consumers are asked about their likelihood to use them, the responses are similar to the ones below:

Prevent splashing water jet
IV5: “Does that mean that the jet broadens his radius? No no bother. I do not believe it otherwise it would stand out.”

Adaptable effervescence level
IV5: “I like to adjust the effervescence. (...). A little higher I do the effervescence and then I keep it that way. I’m not going to adjust it higher and lower, because it doesn’t matter.”

Other consumer indicated no interest in this feature.

Remote software updates
IV7: “I have no idea for what I would like software updates for?

Remote holiday mode activation
IV9: “Is that when you are gone you turn it off? No I would know that that was possible or how to do it. And if I would use that.”

However, a few consumers indicate their interest in this feature:

Volume indicator of CO2
IV5: “I would also like it if I could see continuously ‘if 75% or 25% is used’, because then I can just estimate how fast it goes and then it is not suddenly a surprise. (...) I would check it yes regularly.”

Furthermore, all consumers indicate their interest in this feature:

Proactive service notifications
IV1: “Yes, if it is broken I would rather hear it. In an app. Maybe an email for the elderly. An e-mail would also be good.”

IV2: “Yes, if he has a malfunction, I want to know. It would be great if Quooker knew it and said: then and then we can come by. Or I can call them myself, of course. I don’t look in the cabinet so an app is easier. But who will do that? (...) With a sound would be nice. Then I hear something is wrong. A light is unclear.
The fridge and freezer if you open it for too long you’ll hear it. ”

IV3: “If he is broken I want to know yes. But he shouldn’t break anyway, of course haha.”

IV5: “If he needs maintenance I want to know yes, yes send me an email. Or I don’t know. As long as it is immediately clear what that beep is for. And you must be able to turn it off.”

IV6: “I would like a beep! I would really like a small alarm. Just like the fridge: if you have it open for too long, there is an alarm. I want a beep. (and a light?)
I don’t see that. You hear a beep. It also works very well with the fridge. And we also have it for the oven.
(and how do you know what’s going on?)
Well with that screen of yours.

Then you know what's going on. That it will light up and you'll see the text. But a message is also good. Both actually.
(So it's mainly about the beep?) Yes. Absolutely."

It does not take long, a kind of alarm goes off for both. It's very simple. * demonstrates fridge beep * Yes it takes a minute or 2 or 3. * wait * Hmm normally it never takes that long. * tring tring ... tring tring ... tring tring ..* closes the door * Well I would like that. * demonstrates oven * * turns on the oven * "fade on sound * He gives a warning when it is switched on and off. * turns off the oven * fade out of sound *. And also when he is at the right number of degrees." (how do you know which product the sound is coming from?). The screen that lights up."

IV6: "Push message."

Conclusion

The hypothesis for a prevent splashing water jet feature, an adaptable effervescence level feature, a remote software update feature and a remote holiday mode activation feature is invalidated. The result indicates that consumers say that they are not likely to use the features. Implementing these IoT features could cause 'feature-creep'.

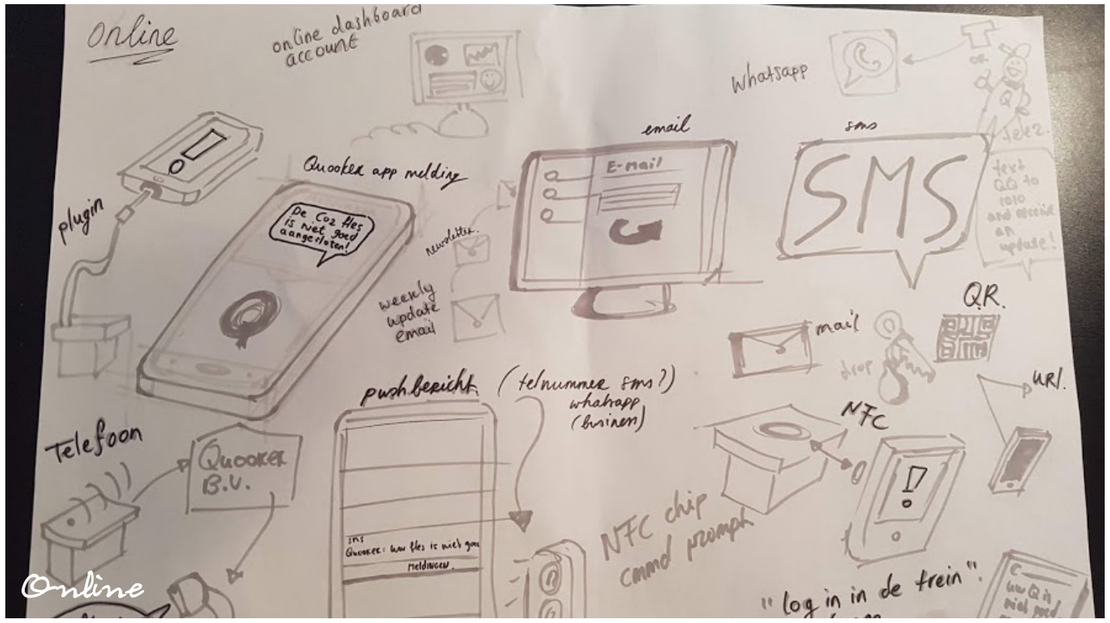
Consumers indicate interest for the volume indicator of CO2 and proactive service notifications.

During the interviews consumers either showed a strong attraction or resistance towards an online interaction. Two persona's were identified and elaborated in appendix U. The final concept should attract both because otherwise a large consumer segment is eliminated.

Figure 30. An online and physical interaction probe of the CO2 volume indicator and a few probes during an interview.

Appendix T - IoT Feature Interactions

Ideas are generated to explore how IoT features are able to interact with consumers. As mentioned before, two different interaction types were identified:



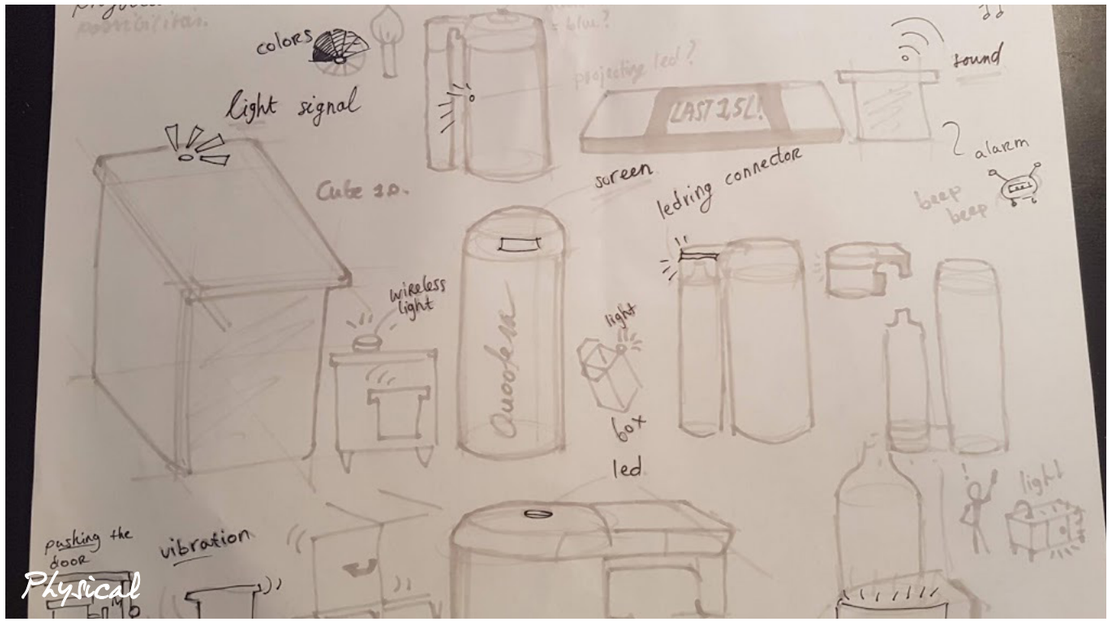


Figure 31. Online and physical feedback interactions with IoT features.

Appendix U - Consumer Insights

This appendix documents the consumer insights collected during the interviews of cycle 1.0. and 2.0.

Persona's

A part of the consumers often use mobile applications, while others express a strong resistance against it. Therefore, two consumer persona's are created (innovative vs. conservative). The final concept should attract both because otherwise a large consumer segment is eliminated.

Innovative (n=5)

This user has many mobile applications on his/her phone and uses them frequently /recently in the past. They indicate that they carry a phone with them during the day and that an app allows them to receive push-messages. The push-messages enables these users to read something quickly while being on the road (flexibility). An e-mail or physical feedback is preferred less as they indicate that it is "more effort and annoying". Physical feedback is location-bound (non-flexible) and requires physical effort to move to the object (move to kitchen cabinet, stoop, move objects in front of the Cube, remembering to look inside the cabinet) and an e-mail is something they sometimes intentionally do not look at as they try to separate work emails from their leisure time. The user sometimes posses domotica (e.g. a smart fridge). This user type mentions more often the innovative aspect of the Cube during the interviews "That was not a reason for the purchase. No, more because it is new."

Other typical quotes are stated below:
"If the Quooker talks to him via the app, he thinks it's fantastic!"
"My husband would blindly go for the app."
"Push messages are the best."
"Via your telephone is by far the easiest."
"You should actually have an appie on your phone! Right? Well, for example, that you have three days before it runs out, that you can follow the quantity in the bottle. That is a good idea. That is the breakthrough !!"

Figure 32. A smart dishwasher with ground display from an innovative consumer

Conservative (n=6).

The conservative consumer shows a strong resistance against mobile applications. These consumers do not want to be bothered with yet another mobile application for an utensil sending them unimportant push-messages and infiltrating their personal life (e.g. interrupting a conversation). These users indicate that they want to product to work and if it does not work, they say that they want a sound alarm. These consumers prefer a web-based application.

"Why does everything have to be digital?"
"So eh, well, I would therefore keep it as simple as possible. It is a daily utensil. You are just standing without tapping water and talking in the meantime, then I don't want to think 'wait my app!"
"I do not want to look at it (the product), he should work. That's it."
"An app ... yes ... how many apps do you have nowadays. I am totally not interested in a Quooker app. Why would I? The product is not that important to me either."
"I don't really care much about it. I didn't even know the price for the thing. But he's doing well, that's the most important thing. An app therefore does not feel necessary."
"I don't need more apps."
"For many things, an app is easier, but look, this is just a utensil. He just has to work, and it's something you don't think about when you tap water."
"I already have so many apps. So I don't need it. I think I would want to do it online anyway. And these apps, you know, are mostly for stuff I really need many times during the day, and this is not something I need daily or weekly. (...) Once per month or so. (...) You know I don't want to be that involved with water. It just comes from the tap. It is just a tap. You choose between bubbles or not and to download an app for that and to put so much effort in to that. Hmm no."

Conservatives are not interested in the CO2 volume indication as long as they always have a spare cylinder.

"As long as I always have a spare bottle, then I don't need to know how much is still inside the bottle."

"We always have a spare one and when the second last is empty we order new ones. You will always notice it when it is empty and then you just have to screw a new one in. (...) Thus, for me you do not have to show what remains inside the bottle."

"Just make sure you have 4 bottles in stock."

"No. No I don't care how much is inside the bottle, no not really. Because if you still have another one. The last one you screw in. And then you order four new ones, right? You just always want to have that home."

Consumers are price-insensitive.

Cube consumers bought the Cube with a new kitchen and do not know the price they paid for the product. By offering the Cube as a kitchen accessory, consumers are more price insensitive.

"Only after the thing was installed, I heard the price. I didn't even know the price."

"I actually bought it way too fast. Within an hour I had bought the whole kitchen."

"I don't really care much about it. I didn't even know the price for the thing."

"Ehm... I think it costs 500 euros?" (it costs 1200).

"How expensive is such a bottle? (...) Well... ehm. 4 bottles of 100 euros something like that?

"No, I don't know how expensive he is...I'm guessing 2000 or something?

"I would not even know what it costs per liter. How much does that cost? (what do you think?) I really don't know, no. (guess?) 30-40 euros per bottle? I actually think more..." (it costs 17,50).

"I have no idea how much it costs. We bought the whole package."

Conclusion

To attract both persona's a mobile application and an alternative is required. Conservatives indicated a preference for a web-based tool and/ or e-mails. Since, conservatives do not need to know the volume of the CO2 inside a cylinder, a web-based alternative is probably not that difficult to create. A volume indicator requires realtime data, but automatic orders can have a lower latency. Therefore, the integration with the Quooker website, a web-based tool and the Cube is probably less difficult to implement.

Furthermore, consumers are price-insensitive for an one-time purchase of the Cube, because they purchase it with a new kitchen (likely from the higher price segment, see consumer analysis).

Appendix V - Credibility of Measuring CO2

During the interviews consumers questioned the credibility of measuring the CO2 volume inside the cylinder.

“How do you want to do that then?”

“Such a message becomes very difficult to implement, don’t you think?”

“Huh, how would you do that?”

The perceived credibility for a MVP is important. When consumers do not think that the MVP works their feedback will be too hypothetical. Therefore a bicycle light acting as an IoT sensor glued to the side of the connector.

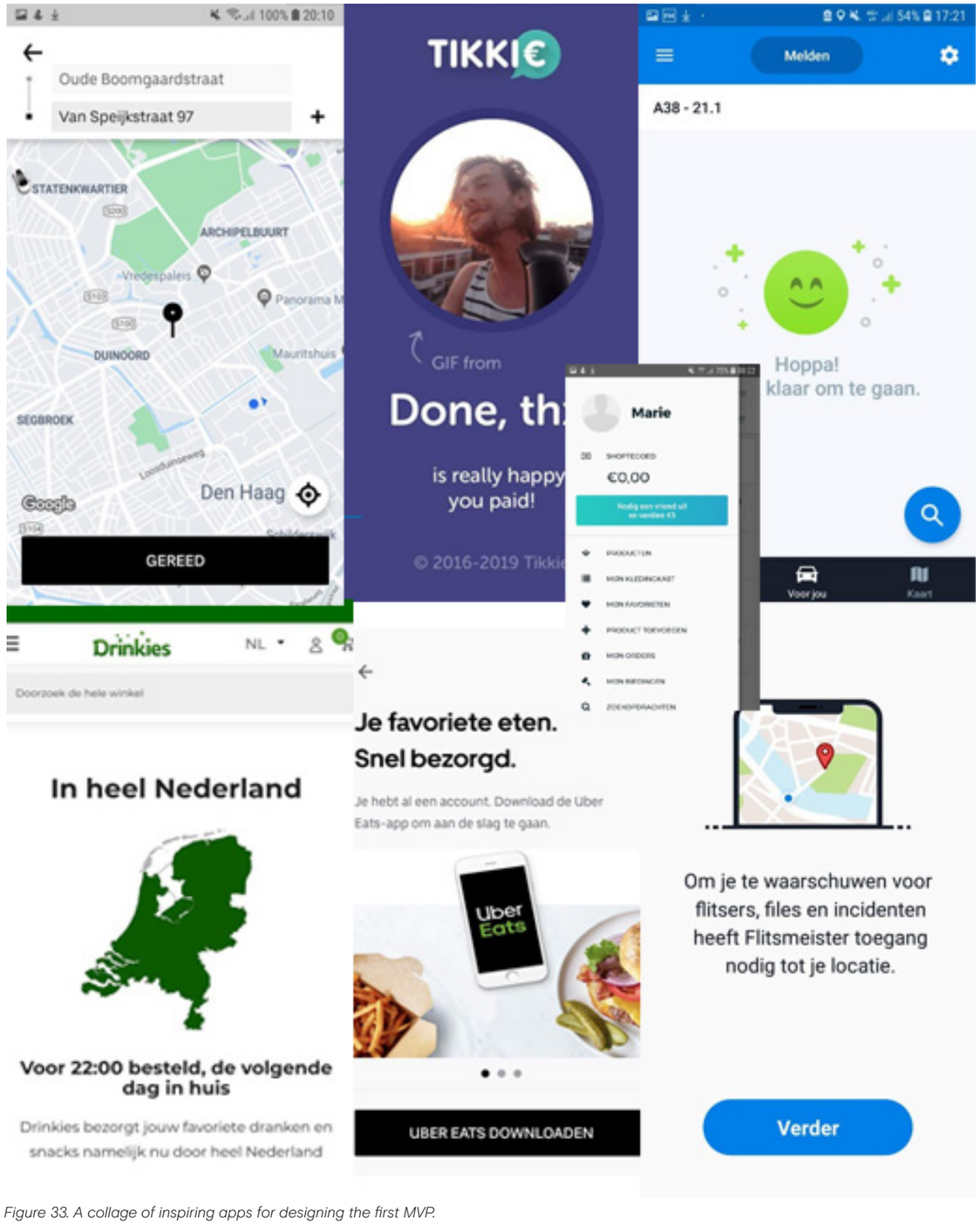


Figure 33. A collage of inspiring apps for designing the first MVP.

Appendix W - Pilot

A pilot is conducted to practise the testing of the MVP with three colleagues before involving scarce Cube consumers.

‘The sparkling water man’

The MVP is a mobile application demo that detects when the Cube is out of CO2 and automatically plans new CO2-cylinders deliveries (see figure 35 and 36). The consumers places its empty cylinders in a swap box (figure 34) in front of their doorstep and the delivery man will swap the empty cylinders with full ones. The sparkling water man is inspired on the milk-man figure to emphasize the company’s Dutch origin.

Learnings

The MVP is not viable if Quooker needs to cover up for the costs of theft. Therefore a new MVP is required that prevents theft. In addition, the MVP is not ‘minimum’. There are too many side features and the concept of automatic ordering was not clear for the colleagues. In addition, the features to decrease the (cognitive) effort to recognise an empty cylinder and to realise it needs replacement were forgotten.

Figure 34. The swap box.

Figure 35. A QR-code to the demo.

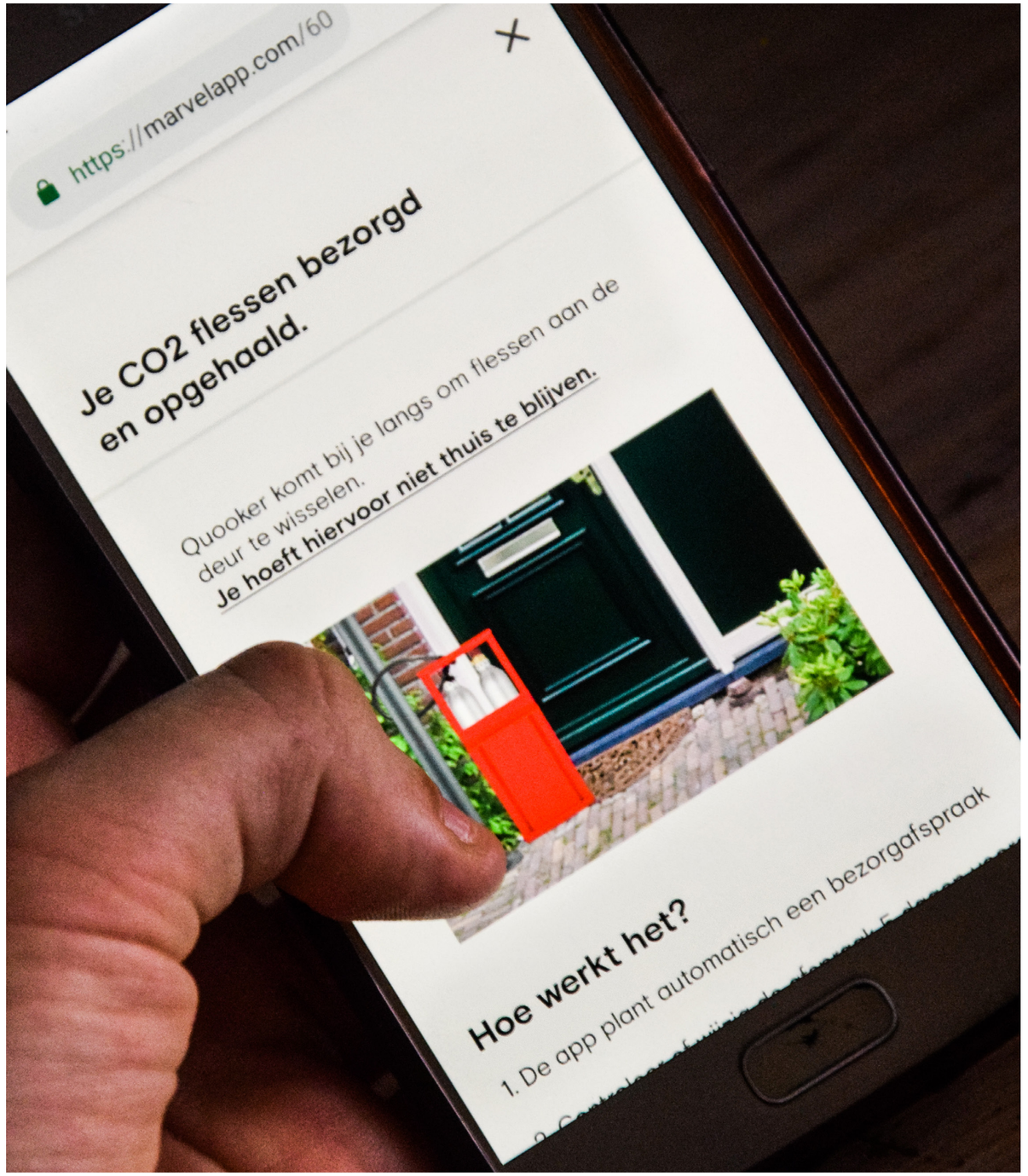


Figure 36. The explanation pop-up of the mobile application demo.

Appendix X - Swap-Crate Design

Three design aspects of the Swap-crate are elaborated.

Crate

A crate is designed instead of a cardbox return box because cardboard can easily be torn open. A hard material can prevent the theft of cylinders. A crate also evokes the association with a supermarket crate. Consumers are used to return these crates to the supermarket and hopefully consumers are nudged to this behaviour. It was not possible in the short time frame to design a crate that could also close to prevent theft. Therefore a cardbox box was used that cloud close accompanied with a plastic crate to simulate the plastic material of the MVP (figure 37 and 38).

Trigger

To trigger consumers to open the app a QR-code is placed on the crate. As mentioned in the stakeholder analysis, kitchen dealers are not responsible to introduce consumers to the MVP and therefore it cannot be assumed that kitchen dealer will introduce it to the consumer. The interviews confirmed the lack of responsibility. Three consumers indicated they had to find out themselves, after the Cube was installed, that they had to replace CO2 cylinders. Without the QR-code trigger on the crate, the design may not be introduced to the consumer and the concept may have a low download- and thus low subscription-rate. Appendix J showed that consumers are not likely to read the documents provided with the Cube at the installation, because the majority purchased the Cube with new kitchen and is overloaded with documents of other electronic kitchen appliances. Therefore the concept is not explained in the user manual of the Cube. The QR-code is placed on the crate, and not somewhere else, because it is the first place where consumers look for instructions to order cylinders.

Text

The crate contains as little text as possible. During the interviews consumers look only briefly at the instructions of return box. Therefore, the message should be conveyed in a short text.

Figure 37. The crate (with some traces of usage).

Figure 38. The swap-crate.

Appendix Y - Interviews Cycle 3.1.

This appendix documents the sub-hypothesis, additional quotes and future improvements of cycle 3.1.

Sub-hypothesis

H1: Consumers enter their personal data into a registration login page.
H2: Consumers subscribe to the fake pre-subscription list
H3: Consumers indicate that they trust to place the crate with CO2-cylinders in front of their door if they are able to secure it with a lock.

Additional quotes

Data sharing:
IV8: “My opinion is that you cannot force people to order. I want to consent first.”

Return label:
IV13: “You know.. at Zalando you just get a sticker. That’s easy. (...) Just bring it to Post NL.”
I have it for BBQ gas as well. I drop them off somewhere next to the highway and I immediately get new ones or at Albert Heijn to go. Yes fine as well.”

IV12: “With a sticker inside. Easy.”

Distrust:
IV9: “Yes, but if you don’t have a fence, it seems like... You know, it’s 70 euros... I would not feel comfortable doing putting it at the front door. More people have a Quooker Cube and you see by the package what’s inside. (...). If the package changes doesn’t matter. They eventually will find out what’s inside. Cars are being broken in here because there is a certain type of airbag.”

The other consumer indicated to trust the system, but only because it is not a crowded neighbourhood and thus he does not trust the system by itself.

IV8: “Oh yes yes. I would trust that. (...). I don’t know if the lock is needed. People don’t really steal over here. It is quite outside here. I think you are dependent on the neighbourhood. Maybe there are other neighbourhoods where the bottled disappear more quickly. (...). Oh but if it goes wrong. Then I would claim it at Quooker. This is your system, your fault.”

The interviews suggest that consumers distrust the concept and maybe some consumers trust the concept in rural areas. Yet, the majority of consumers live in the Randstad (consumer analysis) eliminating 54% of the consumers and the concept is not viable in rural areas due to greater travelling distances.

Fake pre-subscription list:
IV8: “Yes. You have it with you? * enters details *. Cool! When is it coming?”

IV9: “Ehm you know... I already have so many apps. So I don’t need it. I think I would want to do it online anyway. And these apps, you know, are mostly for stuff I really need many times during the day, and this is not something I need daily or weekly. (...) Once per month or so. (...) You know I don’t want to be that involved with water. It just comes from the tap. It is just a tap. You choose between bubbles or not and to download an app for that and to put so much effort in to that. Hmm no. (...) No I would not pay money for it no.”

Improvements:

- Consumers want to consent first before subscribing to anything.
- The concept of the ‘days until next delivery’-feature is unclear
- The explanation pop-up contains too much text. As a result consumer do not completely read it and do not understand that the app detects when the Cube is out of CO2 and automatically plans new CO2-cylinders deliveries.

Appendix Z - Flyer Design

Three design aspects of the flyer are elaborated (see figure 39).

Trigger

A flyer is designed to trigger consumers to download the app. As mentioned before, it cannot be assumed that kitchen dealer will introduce the MVP to the consumer. Without the trigger consumer may not know the MVP exists and the concept may have a low download- and thus low subscription-rate. Appendix J showed that consumers are not likely to read the documents provided with the Cube at the installation, because the majority purchased the Cube with new kitchen and is overloaded with documents of other electronic kitchen appliances. Therefore the concept is not explained in the user manual of the Cube. The flyer is placed onto the cylinder, and not somewhere else, because it is the second place where consumers look for instructions to order cylinders.

Flyer

A design for a flyer is created instead of a crate, because most consumers do not have a return box once they have installed the Cube. They only order the box after a few months. Consumers do receive a first cylinder at installation and thus a flyer on this cylinder will introduce the MVP earlier to the consumer.

Welcome package

The consumer receive a free welcome package of four CO2-cylinders as an incentive to to download the mobile application and share their data. They receive this message via the flyer connected to the first installed CO2-cylinder. The welcome package will increase the subscription-rate of the MVP. Yet, it is not clear if consumers will download the app only for the package or for the actual consumer value. Therefore, it is important to measure the retention-rate of the service.

The welcome package is at the same time a response to the dissatisfaction of consumers of only receiving one cylinder at the installation. By offering the package after consumers have registered themselves in the lading page, Quooker is able to track where the cylinders are delivered. The company does not want to hand out free packages at the kitchen dealer, because then the company does not know where the cylinders finally end up.

Text

The flyer contains as little text as possible. During the interviews consumers look only briefly at the instructions of the cylinder. Therefore, the message should be conveyed in a short text.

Figure 39. A flyer with the text "Download the app and receive a welcome package with four new CO2-cylinders worth €60."

Appendix AA - Interviews Cycle 3.2.

This appendix documents a new viability requirement, the sub-hypothesis, additional quotes and future improvements of cycle 3.2.

New viability requirement

To enable automatic payments, the bankaccount of consumers requires validation with a €0,01 transaction. Downloading an app to subscribe is not equal to the commitment of making a payment and allowing the service to debit money automatically from the consumer's bank account. Therefore consumers are also asked to make small payment to subscribe to the service.

Sub-hypothesis

H1: Consumers enter their personal data into a registration login page.
H2: Consumers set up a Wi-Fi connection to share their data
H3: Consumers are committed to making a small payment allow the service to debit money automatically.
H4: Consumers subscribe to the fake pre-subscription list

Additional quotes

Data sharing:
IV10: "Yes perfectly fine."

IV11: "I am fine with doing this, yes. It is part of it."

Payment:
Consumers want to consent first before the money is automatically debited.

IV15: "Just let the app say: 'Heey if you want, we'll order bottles for you. Just click here."

Improvements:

- Consumers also want to consent first the automatic payment is debited.
- Add a website link for consumers that do not have a QR-code scanner
- Consumers want the text on the flyer to explain the purpose of the app.
- The third slider of explanation pop-up ('How does it work?') contains too much text. Consumer do not completely read it, but understand that the concept of the app.
- Finding the serial number of the Cube is difficult, because the text is small.

Appendix AB - Outcomes

In this appendix multiple possible outcomes are identified and evaluated with a balance-scorecard.

What is the inherent need or desire the consumer is trying to satisfy that motivates him to buy a Quooker tap and Cube? The purchase drivers could offer a lead to the outcome.

The boiling-water tap

The three most important purchase drivers to buy a boiling-water tap are: convenience (81%) (less effort in the kitchen), time-saving (52%) and energy saving(27%) (Quooker, 2016). Consumers also buy a Quooker because of its high-quality long-lifespan products (Quooker, 2018). Three outcome business-models are created.

Convenience (and time-saving)
Convenience is defined as: always having instant accessibility to boiling-water.
The consumer pays per liter used and does not have to pay for the product and maintenance any longer. Quooker analyses the consumption and predicts the required maintenance.

Energy-saving
Energy-saving is defined as: the amount of money and emission saved.
The consumer pays per liter used (of the cylinder) and pays for the product. Quooker analyses the consumption. .

Reliability
Reliability is defined as: a boiling-water tap that always works.
The consumer pays per hour used and does not have to pay for the product and maintenance any longer. Quooker analyses the consumption and predicts the required maintenance.

Balanced-scorecard criteria
An outcome is chosen with a balanced-scorecard. The fit with strategy goals is the most important criteria because it is the purpose of the outcome. All outcomes are able to provide an opportunity for monthly recurring revenue and a loyal consumer base. Not all outcomes are able to provide growth after market saturation by to expanding the market because not all outcomes reduce high up-front costs or offer a more cost-saving pay-per-use model or unburden the consumer of ownership (more information in context analysis). The second criteria is consumer value. If the outcome is not the inherent need or desire the consumer is trying to satisfy then the outcome will not sell. The consumer value is estimated but requires validation. The third criteria is the brand position. Quooker wants to strengthen their position and the outcome should be able to strengthen the company's innovative frontrunner and/or high quality image in comparison to competitors (company analysis). The last two criteria's are cost of development and time to market.

An outcome is chosen with a balanced-scorecard (see figure 40). The convenience and reliability outcome both report the highest score because in a way they offer the same outcome. However, 'always instant accessibility to boiling water' is probably more easy to sell than 'a boiling-water tap that always works' because convenience is the number one purchase driver and reliability (or quality/ lifespan) is not.

Convenience
Convenience fits with the strategy goals because it extends the market by offering an outcome that eliminates high upfront costs, provides a cost-saving pay-per-use and it unburdens the consumer of ownership. However, product failure for the boiling-water tap does not occur often due to its ten-year life span and thus is it questionable how great 'the burden of ownership' is.. In addition consumers may think that an even longer lifespan is not necessary and consumers are already quite satisfied with the current service delivery. Therefore the customer value receives a moderate-high score, because a more afforable tap is still beneficial. Convenience also strengthens the brand position because it reïnforces Quookers innovative brand image (because there are no competitors offering this service yet) and it reïnforces Quookers high quality brand image. The cost of development and time to market are both high because the concept would require many sensors and data in order to predict maintenance.

Energy-saving
Energy-saving does not fit with the goals of the strategy because it does not make the offering more affordable and thus it does not extend the market and provide (significant) growth after market saturation. In addition, the generated consumer value seems low because only for 27% of the consumers energy-saving is the main purchase driver. Energy saving does not provide an opportunity for competitive advantage. Many consumers perceive the tap als energy-inefficient and it is difficult to compare competitors on energy consumption because the competitors have an A-energy label as well (see appendix M). Therefore, the brand position is rated low. The costs of development and time to market are both low because it does not require many sensors and radical changes in the business model.

Reliability
Reliability is is exactly the same as Convenience but it charges the consumer per used hour (or day/ month etcetera).

Cube

The three most important purchase reasons to buy a Cube are convenience (no more hassle with carrying, storing, cooling, and returning (sparkling) water bottles)(52%), sustainability (less waste of plastic bottles)(20%) and cost savings (9%) (Quooker, 2016). Consumers also buy the Cube because of Quooker's high-quality long-lifespan products (Quooker, 2018). Four outcome business-models are created.

Conveniencei
Convenience is defined as: always having instant accessibility to sparkling and filtered water.
The consumer pays per liter used and does not have to pay for the product, cylinders and maintenance any longer. The consumer does not have to recognise an empty cylinder, realise it needs replacement and order a new one. Quooker analyses and predicts the consumption and predicts the required maintenance.

Sustainability
Sustainability is defined as: the amount of plastic waste and emission saved by not using bottled sparkling water.
The consumer pays per liter used (of the cylinder) and pays for the product. Quooker analyses the consumption.

Cost savings
Cost savings is defined as: the amount of money saved by not buying bottled sparkling water.
The consumer pays per liter used (of the cylinder) and pays for the product. Quooker analyses the consumption. .

Reliability
Reliability is defined as: a Cube that always works.
The consumer pays per used hour and does not have to pay for the product and maintenance any longer. Quooker analyses the consumption and predicts the required maintenance.

An outcome is chosen with the same balance-scorecard (see figure 41). The convenience outcome

Criteria	Weight	Convenience	Energy-saving	Reliability
Fit with strategy goals	9	9	2	9
Consumer value	9	7	2	7
Brand position	7	8	1	8
Cost of development	4	3	7	3
Time to market	2	2	7	2
Total		216	85	216

Figure 40. A balance-scorecard for the boiling-water tap outcomes

Criteria	Weight	Convenience	Sustainability	Cost saving	Reliability
Fit with strategy goals	9	9	2	2	9
Consumer value	9	9	2	1	6
Brand position	7	9	2	1	7
Cost of development	4	3	7	7	4
Time to market	2	2	7	7	3
Total		241	92	76	206

Figure 41. A balance-scorecard for the boiling-water tap outcomes

Convenience:
Convenience fits with the strategy goals because it extends the market by offering an outcome that eliminates high upfront costs, provides a cost-saving pay-per-use and it unburdens the consumer of ownership. Convenience also seems to generate significant consumer value, because it is the number one purchase driver for the product and the most frequently mentioned advantage during the interviews. Nevertheless, if convenience generates significant consumer value requires validation. Convenience also strengthens the brand position because it reïnforces Quookers innovative brand image (because there are no competitors offering this service yet) and it reïnforces Quookers high quality brand image. In addition, most consumers compare the Cube with competitors based on convenience and currently bottled water is very inconvenient and the Sodastream is moderate convenient with returning and buying the cylinders at a physical store (competitor analysis). Thus improving this key comparison factor may increase the competitive advantage significantly. The cost of development is high because the concept would require many sensors and data in order to predict consumption and maintenance. The time to market is high because the Cube has to be fitted with many sensors and large quantities of data is required to measure consumption and predict maintenance.

Sustainability
Sustainability does not fit with the strategy because it does not make the offering more affordable and thus it does not extend the market and provide (significant) growth after market saturation. In addition, the generated consumer value seems low because only for 20% of the consumers sustainability is the main purchase driver and during the interviews consumers do not highly prioritise the advantage. Sustainability is not mentioned in the comparison with competitors and thus not significantly influential on the brand position. It will not provide an innovative frontrunner brand image, because Sodastream already distinguishes itself on sustainability. In addition, sustainability is not a key aspect of Quooker brand image (Quooker, 2018). Therefore, the brand position is rated low. The costs of development and time to market are both low because it does not require many sensors and radical changes in the business model.

Cost savings
Cost savings does not fit with the strategy because it does not make the offering more affordable and thus it does not extend the market and provide (significant) growth after market saturation. In addition, the generated consumer value seems low because only for 9% of the consumers cost savings is the main purchase driver and during the interviews consumers actually perceive the product as expensive. Cost saving is not mentioned in the comparison with competitors and thus not influential on the brand position. It will not provide a stronger the brand position because bottled water does not require a €1.200 investment and Sodastream is less expensive . Therefore, the brand position is rated low. The costs of development and time to market are both low because it does not require many sensors and radical changes in the business model.

Reliability
Reliability fits with the strategy goals because it extends the market by offering an outcome that eliminates high upfront costs, provides a cost-saving pay-per-use and it unburds the consumer of ownership. Yet it does not unburden the consumer from maintaining a sparkling water supply. Reliability also seems to generate some consumer value because all consumers of cycle 2.0. seem interested in proactive service (appendix R). However, during the interviews product failure was not a significant pain point and the Cube already has a ten-year lifespan so maybe consumers think that an even longer lifespan is not necessary. Therefore the outcome may be more difficult to sell. Reliability also strengthens the brand position because it reïnforces Quookers innovative brand image (because there are no competitors offering this service yet) and it reïnforces Quookers high quality brand image. Yet, reliability or high quality is not mentioned when consumer compare the Cube with bottled water and the Sodastream. Therefore, reliability may moderately influence the brand position. The cost of development and time to market are both high because the concept would require many sensors and data in order to predict maintenance.

Conclusion
For the boiling-water tap the convenience and reliability outcome both report the highest score because in a way they offer the same outcome. However, ‘always instant accessibility to boiling water’ is probably more easy to sell than ‘a boiling-water tap that always works’ because convenience is the number one purchase driver and reliability (or quality/ lifespan) is not. For the Cube the convenience outcome receives the highest score. Therefore, convenience is chosen and combined for both products into a value proposition.

Appendix AC - Design Decisions IoT Infrastructure

The IoT infrastructure to measure consumption behavior for Quooker's SodaService consist of eight layers. The appendix documents for some of the IoT infrastructure layers the design decisions.

1. Product hardware

In order to predict consumption, the Cube needs to measure the volume of the CO2 inside the cylinder, and needs to identify if the cylinder is being replaced

Measuring CO2 volume and identifying cylinder replacement

There are several options to measure the volume of the CO2 inside the cylinder.

- Pressure switch

A pressure switch can be installed in the pipeline of the Cube. By logging the moment the valve opens until the moment the valve closes and multiplying it with the flow of water, the remaining volume of the CO2 inside the cylinder can be estimated. However, according to the EPD manager, adding a pressure switch in the pipeline is a too invasive operation in production and drives up the costs significantly (Hermanns, B., personal communication, May 9, 2019). Altogether, adding a pressure switch is possible but costly.

- Flow sensor

A flow sensor measures the flow of water passing through a pinwheel in the pipeline. Similarly to the pressure switch, adding a flow sensor into the pipeline is an invasive operation in production. In addition, according to the product manager, the number of liters sparkling water that comes out of a cylinder depends on the tapping behavior. If a consumer quickly taps multiple times, the cylinder can provide 80 liters of sparkling water. If a consumer taps less frequently the cylinder provides 60 liters of water. By tapping less frequently, the water inside the Cube is able to cool down and more CO2 can be absorbed in the water (Looijs, R., personal communication, June 12, 2019). Therefore a flow sensor may be expensive and inaccurate.

- Digital pressure sensor

The pressure inside the CO2-cylinder is 40 bar. When the CO2 leaves the cylinder it passes through a pressure reduction valve which reduces the pressure to 1-3,5 bar. A digital pressure sensor can measures the pressure after the valve. Theoretically, the pressure should decrease as the volume of the CO2 decreases. However, in reality, the pressure behind the valve does not decrease linearly as the volume of the bottle decreases according to R&D engineer Offermans. Therefore the pressure cannot be measured after the valve. The pressure cannot be measured before the valve, because the pressure inside the cylinder always remains constant through an equilibrium (Offermans, C., personal communication, May 6, 2019).

- Liquid level

When the tap opens the CO2 experiences atmospheric pressure and leaves the cylinder as gas. However, the pressure inside the cylinder is 40 bar and a part of the CO2 liquifies at pressures over 5.2 bar (Linde Gas, n.d.). Measuring the difference in the liquid level could indicate the CO2 volume. To measure the liquid level a pin is required inside the cylinder that either measures the temperature or humidity at certain heights. The pin can be integrated on the connector and it should reach almost the bottom of the cylinder. However, a long pin makes connecting the cylinder for consumers difficult. The pin can also be integrated into the design of the cylinder but this will increase the costs per cylinder significantly.

- Weight sensor

A weight sensor can measure the weight of the CO2 and cylinder. If the volume of the CO2 decreases, the weight should decrease linearly. The volume of the CO2 inside a cylinder weights 425 grams. A weight sensor is able to track these amount of weights. Therefore, a weight sensor could be an accurate measurement for CO2 volume. Furthermore, a weight sensor is relatively cheap and does not require invasive operations in production. Therefore, the weight sensor is chosen to indicate the volume.

The weight sensor should be embedded below the CO2-cylinder or in the connector to measure the compressing or pulling force of the weight of the CO2. The overall shape of the cylinder is fixed, because the high pressure inside must be equally distributed over inner walls of the cylinder.

1. On top

The weight can be measured from the pulling force of the CO2-cylinder on the connector (see figure 42). It is important that the bottom of the cylinder hangs freely and does not touch the ground in order to measure the weight accurately. If the cylinder hangs freely a gravity momentum will be exerted on the edge on top of the Cube. In order to allow the cylinder to hang, a contra momentum must be created on the edge of the Cube to create an equilibrium (Tg = Te) (see figure below). By measuring the contra momentum with a sensor, the weight can be identified over-time (w(t)).

$$T_{gravity} = F_{gravity1} * L1$$
$$F(t) = w(t) * 9.81$$
$$L1 = 0{,}05m$$

$$T_{edge} = F_{clamping} * L2 = T_{gravity}$$
$$F(t) = w(t) * 9.81$$
$$w(t) = measured$$
$$L2 = 0{,}007m$$

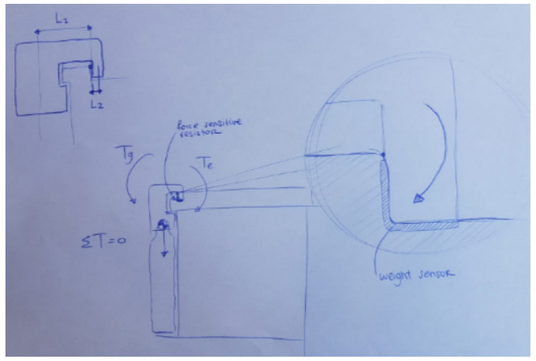


Figure 42. A 2D view of the weight sensor for the contra momentum on the Cube.

The compression is distributed in the vertical and horizontal axis and highly depends on the positioning of the cylinder. A small change in the position (e.g. a bump from a detergent) could easily change the accuracy of the measurement. Furthermore, embedding a sensor in the edge of the Cube either requires to embed a very long sensor covering the whole top of the Cube or it limits the hang versatility of the cylinder as shown in figure 43. Both options require large design compromises in costs or aesthetics and changes in production.

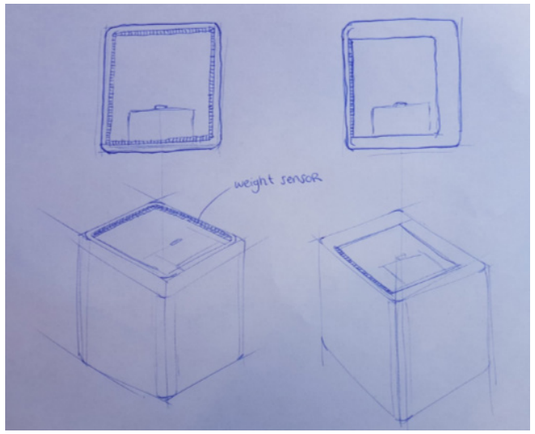
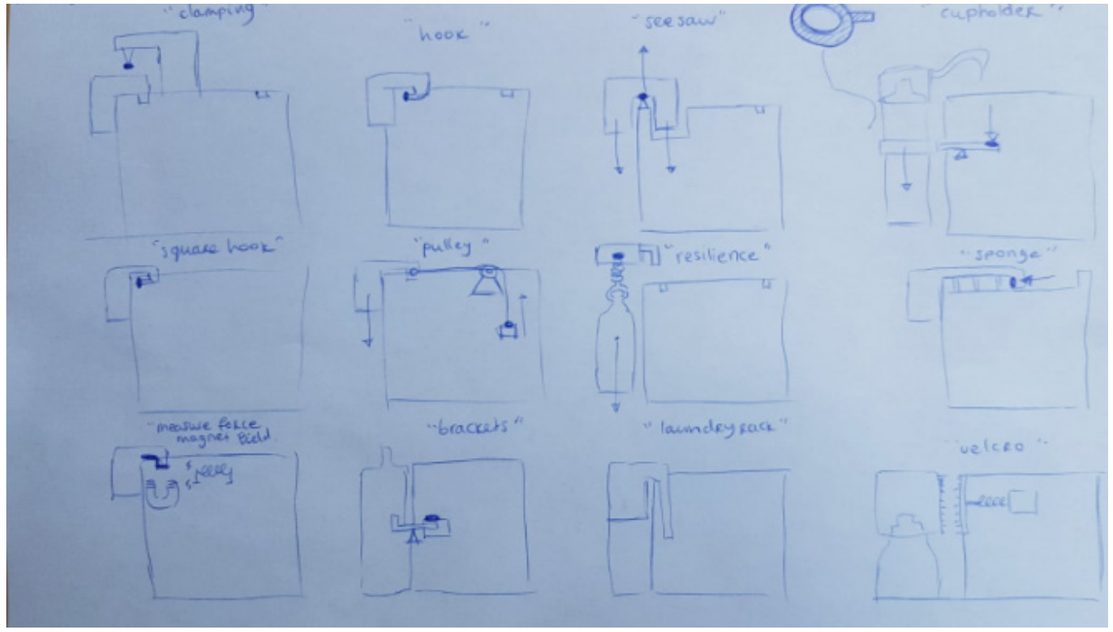


Figure 43. A 3D view of the weight sensor for the contra momentum on the Cube

Other explored options are shown on the next page.



The 'resilience option' is chosen, because out of all explored/considered options it requires the least amount of changes to the existing design of the Cube, while still being able to accurately measure the weight of the CO2 inside the cylinder (See list of requirements). Figure 44 and 45 illustrate the working principle. The disadvantage of this design is that it requires an extra power cable to the connector. The cable must be long enough to allow flexibility in connecting the cylinder.

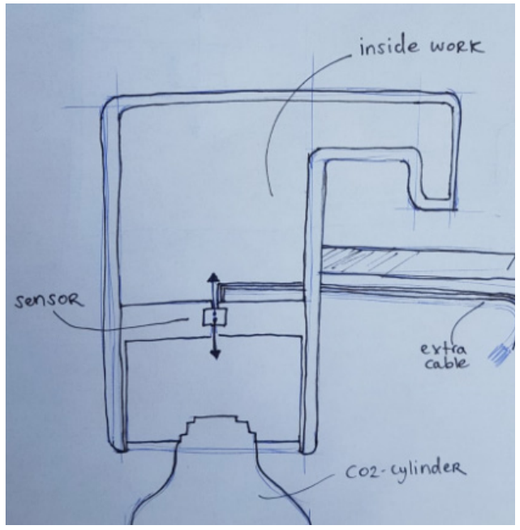


Figure 44. An on-top weight sensor embedded in the design of the connector to measure the pulling force of the CO2-cylinder.

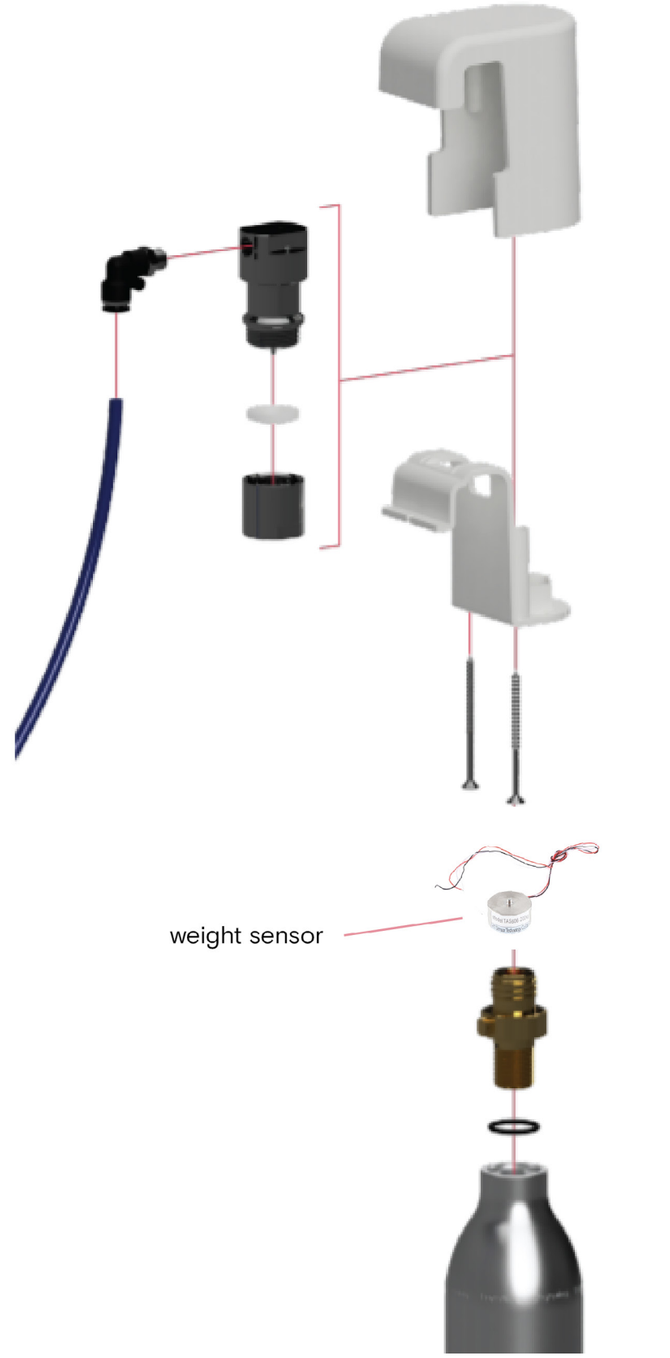


Figure 45. Exploded view of the connector with weight sensor. Adapted from Designing the CO2nnector, Eekhout, den Hengst, Hoeksma, Kolk, Rietveld, & Risseeuw, 2019.

2. Beneath
Currently, the sensor cannot be placed beneath the cylinder, because the cylinder is screwed into the connector. A part of the weight will hang on the threaded connection inside the connector. Relocating the connection to the bottom is also not feasible. A part of the CO2 liquefies and will sink to the bottom and block the way out (see figure 46).

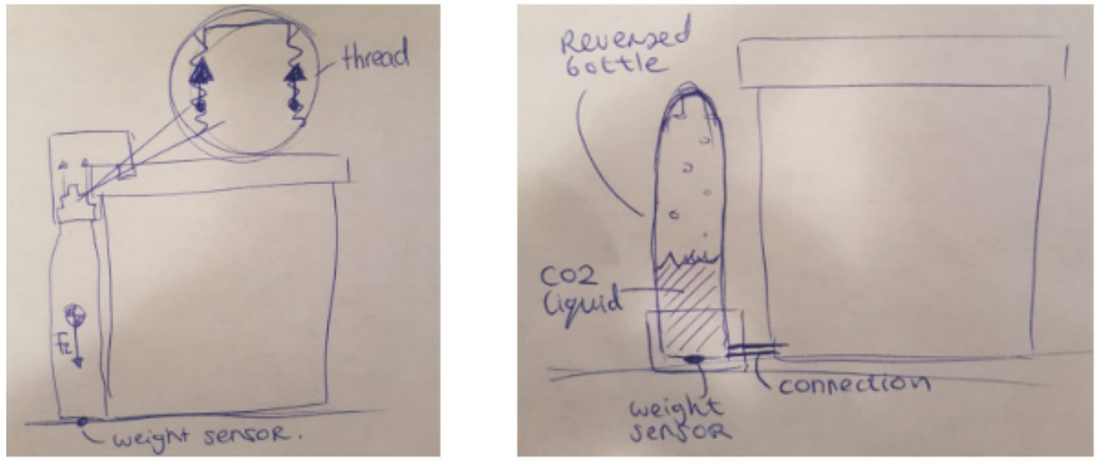


Figure 46. The threaded connection and bottom connection.

Therefore, the cylinder must stand freely on the sensor. The explored options are shown in figure 48. The “loose cap” option is chosen, because it requires the least changes in the existing design of the Cube and it allows easy connection of the cylinder. The figure below illustrates the working principle.

Selection
The disadvantage of this design is that the tube to the cap can exert tension on the cylinder if the tube is being moved. The tension could influence the weight measurement. However, applying a fixed tube obstructs consumers from loosening the cylinder and moving it freely (See list of requirements). Sometimes the Cube is hidden behind obstacles or located deep in the kitchen cabinet and connecting the cylinder without a movable connector is too difficult. For that reason the on-top design for the weight sensor is chosen.

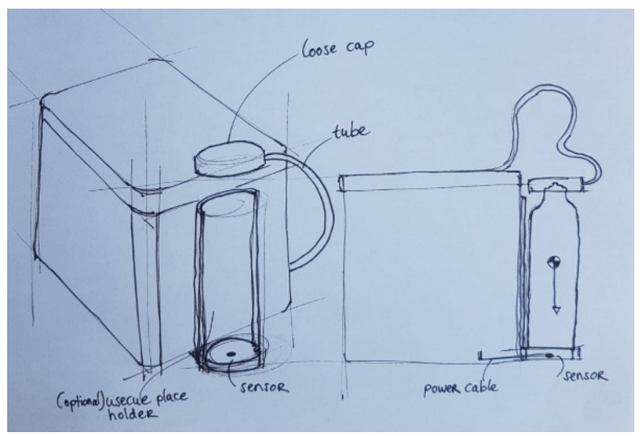


Figure 47. The loose cap option.

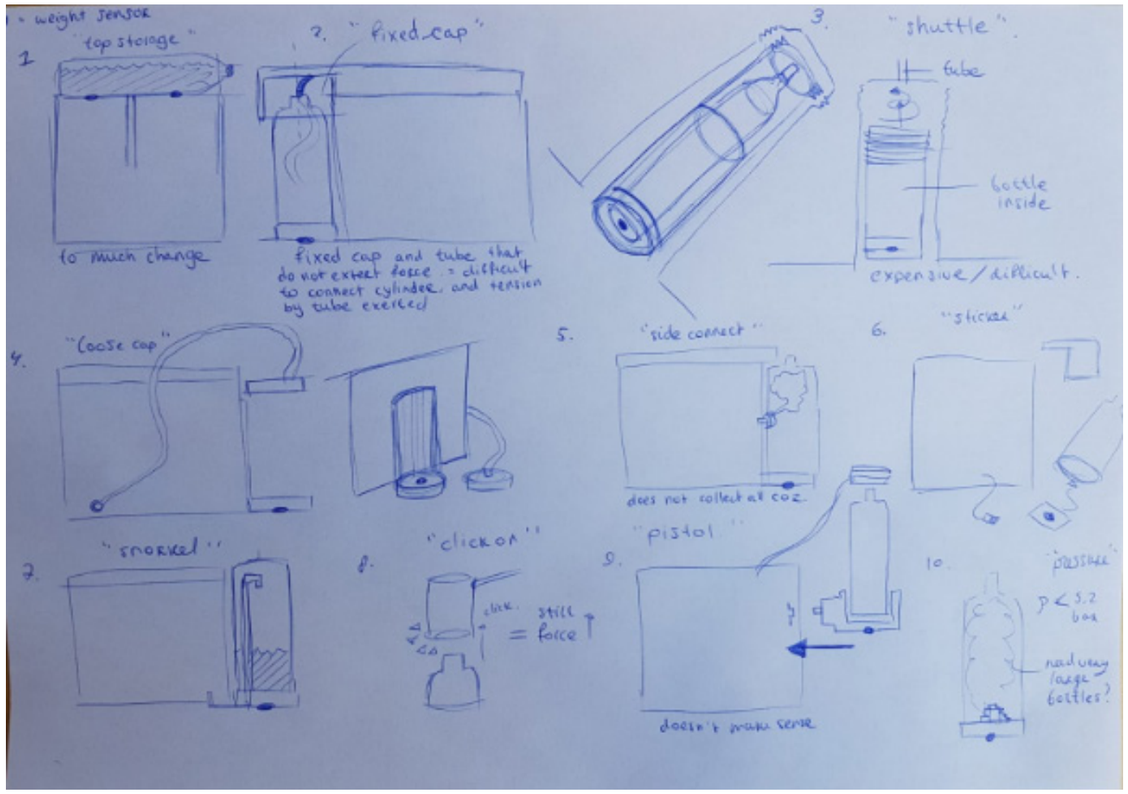


Figure 48. Options for measuring from beneath.

Formula
The volume is measured with the following formula:

- Volume of CO2-cylinder:
  $I(t) = (w(t)*60)/ w(0)$

Type of weight sensor
There are two key weight sensor categories to choose from which influence the redesign of the connector and accuracy of the measurement:

1 Force sensitive resistor
2. Load cell

To compare both sensors, a force sensitive resistor is obtained from an electronics shop and a load cell from a scale, see figure CC. A force sensitive resistor is a thin sensor (0.2 mm) that measures weight with an inaccuracy of 5% (Tekscan, n.d.). For a 60L cylinder this results into an inaccuracy of 3 Liters. Therefore the sensor is not accurate enough to indicate a percentage indication for CO2 volume in a mobile application (See list of requirements). It could also result into an app that indicates that there still remains 3 liter water, but in fact the cylinder is already empty.

Selection
A load cell is less compact than a force sensitive resistor as shown in figure CC, but there is enough space in the connector for this sensor. A load cell is able to more accurately measure the weight of the cylinder (< 0,1%) (Tekscan, n.d.). For a 60L cylinder this means a variation of 60 ml. Therefore, a load cell is chosen to measure the weight.

Further research
Weight sensors are often temperature dependent. Further research is recommended to test the influence of temperature differences in the use case. Furthermore, the variations in the weight of cylinders due to tolerances is unknown, but this can be resolved with self-calibrating the initial weight (w(0)) everytime the cylinder is being replaced. A load cell is accurate enough to display the volume of CO2 in percentages (< 0,1%) in the mobile application, but the weight variances of the CO2 inside the cylinder is unknown. The weight of the CO2 inside the cylinder is required to conform to the EN 13365 and is not allowed to variate over 0.5% (AIGA, 2016). Therefore the total inaccuracy is estimated at 0,6% (0,36 L).

Lastly, external forces may influence the weight measurement. Objects in the kitchen cabinet are able to exert an external force on top of the cylinder and the weight sensor as shown in the interviews

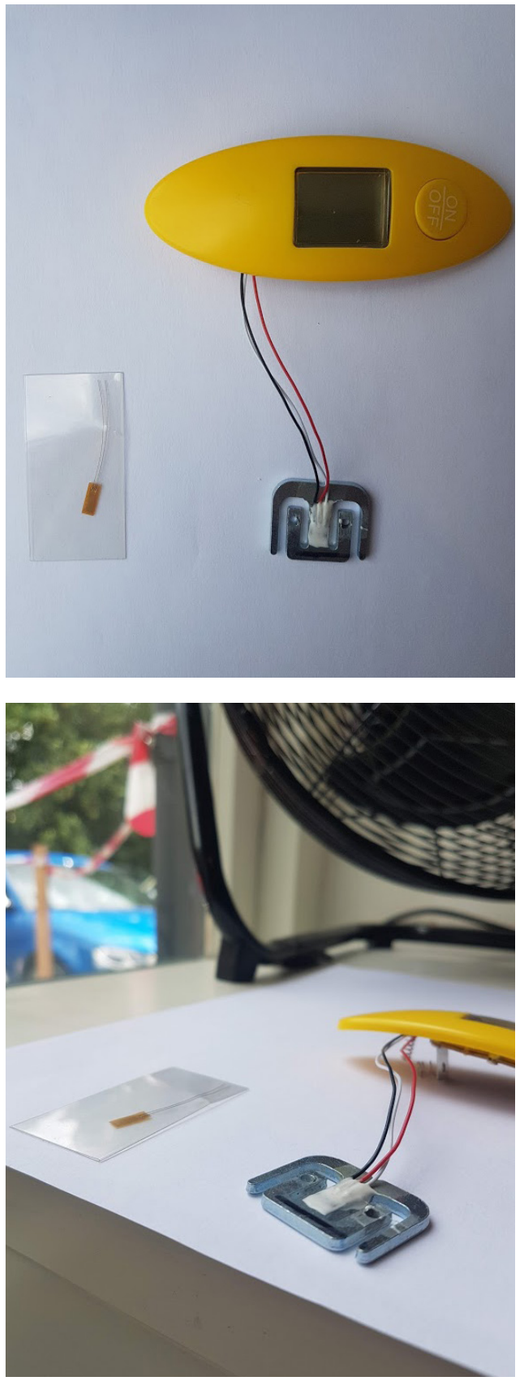


Figure 49. Above: a force sensitive resistor. Beneath: a load cell from a scale

(see figure 50). Or the consumer could slightly move the connector. There are multiple ways to prevent this from happening. For example, a warning sign on the connector, an informative message in the mobile application, the software detecting peaks and re-calibrating etcetera. More research is recommended to find the optimal solution to prevent external forces from influencing the sensor. To prevent consumers from feeling misinformed by the mobile application, it was decided to visualise the CO2 volume of the cylinder not in percentages but in a different less precise way (e.g. with blocks).

Figure 50. Pictures from the user interviews with objects placed on top of the connector or close to the connector that could exert force on the connector.

Identifying cylinder replacement
The Cube needs to identify when a cylinder is being replaced to track consumption. The number of times the cylinder is replaced must be logged. There are multiple options to detect whether a cylinder is being replaced.

- LDR sensor
A LDR sensor could measure the light inside the connector. If the cylinder is being replaced, more light enters the connector and the resistance of the LDR drops (see figure 51).

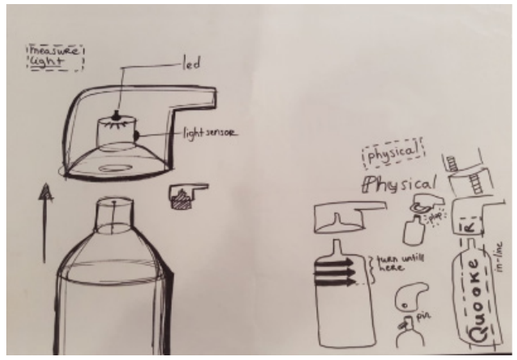


Figure 51. LDR sensor set-up

b) Rotation detection
The detection of the rotation of the cylinder indicates if the cylinders is being (un)screwed. A rotation can be detected with a magnetic strip, a coil and a chip (as shown in figure 52). If the coil passes by the magnet an electric signal is sent to the chip which indicates a rotation.

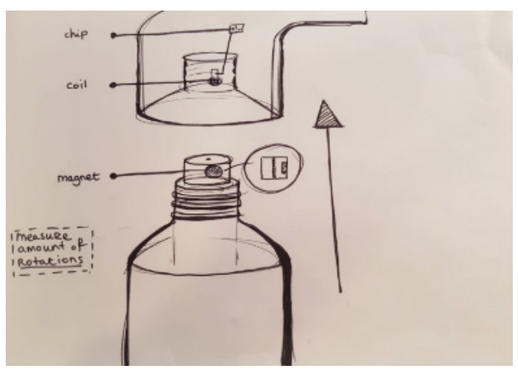


Figure 52. Rotation detection.

- Weight sensor
he load cell used for the volume indication can also detect when a cylinder is being removed from the placeholder. Therefore a weight sensor is chosen because it is already used for the volume indication. The following formula identifies the replacement:

- Cylinder replaced:
  $w(t) < w(0)$

  $l(t)$ is the volume in liters at a certain time.
  $w(t)$ is the function the weight at a certain time
  $w(0)$ is the initial weight after reset (when cylinder is replaced)

Keep track of the absolute time
The Cube also needs to know the absolute time to predict when the cylinder runs out of CO2 and to plan cylinder deliveries on time. The day of the week and time of the day could be influential to the consumption prediction. For example, a certain consumer may drink less sparkling water during weekdays because he/she is at work during the day. The absolute time is also important for delivering CO2-cylinders on time. If the order is placed before 12:00 P.M. the warehouse is able to prepare the package in time to deliver it to Post NL. Post NL delivers packages before 18:00 and orders on both saturdays and sundays arrive on tuesdays. Therefore, the minimal hours to order upfront are dependent per day. An alternative is to choose the safe option and deliver all the packages 114 hours upfront. It is recommended to research if consumer do not mind receiving new cylinder ~ 5 days too early.

Day of the week	torder	tdelivery
Monday - Friday	< 12:00 P.M	30 hours
Monday - Tuesdays	> 12:00 P.M.	54 hours
Friday	> 12:00 P.M.	90 hours
Saturday	-	90 hours
Sunday	-	114 hours

Table 1. The minimal hours to order upfront dependent per day of the week.

2. Product software
Quooker has no access to the software of the control chip in the Cube. The Cube was designed for a quick time-to-market (see product analysis) and therefore an external supplier produced the control chip. Quooker has programmed some software on a small embedded communication chip in the Cube, but re-programming the chip to add a weight sensor is not feasible. Therefore a new control chip is required.

3. Connectivity
There are several options to transmit information between the product and cloud.

- Short-range wireless connections
Short-range wireless connections (e.g. Bluetooth, Zigbee, NFC and Z-wave) are not suited for the concept, because the consumer is required to stay within an approximate range of 10 meter of the Cube (Ab Rahman, 2015). Otherwise, the device cannot feed the consumption data back to the consumer. The short-range is a too great concession on the flexibility of the consumer.

- LoRa
A LoRa network is a wireless long-range connection that can only send small bits of data every couple of minutes (low bandwidth). The connection is not suited for high and frequent data-rate transmission (Santos, 2018). Quooker's SodaService does not require a high data-rate transmission, but possible a frequent one. Consumers need to receive real-time feedback on their consumption in the mobile application. There is a chance that a Lora network cannot meet this requirement and therefore the connection is not chosen for the concept (The things network, 2019).

- Cellular connectivity
Cellular connectivity transmits data wirelessly to nearby cell towers of network providers which are connected to the internet (McClelland, 2019). Cellular connectivity can transmit high quantities of data (3-10Mbps) across great distances (35 km). Therefore, cellular connectivity performs well in outdoor locations. It can also penetrate through kitchen cabinets easily. The disadvantages of cellular connectivity are the recurring costs because a subscription with the network provider is required and the device needs to embed a sim card. Cellular connectivity also does not provide the consumer with an option to consent first before the sim card shares the data (RS Components, 2015).

c) Wi-Fi
Wi-Fi connects devices to a nearby wireless router that in it term connects to an Internet service provider. The connectivity only functions if the device is within the range of the router (Verizon, 2015). The Cube is mostly used in-doors and thus there is often a Wi-Fi point nearby. A Wi-Fi connection has an approximate range of 50 meters (RS Components, 2015) and it easily penetrates wood. Therefore, the Wi-Fi signal is probably able to reach the Cube inside the kitchen cabinet. Unless, the cabinet is made from ceramic, glass or metal (Mistral, 2018; Skylab, 2016). A Wi-Fi connection requires a relatively high power consumption (Evrythng, 2016), but this should not be a problem, because the Cube is plugged in a power outlet.

Furthermore, a Wi-Fi connection has a low latency and for the volume indication a quick response time is required to feed the consumption data back to the consumer. A Wi-Fi connection also has almost no bandwidth restrictions and thus the data-rate is high enough for the concept.

User control
According to Westerman (2013) consumers are willing to share their data if they are in control of what is being shared and if they know what data is being shared. If Quooker subtracts data from consumers without them knowing it, the company may violate expectations and privacy laws, create distrust and deteriorate the brand image. According to Nati (2018) Quooker can build a trust relationship with consumers by increasing the control of the user. A Wi-Fi connectivity gives the user control of sharing their data, because they can disconnect from the internet at any time of the day.

4. Gateway

A gateway cloud be interesting if a consumer possesses multiple Cubes which is more likely to occur in the B2B market. For example, a company that owns three Cubes does not want to download three apps to see the CO2 volume of each device. Quooker could offer these consumers a gateway to bridge the control of all devices. Only 15% of the Cube users is B2B (den Dekker, 2019) and only a part of this segment bought more than one Cube. Therefore, the gateway is excluded from the technical architecture, but Quooker could offer consumers gateways on-request if it is a viable business case.

5. Cloud

A cloud is a software application running on a server with four sub-layers: a 'database system' to store product data, an 'application platform' to design and manage custom business applications (Mendix, 2019), a 'rules/analytics engine' that consists of algorithms to operate the product or to reveal product insights, and 'smart product applications' which are software applications running on remote servers to manage the monitoring, controlling, optimisation and autonomous functions of the product.

Five cloud services are analysed and compared. It has been recognised that there may be other cloud services that better fit the concept than the options mentioned below. Yet, because the emphasis in the graduation project is on strategic design rather than integrated design other cloud services are not analysed and it is recommended to further analyse cloud services to find the optimal fit. A suggestion is to also look at less generic cloud services and to set up an appointment, because their pricing models are often not published publicly.

Amazon web services
Amazon web services (AWS) is a highly customisable and fitting the requirements because it offers the following features: build, train and deploy algorithms, data storage in the cloud, mobile app creation and the connection of devices to the cloud. AWS serves the a pay-per-hour pricing model. AWS is a generic cloud service and is not an optimal solution for the integration with Magento (and later on Exact and the service database). The integration with Magento is required to automatically place cylinder orders.

Evrythng
Evrythng is the market leader platform-as-a-service for consumer products. The company specialises in managing data from consumer electronics and home appliances products in order to apply data intelligence. The service provides "machine learning tools support adaptive analytics applied to real-time product data." (Evrythng, 2019). The machine learning tools are likely to be applicable to the previously explained perception/action loop to optimise the consumption algorithm. Evrythng allows integration of business systems and therefore is likely to be able to create the connection between Magento. Furthermore, the company creates "a range of web interface dashboards, permitting authorized users to view product item data, analytics, and notifications relevant to supported use cases", suited for the web application for the CO2-cylinder concept. The company also has experience in acquiring first party consumer data. Nevertheless, the pricing strategy is unknown and therefore requesting a consult is recommended.

Microsoft Azure
Microsoft Azure is a generic, but more versatile than AWS and it allows clients to "use the services purely on the cloud or it can be combined with any existing applications, data centre or infrastructure you may already have in place." Therefore the integration with Magento may be easier in comparison with AWS. Azure costs €0,030 per GB and is cheaper than AWS (see figure FF)(Microsoft, 2019). Azure fits the requirements because it offers the following features: connect devices to the cloud, the creation, implementation of predictive analytics, data storage in the cloud and mobile app creation.

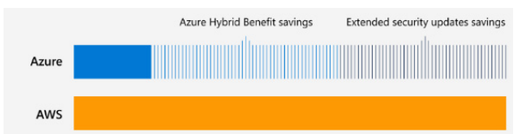


Figure 53. Microsoft Azure (Azure) and Amazon Web Services (AWS) pricing for a PaaS service. Reprinted from Azure vs. Kosten van AWS - Vergelijking, Microsoft Azure, June 2 2019, retrieved from https://azure.microsoft.com/nl-nl/overview/azure-vs-aws/cost-savings/

Oracle Cloud
Oracle cloud is cost-efficient, because it offers self-repairing abilities, allowing easy maintenance and reducing start-up costs for companies. The on-demand hourly cost for Oracle costs is $1,83 per hour (Oracle, 2019). The service is less expensive than AWS. The service is also more versatile, because "All of your data and applications can be integrated. The solution enables the user to migrate all processes to the cloud." (Drake & Turner, 2019). Enabling to integrate all migrate business systems (e.g. Magento) to the cloud. However, Quooker has no experience in maintaining a cloud service and it is important for the brand image and thus cloud service to be reliable. Therefore this option is crossed of as well.

Vcloud
Vcloud is also able to meet the required features for a cloud service. Vcloud uses a pay-per-unit pricing model. The computing of data costs €0.032 per GB per hour and storing data costs €0.11 per GB per month (VMware,2019). Vcloud is more expensive than AWS and Azure.

Selection
Azure and AWS are both well suited for the requirements of the IoT solution. However, Microsoft Azure hourly cost is lower than AWS and ditto for its support plans. Certainly at the start of the migration, Quooker needs a lot of technical support from Azure to set up the cloud connection, stora data and integrate Magento. In addition, Azure is a more user friendly option because the company already uses a Windows platform. AWS requires a learning curve to use the service (Oktava, n.d.). For that reason is Microsoft Azure less expensive and more user-friendly and thus chosen for the IoT solution. As mentioned before, it is recommended to further analyse (less-generic) cloud services to ensure an optimal fit. There may be other cloud services that better fit the concept than the options mentioned before.

8. Security tools

Quooker has no expertise in securing IoT infrastructures and therefore internal development will probably result into a relatively poor end-result compared to the end-result of a security specialist (Cimpanu, 2019). Some security specialists also offer a security label. The label allows Quooker to shift the responsibility of a data breach from the company to the security specialist in order to control the brand damage. In addition, outsourcing security will decrease the time-to-market drastically (de Marco, 2018) and is less expensive than hiring an in-house security expert according to Theriault (2019). Therefore the decision is made to outsource security. It is assumed that a security specialist requires one month to set up the basic operations and two weeks per year for maintenance (Ogilvie, 2017).

Metrics

The metric shows the time elapsed from the point when the last CO2-cylinder of the four pack is installed (C=4), and the time before the consumption runs out is equal to/ or smaller than the delivery time (tremaining ≤ tdelivery) until the point when the Cube sends another signal of a bottle replacement. Indicating a new delivery has arrived (see figure 54).

$t_{min}\ (C = 4+X,\ t_{remaining} \leq t_{delivery})$

Metric2= minimizing the time people have an empty cylinder connected to the Cube.

$t_{min}\ (L_{remaining} < 0{,}36)$

Abbreviation	Explanation
t	time spent
C(t = 0)	The initial counter of cylinders in stock. It sets to a count of 0. At C(t = 0) the Cube is installed and every new Cube comes with a new cylinder and a welcome four-package. When the order is placed in Magento, and the first cylinder replacement signal is received, the initial counter resets C = 1.
C'	Counts the amount of C reset loops + C(t) to count the amount of CO2-cylinders for the 'costs' feature in the app.
X	Manual adding or subtracting of cylinders (by the consumer in the app)
w(0)	The initial weight measurement of the (full) CO2-cylinder. It is self-calibrates after the replacement signal.
w(t)	The weight of the CO2-cylinder at a certain time
Lremaining	The remaining liters in connected CO2-cylinder. 60*w(t) / w(0).
tremaining	The predicted remaining-consumption time of the installed CO2-cylinder. It is the outcome of an algorithm mapping the consumption pattern.

Figure 54. An explanation of the abbreviations used in the metric formulas.

Appendix AD - Future Recommendations for the Second and Third Step of the Strategy

This appendix discusses IoT infrastructure recommendations for the second and third step of the strategy.

1. Product hardware

To predict the degrading of a components, the Cube and boiling-water tap need to be fitted with sensors. It is recommended to analyse the current service analytics to identify product breakdown causes and to test what sensors can indicate these breakdowns in an early phase. Measuring CO2 volume and identifying cylinder replacement.

3. Connectivity

For the second and third step continuous connectivity of the devices is more important, because the consumer pays per liter. If the devices are not connected, no money can be debited per liter that has been used.There are two options to handle the situation. The first option is to trust the consumer to reconnect at a certain point and if they do not, fall back on terms and conditions. The second option is to close off the CO2-cylinders or tap at a certain point until the product is reconnected to the internet. The latter requires a change in the design of the cylinders and/or pipelines.

6. External data sources

For the second and third step external data sources can provide data to optimise predictive maintenance. For example, humidity data from a weather API could predict the decrease in product longevity due to the corroding of product electronics (Khanna, 2017). Temperature data could optimise the energy consumption for cooling the Cube or pre-heating of the boiling-water tap. The amount of limescale in the water depends on the location. If the water in a certain region contains a lot of limescale, the boiler becomes clogged faster and maintenance is due earlier. Therefore it is recommended to look into connections with external data sources.

Third devices

For the second and third step the integration with third devices can be relevant to improve the consumption prediction. For example, an integration with a smart door lock could provide insights into how many people are home. There may be a correlation between the amount of people in the house and consumption. Or there may be a correlation between the amount of times a smart fridge opens at a certain timeframe and the amount of sparkling water used. Or an integration with Google Nest may provide the Cube with information when the consumer is likely to be at home in order to improve the success-rate of automatic cylinders deliveries.

In order for Quooker to set up an integration with third devices, a custom application programming interface (API) can be developed. Software developers should decide what data can be shared with the public throughout the API, so other programmers can request this data for their own applications (Scott, 2016).

According to Lutterop (2018) building a connection for an incoming API takes on average 20-30 days, costs €13.000 and costs €175- €440 per month for maintenance. Quooker should only approve access to third devices when two conditions are met. First, the data sharing should be justified with providing real consumer value (convenience). Second, Quooker should only share its data with trustworthy third devices to prevent insecurities and brand damage. Therefore, Quooker should not publicly distribute its API-key, but only after the incoming request is evaluated and approved.

7. Integration with business systems

When the product is about to break down, the consumer needs to receive message and Quooker needs to send a service mechanic. Therefore, the integration of the cloud, mobile app and service database is required. The service database is not a cloud service and therefore the data needs to be migrated to the Microsoft Azure cloud.

8. Security tools

The boiling-water tap increases the security risks because hackers could remotely increase temperature and thus the pressure inside the kettle and consequently cause an explosion. Therefore the importance of data security increases.

Appendix AE - Costs

The costs are additional costs next to the current operational costs of the company. The costs are summarised in the tabel 2.

Quooker's SodaService

Prototype
The costs for developing a prototype for the pilot is estimated at €100.000 (Blis digital, personal communication, June 12, 2019).

Product design
The hardware, software and connectivity component are estimated based upon Aliexpress.com prices. The costs are estimated at €1.23 per Cube.

Load cell = €0,54
Control chip = €0,29
Altering the design of the connector for the load cell = 0,40

Cloud
Microsoft Azure charges €0,030 per transmitting GB. It is estimated that the consumer uses a Cube five times a day (average consumption 1,5L). Based upon another use case, the data per unit per day is roughly estimated at 4.6 kB to the cloud per Cube per day (Green Vulcano, 2019). The amount of data one Cube sends annually to the cloud is 1.89 GB and costs €0,057. Quooker needs a lot of technical support from Azure to set up the cloud connection, stora data and migrate the data from Magento. A standard technical Azure support plan costs €1.344 annually (Microsoft Azure, 2019).

Algorithms
Similarly to the security specialist, outsourcing the training of algorithms is cheaper than training employees internally or hiring an in-house expert. The costs of consulting a data-scientist is roughly estimated at €52 per hour (Statistics.com, 2019). It is estimated the data scientist works one day per week on the algorithm which is €18.720 annually.

Security
Based upon another use case (Ogilvie, 2017) the total security costs are estimated at:

Set up costs = €32.000
Maintenance costs annually = €8.000

Mobile application
The costs of outsourcing the mobile app development is estimated at €100.000 (Blis digital, personal communication, June 12, 2019).

Flyer & return label
The flyer and return label with freepost number is developed internally at the marketing department of Quooker. The company must find a partner for producing the flyer and label. The cost for the flyer is estimated at €0,12 (Flyersonline, 2019) and the label at €0,05 (Euro label, n.d.).

Second step of the strategy

Prototype
To predict maintenance the product should be fitted with sensors. The amount of sensors is roughly estimated at 10 and therefore the costs per Cube €5. The costs to develop a prototype is estimated at €100.000

Product design
The redesign of the CO2-cylinders and water pipe to close off the water supply if consumers do not connect to the internet or pay is roughly estimated at €0,40 per Cube or Quooker.

Cloud
The amount of data transmitted to the cloud has increased ten times. Therefore the costs are estimated at €0,57 per Cube annually. A more extensive support plan from Microsoft Azure is required to migrate the data from the service database to Azure. The costs are €10.644 annually.

Algorithms
It is estimated the data scientist works one day per week on the algorithm which is €18.720 annually.

Security
The security specialist requires one week per year extra to maintain security: €12.000 annually.

API
According to Lutterop (2018) building a connection for an incoming API costs €13.000. The costs of maintaining the connection costs between €175 and €440 a month. The amount of connections is estimated at six (e.g. weather, mass media, hardness of the water, a smart door lock, a smart fridge and Google Nest): €78.000

Mobile application
It is assumed that updating the mobile application with a proactive service notification feature and a pay-per-use costs-feature requires one week: €25.000

Table 3 shows a very rough estimate for the second step of the strategy.

Cost	
Cylinder subscription sales (annually)	X
Start up costs	€232.000
Variable costs	€1.23*X
Specialist support costs (annually)	€28.064
Flyer and return label	€0,17*X

Table 2. An estimate of the costs of Quooker's SodaService.

Cost	
(Cube & cylinder) subscription sales (annually)	X
Start up costs	€203.000
Total variable costs	€ 5,97*X
Specialist support costs (annually)	€41.804
Flyer and return label	€0,17*X
Total	**€1.322.548**

Table 3. A costs estimate of the second step of the strategy.

New cylinder		
Price	€ 15	(60/4)
Cost Price	€ 2,87	(11,50/4)
Return costs	€ 1,94	(7,74/4)
Delivery costs	€ 1,93	(7,74/4)

Re-used cylinder		
Price	€ 15	(60/4)
Cost Price	€ 0,63	(2,50/4)
Return costs	€ 1,94	(7,74/4)
Delivery costs	€ 1,93	(7,74/4)

Table 4. The cost set-up of a cylinder

Appendix AF - Assumptions Business Case

Quooker's SodaService

Average consumption
For the sake of complexity the average consumption per day of consumers is set to one liter. Cube users consume on average 1,5L sparkling per day, but from the interviews consumers indicated their sparkling water usage increased due to the Cube. Therefore a 'save 1L' is used in the analysis

Price-per-liter
Although Cube consumers seemed price-insensitive for a one-time purchase, it is not validated if the same applies for a pay-per-cylinder model. As mentioned before, IoT should provide as much (or more) value to the consumer than to the company. Therefore, the price per liter cannot exceed the current price of ordering CO2-cylinders (€0,25/L). The service is not cheaper than bottled sparkling water or the Sodastream due to the high upfront price of the Cube, but Quooker can outperform both competitors with delivering more customer value in convenience. Bottled sparkling water is less convenient due to the weekly hassle of carrying, storing, cooling and returning of bottles. Sodastream is less convenient because it requires ordering and returning of cylinders in a physical store once every three months.

Retention-rate
If the pilot is executed successfully the retention-rate is set to 90%.

Subscription-rate
Currently, 3.260 Cube users annually order CO2-cylinders (den Dekker, 2019), only 16,3% of the total amount of Cube users. It is estimated that the sales increase with 16% (similarly to HP's instant ink service (HP Inc., 2018)) due to the increase in convenience = 3.781 annual subscription sales. In other words, a 19% subscription-rate of the total annual Cube users (if the sales target is achieved). Note, the subscription requires validation in the pilot.

Return-rate
The increase in the return-rate of empty cylinders is estimated at 20%. The estimated is based upon HP instant ink return-rate increase. Instant ink reports an increase of 50% by offering a more convenient return procedure (Ellen Macarthur Foundation., 2017). Quooker's return-rate is already at 74% (den Dekker, 2019).

Sunk costs
It is assumed that there are no sunk development costs of the current CO2-cylinders and system.

Retention-rates for the first year
Some consumers abandon the service within the first year. For the sake of complexity these consumers are not taken into account. Consumers are probably not inclined to do so because Quooker asks for a relocation allowance if consumers to cancel within a year (see synthesis phase).

The profit calculation is shown on the next page.

2020			2021			2022		
Average daily usage of sparkling water (L)		1,0	Average daily usage of sparkling water (L)		1,0	Average daily usage of sparkling water (L)		1,0
Subscription sales		3.781	Subscription sales		4.121	Subscription sales		4.492
Costs IoT			**Costs IoT**			**Costs IoT**		
Start-up costs		€ 232.000	Start-up costs		€ 0	Start-up costs		€ 0
Total variable costs		4.651	Total variable costs		5.069	Total variable costs		5.525
Specialist support costs (annually)	€	28.064,00	Specialist support costs (annually)	€	28.064,00	Specialist support costs (annually)	€	28.064,00
Flyer and return label			Variable return improvements		700,62	Variable return improvements		763,68
Monthly IoT step 1 strategy costs per consumer	€	5,85	Monthly IoT step 1 strategy costs per consumer	€	0,68	Monthly IoT step 1 strategy costs per consumer	€	0,64
CO2			**CO2**			**CO2**		
Filled CO2-cylinder cost (excl. profit)	€	2,88	Filled CO2-cylinder cost (excl. profit)	€	2,88	Filled CO2-cylinder cost (excl. profit)	€	2,88
Monthly CO2 costs	€	1,44	Monthly CO2 costs	€	1,44	Monthly CO2 costs	€	1,44
Delivery & return costs						**Delivery & return costs**		
Return costs (per cylinder)	€	1,94	Return costs (per cylinder)	€	1,94	Return costs (per cylinder)	€	1,94
Delivery costs (per cylinder)	€	1,94	Delivery costs (per cylinder)	€	1,94	Delivery costs (per cylinder)	€	1,94
Delivery and return costs (per cylinder)	€	3,87	Delivery and return costs (per cylinder)	€	3,87	Delivery and return costs (per cylinder)	€	3,87
Monthly delivery costs	€	1,94	Monthly delivery and return costs	€	1,94	Monthly delivery and return costs	€	1,94
Increased return-rate		20%	Increased return-rate		20%	Increased return-rate		20%
Cost reduction per re-used cylinder	€	2,25	Cost reduction per re-used cylinder	€	2,25	Cost reduction per re-used cylinder	€	2,25
Total cost reduction of increased return-rate		851	Total cost reduction of increased return-rate		927	Total cost reduction of increased return-rate		1.011
Consumer			**Consumer**			**Consumer**		
Total monthly costs for consumer (excl. profit)	€	9,22	Total monthly costs for consumer (excl. profit)	€	4,06	Total monthly costs for consumer (excl. profit)	€	4,01
Total monthly costs (incl. profit margin)	€	7,38	Total monthly costs (incl. profit margin)	€	7,50	Total monthly costs (incl. profit margin)	€	7,50
Price per liter	€	0,25	Price per liter	€	0,25	Price per liter	€	0,25
Price of Spa Rood per liter (Jumbo)	€	0,62	Price of Spa Rood per liter (Jumbo)	€	0,62	Price of Spa Rood per liter (Jumbo)	€	0,62
Quooker			**Quooker**			**Quooker**		
Profit margin		-20%	Profit margin		85%	Profit margin		87%
Monthly profit for Quooker per consumer	€	-1,84	Monthly profit for Quooker per consumer	€	3,45	Monthly profit for Quooker per consumer	€	3,49
Total annual profit								
(excl. increase in sales due to affordability and convenience)	€	-167.349,79				Total annual profit		
						(excl. increase in sales due to affordability and convenience)	€	376.105,64
Total profit in three years	€	549.813,96						
Total annual profit after three years	€	376.105,64						
Percentage annual profit of total annual Quooker profit		2%						
Payback-time		0,49						

Table 5. The profit calculation for Quooker's SodaService.

Second step of the strategy

The same assumptions were made about average consumption, subscription-rate, retention-rate, return-rate, sunk costs and retention-rate for the first year for the second step of the strategy.

Product lifespan

The product lifespan of the Cube is set to ten years (similarly to the boiling-water tap), and requires within this time-frame two maintenance cycles of €100 each. Quooker is able to maintain such a long lifespan by tracking the product performance with sensors.

Price-per-liter

The price per liter may not exceed the price of bottled sparkling water (€0,62). IoT should provide as much (or more) value to the consumer than to the company. As mentioned before, a pay-per-use model enables cost-savings for the consumer. Companies are better at maintaining the product and optimising the product usage than a consumer is and a company can re-use broken products (the latter is for the sake of complexity not taken into account). As a result, Quooker is able to set a more beneficial pricing for the consumer with a pay-per-use model compared to one-time purchase model. As a result, a pay-per-use model is more likely a recurring saving than a recurring financial pain.

Therefore, both the price and convenience (cycle 2.0.) should and can be optimised. A price reduction is set to 5%= € 0,58.

The company also outperforms bottled sparkling water on convenience: 'instant accessibility' vs. 'the hassle of carrying, storing, cooling and returning bottles'. Quooker outperforms Sodastream on convenience as well: 'automatic ordering and easy returning once in 6 months and no hassle with maintaining the device' vs. 'manually ordering and easy returning once in 3 months and the hassle of self-maintaining of the device'. The service cannot compete on price per liter with Sodastream (€ 0,22).

Profit margin

The profit margin for the Cube is unknown and estimated at 20%. Therefore the cost price of the Cube is €1000 euros including all required operational expenses (R&D, production, marketing etcetera).

The profit calculation is shown on the next page.

2023			2024			2025		
Average daily usage of sparkling water (L)		1,0	Average daily usage of sparkling water (L)		1,0	Average daily usage of sparkling water (L)		1,0
Subscription sales		3.800	Subscription sales		4.142	Subscription sales		4.515
Device costs			**Device costs**			**Device costs**		
Device costs (excl. profit)	€	1.000	Device costs (excl. profit)	€	1.000	Device costs (excl. profit)	€	1.000
Life-span		10	Life-span		10	Life-span		10
Maintenance costs (2*100 euro each)	€	200	Maintenance costs (2*100 euro each)	€	200,00	Maintenance costs (2*100 euro each)	€	200
Monthly device costs	€	10	Monthly device costs	€	10	Monthly device costs	€	10
Costs IoT			**Costs IoT**			**Costs IoT**		
Start-up costs	€	203.000	Start-up costs			Start-up costs		
Total variable costs	€	22.686	Total variable costs	€	24.728	Total variable costs	€	26.953
Specialist support costs (annually)	€	41.804	Specialist support costs (annually)	€	41.804	Specialist support costs (annually)	€	41.804
Flyer & label costs	€	646,00	Flyer & label costs	€	704,14	Flyer & label costs	€	767,51
Monthly IoT costs per consumer	€	5,88	Monthly IoT costs per consumer	€	1,35	Monthly IoT costs per consumer	€	1,28
CO2			**CO2**			**CO2**		
Filled CO2-cylinder cost (excl. profit)	€	2,88	Filled CO2-cylinder cost (excl. profit)	€	2,88	Filled CO2-cylinder cost (excl. profit)	€	2,88
Monthly CO2 costs	€	1,44	Monthly CO2 costs	€	1,44	Monthly CO2 costs	€	1,44
Delivery & return costs			**Delivery & return costs**			**Delivery & return costs**		
Return costs (per cylinder)	€	1,94	Return costs (per cylinder)	€	1,94	Return costs (per cylinder)	€	1,94
Delivery costs (per cylinder)	€	1,94	Delivery costs (per cylinder)	€	1,94	Delivery costs (per cylinder)	€	1,94
Delivery and return costs (per cylinder)	€	3,87	Delivery and return costs (per cylinder)	€	3,87	Delivery and return costs (per cylinder)	€	3,87
Monthly delivery costs	€	1,94	Monthly delivery and return costs	€	1,94	Monthly delivery and return costs	€	1,94
Increased return-rate		20%	Increased return-rate		20%	Increased return-rate		20%
Cost reduction per re-used cylinder	€	2,25	Cost reduction per re-used cylinder	€	2,25	Cost reduction per re-used cylinder	€	2,25
Total cost reduction of increased return-rate		855	Total cost reduction of increased return-rate		932	Total cost reduction of increased return-rate		1.016
Consumer			**Consumer**			**Consumer**		
Total monthly costs for consumer (excl. profit)	€	19,25	Total monthly costs for consumer (excl. profit)	€	4,73	Total monthly costs for consumer (excl. profit)	€	4,66
Total monthly costs (incl. profit margin)	€	17,33	Total monthly costs (incl. profit margin)	€	17,48	Total monthly costs (incl. profit margin)	€	17,46
Price per liter	€	0,58	Price per liter	€	0,58	Price per liter	€	0,58
Price of Spa Rood per liter (Jumbo)	€	0,62	Price of Spa Rood per liter (Jumbo)	€	0,62	Price of Spa Rood per liter (Jumbo)	€	0,62
Quooker			**Quooker**			**Quooker**		
Profit margin		-10%	Profit margin		270%	Profit margin		275%
Monthly profit for Quooker per consumer	€	-1,93	Monthly profit for Quooker per consumer	€	12,76	Monthly profit for Quooker per consumer	€	12,80
Total annual profit	€	-175.584,40	Total annual profit	€	1.268.258,15	Total annual profit	€	1.387.308,43
Total profit in three years	€	2.479.982,17						
Total annual profit after three years	€	1.387.308,43						
Percentage annual profit of total annual Quooker profit		7%						
Payback-time		1,14						

Table 6. The profit calculation for the second step of the strategy..