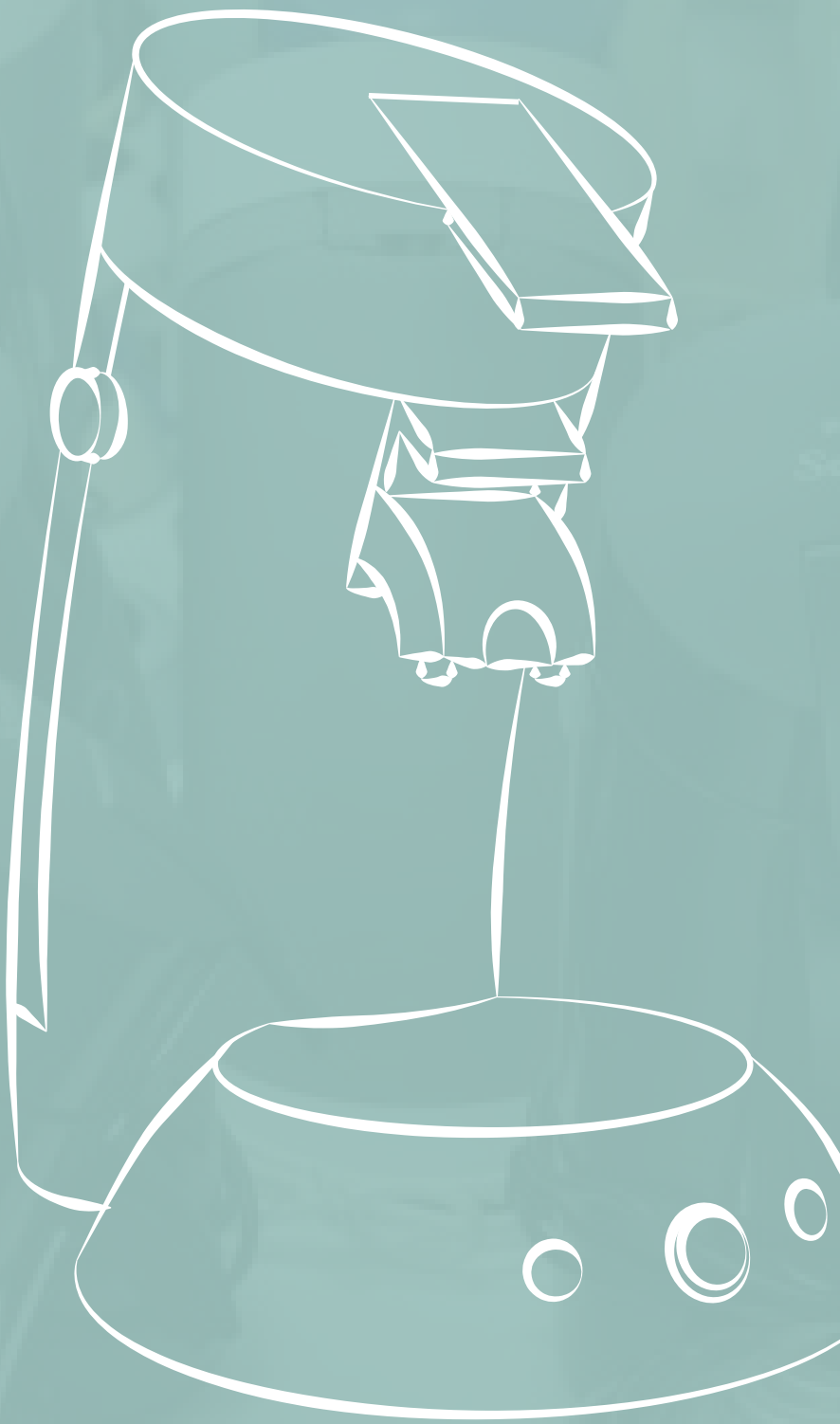
DESIGN FOR CUSTOMER ENGAGEMENT IN THE TRANSITION TO A CIRCULAR ECONOMY

A case study in Senseo coffee machines



Master thesis Jozine Bouma
December 2018

“If we want things to remain the same,
things will have to change.”

– Tancredi

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From Philips
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PREFACE

Dear reader,

This report is a graduation thesis for the master Integrated Product Design at the Delft University of Technology. Carried out in collaboration with Philips Design in the Netherlands.

The main challenge of this project is to discover circular opportunities and design circular solutions for Philips in the business to consumer market. This challenge focuses on the stimulation of circular consumer behavior.

I would like to take the opportunity to thank everyone who helped me making this graduation possible and who supported me during the process.

First of all, thank you Ruth for providing sharp feedback, for the insightful and inspiring meetings, and for the practical advice.

Thank you Jo for your enthusiasm, for sharing your knowledge, and for inviting me to think and reflect on the process.

Flora, thank you for the project initiative and for giving me the freedom to explore and to shape the project to my own interests.

Thanks Kevin, for seeing potential in me and for triggering me to think from different perspectives with your challenging questions. Thank you for guiding me at Philips and for helping me making use of the great knowledge and network within the company.

Aylin, thank you for your endless positivity and your enthusiasm about the topic which provided me with new energy after the coffee breaks.

Thank you Regina and the rest of the Strategic Design Team in Eindhoven for the opportunity to explore the topic and for making me feel at home from the start.

A special thanks to all the people that participated in the interviews, workshops, questionnaires, user tests, and evaluation. Without you I couldn't have done it.

Last, but definitely not least, a big thank you to my sweet friends and roommates for inspiring me and listening to my endless stories about the project, to my family for the unconditional support, and to my boyfriend for keeping me smile and for the motivational speeches.

Enjoy the reading!

Jozine Bouma

EXECUTIVE SUMMARY

The project is about how to engage consumers in the transition from a linear towards a circular economy in which we make more efficient use of materials and resources.

One of Philips' objectives for 2020 (Philips.com, 2016) is that 15% of the turnover should come from solutions that meet Circular Economy principles. This was 8% in 2015 (Philips.be, 2016) which is a big change for a company.

Senseo has an estimated installed base of around 80 million products. This is due to the huge success of the product since its launch in 2001. In 2012 a Senseo could be found in 60% of Dutch, and 27% of French households (Expatica.com, 2012). Besides, Senseo is the best sold product in the coffee business of Philips, mainly because its ease of use (Senseo.nl, 2018). Because of the high volumes and high distribution in the Netherlands and surrounding countries, an opportunity is found for creating much circular impact with the Senseo.

However, companies cannot shift to a circular economy alone: consumers are crucial in the success of the circular economy. Because even if a product is designed to circulate in a closed loop, its potential will only be realized if the consumer participates. Therefore, the goal of the project is to activate consumers to engage in the circular economy with a case study in Senseo coffee machines.

Senseo users can show circular behavior by taking good care of the product and by repairing it when it is malfunctioning, for extending the product's lifetime. At the end-of-life of the product, the user can contribute by disposing the product at proper recycling points in order for the materials to be reused.

The outcome of the project is by integrating connectivity in the product (the internet of things, IoT), circular behavior among consumers can be stimulated and circular impact can be achieved.

Two main findings of the analysis are:
1. Need for support at the point of malfunctioning
2. After-sales data gaps

Connectivity (IoT) can contribute to these findings as follows (Figure 1). Connectivity can improve support because it facilitates easy access. The support stimulates circular behavior because users that receive support are encouraged and more likely to solve the problem instead of replacing it. By registering the product, users data can be gathered. This enables a virtuous circle because with the gathered data the support can be based on customer segmentation (e.g. demographics) and users can receive more customized support.

This corresponds to the Utopian vision that by means of a connected service, the Senseo has an unlimited lifetime and any of its parts can be replaced. Of course this is an ideal situation from an environmental perspective which cannot be achieved on the short term. By creating a roadmap, steps are proposed that contribute to getting closer to achieving this vision.

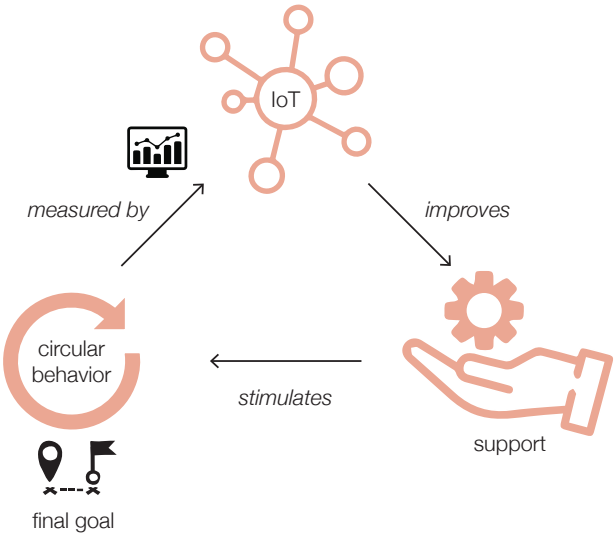


Figure 1: How IoT can contribute to the circular economy

TABLE OF CONTENT

STORY

Carla has a Senseo coffee machine. She uses it every morning before she goes to work. At some point Carla notices there is less coffee coming out of the machine. It still works, but not properly anymore. It might be time for a new one, because she already uses this Senseo for 4 years. The only thing Carla wants is a good cup of coffee in the morning, and therefore she orders a new coffee machine online. She puts the old Senseo in the attic because it is not really broken and it does not feel good to throw it away. It is not the first device to end up there (Figure 2). In the meantime she is happy with her new coffee machine that works perfectly fine.

A year later, she finds her old Senseo again in the attic, completely dusty and dirty. It looks very unattractive to use. Yet Carla still does not really know what else to do with it, so she leaves it where it is.

Relatable?

Figure 2: Attic of Carla with electronics stock

INTRODUCTION

DESIGN CHALLENGE

This story is relatable to many Western people. Whether it is for a coffee machine, a vacuum cleaner, kettle, mobile phone, toaster, or an iron: almost everybody recognizes the situation of an obsolete (definition in pink box) or malfunctioning product which is not completely broken.

A company that has been producing certain consumer products for over a century is Royal Philips. The CEO of Royal Philips China Andy Ho (2018), states that the Philips brand stands for quality. In addition, according to a study conducted on a global level by Philips on brand repositioning and communications (BCS, n.d.), consumers believe that Philips products are reliable and that Philips produces high quality products and services.

Therefore, it is not logical that people so easily give up on a product. It would be more logical if people associate quality brands with something you repair or maintain in case of malfunctioning. This throwaway mentality slowly became part of Western society (Cooper, 2013) and led to environmental challenges such as global warming, dealing with electronic waste, and the depletion of natural resources available on our finite planet.

Luckily, there are movements and organizations that react. One solution is the shift from a linear to a circular economy (CE), visualized in Figure 3. In a circular economy natural resource consumption and economic growth are decoupled in businesses while driving greater competitiveness (Ellen MacArthur Foundation, 2014).

As a large multinational, Philips has influence on this transition by adjusting the current business. Therefore,

DEFINITION

The following definition is retrieved from a study of Den Hollander, Bakker & Hultink (2017).

A product becomes **obsolete** if it is no longer considered useful or significant by its user (Burns, 2010). All **obsolescence** ultimately is a loss of perceived value (i.e., desire or affinity) of the product and/or system, triggered, in some instances, by reduced functionality at the product and/or system side (Box, 1983).

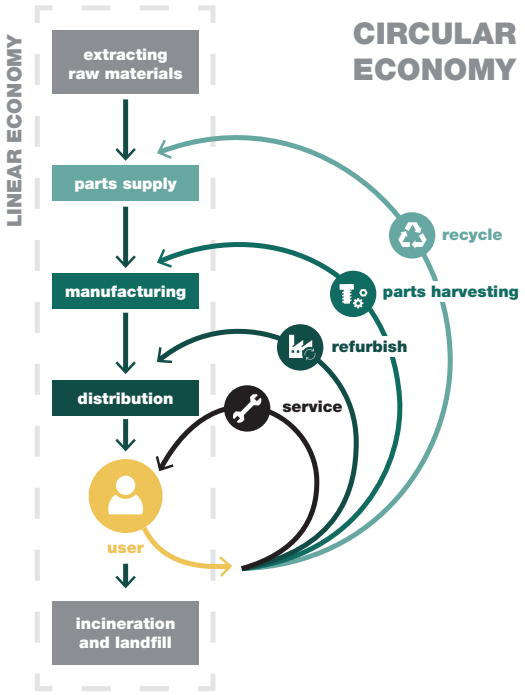


Figure 3: Linear and circular model of finite materials, based on the Butterfly Model of the Ellen MacArthur Foundation

it is now committed to accelerate in the transition to a circular economy. However, companies cannot shift to a circular economy alone: consumers are crucial in the success of the circular economy. Because even if a product is designed to circulate in a closed loop, its potential will only be realized if the owner returns it. In addition, the consumer is responsible for product care. If the user maintains or even repairs the product, the product's lifetime can be extended.

Therefore, the project goal is:

To activate consumers to engage in the Circular Economy

The scientific knowledge shortage to achieve this goal is a solution that enables and stimulates consumers to make circular decisions in practice without forcing it. Many related studies are theoretical and focus on products to be "circular-ready". But without the consumer, circular-ready products will not reach their potential.

Figure 4 shows an overview of the challenge including the current situation and desires of both Philips and the consumer. The figure shows how everything comes together with the design.

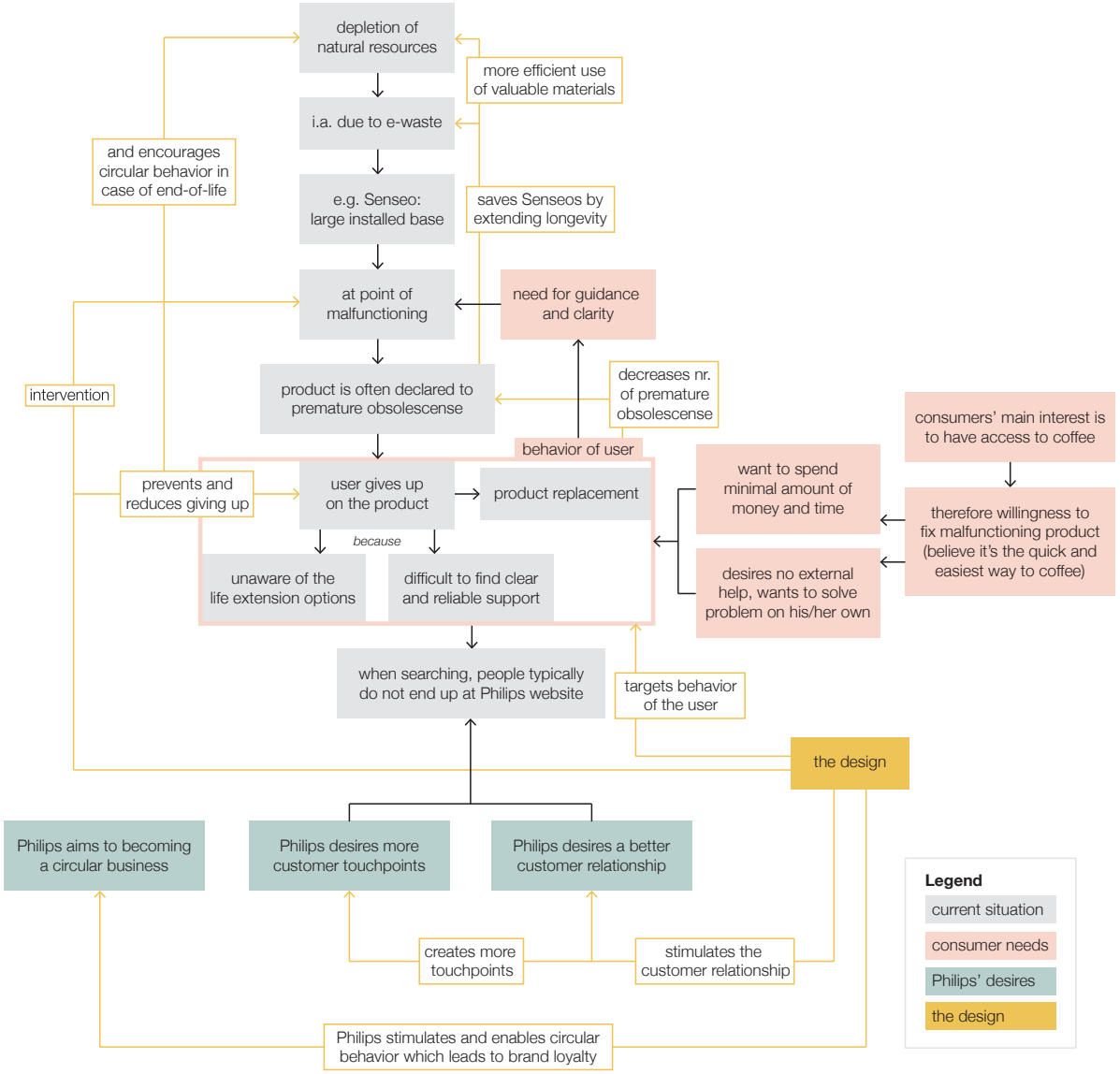


Figure 4: Project structure and overview of the current situation, stakeholder desires, and effects of the design

SCOPE

The focus of this project is on the user experience and on the inner loops of the circular model (Figure 3). The product scope of this project has been defined in consultation with Philips as: low-end unconnected appliances in B2C markets for long-term use in the Netherlands:

- Low-end meaning price ranges <100 euro;
- Unconnected means products that are currently without data exchange between the product and its environment, manufacturer, user, and other products and systems;
- Long-term use means products that are bought with the intention to use it for at least one year.

This product scope is chosen for the following reasons. Connected products are upcoming and relatively new. Still, a high share of the Philips consumer products is unconnected and cost under 100 euro. Therefore, **a solution has to be found to deal with the unconnected products still produced in high numbers within the current business model**. For those products it seems more difficult and challenging to engage the customer regarding low visibility of products after sales and replaceability of low-end products.

CASE STUDY SENSEO

For this project a case study is done as a research method to enable in-depth and detailed examination of the assignment. This will result in a more tangible and practical assignment.

The Senseo coffee machine was selected by Philips Design as case study for this project because internal research on Senseo has been executed by Group Sustainability. Also the Circular Design Team at Philips Design is working closely with the Coffee Business simultaneously with this graduation project. It is a convenient choice for sharing resources, findings, and network connections between all parties.

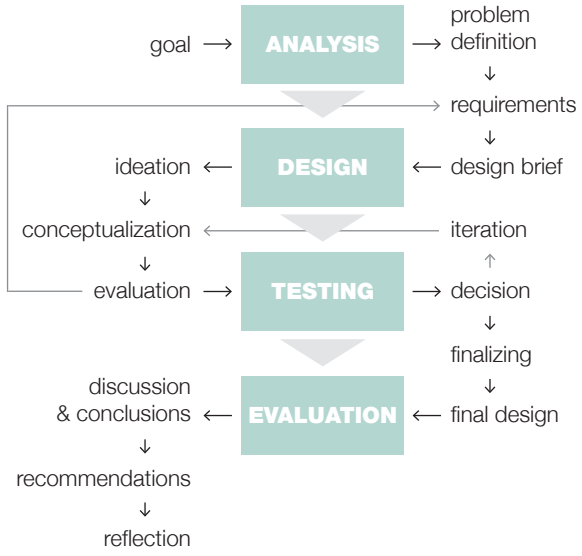


Figure 5: The design process

Senseo is an interesting product to focus on as in the first ten years after the introduction in 2001 over 33 million Senseos have been sold already (Expatica.com, 2012) resulting in a large installed base.

DESIGN PROCESS

The process is illustrated in general terms in Figure 5. The four blocks in the middle of this figure are the main parts that can also be found as a guide in the report. The outcome of this project is the design of a product-service system that stimulates consumer engagement in the CE.

> Arnold Tukker (2004) defined a product–service system (PSS) as "consisting of 'tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs'".

PROJECT STAKEHOLDERS

The project is executed at Philips Design at the High Tech Campus in Eindhoven. At Philips there are three project stakeholders with different interests in this project:

- Strategic Design Team: The interest of this team is to align all company objectives with the businesses. Circular economy objectives are a subset of those company objectives;
- Circular Design Team: Testing circular design methodology and support circular innovation in the Coffee Business in which they are operating;
- Group Sustainability: Beneficial for deepening knowledge and sharing insights.

Project stakeholder at the TU Delft is the Circular Economy Research Team including PhD candidate Flora Poppelaars. Her research project is about improving consumer participation in closing loops with a focus on the development of circular products, services and systems. Findings from this graduation project can contribute scientifically to this research project.

Collaborations with the different project stakeholders are mutual beneficial as the project will provide first insights in how a system can motivate customers to behave more circular, and the teams can share their knowledge and insights to enrich the project.

The project contributes to other designers and engineers who are eager to integrate circularity in their designs by leading them through critical thinking and complex considerations.

GLOSSARY

AR = augmented reality
B2B = business to business
B2C = business to consumer
BLE = bluetooth low energy
CE = circular economy
EMF = Ellen MacArthur Foundation
EoL = end of life
E-waste = electronic waste
IoT = internet of things
IW = in warranty
JDE = Jacobs Douwe Egberts
MCU = microcontroller unit
NFC = near field communication
OOW = out of warranty
PSS = product-service system

PROBLEM

Consumers are not engaging enough in the CE which disables companies as Philips to close the loop and operate as a circular business.

ASSIGNMENT

To design a product service system that activates consumers to engage in a circular economy to enable Philips to become more circular.

RESEARCH QUESTION

How to stimulate Senseo consumers to engage in a circular economy at the point of malfunctioning?

DELIVERABLE

The deliverable is a PSS focused on customer involvement in contributing to a CE. The designed service stimulates consumer engagement.

ANALYSIS

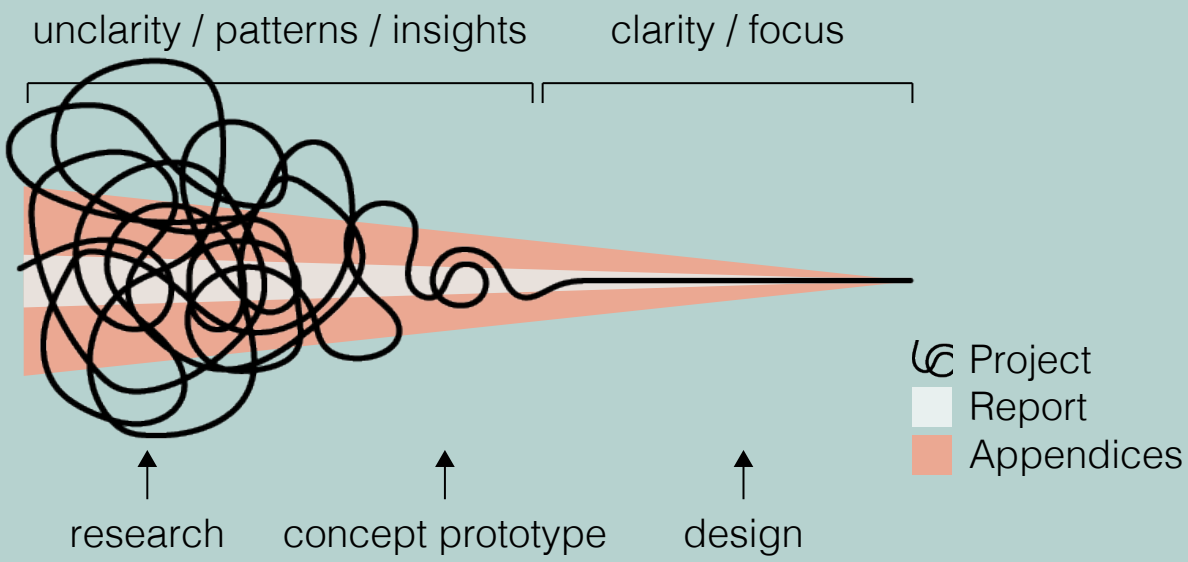


Figure 6: Visualization of the project process

The first part of the project consists of an analysis to identify the key problem. Therefore, the general context of the problem is studied on global challenges. In addition, Philips and its transition towards a circular economy is analyzed as well as relevant consumer trends and technological developments.

Besides, the impact of Senseo and the business around it is studied. The analysis phase ends with studying the Senseo users, their experiences, and behavior. The goal of the analysis was to find opportunities and consumer needs to be fulfilled.

The analysis phase provides insights that help to frame the design brief. Each chapter ends with conclusions on what the findings mean for the project. The last chapter of this part discusses the main insights and functions as the starting point for framing the design brief.

1 UNDERSTANDING THE CONTEXT

The first chapter serves as an explanation of the problem context to better understand the design challenge. The two most important stakeholders in this project are the user and Royal Philips. The environment is also perceived as a "stakeholder". The problem contexts of those stakeholders are introduced in this chapter as well as the concept 'circular economy'. Lastly, trends and developments that are relevant for this project are discussed. Studying the context helps to define the key problem and to find gaps and opportunities for Philips to make an impact.

1.1 GLOBAL CHALLENGE

Since the beginning of the industrialization in the 18th century, we take part in a linear economy where we consume and discard products. Products are designed for short life times as if our planet has an unlimited supply of resources. Especially in Western countries, the throwaway mentality has become part of the society (Cooper, 2013). In this so called 'take-make-dispose' system it is often cheaper and more convenient to buy a new product than to have a product repaired (Watson, 2008).

Since a few years some people start realizing that we are living on a finite earth and resources become scarcer. In a discussion group organized by Stichting Klimaatgesprekken, Rotterdam lead Lynn Vanheule (2018) stated that 74% of the Dutch population is worried about the environment of which 13% actively takes action (for example by being vegan). The highest contribution to CO_2 footprint in the Netherlands comes from products we buy (food excluded).

1.1.1 E-WASTE

One problematic form of waste is electronic waste (e-waste) since it is one of the fastest growing waste streams (Europa.eu, 2012). What e-waste exactly is and why it is a problem is illustrated in the infographic on the next page. E-waste includes almost any household or business item with circuitry or electrical components with power or battery supply (Baldé, et al., 2017) (examples in Figure 7). For the production of electronic devices harmful toxins are often used. E-waste is often being shipped to developing countries where it ends up at landfills for incineration which is extremely harmful to the health of adults and children that are working on those landfills. E-waste is not only harmful to human health, but this consumption behavior and the way of dealing with e-waste largely contributes to the depletion of resources available on our finite planet.

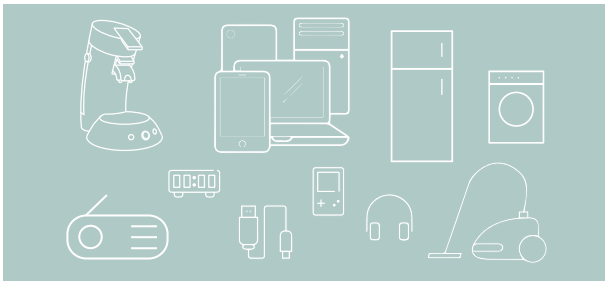


Figure 7: Examples of e-waste

With a fast growing world population it is crucial to change the current unsustainable Western lifestyle because we, Western people, are currently using the resources of 1.7 earths (Figure 8) and this number is moving fast to become 2 earths by 2030 (Sengupta, 2017).

Figure 8: The amount of earth resources we use according to Sengupta (2017)

By shipping e-waste to other countries, the problem is "out of sight out of mind". This makes it especially difficult for consumers to be aware of their harmful behavior, whilst they are not confronted with the problem. Luckily, the European Union takes her responsibility and set e-waste collection targets for all the EU Member States in the WEEE Directive (2012/19/EU). This directive regulates e-waste management in the EU (Baldé, C.P. et al., 2017).

The current statuses and trends concerning e-waste are illustrated in three infographics in appendix A to explain the problem and its context on three different scales: global, Europe, and the Netherlands.

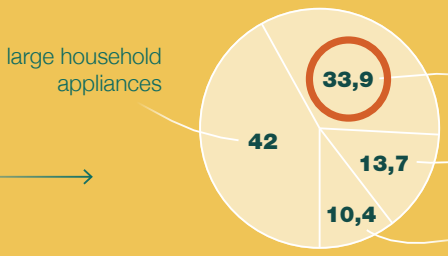
In the infographic on the next page the numbers to be tackled in this project are highlighted in orange. Philips as a large multinational can influence these numbers by adjusting the current business.

WHAT'S E-WASTE
AND WHAT IS THE BIG DEAL?

E-waste (electronic waste) or **WEEE** (Waste Electrical and Electronic Equipment) refers to "all items of EEE and its parts that have been discarded by its owner as waste without the intent of re-use" [6]

E-waste includes almost any household or business item with circuitry or electrical components with power or battery supply [6]

Contribution to e-waste in % [2]



Billions of kilograms of e-waste is shipped to developing nations [4]

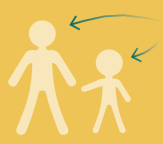
CHINA
INDIA
GHANA
and other developing countries [4]

The disposal methods used in those countries are extremely polluting and damaging to humans [4]

+

Valuable materials go to waste which contributes to the depletion of earth's finite resources

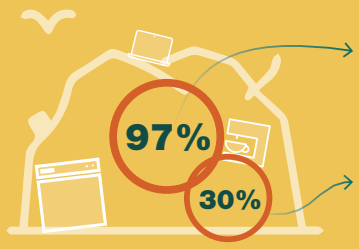
Both adults and children work at e-waste dumps risking their health and wellbeing [4]



highly exposed to toxins

€1,25
daily salary

Greenpeace documented children working with e-waste, mostly boys between the age of 11-18, but some were only 5 [7]



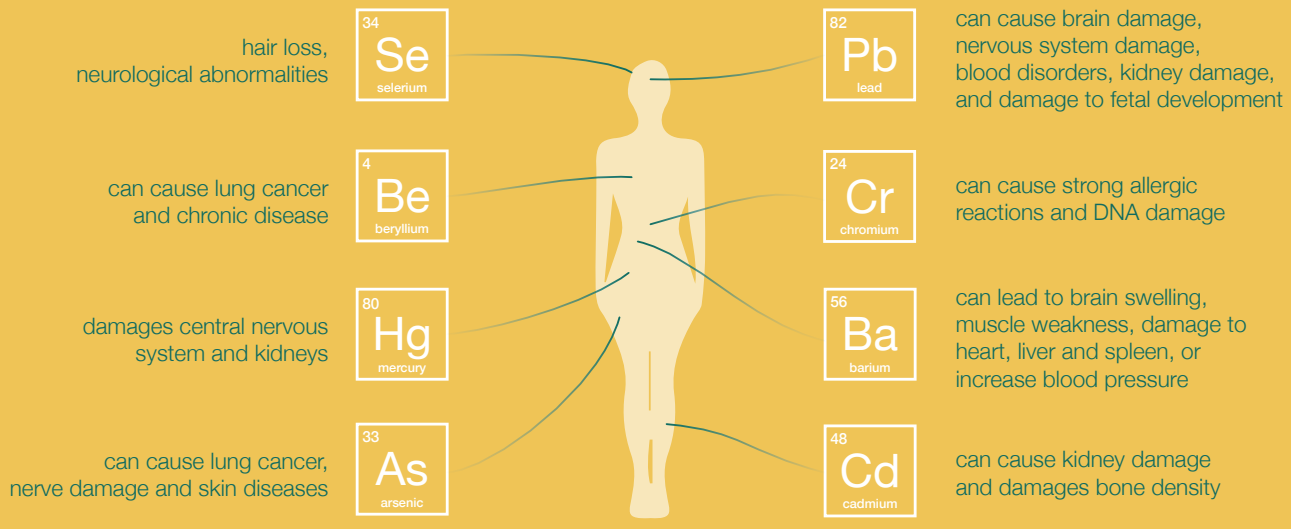
of the electronic devices in landfills are actually usable [5]

of the disposed items can be resold immediately as they are [5]

"Unused products sitting at home still harm our planet because more precious materials are stripped from earth instead of being recycled from unused electronics"

- L. Nyugen (2016)

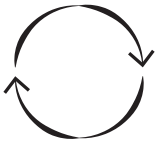
A few of the toxins used in electronic devices [1] and the damaging effects on humans [2, 3]



SOURCES
1. EdLab (n.d.); 2. Huchchannavar, R. (2014); 3. Sankhla et al. (2016); 4. Nguyen, L. (2016); 5. HelpSaveNature.com (n.d.); 6. Baldé, C.P. et al. (2017); 7. Kuper & Hojsik (2008).

1.2 CIRCULAR ECONOMY

The good news is, it is not too late to make a change and there are solutions for the global challenge. As mentioned before, one solution is to shift from a linear to a circular economy (CE). This means that products are being maintained, reused, refurbished, or recycled to enable multiple life cycles in consumer use.



"In a CE, the economic and environmental value of materials is preserved for as long as possible by keeping them in the economic system, either by lengthening the life of the products formed from them or by looping them back in the system to be reused." according to den Hollander, Bakker & Hultink (2017).

In 2010 the Ellen MacArthur Foundation (EMF) was launched with the mission to accelerate the transition to a circular economy (ellenmacarthurfoundation.org, 2017). Since then the foundation became a global thought leader and works with businesses, governments and academia.

The EMF drove the CE to becoming an emerging business trend. It is even referred to as one of the biggest business opportunities of this generation (WBCSD, 2017) as, according to a study of Accenture (McGuinness, 2015), the CE could generate $4.5 trillion of economic growth by 2030. E-waste offers great opportunities to making secondary raw materials available on the market (Europa.eu, 2012). Those raw materials in e-waste had a potential value of €55 billion in 2016 (Baldé, et al., 2017). The CE is called a future cornerstone for companies.

Nevertheless, the shift to a circular economy faces challenges in production, design, consumer behavior, and in logistic systems. The transition requires whole new system thinking and will evoke drastic changes in the current economy.

1.3 ROYAL PHILIPS

Royal Philips is a 127-year-old Dutch company which recently transformed from an electronics and lighting company into a health technology company with sustainability at the core of the company's vision (fortune.com, 2018). In 2017, Philips employed approximately 74,000 employees and operates in more than 100 countries (Philips.com, 2018a).

Philips has three business clusters: "Personal Health", "Connected Care & Healthcare Informatics" and "Diagnosis and Therapy" (Figure 9). This graduation project is executed for the Personal Health division.

Innovation is at the core of Philips' mission which is described as "to improve lives of billions by making the world healthier and more sustainable through innovation" (Philips.com, 2018c). Part of the company strategy is to be a pioneer in innovation and technology. For that reason, Philips became global partner of the Ellen MacArthur Foundation and as a global partner, Philips is committed to accelerate in the transition to a circular economy. Together they are exploring the potential of the circular economy as a source of value creation on strategic level.

Several circular initiatives took place in the Personal Health cluster, examples are provided in appendix B including a vacuum cleaner produced with recycled plastics. What these initiatives have in common is that they are all in its infancy and focusing on products to be "circular-ready". What is missing in these initiatives is a solution that enables and stimulates consumers to make circular decisions, because without the consumer, circular-ready products will not reach their potential. This potential can be reached when focusing on the opportunity areas discussed in §1.3.4.

1.3.1 COMPANY VISION

CEO Frans van Houten launched a five-year sustainability program in 2016 named 'Healthy people, sustainable planet' (Philips.be, 2016).

In 2012 Philips set a target to "improve the lives of 3 billion people a year by 2025 by making the world healthier and more sustainable through innovation" (Philips.com, 2016). The company is on track to achieve the goal.

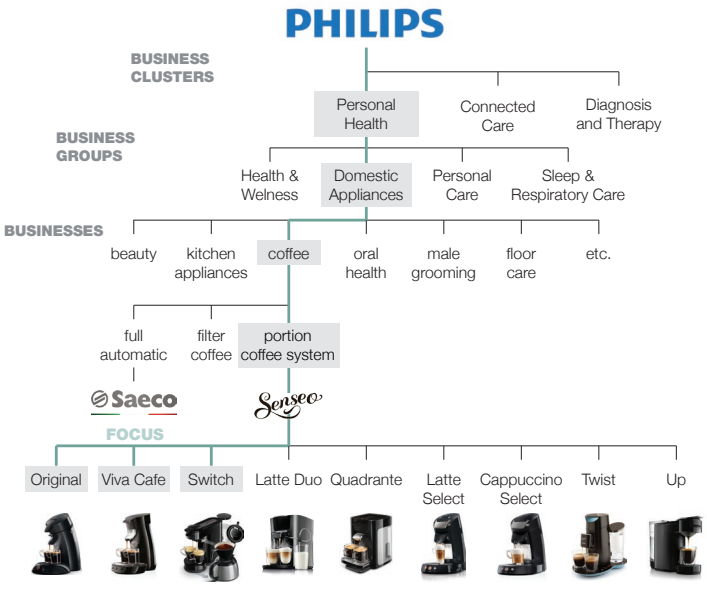


Figure 9: Structure Philips, note: this overview is specified for the Coffee Business and not a complete overview

In addition, Philips is shifting from a product-oriented company to a service-oriented company (Meuffels & Jaartsveld, 2017) which can be beneficial in the transition to a circular economy while it offers new opportunities.

1.3.2 OBJECTIVES FOR 2020

One of the ambitious objectives of Philips for 2020 set by Frans van Houten (Philips.com, 2016) is that **15% of the turnover should be coming from solutions that meet Circular Economy principles**. This was 8% in 2015 (Philips.be, 2016). This requires major changes and this project studies how the business can be stimulated in order to come closer to achieving the objective.

1.3.3 B2C CHALLENGES IN THE TRANSITION TO A CE

Although Philips had some circular breakthrough innovations in B2B markets (e.g. Philips Refurbished Systems) the company encounters challenges in B2C markets when it comes to the transition to a CE for two main reasons:

- B2B models usually deal with high value products which makes asset management easier in comparison with B2C models (Rashid, Asif, Krajnik & Nicolescu, 2013).
- There is limited consumer awareness of the CE and many consumers find value in owning the latest or fashionable items (Oliver Wyman, 2017).

"The scientific and research basis of the CE approach seems to be only in its infancy" (Korhonen, Honkasalo & Seppälä, 2018) but this should change soon regarding CE for B2C businesses to meet the company objectives for 2020.

In the linear economy the customer is responsible after sales or at least after the warranty phase. Because there is a whole piece of consumer engagement missing after sales for unconnected products, Philips **CONFIDENTIAL** portfolio ends up after 5 to 10 years and it most likely ends up on landfills (Shahbazi et al., 2018). There is no track record of how consumers take care of their products and where products end up. There is an option for customers to register a Philips product, but **CONFIDENTIAL** Subsequently, Philips has little influence on consumer behavior and it is complex to look at the potential of for example parts harvesting or refurbishment of consumer goods because that requires a take-back loop or another clear end-of-life system. Philips is facing challenges with getting Senseo users to register their products and wants to increase this number for user data collection (Shahbazi, 2018).

1.3.4 CIRCULAR OPPORTUNITY AREAS

Considering the limited consumer awareness of the CE, and the limited consumer engagement after sales, circular opportunities can be found in enabling and stimulating consumers to make circular decisions. For this, good use can be made of the fact that Philips is shifting from a product-oriented company to a service-oriented company. Consumers can become more engaged in two areas:

Extending longevity

By extending longevity of a product, the product can be used for a longer period by the same consumer. If a product is used longer, customers are less likely to buy a new product and therefore less virgin material needs to be extracted for production of new products. Extending the product's lifetime can be realized by looking into maintenance or repair.

Here is a paradox: if customers buy less new products, this results in less revenue for Philips which makes it unattractive for Philips to invest in lifetime extension. That is a barrier for Philips in the transition to a CE. Where is the value for Philips? This will be further discussed in §2.2.1.

The challenges here are to make product lifetime extension profitable, to motivate users to take care for their products, and to stimulate people to repair a product rather than dispose.

Disposal at end-of-life (EoL)

Even though recycling rates are high for Senseo (once arrived at proper recycling companies), designing the right customer support at the EoL is still relevant. According to Eelco Smit (2018) the number of returned (to recycling companies) and recycled Senseos in relation to the installed base is low. Additionally, the percentage of materials that can get recycled per Senseo once collected is high. The more collected products, the higher the potential for parts harvesting and refurbishing as the amount of products should be high enough to be profitable.

Therefore, product disposal at proper recycling points is essential in the realization of circular potential.

1.4 TRENDS AND DEVELOPMENTS

As mentioned, the CE is an emerging business trend on its own. This paragraph discusses current trends and developments that are more specific and relevant to this project regarding technology trends and consumer trends. The selection of the discussed trends is based on their potential for circular impact.

1.4.1 TECHNOLOGY TRENDS

Digital centralization

Due to the rise and growing popularity of smart devices (e.g. smartphones, smart watches, tablets, and smart TVs, Figure 10) the consumer habits and preferences changed too. Consumers have become reliant on lots of apps for in their daily lives, according to Jayson DeMers (2017), Founder & CEO of AudienceBloom.

DeMers also states that consumers are now craving digital centralization. This means that they are looking for convenient ways to manage basically everything from a minimal amount of devices. According to Luc Geurts (2018), creative innovation lead at Philips

Figure 10: Smart and mobile devices (Preston Mobility, 2016)

NFC: contactless and mobile payments

Another example of the digital centralization is the fact that more and more people are paying with their smartphones (Figure 11). According to Betaalvereniging Nederland (2018), already 500.000 apps are downloaded in the Netherlands for enabling mobile payment. Contactless payments through smartphones are enabled by an NFC chip (Near Field Communication).

Research from Mastercard shows that 27 percent of the Dutch population has payment options through portable devices such as watches, rings and phones (Terra, 2018).

In addition, there has been an increase in the use of Android phones equipped with an NFC chip (Accountancyvanmorgen.nl, 2018).

Figure 11: Mobile payment (Vers Inspiratie, 2017)

Internet of Things (IoT)

Our society becomes more and more connected. An IHS survey estimates there were already 20 billion connected devices globally in 2017 (Newman, 2017). The number of connected devices is expected to grow to more than 40 billion by 2020 (Ellen MacArthur Foundation, 2016).

According to the European Environmental Agency (2017), IoT can lead to circularity in several ways: If products can communicate information about the materials or about the manufacturer, the material recycling can be significantly improved. In addition, the Ellen MacArthur Foundation (2016) mentions that manufacturers can use the information generated by the product during its life-cycle to further improve its design. Another example is that through connected devices the product performance and use efficiency can be measured which makes it possible to predict when the product needs to be maintained to ensure optimal performance quality (EEA, 2017).

A downside of integrating IoT in products is that the IoT trend contributes to increasing product complexity (Kemps et al., 2016) by adding sensors or other electronic components. This will reduce the product's reuse and recycling potential (European Environmental Agency, 2017).

Modular design

According to EEA (2017) modular design is a relatively new and niche trend in the consumer electronics sector. Examples of modular design in practice (Figure 12) are Fairphone (2018), Gerrard St. (2018), and Blocks (2018). According to Jo Best (2016) Google is running a project 'Ara' which is working on an Android-style ecosystem for hardware where manufacturers make modules for smartphones (for example cameras or memory) that can be (re)placed in and out of the phone.

If the modular design trend grows, it could extend the lifetime of products because it can simplify product repair (EEA, 2017). One requirement for modular design is that replacement parts need to be available to the user.

Figure 12: Fairphone (2018), Gerrard St. (2018), Blocks (2018) (from left to right)

Augmented Reality (AR)
Augmented Reality (Figure 13) is defined by Margaret Rouse (2016) of TechTarget as:

"The integration of digital information with the user's environment in real time. Unlike virtual reality, which creates a totally artificial environment, augmented reality uses the existing environment and overlays new information on top of it."

For consumer markets Augmented Reality is a more obvious choice then Virtual Reality (VR), because VR requires additional electronic devices (e.g. VR glasses) and AR can be used by everyday devices as a smartphone or tablet and is therefore more accessible.

In 2015, Snapchat boosted AR by introducing facial filters (van Gent, 2018). Instagram and Facebook followed quickly. In 2016, Pokemon Go gave AR another boost leading to more familiarity with the technique among consumers.

According to Antoni Zolciakvp of Insanelab (2018) AR technology is growing rapidly. He also mentions that businesses are looking into developing mobile AR strategies because the smartphone is becoming the mainstream consumer platform for AR features.

AR technology is an interesting business opportunity for Senseo because the technology is improved day by day and according to Bhagat (2018) AR can provide more engagement to users. AR can for example guide and support customers when they encounter problems with their Senseo.

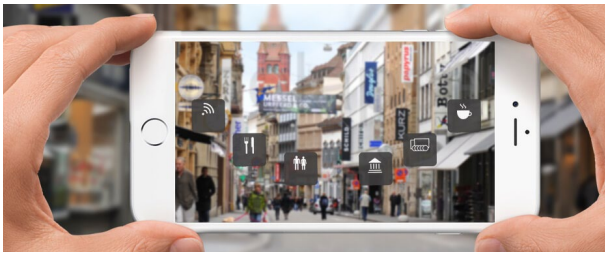


Figure 13: Augmented Reality (ITFirms, 2017)

1.4.2 CONSUMER TRENDS

Growing need for support
There is a growing need visible for support regarding repair, instructions, and tutorials. This might be a result of the rise of the conscious customer (KPMG, 2018). New companies emerge as a response to this consumer pull (e.g. Repair Café) and the amount of repair instructions and platforms are rising up too (e.g. iFixit, repareer.com).

There are even initiatives especially for the repair of Senseos. OnderdelenSenseo.nl for example is proof for a clear need for repair with 15.000 satisfied customers and a 9.1 rating on their website (2018). This website helps consumers to find the problem of their malfunctioning Senseo. In the webshop Senseo parts are being sold and the website shows instruction videos that explain how to fix the problem. The problem with OnderdelenSenseo.nl is that dangerous reparations are encouraged which is a safety and liability risk for Philips.

What is striking about these initiatives is that they are focused on solving problems at home by yourself. Yet there is also another initiative that is growing in popularity: Repair Café.

Repair Café
The concept of Repair Café is that people bring any broken product that can be carried for reparation to a local Repair Café. For this service people pay a voluntary contribution of €2,50 (Vermoolen, 2015). This concept brings people in local communities together. According to the website there are currently 1562 Repair Cafés worldwide (repaircafe.org, 2018).

Senseo is the most brought-in electronic product at Repair Cafés in the Netherlands with a high repair success rate of 77% in 2017 (Martine Postma, 2018). The rest of the products often cannot be repaired because it is too expensive or too difficult to get a spare part (Natuur & Milieu, 2018).

Figure 14: Broken Senseos waiting to be repaired (Credits: Martin Waalboer / Stichting Repair Café)

It has been found that Senseo coffee machines are on top of the list of repairable domestic appliances in the Netherlands (Graag Gedaan, 2014). The result is that hundreds of Senseos are brought to Repair Cafés (Figure 15). Therefore, dozens Repair Cafés organized special 'Senseo Days' (repaircafenijmegen.nl, 2014). According to Nico, a volunteer at a RC in Delft (2018)most Repair Cafés have at least one "Senseo Expert" (appendix C for the interview). There is even a Senseo-workgroup at Repair Café that created a Senseo Repair Guide. See appendix D for a more extended study on Repair Café and Senseo. Repairing electronic domestic appliances might still be a niche, but it is increasing in popularity.

Increase in willingness to pay for sustainability

According to a study by The Nielsen Company (2015) among 30.000 consumers in 60 countries, are people increasingly willing to pay more for sustainable brands from 50% (2013) and 55% (2014) to 66% in 2015. *"An increasing number of consumers in developed regions consider sustainability actions more of an imperative than a costly value-add."* says Grace Farraj, Senior Vice President of Public Development & Sustainability at Nielsen.

But who are the people that are willing to pay more for sustainability? The study found that Millennials are the most willing to pay extra: almost 3/4 in 2015 (approximately 1/2 in 2014). The willingness among Gen Z (under 20) increased strongly from 55% in 2014 to 72% in 2015. Lastly, 51% of the Baby Boomers (50-64) are willing to pay extra (44% in 2014).

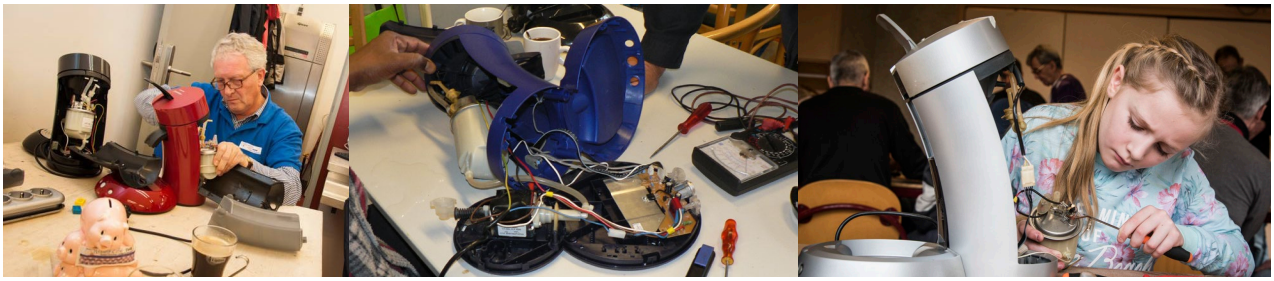


Figure 15: Various pictures of Senseo in Repair Cafés (Credits: Martin Waalboer / Stichting Repair Café)

1.5 CHAPTER CONCLUSIONS

As a large multinational Royal Philips has the capacity to create circular impact which makes this project relevant. For the Personal Health division at Royal Philips potential circular opportunities are found in extending longevity and proper disposal at a product's end-of-life. Therefore, this will be the focus for the project. However, a paradox is found in extending longevity because it might result in less product sales and subsequently less revenue for Philips. The challenge therefore is to find value for Philips and to make product lifetime extension profitable.

Consumers can be engaged in the CE by taking better care for their products and by repairing a product rather than disposing it for lifetime extension, but also by properly disposing products at recycle points at the End-of-Life. Those two aspects will be the focus for this project in engaging the consumer.

A growing need for support among consumers is found at the point of product malfunctioning and many users do not know what to do with their coffee machine when it malfunctions. Besides, consumers are increasingly willing to pay more for sustainable brands. There lies an opportunity for Philips to step in the process and guide customers in decision making at this point and to stimulate lifetime extension and proper disposal.

Regarding technology trends, people are increasingly connected and are making more and more use of smart devices, which is a desired trend for both businesses and customers. For this project digital connectivity is an interesting direction to focus on, especially since it can enable circularity. Lastly, Augmented Reality can induce user engagement and it can be synergistic with customer support. Therefore, this high potential technology will be further investigated in this project.

2 SENSEO ANALYSIS

In this chapter the Senseo is analyzed in its current situation to find where the product and the system around it can be improved in order to become more circular. By studying the product in its current state the focus of the product can be scoped down. Therefore, in this chapter the background, the hardware, the current service system, the business ecosystem, and the competitors of Senseo are analyzed.

2.1 BACKGROUND SENSEO

Senseo is a coffee machine developed by Jacobs Douwe Egberts (JDE) and Philips in a close collaboration. JDE now owns the brand Senseo and Senseo.nl according to a Senseo product developer at Philips.

In February 2001 Senseo was introduced in the Netherlands, and it was immediately a huge success: In the first ten years more than 33 million Senseo machines have been sold and **in 2012 a Senseo could be found in 60% of Dutch, and 27% of French households** (Expatica.com, 2012). One third of the coffee in the Netherlands even came from pads by 2007 (Volkskrant, 2007).

At the time of the introduction of Senseo the coffee market was saturated. But Senseo distinguished itself from traditional filter coffee with a breakthrough innovation: single serve coffee by using coffee pads. This new method saves time and is very easy to use. The taste of Senseo coffee is comparable with filter coffee but the coffee comes with a small layer of foam for a pleasant coffee experience (Figure 16).

Figure 16: Senseo coffee with foam layer (Lathouwers, 2015)

Success factors of Senseo

The great success of Senseo is due to the following factors summed up by Graeme Walburton (2018), Senior Design Lead at the Coffee Business of Philips.

DID YOU KNOW...?

- Senseo is the best sold product in the coffee business of Philips, mainly because its ease of use (Senseo.nl, 2018);
- Senseo is the best known coffee make method with loose coffee pads (Hamer, 2018);
- From 2006 onwards, brands other than JDE can also develop pads for the Senseo (Hamer, 2018);
- The Netherlands makes 6.31 million cups of coffee daily with a coffee pad (Hamer, 2018);
- In every pad there are circa 50 coffee beans (Hamer, 2018).

- Senseo is convenient, easy to use, and low effort;
- Fast, with a filter coffee machine you have to wait longer before you have the coffee;
- With filter coffee the amount of coffee has to be measured which can go wrong (too strong or weak coffee), for Senseo you just pick one pad and you are ready to go (less complex);
- Mess free system, no loose coffee. Simply throw away the pad after use;
- No coffee goes to waste, as one (or two) cup a time is made. Filter coffee machines prepare a whole coffee pot which is often not finished;
- Filter coffee gets cold after a while (because of the amount).

Meanwhile, various competitors started producing coffee pads for Senseo, and other competitors developed their own single serve coffee machines with cups instead of pads. For example Dolce Gusto (collaboration between Krups and Nestlé), Nestlé Nespresso (collaborations with various machine producers), and Tassimo (collaboration with Bosch).

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is based on yearly sales numbers of Original and Viva Café in a study of the Coffee business group (Thomas, 2018) and the assumption that the installed base is seven times the yearly sales number as the lifetime of the device is calculated to be seven years (de Olde, 2018). Consequently, this number is multiplied by 3.5 to account for models that are not studied. The installed base is likely to include Senseo models that are no longer in production. **CONFIDENTIAL** the Senseos was sold in DACH (Germany, Austria, Switzerland), France, or Benelux (Eelco Smit, 2018). The Senseo market is concentrated which offers good post-sales perspectives regarding visibility.

2.1.1 ORIGINAL, VIVA CAFÉ, AND SWITCH

There are nine different models of Senseo. The focus for this project is on the following three models: Original, Viva Café, and Switch (Figure 17).

Those three Senseos require the same form of maintenance since those appliances merely make 'lungo' coffee and are not suitable for making beverages that include milk such as a cappuccino or a latte macchiato. Besides, not all nine models are still in production and the three selected Senseos are. Looking at the sales (Thomas, 2018) and production numbers (BG Coffee, 2018), the chosen three models are among the most popular Senseos.

2.2 BUSINESS ANALYSIS SENSEO

In order to understand the current business around Senseo, the following paragraph analyzes the Senseo business model, the stakeholder ecosystem, and competitors. Retrieved insights will help to understand the limitations to circular initiatives within the current business frame. The study on the current business is executed in collaboration with the Circular Design Team at Philips Design in brainstorm sessions.

2.2.1 BUSINESS MODEL

The current business model of Senseo for Philips (Figure 18) is a transactional business model (product-sales) dependent on selling high volumes. There is no revenue beside product sales (apart from selling some primary spare parts, which have insignificant sales numbers) because there are no service systems for Senseo. The coffee pads are sold by Jacobs Douwe Egberts, thus this revenue goes to JDE. Consequently, there is a low financial incentive

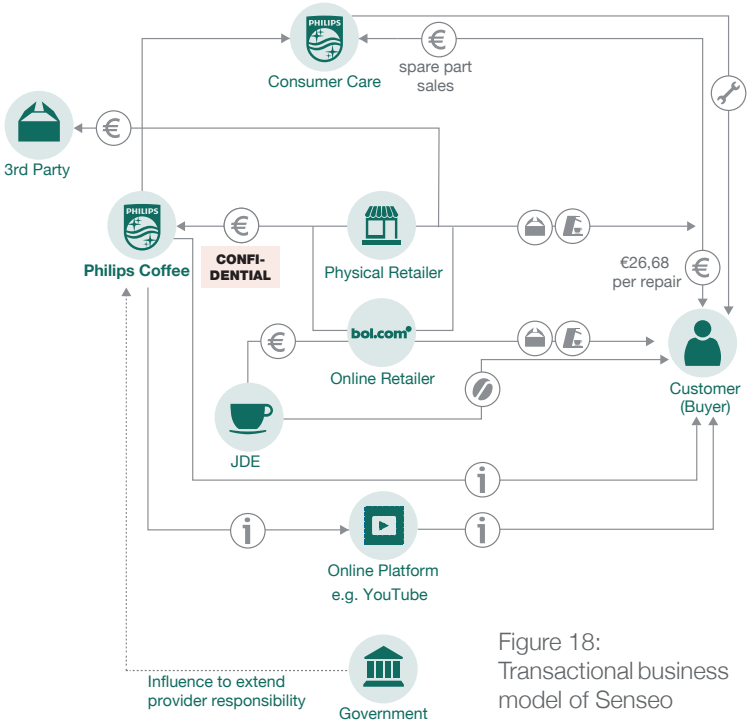

Figure 18: Transactional business model of Senseo

The Senseo **Original** is the first Senseo. An iconic and basic design for simplicity and convenience. The Original is the best sold Senseo (Senseo.nl, 2018).

Viva Café is the latest Senseo. It is most comparable to the Original but contains some extra functions including a descaling indicator and an adjustable spout of metal.

Senseo **Switch** is the first 2-in-1 coffee machine. It is both a filter- and a pad machine. This enables the user to easily 'switch' according to the amount of visitors.

Figure 17: Description of the selected Senseo models

for Philips for products to last. However, according to Eelco Smit (2018), Senior Director Sustainability at Philips, JDE is currently putting pressure on Senseo to ensure a long product life which is a reason for Philips to focus on ensuring long lasting products.

Beside pressure of JDE there is another incentive for Philips to change the current business. According to Emma van der Veen (2018) Consumer Marketing Manager at Philips, an unsustainable business is ultimately fatal. The linear consumption model has its limits. Main drivers for Philips to become a more circular business are:

- **Supply risk**: developed economies annually use more resources than that are sustainable in the long term (Symons, 2016). This logically cannot continue infinitely;
- **Price risk**: business models reliant on virgin materials have the risk of increasing resource prices and supply disruptions. According to Symons (2016), reducing demand for raw materials increase business resilience and cut costs, creates jobs, and supports growth;
- **Support**: Governments today have high priorities for supporting businesses in the transition to a CE and this transition is expected to grow worldwide (Symons, 2016);
- **Regulations**: Regulatory trends as increased carbon or landfill taxes force companies to change their businesses (Ellen MacArthur Foundation, 2015).

In 2017, roughly 11 million Senseos (of all models) were produced in Poland and Romania and approximately 1.5 million are sold yearly in the Netherlands (calculation based on spreadsheets constructed in 2018 by the Philips Coffee Business).

Basic Senseos of the studied models (Original, Viva Café, and Switch) are in low price categories varying from ~€50 to €70 per device. A basic Senseo is a Senseo without extras and additional features. According to the manager of Consumer Marketing Intelligence of the Philips Coffee Business (2018) for each basic Senseo there is a low margin per product

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The low margin on Senseo limits circular business model opportunities, the service, and potential take-back systems (labor intensive). Especially in the Benelux, where labor costs are relatively high, services and other systems often are too costly and not beneficial. Therefore, automated service systems is an interesting opportunity area. Another consequence of the low margin is that no major adjustments can be made to basic Senseos as the financial consequences are too big. A consideration for this project is that i**f the retailer is skipped and there are more direct sales, the rest of the margin would go to Philips instead of the retailer.**

2.2.2 STAKEHOLDER ECOSYSTEM

By exploring the stakeholders involved in the coffee ecosystem more insight is gained on the broader scope opportunities and developments outside of Philips. The stakeholder ecosystem is based on desktop searches, common knowledge, and personal experiences of participants in the brainstorm session with the circular design team at Philips.

The first notable insight when looking at the visualized stakeholder ecosystem in appendix E is how extended it is compared to the simple business model (Figure 18). It shows a broad market with lots of different parties. Most remarkable is the rising amount of repair initiatives and instruction platforms as discussed in §1.4.2.

As a consequence of the extended ecosystem there is a lack of an organized flow and a consumer need for orchestration. Because there are so many options it is confusing and it costs effort to find reliable sources and possible solutions. There are even initiatives responding to this: Repareer.com provides a platform where local repair shops and experts can be found on one website.

2.2.3 COMPETITOR ANALYSIS

To find gaps and opportunities for Senseo, this paragraph is about how Senseo positions itself compared to its competitors regarding circularity and other main business advantages. To understand who the direct competitors are, an overview of competitors in different categories is created (Figure 19). Subsequently this study focuses on the inner circle with the direct competitors in the single serve coffee category.

Figure 19: Direct and indirect competition of Senseo

Circular initiatives

By comparing the competitors regarding circular activities (Figure 20) it is seen that Senseo distinguishes itself with the biodegradable coffee pad. All other direct competitors use capsules made of plastics and/or aluminum. The high amount of single serve waste created by the competitors has a big impact on the environment. Since consumers are increasingly worried about the environment (Vanheule, 2018) this became a risk for the capsule businesses. In 2016, the media even started writing about it (Figure 21) and according to a study of JDE for project EARTH in 2018, consumers confirm that waste of capsules is a barrier for them to buy a single serve coffee machine. Competitors are working hard trying to solve this image problem, mostly by starting capsule-recycling programs. However, they are not the only once responding to this trend: new start-ups are trying to sell reusable capsules or products to craft your own capsules, for example Capsulier.com (2018).

In conclusion, Philips and Senseo have a great starting point and competitive advantage when it comes to circularity of the pads. Where competitors mainly focus on solutions to make the capsules more sustainable, Philips focuses on making the machine and the system circular.

The waste of capsules are a daily recurring confrontation, but the end-of-life of the machine only occurs once in a few years. Therefore, the consumer is less confronted with and focused on the impact of the machine than on the impact of the packaging around the coffee. The challenge for Philips is to make the consumer aware of this and of the fact that the machine itself also has a circular impact.

Business advantage

In appendix F the main business or competitive advantages of the four most popular single serve coffee machines (according to Boyd, 2018) are studied including Senseo. This study is conducted to find how Senseo positions itself compared to its main competitors. Consequently, opportunities can be determined about which advantages or benefits could be used and considered in the design.

Senseo is found to be the most affordable machine. This is a reason for consumers to choose Senseo instead of competitive models and should therefore be retained. Besides, Senseo is chosen for its simplicity and convenience in use. This could be amplified in the solution by for example service design. Furthermore, Senseo has a wide distribution network (mass distribution and online) which makes Senseo widely accessible.

MACHINE BRAND	PHILIPS	KRUPS / magimix / DeLonghi	BOSCH	KRUPS	KEURIG	Verismo
COFFEE BRAND	Senseo	Nespresso	Tassimo	Nescafé Dolce Gusto	GMCR	Starbucks
PAD TYPE	Pad	Capsule	T-disc	Capsule	K-cup	Capsule
MACHINE						
CIRCULAR INITIATIVES	**Coffee** Biodegradable pads [1] **Machine** Senseo UP produced with 13% recycled plastics [2]	**Coffee** Large scale recyling program with 'recycle bag' to collect capsules for aluminium recycling [3] **Machine** No initiatives	**Coffee** Small scale recycling program with collection points in UK, partnership with TerraCycle, raising money for charity [4] **Machine** No initiatives	**Coffee** Recycling program Terracycle to upcycle waste in various products [5] **Machine** Claims to work on energy efficiency, materials recyclability and material reduction [6]	**Coffee** Planning to make K-cup 100% recyclable by 2020 [7] **Machine** Claims to work on take-back loops with retailers for refurbish-ment and recycling [8]	**Coffee** Starbucks makes an effort to have recyclable pods, but they are far behind their competitors [9] **Machine** No initiatives

Figure 20: Analysis of direct competitors regarding circularity

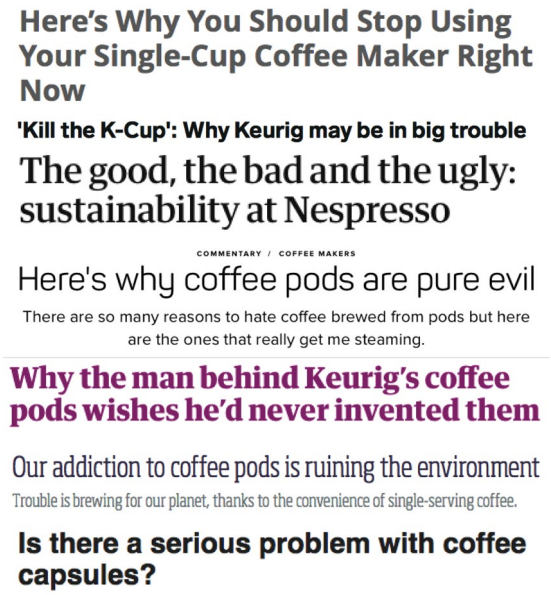


Figure 21: Headlines about the problem of coffee capsules

Consumer preferences

A study conducted by Heartbeat in 2017 analyzed brand and customer experience of single serve coffee machines. In this research Senseo and its three main competitors Nespresso, Dolce Gusto, and Tassimo are studied for its consumer preferences. A summary of the study results can be found in appendix G.

In this study Senseo is found to be the most popular and desired brand in the market with a consistent brand image performance. However, Senseo is also seen as the least luxury brand.

Nespresso is Senseo's main competitor with growing preference and is seen as a more caring brand. This could be a result of all the attention drawn by the recycling initiatives for the capsules. **By focusing on consumer care in this project, Senseo can obtain a stronger competitive position.**

2.3 HARDWARE ANALYSIS

A second-hand Senseo Original was bought on Marktplaats for assessment on reparability. To understand the product's anatomy the Senseo is dismantled (Figure 24). The study is performed in collaboration with the Circular Design Team at Philips Design. Supervised by Graeme Warburton, Senior Design Lead Coffee BG, who could guide us through the process. See appendix H for disassembly flow. The basic anatomy of a Senseo can be classified into three tiers (Figure 23):

1. **Primary**: parts which are easily accessible and removable by the consumer (e.g. drip tray, coffee pad holder, water tank);
2. **Secondary**: parts which are safely accessible to the consumer but require (special) tools to dismantle, (e.g. a screwdriver). Examples are the magnet in the water tank, shower head, brewing chamber, and control panel (buttons);
3. **Tertiary**: parts which are not safely accessible to a consumer (for professionals only) and include internal and electrical components (e.g. boiler, pump, micro controller, capacitor).

Figure 22: Most popular single serve models (Boyd, 2018)

2.3.1 DIS- AND REASSEMBLING

In response to the high success rate in Senseo repairs at Repair Café (77%), a hardware disassembling study is conducted to look into possibilities of tertiary repair by consumers to find if it is wishful for this project to further elaborate on that.

Figure 23: Three tiers of anatomy Senseo

Getting inside the main body of the Senseo is only necessary in case of tertiary malfunctions or problems (e.g. broken boiler, or failing electronics). The dismantling itself is difficult to do without damaging the machine due to snap fits. The snap fits broke as a result of a lack of knowledge and specialized tools (it requires a star screw driver and a tie wrap cutter). An attempt to reassemble the Senseo lead to the following insights.

Findings
The Senseo is not optimized for internal repair by consumers. Physical repair barriers are:
- Snap hooks;
- Repositioning the components;
- Rewiring (remembering the wire attachments);
- Tubing the boiler (valve and zip ties).

It takes long to dismantle the Senseo. Opening up the product requires brutal force and it is an unhygienic job (found: nicotine smell, silverfish insect, stale water). These aspects do not encourage consumers to open up a Senseo themselves.

Experts that have the right tools and knowledge can simply open up a Senseo. So the Senseo is suitable for repair by experts, but still it could be improved (barriers still exist).

For unexperienced consumers trying to open and repair a Senseo it is too dangerous because of the combination electronics and water, and because brutal force is required to open the product if you do not know how to open the product properly. Encouraging this would be a high risk for Philips.

The advise following from this study is: It is not recommended or wishful that consumers open up their Senseo while it is too risky in terms of brand image. The brand image could be damaged if a repair fails and something bad happens (safety). Therefore, the focus of this project should be on primary and secondary repair and problem solving.

Figure 24: Disassembling a Senseo

2.3.2 MAINTENANCE

A Senseo coffee machine requires maintenance. For insights about maintenance an interview is conducted with Graeme Walburton (2018), Senior Design Lead at the Coffee Business of Philips.

According to Walburton, the required form of maintenance for Original, Viva Café, and Switch does not differ much. People are expected to regularly clean the primary parts which are accessible and removable, for example the drip tray, the coffee pad holder and the water tank. Those parts are dishwasher proof according to the user manual of a Senseo Original. The outer part (main body) of the machine can be cleaned with a damp cloth to remove coffee stains. ***"But the main form of maintenance that is required is descaling"***, Walburton states.

Descaling
Descaling (or decalcifying) is removing deposits of scale from metal surfaces that are often in contact with hot water, such as in water heaters, laundry machines, and coffee makers. Descaling agents are acidic compounds. For Senseo it is advised to use citric-acid based descaling agent or to buy the official descaling agent of Senseo. Household vinegar is often used by consumers, but this is not recommended while the acids are too aggressive according to Walburton.

Despite descaling is said to be a relatively easy process, it is still not always done. But why is it so important to descale a Senseo?

"First of all, to retain the coffee quality." says Walburton (2018). Not descaling negatively impacts the coffee taste. In the user manual of the Senseo Original it says that regular descaling extends the lifetime of the machine and it guarantees a long-term and optimal result. At the average use of 2 times per day, the Senseo needs to be descaled every 3 months (User Manual Senseo HD7840 Coffee machine). Walburton explains that users living in hard water regions with high calcium levels, should descale their products even more often. However, this is not communicated to the customers. But if descaling is so important, certain details should be clearly communicated.

An internal Senseo expert at Philips roughly estimated in an interview that 50% of the consumers do not descale the machines at all. There is no internal information about if that is because people are unaware that it increases the chance of the machine to break, or if it is perceived as too much effort. This is discussed in more detail in chapter 4.

Figure 25: Effect of descaling

Experiment
In order to understand the effect of descaling, a second-hand Senseo was bought via Marktplaats. This Senseo desperately needed to be descaled since it only produced a small one third of a cup. The total time for the descaling process is approximately 20 minutes.

As can be seen in Figure 25, the effect of descaling is significant. From a little bit of coffee on the bottom of the cup to a full cup with a nice cream layer.

2.4 CHAPTER CONCLUSIONS

As the current business model of Senseo is dependent on selling high volumes, and the low margin on Senseos, there is a low financial incentive for Philips to focus on repair by Philips and developing take-back systems because it is labor intensive. Therefore an automated service system is an interesting opportunity area for this project.

This conflicts with the incentives for Philips to focus on circular business and product lifetime extension as the current business model is unsustainable in the long term.

Two product attributes to be amplified in the design solution are affordable, convenient, easy to use, and low effort.

As a consequence of the extended ecosystem around Senseo, there is a lack of an organized flow and a consumer need for orchestration. Challenges for this project is to make the options clear for users and to make consumers more aware of the environmental impact of the device. Philips has a competitive advantage with the biodegradable pad.

It is not recommended or wishful that unexperienced consumers open up their Senseo (tertiary) while it is too risky in terms of brand image. The brand image could be damaged if a repair fails and something bad happens (safety). Therefore, the focus of this project should be on primary and secondary repair and problem solving.

50% of the consumers do not descale the machines at all (rough estimation) while regular descaling extends the lifetime of the machine. Yet another reason for focusing on life extension of the product as big improvements can be made here. The importance, effect, and details of descaling should be better communicated to the customer with the design.

3 CUSTOMER SERVICE ANALYSIS

This chapter discovers the 'as is' situation of the current customer service system and options offered by Philips in case of a malfunctioning Senseo. Both in warranty (IW) and out of warranty (OOW). The three main channels of Philips' customer service are discussed: call center, website, and chat box. The goal of this chapter is to find where there is room for improvement in the current customer service system.

3.1 CURRENT CUSTOMER SERVICE SYSTEM AT PHILIPS

In case a product malfunctions within the warranty period of two years, the customer can have the product repaired or have it replaced by a new product. Figure 26 visualizes the journey of a product through customer service. The information in this visual is based on an interview with an internal consumer care expert in the coffee business at Philips (2018).

3.1.1 PHILIPS SERVICE CENTERS

In the Benelux, Philips has partnerships with thirteen repair centers. According to the consumer care expert (2018), the two biggest are E-Care Reverse Logistics in Duiven (the Netherlands) and Servinter in Belgium. Products from Luxembourg go to service

Coffee Business (2018). The decision whether to repair a product or to replace it by a new product is based on the lowest costs for the company (Consumer Care expert, 2018).

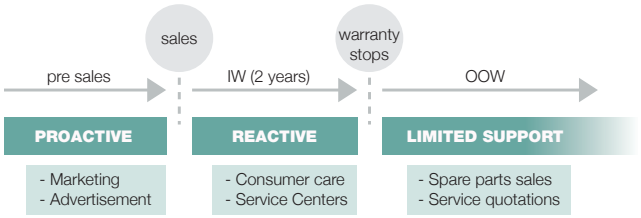


Figure 27: Philips customer relationship

According to the 5R project team (2018), the amount of local repair partners of Philips is reducing due to low profitability and the risk of quality performance. Less repair partners might result in less repairs which is a circular risk.

3.1.2 CUSTOMER RELATIONS

In Figure 27 the customer relationship of Philips is visualized. Philips is only proactive until the product is sold and reactive for two years after (warranty phase). Customers with OOW products can expect limited support from Philips. They can expect sales of primary spare parts, meaning loose parts that can be replaced without the use of screwdrivers. Also service quotations are offered (repair cost estimation). Philips has very limited insight or numbers about OOW products and what happens with those products.

3.1.3 PHILIPS MYSHOP

The Philips MyShop merely targets and supports (former) Philips employees, which is a niche market. The biggest group of their customers are retired people. There is only one MyShop left which is located in Eindhoven.

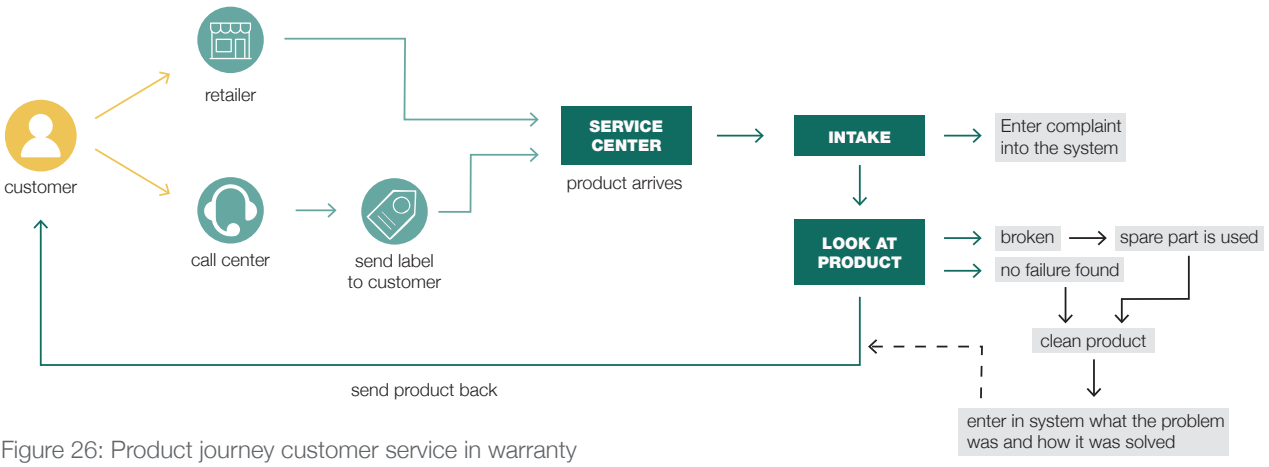


Figure 26: Product journey customer service in warranty

Thijs van Gennip (2018), customer service employee at the Philips MyShop, said in an interview (appendix I), that Senseo is actually never repaired if it is OOW because of the product price.

The high research costs of the repair centers (25 euro, paid in advance without knowing what the problem or outcome will be) usually discourages people. Van Gennip gives an example: *"If the quotation appears for example to be 60 euro (depending on the problem), and the customer then decides not to have it repaired, they still lose the 25 euro."* Therefore, OOW customer service are advised not to send it for reparation. Besides, customers receive only 3 months warranty on the reparation so customers usually prefer to buy a new product with 2 years warranty.

Within warranty Van Gennip estimates that basically all consumers make the effort to bring their product to the shop or to send it via consumer care. *"Mainly because it is a Philips product and customers think it should not be broken within 2 years because the brand Philips is associated with quality."*

Van Gennip predicts that if the research costs could be significantly reduced and the 3 month warranty would become 2 years, the threshold for making the decision to revive the product would be much lower.

3.2 CUSTOMER SERVICE EXAMINATION

For finding opportunities for improvement, this paragraph discusses the main support channels are examined during experiments on find-ability, ease-of-use, and pros and cons. In the experiments the different support channels are tested (appendix J).

3.2.1 PHONE AND CHAT BOX

CONFIDENTIAL per Senseo model are registered per 6 months (globally) at Philips call centers (appendix K). Considering this number can be roughly multiplied by the amount of Senseo models, other types of Philips coffee machines (not Senseo), and by the many other devices of other (non-coffee) businesses, then **this adds up to a lot of phone calls per day which are highly labor intensive. It would be beneficial if this amount of phone calls can be reduced.** The following advantages and disadvantages of the current customer service system at Philips (call centers and an online chat box) are based on the experiments:

Advantages

- Personal and friendly service, the employee takes time and really tries to help even though it was about an OOW product;
- Discount is offered.

Disadvantages

- Only available during working hours;
- Merely advice on cleaning or descaling. More technical problems are typically not solved in case of OOW because there is not much that can be done while it is too expensive for sending the device to a repair center;
- From a business perspective: labor intensive to answer all the calls and to register the complaints;
- Waiting time before you can actually start the conversation: 7 minutes;
- They could not help sufficient, as the employee cannot see or check the Senseo;
- As a user you must have the model number of the device at hand (on the bottom of the product.

3.2.2 SELF-SERVICE ON PHILIPS WEBSITE

There is a self-service and troubleshooting option on the Philips website, however it is really difficult to find. It is hidden in an illogical place and there are many clicks required to get there. Much perseverance is required to find the page and if people do not know of the existence it is probably not often found.

Once the page is found, the first task is to find the model number of the device. The service is purely textual and unattractive to look at. There are extremely limited options (Figure 28) and the solutions do not go beyond provision of obvious information (appendix J) (e.g. "do not fill the water tank above the indicated max. level", and "place the water tank carefully back in the machine"), advice to descale and clean regularly, the advice to only use official Senseo pads, and ordering a new water tank in the online Philips shop. It does not even explain how the Senseo should be descaled or cleaned.

Figure 28: Troubleshooting on the Philips website (Philips.nl, 2018)

The self-service channel seems to be an underdeveloped service channel. It does not answer people's questions and does not encourage people to solve the problem.

3.2.3 GENERAL FINDINGS

The problem is that for all three studied support channels (call center, chat box, self-service), one first has to search specifically for that type of support in order to find it. As soon as people type the problem in the search engine without specifically mentioning 'Philips Support', people often does not appear in the

top 7 search results (found by trying to search various problems in the search engine). As a consequence, customers often do not end up at the Philips website but on other sources such as OnderdelenSenseo.nl. Due to this, Philips loses control over what people do with the product regarding safety and liability. In addition, this is a missed opportunity for customer relationship building and can easily be solved by Search Engine Optimization (SEO).

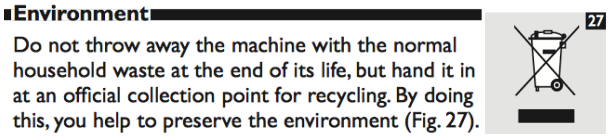
Secondly, there is no orchestration or logical path for consumers in case of a malfunctioning product, which can lead to giving up sooner during the process of resolving the problem (more about this in chapter 4).

3.3 END-OF-LIFE SUPPORT

According to De Olde (2018), Senior Manager Sustainability at Philips, Senseos are calculated to have a lifetime of seven years. However, this is a 'best case' in which the consumer takes care of the product and it is not used extensively. But what is a user supposed to do if their Senseo irreversibly breaks? Philips is currently not offering take-back service (internal expert, 2018). The only form of available guidance by Philips is found in the user manual and is very limited (Figure 29). According to an internal consumer care expert at Philips (2018) disposal is found to be the responsibility of the consumer, not of Philips.

So besides the information in the manual that the machine should be handed in at 'an official collection point for recycling', the rest is up to the consumer to find out. For example by finding out what official collection points are and where to find them. §4.2.3 investigates how users experience this and how they usually handle certain situations.

Furthermore, it is doubtable whether people read the manual for disposal information when they have a broken product. Therefore, the manual does not seem the most convenient place for certain information.


Environment

Do not throw away the machine with the normal household waste at the end of its life, but hand it in at an official collection point for recycling. By doing this, you help to preserve the environment (Fig. 27).

27

Figure 29: EoL guidance from Senseo's user manual (n.d.)

3.4 PROBLEM-SOLUTION ANALYSIS

The following list sums up the most common "observed problems" with Senseo that people called Philips Customer Service for (§3.2.1, and appendix K). This list is based on internal data sources (2018) and corresponds to the data of Repair Monitor 2017 (Natuur & Milieu, 2018) and OnderdelenSenseo.nl (2018).

1. Leakage
2. No coffee
3. Less coffee
4. No foam layer
5. Coffee temperature (cold)
6. Cannot open lid
7. Blinking light (slow or fast)
8. Other

However, these problems do not yet directly say anything about what the corresponding solution is for the problem. It is difficult to translate problems into solutions because multiple causes can be applicable per observable problem.

The data in Repair Monitor 2017, by Natuur & Milieu (2018), is based on 121 registered incoming Senseos (Original, Viva Cafe, or Switch) at selected Repair Cafés in 2017.

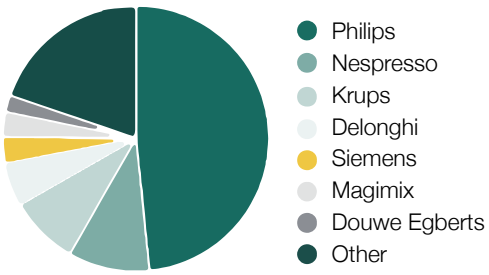


Figure 30: Coffee machine brands brought into Repair Café (Repaircafe.org, 2018c)

DEFINITIONS

The following definitions are based on previous definitions in studies in the field of CE (Johnston, 2016).

The **End-of-Life (EoL)** of a Senseo indicates that the machine is at the end of its useful life. Whereby no user can use it for its original purposes. It is the last stage of a product's life cycle. The product is broken, cannot be saved, and is designated for disposal.

The **End-of-Use (EoU)** of a Senseo means that the owner no longer has a purpose for the product and stops using it. However, the product is still functioning. Reasons for EoU could be replacement, upgrade, oblivion, drinking less coffee, or malfunctioning of the product. In the latter situation the user believes the Senseo is at the EoL but in many cases the product just needs maintenance or (simple) repair. At Repair Café some Senseos are 'repaired' by simply descaling them (Postma, 2018).

In Figure 30 it can be seen that nearly 50% of the broken coffee machines brought into Repair Café is of the Philips brand. According to Repaircafe.org (2018c) the vast majority is of Senseo. According to repairers at Repair Café this is because the Senseo is vulnerable and not very durable.

Nyckle Sijtsma (2018), co-founder of repareer.com, explained the following in an interview (appendix L). *"With our first platform concept, two product categories were the most popular: Senseo and high-pressure water sprayers. Apparently there is a need among people to repair Senseos. We know it is also a popular product at Repair Cafés. From this you can draw two conclusions: 1: People do not want to throw away the Senseo but have it repaired and 2: Senseos often break."*

The Repair Monitor 2017 (Repaircafe.org, 2018c) shows the following top 5 solutions for Senseo repairs. The occurrence percentages are based on the data analysis of the Repair Monitor with Philips specific information in appendix M (retrieved from Postma, 2018):

1. Replacing the magnet in the float (~31%)
2. Cleaning/descaling (~29%)
3. Replacing the capacitor (~12%)
4. Replacing the three-way valve (~10%)
5. Properly tuning it (~3%)

This means that the simple and relatively quick actions of replacing a magnet and cleaning or descaling a malfunctioning Senseo, solve approximately 60% of the problems. The challenge is to find which solution correspond to which problems as the stated problems can be a result of multiple causes.

Harmen Meijer (2018), repairer in Repair Café Delft, explains in an interview (repaircafe.org, 2018c) that there are a few weak parts in the Senseo that break down often. He says that the magnet in the float is not made of stainless steel but surrounded by water. Subsequently it is inevitable that it will rust: a production error (Figure 31). Another weak point is the capacitor which often stops working because of the voltage peaks. At RC repairers often replace the capacitor with a stronger version.

Figure 31: New magnet vs. rusted magnet (Brattinga, S. et al, 2015)

Also on OnderdelenSenseo.nl (2018) it is seen that the float and magnet need replacement often because those are the most sold parts. On this website official Philips parts are sold. However, Repair Café refers to websites for ordering both for official and unofficial spare parts (Repaircafe.org, 2018c).

It is not desirable for Philips that people use unofficial spare parts because Philips cannot guarantee the quality of these parts. Besides, both OnderdelenSenseo.nl and Repair Café encourage to do tertiary repairs which is also not desirable for Philips for the same reasons. Also platforms as repareer.com and iFixit encourage this.

Because OnderdelenSenseo.nl (2018a) already has more than ten years of experience with Senseo repairs, they have some interesting findings. One is that there is an order in possible solutions. For example before tuning the water level or replacing the magnet, first it must be ensured that the pad holders are clean (that the hole is not blocked with dirt) and that the machine has been descaled. Because both aspects affect the amount of water or coffee that ends up in the cup (OnderdelenSenseo.nl, 2018a).

Figure 32 depicts a composed problem-solution flow, including examples of the main identified observed problems with Senseo. In this scheme problems are translated to solutions. The flow for problem categories 'foam layer', 'less coffee', and 'leakage' are well developed and worked out. The information in this flow is based on manual, repair monitor 2017, the Philips website, internal data source (2018), and OnderdelenSenseo.nl.

This scheme shows the complexity of the trouble shooting flow. In the last two columns the 'halt' is added to discourage people doing tertiary and unsafe repairs. In the last (yellow) column solutions are design suggestions. Striking is that there are many solutions safe and possible to execute by consumers and only a few problem causes are outside of the safe-zone.

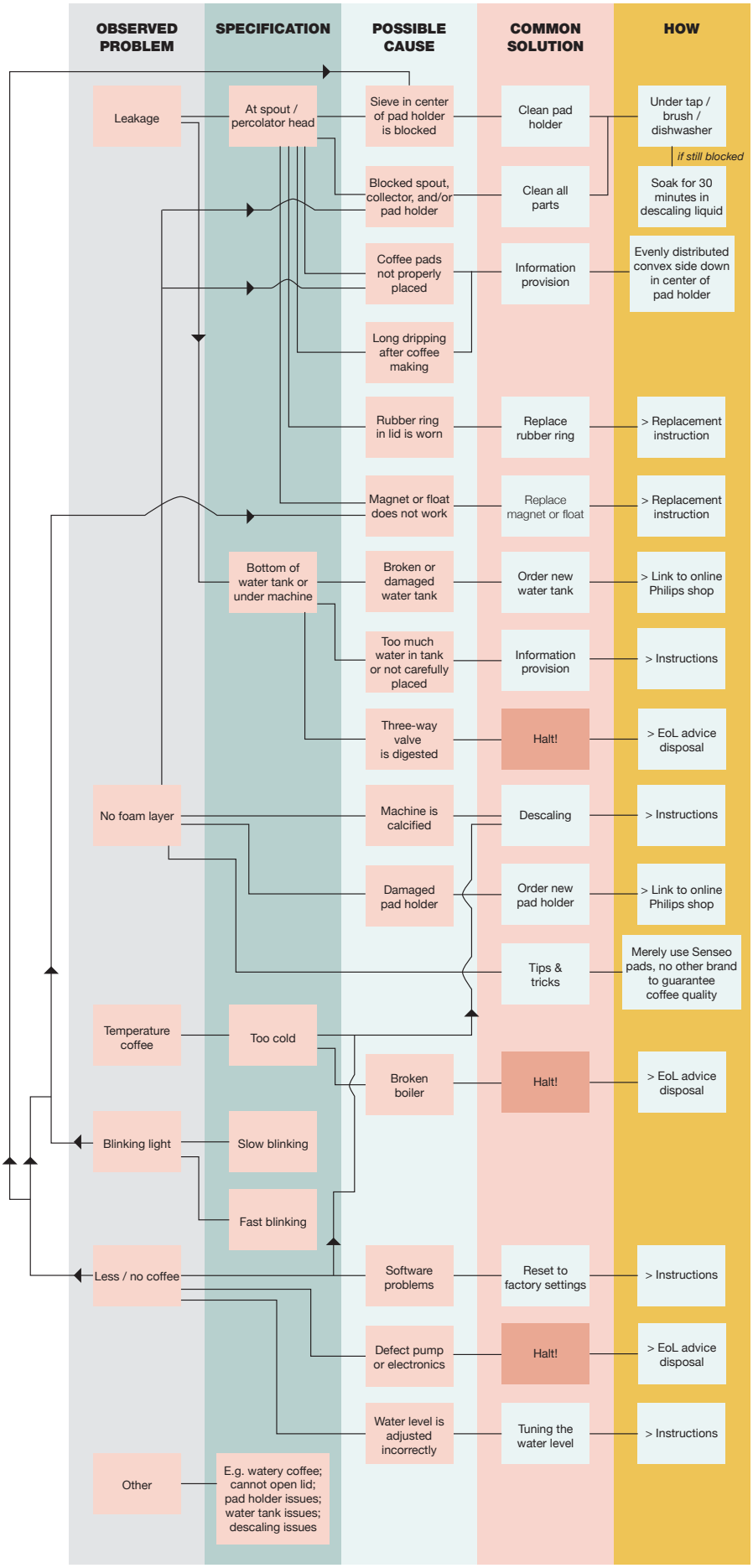


Figure 32: Problem-solution flow for Senseo

3.5 CHAPTER CONCLUSIONS

As there is currently a poor after-sales customer relationship and no track record of OOW products, there is an opportunity for Philips to improve this. By being more involved with the customers post-sales and by offering adequate and satisfactory support, consumers will have positive experiences with the brand which might result in increased brand loyalty. In addition, by investing in customer relationship building Philips will get to know the customer better. This enables Philips to improve services and to target consumer needs more accurately.

Solutions for OOW products in the current customer service system often do not go beyond provision of obvious information and advice because it is too expensive for sending the device to a repair center. Therefore, the focus of this project will be on OOW products because there is much room for improvement.

The current customer support system is highly labor intensive and it would be beneficial if the amount of complaints (for all businesses) through the phone and chat channel can be reduced. For this project it might be interesting to investigate how that workload can be reduced as it can result in cost reduction.

By using the online search engine for troubleshooting, people often end up at other sources than the official Philips environment where tertiary repairs are encouraged (e.g. iFixit, OnderdelenSenseo.nl, and Repair Café). This is not desirable for Philips due to the high risks regarding safety and liability as Philips still gets the responsibility if something goes wrong. This is an important risk for this project to consider in the design.

Roughly 60% of the most common solutions at Repair Cafés are quick actions that are easy to do by consumers. For this project there is a great potential for creating environmental impact by making consumers aware of the possibilities and by stimulating them to try these actions themselves.

4 USER ANALYSIS

The user analysis focuses on understanding who the user is, and his/her behavior, needs, and motivations. These aspects are identified through literature, interviews and discussions with users and people in the coffee industry, and through a questionnaire among Senseo users. Based on this research a persona (Figure 33) is made which creates a clear image of the Senseo user. Though the personal details of the persona are fiction, the information used to create it is not. The persona is later in this chapter used for creating a customer journey map (CMJ) of the current situation to identify pain points and opportunities. Please note that most quotes in this chapter are translated from Dutch.

4.1 SENSEO TARGET AUDIENCE

According to Laura Vlaming (2018) Senior Global Marketing Manager at Philips, Senseo users vary a lot from students to 85 year olds. The users are typically not very luxurious or fancy and they represent a large group in the Netherlands. In an interview with internal consumer markets experts of the Coffee business group (2018), it appeared that three types of Senseo users are defined and targeted:

1. **Senseo lover**: main focus of the coffee business, to keep them as customer;
2. **Senseo challenger**: they are using Senseo but are not attached to the product;
3. **Senseo recruit**: generally drip filter users, potential Senseo user.

According to the consumer markets experts, people either stay with the Senseo or go for an upgrade in case of a new purchase. The estimation is that:

-
-
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The main reasons for consumers to switch to another model or brand are coffee quality, appliance quality, design, and the price of the coffee pads (internal source, 2018).

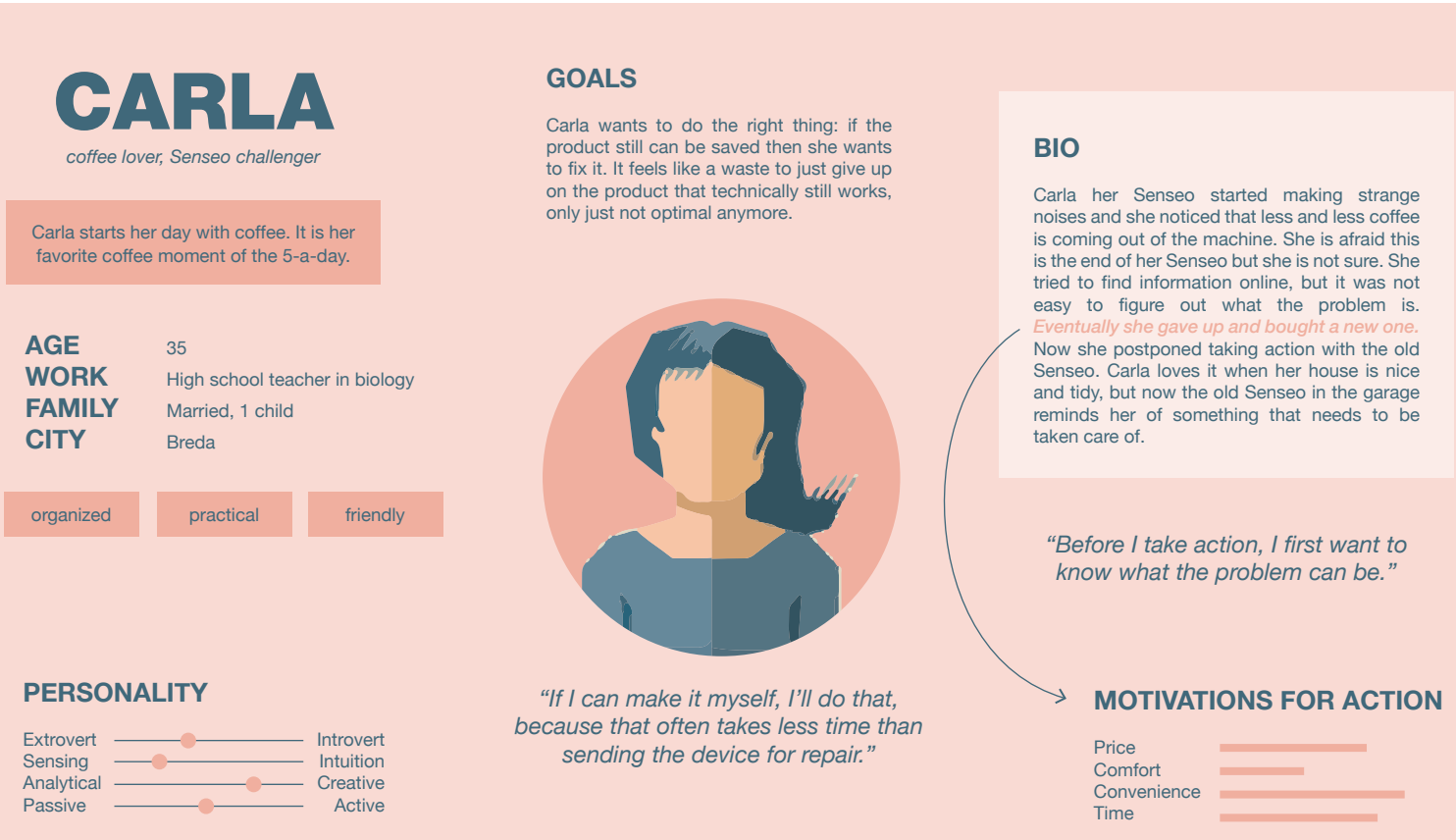


Figure 33: Persona Senseo user

If people have a negative experience with Senseo (in terms of appliance quality or service) they will likely be more inclined to switch to a different brand. With the right support this can be reduced or prevented.

This project focuses on after-sales. Therefore, the first two target groups are relevant to take into account in the ideation phase. The design solution should keep the Senseo lover, and convince the Senseo challenger to stay with Senseo.

4.2 USER BEHAVIOR AND EXPERIENCE

According to Bahmra et al. (2011) *"Understanding consumer behavior can be the preliminary step for seeking solutions to minimizing environmental impacts of consumption through improving product design"*. Therefore, seven in-depth qualitative interviews are conducted with Senseo users between the age of 25 and 58, who have years of experience with Senseo, experienced malfunction and eventually had to deal with disposal (in appendix N the interviews can be found). Besides, five less extended conversations with Senseo users are conducted. The goal is to gain understanding of what Senseo users do in practice with the product and what their needs and wishes are regarding various steps in the user journey. Participants were selected from personal environment, aiming at a large variety in age, occupation, and housing situation (alone, with family or roommates).

A comparable study was conducted by Ackermann, Mugge & Schoormans (2018) and focused on the consumers' perspective on product care. Based on 15 in-depth interviews they found that many consumers are generally motivated to take care of their products but what is often missing are triggers that push people to take care of their products.

4.2.1 MAINTENANCE

§2.3.2 discussed that the main form of required maintenance is regularly descaling (Figure 34). From the interviews it appeared that physical manuals are often not read. Sometimes they are stored away, if not, thrown away. Manuals usually contain extraneous information. If people need information they prefer filtered information: searching the Internet is preferred above going through text-only manuals. This is confirmed by Thijs van Gennip (customer service Philips MyShop, 2018) in an interview (appendix I). *"People don't read the manual anymore when they buy a product."* However, he finds that elderly people still prefer a physical and extended manual. Sometimes retired people complain about the manual because they find it too concise. *"Often there is only a quick start manual which is not enough for the older generation."* A clear generation shift.

Since people do not read the manual anymore, Thijs noticed that the awareness on maintenance also decreased. *"I think there should be more communication on maintenance, it is necessary for extending longevity of the product."*

This limited awareness was also found in the interviews. People generally do clean the loose parts from time to time for hygiene reasons. But when it comes to descaling an estimated 50% of the consumers do not descale the machines at all as mentioned in §2.3.2. From the user interviews it appeared that if Senseo users descale the Senseo, they only descale it after the product starts malfunctioning. This shows that an incentive is required for this action.

"I have never descaled my Senseo because I did not think it was necessary. In a kettle you can see that it is necessary to descale it. But if the product is still working, then I do nothing about it."

"There really needs to be something wrong before I do something about it. For example if a washing machine smells strange I will take action."

"Once there was insufficient water coming through my Senseo. So I asked my father to fix it and he came to descale it. Then the problem was solved."

Some users know in fact the advise is to descale the machine every 3-6 months, *"but it depends how often you use it: some people use it way more often than I do."* said a woman who descaled her Senseo only twice in 5 years time.

In the user interviews it is confirmed that consumers often use household vinegar for descaling, which is too aggressive for the Senseo as mentioned in §2.3.2. *"Vinegar works fine, I never buy anything fancy for it. I think those special products are all just plain vinegar".* This shows a lack of trust in the official products. There is the idea that official descaling products are just a marketing trick.

Figure 34: Descaling a Senseo

In the older Senseo machines there is no descaling indication LED. Despite of this extra feature in the new machines people still seem to ignore the signal according to an internal Senseo expert at Philips (2018). This might be because the product still works fine which makes users believe maintenance is not yet required. Descaling is a point of focus for the coffee business according to the same expert (2018).

4.2.2 MALFUNCTION

In addition to the interviews, an online questionnaire (appendix O) is conducted among 100 respondents of which 88% (ex) Senseo users, aiming at a large variety in gender and age. The questionnaire is for inspiring and guiding purposes in this project and is mainly focused on the user experience regarding malfunction. It consists of both multiple choice questions and open questions. The results (appendix P) are analyzed face value, not statistically. For this chapter it contributes to picturing the as is situation.

9% of the respondents indicated they would give up straight away in case of a malfunction and replace the machine. Only 2 out of those 9 has 'giving up' as the only option, the rest may also try something else first before giving up. The rest (91%) attempts to solve the problem. Figure 35 shows how this is usually approached. In this figure a ranking order is found of the preferred and most common attempts. The three most common actions before giving up are:

1. Search via the search engine;
2. Take a look at the machine;
3. Find and read the manual (on-/offline).

The vast majority of the respondents indicated to prefer to solve the problem themselves. This independence in fixing it on your own, without help of external parties or other people, is a highly valued aspect. People feel most comfortable with Internet support and prefer not to consult customer service. The reasons for preferring online support are:

- To save money and time. *"If I can make it myself, I'll do that, because that often takes less time than sending the device for repair.";*
- People believe it is the fastest, easiest, and low-threshold way to get your cup of coffee anyway. *"This is often the fastest and easiest solution, without waiting time or transport"*;
- Less hassle than consulting external party or sending or bringing the product somewhere *"I don't like to write to the customer service, usually it takes too long till they answer. It is easier to try to fix it myself.";*
- Low expectations of help desk. *"I don't trust the Philips website or service, they probably only want to sell me a new device."* and *"I do not expect the help desk can help me very well";*
- People assume it is easy to find relevant information and solutions online. *"Everything can be found online", "Probably it is a problem that other people dealt with before",* and *"Quickest solution for dealing with common problems".*

It can be concluded that there is an intrinsic motivation to fix the problem (corresponds to the popularity of Senseo at Repair Café and repareer.com) and fixing it at home is the preferred option. 5% of the respondents even like the challenge of fixing it.

It is a good starting point for this project that many people think of repair at the point of malfunction. Many people have the right intentions but from the interviews and questionnaire they appeared to be held back in doing so. This can be explained by the lack of triggers and (perceived) ability (Fogg, 2009).

According to the results of the questionnaire the 'problem finding' aspect is the limiting factor in fixing a malfunctioning product. **Respondents indicated a need for quick and easy access to the right info source** (reducing search time and effort, and increasing certainty or confirmation that you are at the right place). Another aspect that holds people back is the lack of certainty of success, or the assurance that there is a (high) chance of success.

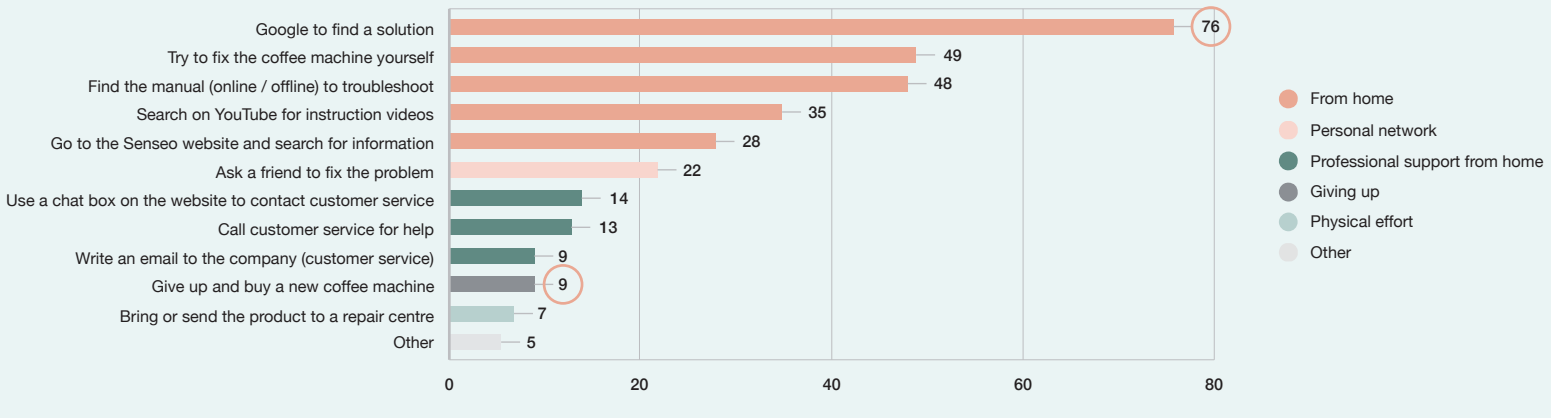


Figure 35: Questionnaire results on preferred actions in case of a malfunctioning Senseo (100 respondents, in %)

Another important insight is that people find it important to find the cause of the problem. If the problem is unclear or the options for fixing the problem are not known, it is found difficult to make a decision or to take action. *"Before I take action, I first want to know what the problem can be."*

People often try to find through the search engine if the problem occurs more often and if it can be easily solved by themselves. However, multiple respondents mentioned: *"I want to put little effort into finding out."* and *"It should not take too long."*

If the problem or solution is not quickly or easily found, or if it appears to be too complex to solve the problem without help, the majority of the respondents indicated to give up anyway and buy a new coffee machine. *"I would try to fix it myself first, but if it becomes too technical or complicated, I would give up and buy a new device."*

If people cannot fix the problem themselves, the majority gives up because *"repair is often more expensive than a new device"* and *"a new device is often delivered at home in 1 to 3 days"* which is a very convenient solution. Besides, respondents mentioned multiple times *"I would not spend money on repair, I do not think a Senseo is worth that."*

Multiple Senseo users indicated to be unwilling to repair electrical parts, because of the combination electricity and water which seems dangerous.

One user had a Senseo that did not get to the right temperature anymore. She made the assumption that it was a technical defect that could not be repaired. *"If the Senseo no longer heats up then I'm sure I cannot repair it anymore. If I were to be told that I could, I might have tried."*

Based on the user interviews and on the problem-solution analysis in §3.4, the assumption is made that signals for descaling (e.g. strange sounds, insufficient amount of water, fast blinking LED) are not recognized as such and the product is perceived as broken. Three Senseo users verbally indicated to have disposed and replaced a Senseo when not enough coffee was coming through anymore. By looking at the numbers of Senseos brought into Repair Cafés, ~29% was perceived as broken while it only required proper cleaning and/or descaling (§3.4).

Therefore, it can be concluded that there is a **need for guidance at the point of malfunction.** When a product malfunctions, people are willing to search, but do not want to do too much effort. In addition, observed problems can have various different causes, which makes it unclear for consumers to understand what the problem is and how to solve it. This can be unsatisfying and frustrating, which increases the number of people giving up on products that could still be saved. As mentioned in §3.2, there is no orchestration or logical path for consumers in case of a malfunctioning product. By creating this, the number of people giving up on their product can be reduced and more Senseos could be saved.

A malfunctioning Senseo never comes at a convenient moment, so the frustration is already there from the beginning. As mentioned, the **priority for consumers at that point is access to coffee**. Thus if the easiest and fastest solution seems to replace the product, this is what consumers will decide to do.

Figure 36: Malfunctioning Senseos waiting to be fixed (Credits: Martin Waalboer / Stichting Repair Café)

4.2.3 DISPOSAL

For disposal of products a distinction should be made for products that still work fine (1), products that still work but not perfectly anymore (2), and products that are broken (EoL) (3). The insights of this paragraph mainly come from user interviews.

1. Disposal of Senseos that still work fine

How people usually deal with Senseos that are still functioning, but that became obsolete:

- People often keep the Senseo as a back-up machine (for special occasions);
- Donate to family / friends (often saved for children when they for example move out);
- Donate to Kringloop (second hand store);
- Sold on secondary market (e.g. Marktplaats).

On Marktplaats, about 1500 used Senseos are being offered in May 2018. In 2017, **CONFIDENTIAL** new in the Netherlands (de Olde, 2018). Based on this, the assumption can be **CONFIDENTIAL** Senseos is offered online each year as second hand.

Three people who upgraded their Senseo with a full automatic coffee machine said in interviews to have kept their Senseo as a back-up or additional machine. *"I still have my Senseo for when my sister visits, she drinks caffeine free coffee which I can not make with my expensive Saeco machine. Or in case my Saeco breaks down."*

"We use the Senseo now for camping holidays."

"My father now uses the Senseo occasionally for his team during major construction projects."

2. Disposal of Senseos that still work, but not perfectly anymore

A malfunctioning or not perfectly performing product often quickly ends up in the EoU phase. As people often do not know exactly whether they should throw it away, the decision is often postponed. Somehow they believe that the product will be fixed eventually or that it might come in handy at some point.

"I replaced my old Senseo with a new one because it was old and calcified. It just did not work perfectly anymore. I did not throw it away because it was not broken. It is now stored in the basement for about 2 years already." This is an intermediate phase, where the product is no longer used and also not disposed which is not Senseo specific problem.

3. Disposal of broken Senseos (EoL)

Findings in this paragraph are not for Senseo specific situations, but apply to disposal of all sorts of electric household devices. The quotes in this paragraph come from interviews with Senseo users (2018).

Available options on what do with broken devices:

- General waste bin;
- Procrastination (electronic waste stock);
- Municipal recycle station (Milieustraat);
- Return to retailer;
- Bring to a Wecycle point.

As mentioned in §3.3, Philips is not offering take-back service. The best options regarding circularity are to bring the product to the Milieustraat, to the retailer (which usually has recycling channels), or to bring it to a Wecycle point (Figure 37). These channels all lead to recycling of the materials.

Disposal of electric devices is not something people have to deal with on a daily base. Therefore, people are not frequently confronted with this situation: consumers want to do the right thing, but they do not know how. For many people, recycling is seen as sensible contribution to reducing the amount of waste and therefore to protect the environment. Still, in 2016, 21,9 million kg of e-waste ended up in residual waste in the Netherlands only (Wecycle.nl, 2018).

The end of life is experienced as unpleasant due to doubts what to do, and guilt and responsibility felt by user. Due to the lack of clear, convenient, and sustainable options, electronic devices end up in the general waste bin or people show 'ostrich behavior': procrastination of disposal by storing it somewhere around the house where it is not seen. The unclarity among consumers and unsatisfying actions lead to frustration.

"I always find it difficult to hand in electronics. I want to do the right thing, but I do not really know what to do with it. And then I also have to force myself not to give in to my laziness to dump it with the residual waste." It takes effort to figure out where it should go, and the actual transport (often off-route) takes time and effort too.

"Underneath the coat rack I have a messy dump of old electrical devices. We want to bring this somewhere in the right way, but it is just difficult, it takes effort. So now they are still there, but we won't throw it into the trash. However, also none of my housemates really feels the responsibility or wants to find out where it should go exactly."

Procrastination of disposal is non-circular behavior as the materials cannot be reused and virgin materials need to be extracted for production of new products.

Wecycle

Wecycle is the non-profit foundation that regulates collection and recycling of e-waste in the Netherlands (appendix A third infographic).

"I usually bring it to a Wecycle point in the BCC store by bike: it is on my route to the university. But it always takes months before I finally do it, in the meantime I place devices in the hallway."

A problem that many consumers encounter is the lack of clarity in the distinction Wecycle makes between 'big' or 'small' electrical devices. *"I often doubt whether a product is 'small' or not and whether you can throw it in that Wecycle bin or not."*

Figure 37: Collection of electric devices (afvalgids.nl, 2015).

Many Dutch supermarkets collect small appliances (e.g. mobile phones, shavers) for Wecycle (hand held-sized). Other stores such as Gamma or Praxis also collect small appliances but 'small' means here for example a kettle, hairdryer, or toaster. Televisions are not covered here but also not by 'big' appliances (e.g. refrigerators or washing machines). It often happens that people bring a product to a store where it is not accepted. A recommendation for Wecycle is to be more consistent and to provide consumers with clear information on where they can bring which product. Wecycle acknowledged this problem in an email conversation (appendix Q).

Besides, people have no idea what happens with the products after they arrived at Wecycle points. Providing information on why it is necessary to bring the product and what happens with it might help motivating people to take action and make the effort.

Concluding, there is a lack of clarity on disposal of electrical devices which makes disposal a frustrating and unsatisfying end of the product journey. This system should be clear, easier, and more consistent. Though, this is a challenge for Wecycle and not for Philips. However, Philips could contribute or play a role in information provision about disposal options.

4.3 USER EXPERIENCE SCENARIO

Now that the users and their behaviors, needs and motivations in current situation are extensively studied a user experience scenario of the current situation could be created (Figure 38). This scenario is made during a brainstorm session with the Circular Design Team at Philips Design. For this scenario it should be mentioned that different Senseo models give different experiences. This scenario is about the experience of Senseo Original users. Besides, the experience of this specific scenario is not the same for every user.

By visualizing a scenario of the customer experience, the situation becomes more tangible and it forces to connect the dots and to tie the story together. This is valuable because the interviews merely provided scattered information.

4.4 CUSTOMER JOURNEY MAP

Based on the content of the persona and the user experience scenario, a customer journey map (CJM) can be created. The purpose of a CJM is to identify pain points from the user perspective and opportunities to indicate where Philips could intervene (Figure 39).

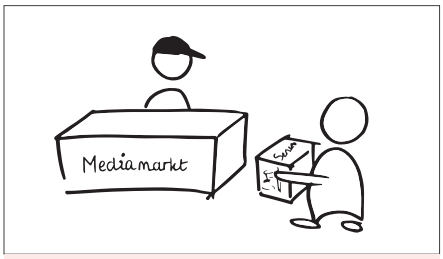
With a focus on product lifetime extension, the main identified pain points and opportunities are found at the critical moment when a Senseo starts malfunctioning. At this point users experience most frustration and are tempted to give up on the product by replacing it. By intervening at this point, and motivating users to fix the problem, the lifetime of the Senseo can be extended and there is high potential to create an impact. Moreover, an intervention at that specific moment can result in increased customer satisfaction which can lead to brand loyalty.

4.5 BEHAVIOR MODEL

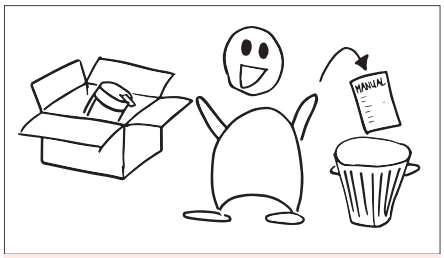
Although behavior cannot be designed (Selvefors et al., 2016), the preconditions which define how somebody may behave can be designed. Preconditions are according to the behavior model by Fogg (2009), **the concurrence of the following three factors: motivation, ability, and triggers.**

In the current situation the triggers are missing as people are not stimulated to solve the problem. In contrary: it costs a lot of effort for people to find the right information. By adding a stimulus in the design people can be provoked to solve the problem. There is limited motivation found in the user analysis which can be increased through the design. The factor that is currently represented in many cases of malfunction is the ability. People are often able to fix the problem themselves, the only problem is that people are not aware of the possibilities. This has to be tackled in the design.

The results of the study by Ackermann et al. (2018) correspond to the findings of this study. According to Fogg's behavior model the triggers can increase the motivation or ability by for example offering helpful service.

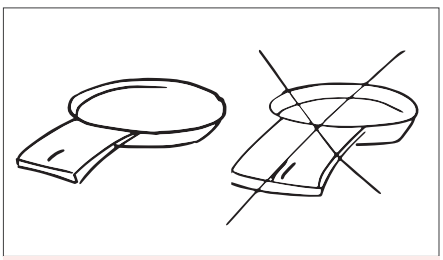


Purchasing at the Mediamarkt

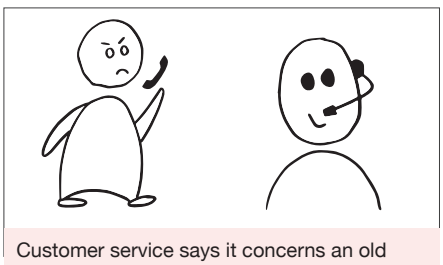


Unpacking the device. Manual not read and thrown away.

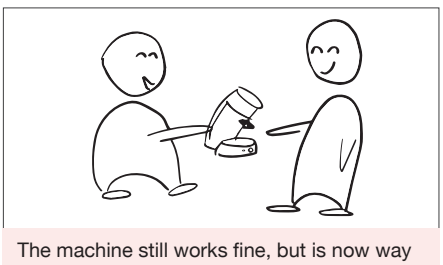
Daily use, every morning to start the day together with her husband. She always makes 2 cups at the same time.



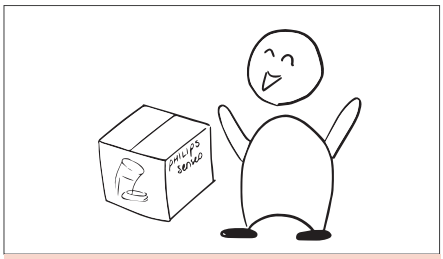
At some point the 2-cup padholder is lost. Carla calls the customer service for a new one.



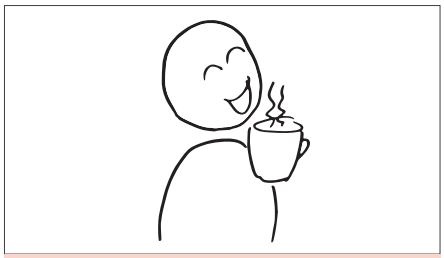
Customer service says it concerns an old model, there is no replacing padholder available. Carla feels frustrated.



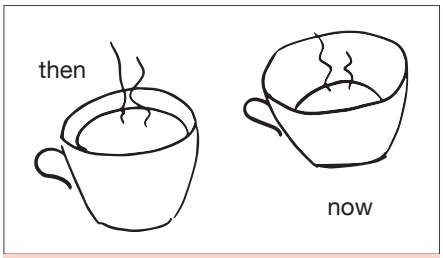
The machine still works fine, but is now way less convenient for her. She donates the machine to her mother-in-law who lives alone.



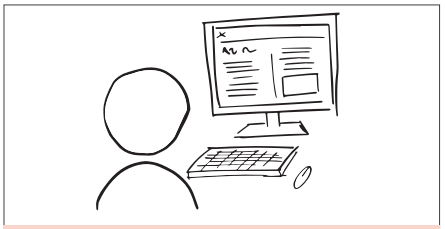
In the meantime, Carla ordered a new Senseo online.



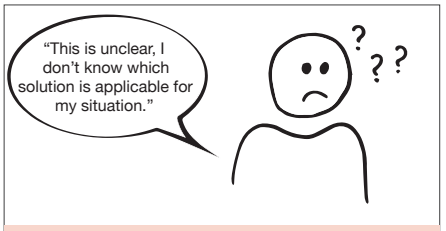
After using the new Senseo for a few years on a daily base with great satisfaction...



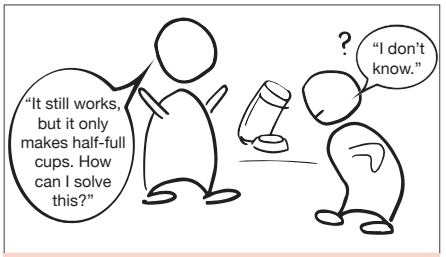
Carla notices that less coffee is coming through lately.



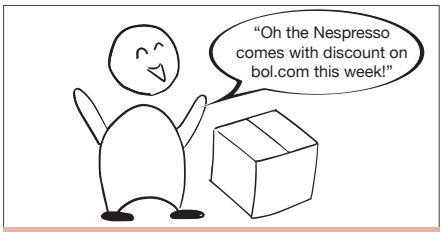
Carla can't find the manual because she threw it away and thus searches Google to find what the problem is.



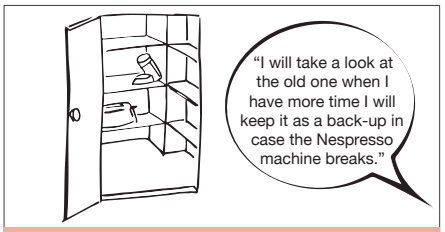
Carla finds many different websites, with different advices, that are communicating various causes and different solutions.



But all Carla needs is coffee, so she asks a friend. But this friend also does not know.

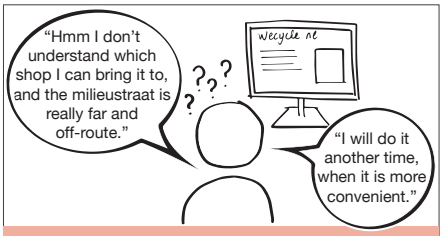


Carla switches to another brand. She found a discount and she feels frustrated with Senseo.



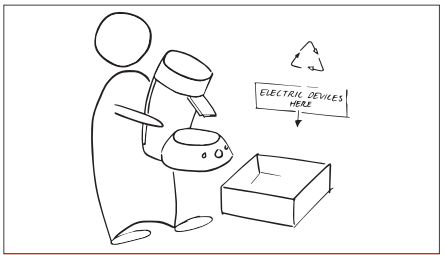
As soon as the replacement arrives, she puts the Senseo aside in the storage space. Little did she know the device only needs descaling.

After 2 years, she finds the old Senseo in the storage space. All dusty and dirty.



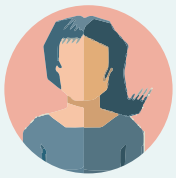
Google search on where to bring it. But it is unclear where she can bring it. Carla gives up for now.

1 year later she and her family move to another house.



She eventually brings the stock of electric devices to the 'Milieustraat'.

Figure 38: User experience scenario



CUSTOMER JOURNEY

The scenario is based on interviews with Senseo users and data retrieved through the questionnaire
The emotion curve is based on qualitative research

CARLA

Coffee lover and frequent coffee drinker (5-a-day)

PROBLEM DEFINITION

Many Senseo users choose to replace the product in case of malfunctioning. This is a waste because many common problems with Senseo devices can be solved by quick and easy actions.

	1	2	3	4	5	6
	Daily life: Carla drinks her coffee every morning before going to work and when she arrives back home.	The Senseo is not working properly, so Carla feels annoyed. This is not the right time and I need my coffee.	Carla doesn't like to call customer service, so she attempts to find what she can do in the search engine online. Hoping for a solution.	Carla finds it difficult to find a solution and gets frustrated. She just wants her machine to work properly and did not want all this hassle.	The best and easiest option at this points seems to buy a new machine. Carla gives up on her machine.	Daily life goes on again and the old Senseo is moved to the attic. Out of sight out of mind.
EMOTION CURVE		*"I just want my cup of coffee"*	*"I do not expect that the help desk can help me very well"*	*"Searching online should not take too long"*	*"A new device is often delivered at home in 1 to 3 days"*	*"I always find it difficult to hand in electronics. I don't really know what to do with it."*
PAIN POINTS		Malfunctioning never comes at a suitable moment.	User actively has to search for possible options to solve the problem. Consumers often do not know how to approach this or where to start. Feels like high effort.	Unclarity about available options, there is a clear need for orchestration.	Feeling forced to spend money. The feeling that it is inevitable to buy a new product.	Procrastination of disposal because it is unclear how and where to dispose it properly. Or perceived as too much effort.
OPPORTUNITIES	Providing easy access to information on how to maintain and care for the product. Taking care of the product can extend the lifetime and can prevent the product from preliminary malfunctioning.		Reducing the experienced effort in the solution finding process.	No touch points with Philips. Consumers do not end up on the Philips website when searching for solutions. Opportunity for Philips to create more touch points for stronger customer relationships.	Offering equally or more convenient solutions than replacing the device that will prevent users from directly giving up on the product.	Clear communication of where the product can be disposed and create awareness about why it is important to dispose it at proper recycle points.

Figure 39: Customer journey map

4.6 CHAPTER CONCLUSIONS

In this chapter it has been confirmed that the earlier found lack of orchestration is a frustration factor for consumers at the point of malfunction. At this point users experience most frustration and are tempted to give up on the product and to replace it. A clear need for guidance is found at the point of malfunction as people are willing to search, but do not want to do too much effort.

Moreover, they prefer having it fixed above buying a new device to save money and time. The problem is that they often do not know how due to a lack of clarity found of what the problem can be and on what the (solving) options are. From the user study it can be concluded that the willingness and motivation to fix a product is not directly related to sustainability: the main priority for users is access to coffee.

Currently, the easiest and quickest solution seems to replace the Senseo. Therefore, this is what many consumers do nowadays. For the project this is an opportunity to create environmental impact: by intervening at the moment of malfunctioning and by motivating, triggering, and making users able to fix the problem instead, the lifetime of the Senseo can be extended.

Besides, if people have a negative experience with Senseo (in terms of appliance quality or service) they will likely be more inclined to switch to a different brand: something Philips obviously wants to prevent. With the right solution this risk can be reduced.

5 CONCLUSION OF ANALYSIS

5.1 MAIN FINDINGS

This paragraph discusses the two main findings of the analysis.

1. Need for support

There is a clear and growing need for support at the point of product malfunctioning. At this point, users feel frustrated because they do not know how to resolve it. Therefore they are tempted to give up and replace the Senseo. This user behavior harms the reputation of Philips because as a consequence the consumer considers products as disposable goods.

People are willing to fix their Senseo. They even prefer having it fixed above buying a new one to save money and time, but they often do not know how or what the possibilities are.

Most of the frequently occurring problems can be resolved by one-off user actions such as descaling or replacing a magnet within the product.

However, signals for actions such as descaling are often not recognized as such and the Senseo is perceived to be broken. The lifetime of the Senseo can be extended by regular descaling which is often not done. Due to a lack of clarity and guidance people are not aware of this and assume the easiest and quickest solution is to buy a new one.

By intervening at this point, and motivating users to fix the problem instead, the lifetime of the Senseo can be extended.

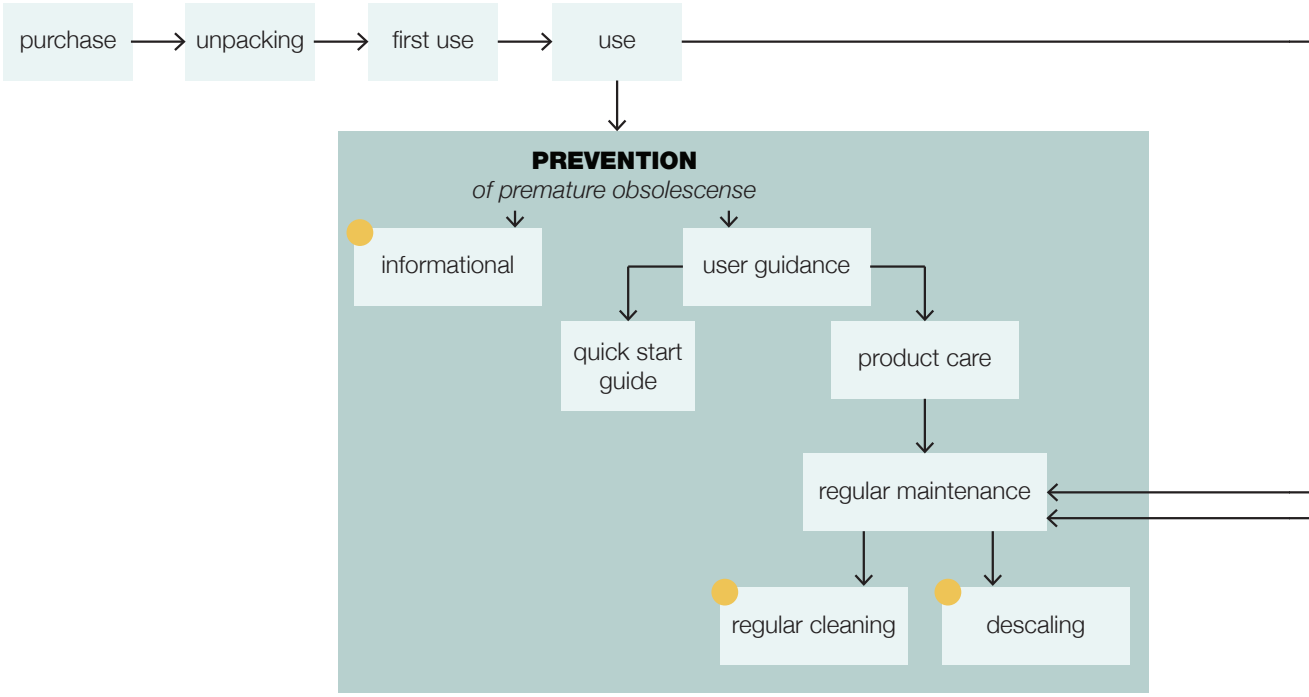


Figure 40: Explored opportunity areas within the journey of a Senseo

2. Data gaps

Another main finding is that within Philips there are lots of data gaps, in particular about the stage post-sales. There is no track record of what happens to the product after sales and **CONFIDENTIAL** consumers registers their product. The lack of data makes it difficult to improve the quality of the support because decisions cannot be based on data.

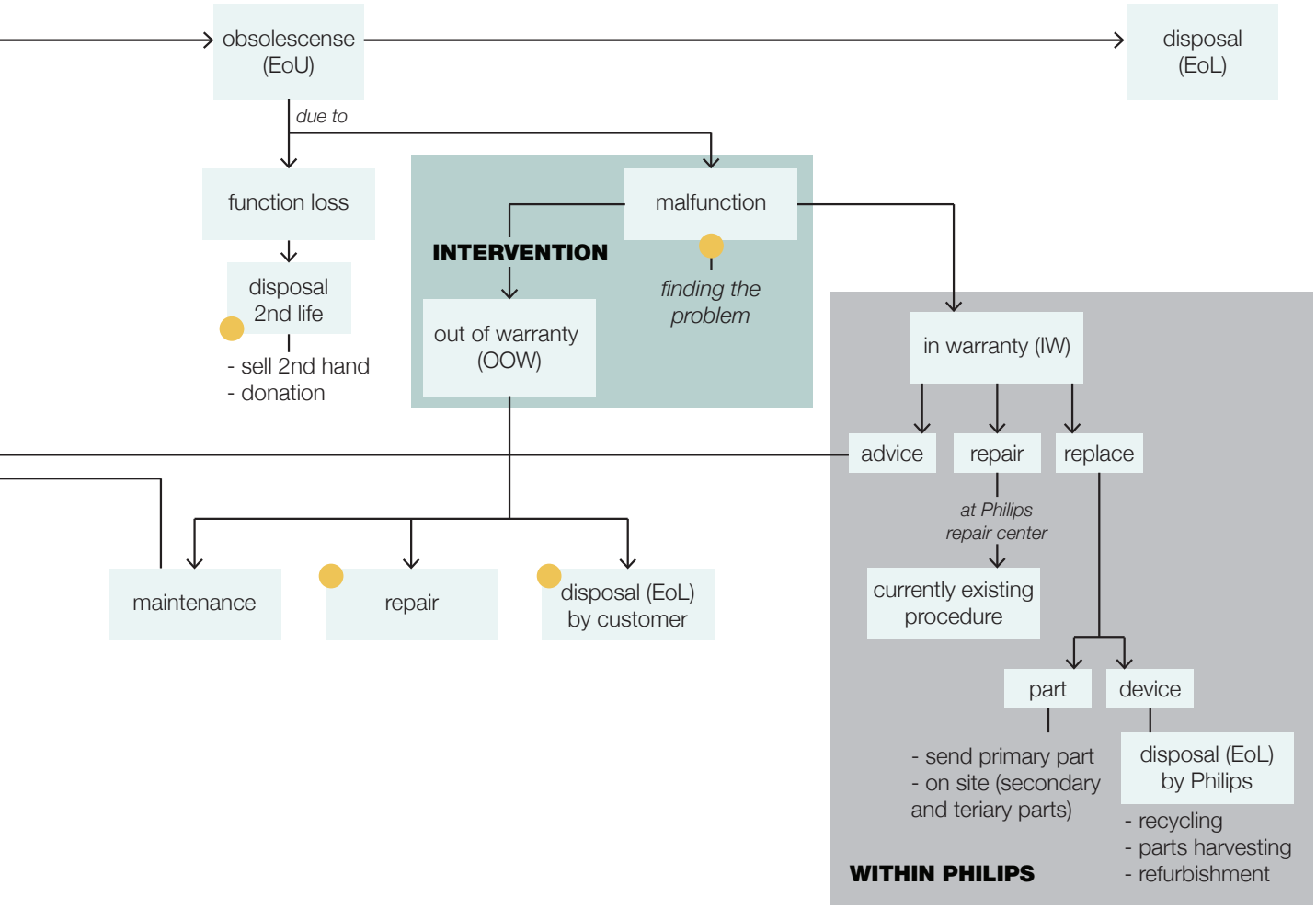
5.2 OPPORTUNITIES AND CHALLENGES

In Figure 40 the explored opportunity areas within the use journey of a Senseo are mapped. The two main opportunity areas and challenges regarding lifetime extension are:

1. **Prevention**: procrastination of obsolescence due to malfunctioning. Create awareness and provoke on the required maintenance such as regularly descaling.
2. **Intervention**: at the point of malfunctioning. Offering guidance through available options (in maintenance, repair, disposal). Tackle unawareness of which actions are required.
3. **Profitability**: to make product lifetime extension viable and desirable for Philips.

Focus

Within this project, the main focus for the design will be on intervention rather than prevention. Intervention is a reactive, and therefore more powerful, design principle at the point of malfunctioning. Another reason for a focus on intervention is that design for prevention is already integrated in a lot of coffee products, e.g. by means of descaling reminders. It is important that intervention is brought in the form of decisions and quick actions to prevent the user from losing interest, giving up, and replacing the product. This focus does not exclude inclusion of prevention or information provision about maintenance in the design.



SOLUTION SPACE

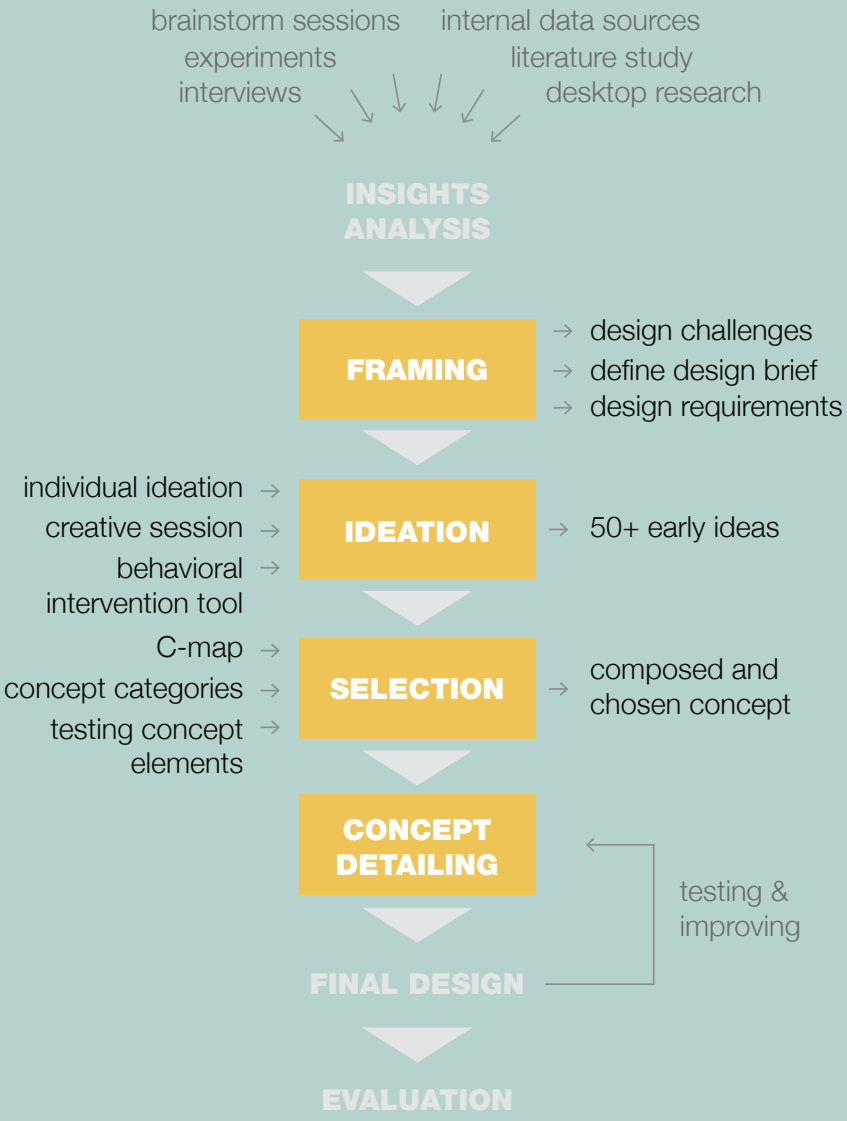


Figure 41: From analysis to ideation

6 DESIGN BRIEF

6.1 PROBLEM DEFINITION

Malfunctioning of the product can be prevented or postponed by taking proper care of the product, for example by regularly descaling it. In practice, customers do not descale in time or they are not aware of the option at all. Signals for descaling are often not recognized as such and the Senseo is perceived as broken. At the point of malfunction, the problem can often be fixed by simple and quick actions as descaling or replacing a magnet.

Unfortunately, it is difficult and time consuming for Senseo users to find information on what to do when an out of warranty (OOW) Senseo starts malfunctioning. Many different websites communicate multiple possible causes of the problem with various solutions and Philips is often not even in the top 7 search results. There is unclarity among Senseo users and the available options are not clear which makes consumers tempted to give up. There is a need for guidance at the point of malfunction.

Consumers are willing to behave in a circular way as long as the actions are clear and do not cost much extra effort. Therefore, the core challenge for users is to make circular decisions at the moment the product starts to malfunction. Users are likely to think the Senseo is at its End-of-Life. Hence, users will be inclined to replace the product, because this seems the most convenient and quickest solution to have access to a cup of coffee. Especially when users are not aware of quick and easy solutions to repair.

6.2 DESIGN CHALLENGE

6.2.1 GOALS

- Extend longevity;
- Reduce e-waste;
- Increase customer satisfaction, decrease frustration;
- Increase confidence, take away doubts;
- Stimulate problem solving;
- Build customer relationship.

6.2.2 FRAMED CHALLENGE

The challenge from a business perspective is to offer guidance to consumers at the perceived “End-of-Life” of the product in order to extend longevity and prevent premature disposal.

The behavioral challenge from the user perspective is to try solving problems with the malfunctioning product instead of directly giving up and replacing it. Changing this aspect of consumer behavior will reduce the environmental impact.

Focus of the project

What: intervention at the moment consumers experience malfunction;
How: by offering guidance through available options to solve the problem;
When: from the moment a Senseo malfunctions.

6.3 PROJECT SCOPE

Due to the limited available time for the project, the project scope has been narrowed down and lifetime extension has been chosen as the main focus. Proper disposal at the EoL is decided to be wishful rather than a requirement to this project. This decision is made based on feasibility and viability, since designing take-back logistics would exceed the project limitations formulated in §6.7. Besides, based on the analysis, designing for lifetime extension has high potential for circular impact as there are many opportunities and aspects that can be improved. The scope area of the project is visualized in Figure 42. The project focus for the next phase is on:

- Keeping the product longer at the same consumer, thus not on reselling to other users;
- Post-purchase consumer behavior and guidance;
- Out of warranty Senseos;
- The DACH, France, and Benelux **CONFIDENTIAL** of the Senseos are sold in those countries;
- Obsolete Senseos due to malfunctioning;
- Future old Senseos (yet to be produced), not on existing old Senseos (already out there), for more design freedom (this does not exclude accessibility for existing Senseo users).

6.4 FRAMING

6.4.1 VISION

The desired end state is a service that provides the consumer with clear options in order to enable and motivate them to confidently make circular decisions at the point of malfunctioning. This end state will postpone Senseos from becoming obsolete and will extend the lifetime.

The ultimate and ideal situation would be that all Senseos and other consumer electronics are less vulnerable and are being repaired by customers. Repair becomes the new social norm.

The Utopian vision is that all problems with Senseo can be solved by anyone, and that the Senseo has an unlimited life extension.

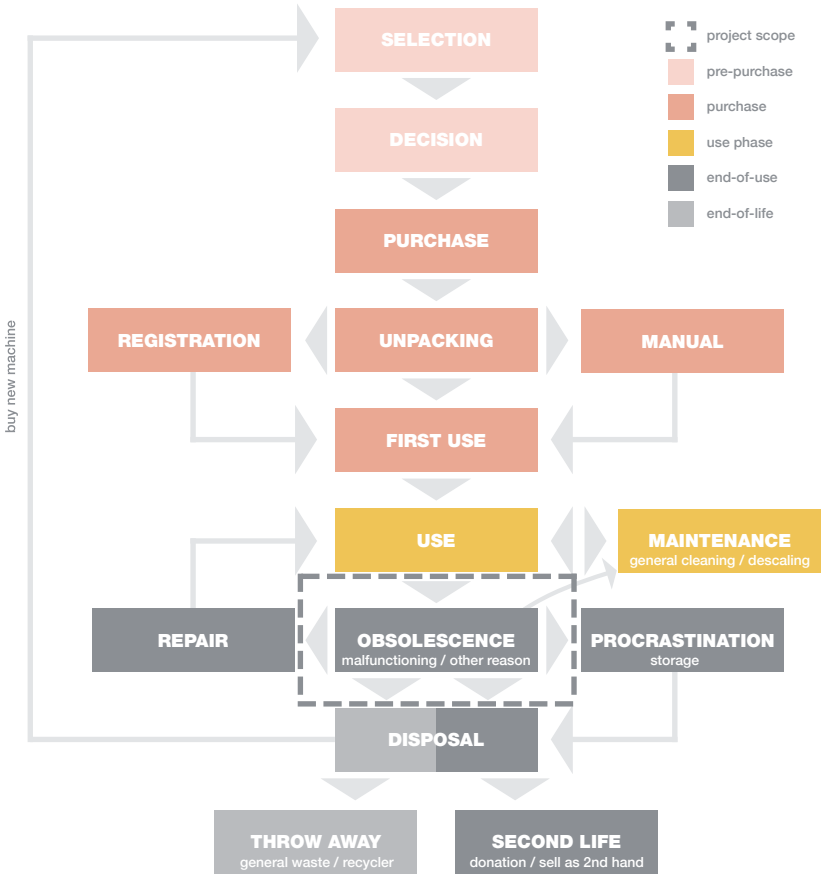


Figure 42: Project scope in journey general use phases based on Solomon, et al. (1995)

6.4.1 FROM ... TO ...

The table communicates which aspects in the current situation need to be changed:

	From	To
End-of-Use	EoU as unpleasant experience	Feeling good about yourself, pleasant experience, knowing you do something good
	Unclarity	Self-explanatory
	Unorganized flow, lack of information	Organized flow, clear options
	Doubts, no feedback or reassurance on choices	Confidence, recognition of good behavior
	No personal benefit in behaving circular	Personal benefit in doing the right thing
	Lack of motivation	Motivation
	Procrastination of disposal, collecting electronics in storage space, unawareness of impact	Quick action
Information	Extraneous information all at once (in user manual)	Providing relevant information at the right moment
Support	Limited support OOW	Guidance and support regardless of warranty
	Need for support, actively seeking support elsewhere (high effort)	Automatically receiving support and guidance from Philips (low effort), convenience
Malfunction	Unawareness of repair as an option	Obvious first step in case of malfunction
	Malfunctioning product perceived as End-of-Life	Extending use time, reverse obsolescence
	Frustration when the product malfunctions, not understanding what the problem is	No struggles, smooth process, low effort, convenient experience, knowing what you are up to
	Fast replacement	Offering quick solutions, procrastination of obsolescence
Philips	No visibility of products after sales	Visibility of installed base
	Poor customer relationship	Involvement, relationship building

6.5 METHODS AND APPROACH

The approach for design development is as follows. The idea generation started with an individual ideation round, followed by a creative brainstorm session with four Senseo users. During this session the Behavioral Intervention Design Toolkit by Anne van Lieren is used for inspiration. The intention is to influence user behavior and to increase the chances of having a durable impact on behavioral change by the inclusion of rational override in service design beside nudging (Van Lieren, 2018). A nudge as defined by Hansen (2016) is *"an attempt at influencing people's judgment, choice or behavior in a predictable way"*.

For the selection of ideas the C-box method is used (explained in §7.3). To evaluate the ideas and for concept selection user input is requested through a questionnaire among 100 respondents including 88 (ex) Senseo users.

For the detailing of the concept, various (technical) experts at Philips, the TU Delft and external technical experts are consulted. For the development of the service, again the Behavioral Intervention Design methodology is used as well as the Service Blueprint tool.

The three Horizons Methodology is used in the concept detailing as a tool to connect the present with possibilities in the desired future through a roadmap.

6.6 LIST OF REQUIREMENTS AND WISHES

The design requirements are categorized under environmental, business, user, and product service system requirements. The requirement categories are ordered by level of detail (Figure 43). The reason for this approach is that stakeholders have different interests and therefore different requirements.

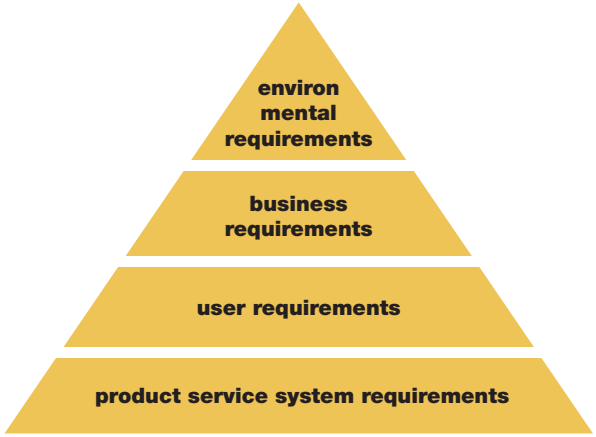


Figure 43: Categorization of design requirements

The design solution should meet all requirements. In the ideation phase, ideas and concepts that cannot meet the requirements are eliminated.

Environmental requirements

The solution supports circularity

- The design reduces e-waste by reducing premature obsolescence of Senseos;
- The design solution provokes lifetime extension and reversed obsolescence.

Business requirements

The design creates value for Philips

- The design is profitable and desirable for Philips to implement;
- The solution is conform to the set objective of Philips that the turnover coming from solutions that meet Circular Economy principles should increase from 8% in 2015 to 15% in 2020;
- The design strengthens the post-sales customer relationship;
- The design increases and stimulate consumer engagement;
- The design increases the visibility of the installed base;
- The solution is feasible and easy to implement on the short term (within 3 years);
- The design corresponds to the success factors of Senseo: low price category, convenient, easy to use (self-explanatory), fast, and low effort.

User requirements

The design creates more value for the user than the current support system

- The design solution increases customer satisfaction, and decreases frustration at the point of malfunction;
- The design creates clarity and an organized support flow;
- The design provides the consumer with clear options in order to enable and motivate them to confidently make circular decisions;
- The solution offers quick solutions and satisfactory results;
- The design solution offers support and guidance whenever necessary;
- The solutions is quickly and easily accessible for as many Senseo users as possible;
- The design provokes a feeling of support and guidance among the user at the point of malfunction;
- The design is more convenient and requires less effort from the user in troubleshooting than the current situation does;
- The design is desirable for users to use.

PSS requirements

The product service system influences consumer behavior at the point of malfunctioning

- The solution motivates, triggers, and enables users to solve the problem;
- The design solution reduces the amount of consumers from giving up on their Senseo at the point of malfunction;
- The design prevents consumers from postponing the problem solving actions;
- The problem solving instructions are clear and easy to follow;
- The design stimulates (directly or indirectly) circular behavior in case of a malfunctioning product;
- The design increases awareness among users regarding environmental impact;
- The design solution is optional and does not interfere with everyday use of the Senseo. Thus, the Senseo functions independently from the solution;
- The design provides a safe and secure environment: the designed concept takes the privacy of users into account and ensures the safety during the problem solving process;
- The design encourages primary and secondary repairs;
- The design discourages and prevents repairs that are considered to be dangerous for inexperienced users.

Wishes

- The design is scalable to other businesses and consumer electronics within Philips;
- The design stimulates an increased number of product registrations;
- The design prevents Senseos from ending up in the landfill at the EoL;
- The design guides consumers to a proper recycle point for product disposal at the EoL.

6.7 DESIGN LIMITATIONS

- For feasibility and viability, the project focus is to design for within the current business model (see page 8). Therefore, a complete new business model is out of scope. This limits the amount of potential circular impact and results in other limitations as low investment costs, no total redesign of the Senseo coffee machine, and that the cost price of the product cannot be significantly influenced by the design;
- JDE owns the brand Senseo and the website Senseo.nl. For major design changes by Philips, JDE must first approve according to a Senseo expert at Philips;
- Limited available data: some conclusions are based on limited after-sales data retrieved from a monitoring study by Repair Café among 12 sites.

DESIGN DEVELOPMENT

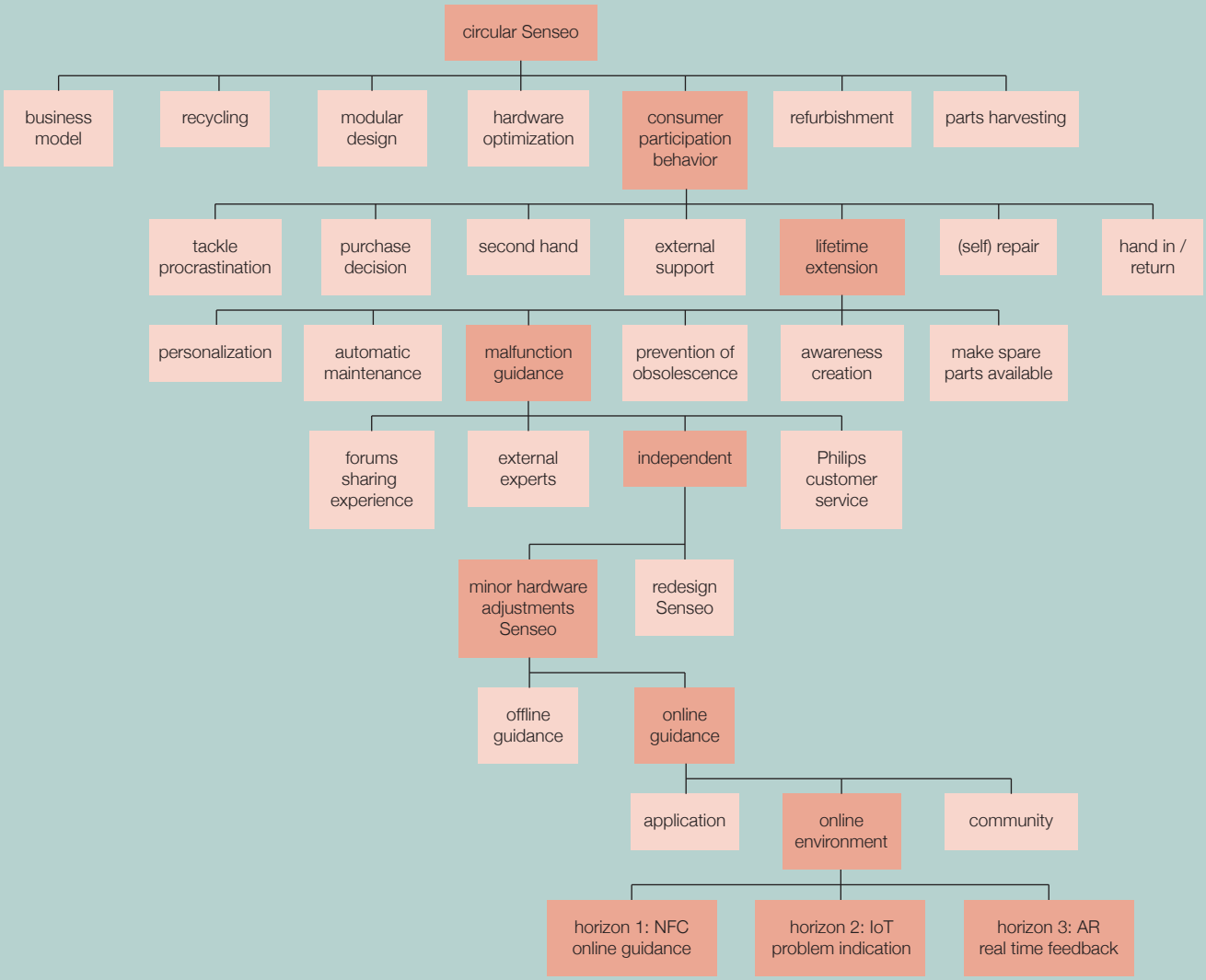


Figure 44: Project and scoping overview with considered and chosen opportunity areas

7 CREATIVE PROCESS

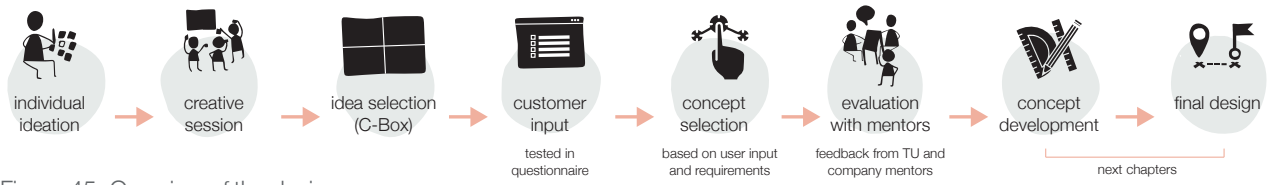


Figure 45: Overview of the design process

This chapter provides an overview of the creative process resulting in an initial concept that will be developed into a detailed design in the next chapters. The design process is visualized in Figure 45.

7.1 IDEA GENERATION

The idea generation started with an individual ideation session. A creative session with four Senseo users was setup to come up with more enriched ideas as a second iteration step (Figure 46). The session plan can be found in appendix R.

Brainstorm session

The starting point of the session was the scenario in Figure 48 combined with the question *"How to be supported at the moment of malfunctioning?"*. The 'How To' tool is a common design tool for at the start of an idea generation (Tassoul, 2006).

For the brainstorm session the Behavioral Intervention Tool was chosen as a means to inspire, because it aims to influence user behavior and to increase the chances of having a durable impact on behavioral change (Van Lieren, 2018). Prior to the brainstorm session a pilot session was done to test if the intervention strategy cards of the Behavioral Intervention Toolkit would inspire during a creative process. This was indeed the case.

7.2 IDEA SELECTION

The multitude of early ideas generated in the brainstorm session were supplemented with the previously generated ideas in the individual ideation. Altogether this summed up to roughly 50 early ideas.

Figure 46: Creative session with Senseo users

The C-Box method was applied to generate an overview, this is a 2x2 matrix (Figure 47). The ideas are judged by the following criteria: 'feasibility' (x-axis) and 'innovativeness' (y-axis). Feasibility is defined by how realistic the idea is and whether it can be realized on the short- or long-term. Innovativeness is defined by how new or advanced the idea or technology is for the user, and if it will create circular impact. This method resulted in a first rough distinction between ideas in the four groups (Tassoul, 2006).

7.3 CONCEPT CATEGORIES

According to the C-box matrix, the ideas in the upper right corner are most promising. Those could be categorized in the following categories (appendix S):

- *Alternative business model* – out of scope for this project and it does not meet the business requirements about short term feasibility. Nevertheless, Philips is recommended to look into alternative business model opportunities as it has high potential for circular impact.
- *Automatic problem solving* – this is desirable for all users. However, the project is about how to intervene and influence behavior at the point of malfunctioning without making a total redesign of the Senseo. Therefore, it does not meet the PSS requirements. Philips is recommended to look into the viability of the ideas in this category.
- *Personalization* – out of scope, Philips is recommended to look into the desirability among Senseo users. This category of ideas is expected to appeal to a small niche in Senseo users thus the circular impact on large scale is expected to be limited. Therefore, it does not meet the environmental requirements.
- *Community* – test desirability with user input.
- *Connectivity* – test desirability with user input.

Ideas in the categories 'community' and 'connectivity' fit within the project scope and are conform to the main environmental, business, and PSS requirements. Therefore, ideas in those two categories are evaluated regarding desirability among consumers.

Figure 47: C-box method

7.4 EVALUATION AND SELECTION

7.4.1 QUESTIONNAIRE

In order to make decisions on further selection, user input is requested in a questionnaire. In this questionnaire, the most promising concept elements (see the next page) that are conform to the design requirements are tested. The opinion of respondents is asked regarding desirability per element in the categories 'community' and 'connectivity'. For this, open questions and a Likert Scale are used with literature based response anchors (Vagias, 2006). The questionnaire (appendix O) is conducted among 100 respondents of which 88% (ex) Senseo users. The results (appendix P) are analyzed face value, for inspiring and guiding purposes in the concept selection. The infographic on the next page depicts the main insights, resulting from the questionnaire. The formulation of the questions was checked by Chéron Huskens (2018), junior research consultant at InSites Consulting.

Approach

The respondents were given the scenario in Figure 48 with the context description: *"Imagine on a Saturday morning you want to make a cup of coffee but the coffee machine does not work for some reason and you don't know why…"*

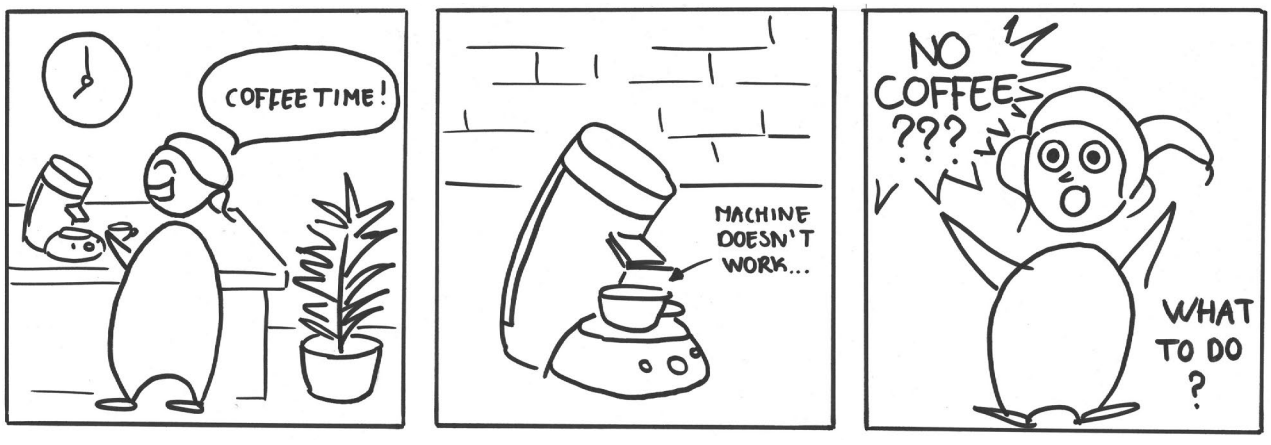


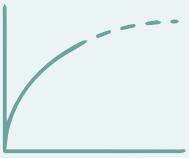
Figure 48: Scenario in questionnaire

VISUAL INDICATOR

Very positive, both about problem indication and about visual guidance and communication.

INDICATION

Very positive about indication of the problem. It is found that 'finding the problem' often stops the person from fixing, it reduces the perseverance. If that barrier is removed, that would yield profit in the fight against premature waste.



PREDICTION

Slightly negative, little or no need for predictions. Those can even be confusing or leading to distrust. People indicated to think that Philips will use it to sell more devices.

APPLICATION

25% indicated on own initiative unwilling to download a Senseo specific app and prefer a website. This influenced the data resulting from questions involving apps. However, people are enthusiastic about the concepts and there is a clear preference for online support.

STEP-BY-STEP

People are positive about step-by-step guidance. A clear need is indicated for clarity during the whole process about which action(s) must be undertaken.

NFC TAG

Mostly positive. However, perhaps it was not clear in the survey that this concept is a means to come to support, not support in itself. This appears from the open answers that indicate several times that people find the findability important by means of, for

TEXTUAL INDICATOR

Strong preference for visual support above textual.

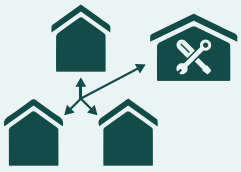
TIP EXCHANGE

Participants are positive about the idea that they can consult about other people's experiences with the same problem and their solutions. However, it is indicated that they are not likely to contribute to the forum themselves by sharing their own experiences. So only commensalistic use of the forum, for own benefit.

INSTRUCTION VIDEOS

Much enthusiasm about instruction videos because it is easy and low-threshold to consult.

CONNECTING NEIGHBORS



Neutral. However, in the open answers people frequently report not to be enthusiastic about consulting other people or parties. They prefer to solve the problem independently. From this it can be assumed that in practice people would make little use of this concept. Building a certain community requires high user effort.

People are positive about forums, mainly because it is accessible and easy to find. People indicate that they would not write anything on the forum themselves. They are mostly interested in the experience of others.

FORUM

Enthusiasm about the idea of having quick and easy access to the right info source. Whether that is a clear link to the website or via an NFC tag.

PHYSICAL

example, a clear URL or a website that is easy to find in the search engine. The NFC tag is a means to make this search shorter, easier, and more efficient. Therefore, in fact participants appeared to be more positive about this idea than the graph indicates.

Other insights from the questionnaire:

- It is indicated that the amount of time weighs out the amount of steps. People are willing to invest 15-30 minutes on average into fixing the device;
- The number of steps people are prepared to take depends on the problem and the situation. The probability of success is more important than the number of steps.

7.5 SELECTED CONCEPT

Based on the main insights of the questionnaire, a desirable concept can be selected. The chosen concept creates physical accessibility to a digital service to support customers with troubleshooting and solving problems of their malfunctioning product. The concept includes the following elements. For each element it is described how it meets the design requirements and how it contributes to desired behavior change according to Fogg's behavior model (2009).

NFC tag - by increasing accessibility and removing barriers to find support, an NFC tag triggers users to resolve the problem. The minor hardware adjustment has high potential for circular impact.

Website for online support - online guidance is desired by consumers and a website functions as a platform and channel for motivating users in the problem solving process. Internet support creates visibility of the installed base and enables Philips to gain understanding on what happens with the products after sales.

Step-by-step guidance - enabling consumers to solve the problem by providing clear options and easy-to-follow instructions. With step-by-step guidance the consumer behavior can be influenced in the desired way.

Visual guidance - by making the problem solving process as clear and easy as possible, the ability among users to solve the problem increases. Subsequently, pain points decrease and an increase in customer satisfaction is expected.

Problem indication - indicating what and where the problem is triggers consumers to take action as time and effort barriers are removed.

7.5.1 ADDED VALUE

The concept provides customized professional advice on maintenance, as well as comprehensive step-by-step guidance on how to identify and solve problems. The chosen concept solution adds value to both Philips and the user because:

- This solution is close to the naturally preferred way of tackling a problem: independently and with online support;
- This solution guides people to the right information source in the fastest way;
- It delivers professional support and guidance after sales, which people expect from a high-end brand as Philips;
- It reduces effort and removes barriers to find relevant information at the right moment;
- The chance that people actively resolve and repair the Senseo is increased by a step-by-step guidance. Subsequently this will result in a reduction of premature e-waste;
- The solution does not only meet the design requirements but it is also potentially scalable to other businesses and provides the opportunity to increase registration numbers (design wishes).

In the following chapters the concept will be further investigated and developed into a detailed design.

8 DETAILING

The selected concept can be rearranged in a roadmap for defining the layout of the different design phases and to provide the reader an abstract perspective.

According to the website Productplan.com (2018), a roadmap is *"a strategic plan that defines a goal or desired outcome, and includes the major steps or milestones needed to reach it."*

The Three Horizons Methodology is applied for the detailing of the design. This method helps to connect the present with possibilities in the desired future and identifies *"disruptions which might occur in moving towards a vision"* (Hobcraft, 2015). With each horizon the design will come closer to the vision of the project: to give shape to the ideal support service experience.

However, for each horizon different technologies are required and different decisions have to be made. This chapter discusses multiple considerations and decisions that lead to the final design (chapter 10). Chapter 10 also contains the fully defined roadmap.

The starting point for this chapter are the three defined horizons (Figure 49). Those are detailed in the following paragraphs.

Approach
Various experts are consulted for the detailing of the design, because the design has a technical nature. Among these experts are: electronic engineers, a data engineer, innovation expert and IoT expert. The opinion of the end-user is important too, so their input is used to make design decisions.

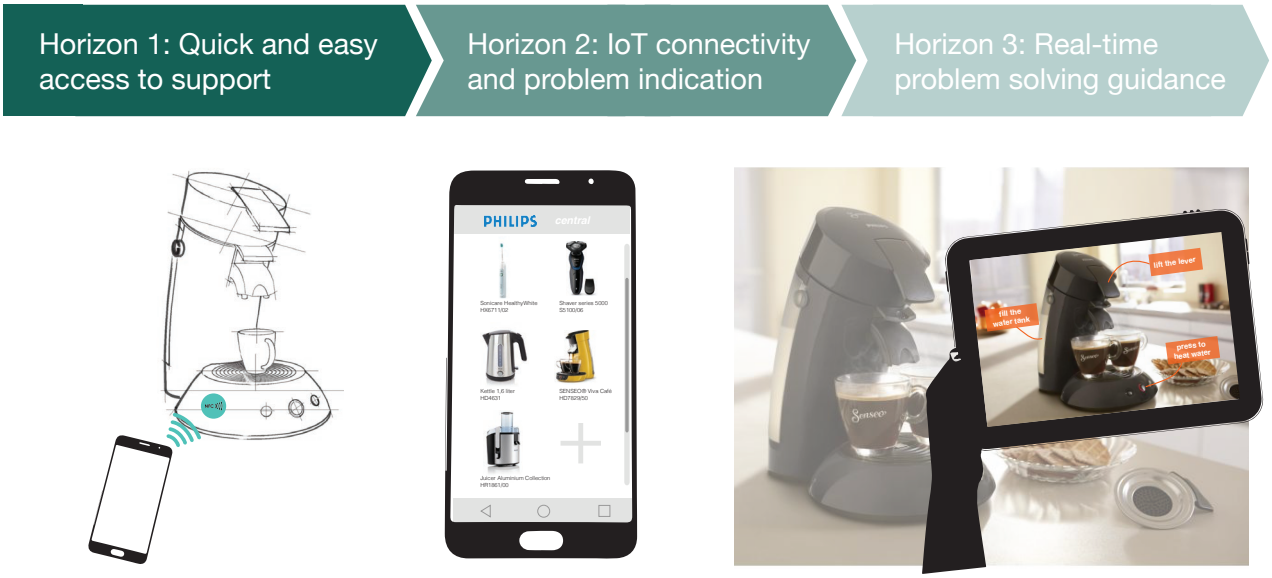


Figure 49: Defined horizons

8.1 HORIZON 1: NFC TAG

The first horizon describes wireless technologies that can be used to facilitate the access to malfunction guidance. These are integrated in the Senseo machine. The main purpose of the concept is creating access for consumers to a Philips support website by means of a smart device and through the interaction of the two devices (Senseo and smart device).

8.1.1 WIRELESS CONNECTION OPTIONS

Four types of wireless connection technologies are taken into consideration for easy access to malfunction guidance: Bluetooth, RFID, NFC, and QR. In appendix T these four technologies are compared and their critical strengths and disadvantages are highlighted.

The main requirements for technology selection are:
- No large investment costs;
- Accessible for as large public as possible;
- Ease of use.

QR vs. NFC

Following from those requirements, both a QR code (Quick Response) and an NFC tag seem feasible (Near Field Communication). Therefore, both are further examined and compared (see pink boxes with comparison). To compare the usability of both technologies, quick prototypes were made and tested (appendix U).

QR

\+ Almost free;
\+ All smart devices with camera can scan a QR code.

\- Requires high contrast: black on white;
\- Minimum size is 2x2 cm (QRcodeMonkey, n.d.);
\- For many smart devices it is required to download a special QR reading app;
\- Aesthetically disturbing.

NFC

\+ No application installation required (ready to use);
\+ Aesthetics: can be hidden;
\+ Nearly all smart devices are NFC compatible.

\- Only Apple devices with the latest operating system iOS are NFC enabled for external parties;
\- Slightly more expensive than QR.

Decision

The Senseo will contain an NFC tag because the aesthetics and ease-of-use (no app installation) are more important than the costs. Hereby the risk of people finding it too much effort to scan is reduced.

Only people who do not have access to a NFC compatible smart device are excluded from using the feature. However, it is found that NFC is an upcoming technology, which is more and more commonly used. People are getting more familiar with it and it is known for its user friendliness and ease of use, just as the Senseo itself. By using NFC in consumer products, Philips once again shows to be a front runner in technology.

Android and Windows devices are NFC enabled since 2012 (Hamblen, 2013). Since 2014 Apple iPhones are NFC enabled as well, but for Apple applications only (Van der Zwaag, 2018). Since June 2018 the latest operating system iOS12 is available by which Apple devices are NFC enabled for external parties (Campbell, 2018). Therefore, it is only a matter of time until Apple users allow a software update and use the latest operating system.

Recommendation

To make the service accessible to the excluded group it is recommended that the URL is also easily accessible through search engines. As mentioned before, the Philips website is currently hardly in the top 7 search results when searching for a problem with the Senseo on Google (§3.2.3). Therefore, Philips could invest in findability on Google of the improved self-service system.

8.1.2 DESIGN

Specifications NFC

For mobile phone use NFC Today (2017) recommends a 30 mm tag with 25 mm antenna which should have a reach of typically 4 cm for communication (Hamblen, 2012). A physical touch is not required to share the information. Based on desktop research an NFC sticker costs approximately €0,05 per tag (Made-in-china.com, 2018).

Location

The main design requirements for the tag are:
- Discoverable and visible;
- Should not disturb the design (aesthetically);
- NFC tags are not dishwasher proof, therefore the tag cannot be placed on parts that are supposed to be washed in dishwasher;
- Must not wear easily.

In appendix V the location determination has been extensively considered and described.

An NFC sticker (see Figure 50) is placed on the inside of the Senseo. An NFC sticker the cheapest form of attachment and most common. As it is thin, it fits on the inside of the device. Therefore, no new mold or mold adjustments needed for that matter.

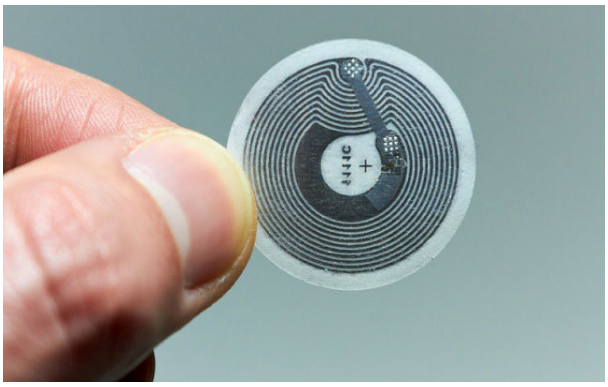


Figure 50: NFC sticker (Triggs, 2018)

Decision
The NFC tag is placed on the control panel. This is an intuitive location because the user interaction takes place in the close vicinity.

Recommendation
The location is determined for the Senseo Original. For other Senseo models the location has to be re-determined.

Information presentation
Since the tag will be placed on the inside of the Senseo body, it will be invisible. Therefore, it has to be indicated where the tag is located for scanning. By looking at how information is presented and printed on intensity select versions, the information about the NFC tag can match the current design of Senseo (Figure 51). On intensity select versions the communicating language is English, regardless of the market in which it is sold.

As can be seen in Figure 51, information is commonly presented with an icon, combined with one or two words.

Figure 51: Senseo Intensity Select control panel (Coolblue.nl, 2018)

Test design information presentation
For the icon-word combination a test is conducted with 8 participants. In this test clarity and understandability of the presented information is tested for selection of the most suitable version.

Participants had to choose and describe which icon-word combination they find easiest to understand and why in short face to face interviews. In appendix W the test and results are described.

The chosen form of information presentation is visualized in Figure 52. This is chosen because people associate the phone directly with the fact that an action with the mobile phone is required for help. The word 'scan' should be included to make extra clear that the mobile device has to scan the NFC tag. And the word 'help' should be included because that communicates most clearly and in an easy way what the tag is meant for.

Recommendation
This icon-word combination is tested for the Dutch market. It is recommended to test if it also works for other markets.

Figure 52: Information presentation design

8.1.3 TECHNOLOGY: HOW NFC WORKS
As visualized in Figure 53, the passive NFC tag is reliant on an active device (e.g. smart phone or tablet). To power the tag an electrical current is created by electromagnetic induction, which is generated by the active device. Subsequently, the coils of wire produce electromagnetic waves which are exchanged between the coil of wire of the NFC enabled device and vice versa.

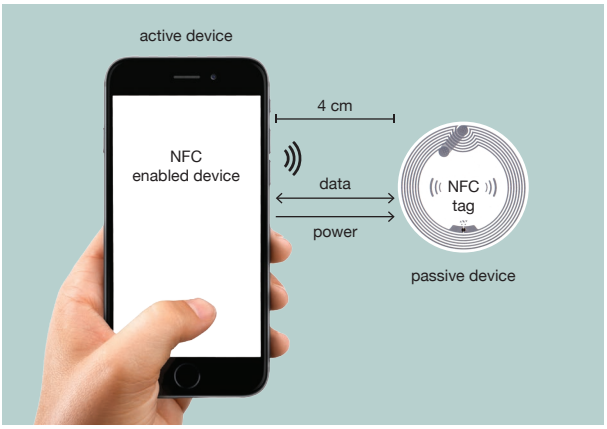


Figure 53: Explanation of NFC technology

According to Triggs (2018) the more turns in the wire coil, the more battery power is required of the active device. Additionally, more current means a larger distance for connection reach (Figure 54). To safe battery power, NFC technology operates within only a few centimeters.

8.1.4 AESTHETIC DESIGN

The aesthetic design is presented in Figure 55.

Note: Senseo comes in many different colors. For each color Senseo that exists, the color combination has to be as follows: for the printed information the color of the logo on top of the Senseo should be selected.

8.1.5 ENVIRONMENTAL IMPACT NFC

According to the website GoGoTags (2018) an NFC tag contains the following materials:

- PET;
- Aluminum or copper (antenna);
- Silicon, gold (circuit);
- An adhesive.

It is difficult to separate the materials when it is all combined in an NFC tag. Therefore, NFC tags are not suitable for recycling.

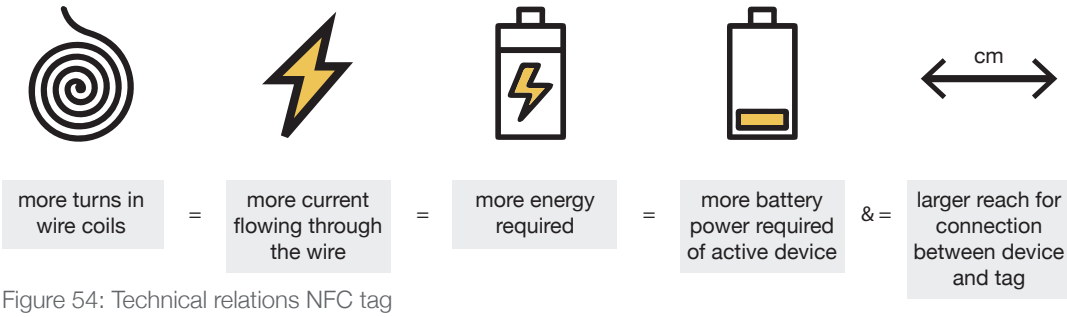


Figure 54: Technical relations NFC tag

Figure 55: Aesthetic design

8.2 HORIZON 2: IOT AND PROBLEM INDICATING SENSORS

When the Senseo becomes IoT connected for simplified and semi-automatic diagnostics, the NFC chip becomes unnecessary (Figure 56). The NFC functions as an intermediate step towards the ideal support service experience.

8.2.1 WHY CONNECTIVITY?

People are more and more used to having all digital services in one central place: the smartphone. According to the findings in §1.4.2, the trend is only destined to grow and to strengthen the centralization of the smartphone in user's daily activities. According

be used for the realization of the design in horizon 2.

An alternative to wireless connection has been considered and consists of a display added to the Senseo machine. This option however does not seem to be efficient in this context: all the functionalities of a display are already available in a smartphone. Extra electronics are required for a screen that can communicate limited information, while users already have a display on their phone through which unlimited information can be communicated. Moreover, adding a display would require a total new production line and new molds which means high investment costs.

Choosing connectivity will save production costs and will cut on environmental impact too. Besides, connectivity will enable database generation which will be discussed in §8.4.

8.2.2 SENSOR SELECTION

Current Senseos already have sensors, but for problem indication additional sensors should be added as well as wireless connectivity. For the selection of sensors two electronics experts at the TU Delft are consulted: Professor Wolf Song, and Electronics Engineer Richard Bekking.

The four most common solutions for Senseo repairs (see §3.4) are taken as a starting point for the sensor selection and the design of the second horizon in the roadmap:

1. Replacing the magnet in the float;
2. Cleaning and/or descaling;
3. Replacing the capacitor;
4. Replacing the three-way valve.

For sensor selection it should be taken into account that adding sensors and other electronic components can lead to more damage than making the Senseo stronger. Therefore, for each situation this balance is made up. Thus for selection of electronics, the following is considered: price, ease-of-use, and environmental impact. Of course the selection of technology depends on the production numbers. Besides, this design is based and focused on the most common solutions according to the database of Repair Monitor 2017, which is a very limited and small sample.

Other considerations that are taken into account for the design are to avoid total new production lines and new or extra molds regarding high investment costs.

1. Replacing the magnet in the float: This magnet serves the regulator of the water level. Magnets are subjected to get rusty and expands over the accepted size. This results in the float getting stuck (Repaircafe.org, 2018c).

A possible sensor that could detect whether the float is stuck could be an optics sensor. However, this is not recommended because sustainability should not be forced by adding complexity. Adding complexity makes the product also more vulnerable for failures. Instead of adding a sensor in the Senseo that detects whether the float is stuck, it is recommended to change the design and replace the currently used

Figure 56: Differences in operation systems of horizon 1 and 2

magnet by a rubber or silicon coated, or stainless steel magnet. **This will prevent up to 30% of the problems (§3.4) and is even cheaper than adding a sensor to the design.**

2. Cleaning/descaling: In newer Senseo models there is a "CALC" LED to indicate whether the machine needs to be descaled. This LED turns on after 400 cups of coffee (Reparatie Handleiding, 2015). The current way is not very accurate because it depends on the water hardness whether a product needs to be descaled and thus on the living area. Besides, some people use a water filter and for them this system is perceived as annoying (user interviews appendix N).

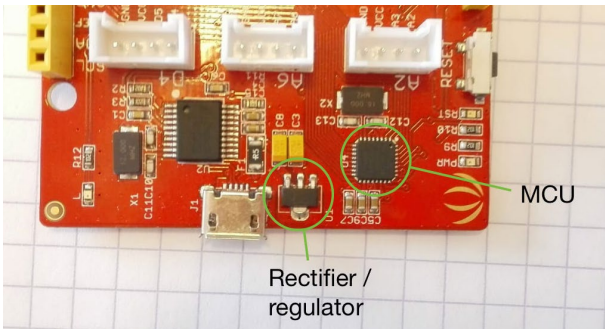


Figure 57: Rectifier and MCU

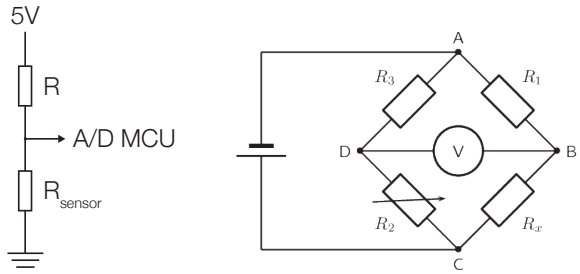


Figure 58: Voltage divider and Wheatstone Bridge

An alternative and more accurate way for measuring if a Senseo needs descaling is with a conductivity sensor. If conductivity changes, the resistor changes. The Analogue to Digital converter is in the rectifier / regulator and the signal is read out in the Micro Controller Unit (MCU) as can be seen in Figure 57. With a voltage divider (Wheatstone Bridge, Figure 58) you can measure if energy conductivity changes and thus if the machine needs to be descaled or not. For reading out the MCU requires probably 1 micro ampere (Song, 2018).

Additionally, by measuring the electric conductivity the energy usage can also be reduced which leads to more efficient and sustainable usage.

Another option for detecting calcium is by creating resonance in the boiler with ultrasonic vibrations. By measuring the frequency it can be detected when the own resonant frequency changes. If it changes, descaling is required. However, for this technology more electronic components are required and therefore it is a less sustainable option than measuring electric conductivity.

A quick online search found that conductivity sensors cost €2,19 per 10 sensors (Alibaba.com, 2018). It is likely to be cheaper when bought in high volumes.

3. Replacing the capacitor: The capacitor breaks down because of the high voltage peaks. The chosen capacitor is too weak (Repaircafe.org, 2018c).

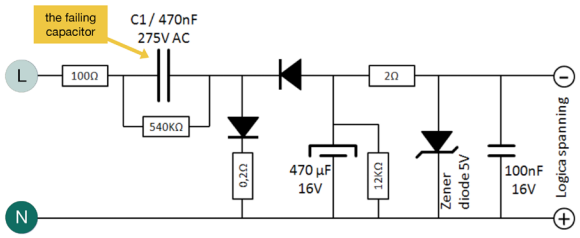


Figure 59: Schematic of the electronics power supply of current Senseo (Reparatie Handleiding, 2015)

There are three capacitors used in current Senseos. Only one of them is typically failing (Figure 59). Changing the currently used capacitor by a stronger version is much cheaper and easier than adding a sensor to measure if the capacitor is broken. Again: sustainability should not be forced (see point 1). Simple solutions are preferred above complex additions. A quick search on Alibaba.com (2018) finds a cost price of €0,04 per capacitor when ordering 5000 pieces.

4. Replacing the three-way valve: Often leads to leakage around the boiler. A broken or defect pump also leads often to leakage around the boiler (OnderdelenSenseo.nl, 2018).

For detection of leakage around the boiler a capacitive sensor can be used according to Richard Bekking (2018). A capacitive sensor is a small metal plate that detects fluids. For this technology a funnel should be added around the boiler to lead leaking fluids to the detector (Figure 60).

Capacitive sensors cost €0,09 per 50 sensors (Alibaba.com, 2018). Additional costs are that of the funnel and the production line possibly needs small adjustments. Therefore, an assessment must be made with regard to the added electronics and funnel versus the fact that leakage is the number one most observed problem (§3.4). It has to be investigated when and whether the benefits outweigh the investments. For now it is assumed that the investment costs will remain low enough and that it is therefore worth the investment.

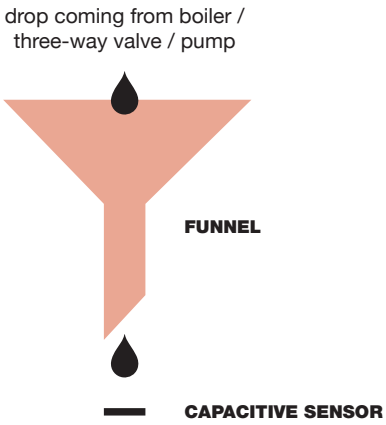


Figure 60: Principle of detecting leakage with a capacitive sensor

Additional considered options

The temperature sensors integrated in the Senseo measure if the water reaches the right temperature and therefore can detect if there is a problem with the heating system or not. In the new design this information can be communicated to the microcomputer with small adjustments.

A 'watchdog timer' can be added to the device to detect and recover computer malfunctions (Bekking, 2018). This timer can self-reset the firmware in case of a software error. However, this might be overkill, and resetting the software is not among the main issues of Senseo.

Conclusion

Based on the limited available data of the Repair Monitor 2017, the following sensors (Figure 61) seem most suitable for the IoT connected Senseo for problem indication:

- Electric conductivity sensor to reduce energy usage and to detect if descaling is required;
- Capacitive sensor to detect leakage.

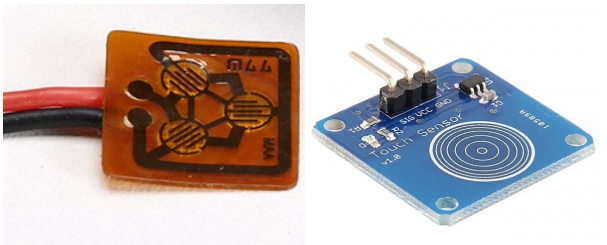


Figure 61: Left: conductivity sensor (Alibaba.com, 2018) Right: capacitive sensor (Ebay.com, 2018)

However, this decision should be reevaluated based on generated data by the NFC in the first horizon of the design and by a more extensive and precise cost calculation.

Beside adding sensors to the Senseo, two other important adjustments are advised to be made in the Senseo:

- Replacing the magnet with a coated or stainless steel version;
- Using a stronger capacitor.

These adjustments will significantly increase the quality of the device and extend the lifetime of the Senseo. These two changes can already be implemented earlier, in horizon 1.

8.2.3 WIRELESS CONNECTIVITY

Six considered wireless connectivity options are discussed in appendix X. For this, Professor Wolf Song (2018) of the TU Delft was consulted. From this comparison two technologies seem suitable to implement in the design: Wi-Fi and BLE (Bluetooth Low Energy). Both are commonly used and widely accessible and therefore considered good candidates. It is important to state that in both cases the Senseo machine can notify the user through push notifications, which, in turns, would require an app installed on the users' smartphones (Urbanairship.com, 2018). Users can receive push notifications but the application is not required to be open and the user is also not required to be using the device.

It will not be necessary to develop an app specifically for the Senseo because the central Philips app can be

the ease of use for users owning multiple Philips products.

After carefully reviewing both wireless technologies in consultation with Giuseppe Guida (2018), data engineer at Coolblue, the BLE shows itself as the most promising alternative, but it is still interesting to show the upsides and downsides of both technologies. The operation of both alternatives is visualized in Figure 62 and Figure 63.

BLE

When using a BLE connection for the Senseo, the achieved objectives are threefold:

1. The user does not need to be connected to the internet;
2. The user can receive a push notification when a problem is detected as soon as (s)he is within the receiving distance;
3. As soon as the user has access to the internet, sensor's data until then stored on the smartphone, could easily be send to Philips for analytical purposes (prior privacy consensus).

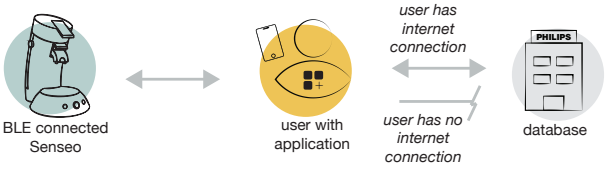


Figure 62: Scheme of Bluetooth operation

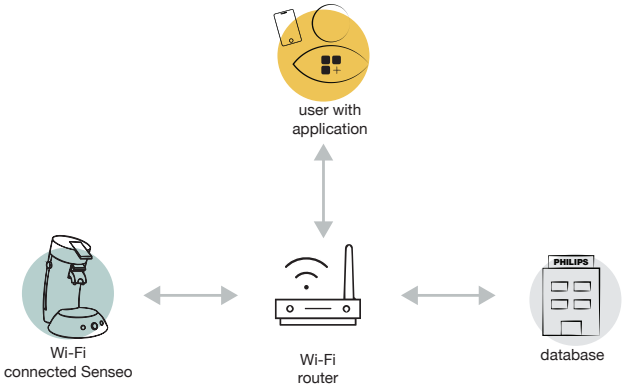


Figure 63: Scheme of Wi-Fi operation

Two important "facts" are important to be highlighted, which are related to the Senseo device:

- In case of problem occurrence, the Senseo should be able to keep the information stored in memory until it is possible to send it to the smart device, which in turns should send a background message of received notification for preventing the user from receiving the push notification in an infinite loop. This requires the Senseo device to be provided with a minimal storage which is not reset when the Senseo is shut down.
- A "first installation", or better, "registration of the Senseo device" to user's smartphone at the beginning of the use phase is required. This would be possible by putting the Senseo in a "Ready to register state" by pressing a Bluetooth button and by pairing the smartphone to the Senseo by selecting the Senseo in the Bluetooth connection among the available devices (Figure 64).

Wi-Fi

Using the Senseo as a smart device connected to the Wi-Fi is an interesting concept but it is doubtful whether this is necessary for providing better support to the users.

With the usage of Wi-Fi the Senseo machine would be capable to automatically dialog with the internet, after a first installation. This methodology is convenient for two reasons:

- The users would seamlessly receive a push notification when a problem occurs regardless of the distance;
- Senseo can directly send sensor's data to Philips, prior privacy consensus, for analytical purposes.

The requirements for providing better support are only satisfied if a Wi-Fi connection is available. It is important to bear in mind that this is not always possible: even though Wi-Fi is widespread on the Dutch territory, the same assumptions cannot be made for all areas in the Netherlands or for foreign markets.

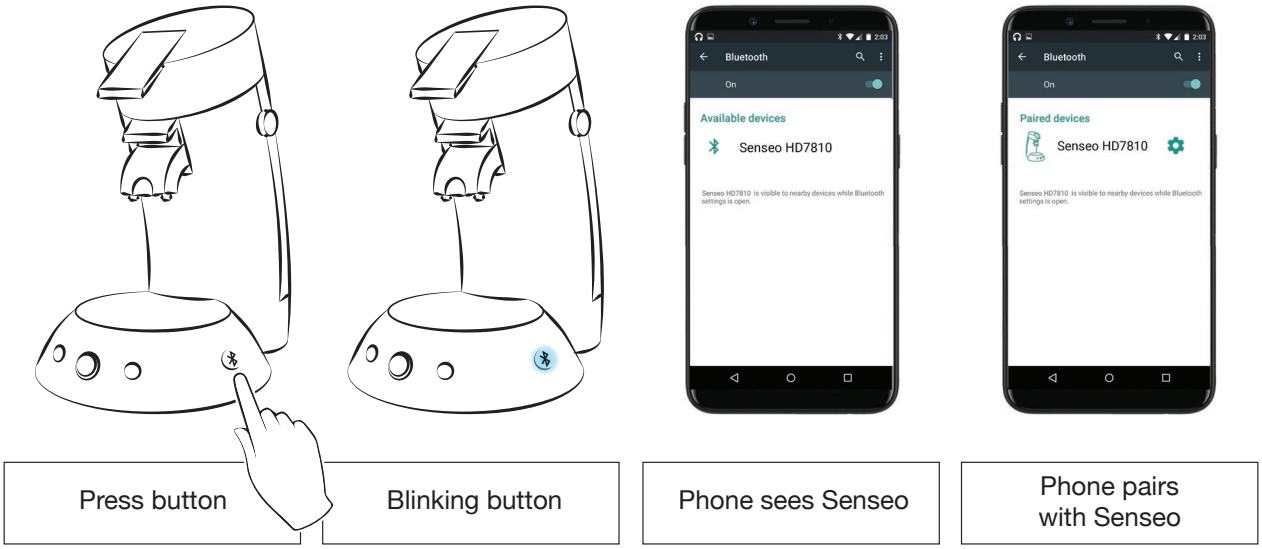


Figure 64: Scenario first installation Bluetooth

Furthermore and differently from BLE, the “first installation” is an uncomfortable aspect: the user would be asked to connect the Senseo to the network through an ethernet cable connected to the router, which, beside requiring the Senseo to have an ethernet port, looks like a time and effort consuming action. This might not be well perceived by users. It might even be perceived as unnecessary, annoying, or even a far too complex action to make for customers that just want a cup of coffee.

Conclusion
At this point, BLE seems the most suitable connection technology in combination with the central Philips app. Both with Wi-Fi and BLE connection the system will be the same. At the evaluation point of horizon 1, this decision should be reevaluated based on the generated data and to see if it is still the most suitable technology for that time.

8.2.4 PCB ADJUSTMENTS

The most suitable and commonly used BLE is ESP32 which is 5x5 mm and has minimal PCB requirements. It can most likely easily be added to the current PCB in Senseo (Song, 2018). ESP32 is a hybrid Wi-Fi and Bluetooth chip engineered for mobile devices, wearable electronics and IoT applications (Espressif.com, 2018).

It might seem strange to select a combination of BLE and Wi-Fi. However, this is a wholesale package which is cheaper than a BLE-only chip due to the demand and production numbers. The Wi-Fi function will be disabled. In this case, in the costs versus environment balance, there has been chosen for the minimum costs. Price per unit is €2,55 on Mouser Electronics (2018).

For integration of the ESP32, which is inside the Micro Controller Unit (MCU), the MCU needs to be shielded and separated from large currents (e.g. hot water = large current). According to Wolf Song (2018) this is common for electronics engineers to take into account while designing the electronic circuit.

Recommendations
- Electronics engineers should design this part of the product;
- After generating a database in horizon 1, the selection of electronics should be reevaluated based on the new data.

8.3 HORIZON 3: AR GUIDANCE

Horizon 3 is a more futuristic and therefore a less technically developed part of the project. It is an investigation of what could be a possible revolution of the devices in Philips and how this can contribute in the transition to a CE. This might not be the way to go. But this should be evaluated in the coming years.

Within horizon 1 and 2, people are driven by visual guidance and support, which is built according to a generic flow chart. At most, this support is customized based on general demographic data. But what if each person could receive unique and personal support? Augmented Reality (AR) technology could contribute in creating the ideal service support experience. This Utopian vision is described as follows:
- All problems with Senseo can be solved;
- Anyone can solve problems with Senseo and repair;
- Senseo does not die: unlimited life extension.

But is this possible? With AR we can get really close. According to Fiarchuk (2016) AR requires the following elements which are already covered in horizon 2:
- Device equipped with a camera and screen;
- Internet connectivity;
- AR apps/software.

During an evaluation round with Luc Geurts (2018), AR expert at Philips, it was found that AR is mostly relevant for tertiary repairs, less for primary and secondary repairs. This is because a specification of AR is that it is suitable to show hidden things and to localize (hidden) parts or problem areas. The first can for example be used for making sliced views which shows the inside of the device without opening it. Localizing can for example be used for indicating the safe zone. This allows Philips to communicate clearly what the consumer can and cannot touch or fix. Another interesting possible add-on could be an AR manual.

Without the possibilities of tertiary repairs, the addition of an AR feature might be an overkill. High investments are required for services that can also be simplified and slightly less advanced, for example by communicating on the basis of videos and images. In that case, the support guidance can be kept simpler in connection with ease of use. The extended users data generated in the first two horizons makes that Philips knows her customers well. This enables the company to offer personal and unique support.

Horizon 3 with real-time guidance via AR technology is only possible under the following circumstances:

- If AR technology is better developed and the costs are reasonable;
- If smartphones are more AR compatible;
- If Senseo is designed modular, which makes it easy and safe to replace a part and repair tertiary problems;
- If (more) spare parts are available in the Philips online store.

For the latter aspect, the amount of time that people are willing to be without a working coffee machine has to be considered. Therefore, it must be ensured that the order and delivery procedure for spare parts should be fast and does not take more than two days. To keep the motivation among consumers high, also the price of the spare parts has to be low compared to the price of a new product. According to Ackermann et al. (2018), high product prices and low prices for spare parts have a positive effect on product care and the motivation among consumers.

Added value

Augmented Reality enables unique and personal support for each user which contributes in creating the ideal service support experience. Furthermore, by selling more spare parts Philips gains recurring revenues.

Implementing the AR technology in the support guidance can potentially have a great contribution to the circular economy. Because expansion of the number of possible repairs of a Senseo increases the number of saved Senseos. Rana Abboud (2014), architect at BVN, states:

"By directly overlaying real-time computer graphics onto actual equipment, AR can guide persons with little or no prior training through maintenance and repair tasks on complex equipment.".

To increase the potential circular impact even more, Philips is recommended investigate the possibilities to create a take back loop for spare parts that are being replaced by the customer for repair. Then the user can simply send the replaced and broken part back to Philips in the same packaging the new part arrived. This will increase visibility of the products at Philips and it will ensure efficient use of materials (e.g. recycling or refurbishment at Philips).

How it works

In tertiary reparations people are guided real-time using AR technology (Figure 65). The AR technology is explained in the scheme of Figure 66. AR enables step-by-step real time guidance (like a tour through the Senseo) and can point out exactly where the problem is located and whether it is within the safe-zone. AR is also suitable for showing hidden parts. While using the application, which requires a software update after horizon 2, customer service (either a person or a robot) can then see what the user sees and offer direct and accurate guidance. In this scenario, it might still be possible that some parts are not to be touched by the consumer.

In the third horizon, the application requires a software update to enable AR repair guidance and personal customer support. This software update can only be launched in case it is confirmed that guided repairs are safe and easy for consumers to execute.

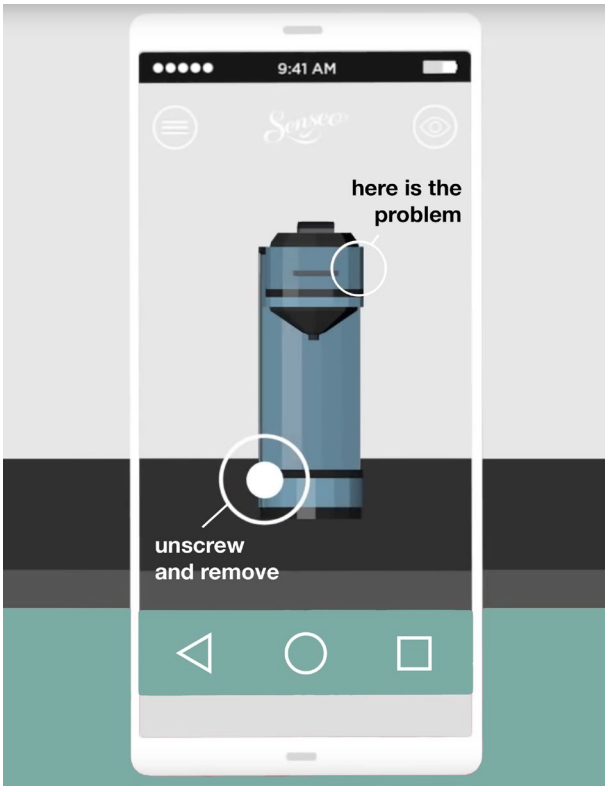


Figure 65: AR repair guidance

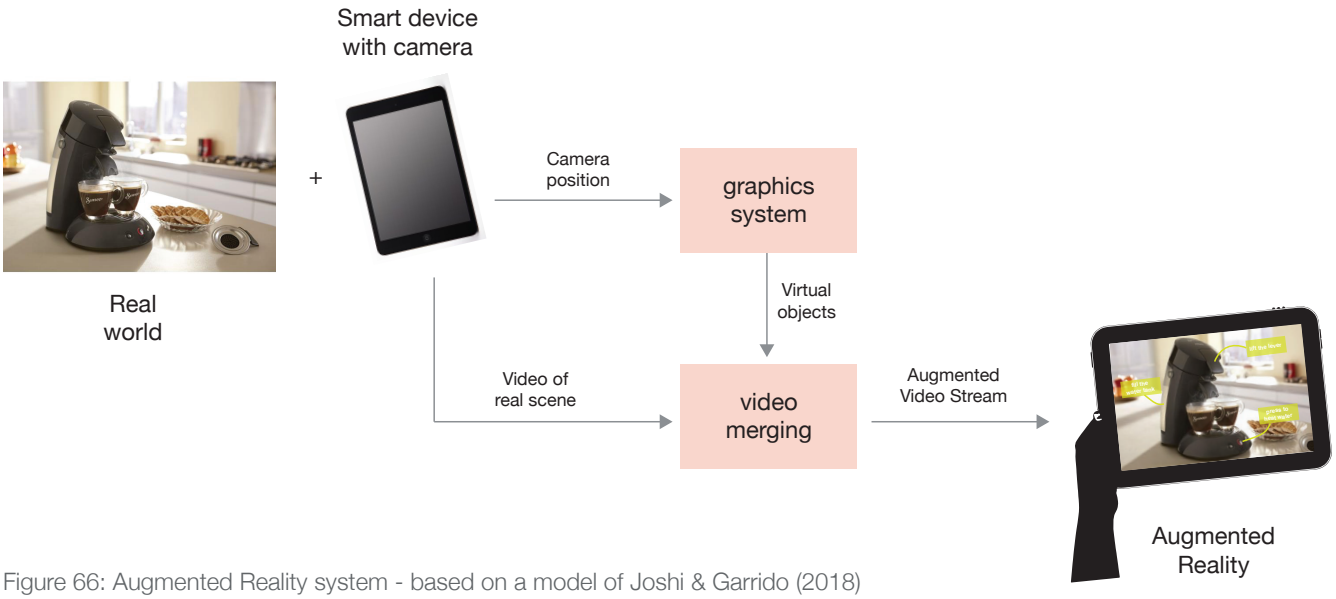


Figure 66: Augmented Reality system - based on a model of Joshi & Garrido (2018)

Technological challenges
According to Rana Abboud (2014), there is one key challenge that AR developers are facing today: achieving stable 'tracking'. However, the AR market is growing so rapidly, that these technologies will quickly be improved too. According to Global Market Insights, the market for AR products is projected to grow 80 percent to $165 billion by 2024 (Gurman, 2017).

Is an eternal device economically reasonable?
In order for the concept of eternal devices to be economically reasonable, the business should shift the main focus from selling devices to selling spare parts: the business of replacement parts can be enhanced.

A benefit for the company is that in warranty (IW) returns and repair costs would decrease. Besides, long lasting products have a competitive advantage, which could lead to more sales than the competitor, because it could be a reason for people to choose for Philips. It might even be a reason for customers to spend more at the purchase because they know the Senseo can last long or 'eternally'. Nevertheless, this is speculative and requires extended research. Therefore, it is recommended to study if this can be economically proved.

Is an everlasting device desirable among users?
The vision of an everlasting Senseo might be ideal from an environmental perspective, but is ideal for users too? Nowadays that is probably not the case. However, if the trends develop as expected it will become increasingly desirable among consumers. Consumers might even expect 'eternal' products from producers at some point. This topic is further discussed in the evaluation (chapter 11).

With the connected Senseo, software updates and upgrades are possible. This can contribute to the attractiveness of the concept of everlasting devices among consumers who consider buying a new machine as an upgrade of their old one. In addition, Philips could start offering their customers the possibility of buying an upgrade kit to refresh their Senseo after using it a couple of years. The upgrade kit includes components that come into contact with the coffee so that the customer can replace those parts. This option will prevent Senseo users from buying a complete new product for hygienic reasons. Therefore, Philips is advised to further explore this direction.

8.4 DATABASE GENERATION

For the design, the data from Repair Monitor 2017, by Natuur & Milieu (2018), is taken as starting point, as this seems the only available after sales data containing distribution of problems and corresponding solutions (appendix M). Further, there is currently no track record on how many Senseos still can be saved at the point of malfunctioning, and how many people give up on that point. A limitation of the Repair Monitor data is that it is a very small sample (121 Senseos) and from a specific time frame: newer Senseos might show different problems than older Senseos. Therefore, in the first horizon of the roadmap, a database has to be generated for making well-founded decisions for the next horizon and for the selection of sensors for horizon 2. This is possible because data can be send from the website or app to the Philips database as in Figure 62.

Requirements for data collection

- The design provides Philips access to relevant data;
- The data gathered by the design is secured;
- Privacy of the user is taken into account.

In consultation with Coolblue's data engineer Giuseppe Guida (2018), the technology of the data generation and how it should work for this design are excogitated.

The main goal of the design is to simplify the process of receiving support, but a side effect of the design is the simplification of "product registration" - currently a manual operation. This can potentially lead to an increase in the number of users that register and that provide their personal descriptions.

By implementing the design it is expected to have more users data involved in the decision making, that can be connected to the data gathered when problems occur. By having more interconnected and descriptive data it will be possible to define better strategies and therefore higher quality and more accuracy of the service provided. Even involving customization.

How it works

A basic context that the analytics department usually takes care of in companies is the datawarehouse. The datawarehouse contains for example sales data from the webstore, B2C, B2B, procurement data, marketing data which all can be connected to users accounts (an example of a possible datawarehouse system can be found in appendix Y). Currently, this connection between the sale of a product and the user account is very limited, because this connection is enabled through the registration of the product. As mentioned before, currently **CONFIDENTIAL** customers register at Philips (Shahbazi, 2018). Therefore, it is very difficult to connect sales data and users data.

Crucial in this connection is the serial number of the product, which is unique for every single product. Currently, at the manual registration system, people are typically asked for the serial number and model number of the product.

In the design of horizon 1, data is send from the NFC to the website, including the crucial serial number. This allows to identify a specific product that has been sold and to connect it to the sales data, procurement data, marketing data, and users data.

By adding the NFC (horizon 1) and IoT (horizon 2) the registration process is simplified for the user by skipping the step of identifying the product, while this happens in the background. Therefore, the registration becomes from manual to semi-automatic. Demographic data and permission are still asked.

Technology

The customer guidance flow will be on the website. In horizon 1 this website is accessible via NFC which is programmed with a unique URL. Whenever the website changes over time, the old URL can redirect to a new URL. An example of how the URL works is depicted in Figure 67. The analytics team should be prepared for this and the back-end software should be able to work with this data.

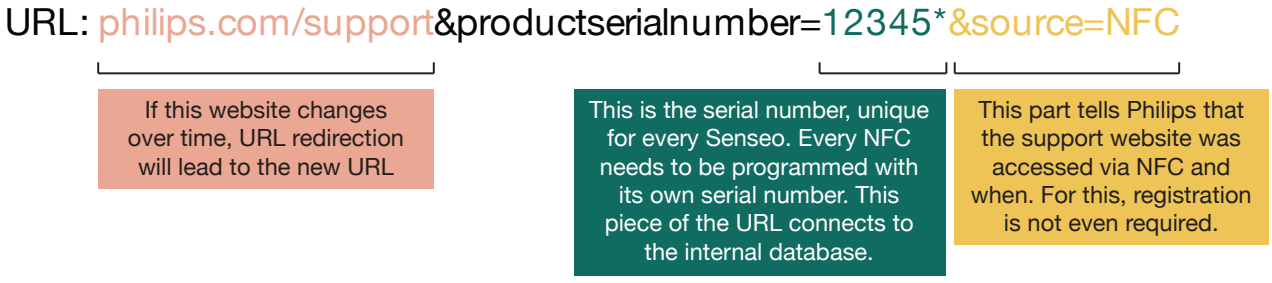


Figure 67: Example of how the URL could work

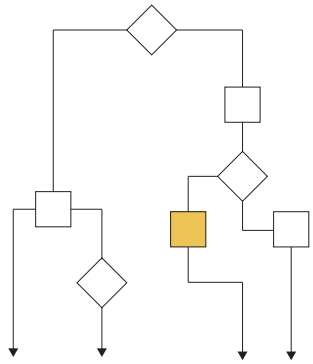


Figure 68: Example of flow with indication of where many people get stuck or give up

By this, Philips could see for example how many people of a certain demographic searched for support via NFC and what the problem with their Senseo was and how and if the problem was solved. Therefore, at the end of the flow, people are always asked whether the problem is solved or not.

Besides, the performance of the support flow can be measured. For example to find a point in the flow where many people give up (Figure 68), then this point in the flow can be improved. Or if a certain group of people (e.g. 60+) often gives up at a certain point in the flow while it works well for younger people, it might be good to make two versions.

Added value

One beneficial side effect of the NFC design is that it will likely increase the number of product registrations. Consequently, the data related to customers in the database is increased, which in turn benefits the whole analytics platform of the company. Because knowing the customer enables the use of customizations and personalization. This can be used for example in marketing strategies and for offering better support. More consumer data is relevant for e.g. statistics, personal campaigns, targeting and analyzing user behavior.

Added value of IoT is that it enables Philips to see whether a Senseo is still alive and being used by looking at which time the last data was recorded.

8.5 CUSTOMER GUIDANCE FLOW

In this paragraph the customer guidance flow is presented which contributes to the ability of users to fix the problem by making them understand how to do it (Ackermann et al, 2018). In the designed flow on the next page one example of a problem with the Senseo is worked out: less coffee is coming through. This example purposes to communicate a set of enablers to make the online customer support guidance work.

The ultimate goal is that no Senseo user gives up on a malfunctioning Senseo and that everyone is determined to solve the problem. Influencing and changing behavior by intervening at the point of malfunctioning, contributes to achieving this.

For stimulating, motivating and activating people as much as possible to solve the problem, tactics and strategies for nudging and rational override are used in the design of the customer guidance flow. Therefore, the Behavioral Intervention Design Toolkit designed by Anne van Lieren (2018) is used. In addition, the Behavior Model for Persuasive Design by Fogg (2009) is consulted for inspiration.

Anne van Lieren, et al. (2018): *"By integrating nudges and rational overrides, we can disrupt mindless automatic interactions and create active, conscious and engaged customers."*

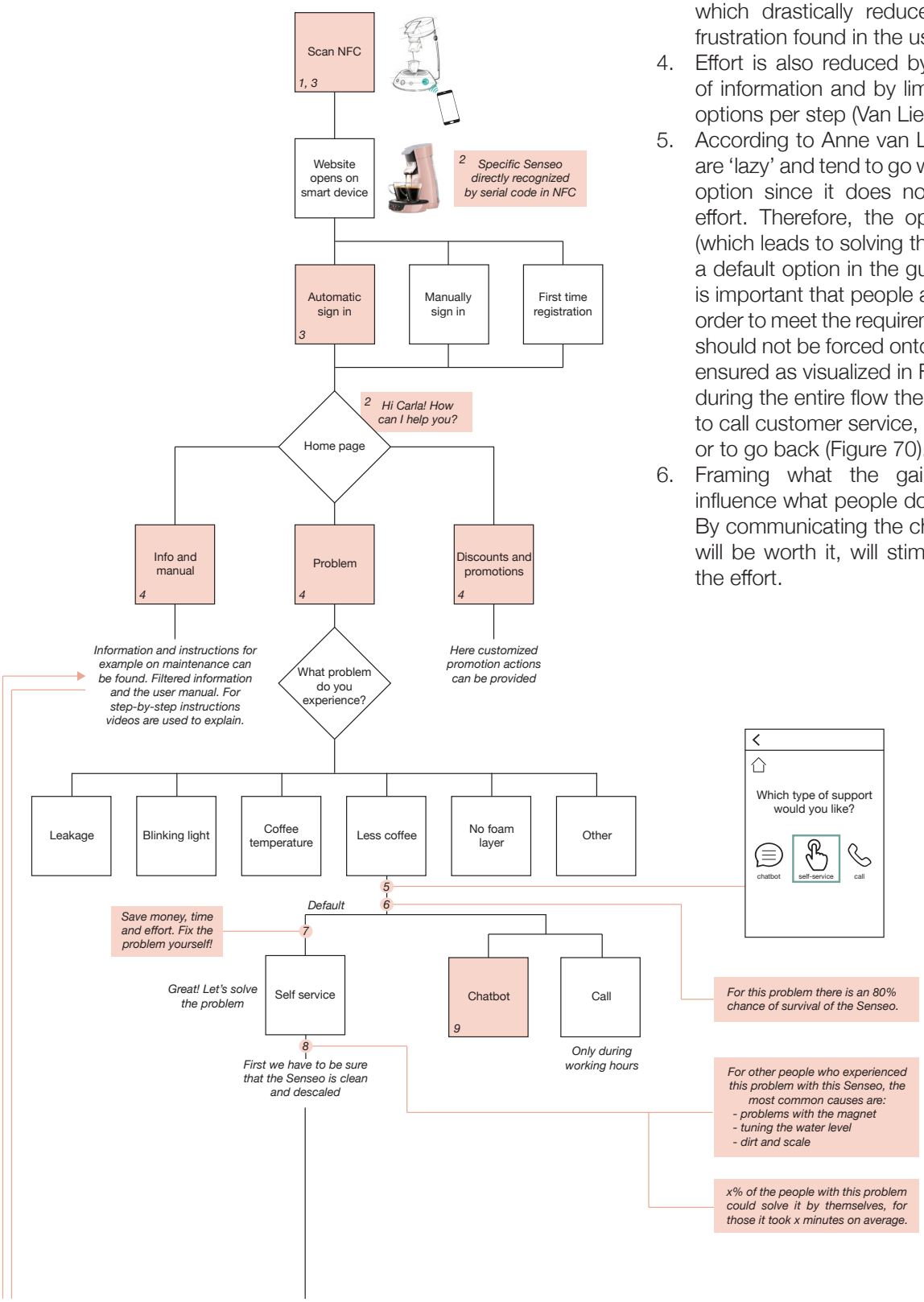
Based on user input from the questionnaire, the most preferred way of support are a visual presentation of instructions and step-by-step guidance. These themes reoccur through the flow.

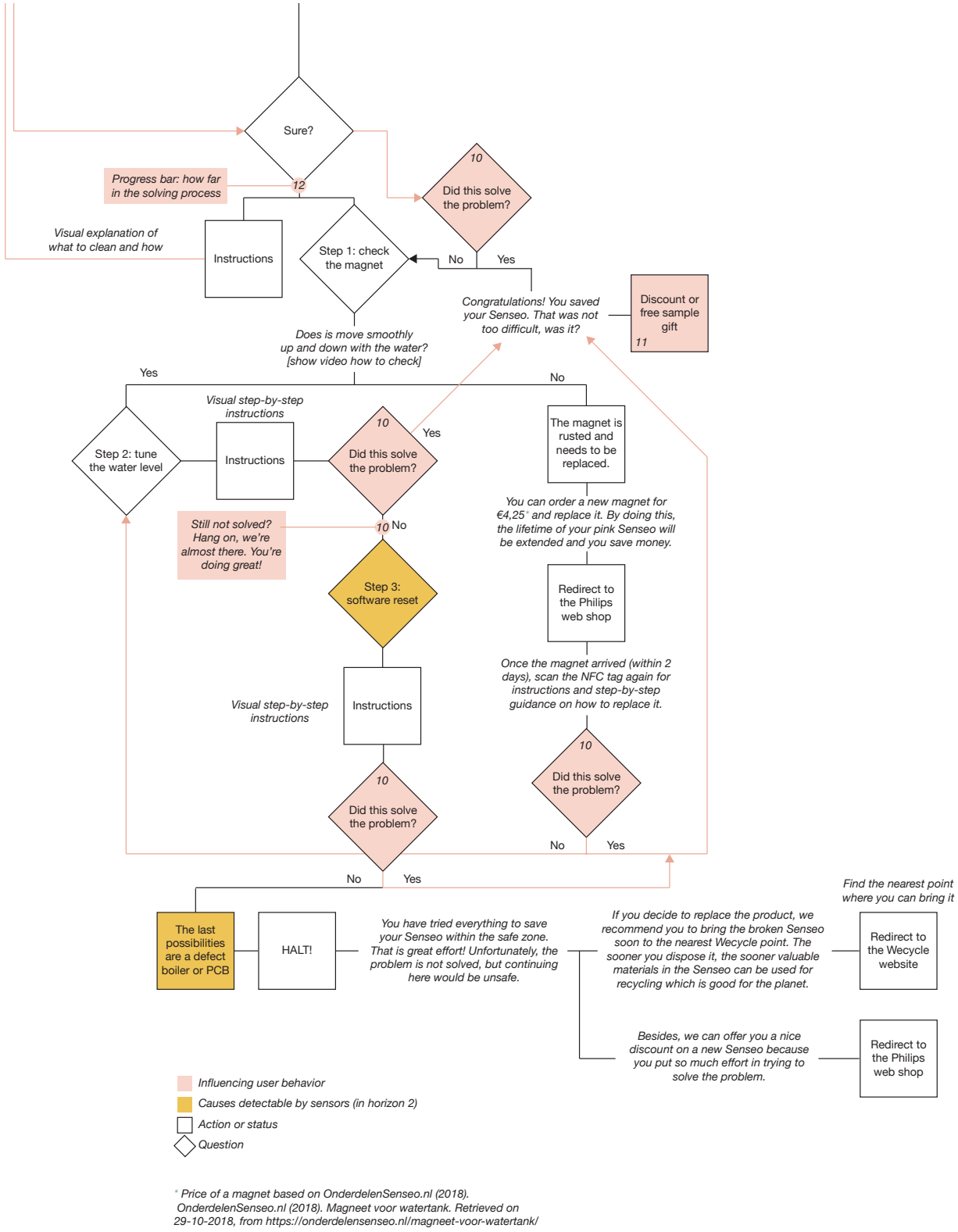
Set of enablers

Highlighted in pink is where user behavior is influenced and where strategies are used for increasing motivation based on the theories of Fogg, Bahmra, and Van Lieren. The designed interventions are based on and in line with the design requirements (§6.6). The numbers in the highlighted boxes refer to the following described explanations. This list functions as a set of enablers to make the system work.

1. The first intervention is physical: the NFC tag triggers and invites users to scan the tag for support, or out of curiosity. By providing easy access to support the ability of problem solving is increased as it leads to knowledge on how to do it (Ackermann et al, 2018).
2. Salience is increased by directly showing a picture of the users specific Senseo. Using personalization attracts attention (Van Lieren, 2017). This is also done by using the user's name enabled by the (automatically) signing in.

3. By scanning the NFC tag and automatic signing in, effort is reduced and barriers are removed for people in looking for support. Small barriers can hold people back from taking action and can lead them to choose the easy, undesirable option (Van Lieren, 2018) which is not fixing the problem. By this intervention, the process of finding support is simplified and now nearly effortless which drastically reduces the experienced frustration found in the user analysis.
4. Effort is also reduced by progressive reveal of information and by limiting the amount of options per step (Van Lieren, 2018).
5. According to Anne van Lieren (2017) people are 'lazy' and tend to go with the pre-selected option since it does not require any extra effort. Therefore, the option of self-service (which leads to solving the problem) is set as a default option in the guidance flow. Here it is important that people are free to opt-out in order to meet the requirement that the service should not be forced onto consumers. This is ensured as visualized in Figure 69. Moreover, during the entire flow the user has the option to call customer service, chat with a chatbot, or to go back (Figure 70).
6. Framing what the gain is can strongly influence what people do (Van Lieren, 2017). By communicating the chance that the effort will be worth it, will stimulate people to put the effort.





* Price of a magnet based on OnderdelenSenseo.nl (2018). OnderdelenSenseo.nl (2018). Magneet voor watertank. Retrieved on 29-10-2018, from https://onderdelensenseo.nl/magneet-voor-watertank/

7. According to Jeni Cross (2013), sociology professor at Colorado State University, people fundamentally hate to lose anything. Therefore, people are more likely to change behavior if they know what they can lose then hearing what they are gaining. Therefore, potential loss should be highlighted, but this loss should resonate with the people (Cross, 2013). So what do people really care about? Money and time (Ackermann et al., 2018). Therefore, undesired behavior can be discouraged by highlighting potential loss of money and time.

8. Van Lieren (2017): ***"People tend to avoid options and behaviors that do not show clear steps or have ambiguous or uncertain outcome."*** As one of the main findings from the analysis is the problem that there are no clear options and the outcomes are unclear, it is important to communicate these aspects clearly. By communicating factual information about the outcome of the desired behavior uncertainty among the users can be reduced and it manages expectations. Therefore, factual information about the successes of other people with the same problem is communicated.

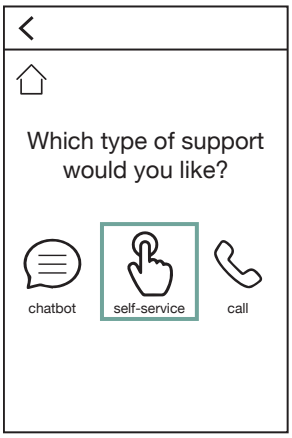


Figure 69: Self-service as the default option.

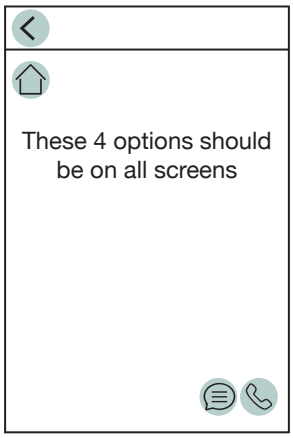


Figure 70: Available options during the process to switch to another type of service.

9. Chatbots on websites can unconsciously stimulate people to act according to social norms to behave in the desired manner as people tend to behave in accordance to what other people do (Van Lieren, 2017). Social norms have the biggest impact on behavior according to Jeni Cross (2013). Therefore, it is recommended for Philips to introduce a chatbot rather than a chat service with real employees. Not to mention the 24/7 availability of chatbots.
10. The user's confidence can be increased with clear instructions and positive feedback. Motivating and encouraging the customers during the process and reminding them that they are almost done and on the right track can stimulate people to continue (Van Lieren, 2017).
11. According to Bahmra et al. (2011) users can be encouraged to make more sustainable decisions with rewarding incentives. Small rewards as a free sample or discounts emphasize the sense of achievement, satisfaction or are as a recognition of the behavior. In case of direct sales, more discounts can be offered as the retailer is skipped and the rest margin goes to Philips.
12. According to Van Lieren (2018) people are motivated to complete a task once they already started. By giving people a 'head start', users feel that they already made progress which makes them more likely to finish a task. For this, a progress bar can be used. *"Generally the closer people are to achieving rewards, the more effort they are willing to put in"*, states Van Lieren.
13. If the product has not been fixed and the only available options left are out of the 'safe-zone', users are encouraged to properly dispose the product at a recycling point. By indicating the location of the nearest Wecycle point procrastination can be prevented as this appeared to be a problem in the analysis phase.

If the problem has not been solved in the end stage people are discouraged to continue for safety reasons. However, more environmental impact could be created by fixing tertiary problems rather than disposing it. In horizon 3, the process will include tertiary repairs which are safe by that time as it will be designed modular for repair.

Until that phase, it is recommended to have the process of sending a product to a Philips repair center easier and to reduce effort in this process. It could be made more attractive for users to send an out of warranty product to the Philips repair center if the research costs could be reduced or removed (see §3.1.3) as high costs are demotivating according to Ackermann et al. (2018). In this flow, people are not referred to for example Repair Café for risk management as there is no guarantee of the use of official parts at Repair Café and no quality control (§2.3.1).

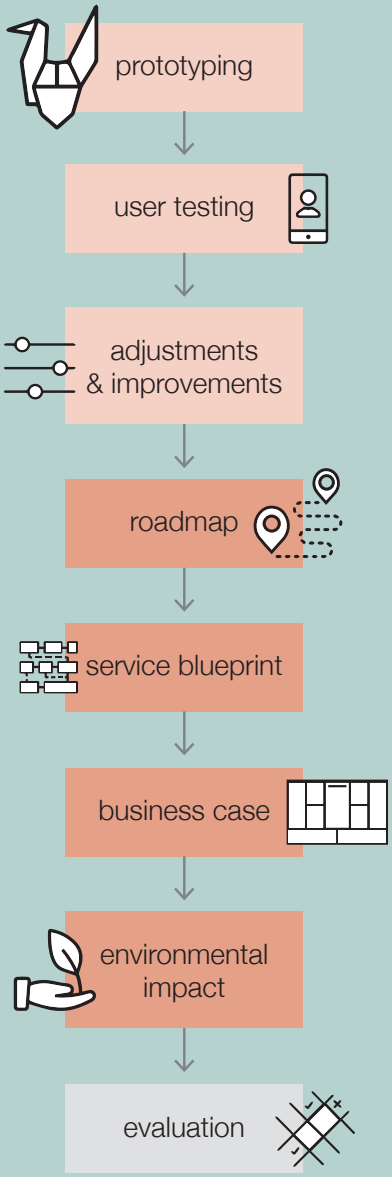
Differences horizon 1 and horizon 2

By adding sensors, the question flow can be shorter and simplified. Highlighted with yellow in the guidance flow (see previous page) are examples of causes that are detectable by sensors. A defect boiler can for example be tested on leakage by sensors added in horizon 2. In that case, the problem would already have been known at the beginning of the flow, and the majority of the steps could have been skipped, reducing the effort and making the process much faster and easier.

Recommendations

- Communication scientists will be involved in further development for filling in the flow based on this set of enablers;
- It is recommended to expand the available spare parts in the web shop. For example magnets are currently not available on the Philips web shop, but are easy and safe to replace;
- Introduce a chatbot instead of real employees for the chat function. This will enable users to chat at all times, and can unconsciously stimulate people to act according to social norms and to do the 'right thing';
- Make the service available in multiple languages.

TESTING & FINALIZING



9 PROTOTYPING & TESTING

A user test is conducted to evaluate whether the design indeed makes a difference regarding behavioral intent at the point of a malfunctioning product. The findings of the study can be used to improve the design and formulate recommendations for further development.

The study is mainly qualitative and is conducted with two user groups: a control group (without support) and a group that receives online guidance through an NFC tag. For the second group, the online support of horizon 1 is prototyped to test the effect of the intervention. In this chapter the prototype and user test are explained. Subsequently, the results are analyzed and design improvements are made. Concluding with recommendations for further development.

9.1 PROTOTYPING

The prototype consists of two parts: a digital prototype for the online support and a physical prototype for quick access to the online support.

9.1.1 PHYSICAL PROTOTYPE

For the user test, two identical Senseos are purchased of the model HD6554/40. One Senseo remains as it is for the control group. The other Senseo is adjusted by the addition of an NFC tag for the group that receives support.

The NFC sticker is an NTAG216 tag and purchased in an online NFC store. The tag is programmed with a URL that redirects to the digital prototype using an application called NXP TagWriter. For the prototype the tag is covered by a sticker that indicates the intended use (Figure 71).

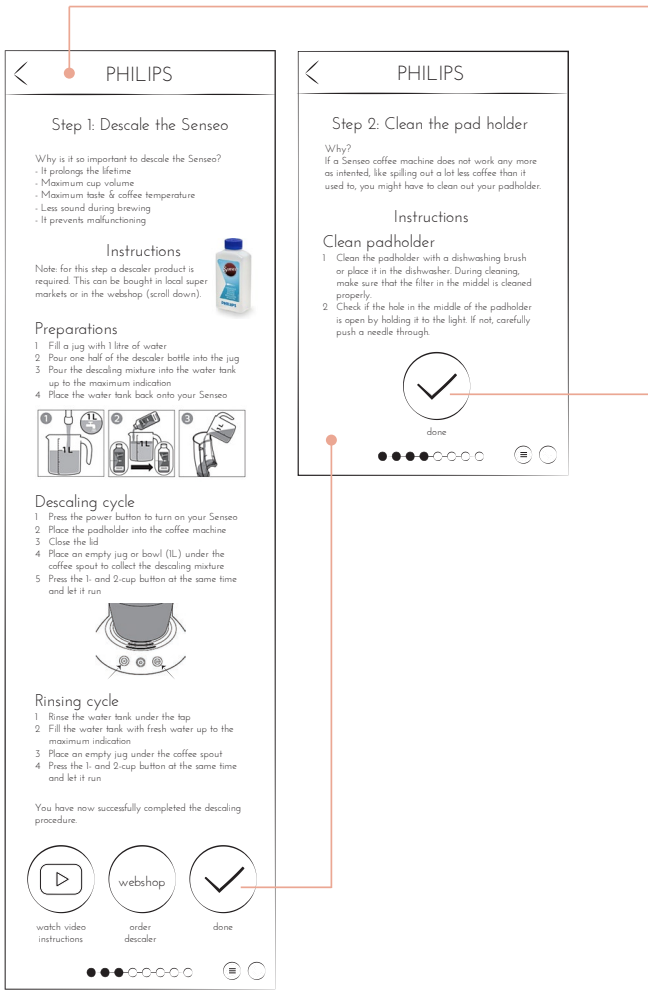
Figure 71: Physical prototype (NFC sticker, cover, on Senseo)

9.1.2 DIGITAL PROTOTYPE

For the digital prototype the platform InVision is used to transform the static screens made in Adobe Illustrator into a working prototype.

The static screens, depicted on this page or visible through scanning the QR code, are based on the guidance flow in §8.5 and designed in a simple way, for a low fidelity prototype. No use of colors is made to prevent participants to get distracted by the design and the prototype is mainly functional.

According to Kara Pernice (2016) Senior Vice President at Nielsen Norman Group, world leader in Research-Based User Experience, low-fidelity prototypes put less pressure on users as participants can recognize that the work is not finished yet. This makes them feel less obliged to be successful.



Scan QR for access to the digital prototype

PHILIPS

Chat with customer service

Hi Carla, any questions today?

type message

PHILIPS

Call us
0 20 79 49 02 40

Monday - Friday: 08.30 am - 08.00 pm
Saturday: 09.00 am - 06.00 pm

PHILIPS

Hi Carla,
how can I help you?

manual and information

problem solving

promo & discounts on spare parts

PHILIPS

What problem do you experience?

leakage

temp-erature

blinking light

other

less coffee

no foam layer

PHILIPS

Less coffee is coming through your Senseo

Don't worry, there is 78% chance this problem can be solved

Which type of support would you like?

chatbot

self-service

call

Save money, time and effort. Fix the problem yourself!

PHILIPS

Self-service

Great! Let's solve this problem

Other people solved this problem by:
- replacing the magnet
- tuning the water level
- descaling and cleaning

64% of the people could solve it in 12 minutes on average

Start!

PHILIPS

First we have to be sure that the Senseo is clean and descaled:

Is the Senseo clean and descaled?

yes

not sure

no

PHILIPS

Great! You have a clean Senseo

Did this solve your problem?

yes

no

PHILIPS

Step 3: Check the magnet

Why?
The magnet in the water tank float informs the electronics module if there is sufficient water in the tank and that the tank is installed in the appliance. Sometimes it happens after longer use that the magnet gets stuck and stops working. In this case the Senseo receives incorrect signals and the magnet needs to be replaced.

Instructions

Check magnet

1 Take the watertank out
2 Fill the watertank slowly with water
3 While filling, check if the float with magnet moves up smoothly with the rising water level

float

Is the magnet stuck?

yes

no

PHILIPS

Still not solved? Hang on, we're almost there. You are doing great!

Step 4: Software reset

Why?
Software malfunction can be the cause of changed amounts of water. This can be solved by setting the device back to factory settings.

Note: before starting this procedure, make sure that the padholder is clean and the machine is descaled.

Instructions

Reset

1 Press and hold the button for 15 seconds and then pull the power plug out of the socket. Continue to hold the button and reconnect the plug after 15 seconds.
2 The middle button now starts to blink very quickly. Hold the button for 1 more second.
3 When you release the button, you will get the normal amount of water out of the Senseo for both 1 or 2 cups.

Your Senseo is now reset!

Did this solve your problem?

yes

no

PHILIPS

Step 5: Tuning water level

Why?
By changing software settings, you can adjust the amount of water to your own satisfaction.

Note: before starting this procedure, make sure that the padholder is clean and the machine is descaled.

Instructions

Tune water quantity

1 Fill the water tank with water.
2 Place the padholder, without a coffee pad.
3 Determine whether too much or too little water has been dosed. The amount of water can be adjusted between 123 and 143 ml.
4 Pull the plug out of the socket.
5 Press and hold both the and buttons while plugging the power plug back into the socket.
6 If you now release the buttons, all three lights (buttons) will light up continuously.
7 To increase the amount of water, press the button. If you press the button and release it again the light of the on and off button goes out, and then on again continuously.
8 Per "button-press" the duration extends to about 0.5 seconds. Pressing the button 4 times in succession, the water will run for 2 extra seconds.
9 The same for reducing the amount of water, if you want for example stronger coffee. Only now use the button.
10 To finish and save the programming, press the On / Off button.
11 Press again, wait until the Senseo is at temperature, and press the button again.

There will be more water in the cup now.

Did this solve your problem?

yes

no

PHILIPS

Unfortunately, we still haven't found the problem and solution to fix your Senseo...

Last possibilities

The last possible causes of the problem are unsafe to repair by yourself.

You have tried everything to save your Senseo within the safe zone. That is great effort! In return for your effort, we would like to offer you a nice discount on a new Senseo.

If you decide to replace the product, we recommend you to bring the broken Senseo soon to the nearest Wecycle point. The sooner you dispose it, the sooner valuable materials in the Senseo can be used for recycling which is good for the planet.

Wecycle

find the nearest recycle point

webshop

get a discount

done

PHILIPS

Congratulations!
You saved your Senseo

That was not too difficult, was it? By fixing your Senseo, you extended the lifetime which saves time, money, and natural resources. This is great for you and our planet. Thank you and enjoy your coffee.

Tell us how it went!

What did you think of the online support? We would love to get your feedback so that we can improve our service.

quit

start survey

PHILIPS

Problem: magnet
Solution: replace it

Replacing a magnet is a quick and easy task. Therefore, you do need a replacing magnet. This can be bought in the Philips webshop. A new magnet costs €4,25 vs €65 for a new Senseo.

webshop

instructions

PHILIPS

Tell us how it went!

What did you think of the online support? We would love to get your feedback so that we can improve our service.

quit

start survey

9.2 USER TESTING

The qualitative study aims to investigate the effect of the prototyped support service of horizon 1 in the problem solving process of a malfunctioning Senseo coffee machine. For the transition towards a circular economy it is important to encourage consumers to solve the problem instead of directly giving up on the product by simplifying the problem solving process. To predict the behavior, the intention is evaluated which is assumed to be the immediate antecedent of behavior according to Icek Ajzen's Theory of Planned Behavior (1991). Based on this theory the following aspects are taken into account in this study: emotional experience, attitude, perceived control, intention, time, and the amount of actions.

In addition to investigating the effect on user experience and behavior, the usability of the tag and online guidance flow are evaluated. For the study, individual participants will be asked to solve a problem with a Senseo prior to filling in a survey.

If the service of horizon 1 appears to be effective, then the assumption is made that the service of horizon 2 and 3 would be effective too and will even improve the support and increase the satisfaction. Because the problem solving process in later stages is expected to be more simplified and user friendly.

Research question: *How is online guidance affecting the consumer experience and behavior in the problem solving process of a malfunctioning Senseo?*

The predicted outcome of this study is that the online guidance encourages consumers to take more actions and invest more time.

9.2.1 METHOD

In the experiment there will be two test groups with 10 participants per test group (20 participants in total):

1. One control group to set a baseline;
2. One group that receives online guidance.

Participants

The participants are familiar with a Senseo coffee machine and smart devices. The participants are all highly educated in non-design disciplines and are between 23 and 32 years old. No experience with repairing devices is required. Each participant will participate in the experiment individually.

Procedure

In front of the participants is a Senseo. For group 1 there is a normal Senseo, for group 2 the prototyped Senseo with an NFC tag.

The participants will be given the scenario that this Senseo is their own since a few years and they noticed that the Senseo is lately filling cups for only one third instead of full cups. The participants are asked to do what they would do in this situation.

The problem is a constant for both groups. In this experiment there is no final solution that will solve it. The chosen problem is a common problem and has relatively many possible causes. The actions that attempt to solve the problem, that are to be tested by group 2 with the prototyped online guidance, are relatively easy to execute (Figure 73).

After the test, the participants are asked to fill in a survey (appendix Z). The experiment ends with a short interview about why certain decisions were made and how the participants experienced the situation. The transcript of the study can be found in appendix AA.

Materials

The test set up is visible in Figure 72. The materials used for the testing are:

- Sink;
- Power socket;
- Coffee pads;
- Coffee cups;
- Senseo for group 1;
- Prototyped Senseo for group 2;
- NFC enabled smart phone for group 2;
- Descaler product;
- Jugs and container boxes (for descaling);
- Dishwashing brush;
- Stopwatch;
- Camera for pictures;
- Laptop for notes and survey.

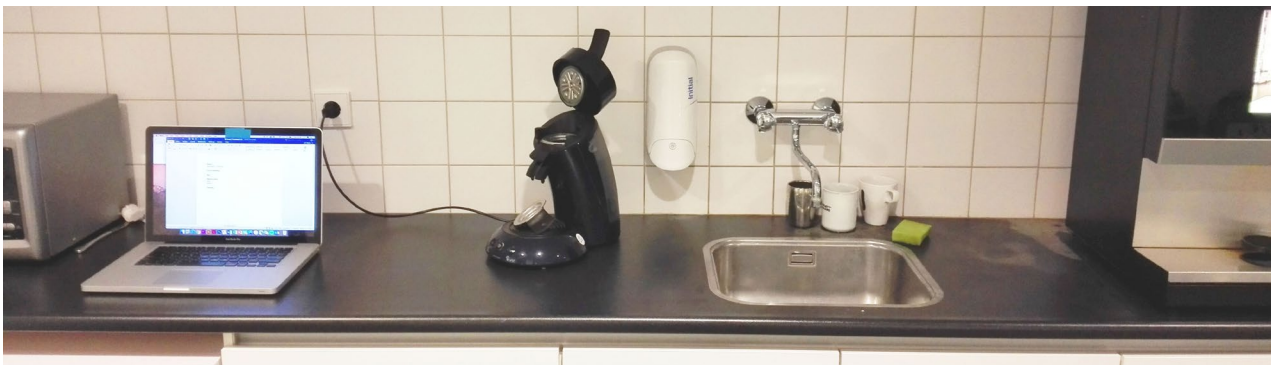


Figure 72: Test set up

The materials required for attempts to solve the problem were not visible for the participant and were only made available when the participant indicated to need it.

Measurements
The following aspects are measured during the tests:
- The time before people give up (stopwatch);
- The amount of different actions (counting);
- If participants find and understand the NFC scanning or if it is necessary to point this out.

The measured time, the amount of different attempts, and the survey are data input for measuring various aspects. The survey is constructed according to the Theory of Planned Behavior (Icek Ajzen, 2006) where the emotional experience (frustration), attitude (determination), perceived control (support, confidence), and intention (motivation, future decisions) are assessed by using seven-point bipolar adjective Likert-scales from 1 (low) to 7 (high). In addition, participants can give suggestions or comments in the interview afterwards and explain why certain decisions were made and how they felt during the process.

Figure 73: Participant of group 2, using the online guidance

Pilot
A pilot test with two participants (one per test group) led to minor adjustments to the formulation of the questions and small adjustments to the available problem-solving materials.

Data processing
The retrieved data will be evaluated qualitatively. Despite the fact that this is a qualitative study, the statistical results are also checked to see if there are some interesting findings. Therefore, the data will be processed in SPSS (software for statistical analysis) and a comparison between group 1 and group 2 will be made and analyzed to see if there is a significant difference between the different groups by:
- Mann-Whitney U test;
- Independent T-test;
- Cronbach's Alpha.

9.3 TEST RESULTS AND DISCUSSION

9.3.1 QUALITATIVE FINDINGS

Actions and time
In Figure 75 a large variety is visible within group 1 in the amount of time (0-34 min.) and in the amount of actions (0-5). In group 2 the ranges for these numbers are much smaller (time: 14-33 min.; actions: 3-5).

In the control group, the executed actions are very different per participant. In group 2, little difference can be seen in what actions participants perform, in which order and how these actions are carried out.

Within group 1 It has been observed that actions (in particular descaling and cleaning) are often not executed in the intended way where this rarely occurred within group 2. Besides, in group 1 actions were often not executed in the most convenient sequence (e.g. tuning without descaling or cleaning). This is because the participants of group 1 did not get notice of instructions or the possible actions. They often found it through online searches, or by trial and error.

Motivation and awareness
A difference in motivation was observed between the two test groups. The motivation in group 2 was generally higher than in group 1. This can also be seen in Figure 74 statement 6. Some participants in group 1 did not even start trying to solve the problem because they did not know how or because they were unaware of the fact that there is something that can be done.
"I have no idea where to start." – participant 1.3
"The moment I open the device, I will probably make it even worse." – participant 1.4

All participants in group 2 finished the guidance flow until the very last step. Based on these results it can be assumed that once people start the guidance flow, they will finish it. Some participants in group 2 did less than 5 steps, but that was because they stepped in somewhere else in the process (for example by skipping the descaling or cleaning step).

Within group 1 it has been found that the Senseo is perceived by some participants as a disposable good, which shows a lack of awareness of the environmental challenges and solutions.
"Cheap stuff is not meant to last long, it's disposable." – participant 1.4

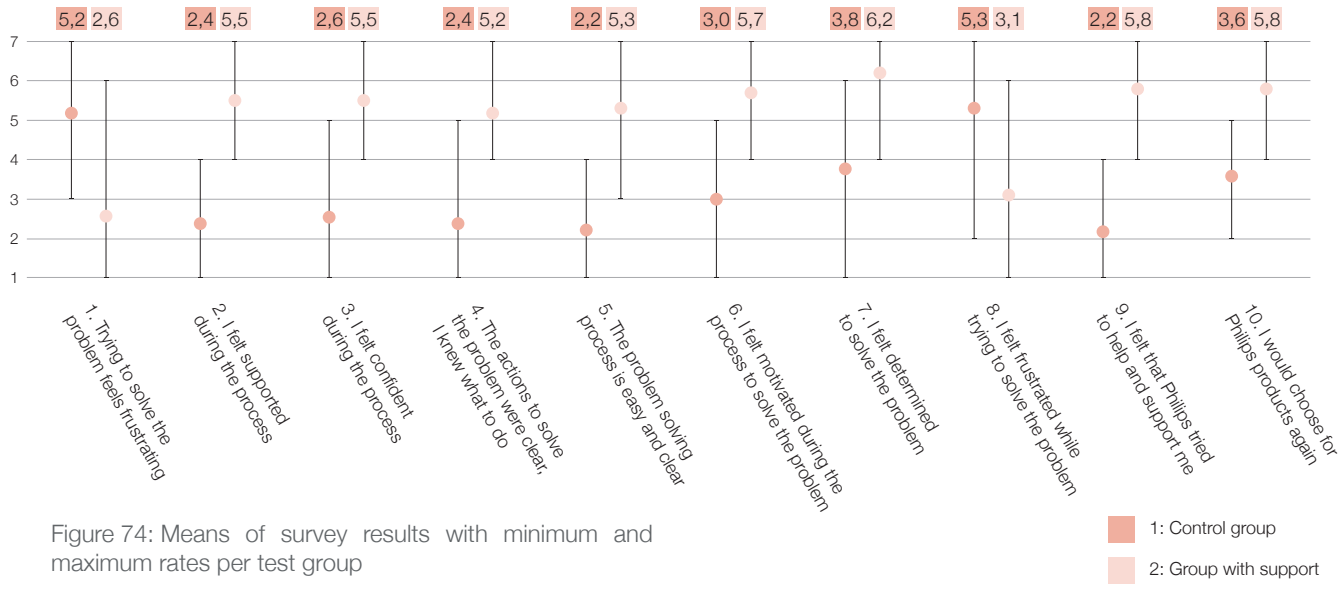


Figure 74: Means of survey results with minimum and maximum rates per test group

"It's just like a calculator: if it does not work anymore and battery replacement does not work, then you throw it away." - participant 1.7

Search results
The differences in actions within group 1 can also be explained by the consultation of search engines which often happened in the test. The search results are strongly depending of which exact words are typed. With one word difference the results are already leading to very different websites or forums. Participants chose many different word combinations and typically they clicked the first link which was therefore different per participant.

Participants of the control group indicated to find it odd not to find a Philips website or Philips instructions while using the search engine. They expected that especially because it appeared to be a common problem.

Several participants from group 1 indicated to be missing a troubleshooting overview. Now they found it unclear what options they have. *"Every time I went through a step, things went well. But it was difficult to find a new option every time."* - participant 1.1

Call support
Most participants indicated they would prefer not to call customer support but to try to fix it by themselves. This confirms the finding from the questionnaire in §4.2.2. However, it should be taken into account that some people still would like to have the option to call if the first attempts do not work.

9.3.2 STATISTICAL ANALYSIS

The statistical analysis is done experimentally and it is important to bear in mind that the sample size was rather small to make statements about significance. The tests can be found in appendix AB.

Significance
By performing an independent T-test, a significant difference is found in all 10 survey questions (Figure 74) and for time and amount of actions between the two groups (Figure 75). The Mann-Whitney U test finds only an insignificant difference between the two groups regarding time.

The insignificance regarding time can be explained by the fact that it was a difficult variable to measure. Some participants in the control group indicated for example they would spread the actions over multiple days (see study limitations).

The measured time within group 2 is more reliable and indicates how much time people spend on average in the support process. For group 1 the measured time is too much spread which makes it difficult to make certain statements.

Reliability and factor analysis
To determine the reliability of the data and to find correlations between the 10 asked survey questions a Cronbach's Alpha Reliability test is performed.

By deleting question 1 and 8 (both about frustration), the data becomes more reliable (higher Cronbach's Alpha). This is most likely due to different interpretations of these questions. In the interviews after the tests, some participants explained to feel frustrated about the fact that the machine is malfunctioning, where others thought about whether the solving process was perceived as frustrating.

Correlations are found between question 2, 4, and 9, between 4 and 5, and between 6 and 7. Hence, these questions resemble each other and might belong together according to a factor analysis.

The question about the likeliness to choose for Philips products again is related to how participants answered the questions 2, 3, 5 and 9.

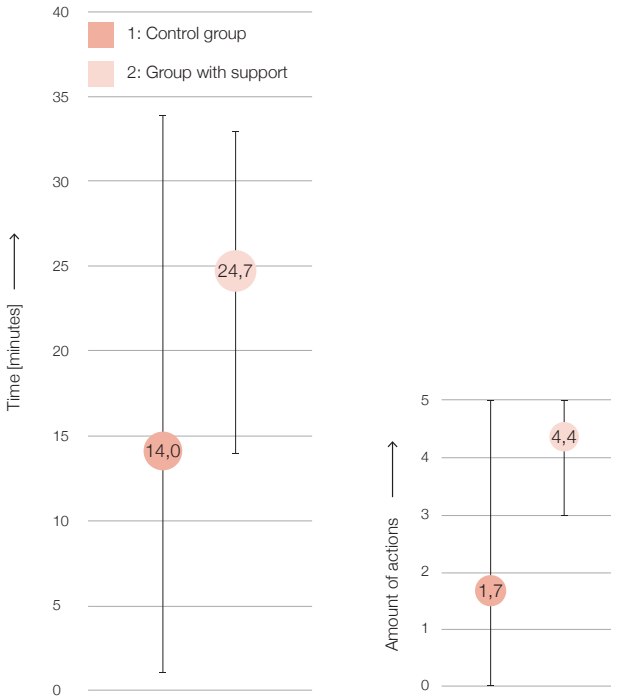


Figure 75: Means of measured time (left) and amount of actions (right) with min. and max. value per test group

9.3.3 USABILITY FINDINGS

Within group 2 insights were obtained regarding the usability of the NFC tag and the online guidance flow. This paragraph merely discusses the general findings. Aspects to be improved in the final design are highlighted in green. Detailed usability findings about the screens and steps are discussed in chapter 10 (final design) and used for making adjustments to the design. However, it must be mentioned that ambiguities were found in the designed instructions that may have influenced the data regarding survey question 3, 4, and 5. For example, there was uncertainty about whether the magnet was stuck or not (how far the float should go up). This topic is further explained in chapter 10 and the instructions are improved.

NFC tag

Most participants noticed the tag, but not everyone read it or recognized it as such. Some people thought it was a simple sticker. It should be more clear that the sticker has a function like an actual button.
"I thought it was just a sticker about getting support somewhere, not necessarily there. I think it has to do with my familiarity with NFC." - participant 2.9

As soon as they realized it was an NFC tag, the participants understood it had to be scanned with a smart phone. However, the scanning itself was somewhat confusing. Some participants directly understood how to scan, others thought it had to be scanned with the camera, others assumed a separate application was required for scanning. It is a new technology, and people will slowly but surely get used to it. Still, it should be communicated clearly how to interact with the tag in the manual, on the box, or on the tag itself. *"After I scanned it, everything was super clear."* – participant 2.7

The location of the tag made that people were holding their phone in a weird angle (Figure 76). If the tag would be placed more towards the front, this can be prevented and the phone would not be held over the drip tray.

Figure 76: Strange phone angle to scan the tag (top) versus if the tag would be placed more towards the front (bottom)

Flow general

Almost all participants directly selected self-service, because they find this more pleasant than calling customer service. Another reason is that the self-service option in the flow states that it can save time and money. *"I think I can solve it myself. Talking to someone else usually takes a lot of time because then you have to describe the problem in the chat."* – participant 2.9

The progress bar has been noticed by most participants and was experienced as a pleasant addition. *"I knew how many more steps there were going to be at max., because it was indicated. That was nice."* – participant 2.1

The intermediate personal encouragements were appreciated too. *"The personal things like "you are doing well" or "you're almost there" made me feel like they are thinking along with you. That they understand that you may feel frustrated."* – participant 2.1

The participants were very positive about the online guidance as can also be seen in the survey results (Figure 74). The service is found to be desirable.

"Very clear, easy to use, and you do not doubt much whether you are doing well. I would like to have this service for vacuum cleaners too." – participant 2.5

"I think it's good for the environment if you are provided with the right tools to solve the problem so that you can make longer use of the product. If producers explain how you can use the product for a longer time, that motivates me. I think every producer should do that." - participant 2.6

"I found the whole app really great. The looks, the overview. A logical step-by-step plan. I always knew what to do and what the next step was. I liked that." – participant 2.8

Most participants mentioned that they preferred to read the instructions instead of watching a video because then you can do it at your own pace. However, there are exceptions. Therefore, the option to watch a video should stay.

What could be added is the option to quit halfway so that people can continue another time. One participant indicated that it would help if the language could be selected.
"If you can read in your own language, it would be easier to follow the instructions and it would cost less effort." – participant 2.7

Last possibilities
There are two main findings about the end of the flow:
1. People like it that the effort is recognized and rewarded;
2. Some participants are not satisfied with the available options and find that a step missing.

This should be adjusted and improved as it can lead to undesirable situations and behavior.

1. Recognition and reward
The discount is experienced as a pleasant reward. By asking further in the interview, it was found that 10% discount is perceived as too little, 20% is considered nice and a lot.
"Oh that's pretty nice. In return for effort I receive a discount. So they recognize the effort you put into trying to save your machine."- participant 2.9

For some people it was unclear whether discount is related to bringing the product to a Wecycle point. It could help as an extra incentive for proper disposal to start with a 10% discount, and double it to 20% discount if the machine is properly disposed for recycling.

The referral to a Wecycle point in the neighborhood is considered practical.
"Oh that is a nice one, they can find the nearest Wecycle point to my place." - participant 2.10

For an extra incentive to start the process, the rewards could be better communicated at the start.
"The environmental aspect, the challenge, and the discounts as reward were not communicated in advance. It would have helped me to know what you get out of fixing the device." - participant 2.3

2. Dissatisfaction about available options
Multiple participants indicated to be unsatisfied about the end of the flow because of the advice to dispose and replace the product.
"This is weird. The actions did not solve the problem so I just need a new one? Is there really no way to have it repaired somewhere else? I think there is a step missing." – participant 2.5

The participants feel that one step is missing here. By asking what other option they would like in this situation the following answers were retrieved:
"I expected the option to consult an expert who can operate within the danger zone." – participant 2.1

"Now I would like to call the helpdesk and that they already know which problem I have and which steps I have been through. I would like to know if they can do anything as professionals." - participant 2.3

"I would like to send the machine somewhere for repair." - participant 2.5

"I still think it can be fixed. It is not super broken, it still works a bit. I don't want to give up yet and simply buy a new one." - participant 2.7

This dissatisfaction can lead in some cases to unwishful and dangerous consumer behavior.
"All options within the 'safe zone'… that does not feel good because how unsafe can it be? If it saves me 50 to 60 euro I am prepared to take that risk." – participant 2.1

"I probably would open the device myself now. Especially because they advise me to buy a new one. In that case it also does not matter anymore if I make the problem worse." - participant 2.3

This undesirable and dangerous behavior should be prevented and discouraged. There are multiple possibilities to add steps between the self-service flow and the recommendation to dispose and replace the old product:
- Call customer service;
- Recommend an expert in the neighborhood;
- Option to send it somewhere for repair;
- Add a 'print label' option for sending;
- Communicate the repair costs;
- Bring it to a store for repair.

9.4 STUDY LIMITATIONS

Participants

The participants are young (23-32 y/o) and have had high education. Therefore, they probably understand relatively quickly that the NFC tag should be scanned with the telephone and how that should be done. In reality, this relatively new technology may be less easily understood. However, according to the trend development of NFC technology described in §1.4.2, people will slowly but surely make more use of it and become better acquainted with it.

Another limitation of the study is that it is conducted with a rather small sample (2x10 participants). It has to be wondered how well the sample reflects the population and therefore how valid and reliable the statements about statistical significance and conclusions will be.

Furthermore, participants are likely to do more effort during the test than they would normally do because they know it is a test. However, participants in both studied groups would do this. Thus, this will probably not affect the results much regarding the differences between both groups.

Chosen problem

The chosen problem was that the machine produced less coffee, which means that still some coffee was coming through. Some participants that did not know what to do came up with the solution to use two coffee pads for making one cup of coffee. They realized this would be a more expensive solution, but some participants would accept that for the time being. If another problem would have been chosen for the study, those people would probably have come up with other solutions. In a few cases this was somewhat restrictive and might have influenced some of the results.

"If this does not work, I think I would accept that I have to use two pads every time and that I have to press the button twice. Then it will eventually become too expensive and I would buy a new device." - Participant 1.9

No solution

To investigate how far users would go, there was no solution to the problem in the test. Therefore, participants might have felt unsatisfied, especially if they had put quite some time and effort into it. This might have influenced the survey results regarding motivation, determination, or frustration.

New Senseos

Two new Senseo devices were purchased for this study, which may have been misleading. Because the Senseos looked new, some participants judged that the device was clean and descaled based on how it looks. This influenced factors as amount of actions and measured time.

"Here [on this forum] it also mentions descaling again. I think scale was not a problem. The machine looks clean." - Participant 1.6

Time

It was expected that the measured time would indicate how long participants are willing to spend on solving the problem. However, many participants in group 1 mentioned to be very likely to postpone this in reality or to spread the actions over various days and not in one go. These findings could not be included in the measured time. This made the time difficult to measure and to compare with measured time in group 2.

9.5 CONCLUSIONS

The online support guidance does make a difference. It positively impacts the consumer experience during the problem solving process. The participants clearly feel more supported with the service than without, and are more likely to choose for Philips again. This finding shows an increase in brand loyalty which supports the business case and it shows that the service is desirable among consumers.

Users do more different actions in trying to solve the problem while using the online support than without. Therefore it can be stated that the online guidance stimulates consumers to solve the problem which results in an increased amount of Senseos with life extension. Especially since the user test involved a common problem including the ~60% (§3.4) most common solutions.

With the online guidance flow, the consumer's behavior can be better predicted and steered, giving Philips more control over how consumers behave with regard to which actions they take and how they carry these actions out.

10 FINAL DESIGN

The final design is presented in this chapter including updates and adjustments following from the user tests. The roadmap functions as a visual explanation of the different design elements plotted on a time line. The service blueprints indicate what the online support delivers in general. Later in this chapter the last design considerations are described regarding environmental impact. Further, business model possibilities are investigated and the environmental impact of the design is examined.

10.1 EXPLANATION OF THE DESIGN

Integrating connectivity in the Senseo responds to the consumer's need for support at the point of malfunctioning and to the after-sales data gaps at Philips. By doing so, connectivity contributes to the transition towards a circular economy (Figure 77).

Connectivity can improve support because it facilitates easy access. The support stimulates circular behavior as users that receive support are encouraged and more likely to solve the problem instead of replacing the product. By registering the product, user data can be gathered. This enables a virtuous circle because with the collected data the support can be based on customer segmentation (e.g. demographics) and users can receive more customized support.

10.2 EXPLANATION OF THE PHASES

The design contributes to the Utopian vision that with connectivity, the Senseo has an unlimited lifetime and any of its parts can be replaced. Of course this is an ideal situation which cannot be achieved on the short term. By creating a roadmap (see the next page), three horizons are proposed that contribute to getting closer to achieving this vision. This paragraph explains each horizon and provides their schematic representations.

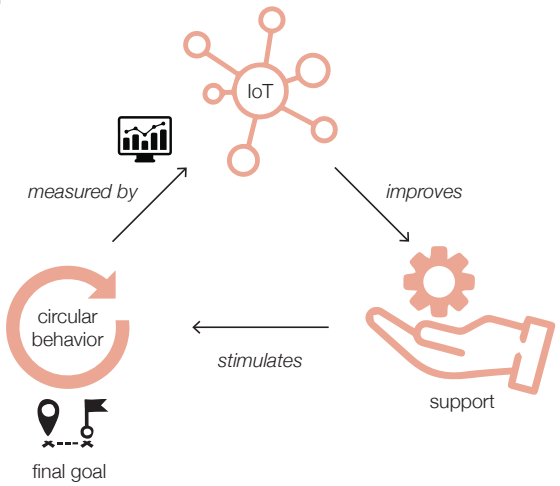


Figure 77: How connectivity contributes to the CE

1: QUICK AND EASY ACCESS TO SUPPORT

NFC

Adding an NFC tag to the traditional Senseo design is a simple hardware addition which does not affect the existing production line and does not require different molds. This small change will impact user accessibility of the service, visibility of the installed base for Philips, and collection of user data.

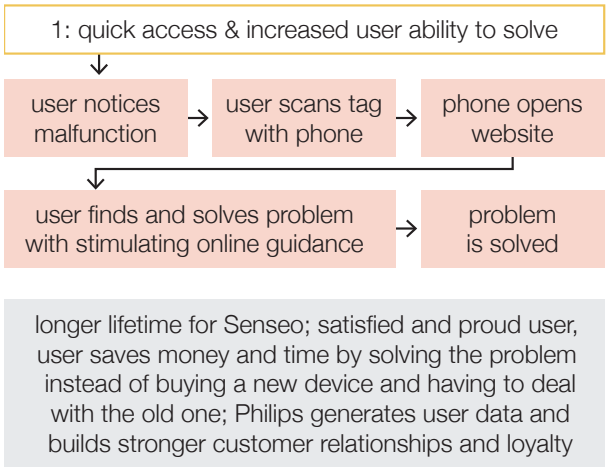
With the simple action of scanning the NFC tag with a smart device, the user is redirected to a website for customer support. This physical intervention lowers the barriers and reduces effort for users to consult support whenever necessary. Simultaneously this website creates another channel for marketing opportunities. Within the first horizon, users actively consult troubleshooting support.

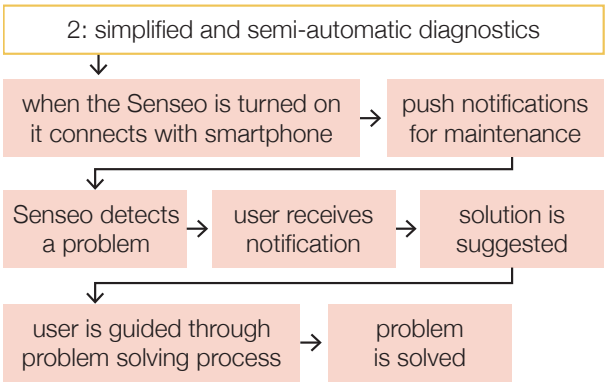
Flow

On the website, which is beside through NFC also accessible through online search engines, a self-service option is provided (beside other services). This self-service guidance flow enables consumers to confidently find and solve the problem in a safe Philips environment because it provides clear actions through step-by-step guidance. The lack of this in the current situation is a common frustration among consumers. The service will increase customer satisfaction which may lead to more brand loyalty. By measuring the performance of the support flow, it can be improved and optimized.

Within the guidance flow safe-zones are indicated to prevent users from taking actions that are potentially dangerous. This enables Philips to control user actions which is important for safety and liability.

In case the Senseo cannot be fixed, the user is stimulated to bring the product to a recycling party and encouraged not to procrastinate disposal.





reduced time and effort for user; increased customer satisfaction; Philips collects data more frequently; enabling support optimization and even stronger customer relationships

Data generation

Each NFC tag is programmed with a URL including the unique serial code of the device. This enables the analytics team at Philips to generate more specified and post-sales data, which can be connected to the user data due to the simplified registration process. Because of the reduced effort, higher registration numbers are expected. The collected users data can be used for personalization and customized support which leads to more consumer engagement. Furthermore, the generated data will be used to improve the product and to make it more circular.

2: IOT AND PROBLEM INDICATION

In horizon 2 the NFC tag is replaced by Bluetooth connectivity. The hardware adjustments are: addition of sensors and a micro-computer unit (MCU). Essential for this phase is the central Philips app. This application combines services from various connected digital consumer innovations.

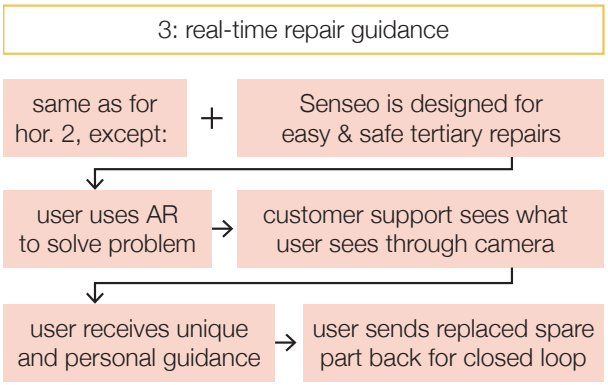
Sensors

Additional sensors are added to the Senseo in this phase for problem detection and for optimizing maintenance behavior. Taking good care of the product increases the expected lifetime of the Senseo and prevents premature malfunctions related to cleaning and descaling.

IoT

Bluetooth connectivity is required for communication between the device and the smartphone (application). If problems are detected by the sensors, the online support guidance will be substantially faster and easier. Also if the user detects a problem which is not detected by the product, the troubleshooting process is better optimized compared to the situation in horizon 1. This is because it requires less questions in the diagnostics flow as some questions are already answered by sensor's data.

IoT connectivity enables more extensive collection of relevant data. For example about the activity of the



higher circular impact; increased customer satisfaction; recurring revenues

Senseo and that it is still being used. Simplification of the problem solving process influences user behavior and will result in an increase of repairs.

Application

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application will mainly include background operations as the machine is not directly controlled through a smart device.

Through push notifications users are notified about required maintenance and if the sensors measure any differences in the status of the product. Thus also before the user notices a problem to ensure optimal product performance (e.g. coffee quality and energy consumption) and to increase the probability that the Senseo can be saved.

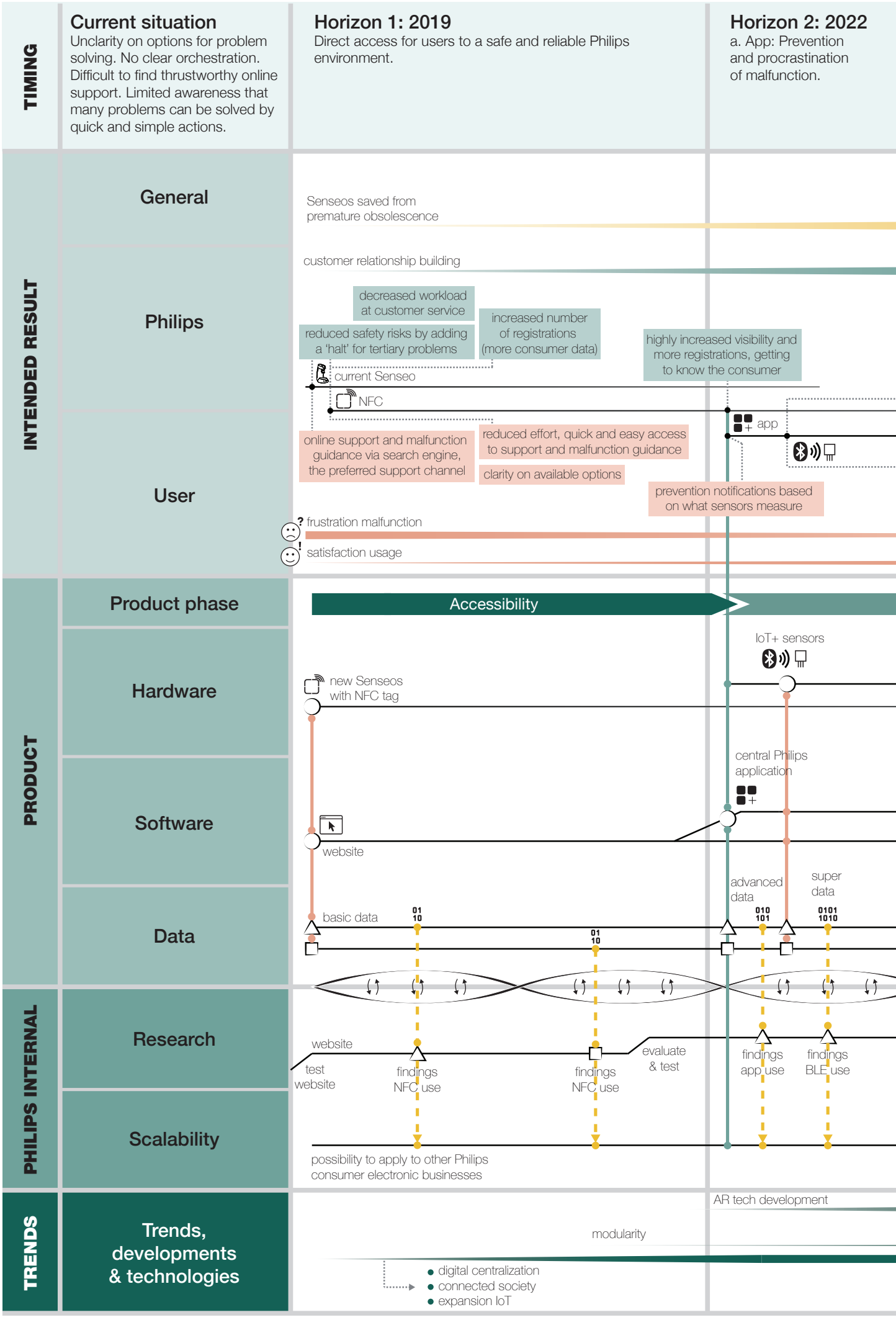
3: REAL-TIME REPAIR GUIDANCE

Essential for this visionary phase is the availability of spare parts in the Philips online store and that tertiary problems can be solved easy and safely by consumers. To achieve that, it is useful to introduce Senseos with modular hardware. Another essential aspect for this phase is that AR technology is better developed and the costs are reasonable.

AR

Augmented Reality enables unique and personal support for each user which contributes in creating the ideal service support experience. In tertiary reparations people are guided real-time using AR technology. Customer service (either a person or a robot) can then see what the user sees and offer direct and accurate guidance. In this scenario, it might still be possible that some parts are not to be touched by the consumer. AR can locate exactly where the problem is and whether it is within the safe-zone. AR is also suitable for showing hidden parts.

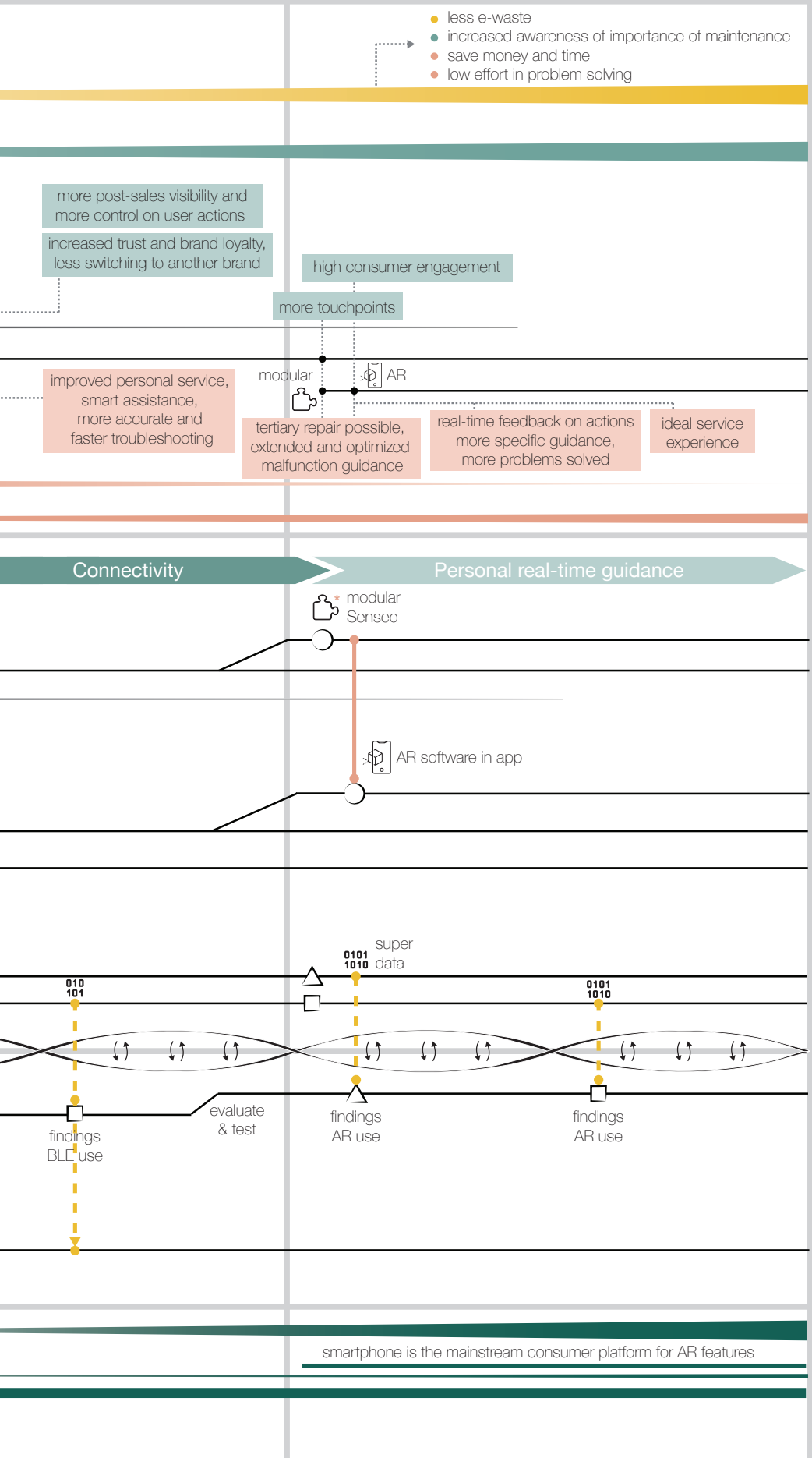
Expansion of the number of possible repairs of a Senseo increases the number of saved Senseos and thus contributes to the circular economy.


TIMING
Current situation
Unclarity on options for problem solving. No clear orchestration. Difficult to find thrustworthy online support. Limited awareness that many problems can be solved by quick and simple actions.
Horizon 1: 2019
Direct access for users to a safe and reliable Philips environment.
Horizon 2: 2022
a. App: Prevention and procrastination of malfunction.
INTENDED RESULT
General
Philips
User
Senseos saved from premature obsolescence
customer relationship building
decreased workload at customer service
reduced safety risks by adding a 'halt' for tertiary problems
increased number of registrations (more consumer data)
highly increased visibility and more registrations, getting to know the consumer
current Senseo
NFC
app
online support and malfunction guidance via search engine, the preferred support channel
reduced effort, quick and easy access to support and malfunction guidance
clarity on available options
prevention notifications based on what sensors measure
frustration malfunction
satisfaction usage
PRODUCT
Product phase
Hardware
Software
Data
Accessibility
IoT+ sensors
new Senseos with NFC tag
central Philips application
website
basic data
advanced data
super data
PHILIPS INTERNAL
Research
Scalability
website
test website
findings NFC use
findings NFC use
evaluate & test
findings app use
findings BLE use
possibility to apply to other Philips consumer electronic businesses
TRENDS
Trends, developments & technologies
AR tech development
modularity
digital centralization
connected society
expansion IoT

b. IoT: Optimizing service and guidance flow for malfunction.

Horizon 3: 2027

More repairs possible, tertiary repairs included.Unique and personal support experience.



Future vision

All Senseos and other consumer electronics are less vulnerable and are being repaired. Repair is the new social norm.

The utopian vision is that all problems with Senseo can be solved by anyone, and Senseo has unlimited life extension.

Legend

- = introduction on the market
- = how long active
- usage
- malfunction
- inseparable
- collaborate
- data flow
- intended result environment
- intended result Philips
- intended result user

* Essential hardware component regarding consumer safety

10.3 ROADMAP

This paragraph explains the roadmap and the different components. The roadmap is created to communicate and describe which elements and steps are necessary to achieve the ultimate vision:

- All problems with Senseo can be solved;
- Anyone can solve problems with Senseo and repair;
- Senseo does not die: unlimited life extension.

Hardware

The first step in the roadmap includes the introduction of the NFC tag. In a later stage, the tag will be replaced by Bluetooth connectivity, a technology that is already available. The intermediate phase of the NFC is chosen for risk management: if the NFC tag appears not to be used as frequently as expected, then this leaves an exit option in the roadmap. Direct implementation with Bluetooth is a risk because it requires high investment in the development of an IoT device, that is based on limited available data. Moreover, the intermediate NFC phase enables to generate more data in order to make well-funded implementation decisions for the second horizon.

With the implementation of the IoT Senseo, more hardware adjustments are required:

- The PCB will be provided with another MCU;
- Sensors are added to the circuit;
- A button for Bluetooth connection is added.

The Bluetooth button is used for setting up the connection at the first installation, afterwards it connects automatically.

For the third horizon, it is essential that the Senseo contains modular parts so it is easier to repair than the traditional Senseo.

Software

Prior to the introduction of the NFC tag, the support website should be developed and launched as the tag redirects to this online environment. Meanwhile, it is recommended to Philips to develop and include a chatbot system as an addition to or replacement of the current chat function with real employees.

The Central Philips Application needs to be on the market prior to the launch of the IoT version of Senseo.

is up and running, a specific Senseo section in the app has to be developed and launched. Meanwhile, the website should remain a channel for malfunction guidance.

Technically, the AR function can also work in a Senseo specific app. However, this is not an option because consumers indicated in the questionnaire that they do not want a separate Senseo app. Especially because people are not likely to download a Senseo specific app for a Senseo that is not controlled by a smartphone.

In the third horizon, the app requires a software update to enable AR repair guidance and personal customer support. This software update can only be launched in case it is confirmed that guided repairs are safe and easy for consumers to execute.

Data and research

Data generation and research are interlinked processes and continuously interchanging which evoke a virtuous optimization circle.

In the first horizon, data collection only happens when users access the website. By implementing IoT data is collected more frequently: every time the coffee machine is turned on it will automatically connect to the phone.

An important decision point is switch from horizon 1 to horizon 2. This decision will be made based on more extended research and on analysis of retrieved data in the first horizon.

Prior to the execution of the second horizon, the generated data is consulted for reevaluation of the wireless technology selection and for final selection of the sensors. For the sensor selection a balance needs to be made up between adding complexity versus increasing sustainability. Therefore, the generated data has to be evaluated to find which sensor types could create the most impact and detect the most common problem.

Throughout the three different horizons, the performance of the service and guidance flow is measured and regularly analyzed for improvement and optimization of the flow. For this, it has to be taken into account that malfunction only occurs after a certain period. If malfunction occurs within the first two years, warranty still applies and different (more extended) services are applicable. Therefore, the results can only be analyzed after a certain time.

In the meantime, research has to be executed on the possibilities of the implementation of the augmented reality technology and the feasibility. In horizon 2 there is an important decision moment on whether to continue to horizon three. This decision includes a final verdict whether tertiary repairs are safe for the user, and to specify which are and which are not.

Prior to the third horizon, modular Senseos have to be researched and developed for easy and safe tertiary repairs. The research should include the feasibility of using standard parts for multiple product types, to meet the required economies of scale.

The extended users data generated in the first two horizons enables Philips to know its customers and related customer behavior. This enables the company to offer personal and unique support.

Scalability
The collected data on NFC usage can be analyzed for making well-funded decisions on the possibility and profitability of applying the NFC technology and online support system to consumer electronics in other Philips businesses. The same applies to data collected through IoT and for the real-time guidance.

Regarding expansion of the service to countries beyond the Netherlands, the same pace as Philips currently has for launching and introduction of Senseos will be used for the designed product service system.

Trends
The extended description of trends and developments can be found in §1.4.2.

The CE is a business trend on its own, but the consumer is also increasingly willing to pay more for sustainable brands (66% of the consumers in 2015).

With the rise of IoT, visibility of products can be increased by tracking location, product use and performance. This can affect circularity in a positive way. In addition, the society is becoming more and more connected and there is a craving among consumers for digital centralization.

Modular design is a new and niche trend for electric appliances. If this trend continues to grow, it can extend the product lifetime of appliances by making part replacements and repairs easier. Therefore, spare parts need to be available for consumers.

AR is becoming more common and if more phones are AR compatible, more advanced and better support can be delivered.

10.4 SERVICE BLUEPRINT

To describe the characteristics of the service interaction that come with the design, a service blueprint is made. The blueprint is an operational service design tool which was first described by G. Lynn Shostack (1982). The graphical technique displays the process functions above and below the line of visibility to the customer. All the touchpoints and the back-of-stage processes are documented and aligned to the user experience.

Before the implementation can be defined, first it has to be identified how the service works for the different horizons. This paragraph focuses mainly on the service system of the first two horizons to study the feasibility on a short term.

10.4.1 HORIZON 1: NFC TROUBLESHOOTING GUIDANCE

If a user notices a problem, the user actively scans the NFC tag for support with a smart device. The website opens directly and the user can start the self-service to solve the problem. Every time the user scans the NFC tag, user data is collected at Philips.

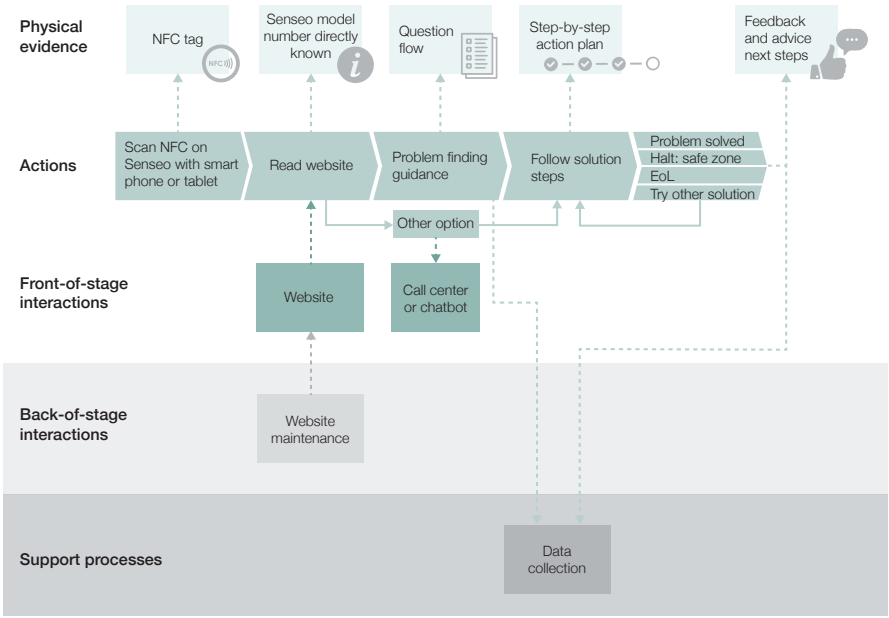
This service requires a website and a data collection system. The website requires maintenance, and the data collection system requires a data engineering and data analysis team.

10.4.2 HORIZON 2: PROBLEM DETECTION AND PREVENTION

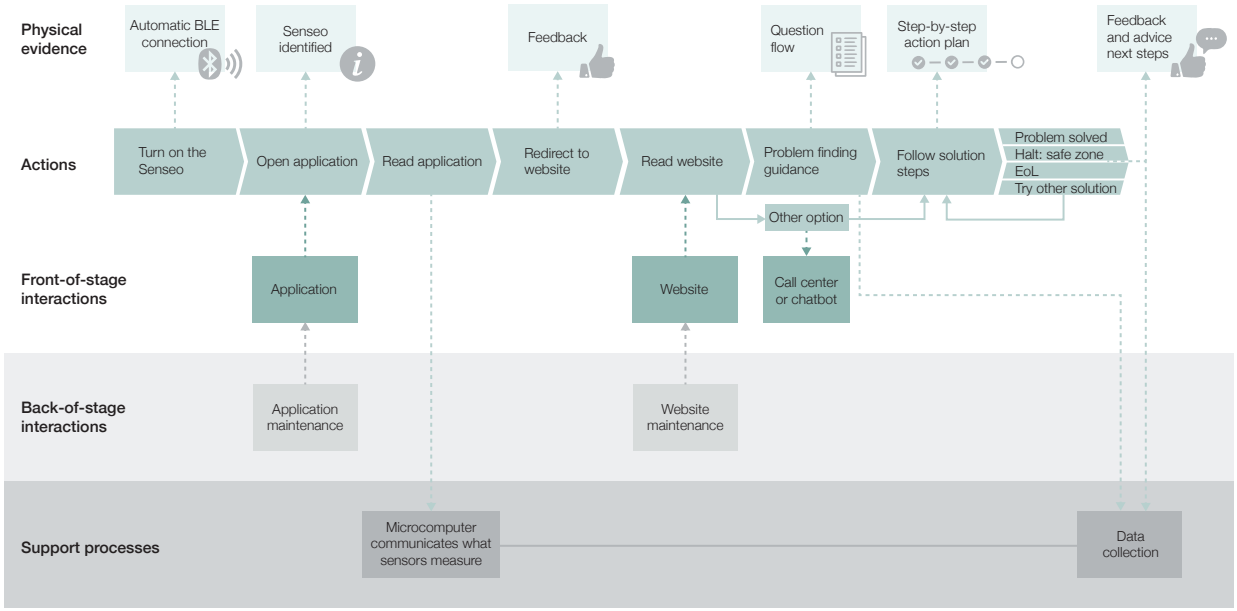
In horizon 2 the central Philips application is included and the Senseo automatically connects to the smart device if the Senseo is turned on. Application maintenance is required for this feature. A microcomputer in the Senseo communicates the sensors' measurements every time the Senseo is connected to the smart device. This way, data is collected more frequently than in horizon 1. There are two ways a problem can be detected in horizon 2: by the user (active) or by the device (passive).

Active
If the user notices a problem, he or she can open the application and indicate the problem. For the problem solving guidance, the application will redirect to the support website in the browser. It is preferred to receive support in the browser instead of the application because support will not be consulted on a regular base by the user and it takes up more memory of the phone if it would be implemented in the application. Besides, every time a change is made in the support flow, the application would require an update which might be experienced as an annoying feature for the user if it often occurs. Therefore, website maintenance is still required for horizon 2.

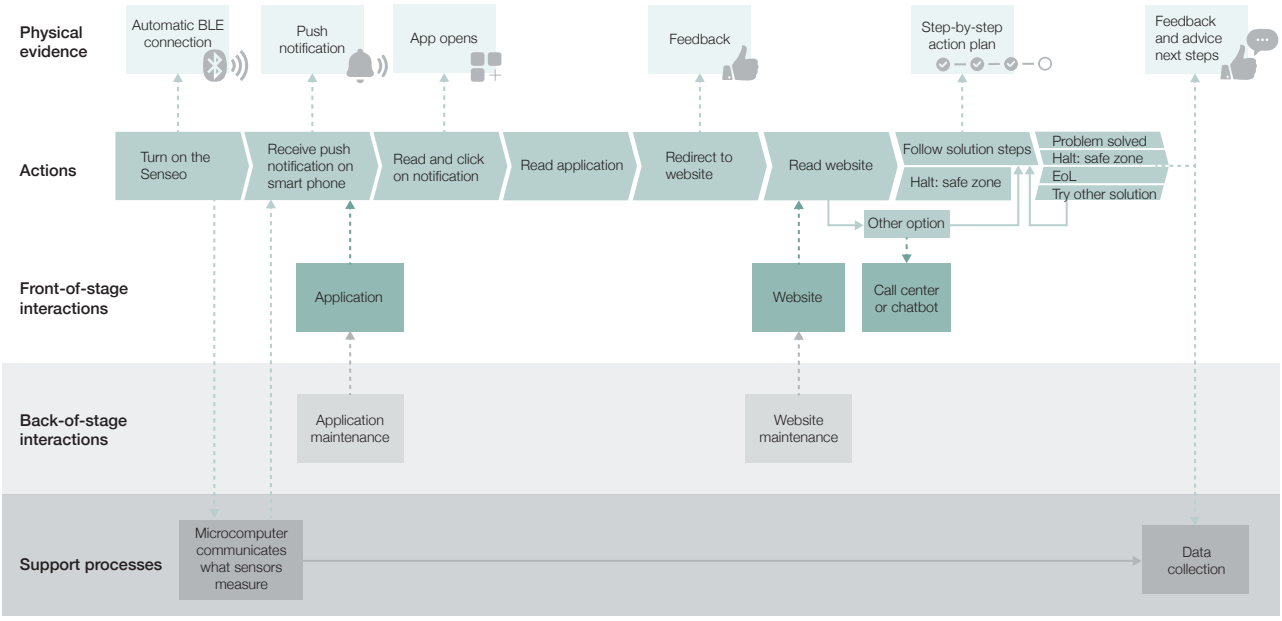
HORIZON 1: NFC TROUBLESHOOTING GUIDANCE



HORIZON 2: ACTIVE THE USER NOTICES A PROBLEM



HORIZON 2: PASSIVE THE DEVICE DETECTS A PROBLEM



The support flow will be less time consuming and complex to run through since more information about the device's state is known due to the microcomputer that communicates what the sensors measure. This automatically answers some of the questions in the flow which simplifies the process.

Passive
In case the device detects a problem, the user will receive a push notification on the smart device. By clicking the notification the application opens. In this case, the user directly knows the cause of the problem and how it can be solved.

10.4.3 HORIZON 3: REAL TIME GUIDANCE WITH AR TECHNOLOGY

In horizon 3, more spare parts are available that are safe and easy to replace. Customer service (either by a human or robot) sees what the user sees through the camera of the smart device which enables unique and real time guidance in the repair process with AR technology. This feature requires a new customer support system.

10.4.4 SERVICE IMPLEMENTATION

As Philips is currently not a service oriented company, it is important to understand how the implementation of the service will affect Philips as an organization. Therefore, service designer at Philips Design Benjamin Lopez (2018) was consulted.

How the organization will be affected depends on the scale according to Lopez (2018). The implementation will be done in different phases. Prior to every implementation a pilot phase has to be executed. This means that first the design has to be tested on a smaller scale in which lots of assumptions are made and initial hypothesis are tested. There are questions to solve in the pilot phase as 'who delivers?' and 'how are the operations executed?'. The way teams within Philips change will depend on the found answers to certain questions.

Pilot phases
During the pilot phases a research team is required to analyze the data. Therefore, there should be a system where the data can be found and analyzed.

Horizon 1
All phases require good customer support that looks at the data and can answer questions from customers. Beside the customer support, there are not many other big capabilities necessary for the implementation of horizon 1. For this, there are no well-defined guidelines at Philips (Lopez, 2018).

The chatbot function does not exist yet for customer service at Philips. Yet, it is expected to be implemented in the near future for general purposes. Therefore, no separate organizational changes are required specifically for this case if it is already being developed.

Horizon 2
The addition of sensors and BLE technology in horizon 2 will require much more organizational changes than horizon 1. Because it will require:

- A maintenance system for the added technology;
- A huge warehouse to collect the data;
- A common platform for research purposes (could be done through the central Philips app);
- Extensive testing to ensure sensors always work;
- Compliance with privacy laws to protect users.

Perhaps Philips does not have all these capabilities yet. Therefore, Lopez (2018) advices that it has to be decided whether Philips should partner up with other parties (e.g. a specialist in privacy protection or a data collection company that manages the warehouse) or whether it should invest in the development of those capabilities.

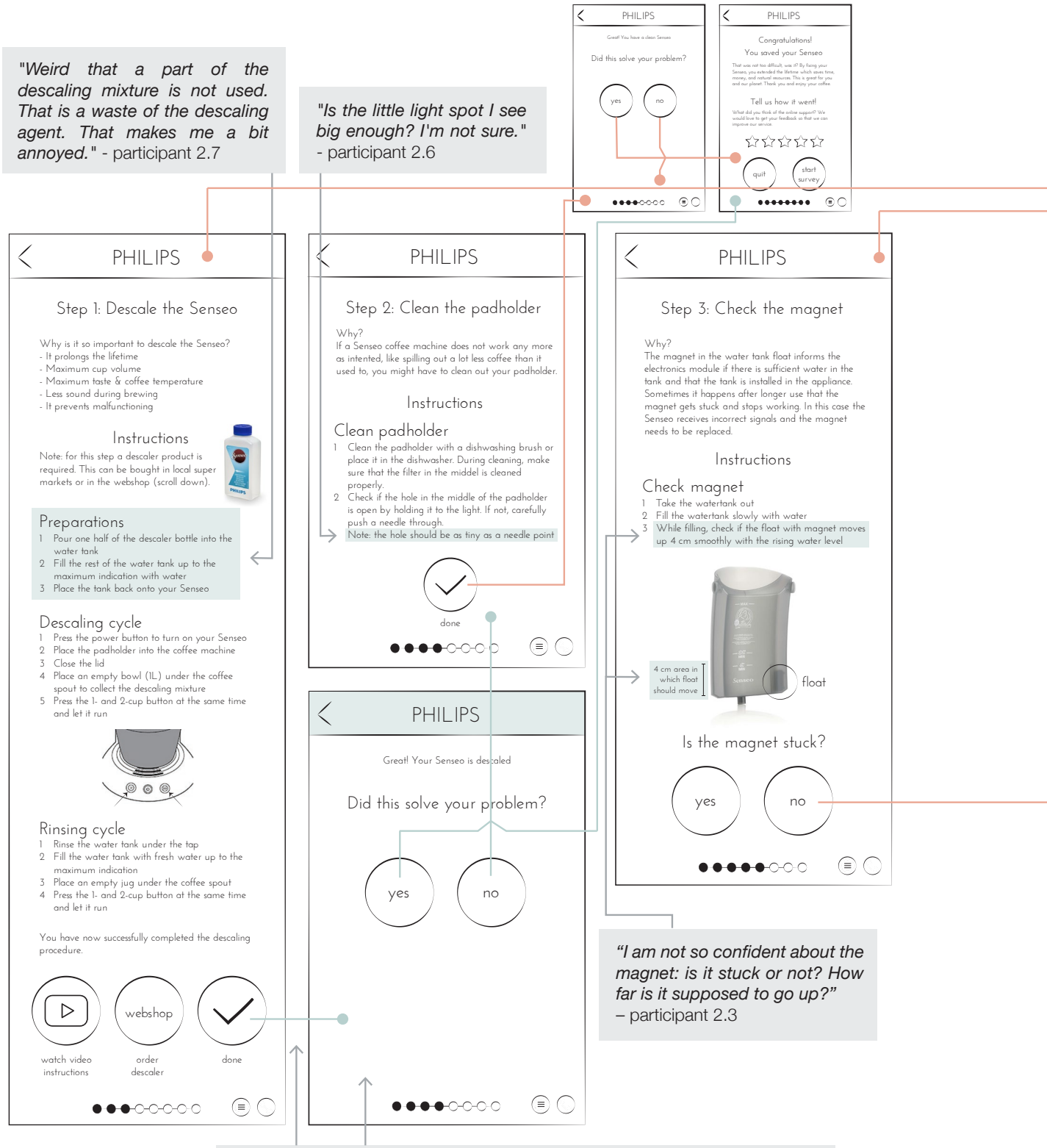
Horizon 3
Horizon 3 requires spare parts logistics. Therefore it has to be decided who the provider of spare parts is. This could be either Philips or a partner such as OnderdelenSenseo.nl that is already in the spare parts business. The logistics do not only include availability, but also a take back system for the broken or replaced spare parts.

Besides, the addition of AR technology for real time guidance requires the development of an entirely new customer support system.

10.5 ONLINE GUIDANCE

Based on the usability findings in the user test, adjustments and improvements are made in the online guidance flow. In the visual on this page adjustments are highlighted in green. The highlighted text in the gray boxes are the findings and quotes of users on which the changes are based.

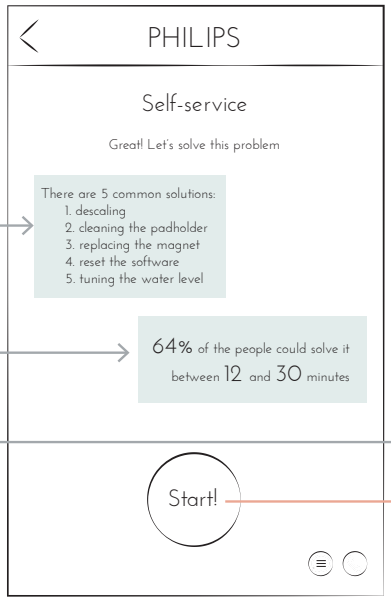
This final design of the online guidance is not the 'final' design. Before it can be implemented further development is required. Hence, in chapter 12 suggestions and recommendations are listed.

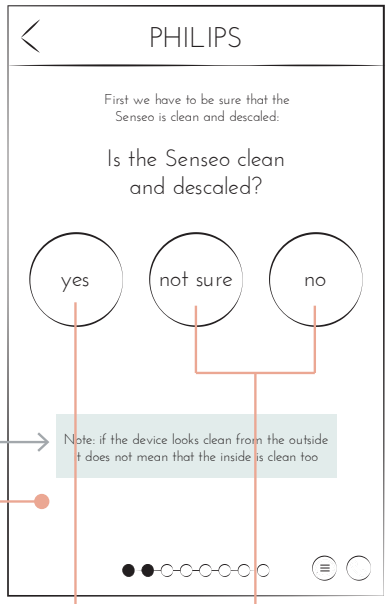


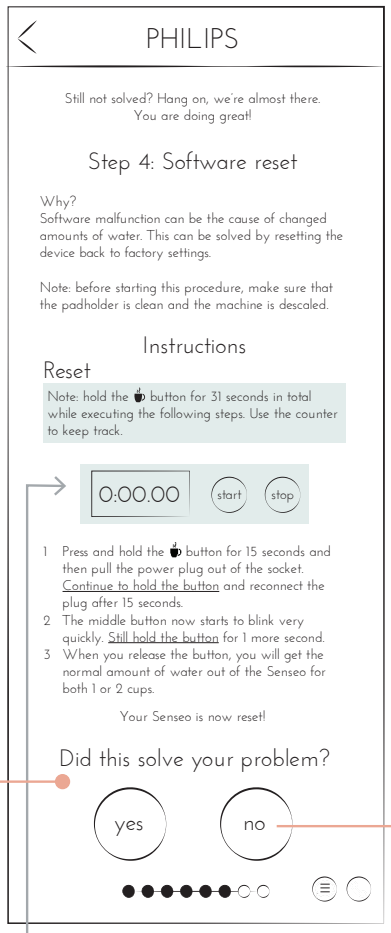
"*Several options were mentioned in the beginning, so I was mentally prepared for the steps. Still it was confusing that in the beginning 3 options were communicated and in the end there were 5.*" - participant 2.1

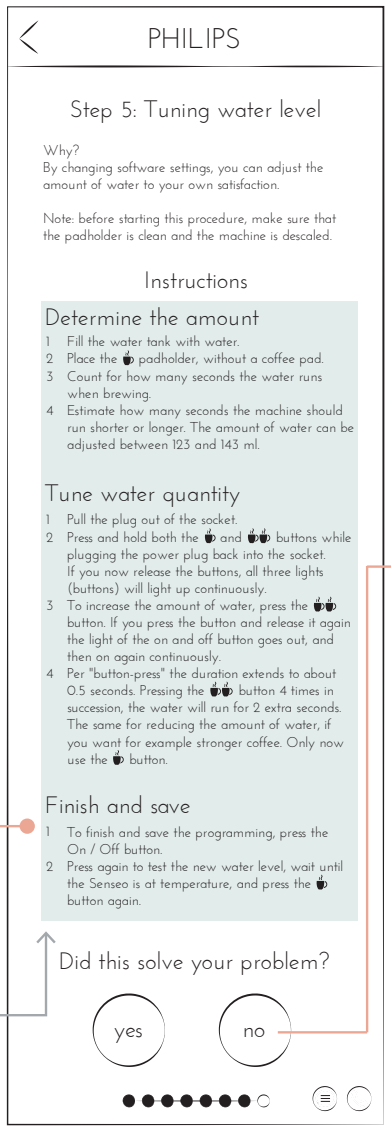
"*Because it took longer than 12 minutes, I felt slow.*" - participant 2.2

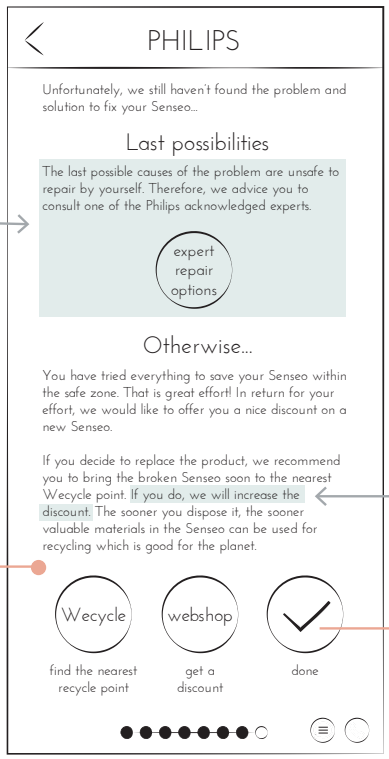
Some participants thought the Senseo was descaled based on how it looked from the outside.

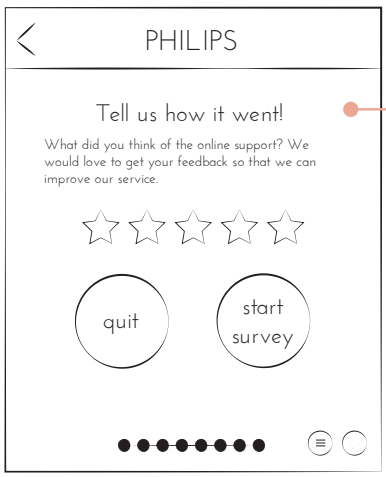












Instructions of step 5 were found difficult and long. Too much text. Unclear steps and the participants did not know where it was leading to.

Multiple participants were confused about when to hold the button and stopped holding it after the first 15 seconds. This was unclear. *"Oh I shouldn't have let it go already."* – participant 2.6

Multiple participants indicated to be unsatisfied about the end of the flow because of the advice to dispose and replace the product. *"I would expect the option to consult an expert who can operate within the danger zone."* – participant 2.1

An extra incentive for proper disposal by offereing a 10% discount, and increase it to 20% if the device is properly disposed for recycling.

10.6 BUSINESS CASE

A business case needs to be developed for the design to be viable. This paragraph describes a search for a profitable business case by defining the right ingredients and by structuring these in a Business Model Canvas (BMC) as can be seen in Figure 78. It is recommended for the business department to calculate the viability more precisely.

Explanation Business Model Canvas

The offered main values for customers are defined as improved product and service experience, addressing real-time and emergent needs, and cost and time reduction in the problem solving process.

The design requires the following key resources to deliver the customer values: an online platform including software and physical resources, and employee capabilities. The key partners to offer these values are the current partners of Philips for Senseo, IoT hardware producers, software developers, cloud service providers, and service partners as Wecycle.

Long term relationships with the customer will be built by offering personal assistance, and self- and automated services. This will increase the amount of post-sales touchpoints. Data analysis and data interpretation are essential for optimization of the provided services. By analyzing the data, the product and services can be further developed and improved, resulting in stronger customers relationships and higher circular impact. For this, Philips can either invest in internal employee capabilities or partner up with an external party. It is recommended for Philips to invest in these capabilities because the company is heading towards a more service centered company.

The most relevant channel between customers and Philips is the online platform in the form of a website (horizon 1) or an application (horizon 2 and 3). These online platforms require maintenance.

The costs have to be kept as low as possible. For cost estimations, the following aspects have to be taken into account:

- Research and development costs (e.g. the pilot phase and the development of the support flow and online platform);
- Production and hardware costs (e.g. the NFC tag, sensors, and the MCU);
- Personnel costs (e.g. the data team);
- Customer support: in case of teething problems during the first stages a customer support system should be developed and integrated in the business to support customers with problems or questions. In later stages the online support system will reduce customer support costs;
- Marketing and sales costs.

As Senseos are expected to last longer, it is expected that there will be less product sales per customer. This does not necessarily mean that the sales numbers drop. The increased lifetime expectation, the service, and connectivity might be reasons for new customers to choose Senseo over the competitor. If the design can tap into a new target group, and more people will choose Senseo, the volumes might even increase. This customer segment can be defined as customers who are willing to try a new way of interaction, and customers who value long lasting products.

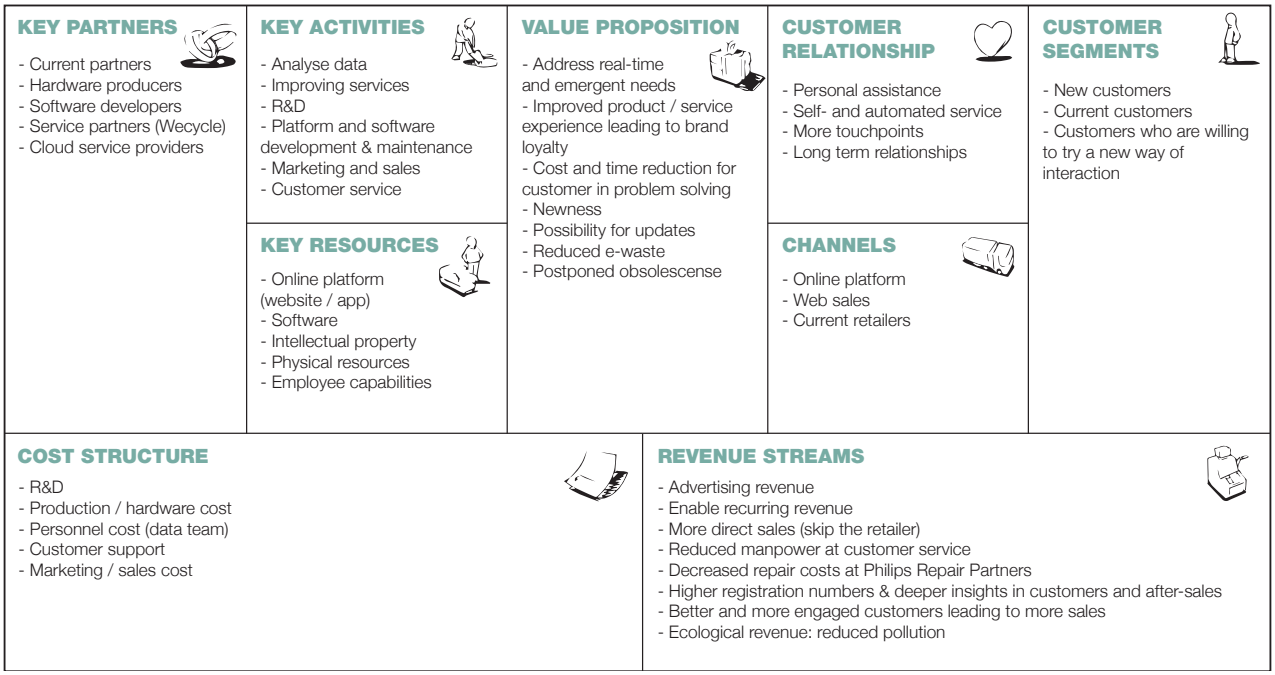


Figure 78: Business Model Canvas of the design

In the user test it is found that the likelyhood to choose for Philips products again is increased with the implementation of the support service. Thus, the design might result in more customers deciding to stay with Senseo. Besides, the increased brand loyalty and stronger customer relationships might affect sales of other consumer products in the Philips portfolio too.

Other revenues streams are:

- Advertising through the online platform enables recurring revenues and can result in a higher sales rate of other products such as descaler products, spare parts, and coffee pads (win-win for Philips and JDE)
- Stimulating direct sales through the online platform saves the retail margin (Van der Veen, 2018). This enables Philips to become competitive in price, e.g. by offering discounts.
- IoT enables software updates and upgrades which can prevent users to buy a new product for new and other functionalities. Those updates can be sold separately and create circular revenue.
- The design will alleviate and lower the costs of customer service (currently **CONFIDENTIAL** Senseo model per 6 months) since customers are able to solve problems themselves.
- Decreased repair costs at Philips repair centers **CONFIDENTIAL**
- Higher registration numbers and more users data generation are expected which will provide deeper customer and after-sales insights. This enables Philips to improve and optimize both the product and the support system. For viability calculations by the business department, it is necessary to determine how the retrieved data can be monetized and quantified in order to use it as a revenue stream for the business case.
- Brand campaign might result in a higher margin on the product and increased customer loyalty
- Ecological revenue: Reduced pollution by saving malfunctioning products, more efficient use of materials and resources, and by stimulating proper disposal for material recycling.

Despite the fact that the revenues look promising, at this point it cannot be determined at what point the revenues will outweigh the costs. A break-even point has to be calculated by the business department.

Recommendations

As mentioned, the business department is advised to make precise business case calculations to confirm the viability. The challenge of creating revenue with circular operations remains because circular revenues are often a long term vision and not a direct revenue stream. Therefore, circular impact is not (yet) included in current business case calculations. Including circular impact would make it easier for companies to choose for circular alternatives. Therefore, it is recommended for Philips to include circular impact in the business case calculations as an enabler and accelerator in the transition towards a circular economy. Therefore, it must be easy to assess circular impact and to track product performance.

For the recurring revenues and higher sales rates of supplementary products it is recommended to study if people indeed would buy more products through the online platform.

10.7 ENVIRONMENTAL IMPACT

With the rise of IoT, a new designer's dilemma arose that also affects this thesis project: Adding electronics and complexity to reduce the environmental impact of a product. This is another paradox.

"The digital revolution affects the environment. Most directly ICT through manufacturing, operation and disposal, but it also provides ways to mitigate of energy use." - Eric Williams (2011).

A comparison of environmental impact of current Senseo and IoT Senseo (horizon 2) is made with a "fast-track" life-cycle assessment (LCA) which is a method developed by Joost G. Vogtländer (2013). This comparison allows to make an estimation of the change in environmental impact and to discuss the circular viability of the design. The LCA analysis can be found in appendix AC. For this analysis a number of assumptions are made:

- A broken Senseo is replaced with a new one;
- Neglect additional transports for the IoT version compared to the traditional version;
- Neglect more energy use towards the end-of-life;
- Neglect potentially added materials used for problem solving;
- Recycle rates Senseo increase with 3% (based on comment Eelco Smit, 2018);
- Neglect impact of added technology on recyclability (based on LCA database numbers);
- Use of cloud service in the specific case of malfunction: negligible, because this situation rarely occurs per device.

The differences for the IoT Senseo compared to the traditional version regarding impact are the added electronics, the use of cloud services and thus extra energy consumption, extended lifetime, and higher recycle rates.

Added electronics

In the LCA analysis two sensors and one micro computer unit are added to the calculations. The impact of those added electronics are roughly estimated based on the kg CO_2 equivalent of the PCB and electronics used in the traditional Senseo. This data is retrieved from an internal study on the materials of the Senseo (Stockwell, 2018).

Cloud services and extra energy consumption

According to Greer et al. (2017) in their study on energy use of cloud services an average amount of 0.026 kWh energy is consumed for one hour when browsing the news with a smartphone connected to internet. According to Greer, using handheld devices (smartphones and tablets) considerably reduce the energy footprint of the user compared to other devices such as a laptop, PC, or television. For the LCA this amount of energy use is taken for the connection between the Senseo and the smart device. Even though for this connection the phone is not required to be actively used by the user, because the connection happens in the background.

For this assumption it should be noted that the Senseo only connects to the smart device when it is turned on. The assumption is made that the Senseo is turned on for a total of 10 minutes a day. This is based on an average of 5 cups of coffee a day, and that brewing one or two cups costs less than 1 minute (De Olde, 2018). Additionally, an extra 1 minute per cup of coffee is taken into account in case the user does not directly act. The total estimated extra used energy for an IoT Senseo is:

*365 * (0,026/6) = 1,5817 kWh/year*

Figure 79: Dis-assembled Senseo sorted by material

Extended lifetime
The extended lifetime is an unknown variable. In this case study it is assumed that the IoT Senseo version is not replaced by a new version. This is the aimed vision, not an expected situation. However, it is assumed that every 3 years a part is changed.

Recycling rates
The difference in the recycling rate is difficult to estimate. Yet, it is known that 62,441% of small domestic appliances is not collected for recycling in the Netherlands (Nationaalweeeregister.nl, 2017). When assuming that this number is directly applicable to Senseo users, and the advice and reminder for EoL disposal will motivate 3 in the 100 users to dispose the Senseo at a recycling point instead of the municipal waste. Then the recycling percentage for Senseo increases with 3%. This impact appears to be unsubstantial compared to the rest.

Results and conclusion
Two formulas followed from the LCA analysis:

*Impact traditional = 9,15715 * Tyears + 2,68735 * lifecycle*
*Impact IoT = 9,30039 + 2,73511 * lifecycle*

These Senseo specific formulas are used to create a graph that depicts the difference in environmental impact between a traditional Senseo and the designed IoT version (Figure 80). For the traditional versions a worst (3 years) and best case (7 years) scenario are plotted for the lifecycle to create a range for different use cases. The best case is based on the expected lifetime what the Senseo is designed for (based on calculations at Philips). In this case the user takes well care of the device. The worst case is based on an office scenario where the Senseo is heavily used and none of the users feel responsible for maintenance (based on practical examples).

From the graph in Figure 80 it can be concluded that in the first lifecycle there is no substantial change or difference between the two Senseo versions. The pre-use impact (time=0) of the added technology is negligible compared to the traditional Senseo and the impact during use is similar. The connected Senseo creates significant positive environmental impact from the moment that traditional Senseos would be replaced.

Furthermore, based on the results it can be assumed that replacing a part every 3 years in the IoT version, has negligible impact compared to the product replacement jumps of the traditional Senseo.

Recommendation
In the LCA analysis it was found that the use phase of the Senseo has a high environmental impact. On average, a Senseo consumes 89 kWh per year (internal data source Philips, 2018). Therefore, it is advised to investigate in the further development of the IoT Senseo version to minimize the energy use in the use phase. Energy consumption can already be reduced by removing the 30 minutes standby option from the Senseo.

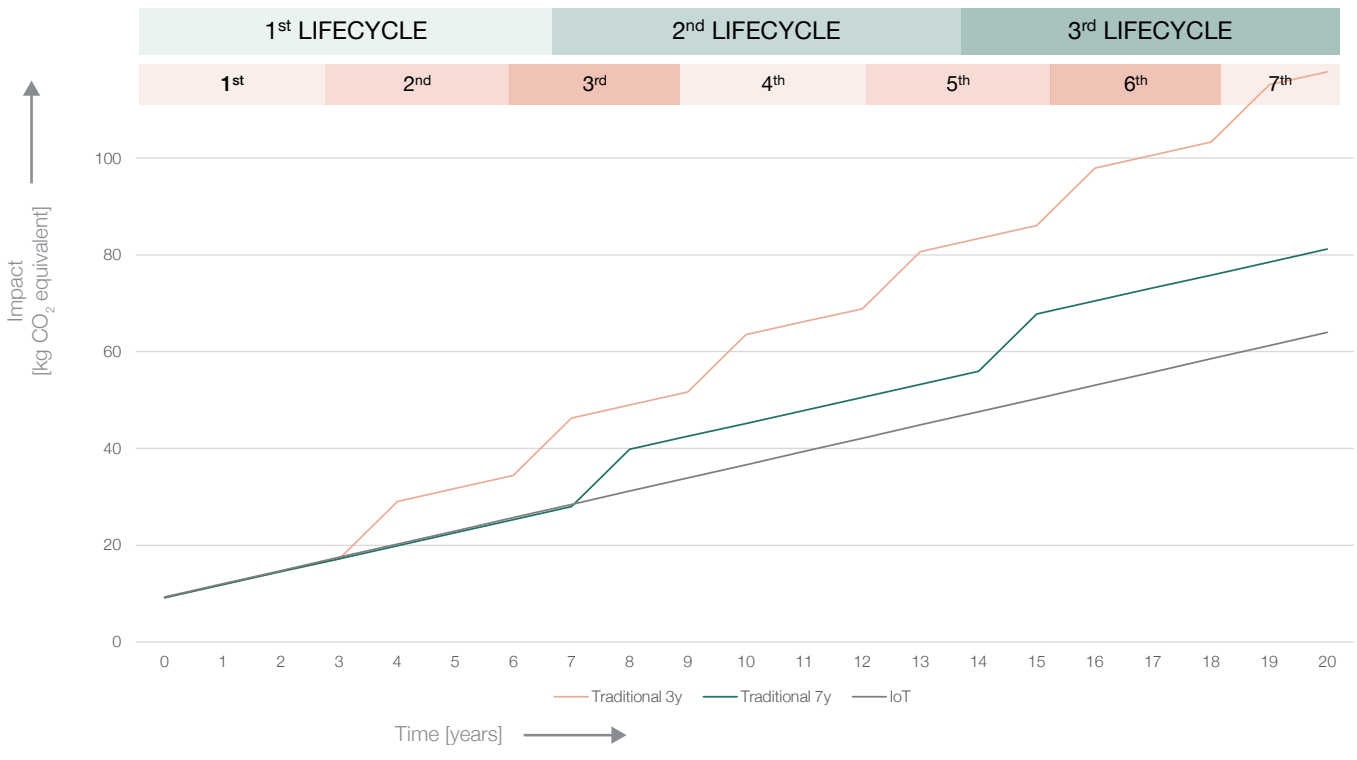


Figure 80: Difference in environmental impact between traditional and IoT Senseos over time in kg CO_2 equivalent

EVALUATION

“More than ever, we see consumers want highly personalized solutions that address their unique needs and fit their lifestyles. We believe in intelligent technology that adapts to individuals and seamlessly integrates into their daily lives. Using our deep expertise in IoT, sensory technology, cloud solutions and Artificial Intelligence, we are introducing next-generation digital health solutions that bring together consumer and professional health, empowering people to take charge of their own health.”

- Frans van Houten (2018)

11 DESIGN EVALUATION

For evaluation the designs are evaluated regarding feasibility, desirability for both the user and for Philips, and scalability, multiple employees at Philips are consulted. Benjamin Lopez, Service Designer, is consulted to evaluate the desirability. Participants in the user tests also evaluated the design regarding desirability. Luc Geurts (creative innovation lead) for feasibility, mainly regarding technologies, and Emma van der Veen (Consumer Marketing Manager at Philips Avent) for scalability to other businesses and products. Besides, a workshop with 9 internal Senseo experts from different departments (marketing, communication, product development, sustainability, and design) was organized on how to make Senseo more sustainable. These experts helped evaluating the design regarding feasibility. The financial and circular viability of the design are already discussed in §10.6 & 10.7. This chapter discusses whether the designs meet the design requirements.

11.1 FEASIBILITY

The design of horizon 1 is perceived as highly feasible regarding service implementation (Lopez, 2018) and hardware adjustments (adding the NFC tag) according to Senseo marketing and product development experts. According to Luc Geurts horizon 1 could be implemented in 2019. The fact that it is such short term oriented contributes to the feasibility and desirability of horizon 1 according to Mili Docampo Rama (2018) Head of People Research at Philips Design.

The feasibility of horizon 2 depends on the retrieved data in the first horizon. Technology-wise (sensors + Bluetooth connectivity) it is highly feasible according to Geurts (2018). The date for implementation depends on the date that the central Philips app can be launched. The designers and product developers in the workshop are open to the addition of connectivity and see this happening in the near future. Horizon 2 would require more organizational changes than horizon 1, but according to Lopez these changes might be inevitable for Philips anyway.

At this point, horizon 3 is not feasible yet since the requirements for this design have not been met. The feasibility depends on various developments (internal) and trends (external). If the future heads towards the predicted direction it is expected to be feasible. The implementation of Augmented Reality technology is according to Luc Geurts feasible around 2025. Senseo experts indicated in the workshop to believe in the idea of repair, modularity, and selling spare parts as a revenue stream. However, it is difficult to say at this point whether it can be viable for low priced products as Senseo. In order to develop a modular Senseo or any other modular consumer product, it is essential that the design is compatible with standard components to reduce costs, as stated by a sustainability expert.

Since JDE owns the brand Senseo and Senseo.nl, JDE must first approve before big changes can be made at Philips according to a product developer. This is a complexity for the feasibility of the designs. However, the designs have beneficial aspects for JDE: by extending the lifetime of Senseos, more coffee pads can be sold.

11.2 DESIRABILITY

The desirable effects of the designs for both Philips and the user are visualized in Figure 81.

PHILIPS

The designs contribute to the vision of Philips to becoming a leader in digital consumer innovations. It is important for Philips to invest in presented technologies because intelligent technology is the future and Philips presents itself as a tech-innovation company (see quote of CEO Frans van Houten on the previous page).

Additionally, Emma van der Veen acknowledged Philips cannot always continue to focus on high volume sales. According to Van der Veen the focus should switch to recurring revenues as the transactional business is an unsustainable business (§2.2.1). Using the designed, circular approach, Philips can differentiate themselves from their competition based on price, quality, durability

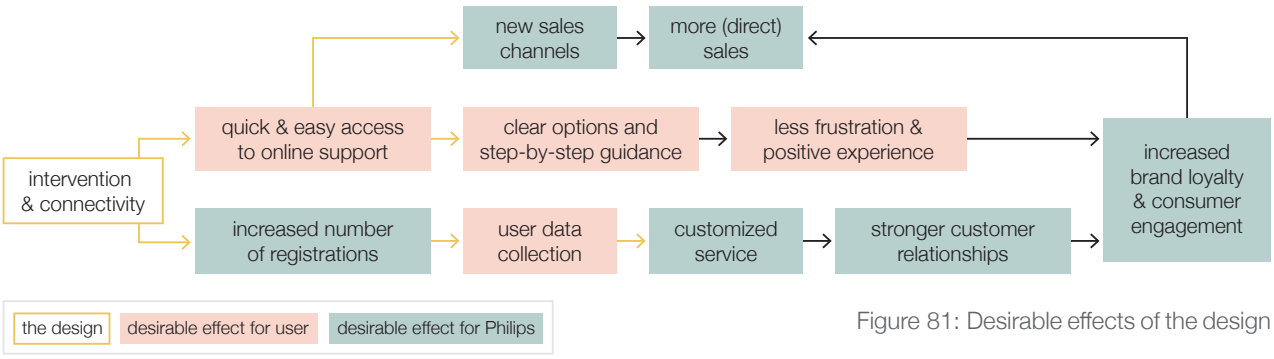


Figure 81: Desirable effects of the design

and convenience. Furthermore, it offers a desirable alternative for Phillips as it induces:

- Increased consumer engagement;
- Stronger customer relationships;
- More consumer insights and post-sales data;
- Increased brand loyalty.

Subsequently, these effects can lead to an increase in the (direct) sales of supplementary products, spare parts, or other Philips products. According to Lopez (2018) the design is *"a nice way to bring maintenance to the user"* without it being forced onto the user. Lopez suggests that through the design a sustainability story can be communicated, about Philips as an eco-friendly brand because this would add brand value. In addition, Lopez mentions that the design is desirable for Philips because it provides a channel to the online shop.

USER

The desirability of horizon 1 is evaluated in the user test (§9.2) and the participants were enthusiastic about the service. The cost price of the product will not be increased significantly by the addition of the tag. Therefore, the user merely has the benefits and it can be concluded that the design of horizon 1 is desirable for users. *"I would like to have this service for vacuum cleaners too."* – participant 2.5

"If producers explain how you can use the product for a longer time, that motivates me. Every producer should do that." – participant 2.6

After investigating the potential of IoT in this case study it can be assumed that adding internet connectivity is not desirable for low-end products if the product also functions well without it. Especially since the cost price of the IoT version will be slightly higher than the current Senseo or the version in horizon 1. The IoT version combined with the application might appeal to users owning multiple Philips products. Yet, it might not be attractive for consumers with one Philips product to install a Philips app for prevention and malfunctioning scenarios only. Especially if there are no extra functionalities or added value for during the use phase it can be assumed that people would not use the service often. As the IoT version would probably target a small and specific group of people, Luc Geurts advices that the IoT version of Senseo should exist next to NFC version, and should not replace it. Then the IoT version could be sold in a higher Senseo segment: slightly more expensive with extra benefits, and it integrates nicely with the rest of the (connected) Philips portfolio.

For low-end products as Senseo there is limited financial space to add extra functionalities. Within the project scope, the design had to be integrated with the current Senseo and no major adjustments or significant cost price increases were possible. Horizon 1 fits very well within this scope, but it does not seem feasible to keep horizon 2 within these boundaries without losing on desirability for the above mentioned reasons. Therefore, Philips is recommended to further investigate the possibilities of horizon 2 within the boundaries. For now, the addition of internet connectivity seems more suitable for high-end and more complex products since these offer more financial freedom to add extra functionalities.

Nevertheless, in this study it has been found that IoT unlocks unlimited new possibilities. Senseo might be a too simple device for it, but the idea is promising and can be very suitable for high-end products. Lopez recommends to investigate what other scenarios are possible with this technology, beyond prevention and malfunctioning and it might be interesting to look into Artificial Intelligence for that.

The desirability of horizon 3 is complex to evaluate because as mentioned before, it is long-term oriented and depending on various trends and developments. If consumers are indeed increasingly willing to make more effort, and sustainability indeed becomes a more important aspect for consumers, then the desirability for horizon 3 among consumers is expected to grow as predicted. Perhaps consumers expect the designed service of all producers in the near future.

11.3 SCALABILITY

This paragraph describes the implications of the Senseo for the rest of the Philips portfolio. Emma van der Veen finds the design of horizon 1 easily scalable and mainly interesting for personal care and domestic appliances as those are typically used in home environments and for personal use (e.g. vacuum cleaners or kitchen appliances). For non-electronic devices such as Avent baby bottles, QR might be more suitable than NFC. In that case the QR code could be used for information and advice, or for product returns to close the loop rather than for problem solving guidance.

The NFC tag method can easily be applied to other products. Yet, the support flow is unique for each product as it includes all possible problems and corresponding solutions. The flow will have to be developed separately for each product type based on limited available product data, which is time consuming and labor intensive. To make this process more efficient, a blueprint can be developed that describes how the design of the support flow should be approached.

As mentioned, horizon 2 might be more applicable and suitable for high-segment products such as full-automatic coffee machines. The possibilities should be investigated in further research.

12 LIMITATIONS, CONTRIBUTION, AND RECOMMENDATIONS

12.1 LIMITATIONS

This thesis offers a new practical way of engaging consumers in the transition to a CE within traditional transactional business models. The following limitations are to be considered in this study.

Circular limitations

For short-term feasibility and viability, the project focus was to design within the current business model. Therefore, a complete new business model is out of scope. This limits the amount of potential circular impact and results in other limitations as low investment costs, no total redesign of the Senseo coffee machine, and that the cost price of the product could not be significantly influenced by the design.

Literature study

In the analysis phase literature has been studied to create an in-depth understanding of the topic and to identify academic knowledge gaps. The main purpose of this study was to gather insights on consumer behavior change and the circular economy, but due to the large amount of available literature some information or insights can be missing. Besides, the literature study had an informal approach while the approach in the analysis phase was mainly focused on retrieving insights from the field.

Design development and evaluation

A practical limitation of the project is specific for the case study Senseo as JDE owns the brand Senseo and Senseo.nl. For major design changes by Philips, JDE must first approve according to a Senseo expert at Philips. This limits the freedom of Philips to make drastic adjustments. However, the design is mutual beneficial for JDE and Philips which is an advantage in this case.

Because there is very limited after-sales data available at Philips, the used data is retrieved from a monitoring study by Repair Café among 12 sites. Based on this data conclusions are drawn and it must be questioned whether this data represents reality well. For this reason, it is also strongly recommended to Philips to implement the design and start collecting substantial after-sales user data. This will enable Philips to make well-funded design decisions.

Within the time-frame of the project not all the aspects of the design could be tested with Senseo users. Besides, the participants in the user test were between the age of 23 and 32 and therefore the design has not been tested with Senseo users of older generations. For more precise and accurate validation of usability and the effects, the design should be tested in a real-life situation.

12.2 CONTRIBUTION

Contribution to Philips

The design contributes to the vision of Philips to becoming a leader in digital consumer innovations. This project has explored the possibilities to accelerate in the CE by engaging consumers with minimal hardware adjustments. Therefore, a solution is found to deal with the unconnected products which are still produced in high numbers within the current business model. For those products it seemed more difficult and challenging to engage the customer due to low visibility of products after sales and due to the easy replaceability of low-end products. The thesis is an exploration of integrating connectivity and digital technologies to existing products as a first step for Philips in influencing consumer behavior for lifetime extension and the circular economy in a desirable and feasible way.

Knowledge contribution

The thesis contributes to the current knowledge shortage about how consumers can be stimulated to make circular decisions in practice in a desirable manner (without forcing it). Many related studies are theoretical and focus on products to be “circular-ready”. This thesis includes consumers because they are crucial in the success of the circular economy: companies cannot shift to a circular economy alone.

The project contributes to other designers and engineers who are eager to integrate circularity in their designs by leading them through critical thinking and complex considerations concerning the use of connectivity for influencing and stimulating circular consumer behavior.

12.3 RECOMMENDATIONS

Circular recommendations

As mentioned, this project was focused on the current business model. However, my advice to Philips is to focus more on the long term strategies as more environmental impact can be created by for example looking into sustainable and circular business models. The current transactional business model is ultimately fatal due to use of finite resources and risks of price shocks.

Lifetime extension is part of the CE but not circular on itself: it is making more efficient use of resources which do not necessarily come back in the loop. In this project product return was not a main focus but it is mentioned in the design. Therefore, Philips is recommended to investigate the possibilities of creating take-back loops for obsolete parts or products for increased circular impact. For example in horizon 3 for the replaced spare parts.

Partnerships and R&D

It is recommended to Philips to develop partnerships with parts suppliers as OnderdelenSenseo.nl and recycling companies as Wecycle. Furthermore, investing in modular design of consumer electronics can cut costs (e.g. by using standard components) and it enables more complex repairs.

In addition, Philips is advised to decide whether to partner up with other digital service parties (e.g. a specialist in privacy protection or a data collection company that manages the warehouse) or whether it should invest in the development of those capabilities.

Liability

The liability was not part of the project as it is not covered by the field of Industrial Design Engineering. However, it is important to study and consider liability before the design can be implemented. For example it has to be re-evaluated which instructions and repairs specifically can be executed by consumers without risking liability claims.

Further development

For further development long term testing long term use should be considered. Behavior change (in this case) is difficult to measure because it requires real Senseo users with broken Senseos and testing behavior change reliably can only be done over a long period of time. For this project that was out of scope and it is recommended to do for further research.

Testing with larger sample sizes would give more reliable results with greater precision and power. But due to limited time-frame and money it was not feasible within this project to conduct a large study. It is recommended for further development to conduct more extended studies with larger sample sizes.

Viability

As it remains difficult to say at which point the design will be financially beneficial for Philips, it is recommended to further research this and to make accurate calculations by monetizing the benefits. This will enable Philips to make well-funded decisions regarding the paradox of extending the lifetime vs. revenue streams

A Philips-wide recommendations is to include circular- or environmental impact in the business case calculations, as this would enable the businesses at Philips to make more circular decisions and to decide to invest in circular projects.

Another Philips-wide recommendation regarding the transition towards a circular economy is to include circularity in the design requirements as important parameter in the product development. This would stimulate and force circular design thinking.

The environmental viability of the design is calculated in this project with a fast-track lifecycle assessment of the Senseo. This contributed in the discussion about the paradox of increasing sustainability by adding electronics and complexity. For further research it is recommended to do more extensive and quantitative assessment to make well-funded design decisions on for example which sensors to include or not.

Next steps

Philips is advised to continue developing the design for horizon 1 for implementation in the next year as a first focus. This design is desirable for both Philips and the user and the circular impact for horizon 1 is high comparing to the implementation investments.

The design of horizon 2 might be more interesting for a higher segment Senseo adding value with extra functions. The design as it is seems more suitable for more complex and higher-segment consumer products. Therefore, Philips is advised to further study the potential of this design and to develop and apply it for other product categories. For example by looking into extra functions that are enabled by the addition of IoT for increased added value.

At this moment, horizon 3 is perceived as rather futuristic. The feasibility and desirability are depending on how the trends and developments go. Technology-wise it is possible and Philips is advised to re-evaluate the design of horizon 3 in the future (2022) to see if it should be implemented by 2025.

13 CONCLUSION

The purpose of this project was to explore opportunities for stimulating consumers to engage in a circular economy at the point of product malfunctioning. The design was developed to enable Philips to become more circular by integrating digital technologies.

By intervening at the moment of experienced malfunction, consumer behavior can be influenced and stimulated in trying to solve the problem rather than directly giving up and buy a new product. This leads to more conscious and engaged customers. As most common problems with Senseo can be solved by quick and easy actions, much environmental impact can be created by intervening and influencing consumer behavior at that critical moment.

The design answers the research question “How to stimulate Senseo consumers to engage in a circular economy at the point of malfunctioning?”. The solution provides Senseo users with clear options at the point of malfunctioning. From the user tests it can be concluded that the design stimulates consumers to solve the problem reducing premature obsolescence, leading to an increased amount of Senseos with an extended lifetime. This meets the environmental requirements. The design enables Philips to better predict and control consumer behavior with regard to which actions they take and how they carry these actions out.

Besides, with the design Senseo users feel supported, less frustrated, and are more likely to choose for Philips again than without the support. This results in an increased brand loyalty. Therefore, it can be concluded that the design is desirable among users and it meets the set user and PSS requirements.

For Philips, the design is also desirable and attractive because it can strengthen the customer relationship and it creates visibility of the installed base while it is highly feasible and easy to implement on the short term. At the same time it contributes to the objective of Philips for 2020 that 15% of the turnover should come from CE principles.

A challenge of this project was to make it profitable for Philips to invest in lifetime extension. The design might result in less product sales per customer but it is likely to attract new customers and the design provides a new channel for additional and direct product sales. Besides, as users are more likely to choose for Philips again, the sales numbers in other product categories within the Philips portfolio can increase too. The design is scalable to other consumer electronics of Philips which increases the potential profitability and makes it more attractive to further develop. As the benefits of the design are mainly indirect revenue streams, it remains difficult to say at which point the design will be financially beneficial for Philips. This requires further research and accurate calculations by monetizing the benefits.

In conclusion, this thesis and the design are a first step towards applying connectivity to influence behavior for lifetime extension and the circular economy in a desirable and feasible way. Thus in the near future when the Senseo starts making strange noises, it will not end up in the attic but the problem will directly be solved instead. Because the user now precisely knows what to do. And in case the problem cannot be fixed, it will be disposed at the nearest proper recycle point. As a result, less virgin materials have to be extracted from our finite planet.

14 REFLECTION

The last chapter of this thesis is a personal reflection. During this project I learned valuable lessons that I can practice in my future career as a designer.

The first takeaway I learned prior to the graduation project: I knew that I wanted to execute this assignment at Philips but I had to arrange that myself. I eventually got precisely what I wanted: a graduation place in the Strategic Design Team at Philips Eindhoven on the Circular Economy. However, it took much effort and time. Sometimes I almost gave up and wanted to take a less exciting but available graduation project at the TU Delft. Luckily I didn't, because by talking to many people, working hard, and getting out of my comfort zone I managed to get the assignment. **Don't take the easy road, because its only reward is that it is easy**.

There were two difficult moments for me during the process but the moment after the analysis phase I experienced as most difficult. I had gathered incredible amounts of information, and the hardest part was to make a definite decision on what to continue with. I struggled with the questions whether the choices I made were the right ones, and whether other directions would not be better. While reflecting back on that moment I realize that **you can only find out whether you made the right decision by making the decision and work with it**. Sometimes I tend to over-think certain decisions while thinking longer about it does not make the decision easier to make.

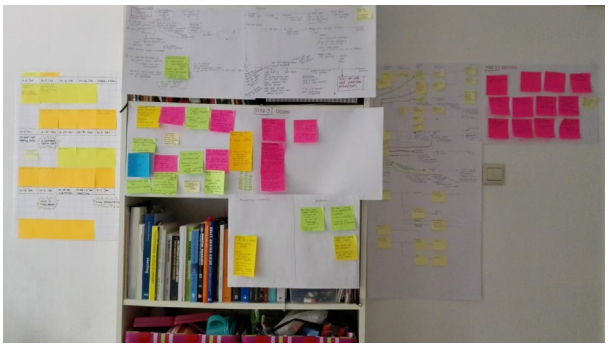


Figure 82: An impression of what the walls in my room looked like during the process on an average day

The second moment I struggled was during the ideation. Reflecting back to this moment, it is quite easy to see why: I had one idea and I could not recognize any of the other ideas I came up with as separate ideas. Instead I tried to add them as sub-ideas or as additions to that one main idea or I directly discarded them. I learned that **I am great at killing my own ideas without properly evaluating them**. By organizing a brainstorm session with Senseo users, I realized what I was doing and I finally could let go of this one idea and suddenly I was able to define my other ideas too. Besides, the brainstorm session also provided me with new inspiration and insights. The takeaway is that it helps to **include stakeholders in the ideation phase when you get stuck: it is a mind opener**.

During the process I found that I have the tendency to constantly make the project bigger that it is. I found it difficult to stick to the scope when I found interesting out-of-scope insights. Mainly because I thought that it would make the project more complete. The problem was that this also made it hard to keep focus in the topic and that I sometimes felt overwhelmed by the amount of work. Until the moment I realized that I was trying to solve too many problems again… So: **stick to your defined scope**. Of course you can explore a bit out-of-scope, as long as you don't let it confuse you.

These were the main takeaways I would like to remind myself of in the future. This project now marks the end of my student life which I enjoyed so much. But no need for sentimentality because I feel more than ready for the next phase in my life!

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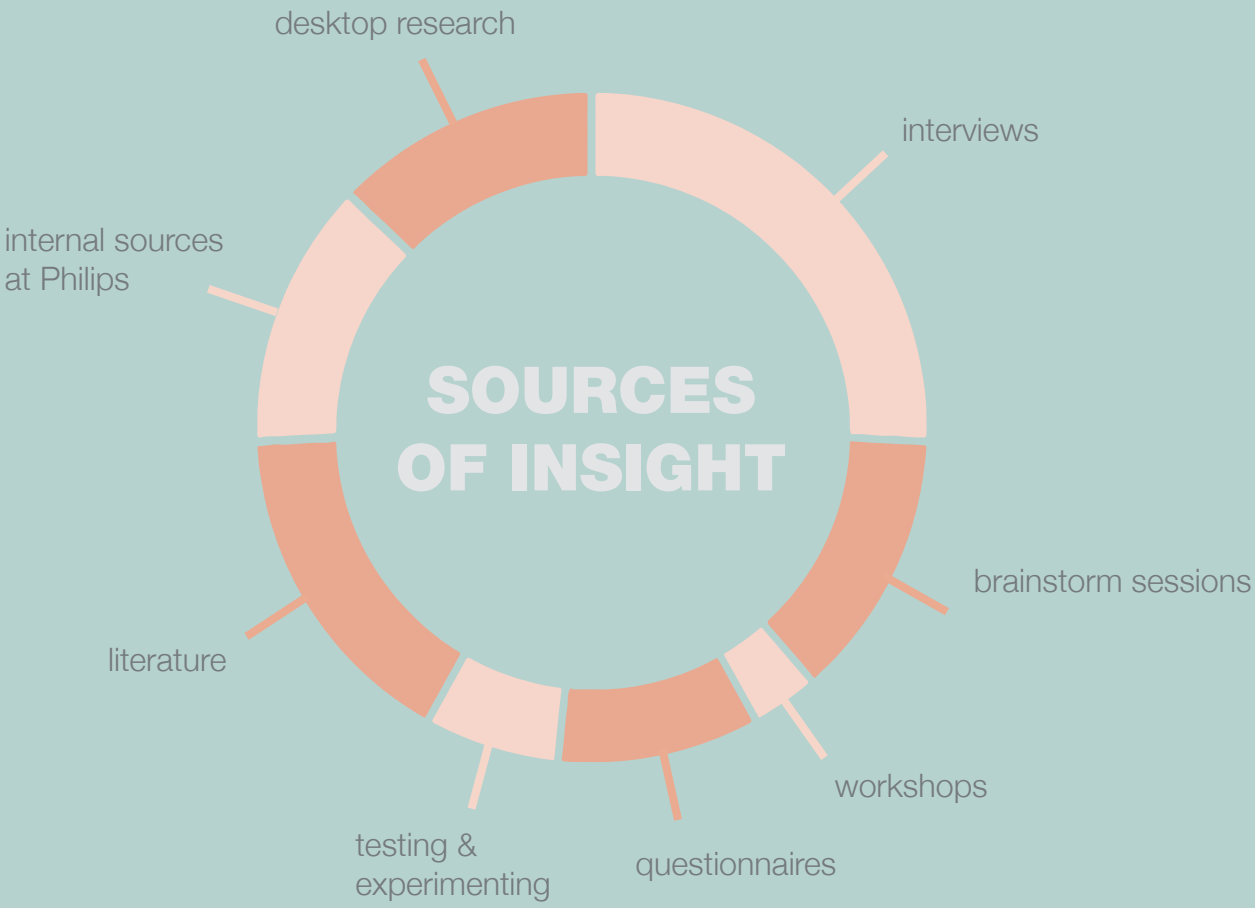
desktop research
interviews
internal sources at Philips
SOURCES OF INSIGHT
brainstorm sessions
literature
workshops
testing & experimenting
questionnaires

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APPENDICES

A. INFOGRAPHICS E-WASTE

On the following pages infographics on current statuses and trends concerning e-waste are depicted. The three infographics are on the scales: Global, Europe, and the Netherlands.

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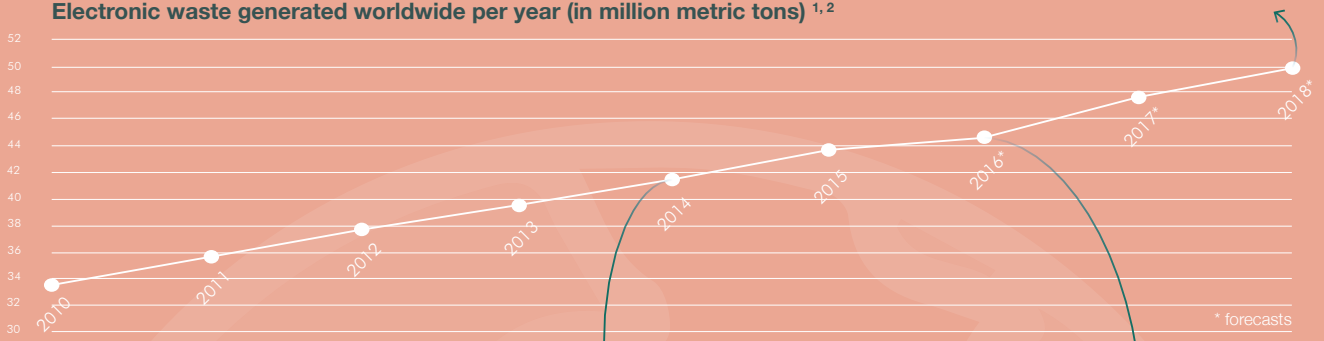
GLOBAL E-WASTE

80-85%
is sent to landfills and incinerators [4]

49,8 billion kg

Electronic waste generated worldwide per year (in million metric tons) [1, 2]



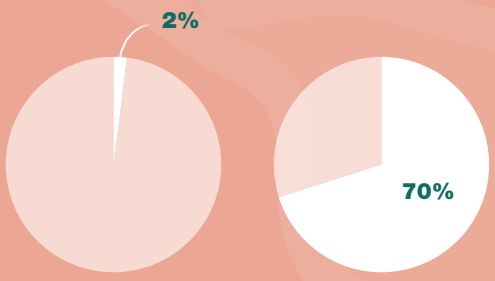
41,8 billion kg

this is like throwing away
800 laptops per second

Potential value of raw materials in e-waste in 2016 [6]

€55 billion

In 2014 **16%** of the total produced e-waste was recycled.
In 2017 this is **20%** at best [2]



of the total municipal waste in the USA is e-waste [7]

of the toxins in this total come from e-waste [7]

Elements in electronic circuit boards (kg per ton) [5]

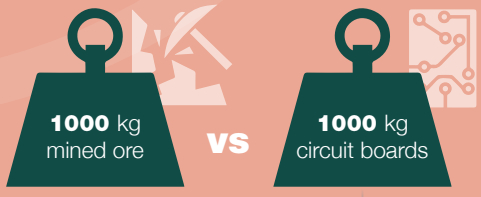
78 Pt platinum	79 Au gold	47 Ag silver	46 Pd palladium	28 Ni nickel
0,07	1	1	0,25	40

29 Cu copper	26 Fe iron	50 Sn tin	30 Zn zinc
286	90	44	9

"If the recycling rates for gold (15%), silver (15%), and platinum (5%) all increased to 100% the electronics sector could realize **€10 billion** in financial and natural capital benefits" [3]

- Jonas Allen, director of marketing for EPEAT, a global green electronic rating system

Recycled aluminium saves **±90%** of the required energy to extract virgin aluminium from mines [7]



40-800 x more gold
30-40 x more copper [3]

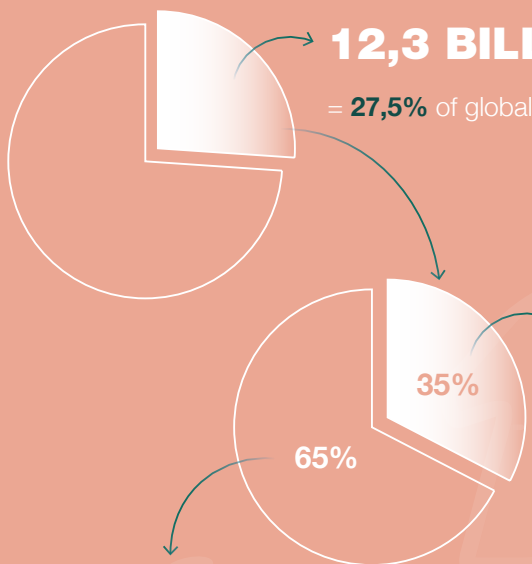
Recycling circuit boards can be more valuable than mining for ore [3]

SOURCES
1. Statista (2016); 2. Ever Green Environmental (2017); 3. Button, K. (2016); 4. TheWorldCounts (2014); 5. EdLab (n.d.); 6. Baldé, C.P. et al. (2017); 7. HelpSaveNature.com (n.d.).

E-WASTE IN EUROPE

40 countries
0,7 billion inhabitants
16,6 kg e-waste per inhabitant annually [1]

Generated e-waste in 2016 [1]



12,3 BILLION KG

= **27,5%** of global generated e-waste

3-5%

Annual increase of e-waste in Europe [4]

4,3 billion kg is documented to be collected & recycled [1]

35%

65%

85% in 2021
Legal target set by European Legislation [3]

The rest was either [2]:
- exported
- recycled under non-compliant conditions
- scavenged for valuable parts
- thrown in waste bins

In the European Union e-waste management is regulated by the "WEEE Directive". The purpose of this directive is to regulate e-waste collection, recycling, and recovery. [1]

Economic consequences

The overall worth of bringing e-waste streams into the circular economy is calculated to be [5]

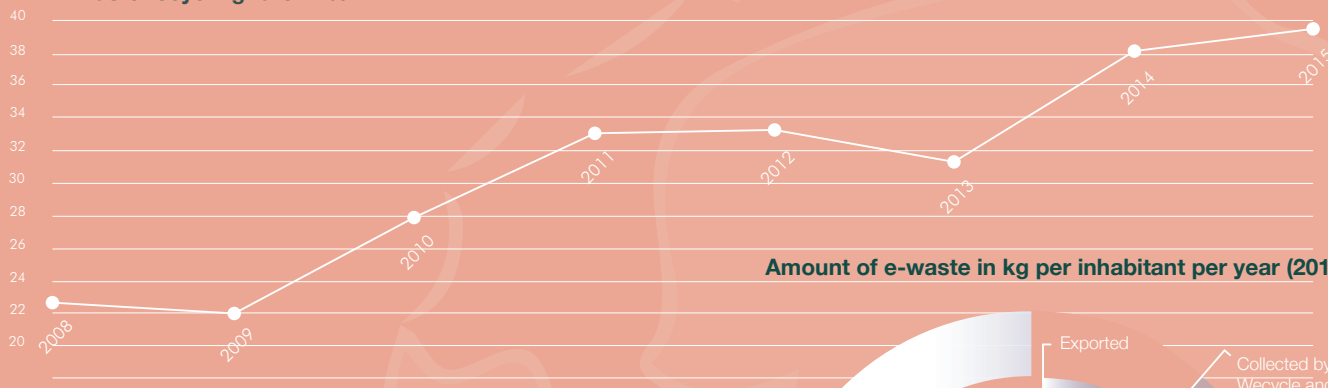
€2,15 BILLION

and could rise to €3,67 billion as the volume of electronic products increases.

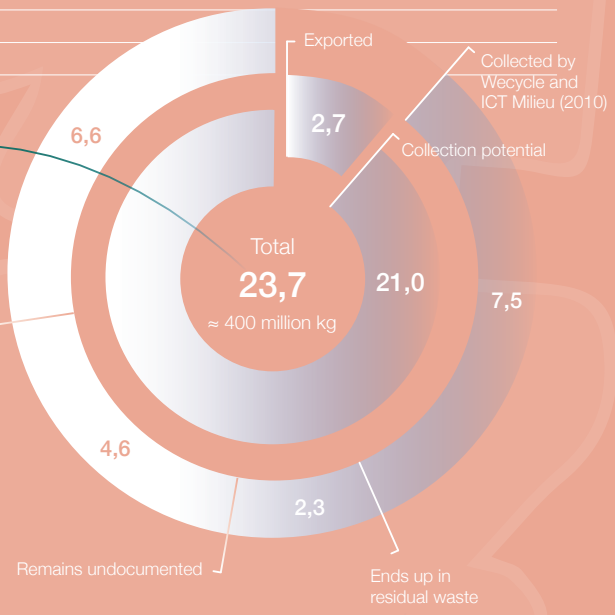
SOURCES
1. Baldé, C.P., Forti V., Gray, V., Kuehr, R., Stegmann,P. (2017); 2. Huisman, J. et al. (2015); 3. United Nations University (2012); 4. Greenpeace International (2005).

E-WASTE IN THE NETHERLANDS

E-waste recycling rate in % [5]



Amount of e-waste in kg per inhabitant per year (2012) [7]



EEE (Electrical and Electronic Equipment) Put-On-Market (POM) per year is **26,5 kg** per inhabitant [7]

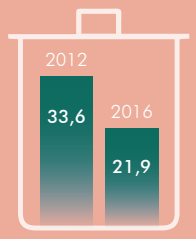
EU TARGET

By 2021 the Netherlands will collect **65%** of the average weight of EEE and energy-saving bulbs POM annually in the previous 3-year period.[8] Or **85% ≈ 340 million kg** [7] of generated e-waste. The recycling rate in 2015 was **39,4%**.[5]

39,4% → 85%

wecycle

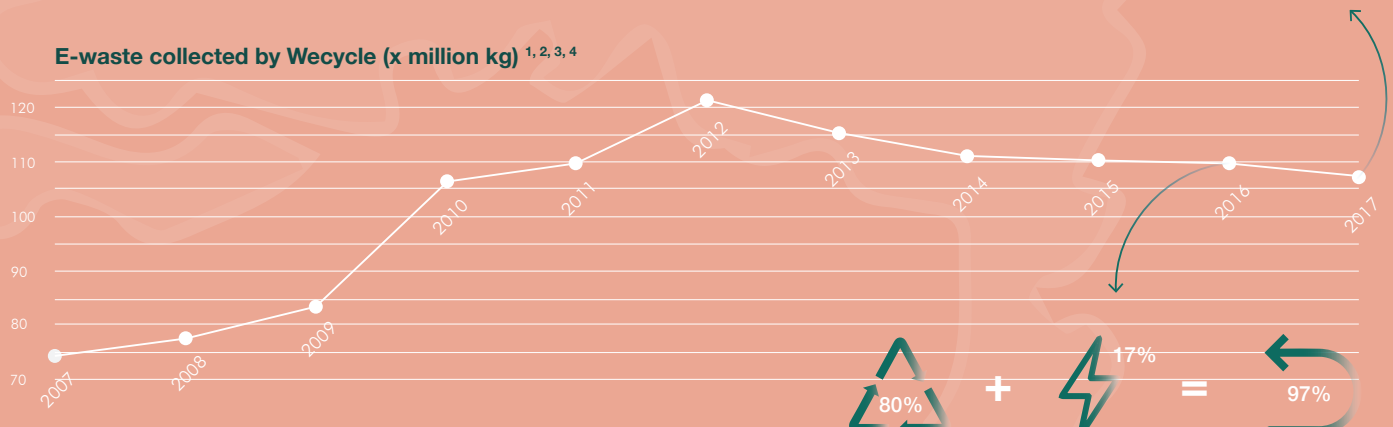
is the non-profit foundation that regulates the collection and recycling of e-waste in the Netherlands [4]



E-waste ended up in residual waste per year (x million kg) [6]

million kilograms avoided CO_2 emissions [4] by recycling at Wecycle

E-waste collected by Wecycle (x million kg) [1, 2, 3, 4]



material recycling + energy recovery = useful application of collected e-waste by Wecycle [2]

SOURCES

1. Haenen, van Hintum & Harms (2012a); 2. Golsteijn & Valencia Martinez (2017); 3. Wecycle.nl (2017); 4. Wecycle.nl (2018a); 5. Statista (2017); 6. Wecycle.nl (2018b); 7. Haenen, van Hintum & Harms (2012b); 8. United Nations University (2012).

B. CIRCULAR INITIATIVES IN PERSONAL HEALTH

This paragraph describes the current circular initiatives in the Personal Health division at Philips.

RECYCLING

Philips collaborates with Coolrec, a recycling company in the Netherlands, Belgium, Germany and France that processes e-waste, plastics and non-ferrous metals and produces raw materials that are used in production of new products (Coolrec.com, 2018). Therefore, this company is an active link in the circular economy. 36% of the recycled plastics from collected Philips vacuum cleaners is used in the production of a new vacuum cleaner: the "Philips Performer Ultimate" (Figure 83) (Coolrec.com, 2018).

Figure 83: Philips Performer Ultimate (Philips.nl, n.d.)

There is a high potential for electronics to stay in the loop since for example PCB boards are for many products the part with the highest environmental impact according to Graeme Walburton (2018), Senior Design Lead in the BG Coffee. Thus, recycling is definitely not optimized yet and needs to be developed and improved.

The coffee business at Philips is also working hard on recycling solutions. With the Senseo Up the following successes have been achieved according to Maja Vincek (2016), the consumer marketing manager of Senseo:

- Energy efficiency: 10% more energy efficient compared to standard Senseo machine
- Recycled plastics: 13% recycled plastics. Up to 20% less material costs compared to virgin plastics.
- Reduced footprint: Transportation cost reduced by up to 50% compared to standard Senseo machine.

However, recycling is called the "loop of last resort within a circular economy". In the book 'The World We'll Leave Behind: Grasping the Sustainability Challenge', Vare and Scott (2018) state that "recycling should only be done when as much material as possible has been recovered for use". Besides, they state recycling requires a waste stream. If there would not be a waste stream, there would be nothing to recycle in the first place. Therefore, it would be more useful to motivate people to produce less waste, instead of encouraging them to recycling. For this project the focus will therefore be on the inner loops of the butterfly model (Figure 3, p. 7) and not primarily on recycling.

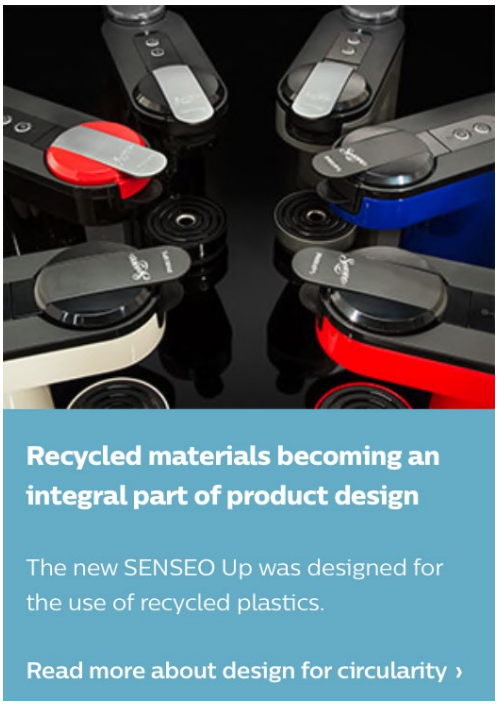


Figure 84: Senseo Up (Philips.com, 2018h)

LEASING MODELS

Philips is currently exploring leasing models for the consumer business. According to Kevin Shahbazi (2018), multiple small pilots with maximum 50 users are running. One case has recently been incorporated in the market: Philips Lumea (IPL hair removal system) in Figure 85.

For this leasing system the consumer pays a monthly fee. After 14 months the lease contract ends and the consumer can keep the product. This product comes with the Lumea application that guides the consumer during use for the best result. This application contributes to the consumer relationship with Philips. The leasing system seems to work for Philips which can be explained by the high product price of €549,99. This amount of money is for many

Figure 85: Lumea leasing system (Philips.nl, 2018r)

consumers too much to invest at once. The entry price of a basic Senseo is generally around 60 euro. Therefore, a leasing model is not as interesting for the Senseo and therefore out of scope for this project.

REFURBISHMENT

Philips wants to incorporate refurbishment and reselling because other parties as Amazon and Remarkt.nl are refurbishing Philips products without proper quality controls (Figure 86). Since it is outside of Philips' control, the brand could potentially be damaged if something goes wrong with the refurbished products which is a threat to the brand image.

Another reason for Philips Personal Health to refurbish

project team (2018).

Certified Refurbished on amazon

ReMarkt De Groothandel in Refurbished IT

Figure 86: Refurbishing by external parties

THE 5R PROJECT

To tackle those risks, a new initiative started in the Personal Health division in July 2018: the 5R project. This project aims to address the 5 R's (Return, Repair, Refurbish, Recycle, and Re-sell) in their mission to find beneficial solutions for consumers, the environment, and of course for Philips.

Since this project recently started, there are no successes yet. But the key milestones for 2019 are mainly focused on refurbishment and on repair (5R project team, 2018):

- Refurbishment: building refurbishment operations with the right partners that are in accordance with quality and regulations. After validation Philips plans to support markets in re-selling refurbished products and product sets.
- Repair: setting up a few large scale and good repair centers that can handle higher volumes and offer value added services.

Product scope:

- 1-3 months old or with damaged boxes
- Only products that are in a very good condition
- Come from unnecessary returns from the Philips online shop and retailers
- Unused or merely contain some small use traces

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C. INTERVIEWS REPAIR CAFÉ VOLUNTEERS

INTERVIEW WITH REPAIR CAFÉ VOLUNTEER [SUMMARY]

Which product is brought most often? (I asked two volunteers independently, they didn't have to think about this question)
- Volunteer 1: coffee machines
- Volunteer 2: Senseo

[Rest of the interview was with Volunteer 2: Nico – specialist electrical appliances]

WHY IS SENSEO BROUGHT TO REPAIR CAFÉS SO OFTEN?

Weak point: capacitors. Philips uses 250V but it clearly should be 400V. The Senseo expert of this Repair Café has a bag full of capacitors. Not provided by Philips, but bought at the local electronics shop.

RC told Philips they should use the 400V capacitors, but the response was that they couldn't change it until a next Senseo line. Then they might look at it.

GENERAL POINTS

- In factories screws are often placed with machines and too tight. Therefore it is hard to unscrew manually.
- One of the advices RC gave to producers: use parts people can disassemble at home. For example my water boiler had a tri-wing screw, and I don't have a screwdriver for that

GOOD POINTS OF SENSEO

- Easy to repair (high repair rate)
- Philips only uses +/- 2 screws in the Senseo, the rest are hook- and click connections. Easy to disassemble and assemble if you know the trick.
- Products that cannot be repaired
- Cannot be left at Repair Café, you should bring them to municipality collection points. In Schiedam you can, because the Schiedam RC has a certain agreement with the municipality.
- No need for Senseo collection for the use of spare parts. In practice the volume is not big enough (not yet).

SPECIALISTS / REPAIR(WO)MEN

- The repairers do have a technical background. There is a simple interview because RC wants to know about your experience and affinity with electronics or technique. If you don't have any technical knowledge you can volunteer in the coffee corner for example.
- Every repairer brings his/her own toolbox. Because every repairer has their own tools they can exchange if they need something that is not in your own toolbox.
- The voluntary donation is used for buying new tools or parts.

INTERVIEW WITH REPAIR CAFÉ VOLUNTEER 1 [ORIGINAL NOTES]

Bettina
Woman behind the counter
Volunteer at RC Delft Science Centre

VAAKST BINNENGEBRACHTE PRODUCT?

Het product dat hier het vaakst binnenkomt is het koffiezetapparaat. Deze komen eigenlijk wel iedere keer binnen. Daarnaast ook andere huishoudelijke apparaten maar soms ook televisies.

INTERVIEW WITH REPAIR CAFÉ VOLUNTEER 2 [ORIGINAL NOTES]

Nico
Specialist with an electro-technical background (retired)
Volunteer at RC Delft Science Centre

VAAKST BINNENGEBRACHTE PRODUCT?

Senseo komt het vaakst binnen.

HOE KAN DAT?

Ze hebben een zwak punt bij de condensator. Er zit een condensator in van 250V maar het moet eigenlijk 400V zijn. Robbert is hier de Senseo expert. Hij heeft allerlei kleine condensators als snoepjes in een zakje altijd bij zich omdat de condensator dus toch vaak het probleem blijkt te zijn (de zwakke plek). Deze condensators zijn niet via Philips besteld maar bij een elektronica shop gehaald.

Er werd gezegd dat Philips op zijn kop heeft gekregen over de condensator. Over dat ze er condensators van 400V in moeten stoppen i.p.v. 250V. Daar werd nu niks mee gedaan, maar misschien dat er rekening mee gehouden wordt bij een volgende lijn.

Vaak worden schroeven te vast / te strak gedraaid bij de productie in fabrieken. Dit maakt het lastig om zelf de schroeven los te maken met de hand, te repareren. Verbeterpunt.

Een van de adviezen die RC dan ook heeft uitgebracht aan producenten: Gebruik onderdelen die mensen thuis zelf uit elkaar kunnen halen bijv. kruiskopschroeven i.p.v. een rare driekopsschroef waar niemand een schroevendraaier voor in huis heeft.

Senseo heeft maar iets van twee schroeven en verder alleen maar haak- en klikverbindingen. Philips is daar een kei in. Dus het is eigenlijk heel makkelijk uit elkaar te halen en in elkaar te zetten, maar dan moet je wel net even weten hoe.

PRODUCTEN DIE NIET GEREPAREERD KUNNEN WORDEN?

Als je product niet gerepareerd kan worden in het Repair Café dat mag je het hier niet achter laten. Mensen moeten dus zelf hun product goed afleveren bij de gemeente. In Schiedam hebben ze besloten dit wel te doen. Daar hebben ze een bepaalde afspraak gemaakt met de gemeente. Je kunt hier ook ‘neuzen’ tussen de producten die daar staan.

Er is ook geen behoefte aan dat je Senseos hier zou kunnen achterlaten voor reserve onderdelen. Want zoveel hebben ze in de praktijk niet nodig, nog niet. Geen behoefte. Ze hebben wel een paar reserve onderdelen liggen, maar dat is voldoende.

ACHTERGROND VAN DE REPARATEURS?

De reparateurs hebben hier wel een technische achtergrond. Er is een soort keuring / sollicitatie ronde. Niet zo streng hoor, maar je moet toch wel iets van technische kennis of affiniteit met techniek / elektronica hebben om hier aan de slag te kunnen als specialist.

De specialisten brengen dan iedere keer hun eigen persoonlijke koffer mee met tools, en daarom heeft iedereen hier ook andere dingen in zitten waardoor ze die dingen onderling uit kunnen wisselen. Bijvoorbeeld de meneer die mij heeft geholpen heeft vroeger in de elektronica gewerkt en is nu met pensioen dus die had allerlei apparatuur en wist er van alles van.

VOLUNTARY DONATION

Uw vrijwillige bijdrage is altijd welkom. Daar kunnen wij weer gereedschappen en onderdelen van inkopen om volgende bezoekers te helpen.

D. REPAIR CAFÉ

CONCEPT

The idea of Repair Café is that people bring anything that is broken and can be carried for reparation. For example, clothes, mechanical appliances, electrical appliances, furniture, anything. At the specified locations materials and tools can be found to repair the product. Of course some products are too complex to repair yourself, therefore there are expert- and skilled volunteers to help. For this service you only pay a voluntary contribution of €2,50 (Vermoolen, 2015). This concept brings people in local communities together. So it does not only tackle the problem of waste, it also stimulates social interaction.

THE EMERGENCE OF REPAIR CAFÉ

In 2009, Martine Postma initiated the very first Repair Café in Amsterdam-West. The concept became a huge success. Therefore, Martine officially founded 'Stichting Repair Café International' in 2011 (RepairCafe.org, 2018). This means it is a foundation and therefore a non-profit organization. According to the website there are currently 1562 Repair Cafés worldwide.

SENSEO DAYS

It has been found that Senseo coffee machines are on top of the list of repairable domestic appliances in the Netherlands (Graag Gedaan, 2014). The result is that hundreds of Senseos are brought to Repair Cafés. Therefore, dozens Repair Cafés organized special 'Senseo Days' (repaircafenijmegen.nl, 2014).

There is even a Senseo-workgroup at Repair Café that created a Senseo Repair Guide. This team says Senseo is by far the most offered electrical device at Repair Cafés and it happens too often that it cannot be repaired due to lack of experience and knowledge (Brattinga et al., 2015).

FACTS AND FIGURES

In 2017, Stichting Natuur & Milieu conducted a study with twelve selected Repair Cafés in the Netherlands to research the 2347 products that are brought to those Repair Cafés for reparation (Natuur & Milieu, 2018). The goal of this research was to make recommendations on how to make products more suitable for repair. The results of this analysis are reported in the 'Reparatiemonitor 2017'.

In 2017, 77% of the Philips coffee machines were repaired according to an email Martine Postma (2018) sent to Philips. This number is based on the twelve studied locations that in total received 123 Philips coffee machines in 2017. It means, despite of the Senseo Repair Guide (2015), 23% could still not be saved. There are multiple obstacles found in the Reparatiemonitor (2018) applicable for all received products (so not Philips specifically):

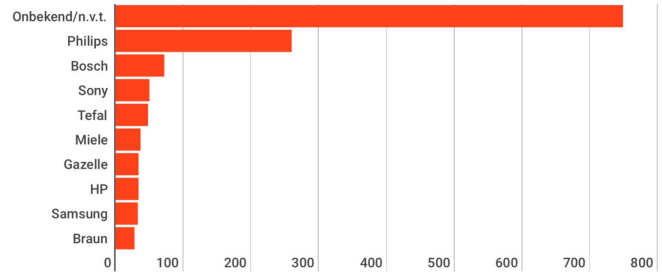
30%	Unrepairable part (e.g. electronics) and not separately available or too expensive to replace
30%	Too complicated to repair (for example because it requires special tools)
20%	The product is not dismountable without causing damage
10%	The cause of the defect is unknown
10%	Part has been demolished and cannot be repaired or glued (e.g. plastic switch)

Philips products brought to Repair Cafés (of which most are coffee machines) are often successfully repaired: 67%. Philips is by far the most offered brand at Repair Cafés (first figure on the next page).

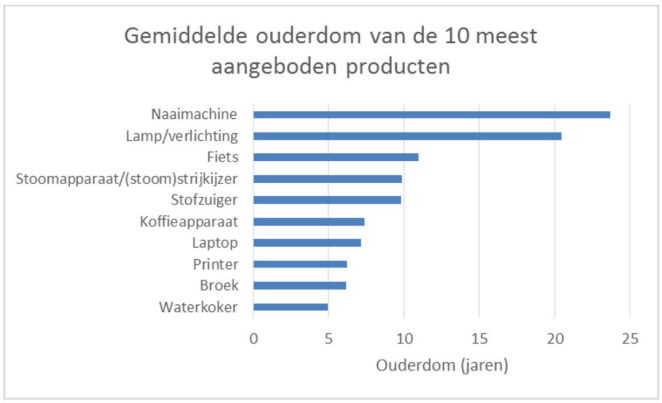
The Reparatiemonitor, the Senseo Repair Guide, an Excel sheet received from Martine Postma on all Philips products brought to Repair Cafés (Repair Café, 2018) and FAQs in the Philips Coffee Business and Consumer Care (2016) show a wide variety in where the weak points of the Senseo product are. There is not one specific part of the product that usually breaks first.

CONCLUSION

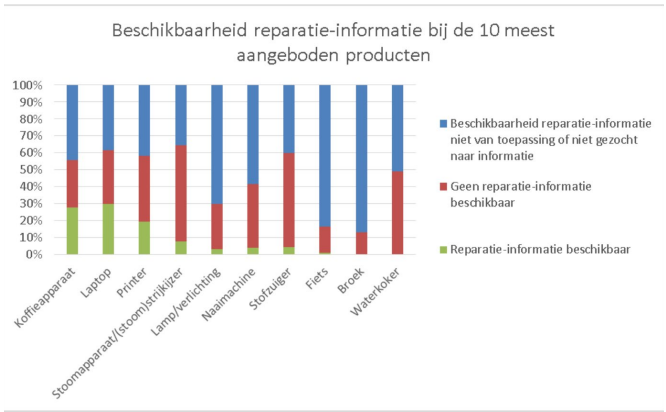
Apparently Senseo coffee machines are already easy to repair. Therefore, Repair Café could be an interesting partner. Though it should be kept in mind that only a small minority knows about this concept. Most people still have no clue what to do with their coffee machine at the moment it breaks. There is an opportunity for Philips to step in the process and guide customers in making the right decision.



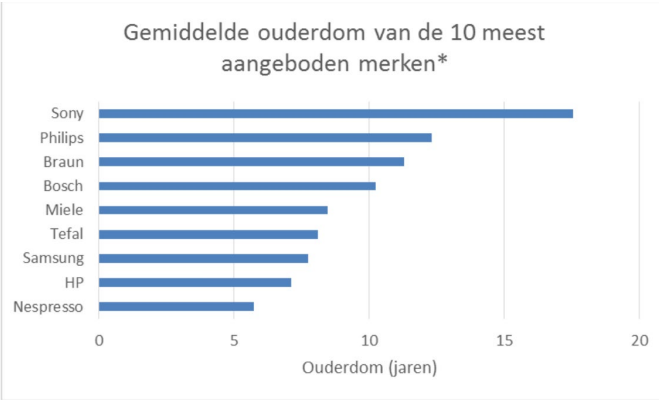
Figuur 2: Top tien merken die het vaakst ter reparatie worden aangeboden bij Repair Cafés.



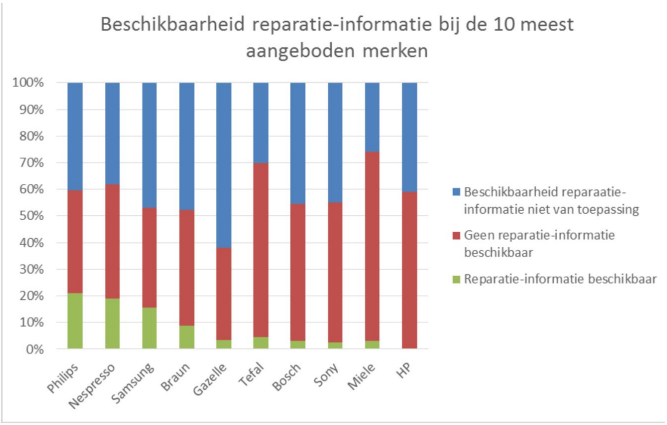
Figuur 5: Gemiddelde ouderdom van de tien meest aangeboden producten



Figuur 8: De beschikbaarheid van reparatie-informatie van de tien meest aangeboden producten.



*Figuur 6: Gemiddelde ouderdom van de tien meest aangeboden producten *Gazelle is i deze grafiek niet meegenomen omdat van minder dan tien van die producten he productiejaar bekend was.*



Figuur 9: De beschikbaarheid van reparatie-informatie bij de tien meest aangeboden merken.

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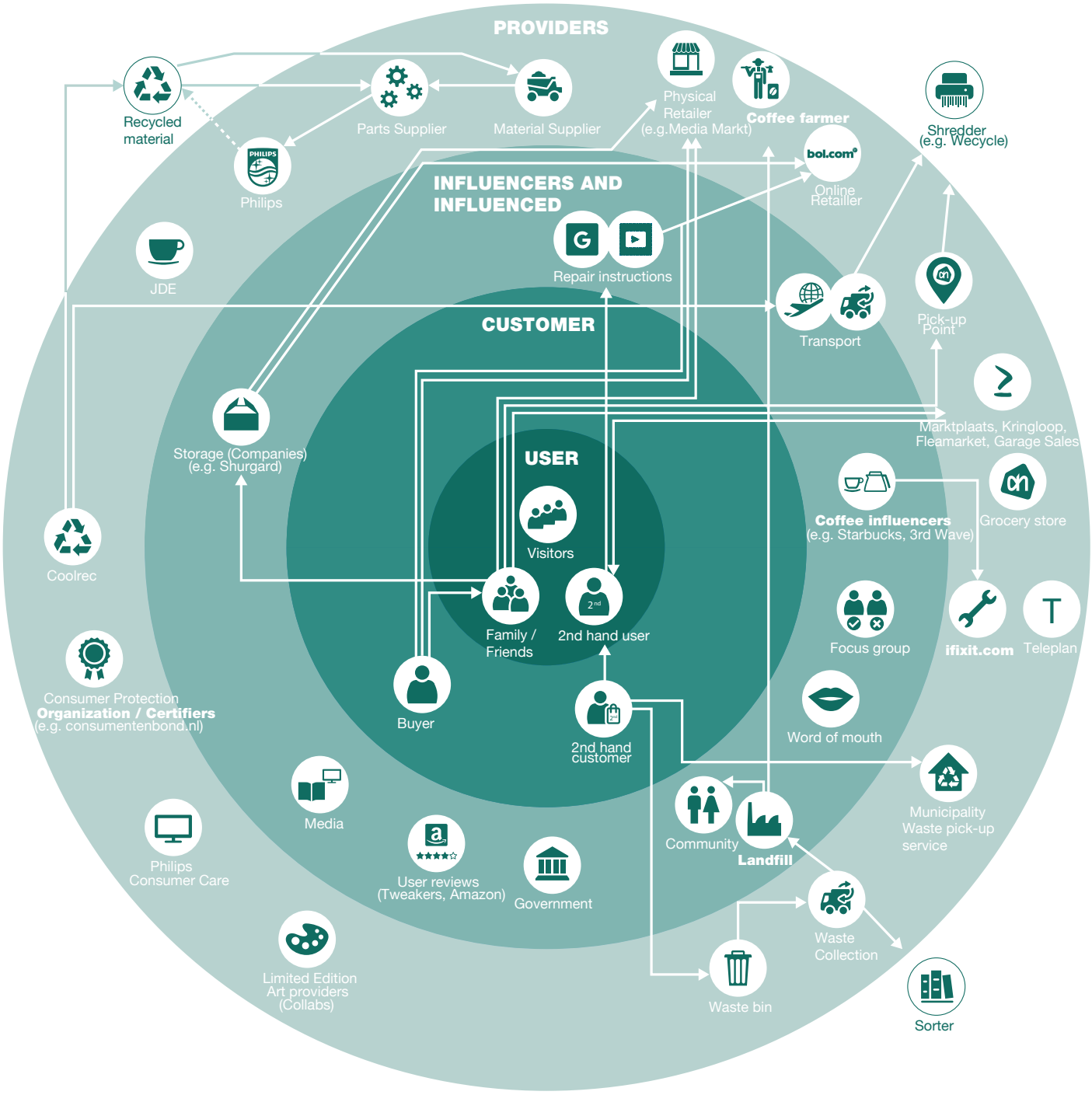
E. STAKEHOLDER ECOSYSTEM SENSEO

This stakeholder ecosystem is made in cooperation with the Circular Design Team in a brainstorm session at Philips.



F. COMPETITOR ANALYSIS: BUSINESS ADVANTAGES AND CONSUMER PREFERENCES

BUSINESS ADVANTAGES

This paragraph discusses the main business or competitive advantage of the four most popular single serve coffee machines (including Senseo) that are also the main competitors of Senseo and naturally in the inner circle of Figure 19 on page 20. This study is done to find the strong and weak points of how Senseo positions itself compared to its main competitors. Consequently, opportunities can be determined about which advantages or benefits could be used in the problem solving.

The four most popular single serve coffee machines (according to a study for JDE by Boyd, 2018) are depicted in Figure 87. This figure shows that Senseo Original has the lowest entry-level machine costs and offers coffee at the lowest price compared to its main competitors. For the coffee price per cup basic black coffee pads and capsules are compared.

CONFIDENTIAL

CONFIDENTIAL

	 Tassimo Vivy 2	 Dolce Gusto Oblo	 Nespresso Inissia	 Senseo Original
Machine price	€ 69 [1]	€ 67 [2]	€ 74 [2]	€ 48-55 [2]
Coffee price	€ 0,30/cup [3]	€ 0,27/cup [4]	€ 0,40/cup [5]	€ 0,12/cup [4]

Figure 87: Four most popular single serve models (according to Boyd, 2018) and the costs per model

CONFIDENTIAL

KEY INSIGHTS

- Senseo is the most affordable machine. Should stay like this in the solution, since this aspect is a reason for consumers to choose this product above competitive models.
- Senseo is chosen for its simplicity and convenience in the use of the product. This could be amplified in the solution by for example service design.
- Wide distribution network of Senseo (mass distribution and online) > could take advantage of this aspect in the design

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Figure:
1: bol.com, geraadpleegd op 30 July 2018
2: coolblue.nl, geraadpleegd op 30 July 2018
3: Tassimo.nl, geraadpleegd op 30 July 2018
4: AH.nl, geraadpleegd op 30 July 2018
5: Nespresso.com, geraadpleegd op 30 July 2018

G. SUMMARY FINDINGS HEARTBEAT STUDY

CONSUMER PREFERENCES

A study conducted by Heartbeat in 2017 analyzed brand and customer experience of single serve coffee machines. In this research Senseo and its three main competitors Nespresso, Dolce Gusto, and Tassimo are studied. The following 4 findings are literally retrieved from the study.

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KEY INSIGHTS

- Senseo is most popular and desired brand in the market
- Main competitor is Nespresso with growing preference
- Senseo is seen as least luxury brand
- Senseo has a consistent brand image performance
- Nespresso is seen as a more caring brand > could be a result of all the attention they are drawing with the recycling initiatives (which Philips does not need)

REFERENCES

Heartbeat+ (2017). Brand and Customer Experience 2017. Single Serve Coffee Machines.

H. DISASSEMBLY FLOW

This disassembly flow is made in cooperation with the Circular Design Team in a brainstorm session at Philips.

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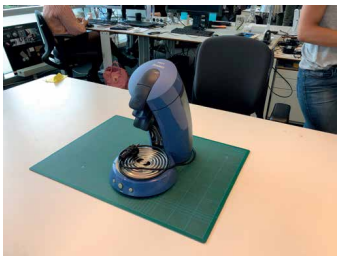
Product information
Product: Senseo HD7820
Distribution site: Made in Poland
Tooling mold machine: made in 2007,
refurbished several times intil 2011
Residual value: €5 Senseo bought off Marktplaats



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I. INTERVIEW THIJS VAN GENNIP

In this appendix a summary is given of the interview with Thijs van Gennip, Customer Service employee at the Philips MyShop in Eindhoven.

Name: Thijs van Gennip
Profession: Customer Service at Philips MyShop
Date: Tuesday 10 July 2018

All products that are being returned or broken come to me. At the desk, so customer contact.

Philips MyShop is only for (former) Philips employees (niche, disguised target audience). The biggest group of their customers are retired people.

Do you think there are consumer needs concerning circularity?
Because most customers in the Philips MyShop are a bit old (retired people), sustainability and circularity is not really a lively subject. So sometimes if they ask why they don't receive a new airfryer but have it repaired I explain that otherwise it's a lot of plastic that would go to waste. Then they are like "oh, yeah". But it isn't something they think of themselves. I don't feel like this audience cares much.

Sometimes the customer is disappointed "why didn't I just get a new Senseo? (regarding the product price)". Because Sonicare (~100 euro) is usually never repaired, the customer receives a new one. But if we explain that it's because of sustainability the customer usually understands.

At the MyShop, Senseo is actually never repaired if it is OOW because of the product price

Customers receive 3 months warranty on the reparation so customers usually prefer a new product (with 2 years warranty).

Costs: first you have to pay 25 euro research costs. Next the quotation is for example 60 euros (depending on the problem). If the customer decides not to have it repaired you still lost the 25 euros. So we advise customers OOW not to send it for reparation. Research costs are deducted from repair costs if the customer decides to have it repaired. The high research costs usually discourage people.

Thus many decisions are probably already made before the consumer has any certainty.

Opportunity: if we could lower this 25 euros to for example 5 euros then the threshold is much lower for people to make the decision to revive the product. Or extent the 3 months extra warranty after repair to 2 years.
Dit kan een recommendation worden for customer service

Within warranty I think all consumers make the effort to bring their product to the shop or via consumer care.

Also because customers think it is a Philips product and it can't be that it is already broken within 2 years: brand perception Philips = quality.

Complaints about the manual: now it's very concise and the rest of the information can be found on internet. I think there should be more communication on maintenance, what is necessary for the product to extend longevity. Because people don't read the manual anymore.

I have the idea that people don't read the manual anymore when they buy a product, but I feel that elderly people still want to do so. But now that the manual is more concise and often just a quick start manual, that is not enough for them. Generation shift.

J. SUPPORT CHANNELS EXPERIMENTS AND FINDINGS

CALL CENTER

When searching for 'Philips Customer Service' on Google, the phone number is the first thing that pops up. When searching for the phone number via the Philips website it is a bit less easy to find but after selecting the product category (Household products) it is only one click away. The find-ability is slightly different for each country, for this the focus is on the Dutch website. It is remarkable that on this web page a distinction is indicated in the choice menu for questions about 'Coffee' or 'Household products' (Figure 88).

Roughly 850 calls per Senseo model are registered per 6 months (globally) at Philips call centers (appendix K). When multiplying by the amount of Senseo models, multiplying by other types of Philips coffee machines (not Senseo), and multiplying by the many devices from other (non-coffee) businesses, then that adds up to a lot of phone calls per day which is highly labor intensive. It would be beneficial if this amount of phone calls can be reduced.

This service is not only used in case of malfunctioning products, also for questions about promotion actions or about how the device works.

Pros

- Personal service, the employee takes time to help
- Discount is offered

Cons

- Only available during working hours
- It takes a few minutes before an employee is available
- It is not a free service, via the mobile network provider
- Only advice on cleaning or descaling. Problems other than that are not solved in case of OOW. There is not much that can be done because it is too expensive for sending the device to a repair center.
- From a Philips perspective: labor intensive to answer all the calls and to manually register the complaints

CHAT BOX EXPERIMENT

On the next pages the chat box experiment can be found. Find-ability on the website is the same as for phone service, slightly less easy via Google search because there you are redirected to the Philips website.

Disadvantages to current chat function:

- Real employees, and therefore only available during working hours
- Waiting time before you can actually start the conversation: 7 minutes
- At the end you receive a request for assessment. And a survey is sent by email. The latter is not something consumer really want.
- They could not help very well, for example because there was no option to share pictures and therefore the employee could not see my Senseo
- The question (in English) did not come through properly: technical error? Or does the service only works in Dutch?
- As a user you must have the model number of the device at hand (which is on the bottom of the product)

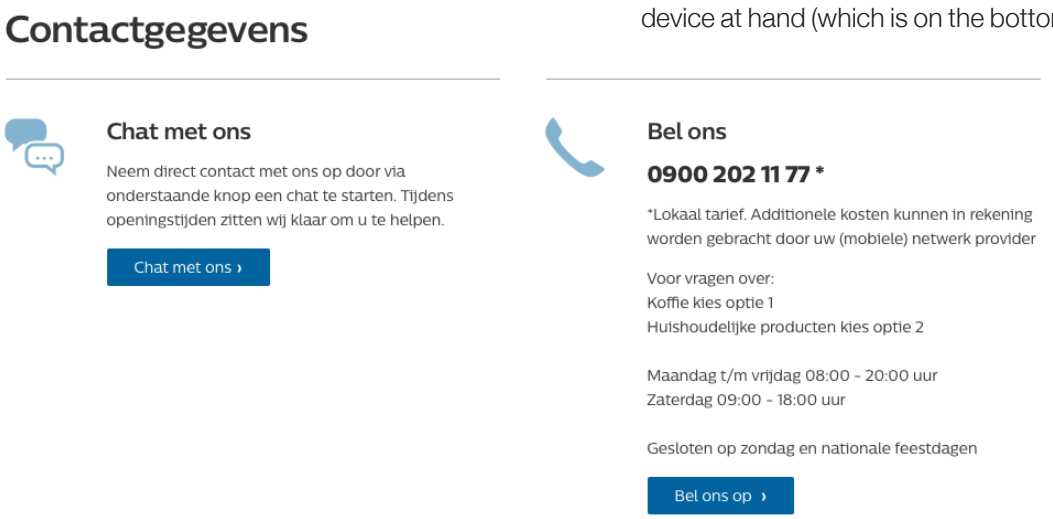


Figure 88: Contact details on Philips website (Philips.nl, 2018i)

Benefits of current chat function:
- Same benefits as with phone support
- Good service, even though it was about an OOW product
- They take the time for you and it feels personal (because real employee)
- Slightly more approachable than calling (social)

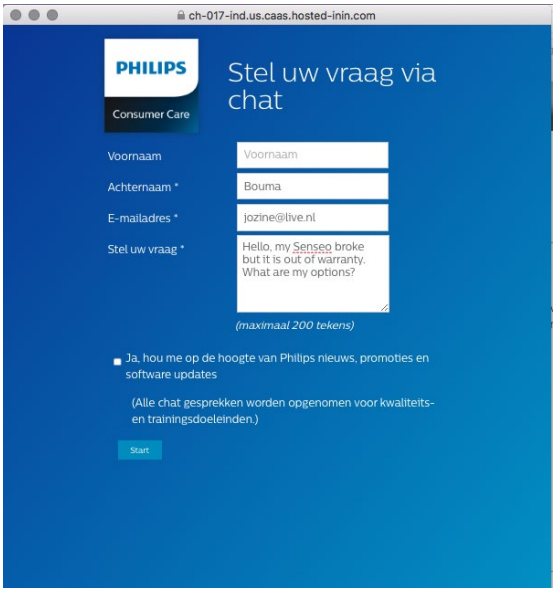
SELF-SERVICE ON PHILIPS WEBSITE

Once the really difficult to find page is found, the first thing is to find the model number of the device. Otherwise, the service does not work. Once you are in, the problem is to be selected. There are only 4 options: making coffee, leakage, other problems, or contact.

When selecting 'contact' you are redirected to the Philips website where you find the phone number and chat option (Figure 88).

When selecting one of the three other options, the solutions are unsatisfying. In Figure 89 the page is shown when selecting 'Leakage' (the other two options are not much different). It is purely textual and unattractive to look at. There are extremely limited options and the solutions do not go beyond provision of obvious information (e.g. "do not fill the water tank above the indicated max. level", and "place the water tank carefully back in the machine"), advice to descale and clean regularly, the advice to only use official Senseo pads, and ordering a new water tank in the online Philips shop. It does not even explain how the Senseo should be descaled or cleaned.

The self-service channel seems to be an underdeveloped service channel. It does not answer people's questions and does not encourage people to solve the problem.



9/3/2018 1:36:36 p.m.	IC:	Welkom bij Philips Consumer Care
1:36:36 p.m.	IC:	Uw chat is verstuurd
1:36:36 p.m.	IC:	Al onze medewerkers zijn in gesprek
1:36:36 p.m.	IC:	Uw positie in de wachtrij is 4
1:36:36 p.m.	IC:	Your estimated wait time is approximately 7 minutes.
1:36:36 p.m.	IC:	Een ogenblik geduld. Wij verbinden u door met de eerst beschikbare medewerker. Dank u wel!
1:38:25 p.m.	IC:	Priscilla neemt deel aan het gesprek
1:38:31 p.m.	Priscilla:	Goedemiddag welkom bij Philips Consumer Care. Mijn naam is priscilla. Uw vraag is niet helemaal goed doorgekomen, zou u de vraag nog een keer willen herhalen zodat ik u zo goed mogelijk kan helpen?
1:40:43 p.m.	Bouma:	Hallo, mijn Senseo is kapot gegaan. Helaas valt het buiten de garantie en ik wil nu graag weten wat mijn opties zijn. Wat raad u mij aan met de Senseo te doen?
1:41:39 p.m.	Priscilla:	Dat klinkt niet goed, u wilt natuurlijk wel kunnen genieten van een heerlijk kopje koffie.

1:41:41 p.m.	Priscilla:	Als u het goed vindt zou ik graag het product voor mij willen nemen, om u zo goed mogelijk verder te kunnen helpen en samen wat stappen kunnen doorlopen, Heeft u daarom voor mij het juiste modelnummer?
1:42:28 p.m.	Bouma:	Ja, dat is HD 7810
1:42:39 p.m.	Priscilla:	En wat is er precies mee aan de hand?
1:43:21 p.m.	Bouma:	Er komt weinig koffie doorheen en de koffie die eruit komt is lauw.
1:43:41 p.m.	Priscilla:	Oke, en dit is zo bij de 1 en 2 kops padhouder?
1:43:59 p.m.	Bouma:	Ik gebruikt eigenlijk alleen maar de 1 kops padhouder
1:44:59 p.m.	Priscilla:	Kunt u eens 2 kopjes koffie zetten=
1:45:03 p.m.	Priscilla:	?
1:45:13 p.m.	Bouma:	Ik ben op dit moment niet thuis...
1:45:27 p.m.	Priscilla:	Aah oke, want als het namelijk niet zo is bij de 2 kops..
1:45:35 p.m.	Priscilla:	Dan kan het enkel aan de padhouder liggen.
1:45:51 p.m.	Priscilla:	Mag ik vragen wanneer het toestel ontkalkt is?
1:46:09 p.m.	Bouma:	Erg lang geleden, ik denk een jaar of twee.
1:46:45 p.m.	Priscilla:	Oke, daarom is de koffie wellicht lauw aan het worden door de kalkaanslag in de koffieleideingen.
1:46:54 p.m.	Priscilla:	Ik wil u allereerst adviseren om dan het toestel te ontkalken.
1:47:26 p.m.	Priscilla:	En daarnaast de padhouder de 1 kops uit te koken in soda water en of een nieuwe aanschaffen als u wel gewoon een vol kopje krijgt uit de 2 kops padhouder.
1:47:56 p.m.	Bouma:	Oke bedankt! Dat zal ik vanavond doen. En wat als het probleem daarmee niet verholpen is?
1:48:30 p.m.	Priscilla:	Dan kunt u het toestel aanmelden ter reparatie... (waar kosten aan verbonden zijn) Of wij kunnen u helpen aan een nieuwe aankoop met een leuke korting :)
1:48:34 p.m.	Priscilla:	Die keuze is dan aan u.
1:48:56 p.m.	Bouma:	Hartelijk dank!
1:49:12 p.m.	Priscilla:	Heeft u verder nog vragen voor mij?!
1:49:20 p.m.	Bouma:	Nee op dit moment niet ;)
1:49:28 p.m.	Priscilla:	Ik vond het leuk om u te mogen helpen en hoop dat u ons contact een 10 waard vond. U kunt mijn service beoordelen via een enquête die u per e-mail zult ontvangen op een schaal van 0 t/m 10. Tussen 0 en 6 bent u ontevreden, bij een 7 of een 8 bent u neutraal en als u mijn service beoordeelt met een 9 of een 10 dan bent u tevreden.
1:50:10 p.m.	Bouma:	10
1:50:12 p.m.	Priscilla:	Super,alvast heel erg bedankt. Dan wens ik u nog een hele fijne dag verder, en mag u de chat hierbij sluiten.

Mijn SENSEO-koffiezetapparaat lekt.

Als u ziet dat er koffie of water uit uw SENSEO machine lekt, probeer dan vast te stellen waar de machine lekt.

Dit is belangrijk, omdat de oplossing afhankelijk is van de locatie van het lek.

Oorzaak	Oplossing	Info
Waar lekt het?	1. Bij de tuit/percolatorkop. 2. Aan de onderkant van het waterreservoir of onder de machine.	Figuur
1. Lek bij de tuit/percolatorkop.	**1) Mogelijk is het zeefje in het midden van de padhouder verstopt.** Ontstop het zeefje in het midden van de padhouder door de padhouder schoon te spoelen onder de kraan. Gebruik zo nodig een afwasborstel of maak de padhouder schoon in de vaatwasmachine. Als de zeef nog steeds verstopt is, plaatst u de padhouder in een ontkalkingsoplossing met citroenzuur en laat u deze 30 minuten weken. **2) De koffietuit, koffiecollector en padhouder zijn vuil of verstopt.** Alle onderdelen kunnen in de vaatwasmachine of met warm water worden schoongemaakt. **3) U hebt de koffiepad(s) niet goed geplaatst.** De gemalen koffie in de koffiepads moet gelijkmatig zijn verdeeld. Plaats de koffiepads met de bolle zijde naar beneden in het midden van de padhouder.	Figuur
2. Aan de onderkant van het waterreservoir of onder de machine.	**1) Er zit te veel water in het waterreservoir.** Vul het waterreservoir niet tot boven het aangegeven maximumniveau. **2) Het waterreservoir is niet voorzichtig genoeg teruggeplaatst.** Als het waterreservoir niet voorzichtig genoeg in de machine wordt geplaatst, kan er water over de rand van het reservoir spatten. **3) Het waterreservoir is beschadigd/kapot.** Als het waterreservoir beschadigd of stuk is, kunt u een nieuw waterreservoir bestellen bij de Philips Online Shop of door contact op te nemen met ons.	

Is het probleem opgelost?

ja nee

Geef uw feedback

Figure 89: Troubleshooting on Philips website – Leakage (Philips.nl, 2018t)

REFERENCES

Philips.nl (2018t). Welkom bij de online Philips zelfservice. Retrieved on 29-09-2018, from https://philips_nl.infotip-rts.com/Home.xhtml?Cid=NL&LgId=nl&Page=ServicePg1

Philips.nl (2018i). Contactgegevens. Retrieved on 29-09-2018, from https://www.philips.nl/c-w/support-home/support-contact-page.html

K. EXAMINATION REGISTERED CUSTOMER COMPLAINTS

In this appendix the customer complaints at the Philips customer service are examined. Based on the calculations in this table an estimation can be made on the amount of calls customer service has to deal with. The data in this table is retrieved from internal data sources at Philips.

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L. INTERVIEW REPAREER.COM

Date: 18/6/2018
Name: Nyckle Sijtsma
Profession: Founder Repareer.com

INTERVIEW GUIDE

- Wat is je droom voor Repareer.com?
- Hoe gaat het met het bedrijf? Wat zijn de successen?
- Is het profitable? Is er een business model?
- Wat is de huidige status? En wat zijn eventuele toekomstplannen?
- Aangezien je ook naar Wecycle punten refereert gaat het dus niet alleen om het repareren van producten zoals de naam suggereert. Wat is jullie visie?
- Via de website kom je terecht bij iFixit, Repair Café en Wecycle inleverpunten. Vind je dat producenten, zoals bijvoorbeeld Philips, hier ook tussen zouden moeten staan? Hoe zie je zoiets voor je?

STORY

Het idee kwam voort uit dat we (Thijs en Nyckle) in 2014 zelf steeds meer producten gingen repareren zoals telefoon schermpjes en auto's. Toen dachten we: het is eigenlijk best leuk als mensen elkaar op zo'n manier kunnen helpen met dingen repareren.

Eerste fase: Soort marktplaats voor mensen met kapotte producten op nationaal niveau. Er waren veel mensen die hun producten hierop aanboden maar er waren toch weinig reparateurs en vaak niet in de buurt van de kapotte producten dus dit was niet de juiste weg. Toch geloofden we nog wel in het concept.

Tweede fase: Per stad bekeken en het concept aanbieden. Maar reparateurs gingen vaak niet actief op zoek naar reparatieklussen. We kwamen er achter dat er toch veel mensen ongeholpen bleven. Die klanten verlies je dan natuurlijk en krijgen een negatief beeld bij Repareer.com.

Derde fase (nu): Onze visie is nu dat we alle klanten op welke manier dan ook willen helpen. Daarom hebben we nu een nieuw platform dat mensen doorstuurt naar de dichtstbijzijnde reparateurs (ook al moet er voor betaald worden), iFixit, Repair Café, en Wecycle punten.

Deze laatste versie is nu ongeveer een maand geleden gelanceerd. Het staat nog in de kinderschoenen en we hebben de pers nog niet benaderd omdat we eerst willen kijken hoe het gaat.

WECYCLE

Omdat we een soort afspraak met Wecycle hadden, staat deze ook op onze website. Dit is natuurlijk niet repareren, maar past wel binnen de visie dat iedereen uiteindelijk geholpen moet worden. Ook als het apparaat uiteindelijk niet gerepareerd kan worden moet het een bestemming hebben.

Producenten op Repareer.com
Wij zouden heel graag producenten en retailers op de website hebben staan. In onze huidige maatschappij is het helaas nog niet 'normaal' om met een kapot Philips product naar Philips toe te gaan. Maar misschien wel naar de retailer?

Waarom staan de producenten er nog niet tussen? Omdat het voor ons logistiek nog lastig is om consumenten via een antwoordformulier door te sturen naar de producent. Die service is er nog niet bij producenten.

BUSINESS MODEL

Via advertenties. Maar ook pakketten aanbieden aan reparateurs die voor bijv. 5 euro per maand hoger in de zoekresultaten komt.

SENSEO

Bij ons eerste platform concept waren er twee product categorieën het populairst: Senseos en hogedrukspuitapparaten. Dat was opvallend. Schijnbaar is er een behoefte bij mensen om Senseos te repareren. Ook bij Repair Cafés is het een populair product. Hier kun je twee conclusies uit trekken:

1. Mensen willen de Senseo niet weggooien maar gerepareerd hebben.
2. Senseos gaan vaak kapot.

PRAKTIJK VOORBEELDEN

https://reparatie.coolblue.nl/
Nieuwe service. Gratis je product opsturen en binnen 48 uur krijg je hem gerepareerd terug. Je betaald via ideal. Wat kan ik hiervan leren voor Philips? Kan Philips hier zijn slaatje uit slaan?

https://www.bol.com/nl/m/algemeen/bestellen/subject/63517067/index.html
Gratis verzendkosten. Garantie dat je product op de juiste manier gerecycled wordt. Hoe kan dit profitable zijn voor Bol.com?

https://gerrardstreet.nl
Acties via Instagram. De onderdelen passen in enveloppen en daarmee is het logistiek allemaal goed geregeld.

https://plannedunobsolescence.com
Design guidelines van Thijs Schippers. Zijn website voor zijn afstuderen aan universiteit in New York. Voorbeeld: Zwitsers Zakmes.
https://www.linkedin.com/in/thijsjschippers/

http://stores.bang-olufsen.com/netherlands/bang-olufsen-ter-horst
Zij produceren hun producten van dusdanig hoge kwaliteit, mensen willen er niet vanaf. Daarom hebben ze het ook erg lastig om hun bedrijf draaiende te houden. Mensen kopen eenmalig een product, maar het is te goed en daarom kopen ze nooit meer een nieuwe.

TOEKOMSTVISIE
Als het in Nederland allemaal goed gaat en van de grond komt zouden we graag uitbreiden naar Duitsland. Daar zien we een markt voor ons platform.

M. REPAIR MONITOR 2017 - SENSEO RESULTS

	Wat is het probleem?	Vermoedelijke oorzaak van het probleem?	Als gerepareerd: wat heb je gedaan om het ding te repareren?	Als advies gegeven aan eigenaar, welk advies?
2	halve kopjes	?	reset naar fabrieksinstelling gedaan	
3	Geen stroom	Kapotte thermische beveiliging	Nieuwe thermische beveiliging gemonteerd	
4	doet niets	vlotter	vlotter vervangen	
5	geeft geen water/koffie	onbekend	uitleg werking gegeven	
6	wordt niet warm	onbekend	boiler vervangen	
7	knoppen werken slecht	vuil		is niet open te maken
8	geeft geen water	onbekend	magneet geleider schoongemaakt	
9	wordt niet warm	boiler		
10	warmt niet op	vlotter		
11	blijft knipperen	vlotter magneet	vlotter vervangen	
12	geeft geen water	pomp of print	pomp vervangen	
13	geeft geen water	electronica		print moet worden vervangen en is te duur
14	lampje blijft branden	kalk	ontkalkt	
15	geeft geen water	onbekend	schoongemaakt	
16	te volle kopjes	instelling	water niveau afgesteld	
17	Kookvat verwarmt niet			Geen reserve vat beschikbaar
18	Lampje knippert , warmt niet meer op	Sensor	Sensor blijft hangen, mw gaat ontkalken	contacten doormeten met meter of pieper
19	doet het niet			Testen magneet watertank
20	lampje blijft knipperen, doet Â´t soms wel/niet		magneet vervangen	
21	werkt niet	magneet defect	magneet vervangen	Kijk altijd als eerste of niveauregeling werkt.
22	lekkage na uitzetten	magneet defect	magneet vervangen	
23	maakt geen goed contact		magneet vervangen	
24	verhit geen water		magneet vervangen	
25	paar weken na ontkalken weer verstopt + lekt bij het doorspoelen met ontkalken		padhouder was verstopt, magneet vervangen	
26	geeft te weinig water		padhouder was verstopt	
27	deksel gaat niet open	padhouder verstopt	padhouder schoongemaakt en condensator vervangen	
28	lekt	dekselbevestiging afgebroken	van twee apparaten 1 goede gemaakt. Oude ingeleverd	
29	doet het niet meer		van 2 apparaten 1 gemaakt	
30	doet het niet	magneet	magneet vervangen	
31	padhouder		veer vervangen/afgesteld	
32	stekker kapot		stekker vervangen	
33	doet niets		Van een ander apparaat print en schakelpaneel	
34	doet niets	magneetjes	magneetjes vervangen	
35	doet het niet	condensator		
36	doet niets		magneet vervangen en nieuw snoer gemonteerd	
37		condensator defect	condensator vervangen	
38	magneet vast		magneet vernieuwd	
39	geeft weinig koffie.	veer?	veer vervangen (en moet nog ontkalkt worden)	
40	sensor kapot.	magneet	magneet vervangen	
41	doet het niet	vuil	schoongemaakt	
42	lekt regelmatig	onbekend	ontkalkt en schoongemaakt	
43	doet het niet meer	onbekend	magneet vervangen	
44	doet niets; lampje knippert	onbekend	magneet vervangen	
45	klepje gebroken	onbekend	klepje vervangen	
46	doet het niet	onbekend	boiler vervangen en magneetje vernieuwd	
47	lampje knippers	defecte magneet	magneetje vervangen	
48	doet niets	onbekend	magneetje vervangen	
49	doet het niet	onbekend	magneetje vervangen	
50	sluiting	nat geweest	draden gerepareerd	
51	doet het niet	smeltveiligheid oververhit	smeltveiligheid vervangen	
52	doet het niet	condensator	condensator vervangen	
53	onbekend		getest en was oke	
54	doet het niet goed		schoongemaakt	
55	lampje knippert	magneet	magneet vervangen	
56	doet het niet		schoongemaakt	
57	geen waterdruk na ontkalken	3 weg klep defect	klep vervangen door gebruikt exemplaar	
58	doet het niet	magneet	magneet vervangen	
59	driewegklep	ouderdom	nieuwe klep geplaatst	
60	kalk	slecht onderhoud	schoongemaakt/ontkalkt	
61	Lampje blijft knipperen, geen water?	Magneet in reservoir zit vast door corrosie	Reservoir vervangen door ander exemplaar (reserve)	
62	Lampje blijft knipperen, te weinig water?	Diverse mogelijke oorzaken, boiler defect, azij	Teveel problemen en defecten, gaat te veel tijd kosten	
63	Gooit water terug in de tank	Waarschijnlijk verstopping van de waterweg, n	Nog niet gevonden waar de verstopping zit. Modern	
64	Het apparaat lekt	Driewegklep afgebroken	De driewegklep vervangen	Driewegklep op voorraad houden
65	Watertoevoer functioneert niet	Verstopping?	Padhouder schoongemaakt	
66	Apparaat lekt	Padhouder verstopt	Padhouder schoongemaakt en hoeveelheid afgesteld	
67	Hapert	Electronica?		Doorgebrand, na onderdompeling in water
68	Lampje blijft knipperen terwijl er water in zit	Magneetje		Watertank vervangen, thuis schoongemaakt, daarna lekkage,
69	Geeft te weinig water		Reset en padhouder schoongemaakt	
70	Lekt	Padhouder verstopt	Padhouder doorgeprikt, instrumentje meegegeven	

71	knippert	Water ingelopen		Elektronica nat geworden: laten drogen en opnieuw proberen
72	Doet het niet meer		Aandrijving motor/machinaal gedeelte zit vast. Niet te repareren	Misschien aan de koffiemeulen
73	Doet het niet meer	Knopje	Schakelaar zat vast. Gangbaar gemaakt	
74	Lekt			Afdichting moet vervangen worden, klant zorgt voor ring. Artikel nummer
75		vervuiling door gebruik		intern gereinigd
76		mogelijk waterpomp defect		apparaat lastig open te maken
77			magneet zat vast	
78	water warmt niet op			
79	deksel sluit niet	veer kapot	veer vervangen	
80	geeft bijna geen water	kalk	ontkalkt en padhouder gaatje opengemaakt	
81	verwarming doet het niet	element		element verkalkt en doorgeroest
82	opvangbak koffiepad loopt vast	ontregeld	machine gereset	
83	lampje knippert	vlotter blijft hangen	ontkalken zodat vlotter in waterbak omhoog komt	
84	lampje knippert snel	vlotter in waterbak blijft hangen	zeepoplossing in waterbak	
85	aardlek knalt eruit	element?	doorgemeten en drooggemaakt condens bij element veroorzaakt aardlek	
86	Geeft geen water	Klep kapot		
87	klepje gaat niet dicht	Breuk		
88	hij weigert, pompt het water niet door	?		
89	Lekt water en laat stoppen doorslaan.	?	3-wegklep vervangen.	
90	water kookt wel, maar druppelt niet in de filter		bi-metaaltje gerepareerd.	
91	doet niets meer		Condensator 0,47uf, had te lage waarde (0,18uf) ... condensator vervangen	
92	vlotter gaat niet omhoog		nieuw magneetje gemonteerd	
93	Maalt geen koffie meer	Verstopping molen/koffiekanaal	Koffiemolen uitgebouwd. vol met vaste gemalen koffie. met perslucht schoon gemaakt, samengebouwd &	
94	mechanisme gaat niet goed aan in begin		magneet vlotter vervangen	
95	Lampje blijft knipperen en klep zit los	Snelle slijtage		
96	Onbekende klacht.	Onwetendheid.	Eigenlijk niets. Nagekeken, getest en goed bevonden.	
97	Vlottertje zit vast.	Slijtage	Nieuw magneetje in vlottertje gemaakt.	
98	Kokend water gaat weer terug naar reservoir.	Onbekend		Nader onderzoeken.
99	Hij maalt niet meer	Schoongemaakt		
100	Lampje blijft knipperen	Vlottertje	Nieuw magneetje in vlottertje geplaatst	
101	Geeft weinig koffie.	Vervuiling en afstellen.	Nieuw driewegventiel geplaatst	
102	Geeft weinig water	Vervuiling	Nieuw driewegventiel en grote schoonmaak	
103	Lampje blijft knipperen	Vlottertje	Nieuw magneetje geplaatst	
104	Gaat uit als hij koffie moet maken.	Condensator	Nieuw condensator	
105	Lekt water.	Vervuiling		
106	Vlottertje zit vast	Vervuiling	Schoonmaken	
107	Water komt er niet genoeg uit	Vervuiling		
108	Werkt niet	element werkt niet		Boiler kapot SHO 02097/7-1
109	Water wordt niet warm			Opengebroken met schroevendraaiers. Boiler doorgemeten, is onderbroken. Komt weer terug (met andere boiler)
110	Doet het niet goed			Apparaat smerig, komt terug na reiniging
111	verwarmt niet	verwarmingselement	ontvochtiger gebruikt	handleiding volgen
112	werkt niet			printplaat control IC kapot
113	werkt niet		Schoon gemaakt	
114	lekt		slang opnieuw bevestigd	
115	werkt niet		magneet los gemaakt	
116	werkt niet		Klem magneet water reservoir ontbrak	
117				zeef moet gereinigd worden
118	maalt niet		mechanisme schoon gemaakt	
119				vlotter kapot, nieuw reservoir kopen
120	defect		magneet water reservoir verroest	
121	defect		water reservoir magneet verroest	

LEGEND

- schoonmaken
- ontkalken
- magneet / vlotter
- ontwetenheid / info
- out of scope
- twijfel, in scope of niet
- reset

SOLUTION OCCURRENCE (%)

1. Replacing the magnet in the float (~31%)
2. Cleaning/descaling (~29%)
3. Replacing the capacitor (~12%)
4. Replacing the three-way valve (~10%)
5. Properly tuning it (~3%)
6. Information provision (~2%)
7. Other (~13%)

N. USER INTERVIEWS AND CONVERSATIONS

This chapter describes summaries of the in-depth interviews with Senseo users. Those are kept in the original language to prevent altering the meaning.

INTERVIEW GUIDE FIRST 4 INTERVIEWS

User experience in the following categories:

- Maintenance
- Disposal

Opinion on:

- Responsibility company / producer
- Information provision

INTERVIEW SENSEO USER 1

36 years old

Maintenance

Ik maak de losse onderdelen af en toe schoon. Afwassen. Nooit ontkalkt. Maar ik had ook niet het gevoel dat het nodig was. Bij de waterkoker zie je bijvoorbeeld met het oog dat het nodig is om hem te ontkalken. Maar misschien zie je het ook wel gewoon niet bij een koffiezetapparaat, die van mijn ouders geeft het bijv. aan (Jura). Daar merk ik dan ook niet dat hij eigenlijk ontkalkt moet worden. Geen idee hoe je zou moeten ontkalken. Je kunt ongetwijfeld dan een ontkalkingsmiddel kopen. En dan hoop je dat er een gebruiksaanwijzing opstaat.

Ik ben een beetje lui: als het product het nog doet, dan doe ik er ook niks aan. Bijv. met een wasmachine 'hm die ruikt een beetje gek' nou dan ga ik iets doen. Er moet echt iets zijn voor ik er wat aan ga doen.

Disposal

Inleveren vind ik altijd wel heel lastig. Je wilt het wel goed doen maar ik weet soms echt niet zo goed wat ik er mee aan moet. En dan moet ik mezelf er ook nog eens toe dwingen om niet aan mijn luiheid toe te geven om het toch ergens anders te dumpen.

Ik moest laatst toevallig op de website van Philips zijn omdat de TV kuren had. Dus ik ging dat even opzoeken. De provided information was vrij matig. Misschien dat je dan een kopje zou kunnen hebben waar je kunt zien wat je met het apparaat kunt doen als het aan het einde van het gebruik is.

Denk dat het lastig is om dit in een manual te doen, want het wordt ook in alle talen uitgegeven. Maar op hun website kan ik me wel voorstellen dat ze je doorlinken of een kaartje hebt waar je bepaalde dingen kunt inleveren.

Als het laagdrempelig is, dan doe ik het wel. Maar ik heb het ook nog niet zo vaak meegemaakt. Het komt gewoon niet zo vaak voor deze situatie. Van een kapot apparaat of een apparaat vervangen.
Voor haar ouders is het nu een plan B / back up apparaat (vakanties, klussen op het werk)

Take-back loop / responsibility company

Ik weet niet of ik mijn koffiezetapparaat wel naar Philips zou opsturen als 'ie kapot is. Ik heb er nog nooit over nagedacht dat een bedrijf ook spullen kan terug nemen. Vanaf de aankoop is het gewoon je eigen verantwoordelijkheid. Omdat het nu niet zo is, voelt het voor mij ook niet dat Philips hier een rol in moet gaan spelen.

Zo'n service, daar moeten mensen heel erg aan wennen. Want het is nu nog geen vanzelfsprekende route. Daarom is dat misschien iets voor de lange termijn. Bij de productaankoop al informatie geven.

De uitdaging zit hem vooral in de motivatie. Mensen zijn heel lui.

Information provision

Ik mis vooral informatie nu over wat ik met mijn product aan moet. Zou je naar de Philips website gaan voor deze informatie? Als Philips.com de eerste hit op Google is dan wel. Ik typ mijn vraag vaak letterlijk in op Google. Ik zou eerder als eerste hit iets van Wecycle verwachten dan Philips.

moet het al duidelijk gemaakt worden. Wij weten ook helemaal niet wat er met het product gebeurt als we het wel goed inleveren. Als we bijv. weten van: als je je product zo en zo inlevert dan kunnen we er wat mee. Dan gebeurt er dit en dit. Bewuster worden: zonde als ik het gewoon zo weg gooi. Mensen hebben weinig sympathie voor grote concerns.

INTERVIEW SENSEO USER 2

25 years old, Senseo Lover

Mijn oude Senseo was gewoon oud en verkalkt. Niet meer top. Niet weggegooid. Moest te frequent ontkalkt worden. Nieuwe Senseo gekocht.

Maintenance

Ik heb hem wel eens laten verschimmelen, want dat was ik vergeten de pad eruit te halen en dan ben je soms een week niet thuis. Dan moest ik hem direct heel grondig schoonmaken:

- Pad eruit
- Padholders en alle losse onderdelen in de vaatwasser.
- En een goedje waarvan mijn ouders zeiden dat ik dat erop kon doen

Mijn vader heeft hem er ook wel eens ontkalkt. Er kwam onvoldoende water doorheen. Mijn vader had ontkalkspul en dat ging hij in de watertank gooien. Niet zelf gedaan dus.

Disposal
Waterkokers gaan heel snel kapot. Waarschijnlijk omdat ik altijd hele goedkope koop. Wecycle separation box hadden we in de jassenkast hangen. En daaronder lag een dump aan oude waterkokers en oude apparaten. Dat was omdat we wel het idee hadden van we gaan dit op de juiste manier wegbrengen, alleen dat was toch net moeilijk. Dus ze staan nog steeds op de goede plek en worden niet in de vuilnisbak gegooid, maar het blijft een studentenhuis waar niemand echt de verantwoordelijkheid voelt of zin heeft om uit te zoeken waar het precies heen moet.

Responsibility producer
Allereerst moet er duidelijkheid komen. Want is iets Groot afval? Of is iets Klein Afval? Dat is me niet duidelijk. I don't know, is een Senseo groot of klein?

INTERVIEW SENSEO USER 3
29 years old, heavy user

Maintenance
Ik heb hem wel eens ontkalkt. Half azijn, half water in de tank. Dan laten doorspoelen, dus dan moet je de twee knoppen tegelijk indrukken dan spoelt hij helemaal door. Dat weet ik omdat mijn ouders zulke grootverbruikers zijn, dat we dit soort dingen gewoon weten. Vervolgens nog 3x met water. Azijn werkt prima, ik heb er nooit iets geks of speciaals voor gekocht als die pillen. Volgens mij zijn die speciale producten allemaal ook gewoon azijn.
> dit duidt op onwetendheid, lack of awareness.

Incentive
Ik merkte dat er minder water doorheen kwam. Of hij gaat oneerlijk verdelen (dus dan is het ene kopje voller dan het ander). En als je hem dan ontkalkt hebt is dat weer helemaal over. Ik denk wel dat het een beetje terugloopt, dus het zal niet helemaal over zijn.

Repair
Ik denk dat heel veel mensen dat niet zouden durven. Omdat je bezig bent met elektriciteit en water en omdat er plastic onderdelen in zitten die kunnen breken. Dus ik denk dat mensen huiverig zijn om er iets aan te doen. Ik denk niet dat mensen de motivatie hebben om er moeite in te stoppen.

Disposal
Mijn waterkoker is stuk en die breng ik dan naar een Wecycle punt. BCC met de fiets, als ik naar mijn werk ga dus ik kom er gewoon langs (op de route). Het duurt wel altijd maanden voordat ik het er uiteindelijk heen breng. Staat dan naast mijn kamer tot ik er een keer langs ga. Ik had een keer gegoogled wat het dichtstbijzijnde Wecyclepunt is.

Driver/motivatie: ik denk het me zou motiveren als ik er iets voor terug krijg. Zoals bijv. korting bij de winkel waar je het inlevert. Ik denk dat het minder ligt aan het merk, maar dat komt omdat ik niet brandloyal ben omdat ik er het geld niet voor heb.

Misschien helpt het ook al als je weet wat er daarna verder mee gebeurd. Maar ik denk dat 'er iets voor terug krijgen' meer doet, meer mensen aanspreekt. En ook voor mezelf toch wel.

Dus als er meer info is over wat er met het product gebeurd, hoe er mee omgegaan wordt en wat er met alle onderdelen gebeurd en waar ze naartoe gaan en waar dat nuttig voor is dan zou dat mij denk ik meer activeren. Ik doe het toch wel, maar als je dan weet dat het echt nuttig is, dan doe ik het misschien eerder.

Ik zou het niet over mijn hart verkrijgen om het in de prullenbak te gooien, dus als het Wecycle punt niet op de route zou liggen dan zouden de producten gewoon nog langer bij mij thuis blijven staan.

Responsibility producer
Awareness, ik denk dat het belangrijk is dat mensen weten dat het waardevol is om je producten terug te brengen. Dus dat je daar informatie over krijgt, tijdens de aankoop of in een nieuwsbrief. Dat mensen weten dat het nut heeft. Het moet makkelijk zijn en je moet erop geattendeerd worden.

Ik twijfel ook heel vaak aan of een product nou wel of niet 'klein' is. Of je het wel in die Wecyclebak mag gooien of niet. Geen consistentie.

Het is een globaal probleem. Laat mensen zien dat zij als individu een impact kunnen maken.

INTERVIEW SENSEO USER 4
58 years old, heavy Senseo user

How to deal with a broken Senseo?
First check if it is repairable (at Philips customer service). If not, bring to the collection point of the municipality.

One Senseo still worked fine but the two-cup pad holder was lost and she couldn't get a new one at Philips (old model). She gave this Senseo to her

mother-in-law so she could buy a Senseo that fits/ matches with the rest of the products in the kitchen.
"De kolder ten top! Dat ze niet universeel te krijgen zijn. Omdat ik dus een dubbele padhouder kwijt ben moet ik of iedere keer een enkel kopje zetten, of moet ik een nieuwe Senseo kopen."

The first Senseo had a clip as closing system instead of the levers they currently have. This clip didn't close properly anymore after a few years and therefore it leaked. Wasn't repairable according to Philips so she had to buy a new one.

Stel Philips had je een nieuwe klem gegeven en je moest het zelf repareren? Had je dat gedaan?
Ja, alleen als hij gratis was. Dan had ik het ook zelf geprobeerd mits er een beschrijving bij was van hoe dat moest. Dan moet het heel logisch zijn, intuïtief.

Never tried to open / repair a Senseo herself.
De tweede maakte de koffie niet meer warm geloof ik. Nooit een Senseo uit elkaar gehaald. Als ie niet meer opwarmt dan weet ik zeker dat ik hem niet meer kan maken. Als mij verteld zou worden dat dat kan, dan zou ik het misschien wel proberen. Maar ik dacht het is een technisch mankement dat ik aan de keukentafel niet kan repareren.

Beide gevallen buiten de garantie periode stuk gegaan.

What should Philips do?
Philips should provide non-electrical spare parts. Maybe no electrical parts, because would find it dangerous to repair it herself because of the combination electricity + water. One Senseo had problems with getting to the right temperature. She would not think of repairing that herself.

Use
Als mijn zus komt om cafeïne vrije koffie te drinken of als mijn koffiebonen apparaat kapot is. Senseo is een toevoeging op mijn dure koffiebonen apparaat. I.v.m. cafeïnevrij > Back up machine

Maintenance (descaling)
- Clean the loose parts once every two weeks (dishwasher)
- Rinse loose parts a bit more often (tap)
- Descaling happened only once or twice (in 10 years).

She knows you have to descale it once every 3-6 months, but it depends how often you use it. "Some people use it way more often than I do."

Disposal
Als die kapot was heb ik hem naar de stort gedaan.

She has no idea what happens with the products if she brings it to the municipality collection point but at least it feels better than throwing it in the general garbage bin and she just hopes they will do something good with it.

Ik denk niet dat er veel mee gebeurt als ik het bij de stort breng. Ik geloof niet dat ze het uit elkaar halen maar dat zou ik wel heel fijn vinden. Ik hoop dat ze het bij een speciaal bedrijf inleveren en dat zij er dan anders mee om gaan. Dat hoop ik dan maar. Het gebeurd niet zo vaak dat ik een elektrisch apparaat dump.

INTERVIEW GUIDE NEXT 3 INTERVIEWS

History and experience with Senseo
Main focus on end-of-use and end-of-life experience

INTERVIEW SENSEO USER 5

Family donation
Één Senseo gehad, toen ik in mijn studio woonde. 1,5 jaar lang. Was van mijn oma geweest, maar stond al een tijdje niet meer daar omdat zij dement was. Mijn ouders hadden de Senseo voor haar gekocht (vervanging van filter) omdat ze dachten 'dit is zo'n simpel koffiezetapparaat deze moet ze wel kunnen hebben'. Maar toch ging het alsnog niet. Ze was een beetje bang voor nieuwe apparaten. Toen ik hem kreeg was ie as good as new.

Toen ik er vanaf wilde, had ik eerst even aan mijn ouders gevraagd of ze 'm terug wilden. Omdat ie toch bij hen vandaan kwam. Werkers van mijn vaders bedrijf nemen de Senseo nu wel eens mee voor tijdens een klus. Mijn ouders hadden er dus nog wel een idee bij. Anders had ik hem denk ik naar de Kringloop gebracht, omdat ik in die tijd toch al heel veel spullen naar de Kringloop bracht, en hij deed het nog. Maar ik zou hem niet meer verkocht hebben. Misschien nog wel gratis weggegeven, maar ik heb het gevoel dat mensen niet meer geld willen neerleggen voor een oude Senseo.

Toen we vroeger op vakantie gingen namen we trouwens ook altijd een Senseo mee. Die gebruikten we thuis dan niet meer, maar in de caravan wel. Plan B coffee machine.

Mijn ouders hadden eerst een Original met klem. Nu hebben ze een met een leaver. Die met de klem ging lekken, volgens mij was dat toen ook een productiefout, daarom hebben ze dat ook aangepast.

Figure 90: Senseo designed by Tord Boontje

INTERVIEW SENSEO COUPLE 6

48 and 51 years old

Senseo experience/history

Zodra de Senseo ongeveer uitkwam hadden we er een gekocht (Original). Vervanger voor filterkoffie apparaat. Senseo was gewoon oud en verkalkt. Niet meer top. Niet weggegooid. Moest te frequent ontkalkt worden.

Vervolgens een gekocht van Tord Boontje (upgrade). Limited Edition (Figure 90). Knalroze, met een patroon. We hadden ook een bijpassend blik erbij. Die hebben we nog steeds, staat in de kast.

Inmiddels is die van Tord Boontje vervangen voor een modernere zwarte met iets van een accentje erin. Geen Original (denken ze). Je kunt bijv. al op het knopje drukken als het water nog opwarmt. Enorme verbetering.

Die van Tord Boontje staat nog op zolder, hij is niet weggegooid omdat ik hem zo leuk vond. Ze zou hem niet snel wegdoen. Hij is ook niet echt kapot. Ze heeft hem ook nog een tijdje in de praktijk gehad. Daar heeft ze nu ook een nieuwe staan.

Family donation

Toen onze dochter naar Delft ging kreeg ze de allereerste Senseo mee. Later heeft ze deze ook meegenomen naar haar nieuwe huis, maar daar was én een filterkoffiezetapparaat én een bonen apparaat aanwezig. Dus de Senseo verloor zijn functie en die staat nu in de opslag. Hij doet het nog steeds, niet kapot.

INTERVIEW SENSEO COUPLE 7

54 and 54 years old

Senseo history

Toen de Senseo net uitkwam namen wij een Senseo. Werden er erg enthousiast van, want we dachten dat we dan minder koffie zouden drinken omdat we daarvoor altijd een hele pot leeg dronken (filter koffie). Dus dachten we: als we per kopje zetten dan drinken we minder en dat is goed voor ons. Dat werkte echter niet helemaal, want het was ook heel makkelijk en laagdrempelig om nog een extra kopje te zetten.

We zijn er best fan van, en in ons vakantie huisje hebben we ook een Senseo, en een reserve voor als de ene stuk ging. Want als een Senseo bevriest dan gaat ie stuk en dat is een paar keer gebeurd omdat het dan binnen ging vriezen omdat de kachel niet aan staat als we er niet zijn. Dus we hadden altijd 1 of 2 reserves.

Family donation

Op een gegeven moment kwam er een ander type Senseo uit: Twist. Toen switchten we van Original naar Twist. Die hebben we genomen omdat je hiermee grote en kleine kopjes kan zetten (slap en sterk). Toen was er dus een over in Nederland en die kreeg onze dochter want die ging net verhuizen.

Zij wilde een Senseo hebben want ze kon geen koffie maken op haar nieuwe kamer. En ze wilde graag koffie kunnen drinken op haar kamer en niet alleen in de gemeenschappelijke keuken.

Voor haar verjaardag kreeg ze een percolator, dus toen gebruikte ze hem helemaal niet meer. De Senseo heeft ze toen in overleg met ons aan haar huisgenoot gegeven. Het was een cadeau dus ze mag ermee doen wat ze wil.

We kopen Senseos altijd tweedehands (marktplaats). Dus dat betekent dat ze vaak al oud zijn. Ze gaan lang mee. We hebben op marktplaats een zoekertje aan staan voor goedkope Senseos. We zijn heavy users. Een van de twee is nu een beetje gestopt met koffie drinken omdat het niet zo goed ging (hartritme storingen, stress). Nu drinkt ze nog 1 per dag. De man drinkt continu koffie.

Attributen

Fijn dat het per kopje gaat. Makkelijk om koffie te zetten. Dan doe je het ook wat vaker/eerder/sneller. Je houdt niets over. En het gaat best snel.

Wat ik minder fijn vond is dat er altijd water in de boiler blijft zitten (ivm bevriezen in vakantiehuisje).

Dat is ook zo fijn aan de Twist: terwijl je hem opwarmt kun je al op het knopje drukken om een kopje koffie te zetten. Dan heb je een stap minder dat je je koffie kan vergeten.

Onze dochter houdt van sterke koffie (espresso) en uit de Senseo komt dan te veel water dus moet je ‘m halverwege stoppen. Onhandig.

De pads gooien we in de prullenbak na gebruik (we hebben geen GFT). Weten wel dat het in GFT kan.

SHORT CONVERSATIONS WITH 5 USERS

Five Senseo users were consulted. They were asked why they gave up on their Senseo and whether they stayed with Senseo or switched to another brand.

CONVERSATION SENSEO USER 8

57 years old

Ik heb geloof ik 4 jaar lang een Senseo gehad. Op een gegeven moment kwamen er nog maar halve bakkies koffie uit dus toen heb ik 'm weggegooid. Vervolgens ben ik geswitcht naar Dolce Gusto. Maar daarvan vond ik de cups wat te duur, dus die heb ik aan mijn dochter (student) gedoneerd. Zij had nog geen koffiezet apparaat in huis. Nu gebruiken ik en mijn man weer filterkoffie thuis.

CONVERSATION SENSEO USER 9

We have a water filter at home (on the tap). Our Senseo indicates when it needs descaling, but that it really annoying because it is not accurate at all. I think it just measures how often we made a cup of coffee, and does not actually measure the scale. Our machine is probably as clean as can be from the inside, but it keeps telling us that we should descale it.

CONVERSATION SENSEO USER 10

26 years old

At some point my Senseo started making loud noises. So I thought: that's not good... I threw it out and I bought another coffee machine, this time Nespresso. That one works fine. I like Nespresso because you can try many different tastes. Even though I settled for one taste now, I only buy that one actually. I never thought of descaling as an option. The louder noises were a signal for me to replace it.

CONVERSATION SENSEO USER 11

32 years old

I dumped my Senseo because the coffee quality worsened. The taste wasn't that nice anymore and it didn't make that foam layer anymore. And the cups were not full either anymore. It was just an old thing, so it was fine. I think we had it for 3 or 4 years already, so it was probably time. I never descaled the product.

CONVERSATION SENSEO USER 12

Irritant aan de Nespresso: je moet het bakje vaak legen met cupjes. En daaronder nog een bakje met lek. Bij Senseo weet je altijd waar je aan toe bent. Je moet gewoon altijd de pad eruit halen. Kocht pads bij supermarkt.

0. QUESTIONNAIRE

Senseo customer support of the future

Thank you for participating in my questionnaire.

You are helping me a lot with the master thesis I am writing for the TU Delft. With this questionnaire, I want to find out what is important in customer support for owners of a Senseo coffee machine. The questionnaire exists of four pages and it will take a maximum of 10 minutes.

Thank you for your great help!
Jozine Bouma

PS: Voel je vrij om de open vragen in het Nederlands te beantwoorden

VOLGENDE

Verzend nooit wachtwoorden via Google Formulieren.

General questions

Which gender do you identify most with? *

- Male
- Female
- Prefer not to answer

What is your age? *

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

Which country do you live in? *

- The Netherlands
- Anders: _____

Have you ever used a Senseo coffee machine? (examples above) *

- Yes
- No

Do you currently own a Senseo coffee machine? *

- Yes
- No

How often do you drink coffee at home? *

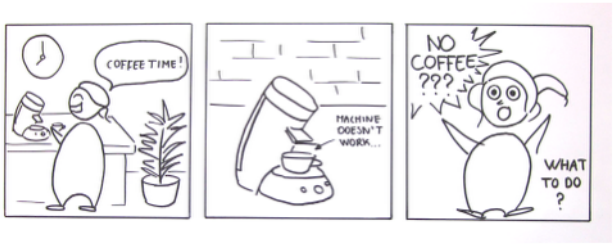
- Never
- <1 times / week
- 1-6 times / week
- 1 time / day
- 2-3 times / day
- 3+ times / day

VORIGE VOLGENDE

Verzend nooit wachtwoorden via Google Formulieren.

Malfunction current situation

Imagine on a Saturday morning you want to make a cup of coffee but the coffee machine doesn't work for some reason and you don't know why...



How do you usually tackle this problem? (multiple answers possible) Please read through all the options. *

- [ ] Give up and buy a new coffee machine
- [ ] Google to find a solution
- [ ] Call customer service for help
- [ ] Search on YouTube for instruction videos
- [ ] Find the manual (online / offline) to troubleshoot
- [ ] Go to the Senseo website and search for information
- [ ] Ask a friend to fix the problem

- [ ] Use a chat box on the website to contact customer service
- [ ] Write an email to the company (customer service)
- [ ] Try to fix the coffee machine yourself
- [ ] Bring or send the product to a repair centre
- [ ] Anders: _____

Why do you tackle the problem in this way? *

Jouw antwoord

Future customer support ideas

After putting effort in searching for the right solution you had no success and eventually you gave up. Right now, companies are looking into better customer support. In the future, fixing a coffee machine will be much easier than it is now. In this section a few ideas are presented.

Other ideas or comments? *

Jouw antwoord

VORIGE VOLGENDE

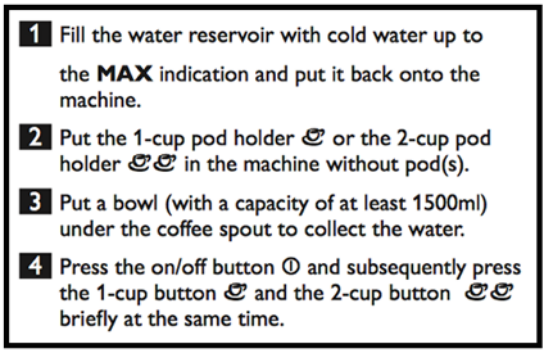
Verzend nooit wachtwoorden via Google Formulieren.

To fix the coffee machine, which (combination of) the following ideas would you be willing to try? *

	Extremely unlikely	Unlikely	Neutral	Likely	Extremely likely
an online forum with tip exchange between users	○	○	○	○	○
an online forum with instruction videos and tips	○	○	○	○	○
an online forum that connects people, experts, and repair centres in the neighbourhood to help each other	○	○	○	○	○
a wireless tag (e.g. NFC) on the Senseo for easy access to an application for guidance	○	○	○	○	○
an app that gives you step-by-step guidance	○	○	○	○	○
an app that gives you a predictive malfunction notification and offers preventive solutions	○	○	○	○	○
an app that visually illustrates where the problem is in the machine	○	○	○	○	○
an app that textually describes where the problem is	○	○	○	○	○

Effort

How many steps would you be willing to take to fix your coffee machine, if the steps are really easy to follow (see example)? *



- ○ 0 steps
- ○ 1-5 steps
- ○ 6-10 steps
- ○ 11-15 steps
- ○ >15 steps

How much time would you be willing to put into fixing your coffee machine? *

- ○ no time
- ○ 1-5 minutes
- ○ 6-10 minutes
- ○ 11-15 minutes
- ○ 15-30 minutes
- ○ >30 minutes

Comments?

Jouw antwoord

VORIGE VOLGENDE

Verzend nooit wachtwoorden via Google Formulieren.

Thank you!

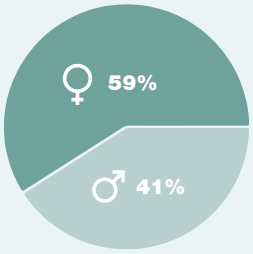
Thank you for participating in my questionnaire.

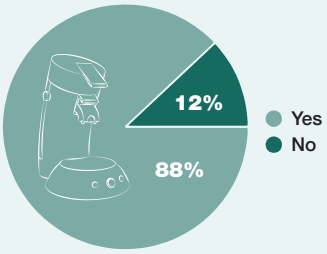
If you have any questions, feedback or further ideas, feel free to contact me at J.A.Bouma@student.tudelft.nl

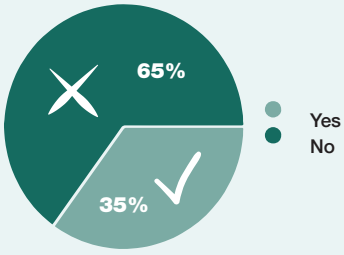
VORIGE VERZENDEN

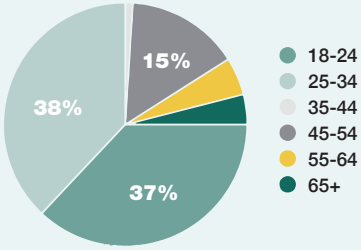
Verzend nooit wachtwoorden via Google Formulieren.

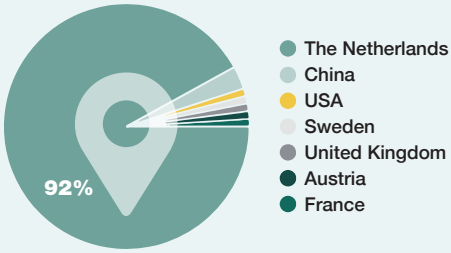
P. QUESTIONNAIRE RESULTS

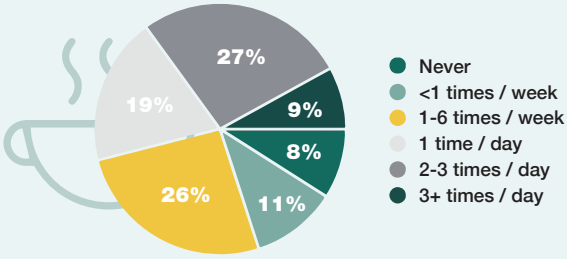


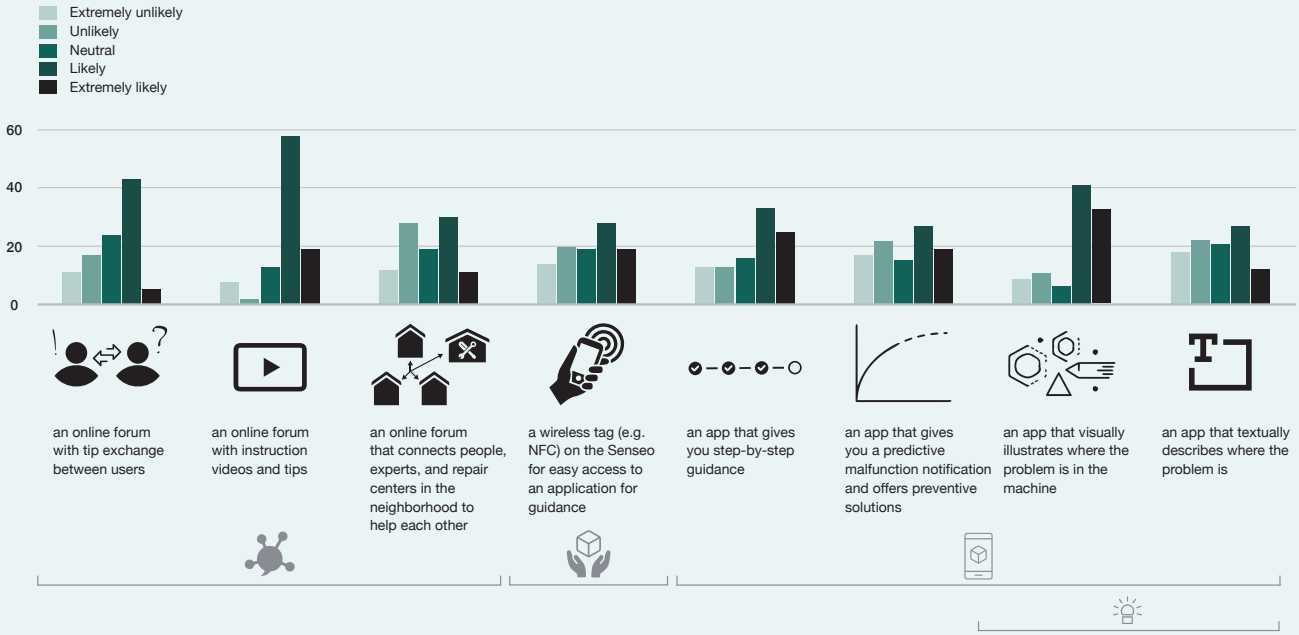


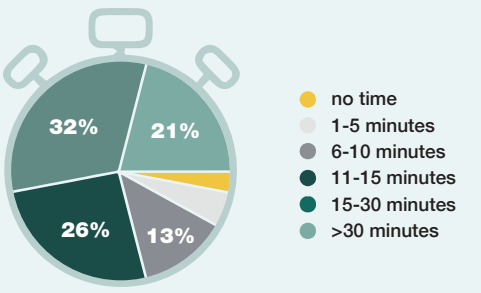


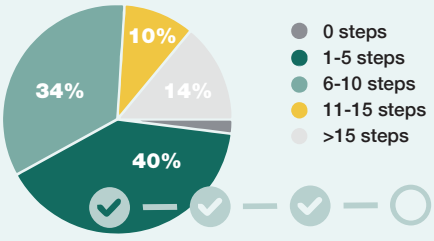












Q.EMAIL CONVERSATION WECYCLE

Suggestie / vraag

4 berichten

Jozine Bouma <jozinebouma@gmail.com> 5 juni 2018 om 15:31
Aan: info@wecycle.nl

Beste mensen van Wecycle,

Ik mail jullie met een suggestie omdat ik enigzins verward raakte toen ik mijn waterkoker op de juiste manier probeerde in te leveren.

Bij de Albert Heijn in mijn buurt kan ik kleine elektrische apparaten inleveren, maar de gaten zijn daar te klein voor een waterkoker. Daarom ging ik naar jullie website om te kijken waar ik het dan in kan leveren. Ik weet dat ik het bij de milieustraat van gemeente in kan leveren, maar dat is ver bij mij uit de buurt en ik ben niet in het bezit van een auto. Op de website klikte ik aan dat het om een 'klein apparaat' gaat omdat er bij 'groot apparaat' een vraagtekentje staat die uitlegt dat dat over wasmachines en koelkasten gaat. Maar door voor 'klein apparaat' te kiezen, kwamen er ook suggesties zoals de Albert Heijn waarvan ik dus weet dat ik het daar niet kan inleveren. Nu ben ik dus een beetje in de war over of mijn waterkoker wel 'klein' is en of er niet nog een derde optie 'middelgroot' hoort te zijn. Mijn suggestie is dan ook om ook een vraagtekentje met uitleg bij 'klein' te plaatsen en/of de optie 'middelgroot' toe te voegen op de website.

Daarnaast is het mij nog steeds niet duidelijk waar ik de waterkoker kan inleveren behalve bij de milieustraat van de gemeente. Zou u mij hier duidelijkheid over kunnen geven?
Tot slot: ik vind dat jullie geweldig werk doen, ik ben blij dat jullie initiatief bestaat.

Ik hoor graag van jullie!

Groeten,
Jozine

Wecycle, Info <info@wecycle.nl> 6 juni 2018 om 09:14
Aan: Jozine Bouma <jozinebouma@gmail.com>

Beste Jozine,

Klein apparaat kan inderdaad wat verwarring geven. Onder kleine apparaten vallen alle apparaten die in een boodschappentas passen, dus ook een waterkoker. Bij de Albert Heijn gaat het echter om echt kleine apparaten zoals een telefoon, elektrische tandenborstel, scheerapparaatje e.d.
Een waterkoker kan je bijvoorbeeld ook inleveren bij een Gamma, Karwei, Intratuin of kinderboerderij die bij ons aangesloten is.

Wat zijn je postcode en woonplaats, dan kan ik even voor je kijken of er in de buurt andere inleverpunten zijn.

Met vriendelijke groet,

Sacha de Haas
Management Assistent

Wecycle
Baron de Coubertinlaan 7
2719EN Zoetermeer

-----Oorspronkelijk bericht-----
Van: Jozine Bouma [mailto:jozinebouma@gmail.com]
Verzonden: dinsdag 5 juni 2018 15:31
Aan: Wecycle, Info <info@wecycle.nl>
Onderwerp: Suggestie / vraag
[Tekst uit oorspronkelijke bericht is verborgen]

Jozine Bouma <jozinebouma@gmail.com> 6 juni 2018 om 09:28
Aan: "Wecycle, Info" <info@wecycle.nl>

Beste Sacha,

Bedankt voor je antwoord. Dit verhelderd al enigszins.
Mijn postcode is 2624NA te Delft.

Groeten,
Jozine

Op 6 juni 2018 om 09:14 schreef Wecycle, Info <info@wecycle.nl>:
[Tekst uit oorspronkelijke bericht is verborgen]

Wecycle, Info <info@wecycle.nl> 6 juni 2018 om 10:08
Aan: Jozine Bouma <jozinebouma@gmail.com>

Beste Jozine,

Hierbij de link waar u en inleverpunt kunt zoeken: https://www.watismijnapparaatwaard.nl/

Als ik uw postcode invul en klein apparaat heb aangevinkt, dan krijg ik de volgende inleverpunten:

Gamma, Leeuwenstein 35

Leen Bakker, Leeuwenstein 7

Praxis, Rijnweg 1

Kinderboerderij en waterspeeltuin Tanthof, Abtswoude 5

Dit zijn allemaal locaties waar u de waterkoker in zou moeten kunnen leveren.

Met vriendelijke groet,

Sacha de Haas
Management Assistent

R. BRAINSTORM SESSION PLANNING

DETAILS

Saturday 8/9/2018
1,5 hour in total
4 participants
Materials: Senseo, intervention cards, markers/ stiften, flipover paper, A3 papier, post-its, sweets (cookies, grapes), tape, chargers, laptop, camera

PLANNING

Energizer (3 minutes)
- Mirroring: in couples. 1 original, 1 mirror. Original makes faces, movements, no talking, music on background.

Introduction (7 minutes)
- Explain planning
- Rules: 1. Listen, 2. Quality through quantity, 3. No ideas are wrong or weird, 4. Hitchhike on each other's ideas 5. No idea killers, 6. Have fun,
- Ice breaker: How many Senseos have you used in your life? (everyone gives an answer)
- Scenario + H2

Idea generation (25 minutes)
- Shedding the known 5 minutes
- Ask intermediate questions (during shedding the known) 10 minutes: What would superman do? What if you had all the money in the world? What if there were no financial barriers? What if there was no money available at all?
- Behavioral intervention strategy cards 10 minutes

Energizer (5 minutes)
- Tie the knot

Clustering (15 minutes)
- Cluster 5 minutes
- Dots (3 per person, use marker) 3 minutes
- Explain each other why you select those 7 minutes
- Select the final 2 as a group

Conceptualizing (30 minutes)
- Divide participants in 2 teams. One group conceptualizes 1 idea, the other team works out the other selected idea.
- Work out concepts 15 minutes
- Both teams present the concepts 2x3 minutes
- Teams give each other feedback on the presented concept 2x3 minutes (directly after the presentation)

S. CONCEPT CATEGORIES

ALTERNATIVE BUSINESS MODEL

Leasing model
Access to a Senseo that always works properly. Does not fit within the project scope. Nevertheless, it has high potential for circular impact.

AUTOMATIC PROBLEM SOLVING
Ideas in this category skip the user. Those ideas are ideal and desirable for every user. Therefore, the desirability does not have to be tested among users. However, it is only procrastination of malfunction: eventually problems might occur that cannot be automatically solved and user actions are still required. It is not within the scope of the project, but it is a promising direction. Philips is advised to investigate and consider the ideas by checking viability.

Automatic descaling
Descaling tablets are placed within the Senseo. The Senseo automatically descales every 3 months until the descaling tablets are finished. Then those need to be filled.

Water filter
Senseo comes with a water filter, descaling is not necessary anymore. After 5 months use of the Senseo, the user receives a new filter as a gift to strengthen the customer relationship. Or the filter can be purchased > revenue stream.

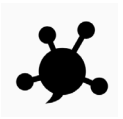
Self-repair
Senseo detects problems and tries multiple solutions by itself before alarming or notifying the user. This postpones experienced malfunction. The responsibility of the user decreases.

PERSONALIZATION

Offering upgrade kits
To prevent people from buying a new product for aesthetic reasons. With the upgrade kit the outer body of the Senseo can be replaced so that it has a total new look. This might increase the personal attachment to the product which might result in people willing to do more effort in case it breaks.

Offering refresher kits
To prevent people from buying a new product for hygienic reasons. With the refresher kit, all primary parts are replaced so that every part that (in)directly touches the coffee is new. This stimulates second hand use of the Senseo.

COMMUNITY
This category can be combined with other ideas. It probably requires high user effort, thus should be tested on user desirability.



Forum
A controlled Senseo forum with tip exchange between customers and instruction videos.

Connecting neighbors and local experts
Through a website or forum. Challenging for Philips to ensure quality control.

Buurman & Buurman
Using the famous characters Buurman & Buurman as a metaphor for helping each other. This is not a service provided by Philips but a campaign. Requires high user effort. Difficult to find revenue streams. Could be combined with other ideas.

Senseo course
Offering trainings for really motivated people to become a Senseo expert.

CONNECTIVITY
The desirability of the ideas and technologies in this category need to be tested among users.

NFC tag
Easy access to (online) guidance or support service. By scanning the tag with a smart device, the service can automatically communicate how long it has been since the last cleaning or descaling. Passive insights, no forced warnings.

Chatbot
A chatbot on the Philips website that is 24/7 available and guides the user through the problem solving process.

Predictive notification
Notifying the user when the machine or parts are expected to stop working or break. Offer direct solutions to deal with the predicted problem. Management of expectations.

Problem indication
Senseo indicates where the problem is (diagnostics). Perhaps through LED lights in the product. Can include maintenance reminders (malfunction prevention).

Step-by-step guidance
As with the printers at the TU Delft.

The latter 3 ideas can be combined with the following technologies or channels:

- Smartphone or tablet > application
- Augmented or Virtual Reality
- IoT and Wi-Fi connected sensors
- Artificial Intelligence
- Data analytics system
- Machine learning

T. COMPARISON OF WIRELESS TECHNOLOGY

	BLE (Bluetooth Low Energy)	Passive RFID (Radio Frequency Identification)	NFC (Near Field Communication)	QR (Quick Response)
				
Aesthetical	Can be hidden, no interference with visual design, but takes up some space	Can be hidden, no interference with visual design	Can be hidden, no interference with visual design [4]	Can be distracting and break overall visual experience [3]
Proximity / distance	Up to 100 meters[2]	Few meters [3]	User should be within range (4-10 cm)[2]	Distance is dependent on size[2]
Compatibility with smart devices	Most smart devices are Bluetooth compatible.[5]	Expensive infrastructure required to read tags, mobile phones incompatible as an RFID reader [5]	Device should be NFC compatible. Most smart devices are NFC compatible [1].	Requires QR reader application on device [4] (for some smartphones it is an automatic feature in the phone)
Cost	High [5]	Low [4]	Low [4]	Almost free[4]
Response time	Connecting with device takes time[3]	Immediate response[2]	Immediate response[2]	Scanning itself can take time, after scan immediate response
Condition environment	Requires a power source. BLE tags last up to 3 years without recharge.[5]	Cannot be placed on metal, may trigger disturbance[4]	Cannot be placed on metal, may trigger disturbance[4]	Solely works in light Print can fade / wear out[2] Requires balance during scanning[4]
Example of use cases	Smart watch, healthcare monitoring 	Packaging. Item and animal tracking. 	Wireless payment, public transport 	Marketing, Mobike 

Figure 91: Comparison of wireless connection technologies
1. Faulkner, C. (2017);
2. Flamingo (2018);
3. Hayer, G. (2012);
4. QR-Patrol (2018);
5. Sainathan, P. (2018).

RESOURCES

Faulkner, C. (2017). What is NFC? Everything you need to know. Retrieved on 6-10-2018 from https://www.techradar.com/news/what-is-nfc

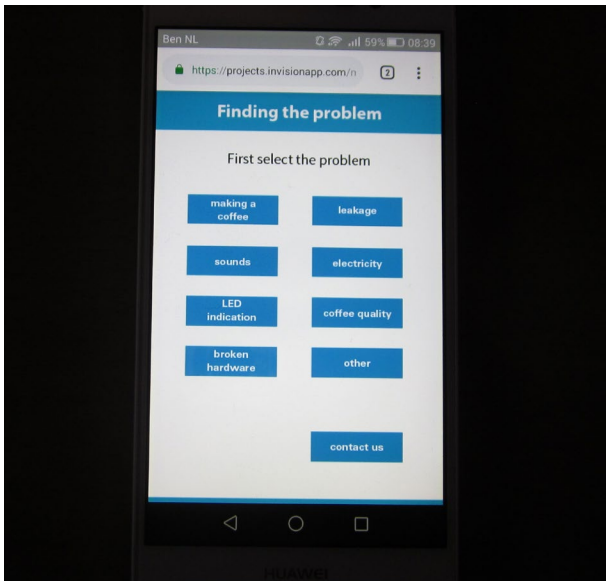
Flamingo (2018). De beste technologie om betrouwbaarheid, toepasbaarheid, snelheid en gebruiksgemak te garanderen. Retrieved on 6-10-2018 from https://flamingo.imbema.com/voordelen-nfc-bluetooth-qr-code/

Hayer, G. (2012). What are the key differences between QR codes, NFC, Bluetooth and RFID? How does NFC work? Retrieved on 6-10-2018 from https://www.quora.com/What-are-the-key-differences-between-QR-codes-NFC-Bluetooth-and-RFID-How-does-NFC-work

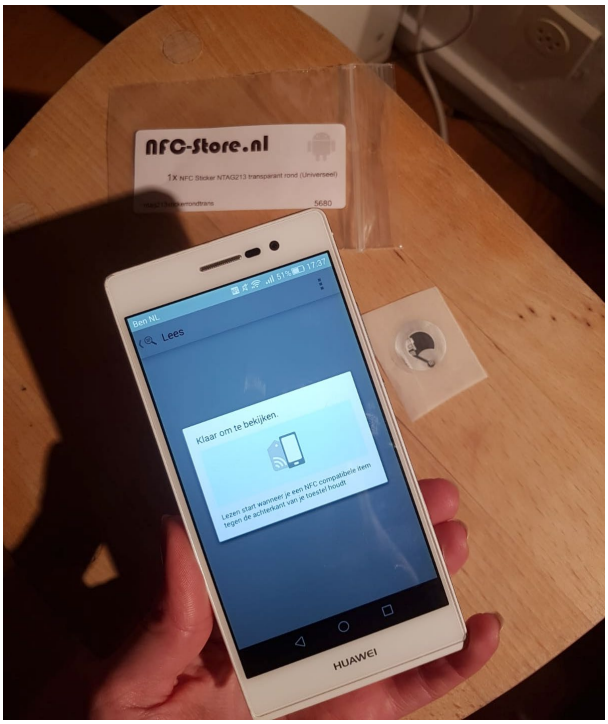
QR-Patrol (2018). NFC or QR-codes? What are the advantages of each one? Retrieved on 6-10-2018 from https://www.qrpatrol.com/blog/nfc-or-qr-codes-what-are-advantages-each-one

Sainathan, P. (2018). Supply Chain Visibility Evolution: Barcodes, RFID, NFC, BLE Beacons. Retrieved on 6-10-2018 from https://blog.roambee.com/supply-chain-technology/evolution-in-supply-chain-visibility-barcodes-to-rfid-to-ble-beacons

U. QUICK PROTOTYPES QR CODE & NFC TAG

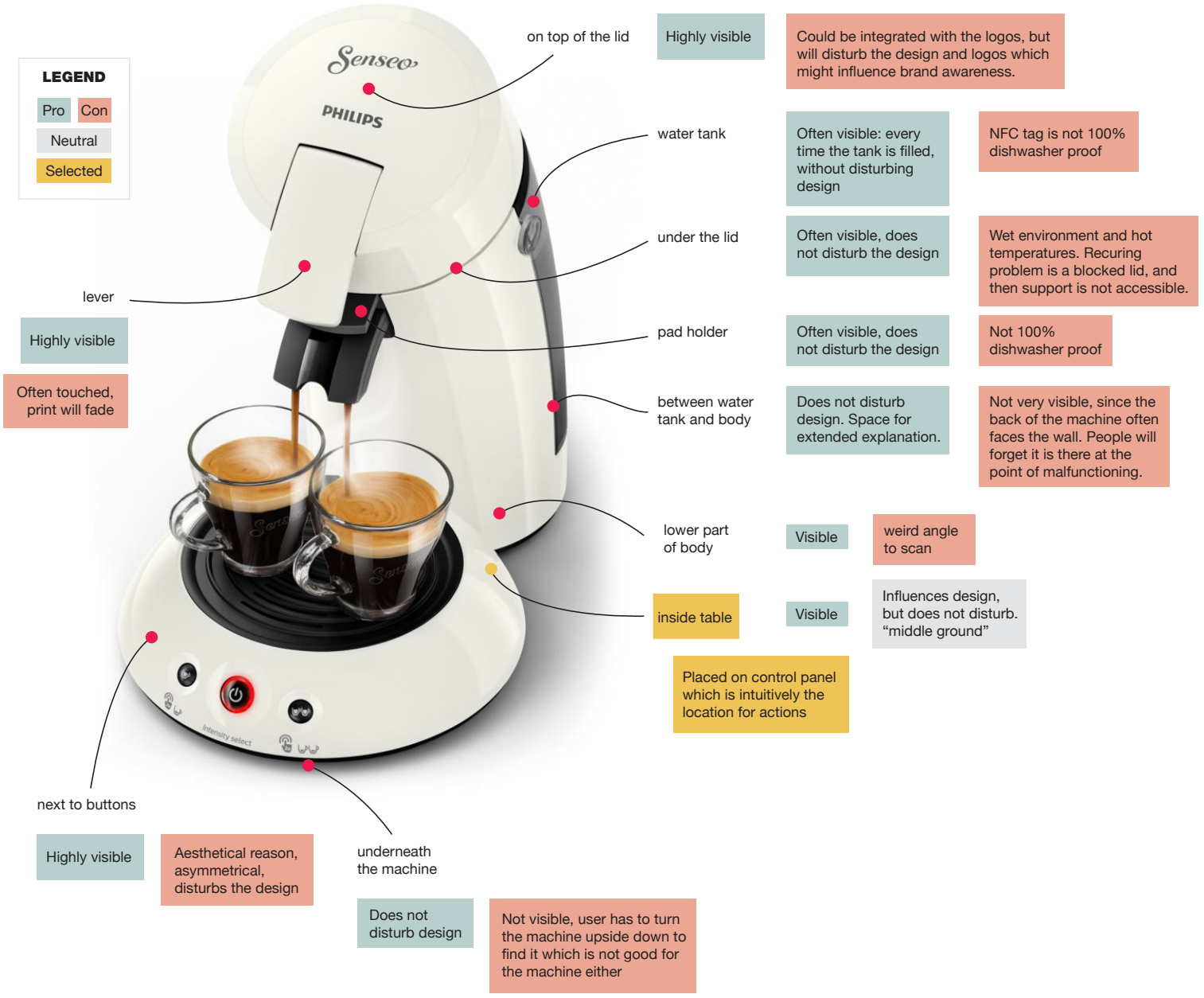


A QR code was generated on the website https://nl.qr-code-generator.com. By using the camera on the smart device (upper left picture), the QR redirects to the first quick online guidance prototype as can be seen in the upper right picture. By trying different colors and sizes it was found that the QR code only works in black on white with a minimum size of 2x2 cm. This is decided to be aesthetically unattractive, therefore an NFC tag was prototyped and tested too. Four different NFC tags were ordered at NFC-Store.nl, they only differed in flexibility and thickness. The most flexible tag appeared most suitable for the Senseo as it will be attached on a curved surface. With the 'NXP TagWriter' application (bottom left) the tag is programmed to redirect to the prototyped online guidance as depicted in the bottom right picture.



V. NFC TAG LOCATION DETERMINATION

The image describes all considered locations on the Senseo for the NFC tag with argumentation for each considered option.



W. USER TEST INFORMATION PRESENTATION

TEST (8 PARTICIPANTS)
Face to face, short interviews.

PRESENTED SCENARIO
Malfunctioning Senseo, you are looking for guidance or information on how to fix it. Which icon – word combination would be the clearest and easiest to understand, best explained?

FEEDBACK

PARTICIPANT 1
Phone of B nicer (personal preference)
B = sending action, looks more like Wi-Fi
D = scanning action

PARTICIPANT 2
icon with mobile phone clearest. Because the action is indicated. Logo of NFC is not recognized or understood.

PARTICIPANT 3
Problem / help is wat je nodig hebt. Support, heb niet echt ondersteuning nodig. Info, klinkt alsof je naar promoties of acties kijkt.

PARTICIPANT 4
Wel iets met scan in de titel vind ik
Scan for support is het beste denk ik
A is niet duidelijk genoeg
Want ik bijv ken het NFC scan ding niet

PARTICIPANT 5
2C
Why not “scan for help”?

PARTICIPANT 6
2B. B because it is the clearest what to with the mobile phone: scan NFC. Especially because not everyone might know what NFC is without that association.

PARTICIPANT 7
B or D, at least with a phone.
D, but not strong preference.
Scan for help would be nice. Because help is an easier word than support. Faster and easier to understand for everyone.

PARTICIPANT 8
2D
Words: include ‘scan’, scan for support or need help indicate best what is meant. Problems? Not so professional. Need help? Too casual. Info, is just not what it is meant for.
Perhaps add on website option ‘other services’ for the more info part. Registration, deals, promotion etc.

CONCLUSION
2D with phone of B. scan for help
Unaniem: telefoon icon moet erbij. NFC logo kent niemand.

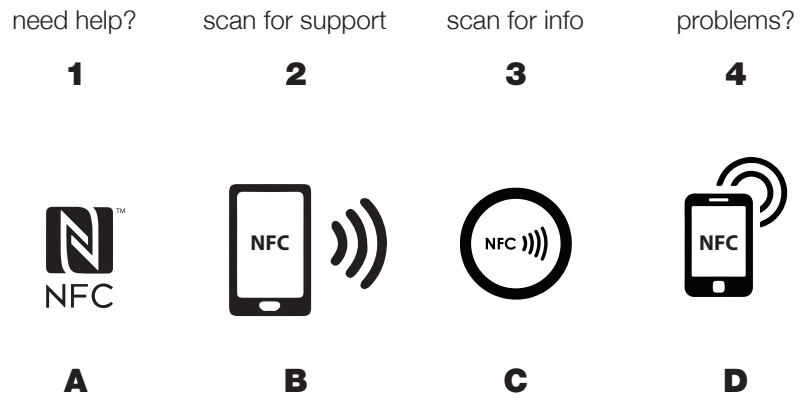
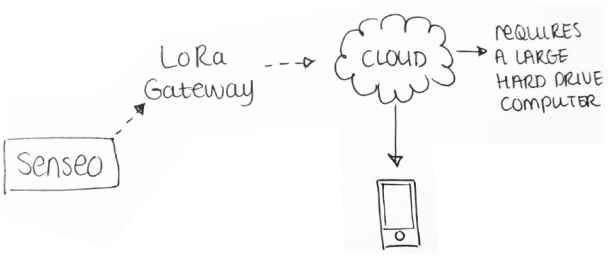


Figure 92: Test information presentation

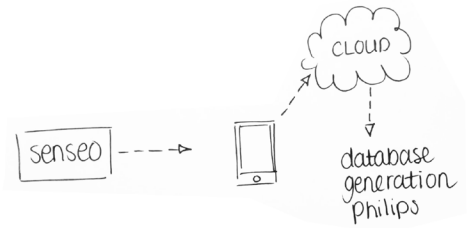
X. WIRELESS CONNECTIVITY

Considered wireless connectivity options are discussed in this appendix. For this evaluation professor Wolf Song working at the TU Delft (2018) is consulted.

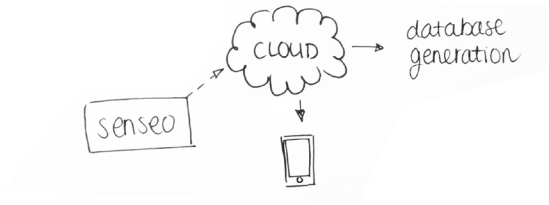
LORA
Is a very expensive option because it is not a popular technology to use. It also requires a separate LoRa Gateway (intermediate station) wherefore many additional electronics are necessary. This would highly impact the cost price and the environment.



BLE (BLUETOOTH LOW ENERGY)
Makes much more sense, because it is on a certain distance. Because the phone is usually within a certain distance of the phone, it is not necessary to first go into the cloud before reaching the phone.
BLE is the best choice price-wise because it is a very common technology, and it is mass produced. It is also the most practical choice because almost every mobile operating system supports BLE (Song, 2018). Also regarding environmental impact BLE is the most logical option because it requires low power, which means low impact in use.



WI-FI
By the use of Wi-Fi the Wi-Fi channel at home would be occupied which is not wishful for the users. Wi-Fi is commonly used and available on every smart device. It has a larger bandwidth than Bluetooth which would be necessary for sending images for example. However, this is not necessary in the case of Senseo.



ZIGBEE
Unsuitable, because it is not available on mobile phones

RFID
Unsuitable, because it is a passive device.

SIGFOX
Unsuitable, because it is not available on mobile phones

Y. DATAWAREHOUSE

This excel sheet shows an example of what the data-warehouse would look like and the influence of horizon 1 (NFC technology) and horizon 2 (IoT) would have on this data collection. This example is made in consultation with data engineer Giuseppe Guida.

Datawarehouse / Analytics storage system

Sales data *SKU = unique serial number of the product*

SKU	product name	sales date	sales location	sales channel	userid
12345 ***	senseo	27/10/2018	Mediamarkt	store	jozine.bouma@gmail.com ***
11111	senseo	27/10/2017	Philips	online	peppe.guida@gmail.com
3333	lamp				
44234343	hairdryer				
11115	senseo	27/10/2017	Coolblue	store	Unknown

Procurement data

SKU	product name	componentid	component name	vendor	vendor location
12345	senseo	1111111111	pump v1.2.89	Fiis s.p.a	south africa
12345	senseo	22222222222	capacitor v1	Fiis s.p.a	south africa
11111	senseo	1111111112	pump v1.0	Zven 90	sweden

Questions you can answer because of the NFC
how many products have been sold online
how many products have been sold online and have something from zven

Users data *e.g. demographics*

userid	age	gender	address
peppe.guida@gmail.com	32	male	Rotterdam
jozine.bouma@gmail.com ***	26	female	Delft

*** This connection of data is possible because of the NFC

Support through NFC *this is what you want to build*

SKU	date	problem
11111	30/10/2018	Leakage
11112	31/10/2018	Leakage
12345	01/11/2018	Leakage
11111	02/11/2018	Leakage
11115	03/11/2018	Leakage
12345	04/11/2018	cold coffee
11111	05/11/2018	Leakage
11118	06/11/2018	less coffeee
11119	07/11/2018	Leakage
11120	08/11/2018	blinking light
3333	09/11/2018	doesn't turn on
3333	10/11/2018	
3333	11/11/2018	
3333	12/11/2018	

IoT *automatically sent from the machine*

sku	date	status
11111	10/30/18 9:04 PM	everything ok *
11111	10/30/19 9:04 PM	broken **

Because of IoT you can see that a product is still active / being used

* with app and IoT I can send this information less frequently in background by masking the information
** sent, from the app to the Philips' database -and stored-, as soon as the wifi / connection is available

Legend

	registered user
	registered through (NFC) support
	unknown user

Z. SURVEY USER TEST

User test Senseo

In this survey you are asked to review the situation on multiple aspects from 1-7 (strongly disagree - strongly agree) with 10 questions.

*Vereist

Test number (ask Jozine) *

- ◯ 1
- ◯ 2

1. Trying to solve the problem feels frustrating *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

2. I felt supported during the process *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

3. I felt confident during the process *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

4. The actions to solve the problem were clear, I knew what to do *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

5. The problem solving process is easy and clear *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

6. I felt motivated during the process to solve the problem *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

7. I felt determined to solve the problem *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

8. I felt frustrated while trying to solve the problem *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

9. I felt that Philips tried to help and support me *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

10. I would choose for Philips products again *

	1	2	3	4	5	6	7	
Strongly disagree	◯	◯	◯	◯	◯	◯	◯	Strongly agree

If you want to win a Senseo please fill in your email address (outcome mid-January)

Jouw antwoord

AA. TRANSCRIPT USER TEST

CONTROL QUESTIONS
Are you familiar with the Senseo?
How old are you?
What do you study? Or are you working?
Would you like a coffee? Then you can make it yourself.

INTRODUCTION
Thank you for participating in this research. In this test I might take pictures or video record your actions for reviewing afterwards. The video records will be kept confidential within the project, the picture can be used in the thesis. Do I have your permission for that? The test exists of three different parts: the test, a small survey, and a short interview.

[Tell the context story]. Imagine that this is your Senseo, you are using it for a couple of years now and lately you notice that less coffee is coming through. It only fills a third of a cup. This is a problem. Please show what you would do in this situation. You are encouraged to think out loud. [remind participant during the process: what are you doing? why are you doing that?]

Try to act how you would act at home. Therefore, you can use all attributes you would normally use. If there is anything you need, just tell me and I probably have it.

If there are any questions (or if the app asks you a question you don't know how to answer) ask me and I will tell you.

Group 1 [Let participant tinker with the prototype]
Group 2 [Wait with indicating NFC]
[Check if participant finds and understands NFC themselves]
[Otherwise give the participant a hint + my NFC enabled smartphone]
[Let participant use the designed service]

[Film it]
[Measure time, until giving up]
[Count the different actions]

Can you please fill in the small survey about how you experienced this situation?
[Let participant fill in the survey]

INTERVIEW
[make notes on laptop]
[ask why]
- What motivated you and what didn't? Did this change during the process?
- What was the point you were thinking about quiting and why?
- What helped and what was confusing?
- What was difficult, what went well?
- What was positive or negative about the received support?
- Do you have any recommendations regarding support at the point of malfunction?

END
Thank you for your participation. Do you have any questions or recommendations?

AB. STATISTICAL ANALYSIS

	Group	TryingFrustrating	Supported	Confident	ActionsClear	EasyClear
1	1	6	4	2	3	2
2	1	5	3	2	3	3
3	1	5	1	2	2	2
4	1	6	1	1	1	2
5	1	7	3	3	1	1
6	1	5	4	5	5	4
7	1	6	1	1	1	1
8	1	3	3	4	3	3
9	1	4	3	4	4	3
10	1	5	1	2	1	1
11	2	6	7	7	6	4
12	2	2	5	6	4	7
13	2	1	6	5	7	7
14	2	2	6	4	6	5
15	2	2	5	5	5	6
16	2	2	6	5	5	6
17	2	6	5	4	5	3
18	2	2	4	7	4	5
19	2	1	5	6	5	5
20	2	2	6	6	5	5

Figure 93: Complete data set

Test Statis

	1. Trying to solve the problem feels frustrating	2. I felt supported during the process	3. I felt confident during the process	4. The actions to solve the problem were clear, I knew what to do	5. The problem solving process is easy and clear
Mann-Whitney U	15.000	1.000	5.500	5.500	3.000
Wilcoxon W	70.000	56.000	60.500	60.500	58.000
Z	-2.714	-3.767	-3.410	-3.434	-3.595
Asymp. Sig. (2-tailed)	.007	.000	.001	.001	.000
Exact Sig. [2*(1-tailed Sig.)]	.007[b]	.000[b]	.000[b]	.000[b]	.000[b]

a. Grouping Variable: Group

b. Not corrected for ties.

Figure 94: Mannwhitney U test

Motivated	Determined	Frustrated	PhilipsSupport	ChoosePhilips	Time	Steps
3	6	6	4	3	27	3
5	6	5	2	2	34	4
4	5	6	1	4	3	0
1	1	7	2	2	4	0
3	6	7	1	4	28	5
5	6	6	3	4	29	4
1	1	5	2	4	1	0
2	2	2	2	5	6	0
5	4	3	3	4	5	1
1	1	6	2	4	3	0
6	6	3	5	6	25	5
7	7	2	4	6	33	4
4	4	1	6	6	18	3
7	7	6	7	7	30	5
7	6	4	7	7	14	3
6	6	1	6	6	26	5
5	7	5	6	4	28	5
4	6	2	5	5	15	4
5	6	5	5	5	31	5
6	7	2	7	6	27	5

stics[a]

6. I felt motivated during the process to solve the problem	7. I felt determined to solve the problem	8. I felt frustrated while trying to solve the problem	9. I felt that Philips tried to help and support me	10. I would choose for Philips products again	Time	Steps
10.000	15.500	17.000	.500	5.000	29.000	14.000
65.000	70.500	72.000	55.500	60.000	84.000	69.000
-3.067	-2.751	-2.536	-3.792	-3.512	-1.589	-2.818
.002	.006	.011	.000	.000	.112	.005
.002[b]	.007[b]	.011[b]	.000[b]	.000[b]	.123[b]	.005[b]

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
1. Trying to solve the problem feels frustrating	Equal variances assumed	1.480	.240	3.806	18	.001	2.600	.683	1.165	4.035
	Equal variances not assumed			3.806	14.995	.002	2.600	.683	1.144	4.056
2. I felt supported during the process	Equal variances assumed	4.594	.046	-6.433	18	.000	-3.100	.482	-4.112	-2.088
	Equal variances not assumed			-6.433	15.750	.000	-3.100	.482	-4.123	-2.077
3. I felt confident during the process	Equal variances assumed	.696	.415	-5.304	18	.000	-2.900	.547	-4.049	-1.751
	Equal variances not assumed			-5.304	17.174	.000	-2.900	.547	-4.053	-1.747
4. The actions to solve the problem were clear, I knew what to do	Equal variances assumed	3.489	.078	-5.209	18	.000	-2.800	.537	-3.929	-1.671
	Equal variances not assumed			-5.209	15.351	.000	-2.800	.537	-3.943	-1.657
5. The problem solving process is easy and clear	Equal variances assumed	.174	.681	-6.041	18	.000	-3.100	.513	-4.178	-2.022
	Equal variances not assumed			-6.041	17.374	.000	-3.100	.513	-4.181	-2.019
6. I felt motivated during the process to solve the problem	Equal variances assumed	1.877	.188	-4.150	18	.001	-2.700	.651	-4.067	-1.333
	Equal variances not assumed			-4.150	15.886	.001	-2.700	.651	-4.080	-1.320
7. I felt determined to solve the problem	Equal variances assumed	18.592	.000	-3.065	18	.007	-2.400	.783	-4.045	-.755
	Equal variances not assumed			-3.065	11.803	.010	-2.400	.783	-4.110	-.690
8. I felt frustrated while trying to solve the problem	Equal variances assumed	.486	.495	2.867	18	.010	2.200	.767	.588	3.812
	Equal variances not assumed			2.867	17.854	.010	2.200	.767	.587	3.813
9. I felt that Philips tried to help and support me	Equal variances assumed	.417	.526	-8.235	18	.000	-3.600	.437	-4.518	-2.682
	Equal variances not assumed			-8.235	17.760	.000	-3.600	.437	-4.519	-2.681
10. I would choose for Philips products again	Equal variances assumed	.103	.752	-5.218	18	.000	-2.200	.422	-3.086	-1.314
	Equal variances not assumed			-5.218	17.955	.000	-2.200	.422	-3.086	-1.314
Time	Equal variances assumed	19.686	.000	-2.240	18	.038	-10.700	4.777	-20.737	-.663
	Equal variances not assumed			-2.240	13.204	.043	-10.700	4.777	-21.005	-.395
Steps	Equal variances assumed	20.677	.000	-3.840	18	.001	-2.700	.703	-4.177	-1.223
	Equal variances not assumed			-3.840	11.941	.002	-2.700	.703	-4.233	-1.167

Figure 95: Independent T-test

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.771	.783	10

Figure 96: Cronbach's alpha for all survey questions

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.951	.953	8

Figure 97: Cronbach's alpha without survey questions 1&8

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
1. Trying to solve the problem feels frustrating	Control group	10	5.20	1.135	.359
	With support	10	2.60	1.838	.581
2. I felt supported during the process	Control group	10	2.40	1.265	.400
	With support	10	5.50	.850	.269
3. I felt confident during the process	Control group	10	2.60	1.350	.427
	With support	10	5.50	1.080	.342
4. The actions to solve the problem were clear, I knew what to do	Control group	10	2.40	1.430	.452
	With support	10	5.20	.919	.291
5. The problem solving process is easy and clear	Control group	10	2.20	1.033	.327
	With support	10	5.30	1.252	.396
6. I felt motivated during the process to solve the problem	Control group	10	3.00	1.700	.537
	With support	10	5.70	1.160	.367
7. I felt determined to solve the problem	Control group	10	3.80	2.300	.727
	With support	10	6.20	.919	.291
8. I felt frustrated while trying to solve the problem	Control group	10	5.30	1.636	.517
	With support	10	3.10	1.792	.567
9. I felt that Philips tried to help and support me	Control group	10	2.20	.919	.291
	With support	10	5.80	1.033	.327
10. I would choose for Philips products again	Control group	10	3.60	.966	.306
	With support	10	5.80	.919	.291
Time	Control group	10	14.00	13.524	4.277
	With support	10	24.70	6.734	2.129
Steps	Control group	10	1.70	2.058	.651
	With support	10	4.40	.843	.267

Figure 98: Group statistics

AC. LIFE-CYCLE ASSESSMENT

TRADITIONAL SENSEO, CURRENT SITUATION			data and references		result	total	
PRODUCTION			copy paste from "Results of Senseo SiZe project, LCA JDE 28.3.18" (internal data source)				
type	*weight (kg)*	*process step*		*kg CO2 equivalent*	*kg CO2 equivalent*	*kg CO2 equivalent*	
Polypropylene granulate (PP)					1,42		
Senseo PCBA					1,33		
PA6.6 part					1,05		
PA6.6-GF40 part					0,97		
Electricity, plastic part moulding					0,92		
Stainless Steel slab (X12CrNi17-7)					0,63		
Circulating pump					0,55		
Immersion heater					0,43		
Connector UK type G (46,5 g, 3 pins)					0,34		
Aluminium die cast part, machined [for ICT]					0,25		
plus other small components, such as the heating coil, electrical cable, and packaging					0,5	**8,39**	production
TRANSPORT			According to Google Maps				
from-to	*m3*	*km*	For Senseo Original incl. packaging https://www.philips.nl/c-p/HD7817_60/original-koffiezetapparaat/specificaties				
Romania-R'dam	0,0329084	2050	idematapp2018 Truck+trailer 24 tons net (max weight/volume ratio 0,32 ton/m3) (m3.km)	0,0271	1,830622755	**1,830622755**	transport
USE PHASE			Lifetime in years =	0			
type	*weight (kg)*	*energy (kWh) / year*	retrieved from "BOM & use scenario coffee.xlsx" (internal data source)				
electricity	-	89	idemat2010 Electricity Low Voltage, domestic use (UCTE)	0,030	0	**0**	electricity
plus materials which are used in the use phase (in this case coffee, packaging, water)							
END of LIFE							
type	*weight (kg)*	*process step*	Eelco Smit 29-06-2018 [feedback on PPT, internal source data]				
Senseo	1,7		http://www.nationaalweeeregister.nl/nederlands/rapportage-2017.html				
80% of collected Senseos	0,8	to recycling		EoL recycling	-1,359092986		
20% of collected Senseos	0,2	to landfill		EoL landfill	0,295618758		
	0,37559					**-1,063474228**	EoL total
	0,62441		idematapp2018 recycling credit average (see below)	-2,66			
plus the materials of the use phase			idematapp2018 waste incineration with electricity average (see below)	1,39			
			37,559% of small domestic appliances is collected for recycling in NL, 2017				
			62,441% of small domestic appliances is NOT collected for recycling in NL, 2017				
					TOTAL	**9,15715**	

Figure 99: Assessment form for the traditional Senseo

Figure 100: Assessment form for the IoT Senseo

IOT SENSEO, NEW SITUATION			data and references		result	total	
PRODUCTION							
type	*weight (kg)*	*process step*		*kg CO2 equivalent*	*kg CO2 equivalent*	*kg CO2 equivalent*	
Polypropylene granulate (PP)					1,42		
Senseo PCBA					1,33		
PA6.6 part					1,05		
PA6.6-GF40 part					0,97		
Electricity, plastic part moulding					0,92		
Stainless Steel slab (X12CrNi17-7)					0,63		
Circulating pump					0,55		
Immersion heater					0,43		
Connector UK type G (46,5 g, 3 pins)					0,34		
Aluminium die cast part, machined [for ICT]					0,25		
plus other small components, such as the heating coil, electrical cable, and packaging					0,5		
2 sensors + ESP32			*Rough estimation based on kg CO2 equivalent PCB /5*		0,266		
						8,656	production
TRANSPORT							
from-to	*m3*	*km*					
Romania-R'dam	0,0329084	2050	Idematapp2018 Truck+trailer 24 tons net (max weight/volume ratio 0,32 ton/m3) (m3.km)	0,0271	1,830622755		
						1,830622755	transport
USE PHASE			Lifetime in years =	0			
type	*weight (kg)*	*energy (kWh) / year*					
electricity	-	89	Idemat2010 Electricity Low Voltage, domestic use (UCTE)	0,030	0		
extra used energy for cloud services		1,581666667	Idemat2010 Electricity Low Voltage, domestic use (UCTE)	0,030	0		
plus materials which are used in the use phase (in this case coffee, packaging, water)						**0**	electricity
END of LIFE							
type	*weight (kg)*	*process step*					
Senseo	1,7						
80% of collected Senseos	0,8	to recycling		EoL recycling	-1,467649629		
20% of collected Senseos	0,2	to landfill		EoL landfill	0,28141565		
	0,40559					**-1,18623398**	EoL total
	0,59441		Idematapp2018 recycling credit average (see below)	-2,66			
plus the materials of the use phase			Idematapp2018 waste incineration with electricity average (see below)	1,39			
					TOTAL	**9,30039**	

Everything in grey is assumed to be the same as for the current situation
Red has a negative environmental impact
Green delivers a positive contribution to the environment

Figure 101: Graph data

Years	Traditional 3y	Traditional 7y	IoT	Lifecycle (best case)	Lifecycle (worst case)
0	9,15715	9,15715	9,30039	1	1
1	11,8445	11,8445	12,0355	1	1
2	14,53185	14,53185	14,77061	1	1
3	17,2192	17,2192	17,50572	1	1
4	29,0637	19,90655	20,24083	1	2
5	31,75105	22,5939	22,97594	1	2
6	34,4384	25,28125	25,71105	1	2
7	46,2829	27,9686	28,44616	1	3
8	48,97025	39,8131	31,18127	2	3
9	51,6576	42,50045	33,91638	2	3
10	63,5021	45,1878	36,65149	2	4
11	66,18945	47,87515	39,3866	2	4
12	68,8768	50,5625	42,12171	2	4
13	80,7213	53,24985	44,85682	2	5
14	83,40865	55,9372	47,59193	2	5
15	86,096	67,7817	50,32704	3	5
16	97,9405	70,46905	53,06215	3	6
17	100,62785	73,1564	55,79726	3	6
18	103,3152	75,84375	58,53237	3	6
19	115,1597	78,5311	61,26748	3	7
20	117,84705	81,21845	64,00259	3	7
21	120,5344	83,9058	66,7377	3	7
22	132,3789	86,59315	69,47281	3	8
23	135,06625	89,2805	72,20792	3	8
24	137,7536	91,96785	74,94303	3	8
25	149,5981	94,6552	77,67814	3	9

For recycling	
Idematapp2018 Aluminium, recycling credit closed loop (66% virgin part market mix)	-5,77
Idematapp2018 ABS, recycling credit	-0,48
Idematapp2018 PA-11 (nylon-11), recycling credit	-4,80
Idematapp2018 PA (nylons, polyamides), recycling credit	-5,97
Idematapp2018 POM, Acetal (Polyoxymethylene), recycling credit	-0,66
Idematapp2018 PP (Polypropylene), recycling credit	1,72
	-2,66
For landfill	
Idematapp2018 ABS (Acrylonitrile butadiene styrene) waste incineration with electricity	1,58
Idematapp2018 PA (Nylons, Polyamides) waste incineration with electricity	1,18
Idematapp2018 PP (Polypropylene) waste incineration with electricity	1,42
	1,39

Figure 102: Idemat database, impact recycling numbers on which the assumption regarding recycling is based.

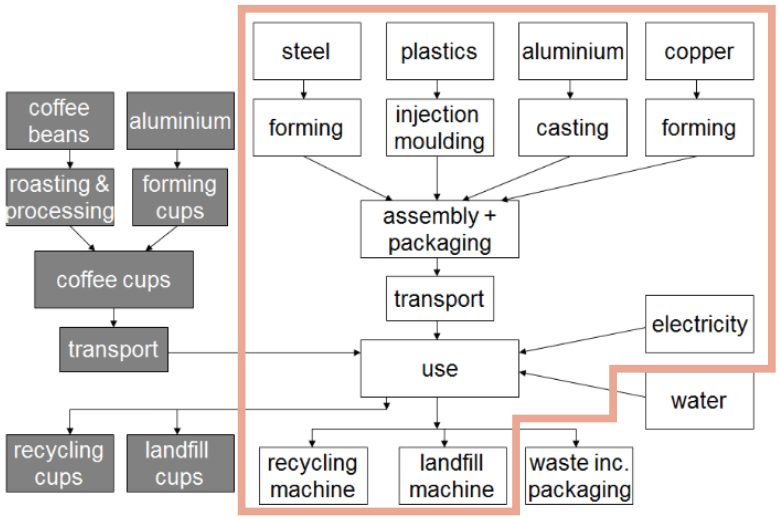


Figure 103: Process tree to set boundaries for the LCA analysis. Based on a model from Vogtländer (2013)

Aspects outside of the studied boundaries are assumed to be the same for the use of the traditional Senseo vs. the IoT Senseo.