Stimulating Willingness to Repair

Designing a Concept for Stimulating Repair via Assemblable Electronics

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Summary

Repair is an essential aspect of the circular economy (Ellen MacArthur Foundation, 2013) and has been discussed numerously (European Commission, 2015; Dangal et al., 2022; Yakimova, 2023). However, the focus has been primarily on the technical possibility of repair, not on willingness to repair (WTR). As a result, many people do not consider repair an option (Magnier & Mugge, 2022) since technical feasibility does not always translate to repair behaviour (Makov & Fitzpatrick, 2021). This is especially prevalent in electronics (Magnier & Mugge, 2022). Therefore, this study explored opportunities to stimulate people who typically do not repair electronic devices to increase their WTR. The process of the project is shown in Figure 1.

Seven barriers of WTR were found (the top left quadrant of Figure 2) (Rosklada et al., 2023). Additionally, products that are less likely to be repaired are either 'up-to-date' (valued for their self and social identity) (Jackson, 2005) or 'workhorse' items (valued for their functionality and long lifespan) (Cox et al., 2013). These factors influence consumer decisions about repair.

The study used the I-Change model (De Vries, 2017; De Klein & Wesselman, 2019) to analyse consumer behaviour and identify opportunities to stimulate WTR. Four opportunities were identified and are illustrated in Figure 3.

Using these four opportunities, a new interaction concept was developed. This concept aims to make people feel proud, excited, and eager to share their experiences. Similar to how when you want to show your friends how well you can drive after you get your driver's license. This approach guided the design direction and established criteria for the final concept (Figure 2).

In the development phase, four concepts were discussed, and two were selected based on the criteria to be combined into one: the Made-By-You product service system (PSS) (Figure 4). This concept allows users to design and assemble their electronics, supported by an application that centralises and streamlines information on assembly and repair. This approach aims to raise users' awareness of the product's components and indirectly encourage repair considerations. Providing a hub for all product-related information makes the repair process more straightforward and accessible.

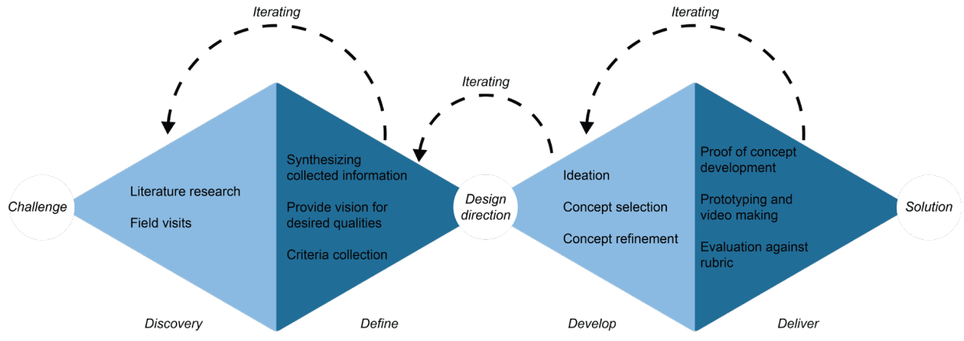

Figure 1: The design journey

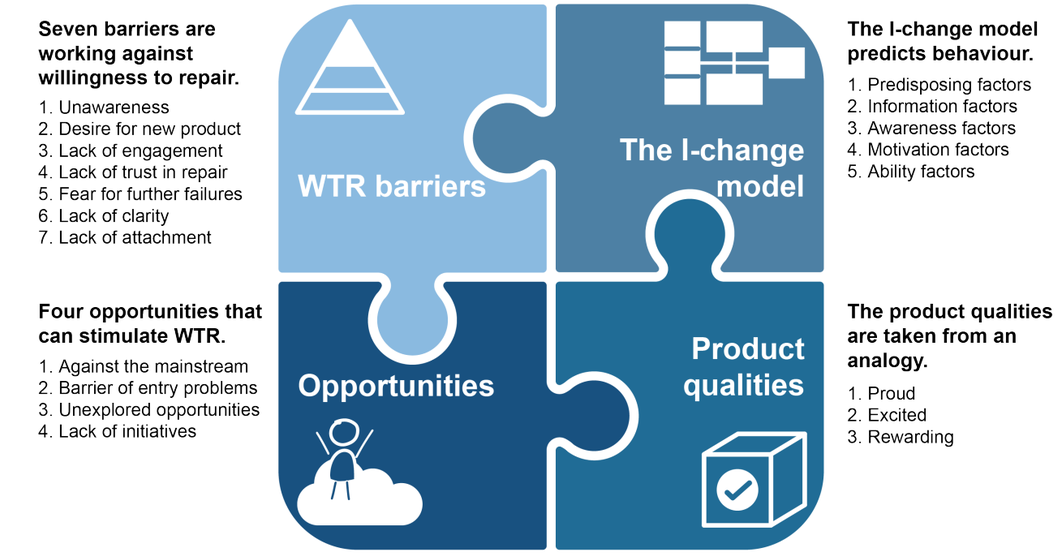

Figure 2: Design Criteria

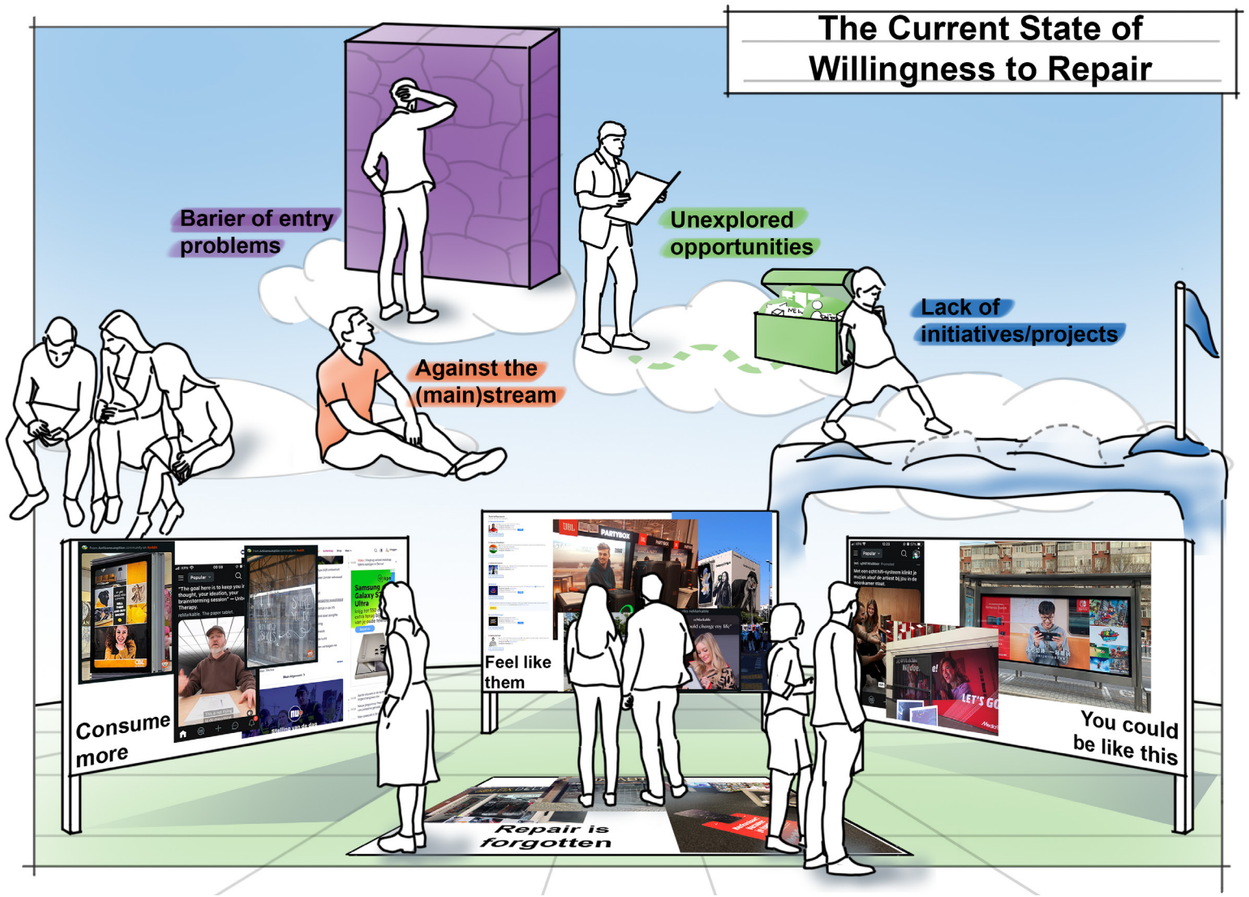

Figure 3: The current state of WTR (on the ground) and opportunities for WTR (in the clouds)

A proof of concept was developed to demonstrate the feasibility of translating this concept into a tangible product. For this, a Senseo coffee machine was redesigned to fit the Made-By-You concept. The redesign involved minor design changes to enhance ‘assemble-ability’, but the key change was how the product was presented to the customer. The parts should arrive in preassembled units, so the assembly process does not feel long or complicated.

The assembly and repair of the product are supported by the Made-By-You application, which offers a clear method for users to gather information. It provides manuals enhanced with digital features to improve the user experience, repair diagnostic tools, recommendations, and expectations for the user journey.

After assessing the proof of concept against the criteria, it demonstrates that the Made-By-You concept can be translated into a tangible product. However, due to the project’s time constraints, a user test could not be conducted, which could have provided valuable insights into its effectiveness. Despite this limitation, this research represents progress towards enhancing WTR. Future studies could expand upon and test the concept, while other designers might leverage the identified barriers and opportunities to design their own solutions.

Figure 4: Made-By-You electronics concept

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1 Introduction

The circular economy is an economy in which materials and products do not become waste but are kept in circulation via activities like repair, reuse, refurbishment and recycling (Ellen MacArthur Foundation, 2013). The goal of the circular economy is to reduce global sustainability pressures by keeping products in use longer and preserving as much value as possible. This means that rather than recycling the product into raw materials, the product should have a prolonged lifetime. This can be done via reuse, refurbishment, and repair, of which repair preserves the most value. Hence, why repair has been at the forefront of policymakers in the last few years (European Commission, 2015; Yakimova, 2023).

In the last few years, focus has been put on making products more repairable. For instance, numerous studies have attempted to enhance product repairability through adjustments in production and business models (Dangal et al., 2022), and even the EU is currently working on a repair rights bill that forces manufacturers to make their products more accessible to repair (Yakimova, 2023).

However, the focus has primarily been on the technical possibility of repair, not the user's willingness to repair (WTR). This has the downside that people are not considering repair as an option yet (Magnier & Mugge, 2022). Since a technical possibility of repair does not always lead to repair behaviour (Makov & Fitzpatrick, 2021).

This is especially prevalent in electronics, where 60% of people do not consider repair an option (Magnier & Mugge, 2022). In this category, people mainly dispose of products before they completely malfunction. This means that products are disposed of when they are partly malfunctioning. This is especially concerning for e-waste, as it is the fastest-growing waste stream (Balde et al., 2015) and is expected to double by 2050 (United Nations University, 2020).

This study will explore opportunities to stimulate the willingness to repair electronic devices for people who do not repair them. This will have academic relevance as there is a knowledge gap around the user's WTR and practical implications since it is one of the main barriers to repair that the European Environment Agency (2022) has noticed. They have also identified that e-waste is an important sector in which to take action. This report will have a focus on the EU.

First, the literature and background around the topic will be discussed. The findings will be synthesised into a design direction. Several concepts will be presented using the design direction, and after a selection and refinement stage, one will be developed further into a proof of concept. The proof of concept is a product service system (PSS) for the Philips Senseo that stimulates WTR via the assemblabilty of a product. The study ends with a discussion and conclusion of the project.

2 Background

In this chapter, the willingness to repair will be elaborated regarding barriers and motivations. Then, different product types will also be discussed, including how much WTR they already have and when repair happens in their product life cycle. Thirdly, consumer decision-making around repair will be discussed. Finally, the current context will be analysed.

2.1 Willingness to Repair

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2.5 Background Conclusion

2.1 Willingness to Repair

As the introduction states, the willingness to repair has been less focussed on than the technical possibility of repair. Rosklada et al. (2023) have identified three categories related to the barriers to repair (Figure 5). These are the technical possibility of repair, the convenience to repair, and the willingness to repair. In this case, the technical possibility is related to the repairability of a product, the convenience is related to the user's environment, and the willingness is related to the user's attitude towards repair. Svensson et al. (2018) also proposed a similar framework (Figure 6). In this framework, the barriers are called levels, and the WTR is related to the mainstream repair level, which is related to consumer attitudes and preferences.

In Figure 5, the categories are arranged by the difficulty of overcoming each barrier, with the technical barrier being the easiest and WTR the most challenging. These levels are interdependent, much like the chicken and egg scenario. For instance, convenience relies on the technical feasibility of resolving it, and the reverse is also true. However, none of these factors are significant unless there is a willingness to address the issues initially (Figure 7).

In the WTR category, seven subcategories are mentioned (Figure 8). Rosklada et al. (2023) also have arranged these barriers on relative importance to each other (Figure 5), unawareness is the most important and lack of attachment the least.

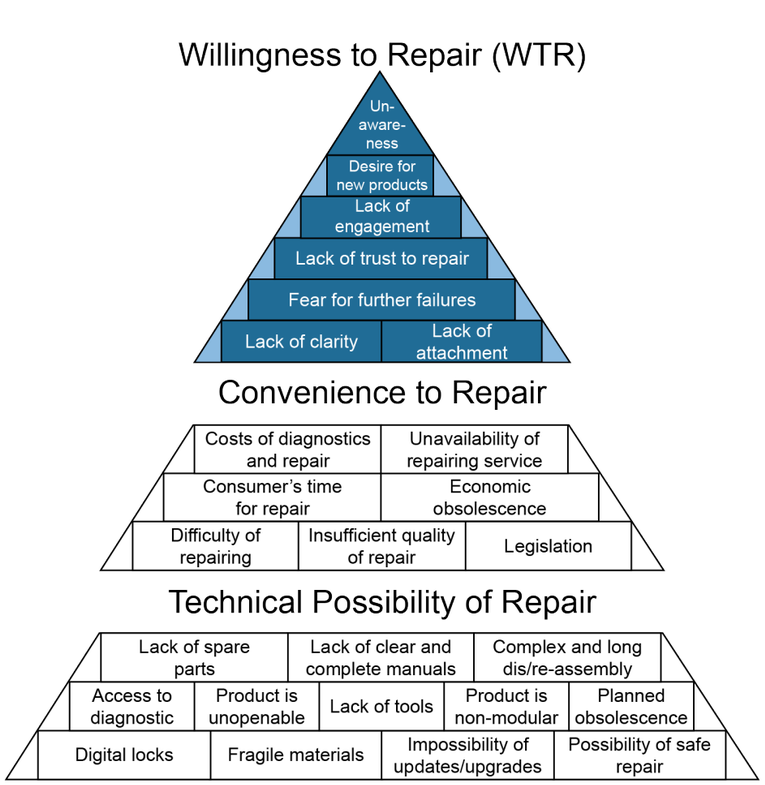


Figure 5: Consumer barriers to repair (based on Rosklada et al., 2023)

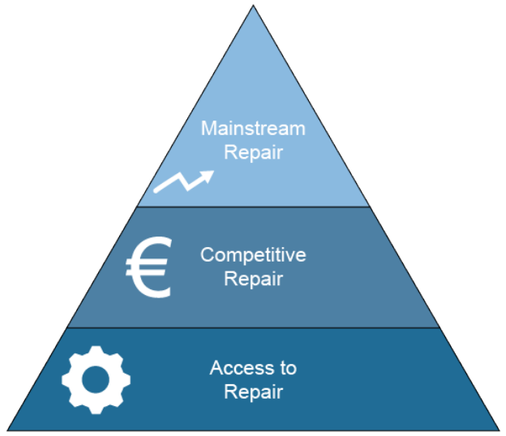


Figure 6: Three levels of repair goals (based on Svensson et al., 2018).

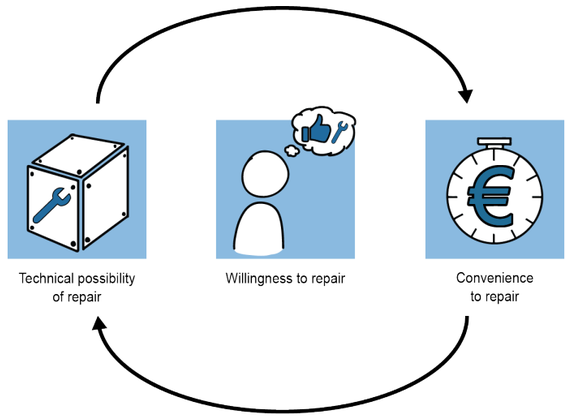


Figure 7: The interaction between consumer barriers

The categories are as follows, in order of most to least impactful.

- Unawareness of repair impact and lack of repair habit

  This is related to the lack of knowledge consumers have about repair impact, replacement morality (whether a replacement is valid or not) (Van Nes & Cramer, 2005), product lifespans, repair rights, options, and the current attitude and norms around repair (Svensson-Höglund et al., 2021).

- Desire for new products or features

  This desire is also called novelty seeking and is related to epistemic values (which are values derived from satiated curiosity and novelty.). New products are acquired due to curiosity or the need for a change of pace (Jaeger-Erben et al., 2021; Van den Berge et al., 2021).

- Lack of engagement and popularisation of repair

  There is a lack of social engagement in the form of peers, media, social media, and so-called 'eco champions'. Engagement reached via close peers is more likely to reach actual repair behaviour (Fachbach et al., 2022).

- Lack of trust in repair services

  People are uncertain whether the repair (service) is trustworthy. This can take shape as overcharging or performing an unsatisfactory repair job (McCollough, 2009; Hilger, 2016; Svensson-Höglund et al., 2021).

- Fear for further failures

  Consumers do not want to repair since they do not know whether a product will fail again due to a new defect or a failed repair attempt (Rosklada et al., 2023).

- Lack of clarity on how repair works

  It is unclear to consumers how repairable the defect is and how much time, effort, and cost the repair would entail (Sabbaghi et al., 2017).

- Lack of attachment

  Whether emotional or economic attachment, people's level of attachment is related to the level

Figure 8: Barriers to WTR

of care for the product and an important motivator for repair (Hernández et al., 2020).

To conclude, seven kinds of barriers are hindering people's WTR, which is currently the least researched consumer barrier to repair.

2.2 When is a Product Repaired?

This section provides a more in-depth look at when a product is considered for reparation. It dives into the kinds of electronics people can have and the stages of product use.

2.2.1 Product Types

Cox et al. (2013) have found three different product types. A product can have a longer or shorter expected lifetime, depending on these types. The types are shown in Figure 9.

- 'up-to-date' products

  These are products that have important values in self and social identity. Thus, they are quite perceptible for changes in technology or fashion (Jackson, 2005). Therefore, they are often replaced by fashion or impulse purchases (van Nes, 2010). Electronics that are often seen are good examples, like smartphones (Jaeger-Erben et al., 2021).

- 'workhorse' products

  These products are valued mainly for their function and are typically expected to have a long lifetime. The products are reliable and are disposed of when broken (Cox et al., 2013). However, Magnier and Mugge (2022) concluded that a significant portion was replaced when it was still repairable. Large electric appliances are found here, like washing machines or refrigerators (Jaeger-Erben et al., 2021), and smaller electric appliances, like kettles or toasters (Cox et al., 2013).

- 'Investment' products

  These products are so-called 'special' products for the consumer and will, therefore, receive 'investment' in the form of care from the owner. This 'specialness' can be due to a high initial monetary cost or high emotional value (like a gift) (Cox et al., 2013). 'quality' electronics are commonly found here, like high-end laptops.

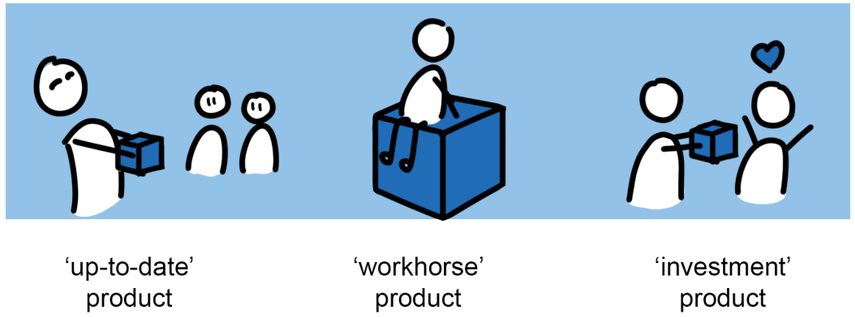


Figure 9: Product types

Thus, 'up-to-date' and 'workhorse' products are the least likely to be repaired (Cox et al., 2013; Dominish et al., 2018). 'up-to-date' products because they are often replaced instead of repaired (Dominish et al., 2018), and while 'workhorses' are expected to perform longer (Cox et al., 2013) repairs are still not always performed (Magnier & Mugge, 2022). Due to their high attachment levels, 'investment' products are the most likely to be taken care of (Cox et al., 2013; Dominish et al., 2018). This means that currently each type of product has different levels of repair associated with it.

The 'investment' product is excluded from this project since it is already being repaired. In contrast, 'up-to-date' and 'workhorse' products typically have lower repair tendencies, making them more effective for stimulating WTR.

2.2.2 Product Use Stages

A product will go through different use stages during its use time. This study will use the framework by Shi et al. (2022), later iterated by Haase and Knudsen (2022). In this framework, five use stages are described. These are described below and shown in Figure 10.

- Pre-acquisition stage (brand-new product)

  This is the first use stage and happens before the initial purchase. In this stage, the customer forms expectations around the product's functional, emotional, and social values.

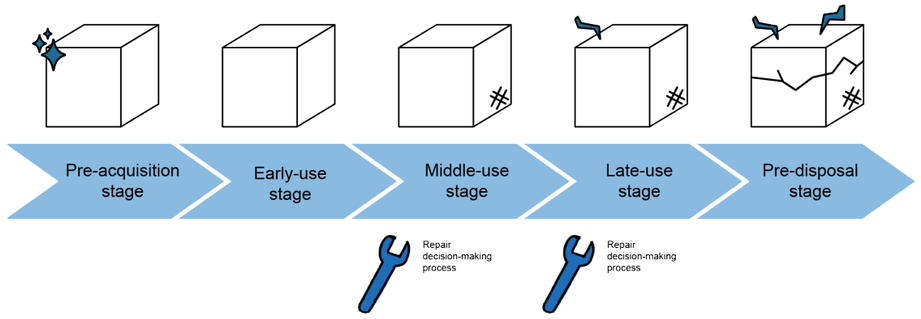


Figure 10: Product use stages

- Early-use stage (almost new, no visible signs of wear and tear)

  The user has acquired the product and is starting to cultivate habits. In this stage, functional value decline can occur, but emotional and social value decline is not typical.

- Middle-use stage (wear marks, minor problems, functions well)

  In this stage, the usage behaviour tends to shift towards hibernation and sharing. Functional value tends to decrease due to lower use, while emotional and social values may either increase or decrease (for instance, increased product attachment). Repairing becomes an option to consider.

- Late-use stage (decide whether to maintain the old consumer-product relationship)

  The product starts to have minor malfunctions, and repair or replacement must be considered.

- Pre-disposal stage (too broken to be repaired)

  In this stage, the product is genuinely broken and considered for disposal.

This framework considers the middle and late-use stages as moments of repair. In another study (Magnier & Mugge, 2022), it has been noted that most people do not consider repair an option when the product is malfunctioning (when it is partially defective but still able to perform its primary function). In contrast, most people do consider repair if it is too broken to function. They also noted that functional depreciation was the most important reason for replacement for 'workhorse' products, and social and emotional values were more important for 'up-to-date' products.

Finally, in this framework, only three values are considered (functional, emotional, and social). However, Van den Berge et al. (2021) identified five values that are considered during decision-making; the additional ones are epistemic and conditional values. All five values are explored in section 2.3.2.1.

2.2.3 When is a Product Repaired Conclusion

To conclude, there are three different product types and five use stages. Not all product types are equally likely to be repaired by the consumer. Repair increases are the most valuable in 'up-to-date' and 'workhorse' products since they are less likely to be repaired than 'investment ' products. Furthermore, the middle and late-use stage is relevant for repair and should be the focus.

2.3 Consumer Decision-Making Process

Whether a consumer even enters the repair process is an essential decision for the consumer to make. In Figure 11, the I-Change model is shown, which is a framework that visualises the user decision-making process. This study will use this framework to predict people's WTR because it is able to convey consumer decision factors in a clear and concise way.

The model shows that the intent is shaped based on the awareness and motivation phases. This intent together with ability factors, challenges the barriers (mentioned earlier in Figure 8), which will result in a behaviour (either a new behaviour (trial) or repeated behaviour (maintenance)) (De Vries, n.d.).

In the case of decision-making for potential repair behaviour, the resulting behaviour could be either DIY repair, use of a repair service (either a repair café or shop,

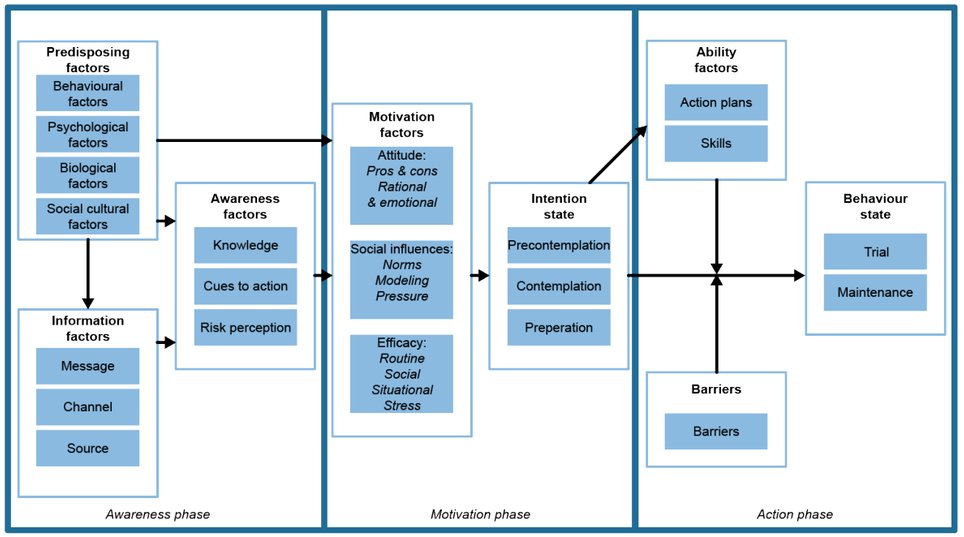


Figure 11: I-Change model for user decision-making, a figure based on De Vries (2017) and De Klein and Wesselman (2019)

as seen in Figure 13), or disposal and replacement of the product. The model can be summarised in three phases: awareness, motivation, and action.

Thus, the awareness, motivation, and ability factors together challenge the barriers of WTR, which results in a final level of WTR that determines the likelihood of someone considering a repair. In the following sections, the makeup of the model will be explained in more depth.

2.3.1 Awareness Phase Factors

Awareness phase factors (predisposing, awareness, and information factors) represent influences situated further away in time or space, contributing indirectly to motivation (De Klein & Wesselman, 2019).

- Predisposing factors are related to the traits and conditions of/around a person that predetermine specific characteristics of them.
- Awareness factors relate to a person's knowledge about a specific action, like risks or calls to action.
- Information factors influence awareness factors. The quality and kind of information are essential determinants of its influence.

Jaeger-Erben et al. (2021) deem that there is a culture of non-repair. People are discouraged from repairing by their current environment and social setting. This predisposing factor discourages repair behaviour.

Following Magnier and Mugge (2022), most people do not consider repair an option yet. This is especially true for 'up-to-date' products. Thus, quality information and, in turn, awareness factors are currently lacking. Furthermore, information acquirement is also a social process; more on this in section 2.3.2.2.

2.3.2 Motivation Factors

Motivation factors are influenced by distal factors, which result in three kinds of motivational factors: attitude, social influences, and efficacy.

2.3.2.1 Attitude

Attitude is related to how people feel. In the case of repair, these are the emotions and opinions related to the act of repair and a malfunctioning product.

People's feelings towards stewardship and innovativeness are the central attitudes determining repair propensity (Scott & Weaver, 2014). Stewardship is the level of value and potential one can see in material possession, and innovativeness is the extent to which new use cases can be put into a product. While environmental concerns and activism may seem like essential indicators, Scott and Weaver (2014) believe that they do not influence the likelihood of repair behaviour.

Attitudes are also formed towards the malfunctioning product and a potential replacement product. When the product is in the middle/late-use stage, this product's perceived value (which has potentially lowered over time) and a potential replacement product's perceived value are compared (Van den Berge et al., 2021). There are five kinds of values that a product can contain.

- Functional value

  This is the value received from its utility, derived from its utilitarian, functional and physical performance (Sheth et al., 1991).

- Emotional value

  Emotional value can be split into two categories: product attachment and aesthetic value. Product attachment is 'the strength of the emotional bond a consumer experiences with a product' (Schifferstein & Zwartkruis-Pelgrim, 2008). Aesthetic value can be described as a value that 'elicits pleasure (positive value) or displeasure (negative value) when appreciated or experienced aesthetically' (Plato & Meskin, 2014).

- Social value

  The value acquired through association with one or more social groups (Sheth et al., 1991). Fachbach et al. (2022) also state that the social network and social acceptance around a person significantly impact their attitude towards repair.

- Epistemic value

  Value derived from satiated curiosity and novelty. Novelty seeking is how Jaeger-Erben et al. (2021) have described it as 'a socially supported thread to longevity'.

- Conditional value

  Conditional value is the value achieved by the situation or the circumstances that are faced by the user. These conditions could be physical or social and will then enhance the original functional or social value. For instance, when it rains, the value of a raincoat goes up (Sheth et al., 1991).

These values together form an attitude that a person has towards a product. For the earlier-mentioned product types, based on the definitions of Cox et al. (2013), the level of value is high for 'investment' products; while the values of 'up-to-date' products change a lot over their lifetime; and for 'workhorse' products the functional, and conditional value are the most important.

2.3.2.2 Social Influences

Social influences are not just about how people perceive certain behaviours (modelling), but also about the norms and pressures that others exert. These influences, as highlighted by De Vries (2017) and De Klein & Wesselman (2019), can significantly shape individual behaviors, potentially leading to a collective shift towards more sustainable practices.

The social circle around a person is an important factor when predicting repair behaviour. People adopt repair practices when their social group encourage them to act sustainably or when to want to appear sustainable to their group (Marikyan & Papagiannidis, 2023).

It is also an important way to increase trust in these services. Trust is important, as it is one of the barriers of WTR. Pit (2020) discovered that repair stores tend to have a lower amount of trust compared to repair cafés. This could be because people in repair cafés socialize more with the repair technicians.

Social influences are also present in information factors. Peers and close friends are one of the main ways to be informed about repair services, besides mainstream information channels like television, newspapers, and social media (Fachbach et al., 2022).

2.3.2.3 Efficacy

Efficacy refers to the person's perception of their ability and skills; it is thus not their actual ability or skills but what they think they can do.

Many individuals have low confidence in their ability to repair things, as Jaeger-Erben et al. (2021) noted. This lack of confidence may stem from limited repair experience, creating a negative feedback loop. In contrast, there is also a positive feedback loop, where past repair success boosts confidence, as Fachbach et al. (2022) indicated. Previous repair achievements serve as a significant predictor of future repair attempts. This positive experience leads to increased self-efficacy in repair tasks. Repair efficacy has also been dubbed the 'can-do' attitude by Van Den Berge et al. (2020).

2.3.3 Ability Factors

In contrast to efficacy, ability factors are the actual skills a person has. In recent years, people have gone through a process of so-called 'de-skilling', in which people lose the ability to repair their products because of the easily disposable and replaceable nature of products. This has resulted in losing time, skill, and interest in these capabilities (Gill & Lopes, 2011; Godfrey et al., 2021). Currently, many initiatives aim to correct this by holding events and classes, workshops, and festivals (more on initiatives in section 2.4.2).

2.3.4 Consumer Decision-Making Process Conclusion

This section has been summarised in Figure 12. In short, WTR barriers are challenged by the awareness phase, motivation phase and ability factors. Regarding WTR, the barriers have already been discussed in section 2.1. People's ability to repair has been through a process of 'de-skilling' and thus has been lowered. Furthermore, distal factors (lack of information, unawareness, and cultural hindrances) hinder repair behaviour. On the motivational side, certain attitudes and perceived values of old products can be encouraged to increase WTR; social factors can also be used to increase WTR as an important motivator; while efficacy is currently low, it is possible to increase it via positive repair experiences.

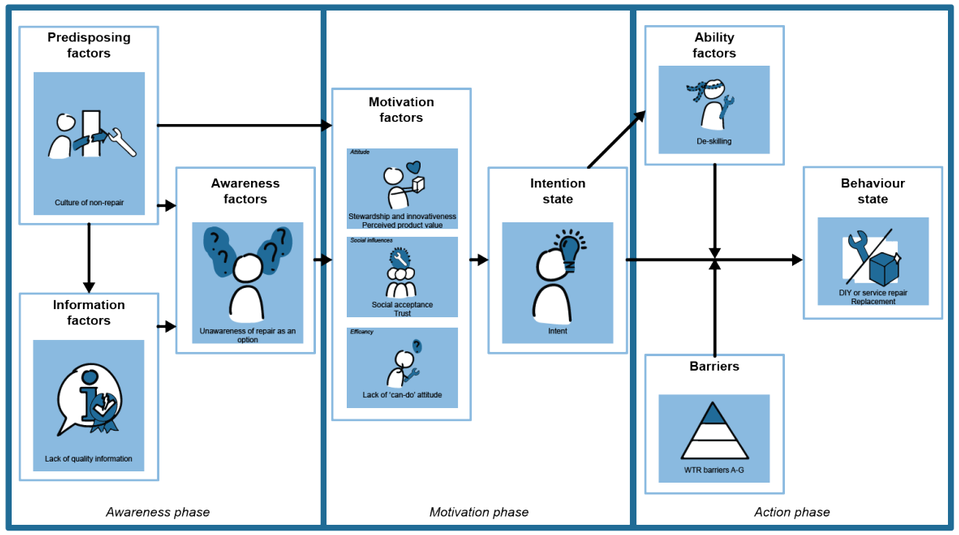


Figure 12: User decision-making around repair behaviour conclusion

2.4 Context

This section will discuss the current context in multiple ways, first with a stakeholder map and then with upcoming significant legislative changes. After this, several initiatives that tackle WTR barriers are collected and sorted into the I-change model. Finally, a critical look will be given to the current status of how well the WTR barriers are engaged.

2.4.1 Stakeholder Framework

In Figure 13, a stakeholder framework is made based on Svensson-Höglund et al. (2021), European Environment Agency (2022), and Heijnen and Rijksoverheid (2023). This framework shows six key players in the repair industry: the consumer, the government, the original equipment manufacturer (OEM), various industry associations, the store and (external) repair services. Internal repair services are from the OEM, while external repair services are from a different company or organisation. The various industry associations can be summed up into four kinds: promoters, consultants, quality checkers, and registration services.

In this framework, the consumer has two options concerning repair—either an external repair service or a warranty service. The warranty service is only accessible during the warranty period (2 years in the EU) (European Consumer Centers Network, n.d.). A warranty encourages repair behaviour (Laitala et al., 2021). However, many people are unfamiliar with their warranty rights. If a product is out of warranty, a person can approach an external or internal service for repair. At this point, the barriers are considered higher, and repair is less likely (Laitala et al., 2021).

The framework shows that the government is an important stakeholder since it influences most other actors via stimulation, regulation, or financial support. Therefore, a more detailed look at this stakeholder will be provided. This part discusses three extensive governmental policies in the EU that have not yet been implemented.

First, the EU is working on a Right-to-repair Bill (European Commission, 2023; Yakimova, 2023), which aims to make

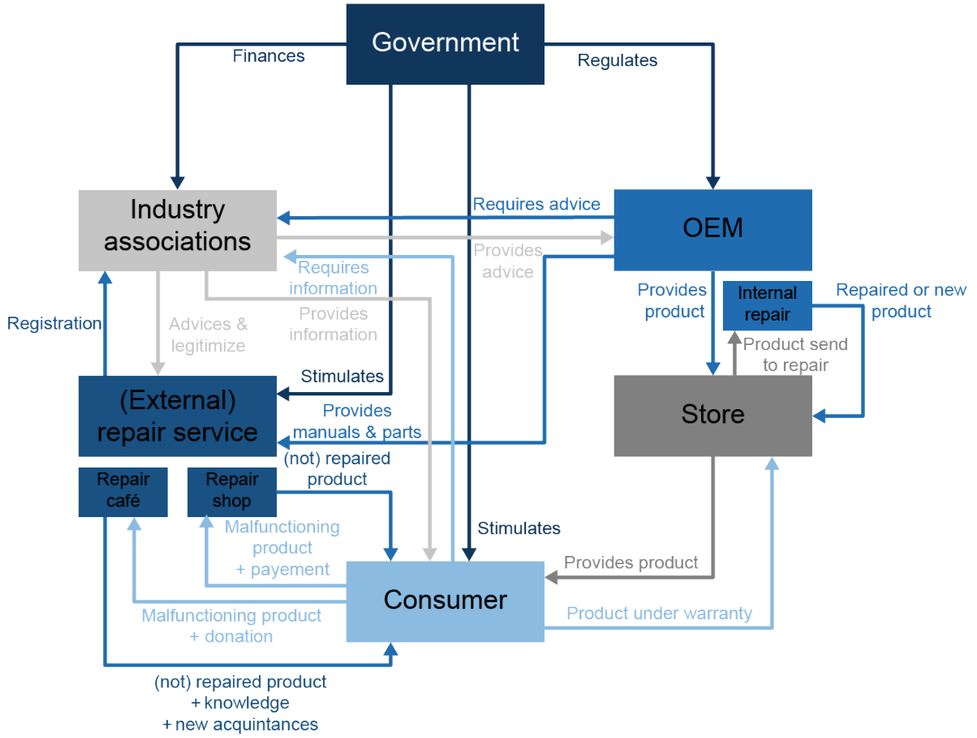


Figure 13: Stakeholders in the repair process

it easier for consumers to repair. This is achieved via five methods:

1. Consumers have a right to demand repair.
2. Informing consumers on how the repair process works.
3. Online repairers' platforms to bring more visibility to and information about repairers.
4. Consumers can request repair information (like pricing) from repairers.
5. Quality standard for repair services.

These methods address various barriers to repair. The first and third methods enhance the convenience of repair by simplifying the process of demanding repairs. The other methods target WTR barriers. Methods 2 and 4 aim to increase awareness and understanding of the repair process, while methods 4 and 5 work to build trust.

Secondly, there is a draft proposal by the EU to introduce a repairability index, indicating how repairable a product is (European Recycling Global, 2023). This draft, planned for 2025, is uncertain in its timeline but is modelled after the French Repairability Index (FRI) (United Nations Environment Programme et al., 2023), later shown in Figure 14 as initiative number 17. It could be either a new label or an extension of the current energy label (Flipsen, 2023). It targets the WTR barriers of fear and clarity.

Finally, several countries in the EU have their own plans to raise awareness and reduce the value-added tax (VAT) on repair services (Dalhammer et al., 2020). The

tax reduction improves the convenience of repairs, while awareness campaigns address the barrier of consumer awareness.

In conclusion, the EU is set to introduce significant changes to promote product repairability. The Right-to-Repair Bill and the repair label aim to improve WTR, while tax changes focus on making repairs more convenient. Although there is no direct regulation to enhance repairability, by making repairs more accessible and convenient, OEMs are encouraged to design products that are easier to repair (as illustrated in the chicken and egg scenario in Figure 7).

2.4.2 Initiatives/projects General

Initiatives/projects have been found to lower the WTR barriers. Search methods were trend reports, governmental publications, and targeted Google searches using relevant keywords. The initiatives are shown in Figure 14. Besides being organised in the I-change model, they are also coded by which barrier they are engaging (an explanation of each initiative is shown in Appendix A, Table of All Considered Initiatives).

Some initiatives appear in multiple categories, as they tackle more than one barrier. No initiatives were found related to the attachment and novelty barrier. This could be due to a general lack of initiatives in this area or the scope of the search area. This could also entail that the other barriers could be missing specific important initiatives. However, an extensive search is outside the scope of this project. A visit to the de Week van de Circulaire Economie (WCE)(2) has also been conducted; more can be found in Appendix B, Field Visits.

Although some initiatives offered personalisation options to form attachments, they primarily did so for financial rather than sustainability reasons. Initiatives that redistributed used products to incentivise reuse were also found, but those were not focused on repair.

A few initiatives will be highlighted as a group and discussed in terms of their strengths and weaknesses. These initiatives can target multiple other barriers (more than three). These are the workshops, classes, and big-scale initiatives.

- The workshops: Repair Café (6) and The Restart Project (7)

  Due to their intensive nature, these workshops can achieve a lot. In these workshops, people come on their own accord to get personal assistance in repairing their products. Not only are they assisted, but they are also getting various instructions on how to repair it themselves. All in all, due to this, they can engage, create repair habits, lower fear, and increase the clarity of repair. Repair Café also improves trust by being a smaller-scale event that enables more personal experiences.

  However, this is an event for which a person has to find their own motivation to attend. Attendance levels can be pretty low, as seen during a visit to a Repair Café (Appendix B, Field Visits). Therefore, while these events can achieve a lot for WTR, a certain (high) level of WTR is also required to attend these events.

- The classes: Circulair Ambachtscentrum (1), and Stichting Technotrend (5)

  A school's organisation requests these classes to be given to a group of students. They are pretty extensive and cover everything around repair and circularity. The classes provide awareness and clarity on the subject while simultaneously engaging the group to discuss the topic.

  As stated earlier, the classes are requested by a person. This person is already knowledgeable about this topic and wants to inform others. However, those who attend the classes might not have the desire or will to learn from them. Which could lower the overall effectiveness of it.

- The big-scale initiatives: de Week van de Circulaire Economie (WCE)(2), the FRI(17), and the Right-to-repair Bill (19)

  These are quite general initiatives and have a big scale due to the governmental nature of their origin. Due to this, they have high visibility to create awareness. They also all aim to make repair more transparent and accessible for the consumer to understand.

  However, as seen during a visit to the WCE (Appendix B, Field Visits), the people attracted to the events were already interested in circularity/repair and did not attract those not yet interested.

  The repairability index is also not without controversy. The majority of the people in France are aware of its existence and find it helpful for purchasing decisions. There are also criticisms: the label can be easily manipulated to show a better score due to the lack of transparency of the underlying scoring system to the consumer; unclear differences between product categories; and differences in implementability depending on the company's size (HOP, 2022; Mikolajczak, 2022). These issues might be addressed in the revised version the EU wants to implement, as mentioned earlier in section 2.4.1. The Right-to-repair Bill is still in development and subject to change. Thus, the positive or negative consequences are hard to predict.

To conclude, no initiatives were found targeting novelty seeking and attachment. This could be a potential design opportunity. Furthermore, practice has shown that initiative can target many barriers at once. This is due to their intensive and broad-reaching nature. However, they all have the same downside: someone must be motivated to attend these events. Figure 15 shows the different kinds of WTR levels and their attitude towards repair. Furthermore, while the repairability index does not have this problem, as there is no barrier to entry for consumers, it still has many critics regarding whether the information on it is accurate and understandable.

2.4.3 Initiatives and the I-change Model

Figure 14 shows that most initiatives are located in the information, ability, and motivation (except attitude) factors. In contrast, predisposing and attitude factors are less targeted. There does not seem to be a trend based on which barrier is targeted and where in the model it is located. This would mean that an initiative that targets a specific barrier does not have to conform to a particular factor/phase of the I-change model. However, there does seem to be a positive relationship between how many barriers are targeted and how many factors they target.

- Unawareness
- Lack of engagement
- Lack of trust in repair
- Fear for further failures
- Lack of clarity

Predisposing factors


Repair voucher Vienna/ Austria (8)


The Sharepair project (9)

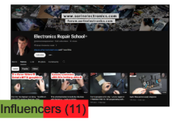

The French repairability index (17)

Creating repair culture

Information factors


Circulair Ambachtscentrum (1)


Repair Café (6)


Influencers (11)


De Week van de Circulaire Economie (2)


The Restart Project (7)

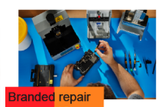

Repairers Register (14)


Mileu Centraal (4)


The Sharepair project (9)


The French repairability index (17)


Stichting Technotrend (5)


Branded repair options (10)


Right-to-repair bill (19)

Providing quality information to create awareness

Awareness factors

Motivation factors


Repair voucher Vienna/ Austria (8)

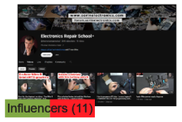

Store Insurance (13)


The French repairability index (17)

Attitude: increasing value in products


Circulair Ambachtscentrum (1)


Repair Café (6)


Influencers (11)


Minicopters (15)

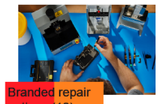

De Week van de Circulaire Economie (2)


The Restart Project (7)


iFixit (12)


Kaputt.de (16)


Stichting Technotrend (5)


Branded repair options (10)

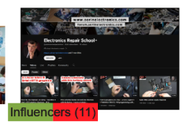

Repairers Register (14)


Right-to-repair bill (19)

Social: creating social acceptance and trust


Circulair Ambachtscentrum (1)

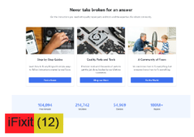

Stichting Technotrend (5)


Influencers (11)


The French repairability index (17)


De Week van de Circulaire Economie (2)


Repair Café (6)


iFixit (12)


ProjectBox (18)


DIY encouragement (3)


The Restart Project (7)

Kaputt.de (16)

Efficacy: increasing self-efficacy

Intention state

Ability factors

Circulair Ambachtscentrum (1)

Stichting Technotrend (5)

iFixit (12)

De Week van de Circulaire Economie (2)

Repair Café (6)

Kaputt.de (16)

DIY encouragement (3)

The Restart Project (7)

ProjectBox (18)

Re-skilling

Behaviour state

Barriers

Unawareness

Desire for new products

Lack of engagement

Lack of trust to repair

Fear for further failures

Lack of clarity

Lack of attachment

Figure 14: Initiatives and upcoming regulations sorted in the factors of the I-change model

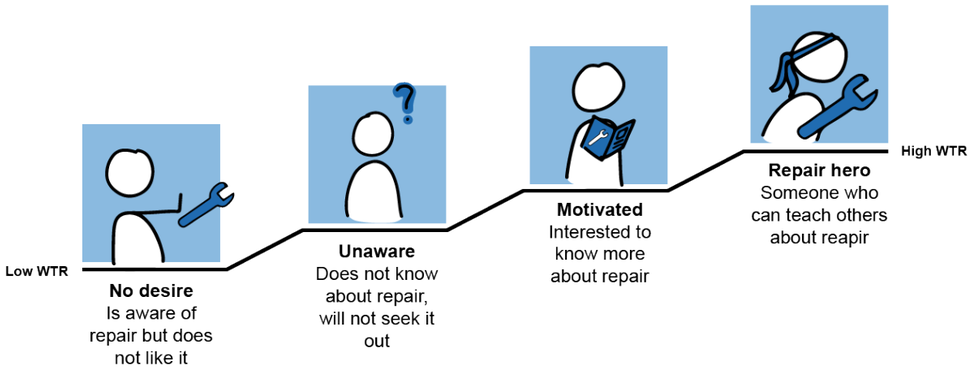


Figure 15: People with different levels of WTR

Some initiatives appear in many factors (Appendix A, Table of All Considered Initiatives). Six initiatives appear four times in the I-change model: Circulair Ambachtscentrum (1), De Week van de Circulaire economy (2), Stichting Technotrend (5), Repair Café (6), The Restart Project, and the FRI (17). This selection may sound familiar as they have also been discussed in section 2.4.2 for targeting the most barriers. The exception is the Right-to-repair Bill (19), which is only found in information and social. This is because while the bill is wide-reaching, the plans are mainly aimed towards awareness creation and trust, compared to the other factors.

As discussed earlier in section 2.4.2, the initiatives that appear frequently in the model are hindered by the need for a predisposed situation for people who are already interested in repair. This means that the current non-repair culture is hindering their effectiveness.

The majority of the selection is located in the information, social, efficacy, and ability factors. The exception is the repairability index, which is the only initiative from the selection that aims to increase predisposed and attitude factors. This would mean that there is currently no initiative that covers the whole I-change model.

2.4.4 In-Depth Analysis of Each Factor

In this section, each of the I-change factors from Figure 14 will be analysed separately and discussed in terms of their strengths, weaknesses, opportunities, and threats. The SWOT method has been used because it allows for an overview of all aspects of the situation.

2.4.4.1 Predisposing Factors

Predisposing factors are related to the environment around a person, and culture is the most significant indicator of repair behaviour. Currently, the non-repair culture discourages repair behaviour.

In this factor, three initiatives (Repair voucher (8), Store insurance (13), and the FIR (17)) are found that aim to improve the situation. These initiatives are all big-scale and quite generic catch-all approaches. The benefit of this is the vast area of effect that can easily change a person's surrounding environment/culture. The downside of this could be a low level of adoption/effectiveness of the plan.

2.4.4.2 Information Factors

Information factors are related to message quality, channel, and source. Many initiatives are located here, from more local initiatives to governmental and even those with an international brand/character. This ensures a wide variety of quality sources and a tailored message for every target group. The wide variety could also be a downside, as there is no clear central source that overseas them.

A current weakness of this factor is that the message only reaches people actively seeking it. For example, the Repair Register of the Netherlands is an initiative that aims to inform people where the closest qualified repairman is. However, no one knows about this register, which results in a very low number of registered companies and vice versa. This creates a self-sustaining negative loop. The exception to this is the repairability index (8), which has the lowest barrier of entry of all.

2.4.4.3 Motivation Factors

In this section, the three subfactors are taken separately for analysis.

2.4.4.3.1 Attitude

Attitude relates to how people feel about repair concerning/and their products. In this subfactor, only three initiatives are located. They are all either started by the government or by a big company. This means that none are started at more local levels targeting local people, but rather quite generic plans.

2.4.4.3.2 Social Factors

Social factors are related to creating social acceptance and trust. A wide variety of initiatives are located here (group events, classes, media channels, big brands, (online) communities and online platforms). They either aim to create a social setting that promotes repair and trust in repair or are repair heroes that people can model after.

The wide variety of social groups is a strength since people can find the one they identify with most. However, the engagement level is still relatively low, as seen during my visits in Appendix B, Field Visits.

2.4.4.3.3 Efficacy Factors

Efficacy is the amount a person believes that they can do something. This belief can be enhanced via training, tutorials, demos, and by setting clear levels of expectation of the repair process. The initiatives located here use these methods in a variety of ways, with different levels of intensity and entry barriers. While the low entry barrier initiatives (influencers (11) and repairability index (17)) increase efficacy the least, more people can access it. The ones that increase efficacy the most are intensive sessions and knowledge providers; they require the user to seek them out and require an extensive repair knowledge base from which to draw.

2.4.4.4 Ability Factors

Ability is the actual skill a person possesses; classes and tutorials are located here. These initiatives can teach a person how to repair their products. The success rate is quite high, as the Repair Café states that 62% of repairs are successful (Repair Café, 2024). However, these initiatives require extensive investment of people's time, tools, skills, spare parts, and product information. There is also currently no initiative with a low barrier of entry.

2.4.5 Current Situation Conclusion

What is clear after this analysis is that each factor of the I-change model has its challenges and opportunities (Figure 16) (an expanded table is available in Appendix C, SWOT Table). Furthermore, it reinforced that the initiatives that target the most barriers are also present in most factors concerning electronics.

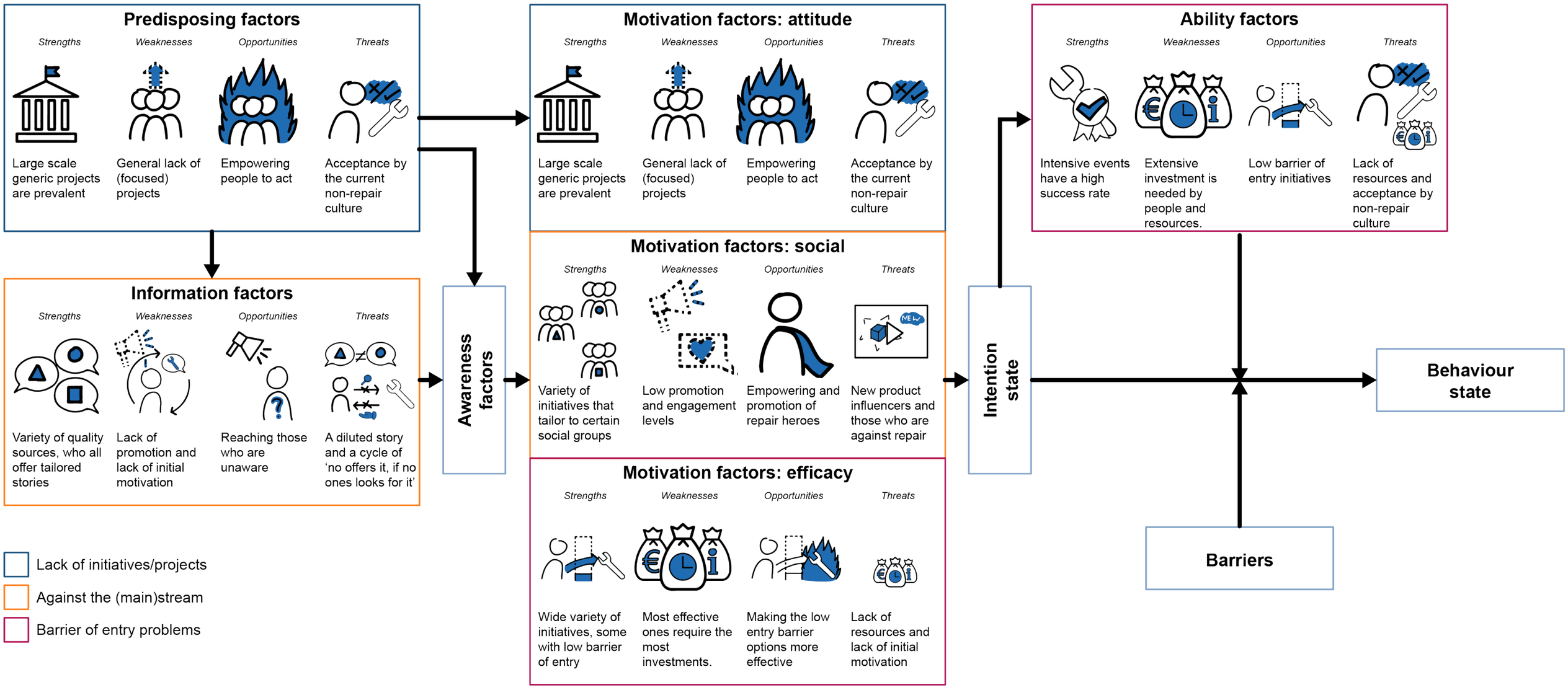


Figure 16: Summary of the factor analysis

In Figure 16, while each factor has its characteristics, three groups of factors are similar:

- Lack of initiatives/projects: predisposing and attitude factors.

  This group shares the same challenges since it is mainly derived from a lack of (focused) initiatives. They both contain three quite general initiatives, either from the government or a big store. Which do not engage people in a personal manner. This could result in a low adoption rate of the shift towards a more repair-centric culture.

- Against the (main)stream: information and social factors.

  These factors are both related to information sharing. Either via more general information sources or via social pressures. While many projects aim to create a social environment to foster a repair mindset, it has not been as successful as desired. There is still a general lack of engagement and awareness of the topic. This could be due to several reasons: a lack of a central repair authority, other (social)media promoting a consume-culture, or a cycle of 'no desire, thus no activity'.

- Barrier of entry problems: efficacy and ability factors.

  Both factors have challenges related to entry barriers and a need for resources (physical or human capital). While both of these factors offer initiatives that go very in-depth, they require extensive resources to maintain and a high barrier of entry for people and new initiatives. There is thus an opportunity for more effective low-entry barrier projects (either easy for users to pick up and use or by making it easier for initiatives to start).

There are also some general takeaways from the most effective initiatives (Figure 17), they target many barriers at once and are also widely present in the I-change model. It identified that governmental and focused projects can effectively target multiple barriers, that participating in events requires motivation and resources, that there currently are gaps/opportunities in the barriers and I-change model, and that there is a cycle of motivated people having to motivate others.

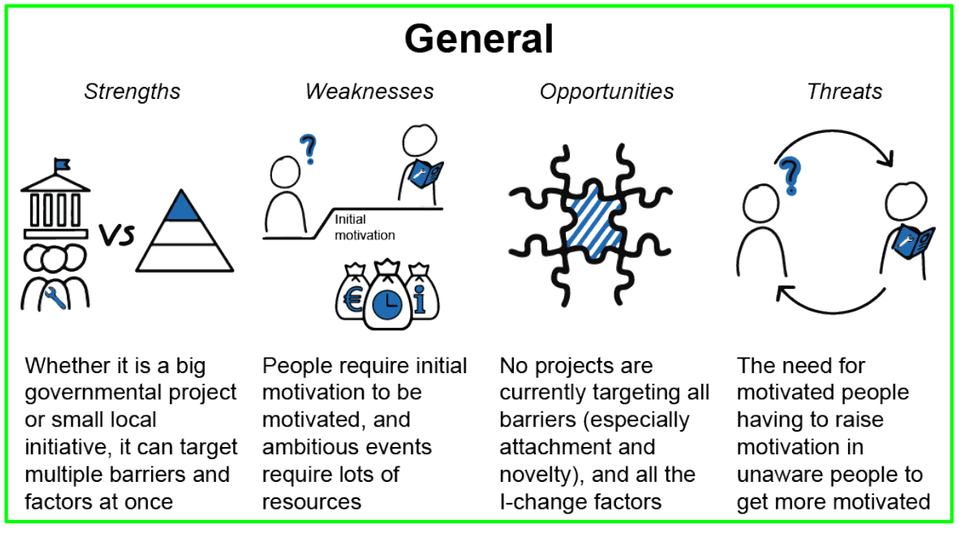


Figure 17: Summary of initiatives in general

2.5 Background Conclusion

This chapter discussed four topics: WTR (barriers), when a product is repaired, consumer decision-making for repair, and the current context.

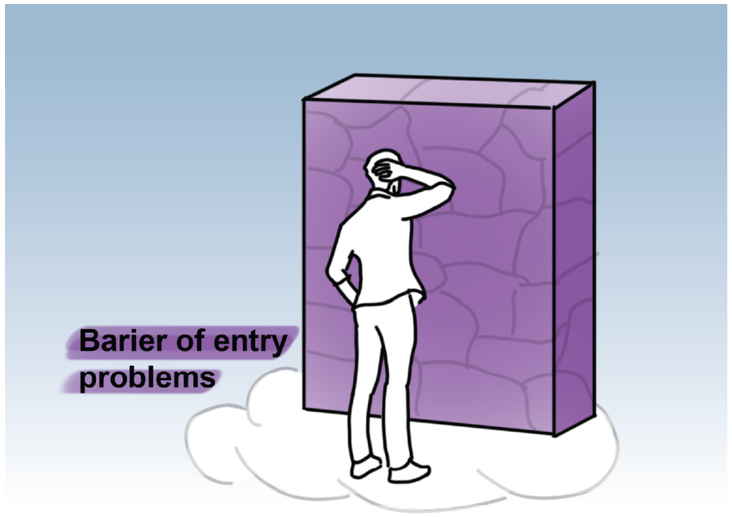
It has been established that there are seven barriers to overcome. These barriers are higher for 'up-to-date' and 'workhorse' products outside the warranty period. When a person must decide whether to repair, awareness, motivation, ability factors and barriers are considered against each other following the I-change model.

At the current moment, many stakeholders are involved in the repair process, of which the government is a very important one. They have multiple projects and plans around repair and are actively engaged in new policymaking.

Four opportunities have been found (Figure 18). Creating initiatives and projects to empower individuals to repair instead of a general catch-all approach; increasing mainstream popularity of repair by increasing motivation of the unaware/unmotivated; increasing the effectiveness of repair initiatives by improving the low-barrier projects; and new concepts that aim to improve the unexplored opportunities of certain barriers and factors related to repair.

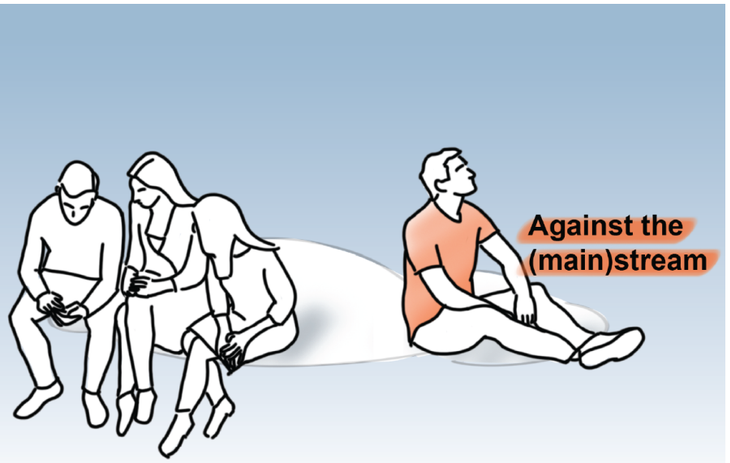
There is a general lack of initiatives that are focused on individuals. This is especially prevalent for projects that are aiming to change the culture and attitude around/of people. While general governmental projects are aiming to change this, there is still a long way to go.

Like stepping stones in the water, a person needs multiple points of guidance to reach the goal.



Numerous projects are aiming to create more efficacy and repair ability with people. However the low entry barrier projects, either are not as effective or require numerous resources from the users and providers. Possibilities lie in creating more options or by improving their effectiveness.

Like a wall, this can turn people away with from repairing or assisting others with repair.



Multiple initiatives related to information sharing and social events are struggling against the current mainstream media and culture of non-repair. Possibilities lie in creating more engagement and awareness. However the biggest hurdle seems to be ‘how to motivate people, if there are no motivators’.

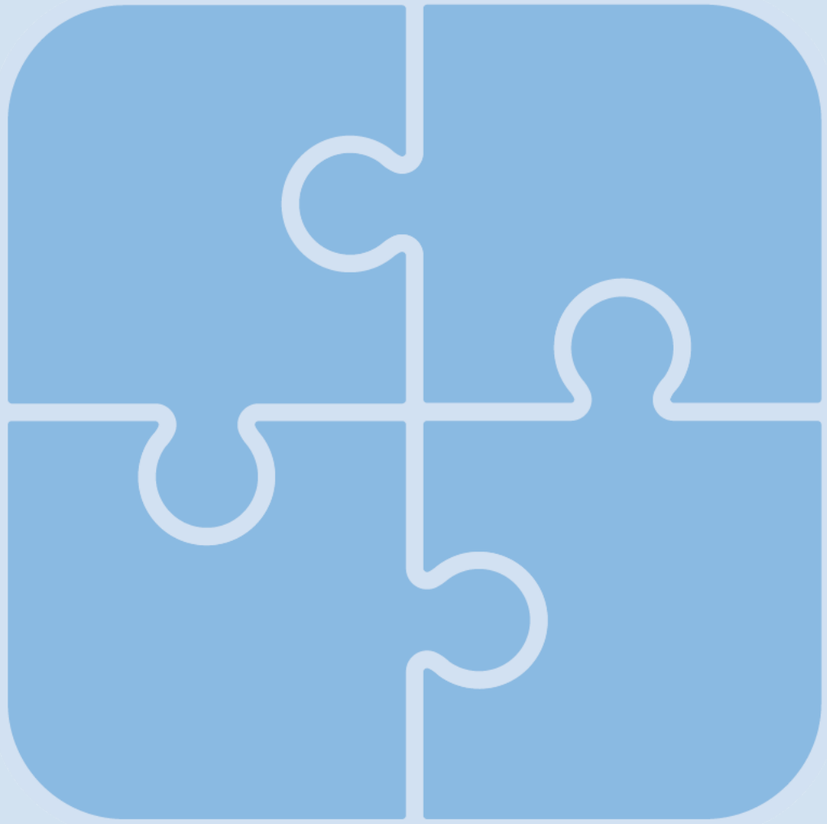
A lot of initiatives have been collected, but there still seems to be unexplored WTR barriers, there is also not yet an initiative that targets all barriers or all factors of the I-change model. The barriers that are unexplored are attachment and desire for new features.

Like a treasure hunt, the chest is still not found and the bounty could be worthwhile.

Figure 18: Four possible opportunities

3 Design Direction

In this chapter, a design direction will be formed based on the findings of the previous chapter.



3. Design Direction

The project started with the goal of exploring strategies to improve people's willingness to repair electronics, and in the last chapter, four opportunities were found that could improve WTR. In the current situation, people are being incentivised to consume more, and influencers using new products are used to aspire to. Meanwhile, repair is shown as an afterthought. This is shown in Figure 19, the current situation is presented as a collage on the boards and floor, while the opportunities are shown on the cloud. The opportunities have been explained in Figure 18 and the collage of the current situation is explained below.

- Consume more

  Advertisements and banners promote consumption via inspirational slogans, buyback sales, and the creation of new product desires.

- Feel like them

  Famous people are used to inspire people to model after them. Influencers and famous people/ groups are used to tie their image with a product.

- You could be like this

  Everyday people are shown using the product in everyday life, creating a feeling of desire and need.

- Repair is forgotten

  Repair shops and stickers are shown in a forgotten manner. For instance, the stickers on the ground promoting repair are trampled upon and disregarded live Covid-distance stickers. To symbolise this, the board has been placed on the ground for people to stand on

Using the four cornerstones of possibilities, a new interaction can be created. In this new concept, people should feel proud, excited, and willing to share their experiences. Similar to how when you want to show your friends how well you can drive after you get your driver's license (Figure 20).

The analogy is a proxy for the qualities the concept should contain. This, together with the barriers, the opportunities and the I-change model, form the basis of the design direction. A design rubric can be created using these criteria, which can be used to judge how well a concept adheres to the design direction (Figure 21).

'Figure 19: The current state of WTR and opportunities for WTR' is located on the next page.

Figure 20: Analogy used for the design direction

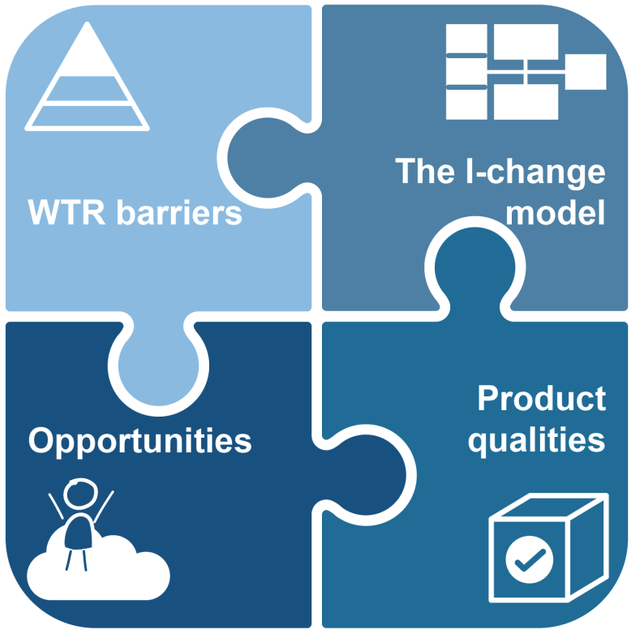
Figure 21: Design criteria

Seven barriers are working against willingness to repair.

1. Unawareness
2. Desire for new product
3. Lack of engagement
4. Lack of trust in repair
5. Fear for further failures
6. Lack of clarity
7. Lack of attachment

Four opportunities that can stimulate WTR.

1. Against the mainstream
2. Barrier of entry problems
3. Unexplored opportunities
4. Lack of initiatives



The I-change model predicts behaviour.

1. Predisposing factors
2. Information factors
3. Awareness factors
4. Motivation factors
5. Ability factors

The product qualities are taken from an analogy.

1. Proud
2. Excited
3. Rewarding

The Current State of Willingness to Repair

Barier of entry problems

Against the (main)stream

Unexplored opportunities

Lack of initiatives/projects

Consume more

Feel like them

Repair is forgotten

You could be like this

4 Conceptualisation

This chapter presents four concepts based on the opportunities discussed in the earlier chapters. In the end, a concept is selected and refined.

4.1 Initial Concept Ideation

4.1.1 AI Consultant App

4.1.2 Dedicated Social Spaces

4.1.3 Expanded Voucher System

4.1.4 Beginner’s Repair Play Kit

4.2 Concept Assessments and Selection

4.3 Concept Refinement: Made-By-You

4.4 Concept Conclusion

4.1 Initial Concept Ideation

Multiple methods have been used to generate ideas: a morphological chart, a brainstorm and a scamper. The whole process is shown in Appendix D, Ideation Process. Four concepts, each representing an opportunity, have been chosen to be discussed in more detail. A brief overview will be given.

4.1.1 AI Consultant App

In earlier research, it became clear that there was a high barrier of entry in two ways: one for the initiative due to the need for extensive resources like manpower and knowledge, and one for the consumer who has to invest lots of time to visit a shop and costs. This concept aims to address this issue.

The concept is an application that allows a person to do an initial evaluation of their malfunctioning product (Figure 22). By filling in the product name, the application can provide the required information in an easy-to-read format with the help of Artificial Intelligence (AI). This application provides a clear overview of what could be wrong, what the repair could entail, and what it would cost. AI is used as it can to cover a wide range of products without needing specialised knowledge. This would solve the issue of decentralised information and lower the barrier of entry for understanding these kinds of documents and videos. Furthermore, image recognition can analyse the product more in-depth and provide a more accurate evaluation of the product and the required repair.

The concept tackles the barriers of trust, further failures and lack of clarity by providing unbiased advice, a clear overview of possibilities, and a clear expectation of the repair process. It increases the quality of the provided information and people's efficacy and ability to repair it. By figuring it out themselves, people feel more proud of their repair job and might share their achievements. However, it does not provide a high excitement level.

The application could be developed in cooperation with a governmental organisation that is focused on repair/ sustainability. It would be similar to the Eetmeter (Mijn voedingscentrum, n.d.). This app assists in creating a healthy eating pattern by having a centralised hub for all nutritional information for every food item. It is provided by a governmental organisation, Voedingscentrum, that is tasked with informing the public about healthy eating.

However, due to the use of AI and image recognition, the development of this application may be challenging and may take a while before it becomes available. While the concept increases sustainability via repair, AI requires lots of energy, which decreases the net gain of the concept. Lastly, it does not solve the issue of physical resources like tools and parts, for which a physical location, rental service or purchase acquirement is still needed.

4.1.2 Dedicated Social Spaces

Currently, there are many local initiatives with their own story and resources; due to this, the information and resources around repair are splintered and thus less visible. Furthermore, many of these projects are not always available. These are some of the reasons that are making it hard for repair to get into the mainstream. A possibility to alleviate this issue would be a centralised repair hotspot that can target the local population, that is always available and provides a clear and consistent story.

This can be done in a manner of ways; in this concept, it has been chosen to work together with local municipal libraries in the Netherlands (Figure 23). They are a prime candidate for hosting a constantly available repair workshop. Currently, they are transitioning from a traditional library to a hub where information and guidance are shared between people and as a workshop for increasing skills and knowledge (Bnetwerk, 2021).

Figure 22: AI consultant app concept

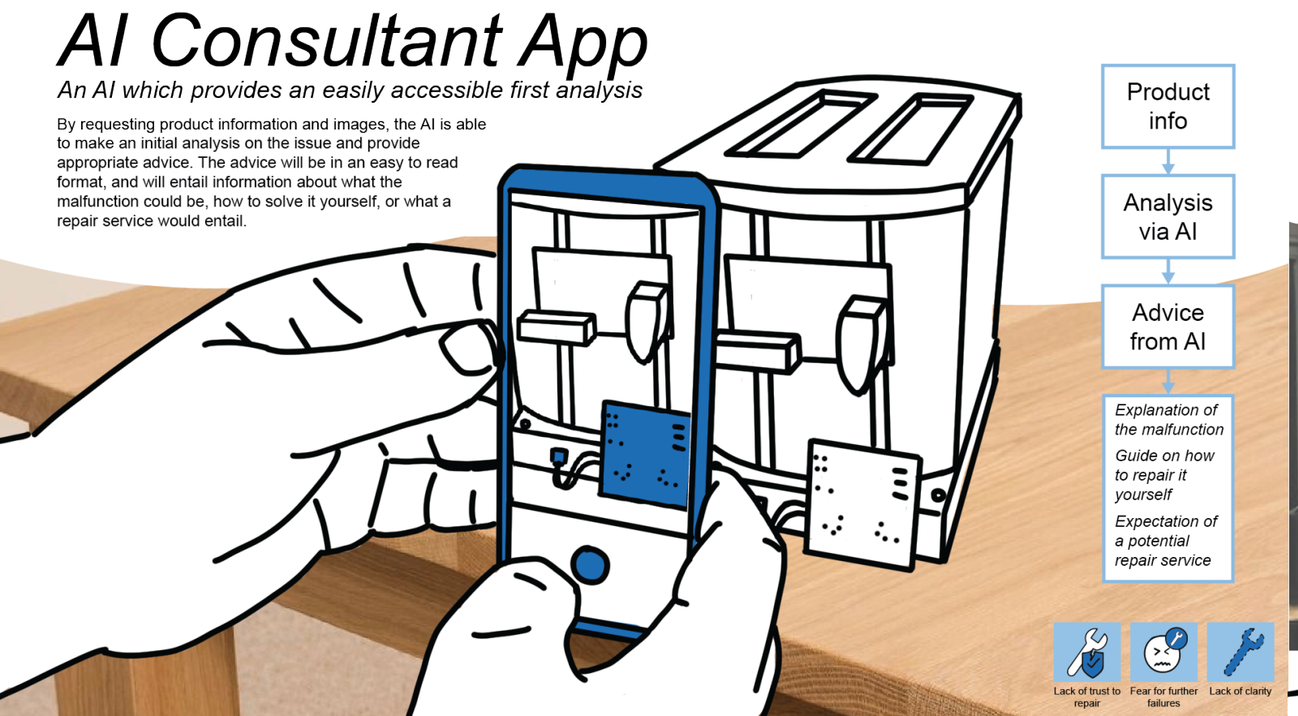


Figure 23: Dedicated social spaces concept

Libraries are already working on a project called Makerspace. These spaces aim to create skills and knowledge for the public. Currently, most Makerspaces are focused on digital skills (75%), while a few spaces also offer tools for textiles (27%) and material processing (18%) (Van Den Dool et al., 2021). Most of their visitors are children from primary school (50%); however, most libraries want to attract more adults and high school students.

Thus, there is no repair infrastructure at these places at the moment. However, providing repair opportunities would fit in with their goal of providing knowledge and skills to the public. Repair Café visitors also tend to fall in the adult category, one of the categories the libraries are trying to attract (Schägg et al., 2022).

Therefore, there could be a beneficial partnership between the Makerspaces of libraries and Repair Café or other local repair initiatives. Libraries would also be open to cooperation with local parties (Van Den Dool et al., 2021). In this partnership, libraries would assist Repair Café with awareness and engagement for their cause, and Repair Café would offer resources like tools and expertise from their staff.

This concept tackles the barriers of awareness, engagement, trust, further failures and clarity by combining the strengths of the local library and Repair Cafés/ local repair initiatives. It aims to create more information and awareness around repair and introduces a repair culture. It also creates an inviting social setting and increases people's efficacy and ability to repair. By doing it together in a social setting, people can share it with their social group and feel proud and excited about their accomplishments.

However, there are also obstacles to consider. Adding a repair service would require additional resources like space and staff. Off which staff is the biggest hurdle. Keeping the Makerspace full-time open is challenging due to a lack of staff and volunteers (Van Den Dool et al., 2021). Which Repair Café is unable to provide as they are only open a few times a month.

4.1.3 Expanded Voucher System

In the last chapter, it was made clear that there are still unexplored areas of repair initiatives. One of these was an opportunity for a project that could target the whole I-change model. While numerous initiatives target half of the model, there is not yet one that targets all.

This concept aims to expand an existing initiative, the Repair voucher (8). In the existing initiative, the government provides vouchers and offers a discounted repair service through one of its supported repair shops. These repair shops must be certified by the Repair Register (14), a government-certified website. Together, they tackle barriers of awareness and trust and are present in the predisposing, information, attitude and social factors of the I-change model. It could be argued that a stronger concept has been created by integrating these two initiatives. The Repair Vouchers have been deemed adequate, and a nationwide rollout has been initiated under the new name of Reparaturbonus (HelferLine, 2023).

The expansion of this project would be a discount on DIY parts (Figure 24). Currently, the voucher aims to stimulate people to use repair services while ignoring the possibility of a DIY repair. By subsidising DIY projects, governments are stimulating people's efficacy and ability in repair, which are not yet targeted in the I-change model, and by increasing people's knowledge of the repair process,

Expanded Voucher System

Adding DIY support

The repair voucher is a successful initiative by the Austrian government to stimulate people to repair more. It provides information and trust, and stimulates culture/attitude shifts. It does this by providing one heavily discounted repair job each year at a registered repair service.

An opportunity lies in increasing people's skills/abilities and efficacy around repair. By also providing discounts on product parts, people will have a choice between repairing it themselves or going to a repair service.

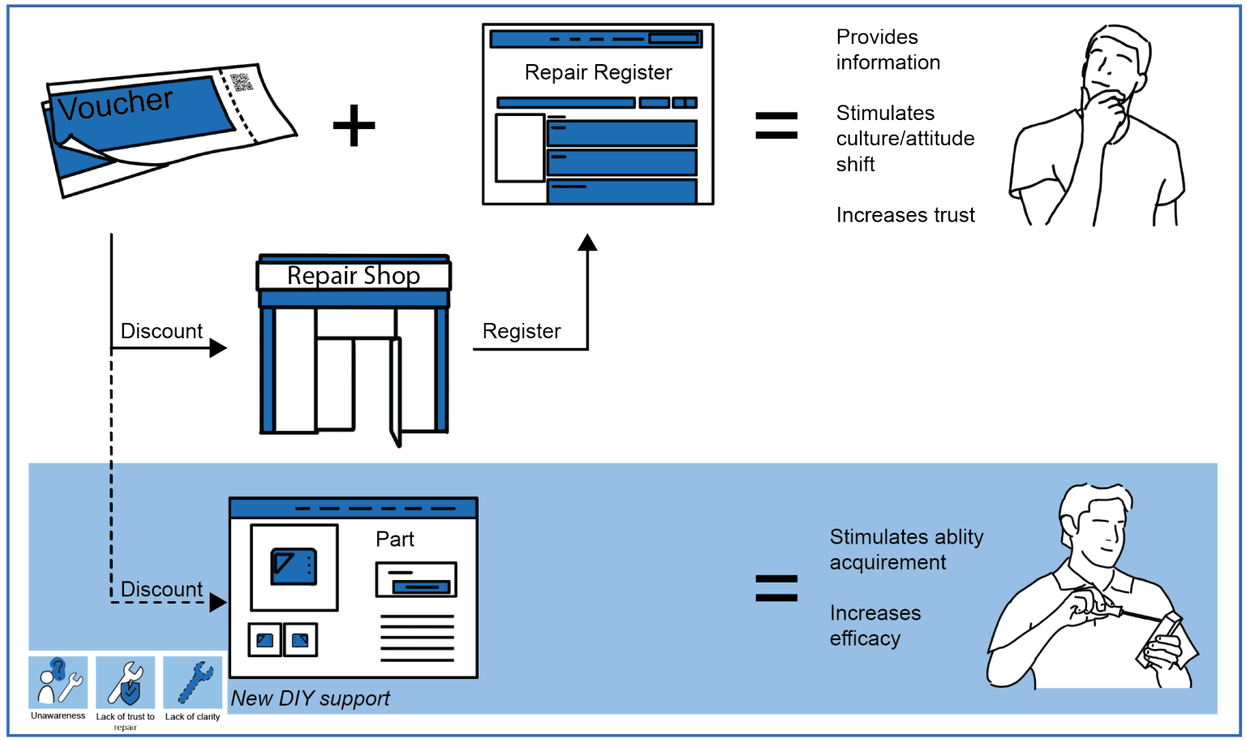


Figure 24: Expanded voucher system concept

the barriers of trust and clarity are further lowered. By providing this alternative to repair, people will feel proud and excited when it is repaired.

There are a few concerns with this concept. Since this is a widespread governmental project, it would be financed via the state. This means there would be a need for widespread acknowledgement of a repair culture, which is currently absent in the non-repair culture. Therefore, creating public awareness and desire around the need for repair would be a required first step.

4.1.4 Beginner's Repair Play Kit

In the last few chapters, it became clear that mainly big general governmental projects aim to increase predisposing and attitude factors, while more individual and personal stimulation to promote repair is currently lacking. This concept aims to introduce a new concept that stimulates these factors. It is a product aimed at familiarising children with the repair concept. This would increase the overall attitude toward repair and create a repair culture.

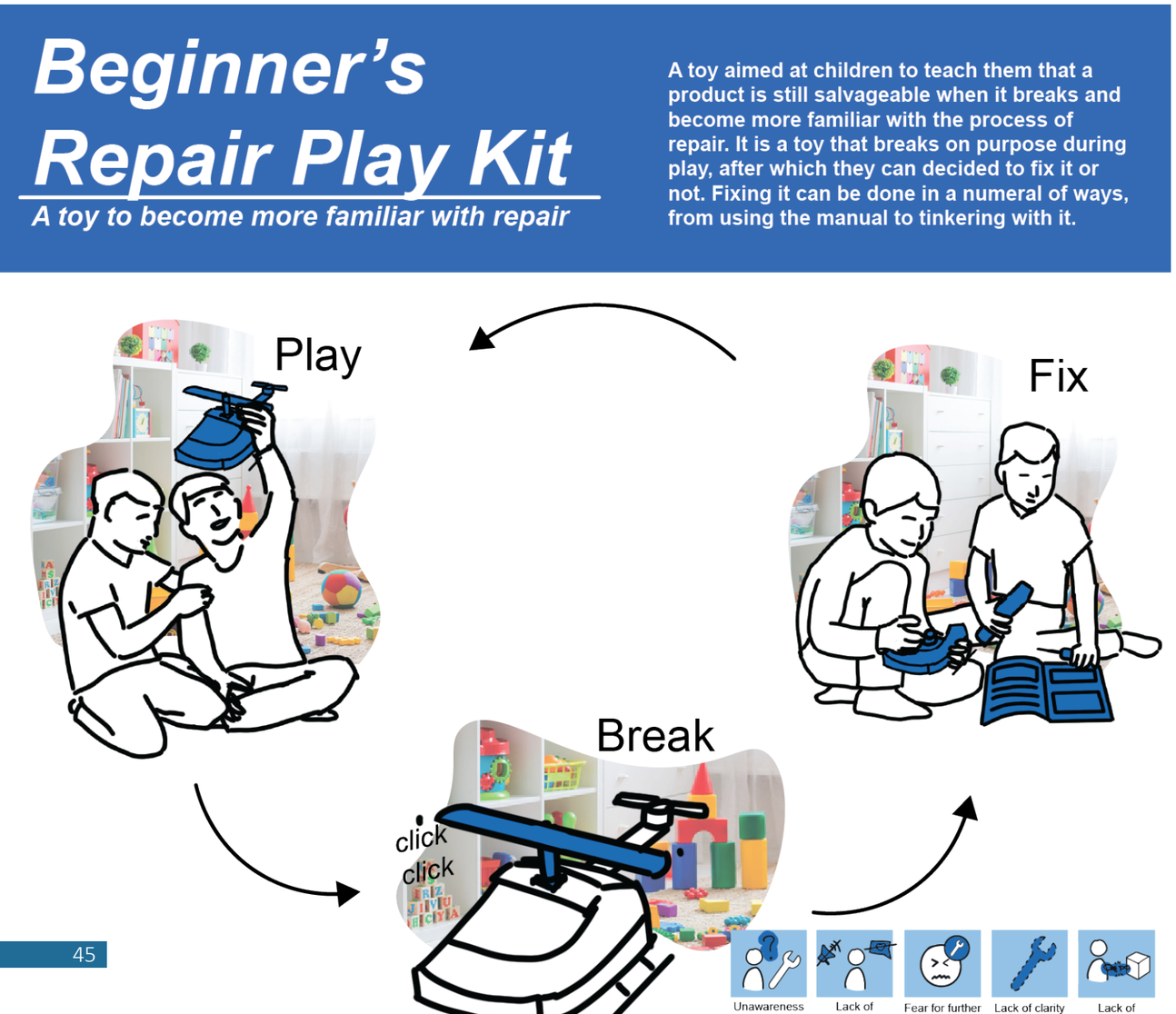
The concept is an educative toy that children must build before using. During the play phase, the product will 'malfunction' in various ways. To fix this, the children can either look at the manual or figure it out themselves. Once it is fixed, the children can continue the initial play. This cycle of 'play, break, fix' is the concept's core and increases children's

stewardship and literacy around repair information. The toy can be used in private homes and public spaces like schools and daycares. Furthermore, it can be used by a single child or a group of children

This concept aims to tackle the barriers of further failures and provide clarity by making it clear how repair works and can be done. Furthermore, it introduces the concept of repair to children from a young age, encouraging engagement in the repair process through the social nature of play. This approach could also foster a unique attachment to the product as users assemble it themselves, creating a personal bond with the item.

Besides the predisposing and attitude factors, the concept is also present in the information, efficacy, and ability factors of the I-change model. Therefore, this concept targets a wide area of the I-change model. Children will feel proud and excited about their solution-finding skills and accomplishments.

Figure 25: Beginner's repair play kit concept



Nevertheless, this concept has a few obstacles to overcome. First, this product is acquired by adults who are already interested in repair. This creates the earlier-mentioned situation in which someone motivated by repair needs to be present to motivate others. Furthermore, the product's gimmick is to stop the current play loop. Whether children want to change their play towards play-repair is up to them. Children could, therefore, choose to continue playing with a malfunctioning toy, which does not result in the desired outcome.

4.2 Concept Assessments and Selection

In the previous sections, each of the four concepts has been discussed and judged based on the four design criteria from Figure 21. An overview of all the positive points is provided in Table 1. This table shows that each concept targets different opportunities and addresses different barriers. Of the concepts, Dedicated Social Spaces and Beginner's Repair Play Kit target the most barriers and cover most of the I-change model. In contrast, the Expanded Repair Voucher System covers the least. Furthermore, the two concepts mentioned above contain all three qualities, while the others lack one.

It makes the most sense to continue with either Dedicated Social Spaces or the Beginner's Repair Play Kit. Since Makerspaces are not stakeholders in this project, it would be more appropriate to focus on developing the Beginner's Repair Play Kit in more detail. Although pursuing Makerspaces is an interesting avenue, it falls outside this project's scope.

Furthermore, the Repair Kit could be combined with another concept, namely the AI Consultant app. By combining two concepts, each of their strengths could be leveraged (in the same manner that the repair vouchers and repair register are integrated). This can be achieved because the Repair Kit requires an easy-to-read and understandable manual for assembly and repair, which the application could provide, thus leveraging its strength. This would also increase trust and lower barrier of entry problems for Repair Kit.

4.3 Concept Refinement: Made-By-You

Combining the two concepts could elevate each individual idea, but the overall concept must be adapted for better alignment to create a coherent product service system (PSS) (Figure 26).

Firstly, the Repair Kit's target audience shifts from children to young adults, as the application requires more advanced digital skills than those typically possessed by young children. Consequently, the Repair Kit transitions from a toy to a genuine electronic product. This product must be designed for easy assembly and provide users with sufficient knowledge to perform repairs confidently.

The assembly process would familiarise the person with the product and the knowledge and skills needed for DIY/ repair. Furthermore, the assembly process would encourage the 'IKEA effect', which describes people's relationship with their build-it-yourself products. People will be more attached to products due to the labour spent on them, and it will also provide a social utility since people want to share their accomplishments with others (Norton et al., 2011). For this to happen, the product has to be relatively easy to assemble and, in case of repair, to disassemble and reassemble.

Additionally, since the product arrives in assemblable pieces, customisation

Category	Aspect	Review AI Consultant App	Review Dedicated Social Spaces	Review Expanded Voucher System	Review Beginner's Repair Play Kit
The concept addresses the WTR barriers					
WTR barriers	Unawareness		It aims to create more information and awareness around repair and introduces a repair culture.	Awareness is created because the government has to promote it.	It increases the concept of repair to children from a young age.
	Desire for new product				
	Lack of engagement		It increases engagement by attaching repair to an existing popular social hub.		It allows for engagement in the repair process due to the social nature of play.
	Lack of trust in repair	The app provides unbiased advice, a clear overview of possibilities, and a clear expectation of the repair process, which can increase trust in the process.	Trust, fear, and clarity can be improved by having trustworthy people in a known setting explain the repair process to them and then do it themselves.	Due to people's increased knowledge of the repair process, the barriers to trust and clarity are lowered.	
	Fear for further failures				This concept aims to tackle the barriers of further failures and provide clarity by making it clear how repair works and can be done.
	Lack of clarity			Due to people's increased knowledge of the repair process, the barriers to trust and clarity are lowered.	
	Lack of attachment				It could create an attachment to the product since the user had to assemble it themselves, creating a unique bond with the product.
The concept is tackling new opportunities					
Opportunities	Against the mainstream		Many local initiatives are available with their own story and resources; due to this, the information and resources around repair are splintered and, thus less visible and are not always available. The concept is a repair hotspot that can target the local population, is always available and provides a clear and consistent story.		
	Barrier of entry problems	The concept addresses the need for companies and consumers to have extensive resources like manpower and knowledge.			
	Unexplored opportunities			By expanding on existing initiatives, an initiative can be created that spans the entire I-change model.	
	Lack of initiatives				A new individual and personal stimulation concept to promote repair in areas dominated by big governmental projects.
The concept is in line with the I-change model					
I-change model	Predisposing factors		It aims to create more information and awareness around repair and introduces a repair culture.		The product aimed to familiarise children with the repair concept. This would increase the overall attitude and efficacy towards repair and create a repair culture.
	Information factors	It increases the quality of the provided information via clear and transparent overviews.			By providing the user with easy-to-understand information on repair, the general knowledge will be higher.
	Awareness factors				
	Motivation factors	It assists in the repair process via information gathering and provision, which should increase people's efficiency and ability to repair.	It creates an inviting social setting and increases people's efficacy and ability to repair.	By subsidising DIY repair, people are incentivised to improve their efficiency and ability to repair.	The product aimed to familiarise children with the repair concept. This would increase the overall attitude, efficacy and ability towards repair and create a repair culture.
	Ability factors				
The design contains the following qualities					
Qualities: Showing off your driving skills	Proud	The app allows the user to repair the project in a DIY manner, which can make the user feel proud and excited about the results of their labour.	People will feel proud and excited about their accomplishments.	People will feel proud when it is repaired and might tell others about their experience.	Children will feel rewarded for their solution-finding skills and be proud and excited about their accomplishments. Moreover,they can do it together with their friends.
	Excited				
	Sharing		People are showing off to the new social group.	People will feel proud when it is repaired and might tell others about their experience.	

Table 1: Review of the four initial concepts based on the criteria

Figure 26: Made-By-You electronics concept

opportunities can be leveraged. Customers can modify certain parts to suit their preferences. Due to DIY assembly, there is no need for extensive specialised assembly lines in factories for custom orders. By offering this benefit, people are more incentivised to choose this line of products over the conventional one.

While the product instils confidence in users about their capabilities, it falls short of providing guidance on what to do and how to do it. For instance, when individuals build their own PCs and encounter issues (during assembly or when a malfunction occurs), they often spend significant time researching potential problems and solutions. The new application is designed to simplify and expedite this troubleshooting process.

This revised concept's application is based on the previously mentioned AI Consultant App, which would assist in assembly and repair via personalised advice. The concept has been adapted in the following ways. First, the application has been scaled down. This would entail removing the complex AI functions and substituting them for more traditional (search) algorithms.

This is preferable since new developments in the EU will force manufacturers to provide manuals (Šajn & European Parliamentary Research Service, 2022), and an assembly manual would already be needed for the MYB product. This would make AI manual generation redundant. Furthermore, several other concerns related to AI in general are also barriers to AI adoption in this concept: IP rights concerns (Generation Climate Europe, 2023), lack of a substantial amount of data, high cost and long development times (Threws The Research World, 2023), and low accuracy and tendency to provide confident untruths (Cappellani et al., 2024).

In the revised concept, users will be guided through a repair flowchart (Figure 27), which is now based on an algorithm rather than an AI-generated system. This change is feasible because products often have critical parts. These are parts that

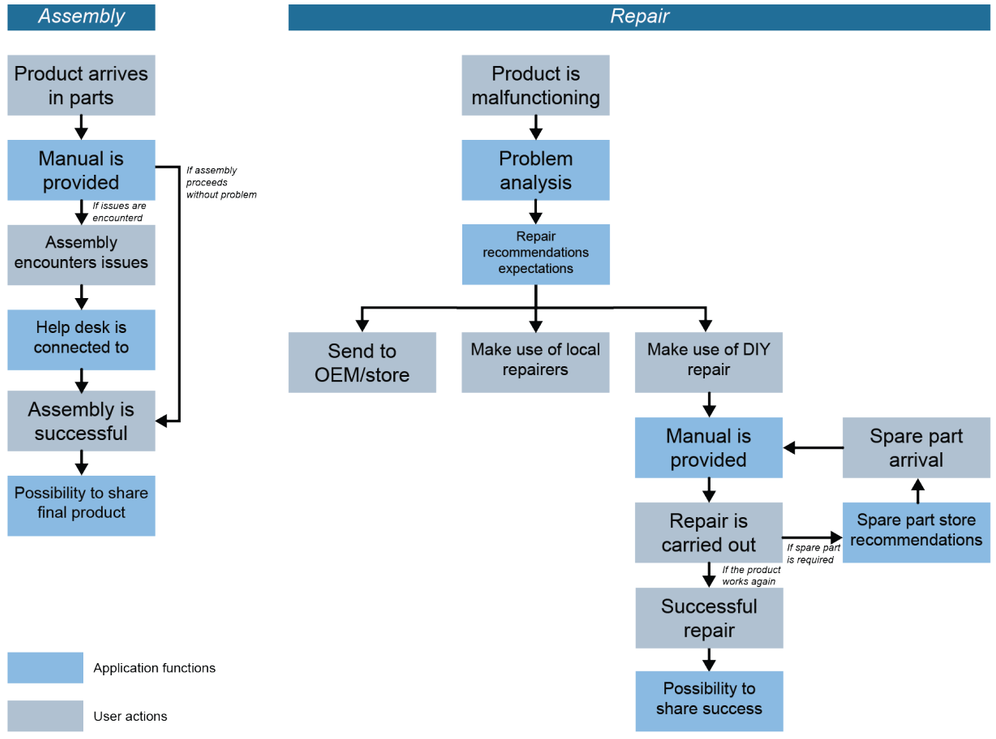


Figure 27: Application flowchart

fail the most often and are thus often the source of the malfunction. Consequently, the flowchart operates within a closed system, making the problem diagnosis deterministic. The algorithm-based approach simplifies the repair steps and enhances user understanding and engagement by providing clear, consistent guidance.

The application provides the following functions (Figure 28):

- Manual provision

  The application either already has access to the manuals or uses search algorithms to find the necessary manuals online. This alleviates the user's barrier to (repair) terminology needed for finding the desired infromation.

- Problem diagnosis

  The application provides the user with several questions about the condition of the product to single out the problem. In this manner, it provides the user with stepping stones to reach their solution.

- Expectations for Repair Options

  Based on the problem diagnosis, the application determines the user's possible actions to proceed. The application suggests possible actions and expected outcomes. This allows the user to trust the repair system and make their own clear and deliberate choices.

- Connecting people, businesses and peers

  The application provides the user with a direct method to contact the OEM for additional support. It also provides manners to share

their achievement via social media integration. This allows the user to engage more with their achievements and provides businesses a channel to increase customer relations.

By digitising manuals, they can be improved upon with digital features. Currently, this is not often done, and it can be a step forward in providing easier-to-understand and more readable manuals (Sirkas et al., 2022). Possible digital features that can enhance the customer experience are (Figure 29):

- Searchability

  The digital version allows users to search the document for their specific scenarios and problems. It allows users to quickly find their desired information without the hassle of going through a thick booklet in multiple languages with a small typeface.

- Interactive elements

  Digital manuals can incorporate interactive elements such as hyperlinks, videos, animations, and pop-up explanations, making complex information easier to understand and engage with.

- Retrievability

  Digital manuals can be accessed through various methods and are not restricted by the bulkiness of paper manuals or the risk of losing a physical copy.

- Accessibility

  Digital manuals can be designed to be accessible to people with disabilities, including features like text-to-speech, screen readers, adjustable text size, and high-contrast modes.

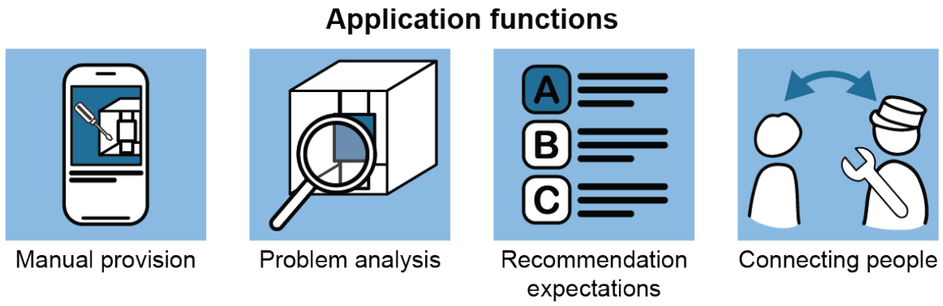


Figure 28: Application functions to improve the repair process

Figure 29: Digital features that improve the user experience of manuals

- Customer service integration

  Digital manuals can have quick links to customer service representatives, may it be a chatbot or a service desk. This streamlines the process of finding assistance for the customer.

The concept aims to create a new business opportunity for either new or existing companies. It allows businesses to target a user group of people who are interested in designing and making their own products, which may lead to additional customer loyalty and engagement with the product. By providing an additional service via the application, customer satisfaction and new communication channels between customers and businesses can be reached.

Finally, the concept is called Made-By-You; it combines elements of DIY (Do-it-yourself), 'Made in China' (or any other country, like 'Made in Germany'), and BYD (Build Your Dreams). The name is intended to evoke the idea that the product is designed, assembled and repaired by the user. Additionally, it signifies that the product embodies the user's unique qualities and skills, much like how 'Made in Germany' is associated with the attributes of the country.

To conclude, by allowing people to experience the assembly process, Made-By-You strives to enhance people's confidence and skills in assembly and repair. Furthermore, it offers a centralised and streamlined information hub for everything related to the product, which reduces users' barriers when seeking information and evaluating various repair options. Made-By-You presents a business opportunity for companies by creating new markets, interactions, and customer experiences with their products.

4.4 Concept Conclusion

The final concept combined two concepts into one product service system (PSS) named Made-By-You. It lets the customer assemble the product that they have designed themselves alongside streamlined instructions for assembly and repair provided by an additional application.

This concept has been judged based on the earlier determined rubric, and its results are shown in Table 2.

From the table, it can be concluded that merging the two concepts results in a stronger concept that covers a greater portion of the rubric. Here is a detailed analysis per category:

- WTR barriers

  By allowing people to assemble their own products, people become more aware of how the product functions from the inside. This familiarity alleviates fear and increases clarity about handiwork, and the effort involved can foster a stronger attachment to the product. However, the extent to which barriers are lowered depends on the amount of assembly required. While extensive assembly can boost awareness, reduce fear, and enhance clarity, it can also deter people if it is too complicated. It is essential to find a balanced level of difficulty that is neither too simple nor too challenging.

  Allowing people to customise certain product parts can increase their attachment to it and make them more likely to share their experiences with others. However, while this customisation may foster attachment, it does not necessarily

Category	Aspect	Review Made-By-You
The concept addresses the WTR barriers		
WTR barriers	Unawareness	It makes people more aware of what is on the inside and what repair options are available. However, it does not advertise itself as a repairable product.
	Desire for new product	While the product may create attachments, it does not discourage the user from buying new products.
	Lack of engagement	It introduces engagement and social value due to the customisable nature of the product.
	Lack of trust in repair	By introducing clear expectations and recommendations about the repair process based on customer needs, trust can be created.
	Fear for further failures	This concept aims to tackle the barriers of further failures and provide clarity by familiarising people with handiwork.
	Lack of clarity	
	Lack of attachment	It could create attachment to the product, since the user had to assemble it themselves, creating a unique bond with the product. Furthermore, if the product is customised, personal value will be added.
The concept is tackling new opportunities		
Opportunities	Against the mainstream	The product is not targeted towards the whole public since not everyone wants to customise or build their own products.
	Barrier of entry problems	The concept lowers consumers' need for advanced knowledge around repair due to easy-to-access and understandable information.
	Unexplored opportunities	It is aiming to increase attachment towards the product, which no initiative has targeted yet.
	Lack of initiatives	It is a more personal and intimate project than widespread governmental ones.
The concept is in line with the I-change model		
I-change model	Predisposing factors	The product aimed at familiarising people with the DIY assembly/repair concept. This would increase the overall attitude and efficacy towards them and create a repair culture.
	Information factors	The general knowledge will be higher by providing the user with easy-to-understand information on repair.
	Awareness factors	While people become aware of assembly, it does not necessarily make them aware of repair.
	Motivation factors	The product aimed to familiarise people with the repair concept via an initial assembly and information spread. This would increase the overall attitude and efficacy towards repair and create a repair culture.
	Ability factors	
The design contains the following qualities		
Qualities: Showing off your driving skills	Proud	People will feel proud of their accomplishments and are excited by showing them off to their peers.
	Excited	
	Sharing	

Table 2: Review of Made-By-You based on the criteria

discourage them from purchasing new products.

Providing an easy way for people to access and understand repair information can reduce barriers related to trust, fear, and clarity. However, the product service system does not directly promote repairing items and may leave people unaware of the repair options available.

- Opportunities

  initially, the concepts aimed to answer the opportunities of entry barrier problems by providing people with easily accessible information via a centralised and streamlined information hub and by providing a more personal experience for repair, in contrast to widespread governmental projects. During the refinement process, the concept also targeted the barrier of attachment, an unexplored opportunity. However, it does not cater to a general mainstream audience; the primary target group consists of individuals who value customisation and are already comfortable with handiwork due to the assembly process. While it is possible to reach a broader audience, as demonstrated by IKEA, it remains a challenge.

- I-change model

  By having people assemble the product themselves, their overall DIY skills and efficacy will improve, and they will become more aware of a product's internal components. However, this process does not necessarily teach them the purpose and function of each part, remaining quite surface-level. While this approach makes the experience more accessible, it provides only minimal education to the user.

  The application simplifies the repair process, enhancing people's efficacy and ability while giving them adequate knowledge of the process. This is a step toward fostering a repair culture. However, the concept does not immediately convey that assembling the product makes it easier to repair.

- Qualities

  By creating a unique product yourself, it becomes their creation to be proud of. Envisioning the final result and seeing it come alive can create excitement that motivates people to finish the assembly. Furthermore, repairing the product on your own is an accomplishment that brings a sense of pride and reward for the effort invested. The experience of this excitement and pride can be shared with their peers.

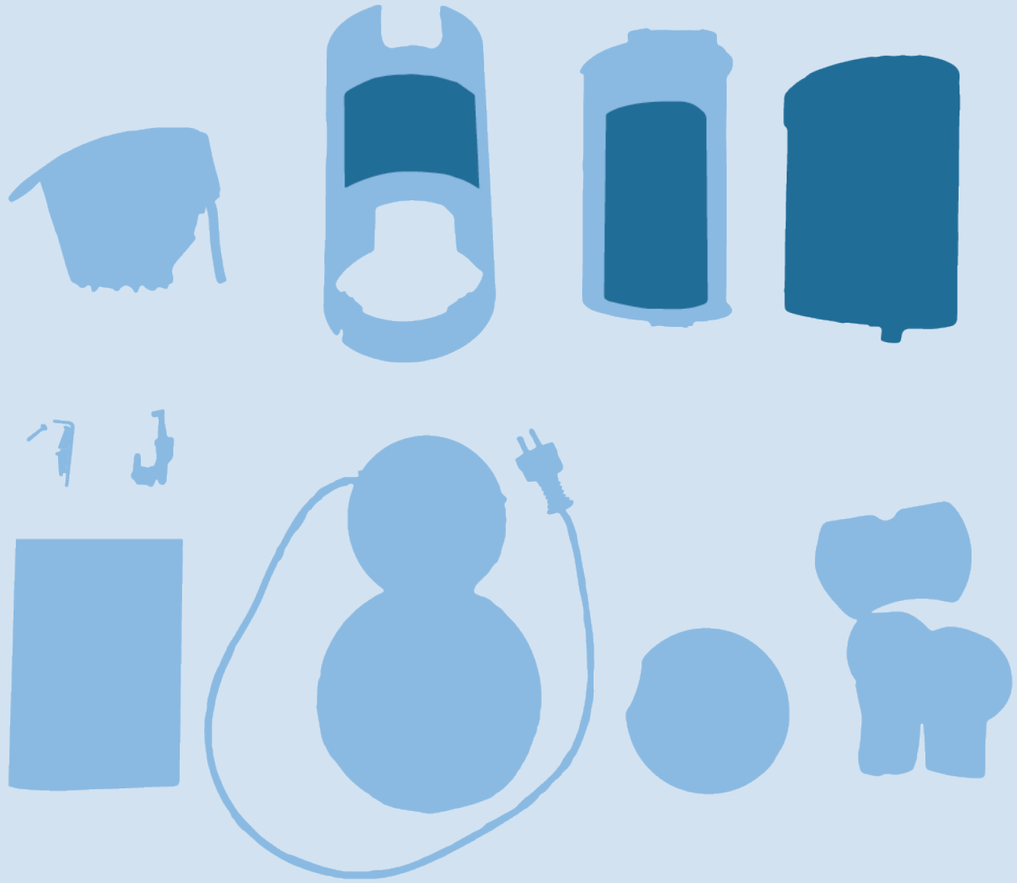
In the next chapter, a proof of concept will be shown to test whether the concept can be applied to a tangible product.

5 Proof of Concept Development

The concept described in the previous chapter is still quite broad. While this means that the service can be applied to many products, the downside is that it is hard to imagine and grasp. To alleviate this problem, a proof of concept will be developed based on a singular product and the service around it. The Philips Senseo has been selected for this proof of concept.

This product has been chosen for this project for several reasons. First, it is the most common type of product to be repaired at the Repair Café (Repair Café, 2024). Second, it is a widely owned product that is familiar to most people. Third, due to its common nature and numerous repairs, many models, documentation, and videos can be found about the product and its repair process. Fourth, it is a 'workhorse' product, which is currently less repaired.

This chapter will first discuss the redesign guidelines collected to guide the design process. Then, an overview of the Senseo, including its current state, will be given. The redesign will then be provided alongside a description of how the application would complement it. To assist in making the proof of concept tangible, a prototype has been created (Appendix H, Prototyping of a Transparent Made-By-You Senseo), and a video has been made to show the product in context (youtube.com/watch?v=OucIFC-FWE0).



5.1 Redesign Guidelines

5.2 An Overview of the Philips Senseo

- 5.2.1 General Description
- 5.2.2 Components
- 5.2.3 Assembly Plan
- 5.2.4 An Overview of the Philips Senseo Conclusion

5.3 The Made-By-You Senseo

- 5.3.1 Designing for Assembly, Disassembly, Reassembly and Repair
- 5.3.2 Customisation Possibilities for the Made-By-You Senseo
- 5.3.3 The Made-By-You Application

5.4 Proof of Concept Development Conclusion

5.1 Redesign Guidelines

For the redesign, guidelines around ease of assembly and disassembly have been collected (Table 3, Table 4, Table 5). These guidelines have been compiled from numerous papers about ease of assembly and the FRI criteria. The tables contain sixteen guidelines, each providing a recommendation and clarification for their reasoning. While each guideline is unique, they can be roughly classified into four categories (except for product specifics, since they depend on the product) (Figure 30).

- More is less (number of components, number of fastenings, number of subdivisions, component variety, ease of dis- and reassembly, and number of steps)

  These categories all conclude that the less you have of something, the easier the assembly process becomes.

- Navigating structures (difficulty level, vertical/hierarchical assembly, and action types)

  These categories are related to how streamlined the assembly process is and how easy it is to perform.

- Spare part convenience (spare part prices and spare part availability)

  These categories are all related to how spare parts are handled.

- Manual specifications (document access, text, and figures/diagrams)

  These categories are related to how well the manual is designed and distributed.

Additionally, for this redesign, the original design will be preserved as much as possible, as it is an iconic feature of the Senseo. In section 5.2.4, the Senseo will be analysed based on these criteria.

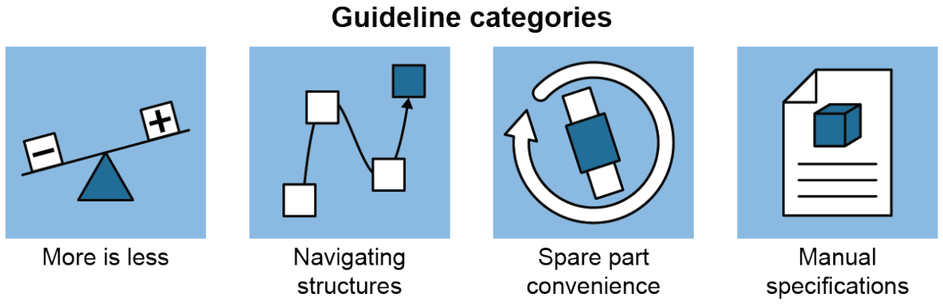


Figure 30: Guideline categories

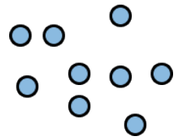
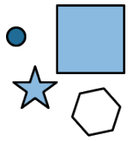
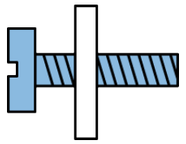
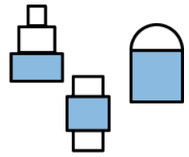
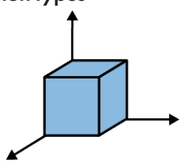
Category	Recommendation	Clarification
Difficulty level 	The difficulty level should be appropriate for the situation.	The tasks should not be too hard as an unsuccessful completion will cause a negative attitude towards the product. However, it should not be made too easy, as the social utility of the product would decrease (Norton et al., 2011).
Number of components 	The amount of components should be kept low.	Difficulty and complexity increase as the number of components rises (Richardson et al., 2004; Richardson et al., 2006).
Component variety 	The amount of different components should be kept low.	Difficulty and complexity increase as the variety of components rises (Richardson et al., 2004; Richardson et al., 2006).
Number of fastenings 	The amount of fastenings should be kept low.	More fastening increases assembly complexity (Richardson et al., 2004), but it does not increase thinking time (Richardson et al., 2006).
Number of subdivisions 	The amount of subdivisions should be kept low.	Complexity rises with the amount of subdivisions (Richardson et al., 2004).
Action types 	Weird and uncomfortable movements and actions should be avoided.	Large changes in arm, wrist, torso, head movement increase difficulty (Santhi et al., 2014). Furthermore, the shape of the product should also allow for easy grasping and manipulation (Samy & ElMaraghy, 2010).

Table 3: Guidelines for DIY product assembly

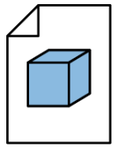
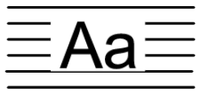
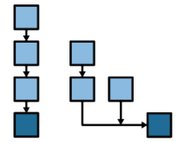
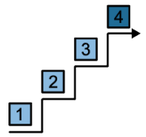
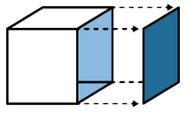
Category	Recommendation	Clarification
Figures/diagrams 	Figures and diagrams should be used to assist the user.	Diagrams and figures ease the cognitive load of complex assemblies (Richardson et al., 2004). Other media types have also been used like videos, pictures and gifs (Esteban, 2018).
Text 	Text usage has to be appropriate for the target audience.	There seems to be reason to believe that adding text to illustrations has beneficial results. However, it has to be appropriated to the target audience (Richardson et al., 2004).
Vertical/subdivided assembly 	A vertical assembly structure is recommended over a hierarchical one. If the product requires many parts, they should be introduced in sections.	Vertical structures (a process in which each steps follows another) are preferred over hierarchical structures (a process in which small subassemblies are first made, then later put together)(Prabhu et al., 1995; Richardson et al., 2004). If many parts have to be identified, splitting them up into packaging groups is recommended (Richardson et al., 2004).
Number of steps 	The amount of steps should be kept low.	Fewer steps result in higher accuracies (Richardson et al., 2004).

Table 4: Guidelines for instructions

Category	Clarification
Document access 	Technical documents should be provided.
Ease of dis- and reassembly 	The kind of fasteners should accommodate dis- and reassembly, and should not require many additional tools.
Spare parts availability 	Spare parts should be made available over a long period of time.

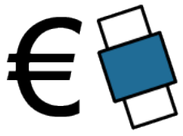
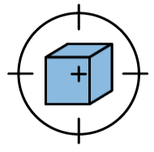
Category	Clarification
Spare parts prices 	The price of spare parts should be competitive.
Product specifics 	These are product category-specific.

Table 5: French Repairability Index (FRI)criterion (Microsoft, n.d.; Punctuate, n.d.)

5.2 An Overview of the Philips Senseo

In this section, a general product description will be given, after which the components will be described, and the current assembly method will be provided. Using this overview, the Senseo will be analysed based on the previously provided guidelines.

5.2.1 General Description

The Senseo is a pad coffee machine produced by the company Philips (Figure 31) and costs about 80 euros. When the user wants to make coffee, a button has to be pressed (located at the foot of the machine). This will send a signal to the pump to start pumping water out of the tank in the back (the tank is removable so that the water can be refilled by the user). The water will then enter the boiler. After this, it is sent to the top of the machine, which contains the coffee pad. Then, the coffee will exit the machine through the nozzle attached to the top of the machine.

Figure 31: Philips Senseo (Philips, n.d.-a)

The coffee machine is delivered in a 227 x 367 x 392 mm box (Figure 32) (Philips, n.d.-a) and weighs 1.718kg (4.065 kg including the box). The product arrives in a ready-to-use stage (Figure 33) and requires minimum unboxing time and first-time setup procedure time.

Figure 32: Philips Senseo box

Figure 33: Philips Senseo in the box (Mbark 86, 2017)

The box contains two glasses and a few documents like ads and manuals. The manuals provide information on the accessories, safety, requests to save the booklet, setup, maintenance, warranty, and common problems (Figure 34) and are mandatory by the EU (Mo, 2023). If the leaflet goes missing, a digital version is also available on the Philips website (Figure 35) (Philips, n.d.-b).

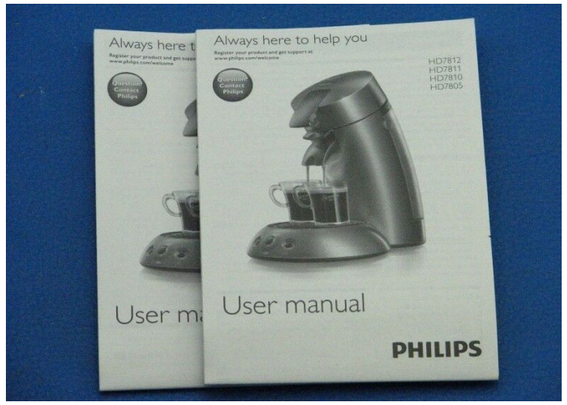
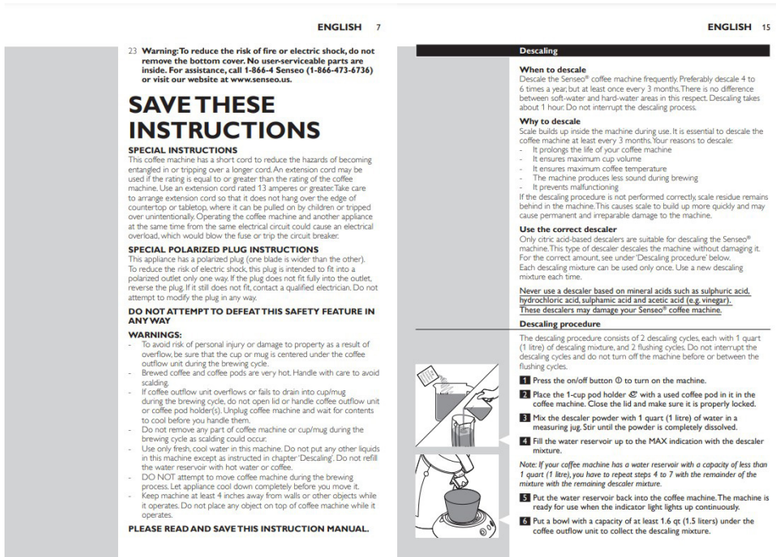


Figure 34: Physical Senseo manual (Shopping.com, n.d.)


ENGLISH 7

23 **Warning:To reduce the risk of fire or electric shock, do not remove the bottom cover. No user-serviceable parts are inside. For assistance, call 1-866-4 Senseo (1-866-473-6736) or visit our website at www.senseo.us.**

SAVE THESE INSTRUCTIONS

SPECIAL INSTRUCTIONS

This coffee machine has a short cord to reduce the hazards of becoming entangled in or tripping over a longer cord.An extension cord may be used if the rating is equal to or greater than the rating of the coffee machine. Use an extension cord rated 13 amperes or greater.Take care to arrange extension cord so that it does not hang over the edge of countertop or tabletop, where it can be pulled on by children or tripped over unintentionally. Operating the coffee machine and another appliance at the same time from the same electrical circuit could cause an electrical overload, which would blow the fuse or trip the circuit breaker.

SPECIAL POLARIZED PLUG INSTRUCTIONS

This appliance has a polarized plug (one blade is wider than the other). To reduce the risk of electric shock, this plug is intended to fit into a polarized outlet only one way. If the plug does not fit fully into the outlet, reverse the plug. If it still does not fit, contact a qualified electrician. Do not attempt to modify the plug in any way.

DO NOT ATTEMPT TO DEFEAT THIS SAFETY FEATURE IN ANY WAY

WARNINGS:

- To avoid risk of personal injury or damage to property as a result of overflow, be sure that the cup or mug is centered under the coffee outflow unit during the brewing cycle.
- Brewed coffee and coffee pods are very hot. Handle with care to avoid scalding.
- If coffee outflow unit overflows or fails to drain into cup/mug during the brewing cycle, do not open lid or handle coffee outflow unit or coffee pod holder(s). Unplug coffee machine and wait for contents to cool before you handle them.
- Do not remove any part of coffee machine or cup/mug during the brewing cycle as scalding could occur.
- Use only fresh, cool water in this machine. Do not put any other liquids in this machine except as instructed in chapter 'Descaling'. Do not refill the water reservoir with hot water or coffee.
- DO NOT attempt to move coffee machine during the brewing process. Let appliance cool down completely before you move it.
- Keep machine at least 4 inches away from walls or other objects while it operates. Do not place any object on top of coffee machine while it operates.

PLEASE READ AND SAVE THIS INSTRUCTION MANUAL.

ENGLISH 15

Descaling

When to descale

Descale the Senseo® coffee machine frequently. Preferably descale 4 to 6 times a year, but at least once every 3 months. There is no difference between soft-water and hard-water areas in this respect. Descaling takes about 1 hour. Do not interrupt the descaling process.

Why to descale

Scale builds up inside the machine during use. It is essential to descale the coffee machine at least every 3 months. Your reasons to descale:

- It prolongs the life of your coffee machine
- It ensures maximum cup volume
- It ensures maximum coffee temperature
- The machine produces less sound during brewing
- It prevents malfunctioning

If the descaling procedure is not performed correctly, scale residue remains behind in the machine. This causes scale to build up more quickly and may cause permanent and irreparable damage to the machine.

Use the correct descaler

Only citric acid-based descalers are suitable for descaling the Senseo® machine. This type of descaler descales the machine without damaging it. For the correct amount, see under 'Descaling procedure' below. Each descaling mixture can be used only once. Use a new descaling mixture each time.

Never use a descaler based on mineral acids such as sulphuric acid, hydrochloric acid, sulphamic acid and acetic acid (e.g. vinegar). These descalers may damage your Senseo® coffee machine.

Descaling procedure

The descaling procedure consists of 2 descaling cycles, each with 1 quart (1 litre) of descaling mixture, and 2 flushing cycles. Do not interrupt the descaling cycles and do not turn off the machine before or between the flushing cycles.

1. **Press the on/off button ⏻ to turn on the machine.**
2. **Place the 1-cup pod holder & with a used coffee pod in it in the coffee machine. Close the lid and make sure it is properly locked.**
3. **Mix the descaler powder with 1 quart (1 litre) of water in a measuring jug. Stir until the powder is completely dissolved.**
4. **Fill the water reservoir up to the MAX indication with the descaler mixture.**

Note: If your coffee machine has a water reservoir with a capacity of less than 1 quart (1 litre), you have to repeat steps 4 to 7 with the remainder of the mixture with the remaining descaler mixture.

5. **Put the water reservoir back into the coffee machine. The machine is ready for use when the indicator light lights up continuously.**
6. **Put a bowl with a capacity of at least 1.6 qt (1.5 liters) under the coffee outflow unit to collect the descaling mixture.**

Figure 35: Digital Senseo manual (Philips, n.d.-b)

However, package leaflets are often difficult to read due to small font sizes, multiple languages, and hard-to-find information. Additionally, electronic versions typically do not improve readability (Sirkas et al., 2022), as they are often just PDF replicas of printed booklets and do not provide advantages over the physical version. While men generally support the digitisation of leaflets, a transition to digital should be implemented gradually (Hammar et al., 2016).

Repair Café has identified the five most common problems/repairs of the Senseo (Repair Café, 2023):

- Replacing the magnet of the water level sensor of the water tank
- Cleaning/descaling of the machine
- Replacing the capacitor of the PCB
- Replacing the three-way valve connected to the top shell
- Properly tuning it (software system)

Of these common issues, descaling and software tuning are not part of the repair process but rather of maintenance and will thus not be focused upon further in the chapter. Furthermore, it has been noted that only the water tank can be bought separately from the official Philips website (https://www.philips.nl/; Philips, n.d.-a). Additionally, Repair Café's manuals do not direct users to Philips for spare parts but instead recommend third-party webshops (Brattinga et al., 2020). The water tank is priced at €13.99, which is within the recommended 15-20% threshold of the product price for spare parts, considering the Senseo's 80 euro price, as suggested by ADEME (2023).

This section has relevance to two key guideline categories, 'Spare part convenience' and 'Manual specifications'. While the water tank can be purchased officially from Philips at a reasonable price, other spare parts are unavailable through the official channel, leaving their prices to be determined by third-party vendors. This highlights a need for improvement in the availability of spare parts for this product. Additionally, although the manual is available in both paper and digital formats with detailed figures and extensive text, there is still room for enhancing its readability and ease of use.

5.2.2 Components

In this part, the senseo is described in its components. Figure 36 shows what a person sees after opening a Senseo for the first time. Opening it up for the first time can be scary and overwhelming because one can be scared of breaking any of the wires or tubes.

A list of parts has been made using product models (Appendix E, Models Used for the Analysis), online resources and online documentation. The parts listed in Table 6 are based on subdivisions (e.g. a

Figure 36: Inside of an Senseo

pump instead of a pump metal brace). This level of detail has been chosen for clarity. The critical parts (parts that are often repaired) that are identified in section 5.2.1, are indicated with a '*'.

Figure 37 shows an exploded view using the same part size to stay consistent with the parts and assembly schemes. The figure shows 11 unique parts and 12 parts in total. A complete list of all parts, containing 43 unique parts and 47 parts in total, is available in Appendix F, Detailed Assembly Description.

To conclude, this section has relevance to the guideline category of 'More is Less'. As illustrated in the figures and tables, the Senseo contains too many parts for an average person to assemble reasonably. Therefore, the product should utilise subassemblies to achieve an assembly-friendly design. However, even with subassemblies, the product may still require partial preassembly before delivery. While the number of screws is low due to the extensive use of

Figure 37: Exploded side view of a Senseo HD7817 existing out of recognisable subassemblies (numbers correspond to Table 6; '' are the critical parts)*

Number	Amount	Component description	Amount of parts included in the subassembly
1	1	Top shell	1
2	1	Front shell	1
3	1	Back shell	2
4*	1	Water tank	3
5*	1	Three-way valve	1
6	1	Boiler	3
7	2	Long hex screw	2
8*	1	PCB	8
9	1	Bottom shell	1
10	1	Pump	22
11	1	Drip tray shell	1

Table 6: Senseo component description ('' are the critical parts)*

snap-fits, this design choice could impede disassembly, which will be further explored in the next section.

5.2.3 Assembly Plan

Using online resources, documentation, and a teardown and rebuild of multiple models (Appendix E, Models Used for the Analysis), an assembly plan has been created (Table 7) based on the subdivisions established in the previous section. The assembly plan details the actions required and provides commentary on the current ease of assembly and disassembly. The steps that include critical parts that are identified in section 5.2.1are indicated with a '*'. For disassembly, follow the steps in the assembly plan in reverse.

Because the subassemblies of the Senseo are already completed in this scheme, the assembly becomes a vertical assembly structure, which is preferable for assembly due to its clarity. However, if these subassemblies still need to be assembled, the process becomes hierarchical, which is less desirable as it is deemed more confusing (Prabhu et al., 1995; Richardson et al., 2004). The current assembly requires 17 steps, which increases significantly if subassemblies are included.

Furthermore, in the scheme, it becomes clear that the primary difficulties in assembly and disassembly arise from hard-to-reach screws, snap-fits, and the entanglement of wires and tubes, which complicate fitting the shell in place.

Based on the scheme, the process can be evaluated following the guidelines categories of 'More is less' and 'Navigating structures'. While the vertical assembly structure can be achieved for the Senseo, it requires the preassembly of subdivisions and still involves many steps to complete. To improve the experience, the screw locations and snap-fits should be repositioned for easier access, and a method to manage the wires should be considered. Additionally, connecting the wires may appear challenging and

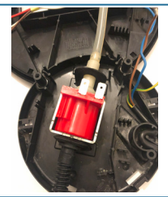
Step	Description	Picture	Comment
1	Ready the bottom shell.		
2*	Click the PCB in the shell's PCB slot.		The PCB has many wires to take manage and is hard to keep tidy and structured.
3	Pull the pump tubes through the pump holes in the shell.		The tubes must be disconnected and reconnected to get the main body of the pump in place.
4	Connect the white and brown wires from the PCB, plug them in, and connect them to the pump. Then, tape the pump to protect it from water.		The position of the wires is not determinable. The wires have to be connected via a metal clip.
5	Connect the drip tray shell to the bottom shell via snap-fits.		The snap-fits make disassembly hard. The wires have to be arranged neatly otherwise they will not fit.
6	Connect the front shell to the bottom shell via 2 Torx screws and snap-fits.		The screws are hard to reach from the inside, and the snap-fits make disassembly hard. The wires have to be pulled through and are hard to keep tidy.
7	Put the Hall sensor in the sensor slot of the front shell.		The wires are easily tangled.

Table 7a: Assembly scheme of Philips Senseo HD7817 ('' are steps with critical parts) (pictures 8-10 and 12-17 are taken from Jozef Van Bouwel (2023)) (part 1/3)*

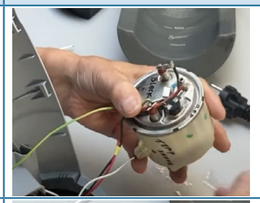
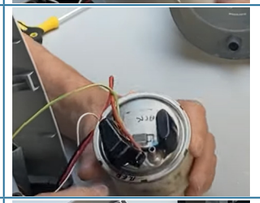
Step	Description	Picture	Comment
8	Connect the three leftover wires to the correct spots on the boiler. And connect the temperature sensor to the side.		Only the temperature sensor clearly indicates the position. The other wires must be connected via a metal clip.
9	Cover the wire connection points with the two plastic shells.		The shells are hard to orientate and put on.
10	Connect the boiler to the pump tube.		During disassembly, the boiler could leak.
11 *	Connect the boiler to the three-way valve.		The three-way valve connects via a soft tube.
12	Connect the boiler to the top shell, then connect the three-way valve to the top shell.		This white clip is hard to reach during disassembly.
13	Place the top shell on top of the front shell.		This is done via snap-fit. This snap-fit is easy to remove due to access from the back.
14	Connect the back shell to the pump broad tube.		

Table 7b: Assembly scheme of Philips Senseo HD7817 ('' are steps with critical parts) (pictures 8-10 and 12-17 are taken from Jozef Van Bouwel (2023)) (part 2/3)*

Step	Description	Pictures	Comment
15	Put the three-way valve in the back shell valve and connect the back shell with the snap-fits.		This is done via snap-fits, and during disassembly, it is hard to open.
16*	Put the water tank in place.		This action is part of everyday use.
17	Put all the accessories in place.		Accessories are parts that are normally cleaned and easily removable.

Table 7c: Assembly scheme of Philips Senseo HD7817 ('' are steps with critical parts) (pictures 8-10 and 12-17 are taken from Jozef Van Bouwel (2023)) (part 3/3)*

potentially dangerous to the general public, so such actions should be minimised or avoided.

5.2.4 An Overview of the Philips Senseo Conclusion

The Senseo has been reviewed in the previous sections based on the general overview, the components, and the assembly/disassembly process. It has been reviewed based on the earlier established guidelines. In Appendix G, Detailed Review of the Senseo, each of the sixteen individual guidelines is discussed in detail. In Table 8, the key takeaways per guideline category are shown.

Based on the takeaways, the current assembly process for the Senseo is incredibly intimidating for users and needs significant simplification. The complexity arises from a lengthy assembly process, numerous parts, and many electrical wires and tubes. Additionally, the disassembly process is challenging due to the current fastening methods and the disorganised entanglement of wires.

The manuals should be enhanced to facilitate assembly and repair. Potential improvements can be achieved by leveraging digital features for the electronic version to enhance the user experience. Moreover, spare parts should be easily accessible, either through official retailers or by clearly indicating trusted sellers.

The Senseo will be redesigned in the following sections using the guideline results to fit the Made-By-You concept.

5.3 The Made-By-You Senseo

In this section, the Senseo will be redesigned using previously outlined considerations. The Made-By-You Senseo is a PSS, which means that it includes a product and a service. First, the product is described, detailing the changes made and its argumentation. Then, the service will be described, focusing on how the application supports users throughout their journey.

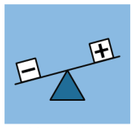
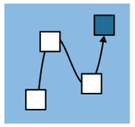
Guideline category	Considerations
 More is less	• The amount of steps required to assemble the product should be lowered as much as possible. • The product should arrive partially preassembled to lower the difficulty and skill level required for the barrier of entry.
 Navigating structures	• The assembly process should reflect the repair process. The critical parts should be easy to reach, and the user should assemble them. The user is not expected to repair the PCB since it is challenging and intimidating and often requires tools that are not easily accessible. • The wires and tubes should be provided in an easy-to-organise manner. • The screws and snap-fits should be reworked to accommodate assembly and disassembly.
 Spare part convenience	• Spare parts should be made better available, either via official channels or by referencing officially supported stores.
 Manual specifications	• The digital manual should be improved by utilising digital opportunities to enhance the user experience.

Table 8: Summary of guideline results

5.3.1 Designing for Assembly, Disassembly, Reassembly and Repair

In this section, the redesign of the physical product will be elaborated upon. In Table 9 an overview is provided of all modifications and adjustments.

First, the product should be delivered in parts for the Made-By-You concept. However, the current assembly process is complex, requiring numerous parts and steps. To simplify this, part of the product will arrive preassembled, not just as subassemblies. Specifically, the bottom shell, drip tray shell, pump, boiler, and PCB will be shipped as a pre-assembled unit. These components are among the most challenging to assemble, primarily due to the complexity of wiring and tubing. Figure 38 shows how this unit may arrive if it was only connected to the bottom shell. This may be perceived as intimidating and a challenge by most people.

The PCB is particularly intimidating for users, as many do not have much knowledge about PCBs, and it is a part that can be easily broken. While it would be ideal for users to install the PCB

Senseo modifications	Description
The product is delivered in parts	The product should be delivered in parts for people to assemble. To reduce the complexity of the process, some components will come preassembled. Specifically, the bottom shell, drip tray shell, PCB, pump, and the boiler will be preassembled as a unit called the base.
An internal boiler scaffold	A small scaffold will support the boiler in the correct position, ensuring proper alignment and securing the tube.
Relocated screw locations	The fastening methods will be updated. Snap-fits will be removed from the drip tray, the front and back shells. The current screw locations will be adjusted: two new hex screws will secure the drip tray shell to the base, while four additional screws will hold the front and back shells together to the base.

Table 9: All product modifications

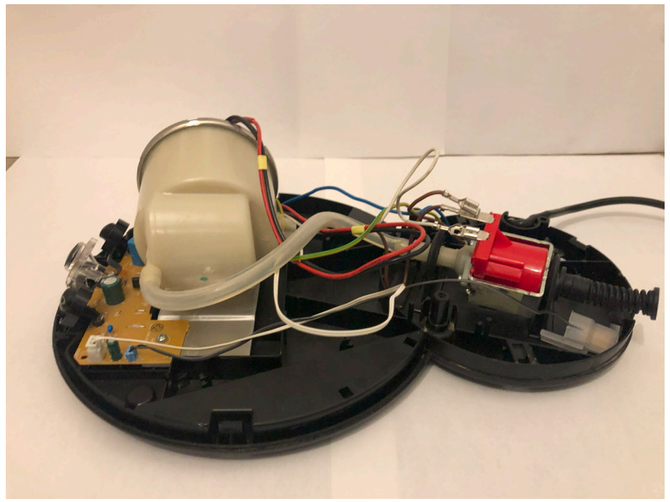


Figure 38: Entanglement of wires and tubes of the current Senseo

themselves to become familiar with this critical component, it is not a significant issue if they do not. Most users are unlikely to attempt repairs on the PCB themselves, preferring to seek professional assistance. Therefore, to reflect the actual repair process, the reduced familiarity with this part is not a major repair concern.

Consequently, it makes sense to preemptively cover the PCB with the drip tray shell for the assembly of this product. This would result in the base appearing as shown in Figure 39, which is significantly less intimidating and already tidies a part of the wires and tubing.

The figure still depicts the boiler and tubes scattered haphazardly outside the shell. To make it neater, less challenging to manage, and less prone to breakage, a small scaffold can be added to support the boiler in the correct position (Figure 40). This scaffold ensures the tube bends correctly and does not stick out during assembly. The scaffold is a plastic frame surrounding the boiler, with the wires and tubes positioned below it. The Hall sensor, which is part of the PCB, is also attached to it.

The result of these two considerations for the base is shown in Figure 41.

Figure 39: Wires and tubes are covered by drip tray shell

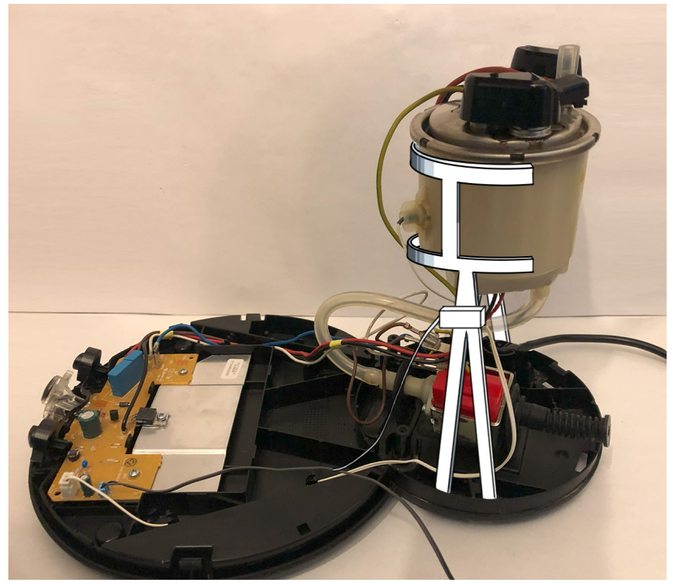


Figure 40: Internal scaffolding to prop up the boiler and keep the tubes tidy (drip tray is not visible in this image)

Figure 41: The base of the Made-By-You Senseo, a scaffold has been repurposed from a different product and adapted to support the boiler

The Made-By-You Senseo would arrive in the following seven parts (Figure 42):

- The base: the bottom shell, drip tray shell, PCB, boiler, pump, and scaffold
- The front shell
- The back shell
- The top shell
- The three-way valve

  This is a critical part that can be quite easily attached and removed. Nevertheless, people should be familiar with this part and be confident in their actions when replacing it during repair.
- The accessories: the water tank and other accessories.

  The water tank is included in this since most people would not consider it part of the main assembly, due to its removable and cleanable nature, similar to other accessories. While the water tank is a critical component, it is relatively easy to replace. The main issue preventing people from replacing it is often unawareness or inability to diagnose the malfunction rather than the complexity of the replacement process.
- The fastening methods: six hex screws and a hex key

While seven parts might seem like a lot, three of these are shells, which are straightforward to attach and require

Figure 42: Made-By-You Senseo out of the box

similar actions without introducing any new assembly methods. One part consists of the screws, and another part includes the accessories.

Figure 42 shows the product when it is taken out of the box. The product shown in this picture is a prototype of a see-through model (based on the transparent Made-By-You Senseo, later discussed in section 5.3.2). The prototype differs slightly from the drawings presented in Figure 43, because of certain constraints encountered during the prototyping process (additional details can be found in Appendix H, Prototyping of a Transparent Made-By-You Senseo).

After unpacking the product, the three-way valve, accessories and shells must be assembled to complete the build (Table 10). The repair process follows the assembly steps in reverse order.

The assembly process consists of five steps, three of which involve the shell. Steps 0a and 0b are related to repair and are only relevant if the repair involves the PCB, which would be performed by a professional and not by the user.

For the remaining steps, the shells are connected using screws and snap-fits. The only snap-fits are located on the top shell, which are easy to remove during disassembly because they can be accessed from the back. Six new hex screws have replaced the two original ones. The drip tray shell will be connected to the base via two hex screws located at the position

indicated in step 0b of Table 10 . The front and back shells will use the same two hex screws to fasten themselves to each other and the base, located at the back of the product (step 4 of Table 10). To accommodate the use of screws, a hex key is provided.

The most novel action is connecting the three-way valve, which involves attaching it to three different tubes. This component is a critical part, and users should be familiar with its location and installation process.

The downside of this assembly scheme is that the PCB is positioned very low within it. This means that for any repairs, all other parts must be removed first to access the PCB. While not ideal, this has been deemed an acceptable compromise to lower the intimidation factor of the build by having the PCB preassembled, especially since users are not expected to repair electronic components themselves.

To conclude, three adaptations are proposed to align the Senseo model with the Made-By-You model: delivery in parts, scaffolding, and replacement of the current fastening methods. While the changes are small, these modifications aim to make users more familiar with their product's internal components and critical parts. The result is that the assembly process should become less challenging and more user-friendly by presenting more manageable parts and actions and maintaining a relatively low number of parts and steps. Nevertheless, it should not become too easy. Otherwise, the social utility of sharing their accomplishments will be lost (Norton et al., 2011).

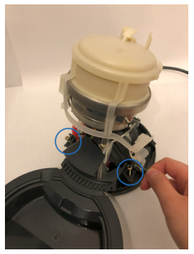
Step	Description	Picture
0a*	Ready the base.	
0b	Screw the drip tray shell to the base.	
1	Place the front shell in place.	
2*	Connect the three-way valve.	
3	Connect the top shell to the three-way valve and place it on the front shell using snap-fits.	

Table 10a: Assembly scheme of Made-By-You Senseo ('' are the steps with critical parts) (The model used is the previously mentioned prototype shown in Figure 42 and discussed in Appendix H, Prototyping of a Transparent Made-By-You Senseo) (part 1/2)*

Step	Description	Pictures
4	Connect the back shell to the three-way valve and place the back shell in place by screwing it to the front shell and base.	
5*	Place the water tank.	

Table 10b: Assembly scheme of Made-By-You Senseo ('' are the steps with critical parts) (The model used is the previously mentioned prototype shown in Figure 42 and discussed in Appendix H, Prototyping of a Transparent Made-By-You Senseo) (part 2/2)*

5.3.2 Customisation Possibilities for the Made-By-You Senseo

As mentioned earlier in section 4.3, the self-assembly feature allows the product to be more customisable, as certain parts can be adapted to the user's preferences without needing a specialised assembly line. This customisation makes the product more personal, increasing user attachment. Additionally, it creates excitement as the product takes shape, and users can feel proud of designing and assembling it themselves. This added benefit can convince users to choose this product over the conventional one.

In this product's case, certain parts make more sense to be customisable than others. In Table 11, the parts of the Made-By-You Senseo are discussed based on their feasibility for being customisable.

As seen in the table, the only parts that make sense to be customisable are the shells and water tank (Figure 43). This is because it requires no significant changes to the product's overall design. In contrast, the other parts either drastically impact

Part	Customisable?	Reason
The shells (drip tray shell, front shell, back shell, top shell)	Yes	The Senseo currently comes in various preset colours, and the ability to mix and match shells adds a personal touch to the user's product. Additionally, introducing a transparent option would offer a new opportunity for users to view the internal components, fostering a greater sense of familiarity with the product's inner workings.
The water tank	Yes	The water tank can be upgraded to a larger variant for those who require a larger water capacity. However, this modification will affect the product's overall shape. It is important to indicate this concern for users interested in this feature.
The base	No	While increasing the size of the pump and boiler would enhance the overall boiling water capacity, the main limitation of this is the use of coffee pads. Unlike simply enlarging the water tank to contain more water, this would necessitate a change in the product's overall design and category.
Three-way valve	No	The three-way valve is purely utilitarian and does not provide many possibilities for personal touches.

Table 11: Customisability of the parts

Figure 43: Customisation of the Senseo (Philips, n.d.-a; Philips, n.d.-c)

the product's shape or have no impact on the user experience when customised.

By making the shells and water tank customisable, users can design the Senseo based on their preferences and acquire a sense of ownership and achievement for their efforts. Additionally, the opportunity to provide transparent covers would allow people to gain a greater familiarity with their product.

5.3.3 The Made-By-You Application

In this section, the service part of the PSS will be explained and elaborated upon. As outlined in section 4.3, the service is an application designed to function as a centralised and streamlined information hub. Its primary goal is to facilitate access to assembly and repair information for the company's products, thereby reducing user barriers to acquiring information. The service achieves this through four key methods: providing manuals, utilising algorithms for problem diagnosis, setting clear expectations for recommendations, and connecting users to the appropriate resources.

Based on Senseo's review of the guidelines, the application should also prioritise enhancing user interaction with manuals by incorporating digital features. Additionally, the application should educate users about their options for dealing with a malfunctioning product, including the possibility of repair. Furthermore, it should provide information on where to acquire spare parts, making the entire process more streamlined and centralised.

A storyboard is created to make the user journey more clear. In the storyboard, a Made-By-You Senseo is assembled (Figure 44) and a repair job is performed (Figure 45). The stories are based on the flowchart of Figure 27. The storyboards depict the journey of a woman who ordered a Made-By-You Senseo and demonstrate how she uses the application's various functions (highlighted in bold and blue text). These functions were previously discussed in section 4.3 and Figure 28. For a better understanding of the concept, a short video has been created based on the storyboards (youtube.com/watch?v=OucIFC-FWE0).

The user uses a digital assembly manual in the storyboard. Unlike the digital repair manual, it does not need a problem diagnosis or a repair expectation and recommendation function. Nevertheless, the digital version also has advantages over the paper version. As mentioned earlier in section 4.3, the digital version can be enhanced to improve the user experience. This can take shape in the form of searchability, interactive elements,

Figure 44: Storyboard of using the application to guide the assembly of the Made-By-You Senseo

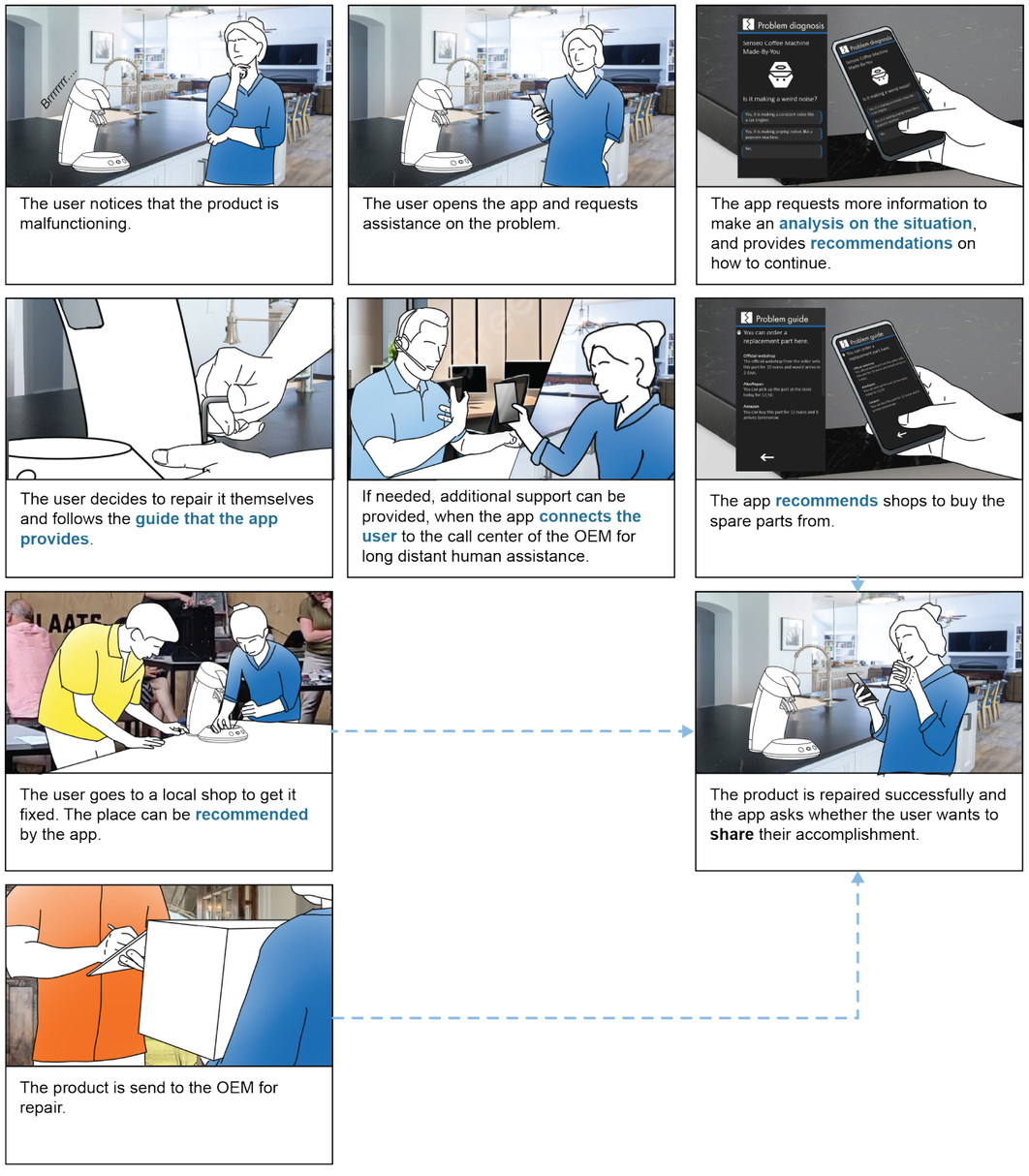


Figure 45: Storyboard of using the application to guide the repair process, three different scenarios are shown

retrievability, accessibility, and customer service integration. While a digital manual is not always expected to have all these features, these are a list of options that digital manuals can use to improve the user experience. Figure 46 shows how the desired features have been integrated into the application.

Furthermore, three scenarios are shown in Figure 44. In this story, the user can choose three different methods to repair her product.

- Repair it themselves

  In this scenario, the user deems the repair job doable themselves based on the expectations that the application provided (e.g. how long the repair takes, how hard it is to perform, what kind of tools are needed, etc.). The user is provided with a manual that is specific to their problem based on the earlier problem diagnosis. Similar to the assembly process, customer service integration is also available. If spare

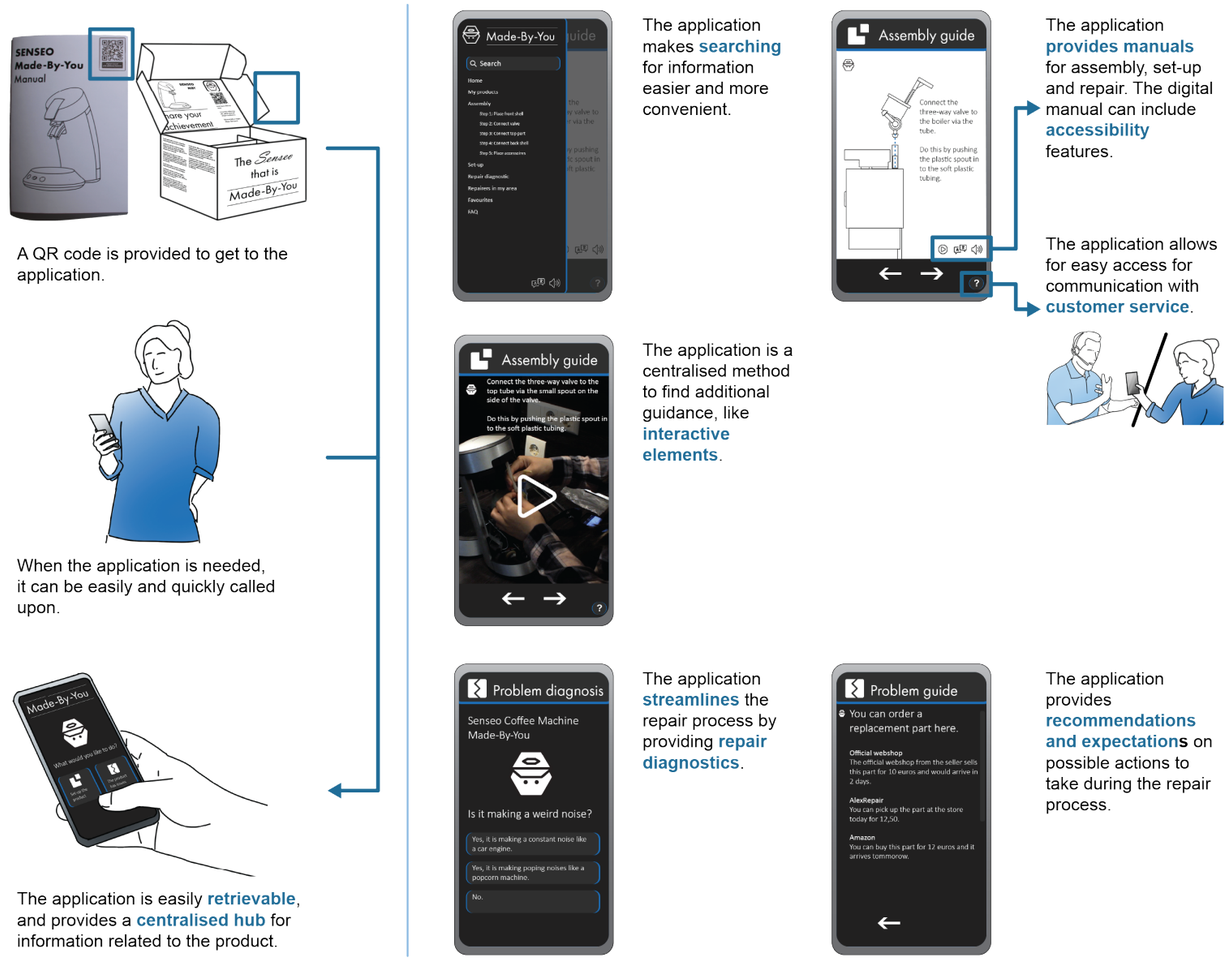


Figure 46: The application

parts are needed, the application will also provide recommendations on where to acquire these parts (e.g. the official store, wholesalers, etc.).

- Acquire assistance from a local repair shop

  In this scenario, the user considers the repair job too difficult to perform on their own and seeks assistance from a local repairman. They may prefer this option over sending the product to the OEM for reasons such as being out of warranty, cost, or time considerations. The application will offer recommendations and set expectations for local repair shops in the user's area.

- Send to OEM for repair

  In this scenario, the user opts to send the product to the OEM for repair. This preference might be due to the product still being under warranty, the complexity of the repair, cost considerations, or time constraints. The application will provide the user with the necessary information on how to proceed.

Service blueprints (Figure 47 and Figure 48) offer a detailed view of the service ecosystem, highlighting the backstage processes necessary for the previous customer journey. These figures reveal opportunities for the application to collect data on critical product components and the assembly process. This data can then be leveraged to enhance the repair and assembly of the product.

Additionally, the figures suggest that developing the Made-By-You application requires several investments required by OEMs: a new factory line, an enhanced digital manual, and additional customer service desks or a chatbot. These elements necessitate investments and time to implement, which may pose a challenge to the development of the service system.

It is evident that substantial investments are needed to develop the application and the supporting backstage infrastructure for OEMs. However, the application development could potentially receive EU funding as it aligns with the EU's Right-to-repair Bill (previously discussed in section 2.4.1). The application supports the EU's plan to create platforms that provide information on repair conditions and services, thereby aiding consumers in assessing repair information, including potential defects and local repair services (Yakimova, 2024).

While development could be funded via investors like the EU, the service should also be able to be sustainable in the long term. One viable option is to charge OEMs for access to the valuable data collected about their products. This data would be of significant interest to OEMs, as it can inform them about possible improvements in product design, assembly, and repair processes. This service can generate a steady revenue stream by monetising this data, contributing to its financial sustainability.

To conclude, this section delved into the service aspect of the PSS, specifically focusing on the application designed to centralise and streamline information related to assembly and repair. By providing digital manuals, leveraging algorithms for problem diagnosis, setting clear expectations, and connecting users to resources, the application aims to reduce user barriers and enhance the overall user experience. Additionally, the application aligns with EU initiatives, potentially securing initial development funding. Leveraging the valuable product data collected can achieve long-term viability.

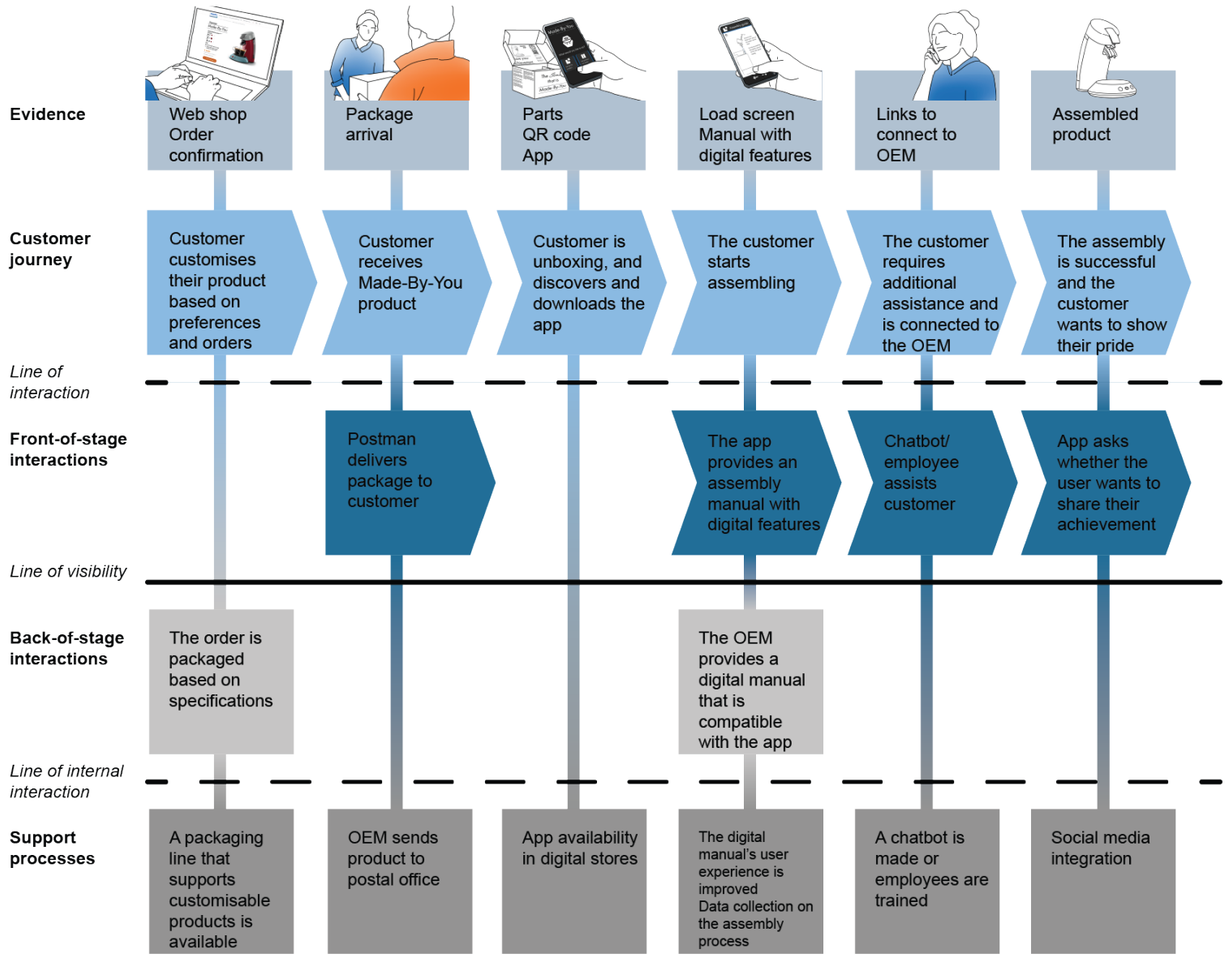


Figure 47: Service blueprint of the application during assembly

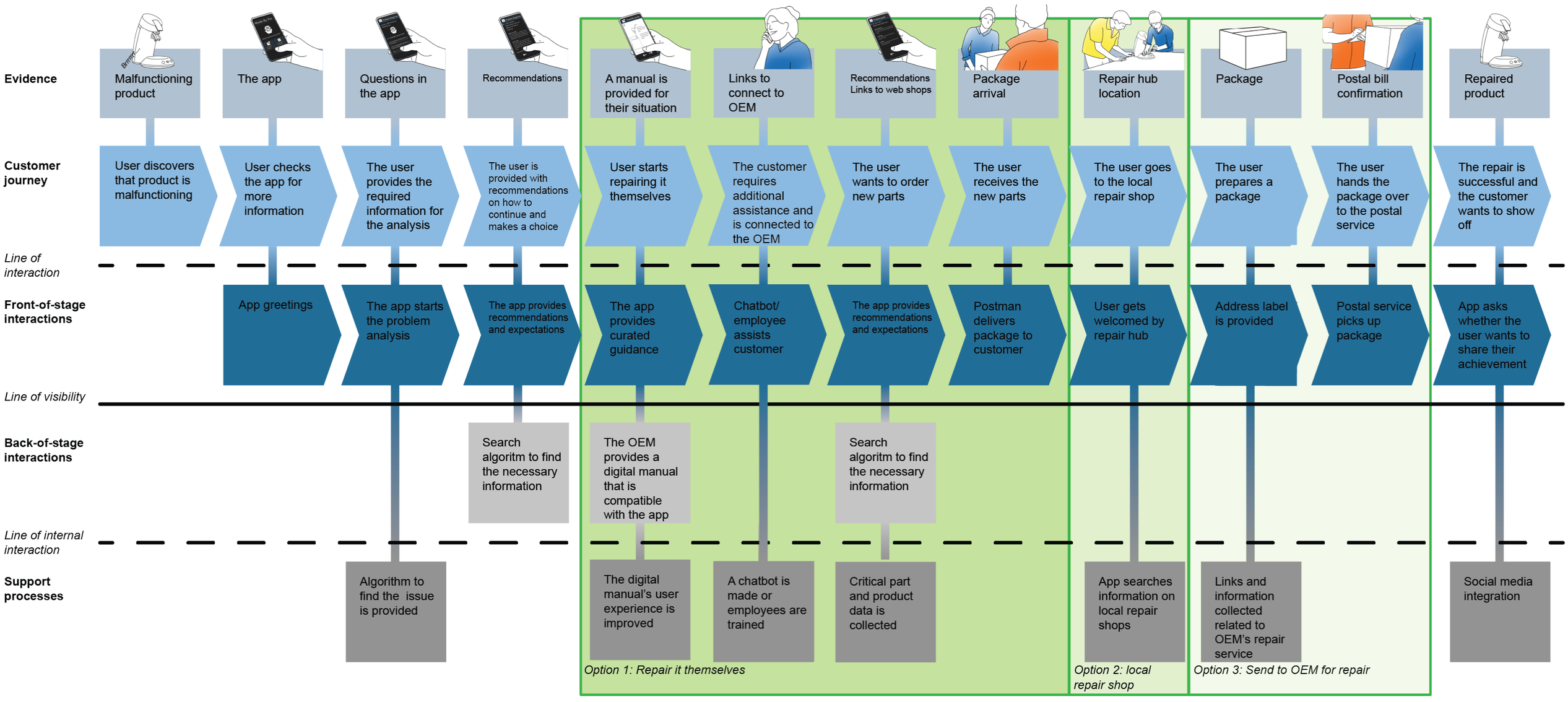


Figure 48: Service blueprint of the application during repair

5.4 Proof of Concept Development Conclusion

In this chapter, a proof of concept has been developed in the form of a Made-By-You Senseo. It started by gathering guidelines to assist in redesigning the Senseo towards a more assemblable and repairable model. Based on those guidelines, the Senseo has been reviewed and modified into a Made-By-You PSS.

The Made-By-You Senseo is a customisable pad coffee machine designed for customer assembly. This is achieved in three ways: by adding scaffolding, relocating screws, and providing the components in preassembled parts. While the design modifications are minimal, the most important factor is how people perceive the difficulty of the assembly, which has been lowered with the small design changes. This has mainly been achieved via the way the product is presented out of the box.

Additionally, the product is supported by an application that centralises and streamlines information related to assembly and repair. The Made-By-You concept eliminates the need for extensive assembly lines, allowing customers to personalise their Senseo to their liking. It is ideal for individuals who desire a unique, custom coffee maker and are comfortable assembling it themselves.

This has demonstrated that adapting an existing product to this concept is possible without requiring a complete redesign. The Made-By-You Senseo is evaluated in Table 12 against the original Made-By-You concept from section 4.3. This table shows the initial review based on the design criteria established in the vision of the general Made-By-You concept (from Table 2) and compares it with the review of the Made-By-You Senseo. This side-by-side comparison highlights differences between the concept and its execution, allowing us to assess how effectively the concept has been adapted into a product.

The table indicates that the concept has been adapted successfully into a product, with the proof of concept incorporating the initial points, such as targeting the applicable WTR barriers (Figure 49), its ability to change user behaviour by following the I-change model, tackling the targeted opportunities, and instilling the desired product interactions.

Because it has been translated successfully, it also retains some of the original shortcomings. The proof of concept, similar to the initial concept, does not stimulate direct awareness about repair. Instead of actively promoting repair, it increases users' awareness of the product's components, indirectly encouraging them to consider repair options.

Additionally, this product targets a niche audience, those who desire custom products and are comfortable with self-assembly, rather than a mainstream audience. Nevertheless, for those users, it has the potential to instil a sense of pride in them after successful assembly and create excitement about bringing their customised design to life. This accomplishment can motivate users to showcase their unique Senseo to their peers, further enhancing their satisfaction and social engagement, which may invite a larger target group to try the product.

To conclude, the proof of concept has demonstrated that the Made-By-You concept can be successfully adapted to an existing product (in this case, a 'workhorse' product). Although modifications are needed to make the original product more user-friendly for assembly and repair, and additional investments are required to support the PSS, redesigning a product is achievable. Additionally, the concept has shown potential for enhancing user engagement and satisfaction through customisation and personal accomplishment.

Figure 49: WTR barriers that Made-By-You improves

Category	Aspect	Review Made-By-You	Review Made-By-You Senseo
The concept addresses the WTR barriers			
WTR barriers	Unawareness	It makes people more aware of what is on the inside and what repair options are available. However, it does not advertise itself as a repairable product.	Similar to the initial concept, the product actively fosters awareness about repair. Instead of directly promoting repair, it increases users' awareness of the product's components and indirectly encourages them to consider repair options.
	Desire for new product	While the product may create attachments, it does not discourage the user from buying new products.	Like the initial concept, the product can create attachments due to customisation, but this does not stop the desire for novelty.
	Lack of engagement	It introduces engagement and social value due to the customisable nature of the product.	It introduces sharable moments by creating unique experiences, such as assembling your unique Senseo. Furthermore, the application allows for quick sharing.
	Lack of trust in repair	By introducing clear expectations and recommendations about the repair process based on customer needs, trust can be created.	The application provides a centre for repair information, with clear recommendations and expectations of repair (services), becoming a trustworthy source.
	Fear for further failures	This concept aims to tackle the barriers of further failures and provide clarity by familiarising people with handiwork.	The product familiarises people with handiwork specially tailored to the product itself (like critical parts); furthermore, by providing clear and adequate guidance via the application, fear can be alleviated.
	Lack of clarity		
	Lack of attachment	It could create attachment to the product, since the user had to assemble it themselves, creating a unique bond with the product. Furthermore, if the product is customised, personal value will be added.	Since the shell and water tank can be customised to the user's preferences, each product will be unique and tailored to the user's needs. Furthermore, the labour needed to assemble the product can introduce the 'Ikea-effect', which may create an attachment to the product.
The concept is tackling new opportunities			
Opportunities	Against the mainstream	The product is not targeted towards the whole public since not everyone wants to customise or build their own products.	The Made-By-You Senseo targets a niche audience of individuals who want to customise their coffee experience and are willing to assemble their own products. While this desire may not appeal to everyone, it has the potential to reach a dedicated segment of consumers. Moreover, it can attract those initially interested in customisation who may become more aware of and open to repair due to the hands-on nature of the product. This dual focus on customisation and repair can foster a broader awareness and appreciation of product maintenance among users.
	Barrier of entry problems	The concept lowers consumers' need for advanced knowledge around repair due to easy-to-access and understandable information.	This product is designed for individuals with limited handiwork skills. It features an easy assembly process and provides clear, understandable instructions, ensuring no prior skills or knowledge are needed.
	Unexplored opportunities	It is aiming to increase attachment towards the product, which no initiative has targeted yet.	Offering customisation options, such as interchangeable shells and adjustable water tank capacities, allows individuals to tailor the product to their specific needs and preferences. This personalisation can foster a sense of attachment and social value, which are currently unexplored opportunities.
	Lack of initiatives	It is a more personal and intimate project than widespread governmental ones.	The product targets a small-scale audience with a product tailored to their needs.
The concept is in line with the I-change model			
I-change model	Predisposing factors	The product aimed at familiarising people with the DIY assembly/repair concept. This would increase the overall attitude and efficacy towards them and create a repair culture.	The product familiarises people with assembling a Senseo, and while it actively encourages repair, it does provide a viable option to consider. This may create a start towards a repair habit/culture.
	Information factors	The general knowledge will be higher by providing the user with easy-to-understand information on repair.	The application centralises the information provided regarding repair. This ensures that clear, relevant, and streamlined information is provided.
	Awareness factors	While people become aware of assembly, it does not necessarily make them aware of repair.	The product aims to foster awareness about repair actively. Instead of directly promoting repair, it increases users' awareness of the product's (critical) components and indirectly encourages them to consider repair options.
	Motivation factors	The product aimed to familiarise people with the repair concept via an initial assembly and information spread. This would increase the overall attitude and efficacy towards repair and create a repair culture.	Providing easy-to-understand repair guidance boosts individuals' confidence in their repair skills and can lead to a more positive attitude towards handiwork, especially after successfully assembling the Senseo. Additionally, the sense of accomplishment from this achievement offers significant social value.
	Ability factors		The need to assemble the product first will increase people's overall handiwork ability. These abilities, skills, and knowledge (about critical parts) can be transferred to the repair process.
The design contains the following qualities			
Qualities: Showing off your driving skills	Proud	People will feel proud of their accomplishments and are excited by showing them off to their peers.	Successfully assembling the product instils a sense of pride in users, especially when they are excited about the prospect of seeing their customised design come to life. This accomplishment can motivate users to showcase their unique Senseo to their peers, further enhancing their satisfaction and social engagement.
	Excited		
	Sharing		

Table 12: Review Made-By-You Senseo compared to the initial concept based on the criteria

6 Discussion and Conclusion

This chapter critically examines and discusses the project, ending with an overall conclusion.

6.1 Discussion

6.2 Conclusion

6.1 Discussion

The study began by exploring opportunities to encourage people who typically do not repair electronic devices to increase their willingness to repair. Seven barriers were identified as obstacles to this goal. While initiatives already exist to reduce these barriers, additional opportunities were discovered by integrating these initiatives with a consumer decision-making model, the I-change model. These opportunities and the project's design direction guided the design, resulting in the Made-By-You electronics concept.

This concept could stimulate a willingness among consumers to repair, which has been deemed one of the main challenges of repair (Roskladka et al., 2023). It allows users to familiarise themselves with assembling a product that they have designed themselves. This is supported by an application that provides streamlined instructions for both assembly and repair. While it is feasible to translate the concept successfully, it did not improve on the initial concept. The main downside of the design concept is that it does not directly increase awareness of repair. Instead of directly promoting repair, it increases users' awareness of the product's components and indirectly encourages them to consider repair options.

The proof of concept demonstrated that redesigning an existing product into an assemblable model is feasible with minimal design changes. These changes included replacing snap-fits with screws to facilitate repairs and adding scaffolding to reduce the intimidation of assembly. The key factor in the design's 'assemble-ability' is its packaging and presentation to consumers, ensuring that parts are neither too numerous nor overly complicated and that assembly requires only a few steps. As stated by Norton et al. (2011), the 'assemble-ability' of the product should not be too hard or too easy; otherwise, an increase in the valuation of DIY products would not be achieved alongside the potential social utility of the product (e.g. bragging rights). The Made-By-You design aims to be in this sweet spot.

Allowing users to design and assemble the product themselves introduces customisation features, enabling them to tailor the product to their specific needs and preferences. This makes the Made-by-You Senseo more desirable to specific customers than the original Senseo. However, the self-assembly nature of the product might deter some individuals, potentially limiting the product's mainstream appeal. Nevertheless, customer-assembled products could serve as a stepping stone to mass customisation, which is anticipated to play a more significant role in the future of manufacturing (Prendeville et al., 2016). This customisation may also lead to product care, as Ackermann et al. (2021) indicated.

The entire process is supported by a service that centralises and streamlines product assembly and repair information. The application employs traditional and simple search algorithms to analyse product malfunctions, making it quite feasible to develop. The application aligns with the EU's Right-to-Repair Bill (Yakimova, 2024), which could provide financial support for its development, enhancing the product's viability initially. Additionally, the application can collect data on the product, such as critical part information and the assembly process. Since product data across the product lifecycle is a valuable asset for OEMs to have (Rusch et al., 2022). Providing this information to them can be seen as a potential revenue stream.

While the concept initially only aimed to stimulate repair by improving people's willingness to repair, it also improved upon the barriers of the technical possibility of repair and convenience to repair. These were the other levels mentioned in the consumer barriers of repair pyramide in section 2.1. The technical feasibility of repairs was increased by making the Made-By-You Senseo easier to assemble and disassemble, improving access to spare parts, enhancing manuals, providing diagnostic access, and introducing different fastening methods. Repair convenience has been improved, with a reduced repair time due to a streamlined information-gathering phase. Although not part of the original design vision, overcoming these barriers proved beneficial overall. As noted in section 2.1, all barrier levels interact to influence consumers' repair decisions and should thus all be improved.

Nevertheless, the study has limitations, primarily the lack of user testing due to time constraints. Future research could build on this design concept, developing and testing it in greater detail to address these limitations. In terms of development, attention can be given to factors such as the amount of additional packaging material required or how well the structural integrity keeps up after the redesign. Other future research can use the unutilised opportunities and barriers as a starting point to design new concepts to stimulate WTR.

6.2 Conclusion

The study began by exploring opportunities to encourage people who typically do not repair electronic devices to increase their willingness to repair (WTR). Through this exploration, seven barriers to WTR were identified. Using the I-change model to analyse the current context regarding WTR, several opportunities were found that could stimulate WTR.

This design direction resulted in the development of a product-service system (PSS) named Made-By-You.

The Made-By-You concept includes electronics that users can design and assemble themselves and an application that centralises and streamlines information gathering around the product's assembly and repair. This approach aims to raise users' awareness of the product's components and indirectly encourage repair considerations. Providing a central hub for all product-related information makes the repair process more straightforward and accessible. A proof of concept was developed to demonstrate the feasibility of translating this idea into a tangible product.

While the research outlines several opportunities to enhance WTR and presents a design that could achieve this, it was limited by time constraints, preventing a user test from being conducted. Such an evaluation could have offered valuable insights into the concept's effectiveness. Despite this limitation, the research marks a step towards increasing WTR. Future research could further develop and test the concept in detail, or other designers might build on these identified barriers and opportunities to create their own innovative solutions.

In conclusion, the research identified opportunities to stimulate WTR for electronics and introduced a design promoting repair through self-assemblable electronics. Although the design has yet to be evaluated by a target group, it can serve as a foundation for future advancements in this field.

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Appendices

8 Appendix A, Table of All Considered Initiatives

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16 Appendix I, Project Brief

8 Appendix A, Table of All Considered Initiatives

Barriers	Initiatives	Description	Explanation for placement	Reference	#
Unawareness of repair impact and lack of repair habit	Circulair Ambachtscentrum	A place where a recycling centre, thrift store, and repair workshop are combined into one. They also offer lessons in schools. It is organized by municipalities and multiple related organizations.	It teaches people about repair skills and how to do it themselves.	https://circulairambachtscentrum.nl/	1
	De Week van de Circulaire Economie	It is a week dedicated to the Circular Economy. It is meant to raise awareness, inspire and assist in networking for entrepreneurs (more on this in Appendix B, Field Visits).	It increases engagement in repair by making it an event and some workshops are showing how repair works.	https://deweekvandecirculaireeconomie.nl/	2
	DIY encouragement	Commercial repairers and other organizations are encouraging and assisting with DIY repairs.	DIY repair is being encouraged and supported. Awareness is also raised.	European Environment Agency (2022)	3
	Mileu Centraal	A guide made by the government to encourage and inform people about sustainable behaviour and repair.	By spreading information from a qualified source, it can create awareness.	https://www.milieucentraal.nl/	4
	Stichting Technotrend	An organization that offers teaching material focused on circular skills and repair for primary and high school.	It teaches people about repair skills and how to do it themselves.	https://stichtingtechnotrend.nl/	5
	Repair Café (Delft)	Free shops that offer repair knowledge, skills, materials, and equipment. Run by volunteers who assist a person in repairing their products.	It teaches people about repair skills and how to do it themselves.	https://www.repaircafe.org/ https://repaircafedelft.nl/	6
	The Restart Project	An organization which runs repair events where people learn how to fix their electronics.	It teaches people about repair skills and how to do it themselves.	https://therestartproject.org/	7
	Repair voucher Vienna/ Austria	An incentive provided by the Austrian government to encourage people to repair. It is also tied to a Repair Register, to show who is viable for the voucher.	By promoting this campaign, they are creating awareness. And by lowering the initial cost, the barrier of entry is lowered to create a repair habit.	https://mein.wien.gv.at/wienerreparaturbon/#/ https://repair.eu/news/austria-launches-a-nation-wide-repair-bonus-scheme/ https://www.wien.gv.at/umweltschutz/wienerreparaturbon.html	8
	The Sharepair project	Cities that are working together and sharing information on how to introduce repair.	It creates awareness among political leaders on how repair should be implemented.	https://www.sharepair.org/	9
	Influencers	Online, there is a growing presence of influencers who are sharing repair-related content.	By sharing their content, they are making more people aware of it.	https://www.youtube.com/@electronicsrepairschool/videos https://www.instagram.com/digytronix/ European Environment Agency (2022)	11
	The French repairability index	An index similar to the energy label, that shows how repairable a product is.	By having a label on a product, more people become aware of this phenomenon.	https://www.indicereparabilite.fr/	17
	The Right-to-repair Bill	A bill from the EU which aims to stimulate repair in 5 ways (more on this in section 2.4.1).	The bill aims to inform and provide information to make people more aware of their repair options.	(European Commission, 2023; Yakimova, 2023)	19
Desire for new products or features	-	-	-	-	-

Table 13a: Initiatives related to WTR (part 1/3)

Barriers	Initiatives	Decription	Explanation for placement	Reference	#
Lack of engagement and popularization of repair	Branded repair options	Big brands (e.g. Nike, Uniqlo or Apple) are offering in-store repair options.	Big brands can put repair in the mainstream discussion.	https://www.vml.com/insight/the-future-100-2023	10
	Influencers	See earlier	Influencers are popularising repair and thus increasing social engagement.	https://www.youtube.com/@electronicsrepairschool/videos https://www.instagram.com/digytronix/ European Environment Agency (2022)	11
	iFixit	A website that provides manuals and a community to help people fix their products.	It provides an online community to engage yourself in and find like-minded peers around repair.	https://www.ifixit.com/	12
	Store insurance from resellers	A reseller that offers their insurance for all their electronics with clear descriptions.	While not as big of a brand like the big brands, they are still able to put repair in the minds of the consumers.	https://www.mediamarkt.nl/nl/specials/verzekeringen	13
	Circulair Ambachtscentrum	See earlier	By giving classes, they are able to engage a group of people in a discussion.	https://circulairambachtscentrum.nl/	1
	De Week van de Circulaire Economie	See earlier	An event in which people are encouraged to talk with other people about repair and circularity. Thus, new social connections are being formed that are increasing engagement levels.	https://deweekvandecirculaireeconomie.nl/	2
	Stichting Technotrend	See earlier	By giving classes, they are able to engage a group of people in a discussion.	https://stichtingtechnotrend.nl/	5
	Repair Café (Delft)	See earlier	It is a social event where people come together to repair. Thus, new social connections are being formed that are increasing engagement levels.	https://www.repaircafe.org/ https://repaircafedelft.nl/	6
	The Restart Project	See earlier	It is a social event where people come together to repair. Thus, new social connections are being formed that are increasing engagement levels.	https://therestartproject.org/	7
	The Sharepair project	See earlier	It creates engagement among politicians to work on repair.	https://www.sharepair.org/	9
Lack of trust in repair services	Repairers Register	A register in which repairers can register themselves. Registration requires a quality control check and is supported by the government.	This is a trusted source for people. Which provides information that can thus be trusted.	https://www.nationaalreparateursregister.nl/ https://installq.nl/ https://www.reparaturbonus.at/	14
	Minicopters	A repair service that livestreams their repairs.	By being able to view the repair job, the job becomes more transparent and thus more trustworthy.	https://www.minicopters.nl/	15
	Kaputt.de	A website that offers (video) manuals and transparent repair services for electronics.	They are very transparent about who they are and how they operate and are putting a lot of effort into making sure the customer is informed.	https://www.repaircafe.org/ https://repaircafedelft.nl/	16
	Repair Café (Delft)	See earlier	In the Repair Café, people are getting explicated told and shown what the repairer is doing in a one-on-one setting. Not only that but they are also encouraged to do some repairs themselves.	https://www.repaircafe.org/ https://repaircafedelft.nl/	6
	Branded repair options	See earlier	Not only do they attach the quality of the brand to the repair job, but they are also seen as the expert of their product.	https://www.vml.com/insight/the-future-100-2023	10
	Store Insurance from a reseller	See earlier	By attaching a trusted brand, the trust will also be transferred to the services that are offered.	https://www.mediamarkt.nl/nl/specials/verzekeringen	13
	The Right-to-repair Bill	See earlier	The bill aims to make the repair process more transparent and assure quality standards to increase trust.	(European Commission, 2023; Yakimova, 2023)	19
Fear for further failures	The French repairability index	See earlier	It is a label that clearly shows how easy it is to repair, which should lessen the fear for repair.	https://www.indicereparabilite.fr/	17
	Mileu Centraal	See earlier	By informing the consumer well about repairs, possible fears can be alleviated as it is a trusted governmental source.	https://www.milieucentraal.nl/	4
	The Restart Project	See earlier	By doing the repair with them, it should alleviate fears.	https://therestartproject.org/	7
	Repair Café (Delft)	See earlier	By doing the repair with them, it should alleviate fears.	https://www.repaircafe.org/ https://repaircafedelft.nl/	6

Table 13b: Initiatives related to WTR (part 2/3)

Barriers	Initiatives	Description	Explanation for placement	Reference	#
Lack of clarity on how repair works	ProjectBox	A box that brings together all the tools, manuals and items a person needs to complete a DIY project.	People are being taught how to complete a project and thus how it works.	https://agencyofdesign.co.uk/projectbox/	18
	Circulair Ambachtscentrum	See earlier	People are being taught how to repair and thus how it works.	https://circulairambachtscentrum.nl/	1
	De Week van de Circulaire Economie	See earlier	People are being taught how to repair and thus how it works.	https://deweekvandecirculaireeconomie.nl/	2
	Stichting Technotrend	See earlier	People are being taught how to repair and thus how it works.	https://stichtingtechnotrend.nl/	5
	Repair Café (Delft)	See earlier	People are being taught how to repair and thus how it works.	https://www.repaircafe.org/ https://repaircafedelft.nl/	6
	The Restart Project	See earlier	People are being taught how to repair and thus how it works.	https://therestartproject.org/	7
	iFixit	See earlier	People are being taught how to repair and thus how it works.	https://www.ifixit.com/	12
	Kaputt.de	See earlier	People are being taught how to repair and thus how it works.	https://www.kaputt.de/	16
	The French repairability index	See earlier	While it does not show how repair exactly works, it does show how easy it is to repair.	https://www.indicereparabilite.fr/	17
	The Right-to-repair Bill	See earlier	The bill aims to inform and provide information to make the process more transparent.	(European Commission, 2023; Yakimova, 2023)	19
Lack of attachment	-	-	-	-	-

Table 13c: Initiatives related to WTR (part 3/3)

		Barriers							WTR	I-change model						Factors
Name	#	Unawareness	Desire	Engagement	Trust	Fear	Clarity	Attachment	Total	Predisposing	Information	Motivation: Attitude	Motivation: Social	Motivation: Efficacy	Ability	Total
Circulair Ambachtscentrum	1	1		1			1		3		1		1	1	1	4
De Week van de Circulaire Economie	2	1		1			1		3		1		1	1	1	4
DIY encouragement	3	1							1					1	1	2
Mileu Centraal	4	1				1			2		1					1
Stichting Technotrend	5	1		1			1		3		1		1	1	1	4
Repair Café (Delft)	6	1		1	1	1	1		5		1		1	1	1	4
The Restart Project	7	1		1		1	1		4		1		1	1	1	4
Repair voucher Vienna/ Austria	8	1							1	1		1				2
The Sharepair project	9	1		1					2	1	1					2
Branded repair options	10			1	1				2		1		1			2
Influencers	11	1		1					2		1		1	1		3
iFixit	12			1			1		2				1	1	1	3
Store insurance from resellers	13			1	1				2			1				1
Repairers Register	14				1				1		1					1
Minicopters	15				1				1				1			1
Kaputt.de	16				1		1		2				1		1	2
The French repairability index	17	1				1	1		3	1	1	1		1		4
ProjectBox	18						1		1					1	1	2
Right-to-repair Bill	19	1			1		1		3		1		1			2

Table 14: Instance count of barriers and factors

9 Appendix B, Field Visits

During the study, visits were made to three different events during de Week van de Circulaire Economie (WCE) (English: the Week of the Circular Economy, initiative 2 in Appendix A, Table of All Considered Initiatives). A video showcase, a repair café and a circular festival were visited. While not all events were directly related to repair, it does show the general engagement in the circular economy.

9.1 Video Showcase

During the WCE, a video showcase of sustainable architecture is shown at the faculty of architecture at the Tu Delft (Figure 50). This showcase was available for the whole week. The exhibit included three stools, 2 headsets and a touchscreen TV. The TV showed 5 videos of architects who practice sustainability in their work. It is meant to inspire students to be more sustainable in their work.

During my time there, I noticed that it was poorly advertised. No posters or other kind of indicators were present to notify you about it. While it is in the main hall, it does not grasp your attention. Thus, whether the goal of inspiring students is achieved is debatable.

9.2 Temporary Repair Café

During the WCE, a temporary Repair Café was set up in the centre of Leiden. The event lasted two and a half hours and was located in a busy area (10 minutes away from the central station). This Café is normally not present here but in a different neighbourhood.

Figure 50: Video showcase

The Repair Café (Figure 51) had 2 people working there. In total, 5 objects were brought that day. There was also some media attention (however, the item in the newspaper was quite small). The visitors who were there were mostly friends of the staff or people who learned about the event via newspaper advertisements. Two people had already visited a café before.

Figure 51: Repair Café Leiden, the staff is on the right and a client is on the left (Zeeuwe & Kuipers, 2024)

Talks with visitors and observations were able to confirm earlier research. People brought their products here because they thought it was wasteful to throw them away. In a sense, they were motivated by the functional, emotional and social value of their products. The visitors also chose service over DIY as they lacked the knowledge and equipment to do it themselves (Figure 52).

They also trusted the repair more as they had to perform it themselves, which also made the process very transparent. While their initial goal was not to learn how to repair, they did enjoy the repair process themselves.

To conclude, people who went to this café were made aware of the event via different means, the people who went more often were also friends with the staff. While not all the products were there due to high attachment levels, it was an important motivator for a few of them.

Figure 52: Repair Café equipment

9.3 Circular Festival

A circular festival was held in Delft (Figure 53). This festival was a 4-hour long event in which lots of activities were planned. The festival had tours, information markets, swap events, workshops, lectures, and brainstorms (Figure 54). The municipality holds the festival in cooperation with local circular organizations. They were also the main advertisers.

It was quite busy with people ranging from young to old (the only age group that was absent were high schoolers). There was also some media presence in the form of the municipality's own media team, the organization's media personnel and two news websites. The visitors were from around the area and were generally already interested in sustainability.

9.4 Field Visits Conclusion

To conclude, the events held during the WCE ranged a lot in terms of the level of activity that was present and the number of people that showed up. All the people who showed up to these events were already interested in sustainability.

The main point of interest is that circularity and thus repair, is not yet an important topic for most people. This was evident by the lack of enthusiasm among high schoolers and the lack of attendance at the Repair Café. While the attendance level was high at the festival, everyone there already had an interest in circularity, and it did not attract those with lower interest levels. This means that actual engagement is still quite low despite the many initiatives surrounding it.

Figure 53: Circular Festival Delft

Figure 54: Events at the Circular Festival (top left: information market, top right: lecture, bottom left: sewing workshop, bottom right: clothing swap)

10 Appendix C, SWOT Table

Category	Strengths	Weaknesses	Opportunities	Threats
General	• Small and big events can target many barriers at once • Intensive sessions achieve more • Repairabilty index is considered for bigger implementation with revisions	• Intensive sessions require a lot of time • A certain level of motivation is required initially	• An initiative that targets all barriers is not present yet An initiative that targets all user-decision factors is not present yet • Novelty-seeking initiatives • Attachment initiatives	• The requirement of motivated people/repair heroes to activate the unaware
Predisposing factors	• Large-scale governmental projects	• Lack of bottom-up approaches • Very few initiatives	• More bottom-up approaches	• Acceptability by the current non-repair culture
Information factors	• Wide variety of quality sources • A tailored story for each group	• People need to be motivated to know more • Bad promotion of information-providing services	• Reaching people who are unaware	• A diluted/conflicting story • No one looks for it if no one offers it and vice versa
Motivation factor: attitude	• Large-scale governmental projects	• Lack of bottom-up approaches • Small amount initiatives • Generic catch-all approaches	• More bottom-up approaches	• Fighting against acceptability
Motivation factor: social	• Variety of social groups	• Current influencers are not prominent • Branded repair is not well-advertised • Low engagement levels	• Promotion of repair heroes	• The new product influencers • Not all want to associate with repair
Motivation factor: efficacy	• Wide variety of initiatives • Low entry barrier possibilities	• Most effective ones require lots of resources	• More knowledge conversion at low entry barriers	• Intensive events require the user to seek them out • Repair services require an extensive repair knowledge base to draw from.
Ability factors	• Repair workshops have a high success rate	• Extensive investment of people's time • Extensive investment of tools, skills, spare parts, and product information • High barrier of entry	• Low barrier of entry initiatives	• Adoption by a non-repair culture

Table 15: Expanded SWOT initiatives

11 Appendix D, Ideation Process

Morphological chart

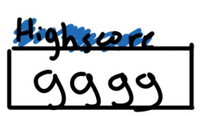
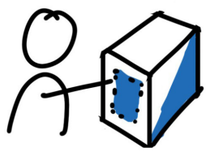
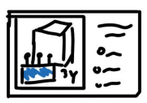
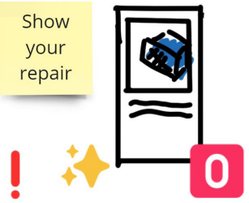
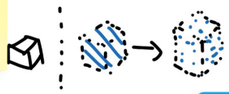
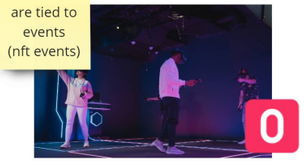
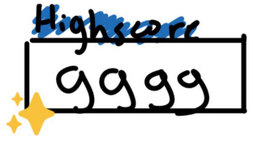
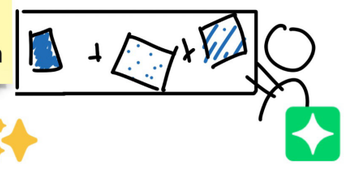
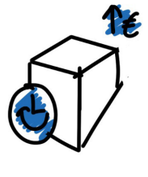
How to provide models	AI ad as yourself 	Show repair heroes 	Have a tv show,of how to live with repair 			
How to provide incentive	Score element 	Level up 	Old is worth more 			
How to make peole share	fragments when repairing 	Product diary 	Happy birthday for product 	Show your build 	Show your repair 	AR glasses record repair process 
How to create novelty	Product changes in digital world 	Products are tied to events (nft events) 	Products are upgradable 			
How to create engagement	Score element 	Level up 	Show your build 	Show your repair 	Happy birthday for product 	
How to create attachment	Own design 	Old is worth more 	Product diary 	NFT Owner list 		

Figure 55: Morphological chart

Proud

Excitement

Rewarding

Visible

Configurations

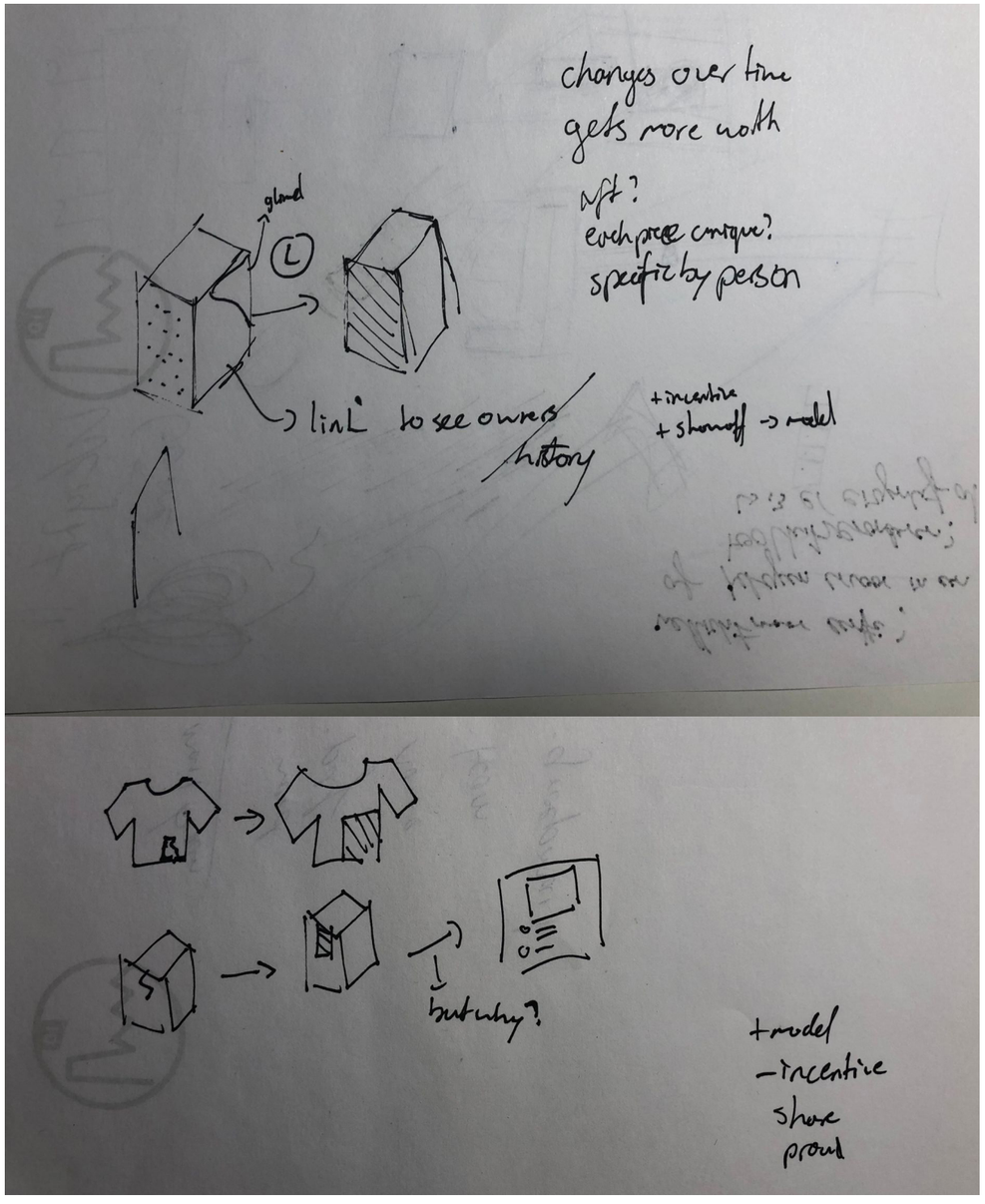


Figure 56: First sketches of Digital Product Twin based on morphological chart: Blue 1

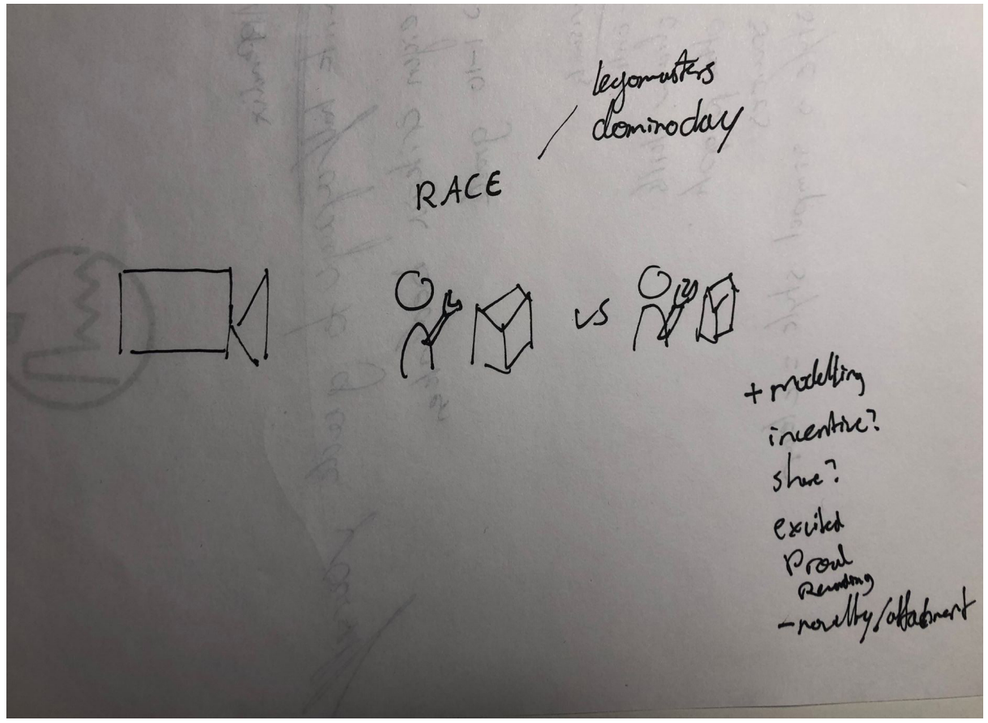


Figure 57: First sketch of NK Repair based on morphological chart: Orange Chinese symbol

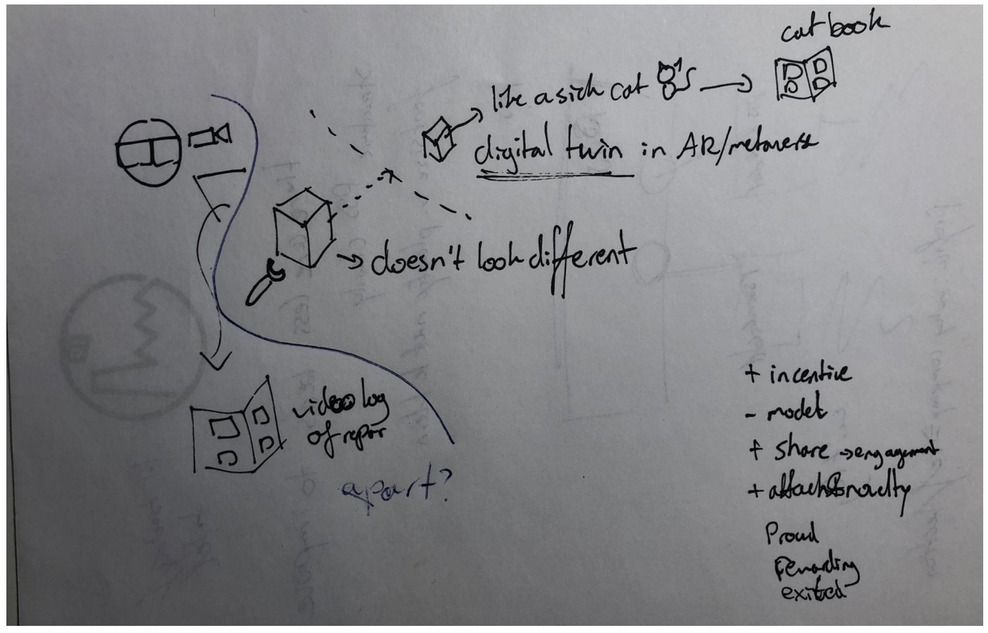


Figure 58: First sketch of Personified Product based on morphological chart: Green star

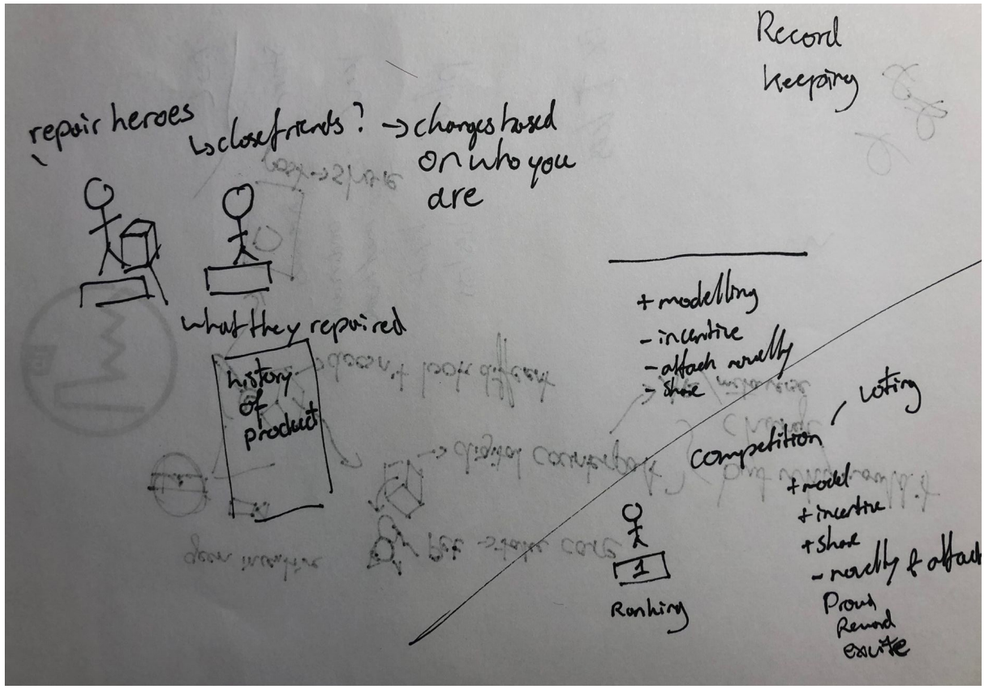


Figure 59: First sketch of Repair Heroes Exhibition based on morphological chart: Red 0

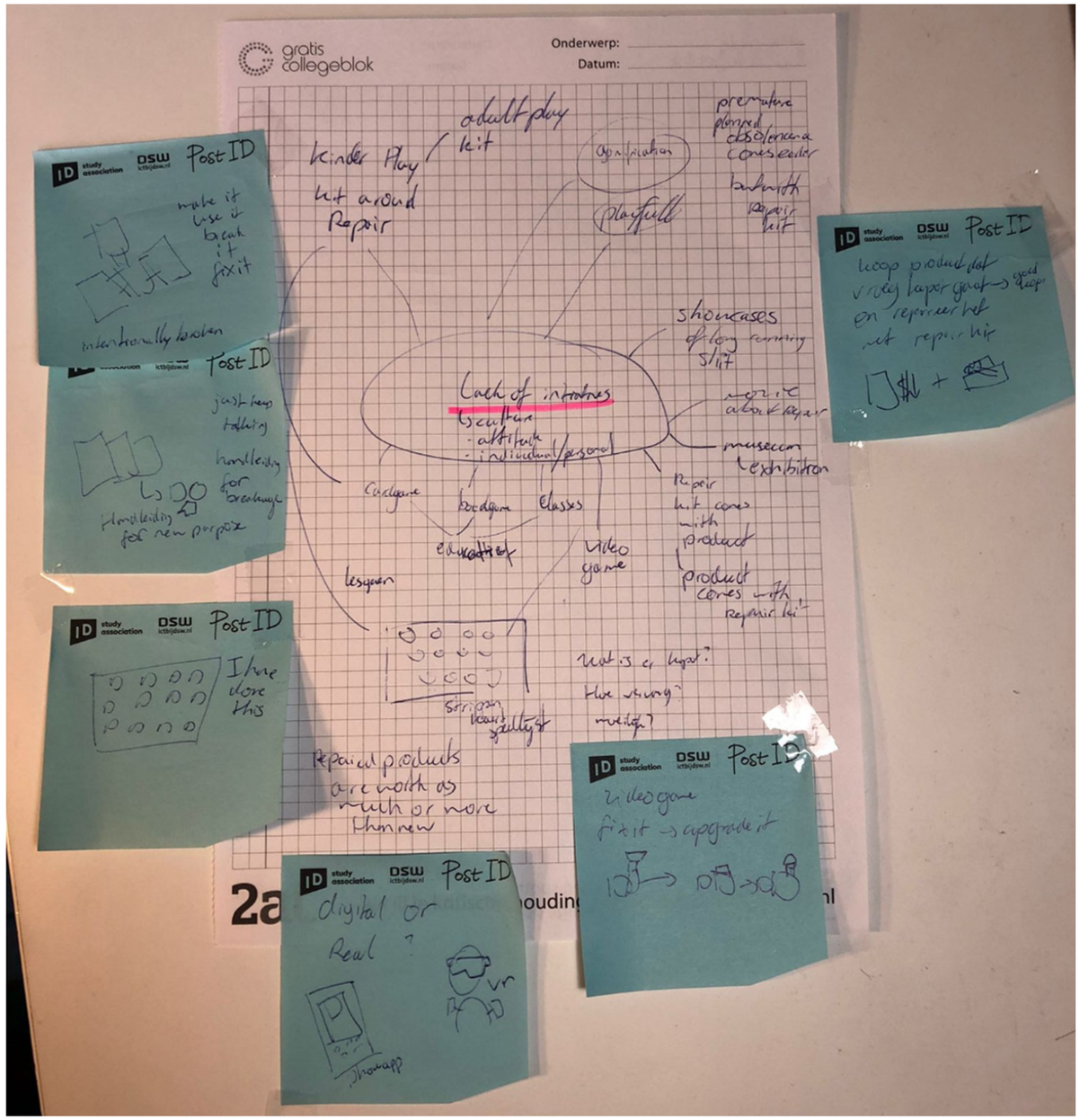


Figure 60: Brainstorm and scamper for Lack of initiatives opportunity

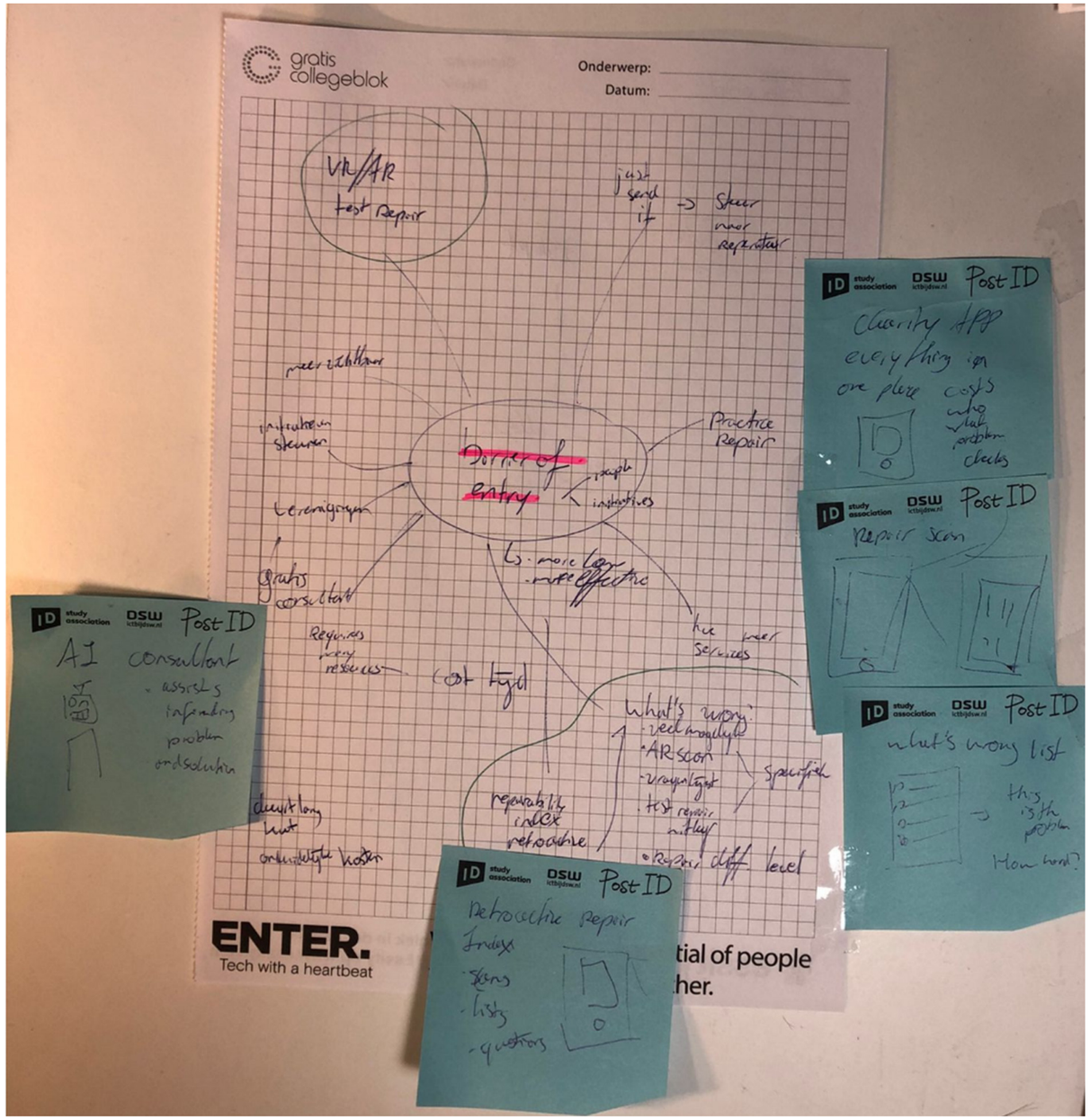


Figure 61: Brainstorm and scamper for Barrier of entry problems opportunity

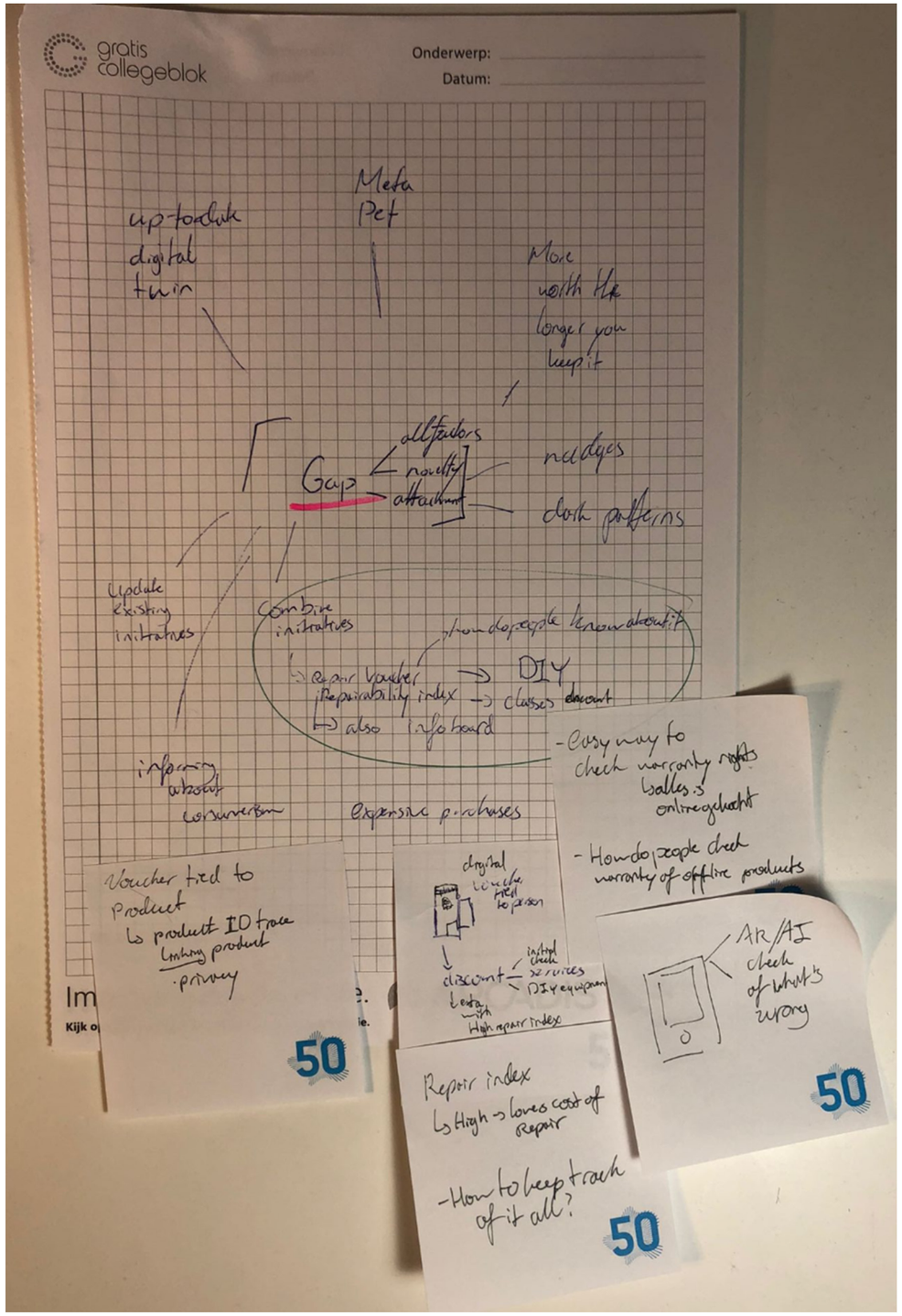


Figure 62: Brainstorm and scamper for Unexplored gaps opportunity

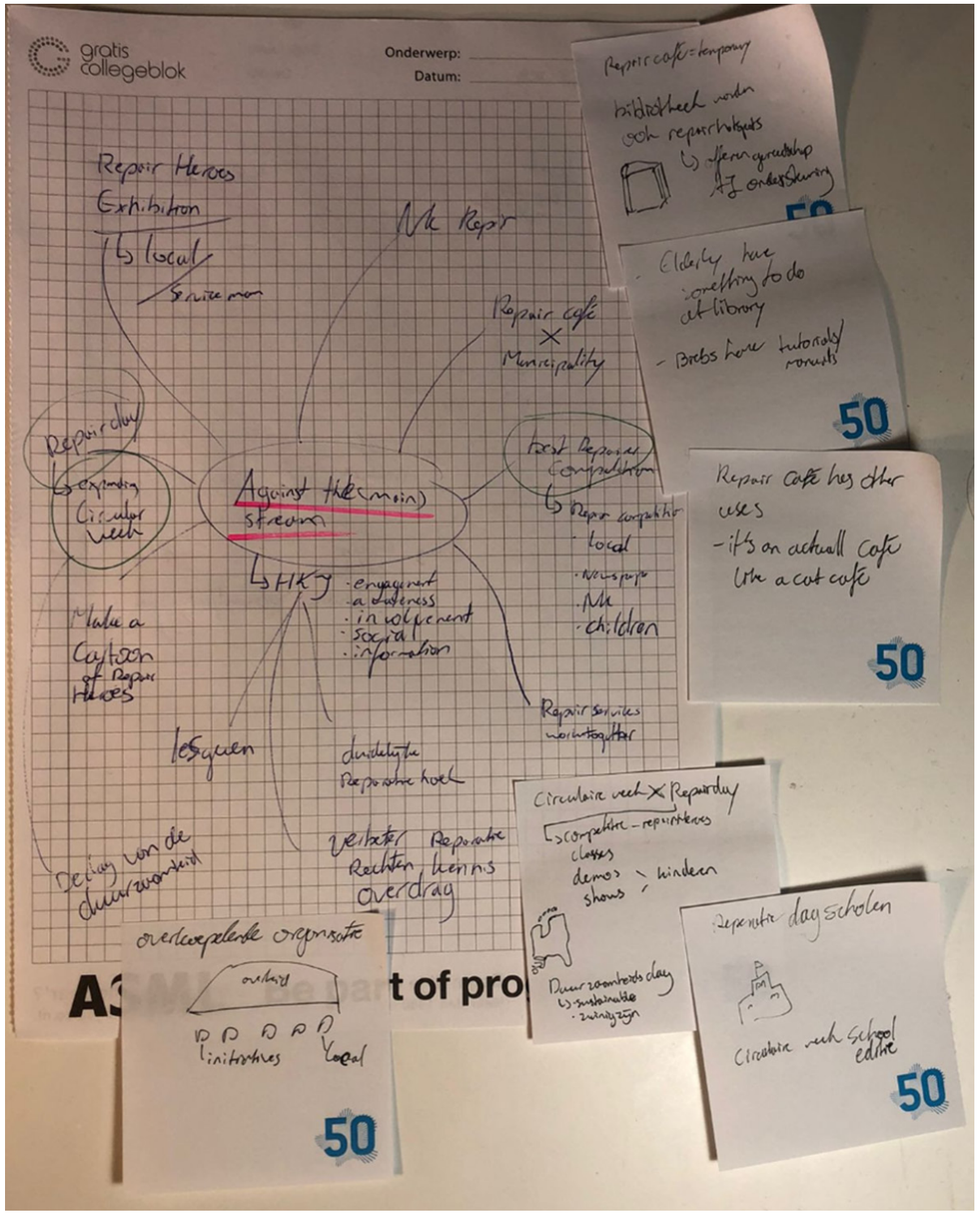


Figure 63: Brainstorm and scamper for Against the (main)stream opportunity

In the following sections, four concepts are presented that were developed in greater detail but have not been included in the main body of the project. This exclusion is primarily due to their misalignment with the overall design direction compared to the other concepts.

11.1 Digital Product Twin

This concept consists of two main parts, a digital and an analogue one (Figure 64). First off, the device's appearance changes based on the interaction with the user. It could for instance become shinier in places it is frequently touched, like statues. This will create a unique look that is personal to the user. This should create attachment levels and novelty which should negate the desire for new products.

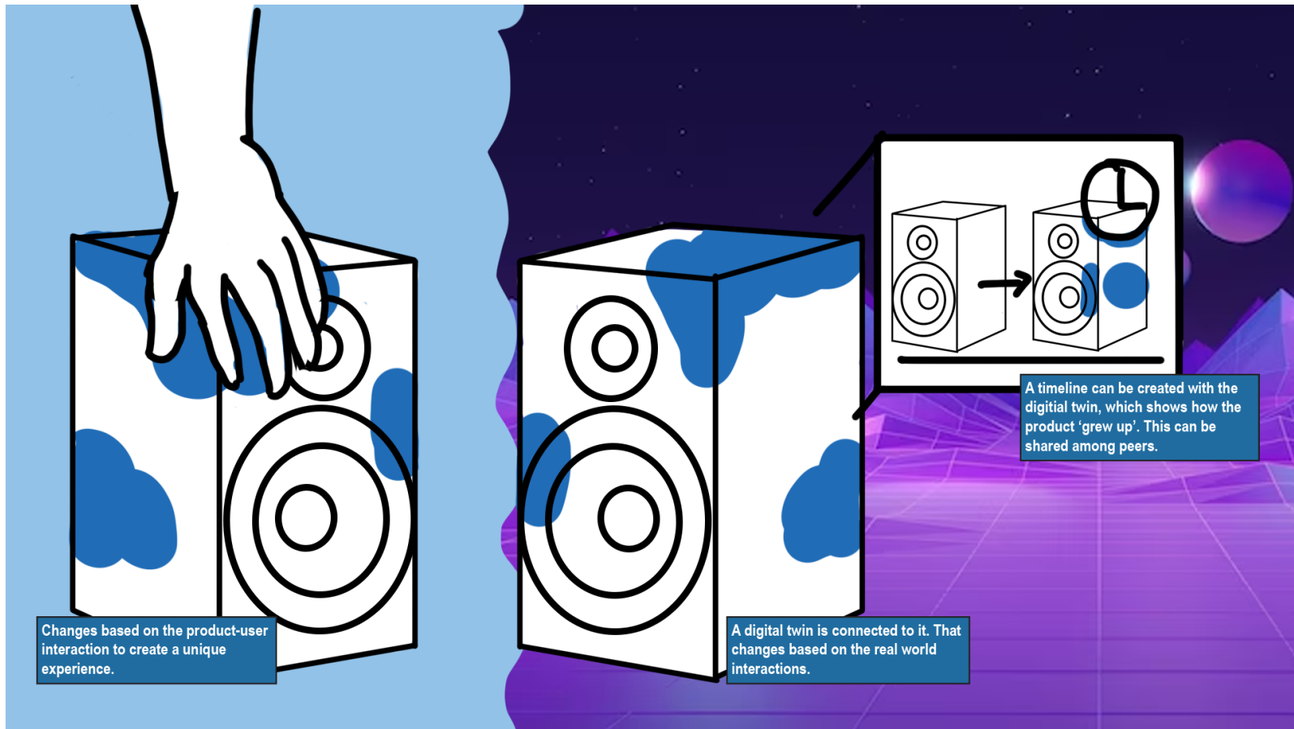
Secondly, the product has a digital twin connected to it. The digital twin changes based on the condition of the real product. This twin can be shown off in the digital world in its current form but can also rewind to show the process of change. This way, a kind of photobook can be created of the product, like that of a child growing up. This should create attachment and engagement, as people want to show their unique product off to their friends.

The concept creates an incentive for the user to keep the product longer and it excites the user with an ever-changing appearance. By sharing their stories, the users themselves become models for others to follow. It tackles the barriers of novelty, engagement and attachment. The concept is currently lacking in making the user feel proud about their accomplishments. It also does not stimulate repair directly but rather attachment levels as a proxy. Therefore, awareness and motivation for repair are not stimulated directly.

11.2 Repair Heroes Exhibition

Nowadays, engagement for repair (and general circularity) has been low. Despite the many initiatives that aim to create engagement. This is similar to how mental health was treated in the past. Nowadays,

Figure 64: Digital product twin concept



it is treated like an everyday topic that is discussed widely, and all people know at least something about it. This has been achieved by creating awareness and engagement in the topic, via dedicated events and days.

Currently, repair has similar events; however, they are all quite small-scale or aimed at a very specific audience, and they have been unable to gain a wider audience with them. This concept aims to create more engagement with the general public. It is an installation that shows up (Figure 65) (for instance, during the WCE). The installation contains displays that provide a podium for everyday repair heroes to be shown. These are not famous people but local people of the area to minimise the distance between the viewers and them.

The displays show the personal stories between them and their products, their motivations, their ability and their repair journey. The displays contain interactive elements to bring the story to life, by showing people how the repair job was done and bringing more interaction between the viewer and storyteller. This could be achieved via a touchscreen or an AR scanner. The installation aims to create engagement via local models. The models will feel proud and rewarded for their achievements, while also excited to show the world their story.

However, this concept has some downsides. It does not directly create an incentive for the viewers to repair. A way to mitigate this is by making it possible for the display to change over time to show new repair heroes. These new heroes would be inspired by the old heroes, thus there would be incentivization in the form of local recognition. This concept tackles the barrier of engagement, and a little bit of novelty-seeking and attachment by showing stories of those who overcame it.

11.3 NK Repair

NK Repair (Dutch Championship Repair) would be a competition to show the repair skills of the contestants (Figure 66). It is similar to old masonry competitions in the Netherlands, which were held to promote trade jobs. The result was that a lot of respect was generated for those jobs and more people joined the trade. Nowadays similar events are Domino Day and the show Lego Masters.

It would be a competition to showcase how repair is done on products, but also to tell stories about their motivations or why they chose to repair. Similar to Repair Heroes Exhibition, it tackles the barrier of engagement, and a little bit of novelty-seeking and attachment by showing stories of those who overcame it. It brings respect and pride to the repairers, and excitement and reward in the form of a competition. While it is not focused on providing direct incentives to be motivated to repair yourself, it does motivate you via modelling.

11.4 Personified Product

The personified product is a concept that consists of two parts, like the Digital Product Twin a digital and analogue part. On the analogue part, while the product does not change visibly, it contains IOT sensors to determine its current status. On the digital side, the product has a ‘twin’ that is a personified version of themselves in the form of a pet (Figure 67). For instance, while the product in the real world is a toaster, in the digital world it is a toaster cat. It can be compared to a Tamagotchi.

The digital counterpart will behave and look differently depending on the state of the real-life counterpart. This means that the digital version will act sickly when the product is malfunctioning. The intention of this is that people will want to take care of the pet, which means that repairing the malfunctioning product would make it feel better. People will feel proud of their accomplishments and want to show off their healthy pet in the digital world.

This concept aims to make repairing more rewarding by attaching a digital personified version of itself that reacts to the caretaking process. By seeing a healthy pet, the owners would feel proud of themselves and excited by the positive reactions of the pet. This concept aims to create a more direct motivation and awareness factor of repair by personifying the product’s health; it creates a direct incentive to repair the product. It also aims for people to share the status of their pets with their peers. This way the sharers become models for others.

Figure 65: Exhibition of repair heroes concept

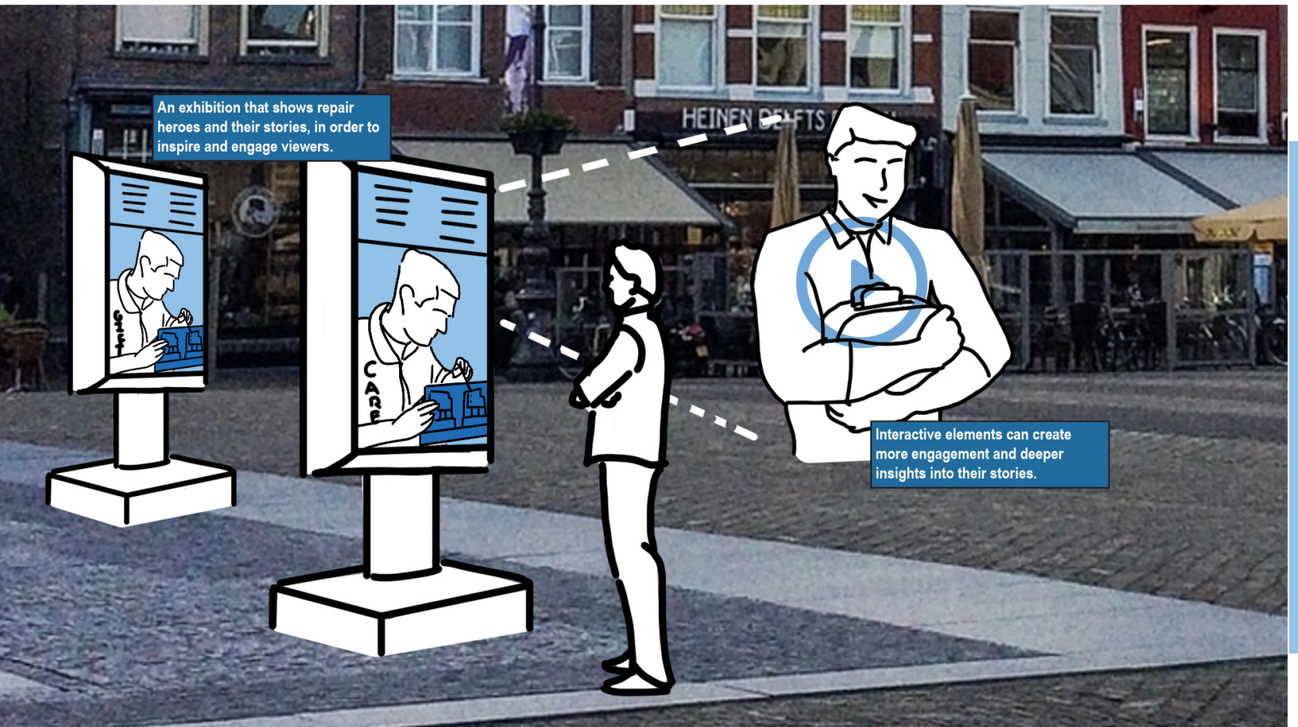
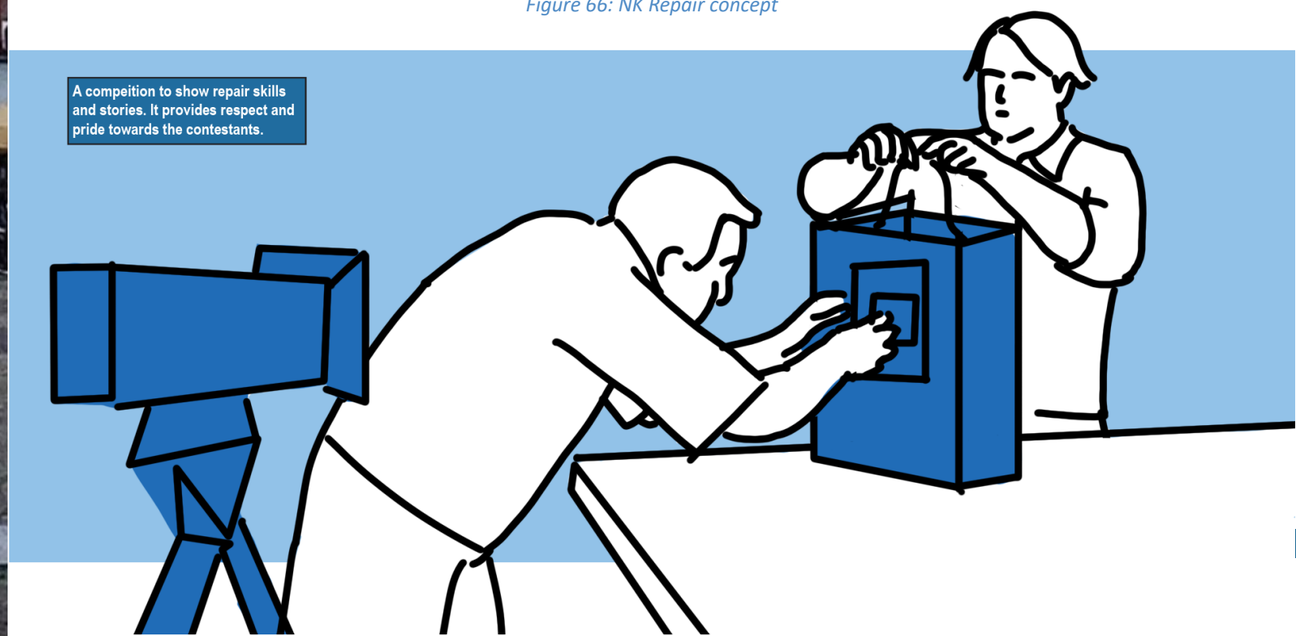


Figure 66: NK Repair concept



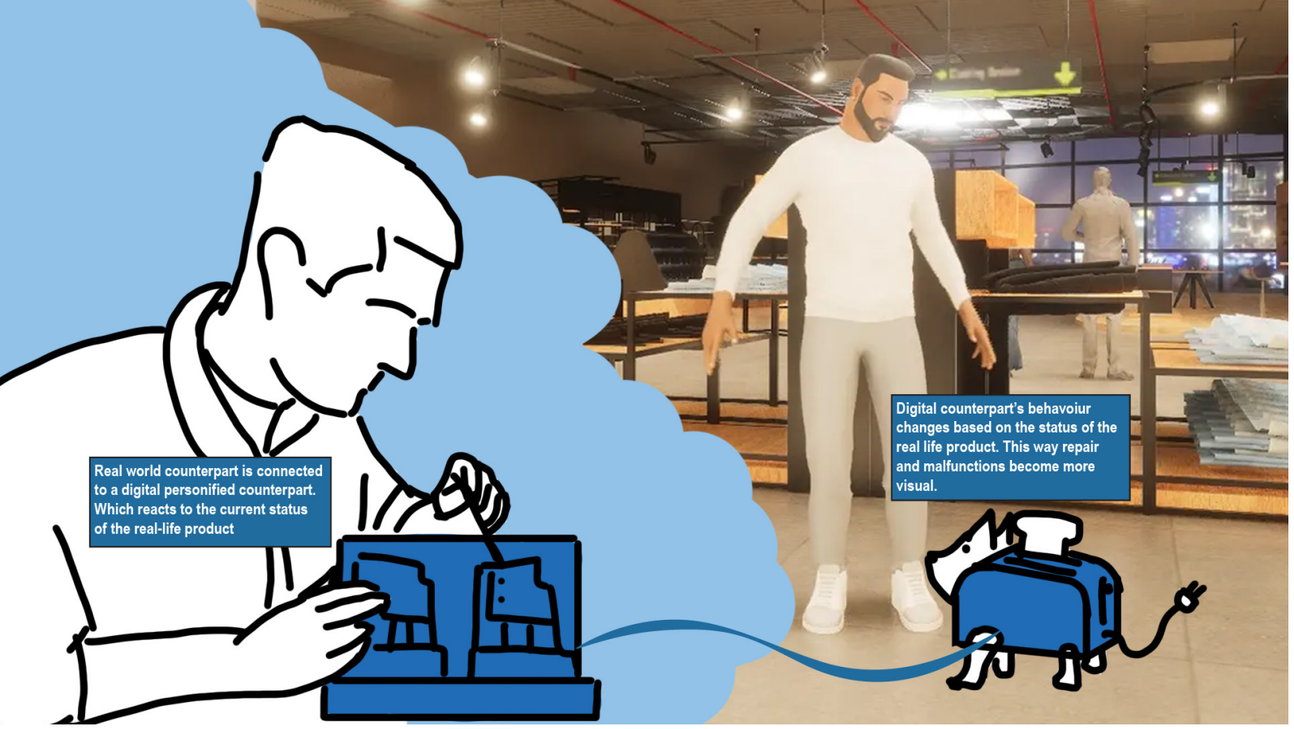


Figure 67: Personified product concept

12 Appendix E, Models Used for the Analysis

Figure 68: Senseo HD7817

Figure 69: Senseo HD7840

Figure 70: An exploded model of Senseo

Figure 71: Senseo 7860

13 Appendix F, Detailed Assembly Description

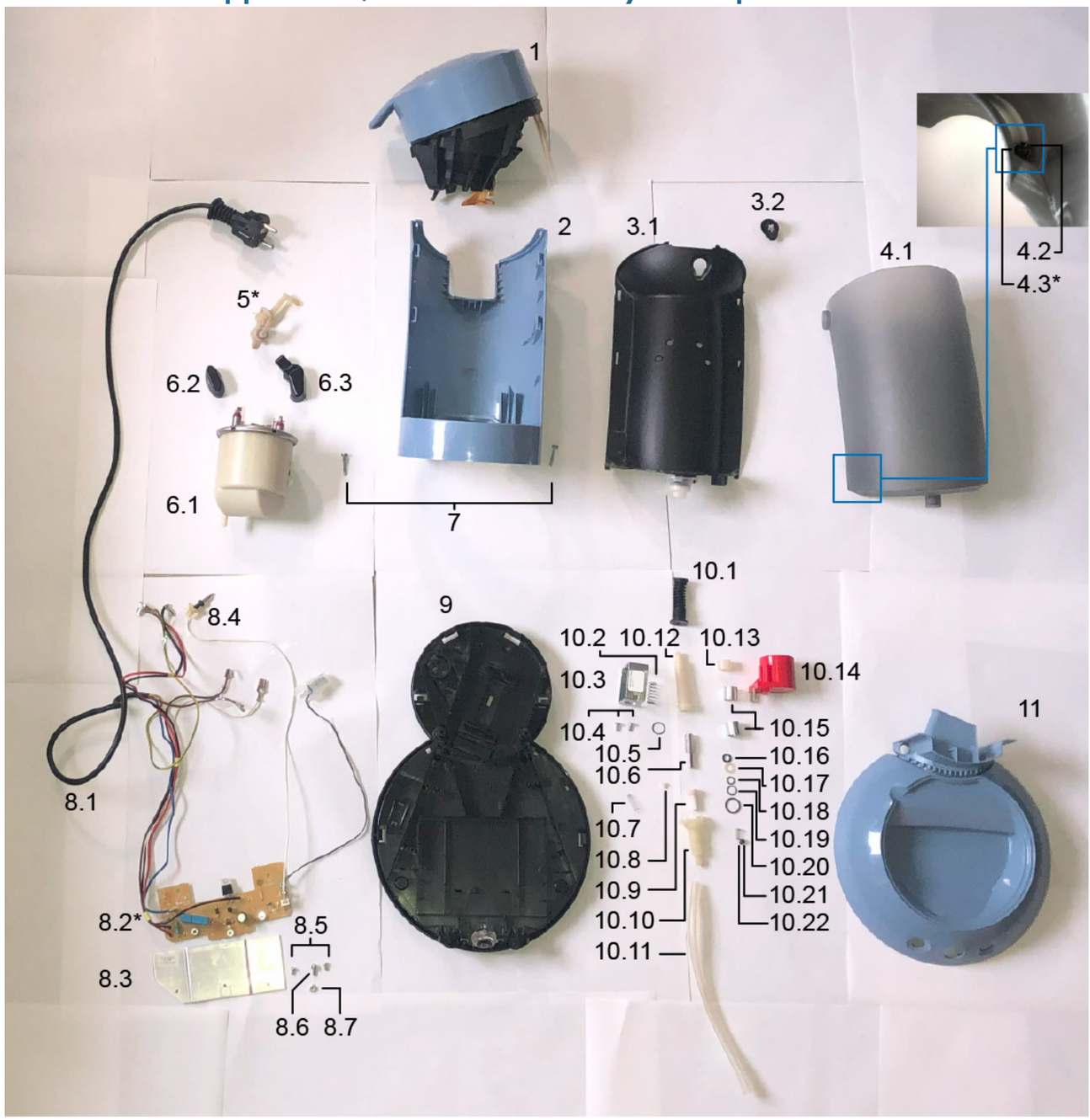


Figure 72: Detailed exploded view of Senseo ('' are the critical parts)*

Number	Amount	Part description
1	1	Top shell
2	1	Front shell
3.1	1	Back shell case
3.2	1	Back shell valve
4.1	1	Water tank container
4.2	1	Metal clip
4.3*	1	Water level senseor
5*	1	Three-way valve
6.1	1	Boiler tank
6.2	1	Boiler lid small
6.3	1	Boiler lid big
7	2	Long hex screw
8.1	1	Plug
8.2*	1	PCB electronics
8.3	1	PCB metal
8.4	1	Max temperature sensor
8.5	2	Short cross screw
8.6	1	Long cross screw
8.7	1	Bolt
9	1	Bottom shell
10.1	1	Pump black valve
10.2	1	Long spring
10.3	1	Pump metal brace
10.4	2	Medium cross screw
10.5	1	Rubber ring #1
10.6	1	Metal cilinder
10.7	1	Medium spring
10.8	1	White spring piece
10.9	1	Plastic cilinder
10.1	1	Broad pump connector
10.11	1	Pump tube
10.12	1	Long pump connector
10.13	1	Pump plastic ring
10.14	1	Pump red case
10.15	2	Pump metal ring
10.16	1	Rubber ring #2
10.17	1	Plastic ring
10.18	1	Rubber ring #3
10.19	1	Rubber ring #4
10.2	1	Rubber ring #5
10.21	1	Black spring piece
10.22	1	Short spring
11	1	Drip tray shell

Table 16: Part description of Senseo in detail ('' are the critical parts)*

14 Appendix G, Detailed Review of the Senseo

Type	Category	Judgement
DIY product assembly	Difficulty level	The assembly of the Senseo is quite challenging, even if the subassemblies are preassembled. This is due to the many required steps, alongside awkwardly placed screws and entanglement of tubes and wires. *Providing a proper partially preassembled set should be considered. Furthermore, the wires and tubes should be easier to keep tidy and organised.*
	Number of components	Based on the smallest possible size, there are 47 parts (excluding accessories) to assemble. If subassemblies are considered, there are 12 parts. While more manageable, it's still quite a lot. *The number of components considered for the assembly process should reflect the repair process. The user is not expected to disassemble a subassembly to replace a small part; instead, they might want to replace the whole subassembly.*
	Component variety	Based on the smallest part size, there are 43 kinds of parts (excluding accessories and fasteners) to assemble. If subassemblies are considered, there are 11 kinds of parts. While more manageable, it's still quite a lot. *The number of unique components considered for the assembly process should reflect the repair process. The user is not expected to disassemble a subassembly to replace a small part of it. Instead, they might rather want to replace the whole subassembly.*
	Number of fastenings	There are multiple snap-fits and two hex screws necessary to open the product (excluding the five cross screws in the subassemblies). In practice, the snap-fits are hard to loosen and may easily break, and the screws are hard to reach. *Redesigning the fastenings into a more easily reachable and disassembled one should be considered.*
	Number of subdivisions	There are 11 subdivisions in the Senseo, which is quite a lot. *The assembly process should reflect the repair process. The most critical subdivisions should be easier to reach.*
	Action types	Due to the snap-fits, the current product requires turning the product in many different ways. Furthermore, awkward screw placements require difficulty positioning of the hand, and many loose wires are making the assembly difficult to handle. *Changing the manner of fastening and improving cable management is recommended.*
Instructions	Figures/ diagrams	There is currently only a maintenance manual. This manual does provide clear figures. *Create a user-friendly assembly and repair manual that leverages digital enhancements wherever possible.*
	Tekst	Currently, there is only a maintenance manual available, which includes text in multiple languages. However, the extensive information may feel overwhelming or redundant to some target groups. Additionally, it can be challenging to find and understand specific information when needed quickly. *Create a user-friendly assembly and repair manual that leverages digital enhancements wherever possible.*
	Vertical/ subdivided assembly	The assembly process is very vertical, as every step follows another. However, this requires premade subassemblies. Without them, the assembly becomes very hierarchical and hard to follow. *The assembly process should make use of premade subassemblies.*
	Number of steps	There are 17 steps needed for the assembly (and a lot more if subassemblies are not premade). *The amount should be lowered. Preparing certain parts of the assembly process, for instance, can achieve this. Nevertheless, the assembly process should reflect the repair process.*

Table 17a: Analysis of the Senseo based on the collected guidelines (part 1/2)

FRI criterion	Document access	Only maintenance documents are accessible. They are also accessible in digital format in case the paper format is lost. *Create a user-friendly assembly and repair manual that leverages digital enhancements wherever possible.*
	Ease of dis- and reassembly	The assembly process is quicker than the disassembly due to the heavy usage of snap-fits and clicks. However, this hinders the disassembly during repair as they are quite hard to separate and may break during the process. Furthermore, it is possible to access all the parts. However, the wires are often tangled and get in the way of one another. They also do not provide information about where and how they should be connected, which may also scare people off from attempting a repair. The critical parts of the Senseo (parts 4.3, 5, and 8.2) are accessible. However, the tank's water level sensor is hard to reach, and the PCB is connected to all the parts via wires. *Replacing the snap-fits and current screws with easier and one kind of screw would be an improvement, alongside streamlining the wires and making them easier to keep orderly. Furthermore, whether the user should be able to replace the specific critical part or just the whole subassembly instead of one specific part should be considered, alongside whether the user should have access to the electronic unit.*
	Spare parts availability	Spare parts are currently available via third-party sellers. Philips offers spare parts for the accessories and water tank. *Making critical spare parts available via official sites/stores would be an improvement.*
	Spare parts prices	Spare part prices are determined by individual stores, not by the OEM. Thus, there is not one set price per part. Except for the water tank, which pricing is considered to be decent based on ADEME's (2023) advice. *Making them available via official sites/stores to regulate the prices would be an improvement.*
	Product specifics	The FRI does not provide product specifics for this type of product.

Table 17b: Analysis of the Senseo based on the collected guidelines (part 2/2)

15 Appendix H, Prototyping of a Transparent Made-By-You Senseo

This chapter details the prototyping process, explaining why certain choices were made and how the end result was achieved.

The initial plan was to prototype a version of the Senseo HD7817, as depicted in Figure 68. This Senseo model has been the primary focus for all analyses throughout the project. The decision to create a transparent Senseo (mentioned in Figure 43) was chosen because it would most accurately present the customisation options available to customers, show how people have become more familiar with the product's interior, and demonstrate the user's accomplishment in assembling the product.

However, creating transparent shells for the Senseo proved impractical due to the extended time required to craft the curved shape of this particular model and the absence of a precise and usable mould. As a result, a partial see-through model has been made instead by cutting windows into the shell, and the model was changed to the Senseo HD7840 (Figure 69). This model closely resembles the original one, utilising almost all the same internal parts in the same locations. The fastening methods and assembly process are also nearly identical. The change was made for the prototype because the HD7840's straight shell simplifies the prototyping process significantly while remaining true to the original design.

Four windows were created in the model's shell during the prototyping process (Figure 73). One in the top shell, one in the back shell, and two in the front shells (this model's front shell consists of two parts, plastic and a metal layer; these shells have been stuck together in the prototyping process).

The cutouts have been strategically placed to reveal many of the internal components (Figure 74). Although the top shell was cut, this window was not featured in the rest of the prototype showcases, as the user did not need to assemble this part, thus leaving the user unfamiliar with it. It has thus been covered with a metal plate in further depictions. Additionally, the drip tray shell did not receive a cutout because, unlike the original Senseo HD7817 model, the PCB is well hidden (Figure 75) and would not be visible through any cutout.

Figure 73: Prototyping process

Figure 74: The internal components as seen through the cutouts

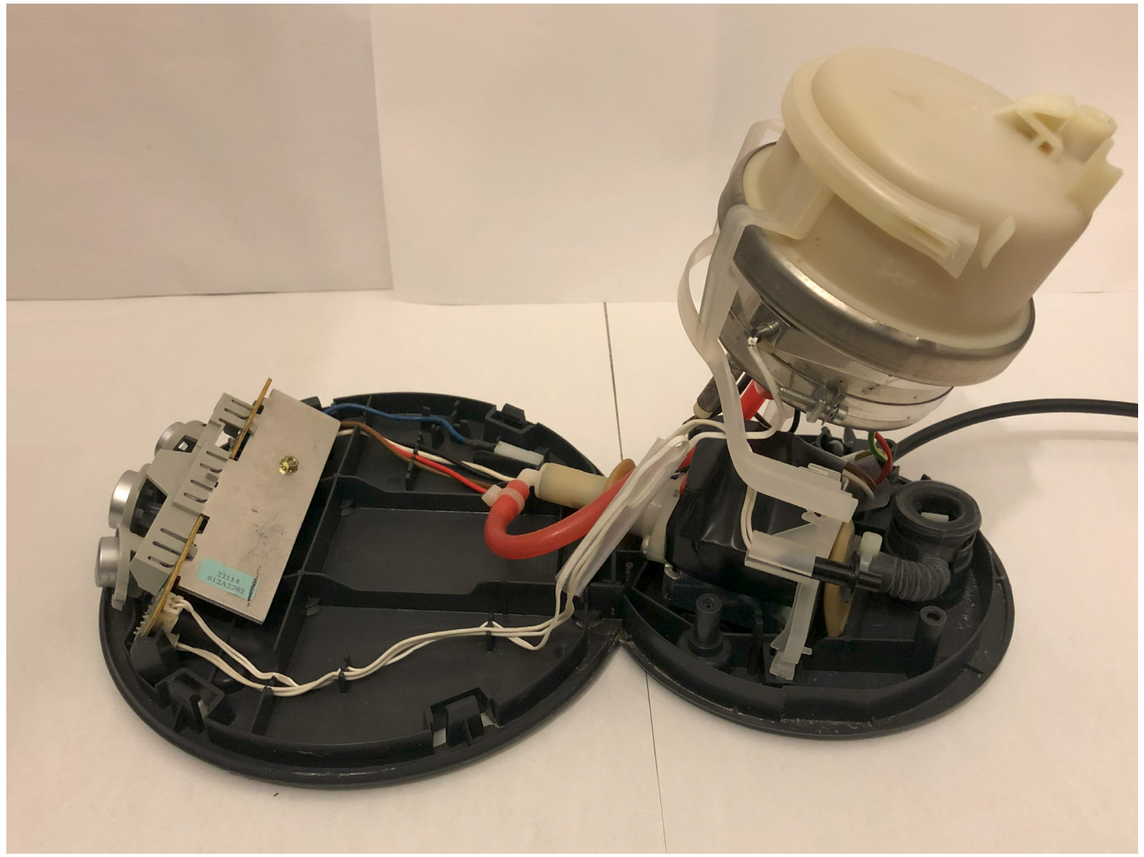


Figure 75: Internal components of the Senseo HD7840

16 Appendix I, Project Brief

TU Delft

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

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

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Xu	7051	
Initials	K		
Given name	Kelly		
Student number	4841026		

IDE master(s): IPD ☐ DfI ☐ SPD ☑

2nd non-IDE master:

Individual programme *(date of approval)*:

Medisign ☐

HPM ☐

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Ruth Mugge	dept./section	DOS/MCR
mentor	Conny Bakker	dept./section	SDE/CPD
2nd mentor			
client:			
city:		country:	
optional comments			

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

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Ruth Mugge

Digitally signed by Ruth Mugge
Date: 2024.03.04 10:46:32 +01'00'

Name Ruth Mugge Date 3 Apr 2024 Signature

CHECK ON STUDY PROGRESS

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

Master electives no. of EC accumulated in total ____ EC

Of which, taking conditional requirements into account, can be part of the exam programme ____ EC

★	**YES**	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Robin den Braber
Digitaal ondertekend door Robin den Braber
Datum: 2024.03.11 10:45:41 +01'00'

Name Robin den Braber Date 11 mrt 2024 Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	**ALLOWED** to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Monique von Morgen
Digitally signed by Monique von Morgen
Date: 2024.03.12 11:02:58 +01'00'

Name Monique von Morgen Date 12 Mar 2024 Signature

Personal Project Brief – IDE Master Graduation Project

Name student Kelly Xu **Student number** 4,841,026

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Design strategies to improve people's willingness to repair their electronics.

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

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

Reparation is an important activity when we want to move to a more circular business model. However, people are not considering repair as an option. Especially, electronics in which 60% of people do not consider repair as an option (Magnier & Mugge, 2022). Here, people mainly dispose of products before they completely malfunction. Thus products are disposed of when they are partly malfunctioning. This premature obsolescence could be fixed by repairing it.

People are thus not repairing, despite numerous studies attempting to enhance product repairability through adjustments in production and business models (Dangal, Faludi and Balkenende, 2022). Van den Berge et al., (2021) and Selvefors et al. (2019), believe that these studies overlooked the user's connection to both their environment and their products as a factor that influences repairability. Rosklada et al. (2023) have categorized the barriers around repair (Figure 1). In this model, the technical category is related to repairability, convenience is related to the environment, and willingness is related to the user.

The EU is also in favour of a more circular market and is working on a repair rights bill that forces manufacturers to make their products repairable (Yakimova, 2023). However, if the willingness to repair (WTR) is low, the bill will not achieve its intended effect. The EU has also noted that this kind of consumer behaviour must change (European Environment Agency, 2022).

Therefore, consumer behaviour is an important factor in the repair transition. Thus, in this study, I want to stimulate people's WTR, with a focus on electronics. Since this is a field of products that have a much shorter use time than their lifetime (Jaeger-Erben et al., 2021) and is also one of the biggest waste streams (European Environment Agency, 2022).

This research may interest policymakers, who want to increase repair adoption rates; designers, who want to improve the repair rate for their products; and manufacturers, who want to increase product longevity. This all will impact the consumer in the end as their behaviour will have to change to accommodate a more repair-centric future.

➔ *space available for images / figures on next page*

introduction (continued): space for images

image / figure 1 Pyramide of barriers around repair (Roskladka et al., 2023)

image / figure 2 Drone repair service livestream to increase trust and reviews on the sidebar (Minicopters, n.d.)

DESIGN FOR our future

TUDelft

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

As stated in the introduction, research has been focused on making the product easier to repair. It has overlooked the user's connection to their environment and products as a factor that influences repairability. These relationships have also been called the convenience and the willingness to repair (WTR) (Roskladka et al., 2023) (Figure 1).

The opportunities lie in the WTR as it is the most challenging to change and will still have the most to gain. In Figure 1, the categories are ordered by how challenging it is to solve (with the bottom layer being the easiest). Solutions to increase WTR could be related to informing, educating and making people/society care about the repairability of their products. For instance, to increase trust in their repair service (point 3.1 in Figure 1), Minicopters livestreams their work (Figure 2).

In short, there is an opportunity to encourage people to repair via (communication) channels to educate and create awareness. Currently, design interventions have overlooked the barriers around the WTR. The EU also states this as a barrier (European Environment Agency, 2022).

I will limit this project by not looking into the following:
- I will not be looking into legislative interventions.
- I will not be looking into design interventions that make the repair of a product easier.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design strategies/toolkit to stimulate the willingness of repair for people who do not repair electronic devices

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

I divided the 20-week (+1-week break) project into 5 phases: Discover, Define, Design, Evaluate, and Documentation.
The goal of this project is to investigate consumer behaviour around WTR and design strategies that stimulate WTR. The final artifact could take shape in the form of a toolkit.

In the Discover phase, I am planning to delve into the project by familiarizing myself with the current context. This will be done via literature research, current practices and DEPEST I will also look at the context, and stakeholders, along with that I want to do user research.

Considerable user research has been dedicated to exploring the motivations behind repair behaviour (Marikyan & Papagiannidis, 2023), however there is a noticeable gap in understanding how to effectively reach and educate individuals who do not engage in repair activities. This demographic represents a diverse and sizable portion of consumers, thus prompting the need for a quantitative survey to capture insights from various segments within this group. I want to reach them via an online survey (via channels like Reddit, WeChat and WhatsApp).
It would also be valuable to visit a repair café. While a visit might be possible, multiple interviews about their experience alongside a survey might not be possible in the time frame of this project. Luckily, Pit (2020) has already conducted 10 in-depth interviews with people in a Repair Café about the question 'Why do people repair their product at the Repair Café?'. This could substantiate the gap of knowledge in the user research.

After this, the development of a strategy will start, right before the midterm. Later it will also be evaluated with the user group and iterated upon.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	23 Feb 2024
Mid-term evaluation	19 Apr 2024
Green light meeting	21 Jun 2024
Graduation ceremony	19 Jul 2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

The motivation of this project started initially around the concept of mass-customisation and its relation to sustainability. However, during my preparation phase, I soon realised that care was the most important relationship between the two. In the literature, it was also made clear that the knowledge gap was mainly located in long-term care and bonding, which would not be doable in the time frame of this project.

During this initial research, I also stumbled upon the current context around repair and care. And that people are not that eager to repair their products, as it requires a behavioural change. This behaviour change is similar to what I wanted similar to what I wanted to achieve in the initial proposal.

Competencies that I want to prove or develop:
- I want to prove that I can organise and do a project on my own.
- I want to challenge my ability to visualise the bigger context, with all the trends and stakeholders.
- I want to develop my skills when pitching my ideas.

Thank You for Reading