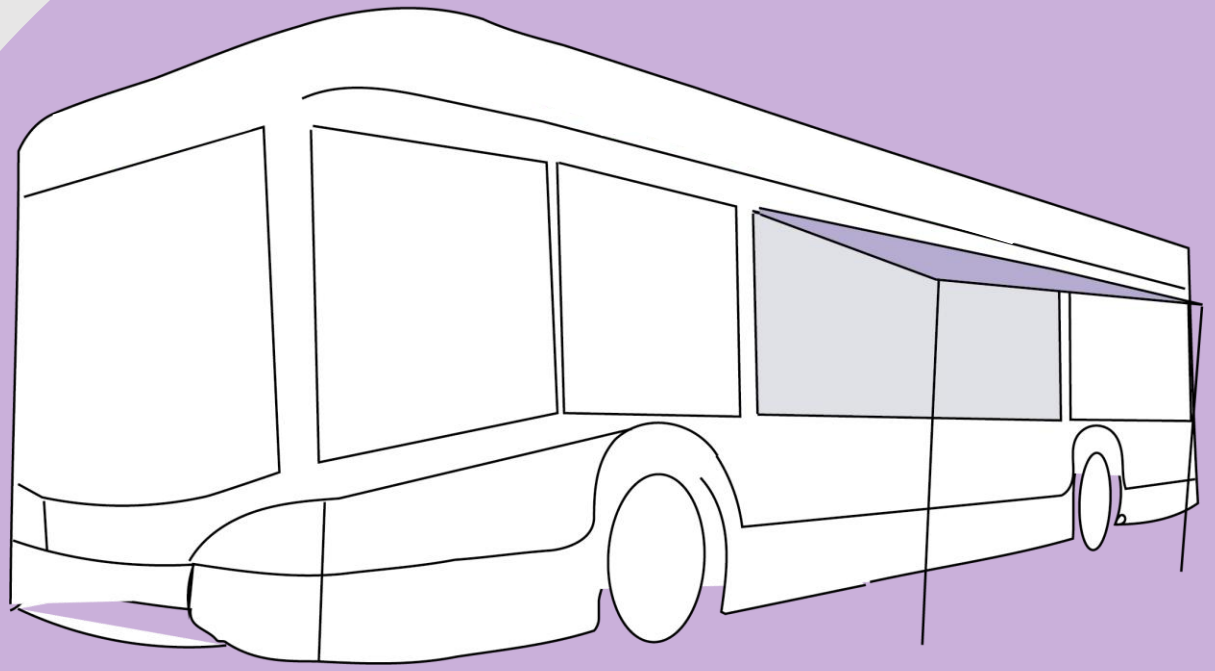
Stimulating Residents of Rotterdam in Repairing Small Household Appliances

Master thesis Strategic Product Design



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Key words

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Preface

This thesis researched how residents of Rotterdam could be stimulated in repairing their household appliances. It marks the conclusion of my studies, but more importantly, it represents the beginning of a longer-term ambition: to contribute to lasting, systemic change that is both circular and socially rooted.

From the very start, this assignment inspired me deeply. It allowed me to combine two perspectives I like to operate on: behavioural change and system thinking. This enabled me into addressing a challenge that touches both the environment and people's everyday lives. With my background in Strategic Product Design and a passion for circularity, I felt equipped and energised to take on this question. Yet, what truly made this project meaningful, and, I believe, successful, was the network I built throughout the journey. Every person I spoke to recognised the importance of the issue and generously offered their support. The project gradually became a shared effort, shaped together with those who live the world of repair. There are two key lessons I will carry with me into every future project:

The first: **invest in people.** The success of this project was not the result of solitary work, but of the connections that were forged. Many of these were built during interviews or Repair Café visits. I deliberately chose to take time for each conversation, sometimes spending an entire day with just one person. While not efficient, this approach allowed me to truly see the human behind the words. It helped me uncover deeper needs and motivations, and, perhaps more importantly, created a bond of trust that sparked a willingness to help beyond what I ever expected and dared ever ask. The insights and support I received as a result were invaluable. Without these, this project would not have reached the same depth, nor would I have completed it with the same sense of pride.

The second: **let passion lead.** Passion attracts others who share it. Throughout my time at Industrial Design Engineering, I've always gravitated towards sustainability and circularity. It's my way of reconciling the fact that, as a designer, I am educated to create 'things', which can ultimately become waste. Circularity, to me, is the answer. And while I had not yet explored repair in depth before this project, the moment I did, I felt a connection. I discovered a community of people who care about repair with such intrinsic dedication that it not only inspired me, but energised the entire project. Passion fuels collaboration. This, paired with the human connections I mentioned before, became the backbone of my process, and the quality of the final outcome.

Collaboration, of course, goes beyond stakeholders and users. It also includes guidance. I've been incredibly fortunate to have had the support of my graduation chair, mentor and coach, who each in their own way challenged me, encouraged me and helped me stay grounded. A heartfelt thank you to Bart Bluemink, Tobias Hebbink and Virpi Heybroek, without whom this journey would have looked very different.

With pride, I now hand in this thesis. With gratitude, I look back on the journey that brought it to life. And with great enthusiasm, I look forward to the implementation of *Reparatie op Wielen,* a project I now pass on, yet one I'm deeply thankful for as a designer. Seeing my very first idea take shape in the real world is something I'll carry with me for a long time to come.

Summary

This thesis investigates how Rotterdam Circulair can stimulate residents of Rotterdam to repair their broken household appliances more often. Using a human-centred, context-specific design approach, it explores the repair ecosystem and behaviours in the city to develop an embedded and actionable intervention.

The research unfolds in three parts. The first focuses on local repair behaviour and attitudes, drawing from interviews with DIY repairers, Repair Café visitors, non-repairers and repair professionals. Although residents are motivated by cost savings, environmental concerns and emotional attachment, they face persistent barriers such as inconvenience, lack of awareness, and low repair confidence. Repair Cafés play a valuable role but remain underused due to limited visibility and access. Repair is not yet culturally embedded as a default response to product failure.

The second part investigates the technical side of repair. Most household appliance failures occur during the use phase and are often preventable or repairable. However, users struggle with the key repair stages, fault detection, location and isolation, due to inaccessible product design and limited knowledge.

The third part maps the local repair ecosystem through stakeholder interviews and empirical studies. Rotterdam hosts a fragmented but active repair network, including certified services, Repair Cafés, digital platforms like iFixit and Jafix, and emerging municipal efforts. While European policy developments like the Right to Repair directive aim to improve repairability, local gaps in spare parts access and repair guidance remain. A mystery guest study using three broken appliances tested the accessibility of repair support via digital platforms, professional services and manufacturer options. The study confirmed the value of these resources but revealed a lack of consistency and navigability.

These insights pointed to the need for a low-threshold, visible, and locally embedded repair initiative. In a co-creation session with municipal stakeholders, five intervention concepts were evaluated. Reparatie op Wielen (RoW), a mobile repair service, was selected as the most promising concept. The repair spectrum was co-developed with Repair Café volunteers to define its scope and referral system.

A pilot was conducted to test the concept. Visitors felt supported by the service, whether through repair, diagnosis or referral. Barriers around time, cost and knowing where to go were reduced, while confidence and repair knowledge showed modest growth. Collaboration with the pop-up recycling centre (PUR) emerged as both promising and in need of improvement, particularly in communication and visitor recruitment.

An implementation plan was developed to embed RoW in municipal practice. A second co-creation session shaped the organisational structure across Schoon & Circulaire Stad, Repair Cafés, the Mobiele Wijkhub and the PUR. The plan addresses risks, communication, operations, funding and evaluation through the DIN model. Five SMART goals and a phased roadmap guide its sustainable rollout.

In conclusion, the thesis shows that stimulating repair requires more than raising awareness, it demands coordinated infrastructure, community presence and approachable services. Reparatie op Wielen responds to these needs by making repair visible, accessible and integrated into the wider ecosystem, advancing Rotterdam Circulair's ambition to make circular behaviour easier for all.

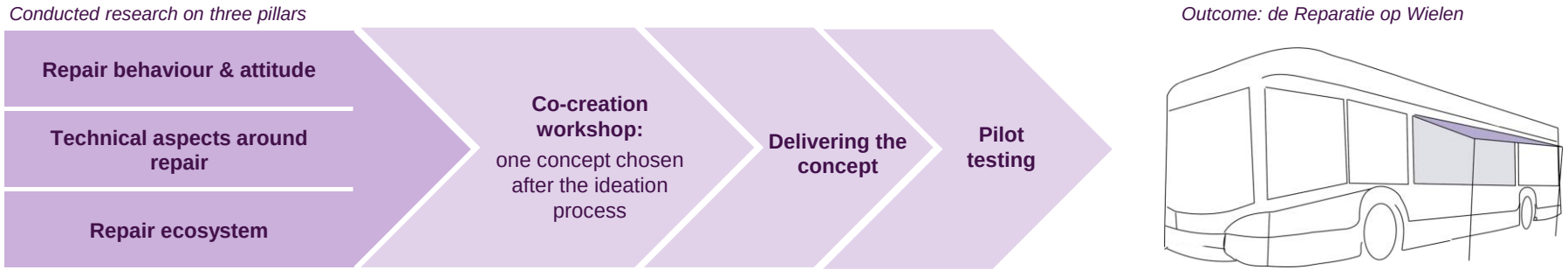


Fig. 1 Summarized process to get to the Reparatie op Wielen

Content

0.1 Context & background

The 1990s and early 2000s were the decades when "Made in China" products started to dominate global markets, facilitated by China's WTO entry in 2001 and the rapid globalization of supply chains (Hart, 2020). During this period, Chinese goods became synonymous with affordability and mass production. For competitors, competing with such affordable and ever-available products created a new norm of cheap global consumerism (Acosta, 2024). Unfortunately, this new norm paved the way for badly designed products. Most business models of product manufacturers run on numbers of sales, resulting in products designed to break down in a given time so product replacement would not be far gone. Nowadays, in a timeframe of minutes one can replace a broken product without needing much money. Replaced products form a large pile of waste that is ever growing, where perhaps a great number could have been prolonged in lifetime by repair practices. However, looking at the trade-off between replacing or repairing, product replacement presents very few obstacles compared to product repair (Bakker et al., 2023). Repair, in this context, refers to the process of restoring a product to a functional state, thereby extending its lifespan and reducing waste (Fachbach, 2022).

The concept of the circular economy (CE) has gained significant traction in recent years as a sustainable alternative to the traditional linear economic model. The circular economy emphasizes the importance of resource efficiency, waste reduction, and the continual use of materials through practices such as recycling, remanufacturing and repair (Ellen MacArthur Foundation, 2013). As e-waste numbers are increasing, as well as resource poverty, the EU has raised concerns on the current way of consuming, facilitated by the way of manufacturing. From this year, in 2025, the EU is answering to these concerns by using incentives. To incentivise EU citizens to repair their broken goods, the EU has set a Directive on repair of goods, the so-called “right to repair”, that will have to transpose into national rules and be applied by EU’s Member States from 31 July 2026 (European Commision, 2024).

The right to repair directive tends to make it easier and more appealing for consumers to repair goods by addressing the manufacturer’s Extended Producer Responsibility (EPR). For years, manufacturers were bound by the EU's regulated warranty of 2 years for consumer goods intended to influence manufacturers to design more durable products. Now, the EU influences manufacturers to design repairable goods by implementing an obligation to repair broken common household goods for a reasonable price and within a reasonable timeframe (News European Parliament, 2024). Manufacturers will have to provide spare parts and tools at a reasonable price and will be prohibited from using contractual clauses, hardware or software techniques that obstruct repairs. In particular, they cannot impede the use of second-hand or 3D-printed spare parts by independent repairers, nor can they refuse to repair a product solely for economic reasons or because it was previously repaired by someone else. To make repairs more affordable, each member state will have to implement at least one measure to promote repair, such as repair vouchers and funds, conducting information campaigns, offering repair courses or supporting community-led repair spaces (News European Parliament, 2024).

The Right to Repair movement is seen as evolutionary in the field of repair (Bakker et al., 2023), however a challenge still remains for consumers to choose the option repair instead of replacing the product. A trade-off that is made more equal by the law enforcement, yet still will not take the upper hand. Repair costs are relatively high (Echegaray, 2016) (Sabbaghi & Behdad, 2018) and participating in repair activities takes time (van den Berge et al., 2023). Stimulating repair decisions over product replacement takes a change in consumer behaviour (Bakker et al., 2023).

With the right to repair movement, a first step in the right direction is made towards a circular economy. Next is making repair the new norm, which is crucial in exceeding the entire repair transition.

In this context, Rotterdam Circulair plays an important role in promoting circularity within the city of Rotterdam. Rotterdam is a large and still growing city with a significant ecological footprint, mainly due to its reliance on fossil-based industries and harbour. Rotterdam Circulair is a department within the municipality of Rotterdam with the intention to transform Rotterdam from a city with a linear economy to a circular one. It sets up and supports initiatives designed to address various aspects of circularity categorised into separate transition agenda's (Zeegers et al., 2023). Transitioning to a circular economy is essential to reduce this footprint, address resource scarcity and create a future-proof city. In 2030, the city should use 50% less primary (abiotic) raw materials and in 2050 Rotterdam intends to be fully circular (Zeegers, et al., 2023). However, a critical area that remains underexplored within the practices of Rotterdam Circulair is the promotion of repair practices among citizens.

0.2 Research question

This thesis will explore how Rotterdam Circulair can stimulate the residents in participating in repair activities. It will answer to the main research question

R: How can Rotterdam Circulair stimulate residents of Rotterdam to repair small household appliances?

To be able to give an enriched answer to this question, themes are formulated with the use of the three pillars of design (Voûte, 2018), looking at the context from the perspective of the user, business and technology (Fig. 1).

Theme 1: Current repair behaviour & culture in Rotterdam

Theme 2: Technical aspects to repair household appliances

Theme 3: Current repair ecosystem in Rotterdam

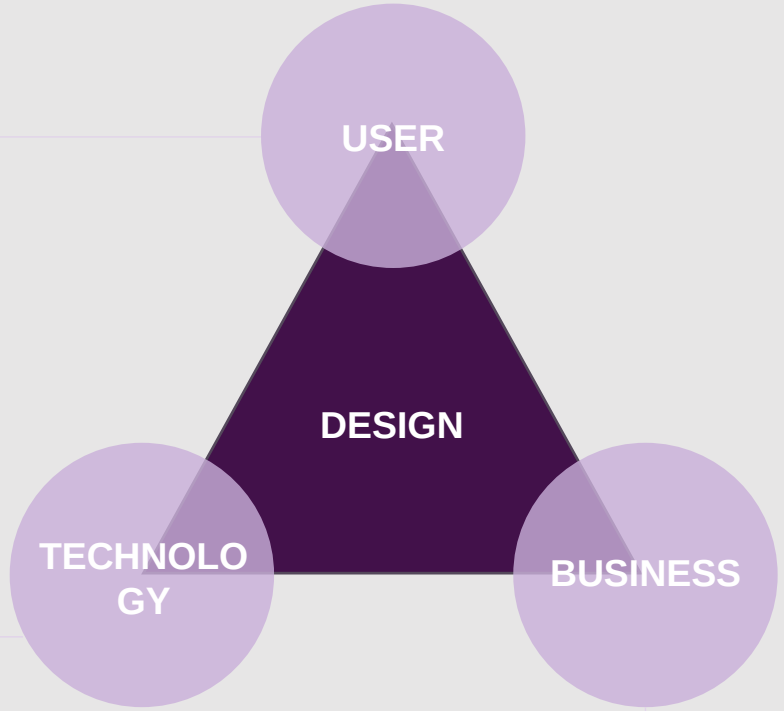


Fig. 1 Three pillars of design

0.3 Scope and Limitations

A limitation of this research is the time in which the research is conducted, accordingly 5 months. To be able to ensure a fully enriched answer to the main research question, a scope is included. As the main research question already gives away, the geographical and sociological focus will be on the city of Rotterdam and its residents. All respondents involved live in Rotterdam and context specific research is based on Rotterdam.

Product focus is included as well, where the stimulation of repair will be researched on small household appliances. E-waste poses significant environmental challenges due to its hazardous components and the potential for resource recovery (Balde et al., 2017). Household appliances represent a substantial portion of e-waste that remains largely unrepaired due to their low perceived market value and the comparatively high costs associated with its repair services (Islam et al., 2020b). Household appliances in this research hold the definition of a device that helps with household chores, including cooking, cleaning and food preservation.

Three categories can be derived from this definition (Vedantu, n.d.), namely:

Major appliances, or white goods (e.g. washing machine, fridge, oven)

Small appliances: compact electrical appliances for practical use in the home and that are simple to install (e.g. electric kettles, coffee makers, blenders)

Brown goods or consumer electronics: devices for entertainment, communication and recreation (e.g. CD players, DVD players, digital cameras)

The scope of this research will include small appliances only. Major appliances or white goods could be perceived as more inconvenient to repair due to their larger size and brown goods or consumer electronics are more complicated to repair as they mostly include the use of sound and screen (Mauro et al., 2019). This thesis has the intention to start more relatively simple, but create impact at the same time. With the intention to broader the perspective when the less advanced repairs are imbedded in everyday life. So, when talking about small household appliances, this research means:

Compact electrical appliances for practical use in the home that are simple to install and do not include sound or screen.

0.4 Research approach

The approach in answering the research question is the Double Diamond model, which is a design-thinking framework known for its implementation of design thinking and problem-solving (Britsch Design Council, 2005). It consists of four stages, namely the Discover, Define, Design and Deliver phase (Fig. 2 on the next page). In the Discover phase a lot of knowledge is collected within the design context on all three pillars. The Define phase will synthesize these findings into a problem statement and design challenge. The Design and Deliver phases build upon this design challenge to solve the problem stated in the Define phase. After the Deliver phase, the solution is finalized.

0.5 Research methodology

Several research methods will be used to gain data that is rich, multi-perspectival and that suit the different themes. In researching the repair behaviour & culture and the technical aspects behind repair of Rotterdam, data will be derived through qualitative research. Interviews will be conducted amongst different target groups and will be analysed through thematic analysis. To research the current repair ecosystem, an empirical study will be conducted with the researcher taking the role of a mystery guest. Several co-creation sessions will be organised, one to gather insights into the desired concept and one to establish the organisational structure behind the final concept. Finally, a pilot will be conducted to test the concept on several aspects of the design.

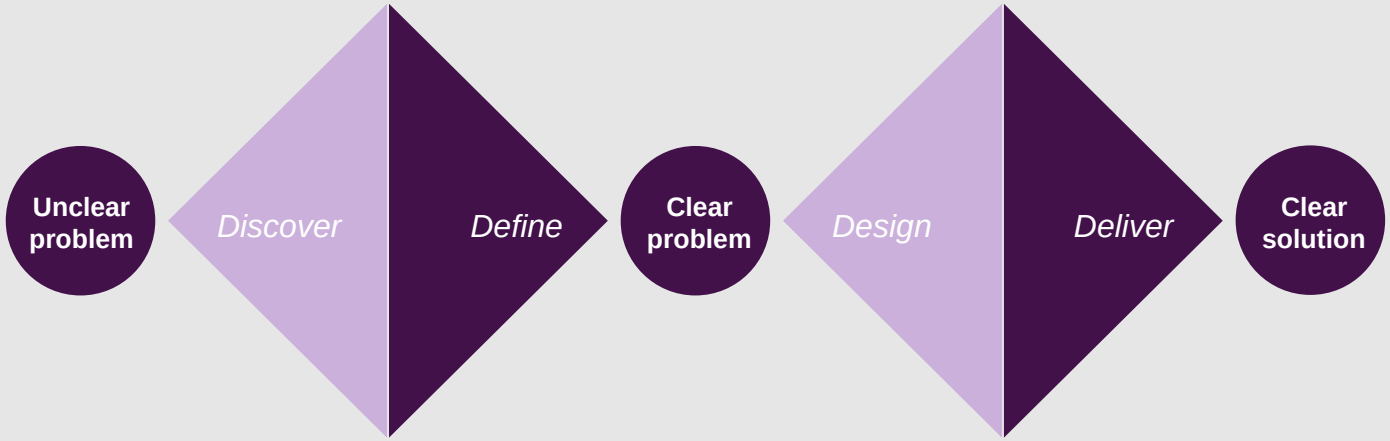


Fig. 2 The four phases of the Double Diamond

Part 1: Discover

The **Discover phase** is about **broadening the perspective** before defining the problem (Fig. 3). It helps understanding the user needs, context, and challenges related to the problem. The emphasis is on **curiosity** and **exploration**, avoiding premature solutions (British Design Council, 2005).

A broad perspective of the problem context is included though the **three pillars of design,** namely the user, technology and organisation. In this context the pillars will be:

1. ***Current repair behaviour & culture in Rotterdam***
2. ***Technical aspects to repair household appliances***
3. ***Current repair ecosystem in Rotterdam***

All pillars conclude a theme and sub-questions which will be treated in the chapters corresponding to each pillar. The structure of part 1 will therefore be three chapters on the three pillars, each including a literature review, method of the sub-research, results and a conclusion.

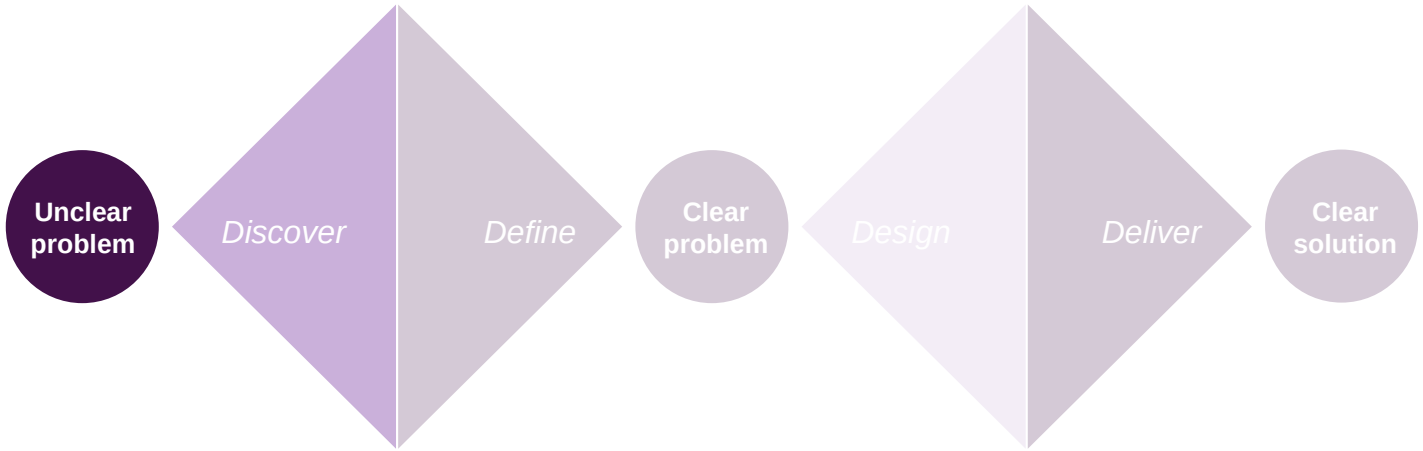


Fig. 3 Discover phase of the Double Diamond

Chapter 1
Repair behaviour and attitude

1.1 Introduction

When choosing what to do with a broken product, a trade-off is being made by the consumer between choosing to replace, or to repair. As for now, repairing a product comes with more obstacles than choosing to replace (Fachbach et al., 2022 ; Van den Berge et al., 2023 ; Luukkonen & van den Broek, 2021 ; Jaeger-Elben et al., 2024), therefore a challenge still remains for consumers to choose the option repair instead of replacement. Unfortunately, as for now, a large group of consumers do not include the option to repair at all (Magnier & Mugge, 2022). Yet, consumers are crucial in realising the repair-transition, as they are the ones to choose what to do with a broken product (Bakker et al., 2023). Therefore, stimulating repair decisions over product replacement takes a change in consumer behaviour. Consumer behaviour can be influenced by implementation of design practices or policies (Bakker et al., 2023). In order to establish a change in consumer behaviour, the behaviour and attitudes must be thoroughly examined. This chapter will delve into the attitudes and behaviour towards repairing or replacing a broken household appliance. It will do so by reviewing existing literature on the trade-off behaviour between replacement and repair. Triggers around replacing such products, and drivers and obstacles around repairing them will be examined.

After completing the literature review, this chapter introduces the sub-themes, including the introduction of qualitative research and its results. This chapter concludes with a sub-conclusion by presenting the context to the sub-themes.

1.2 Literature review

To understand the choices made during the trade-off between product replacement or product retention (e.g. through repair), literature has been analysed on traditional consumer behaviour (Sheth et al., 1991), how consumers treat their products (Ackermann et al., 2018 ; Bellezza, 2016), the choices made during product replacement (Mugge et al., 2010 ; Bolton & Alba, 2011; van Nes & Cramer, 2005 ; Echegaray, 2015 ; Fels et al., 2016 ; Grewal et al., 2004 ; Hou et al., 2020) and strategies to stimulate consumers to choose for retainment during the trade-off (Magnier & Mugge, 2022 ; Mugge et al., 2008 ; van den Berge et al., 2020).

To investigate the factors that influence the intention to repair, several interesting researches have been analysed that researched the drivers and barriers behind (DIY)-repair activities (Fachbach et al., 2022 ; Van den Berge et al., 2023 ; Luukkonen & van den Broek, 2021) and one that researched this topic in the context of Repair Cafés (Jaeger-Elben et al., 2024). From these researches, factors have been identified and combined that influence repair intention. Drivers and barriers behind attitude towards repair intention have been collected on top of that.

1.2.1 Understanding the trade-off between replacing and repairing products

Consumers frequently encounter, consciously or unconsciously, a trade-off decision as a product starts showing signs of wear: should the product be replaced or should its lifespan be prolonged through maintenance or repair? Despite an expressed desire for durable and long-lasting products, consumer behaviour often moves toward premature replacement (Whalen, 2019). This pattern describes the unnecessary replacement of items that could remain functional with minor adjustments to their design or consumer behaviour, for instance prioritizing repair over new features (Magnier & Mugge, 2022). The replacement-retainment

decision is shaped by a complex interplay of values and perceptions (Magnier & Mugge, 2022 ; Grewal et al., 2004 ; Fels et al., 2016). During the decision-making process, consumers weigh the relative values of their current product against those of potential replacements, often prioritizing the latter when existing items no longer meet their expectations (van Nes & Cramer, 2005 ; Echegaray, 2015).

However, many also feel guilty about wastefulness, sometimes justifying replacement by neglecting or misusing items, which accelerates their decline (Bolton & Alba, 2011; van Herpen & de Hooge, 2018; Bellezza et al., 2016).

1.2.1.1 Factors influencing replacement behaviour

As mentioned above, the decision to replace a (potentially still working) product is influenced by several factors (Sheth et al., 1991) which will be further explained below including found stimulants and strategies in influencing retainment of the product.

Functional value

A product's functional value depends on its utilitarian and physical performance. When performance declines, consumers perceive the product as less useful or reliable (Hou et al., 2020). Maintaining functional value through care, such as cleaning, maintenance and repair, can prevent premature disposal (Harmer et al., 2019; Laitala et al., 2021). However, consumers need motivation, ability and reminders to engage in these practices. Simplifying maintenance, providing accessible repair services and fostering enjoyable care routines enhance consumer participation (Mugge, 2017; Ackermann et al., 2018). Repair, one of the most effective lifespan-extending strategies, directly addresses functional deficiencies. Improved product design, repair-friendly policies and consumer education can reduce premature obsolescence and its environmental impact (Bocken et al., 2016).

Emotional value

The emotional value refers to a product's ability to evoke feelings and affective states (Sheth et al., 1991). Here, aesthetics play a crucial role, where visible wear, such as scratches or discolouration, reduces appeal and weakens emotional attachment. Strong bonds, formed through personal memories or self-expression, increase the likelihood of maintenance and repair. Products designed for meaningful experiences or customisation can reinforce attachment and encourage prolonged use (Schifferstein & Zwartkruis-Pelgrim, 2008; Mugge et al., 2008, 2010).

Epistemic / social value

Epistemic value relates to a product's ability to spark curiosity or novelty, while social value reflects a sense of belonging (Sheth et al., 1991). Trends, new technologies and social influences often drive consumers to replace products for novelty (Fels et al., 2016; Sheth et al., 1991). Modular and upgradable designs help consumers adapt to changing needs, reducing unnecessary replacement and supporting sustainability (Michaud et al., 2017; Khan et al., 2018).

1.2.2 Factors influencing repair intention

Repair is a proven method for extending a product's lifespan, as it can restore or even enhance its current value (Ackermann et al., 2018). The intention to repair is shaped by various factors, which can either encourage or hinder repair behaviour. Some factors function only as enablers when present, and have no influence when absent. These factors are categorised as follows, in a non-hierarchical order:

Economic considerations

The economic attractiveness of repair versus replacement significantly influences consumer decisions. This perception can discourage consumers from considering repairs, including both professional services and DIY options (van den Berge et al., 2023; Echegaray, 2016; Sabbaghi & Behdad, 2018; Jaeger-Erben et al., 2024). Although new products are often perceived as inexpensive, research suggests that repairing can be more cost-effective. According to Luukkonen and van den Broek (2021), the cost-effectiveness of repair is a key driver of repair intention, with the economic trade-off between repair and replacement having both positive and negative effects. The perceived cost of repair services and the expected lifespan of repaired products are also crucial factors. If repair costs are seen as reasonable, consumers are more likely to repair rather than to replace (Fachbach et al., 2022). Fachbach et al. (2022) also found that economic considerations often outweigh environmental concerns when consumers are aware of repair options, suggesting that financial incentives can promote repair behaviour.

Informational factors

Many consumers lack the knowledge to perform repairs, which can discourage DIY attempts (van den Berge et al., 2023; Luukkonen & van den Broek, 2021; Islam et al., 2020b). Visitors to Repair Cafés often seek assistance from volunteers when they lack repair skills (Jaeger-Erben et al., 2024). Additionally, difficulty in diagnosing faults can reduce the perceived ability to repair. However, when fault diagnosis is integrated into products, it can increase repair willingness (van den Berge et al., 2023).

Perceived self-efficacy

Psychological factors, such as a lack of confidence in one's ability to repair devices, can lead to a preference for replacement over repair (Blake et al., 2019). Many users lack the skills to perform repairs, which discourages them from attempting repairs, as they may feel unqualified. Consumers' belief in their ability to repair significantly influences their willingness to engage in DIY repairs. Those with higher perceived self-efficacy are more likely to attempt repairs rather than replace the device (van den Berge et al., 2023).

Meaning of longevity vs. novelty

The social value placed on novelty strongly predicts non-repair behaviour. Users who prioritise having the latest technology are more likely to replace devices rather than repair them. In contrast, a strong sense of obligation to extend the lifespan of devices (meaning of longevity) can encourage repair behaviour (Jaeger-Erben et al., 2021).

1.2.2.1 Drivers

Some factors influence repair intention only positively, when turned out negative in a context it is not the reason for consumers to remove themselves from repair activities.

Environmental concerns

A significant driver for engaging in repair activities is individual environmental concern (van den Berge et al., 2023; Luukkonen &

van den Broek, 2021). Concerns about waste reduction and opposing the throwaway culture can motivate repair decisions (Luukkonen & van den Broek, 2021). Research by Luukkonen & van den Broek (2021) highlights how many participants supported Repair Cafés to promote repair awareness. Consumers who recognise the environmental benefits of repairing, such as reducing waste and conserving resources, are more likely to repair (Fachbach et al., 2022). However, van den Berge et al. (2023) notes that high repair costs can overshadow these concerns, making replacement a more appealing choice.

Social acceptance, especially the influence of social norms, plays a significant role in repair intentions. Consumers are influenced by the repair behaviours of their peers. Observing friends or family members repair products can encourage similar actions. This influence is particularly strong in communities with established repair networks where repair practices are normalised (Fachbach et al., 2022).

1.2.2.2 Obstacles

Some factors influence repair intention only negatively, when turned out positive in a context it is not the reason for consumers wanting to engage in repair activities more.

Repair tasks can be time-consuming, discouraging users who are unwilling or unable to invest the necessary time and effort to diagnose and repair their products (van den Berge et al., 2023). For those considering professional repair, the inconvenience of accessing services, such as availability and time constraints, can also act as a barrier (van den Berge et al., 2023). For Repair Cafés this was similar, where some participants viewed the time and effort required to attend as a barrier, though this was less significant once they decided to visit (Luukkonen & van den Broek, 2021).

Difficulty in finding spare parts is a significant barrier to repair (van den Berge et al., 2023). Consumers may face challenges related to cost, delivery time and availability of spare parts, which can prevent them from initiating repairs.

1.2.3 Conclusion literature review

The literature review provides an understanding of the trade-off between replacing and repairing products, shedding light on consumer behaviour, attitudes and the factors influencing these decisions. In conclusion, consumer decisions regarding product replacement or repair are shaped by multiple factors, including functional, emotional, social and epistemic values. Consumers often opt for premature replacement due to convenience, novelty, or social pressures, despite the environmental and emotional advantages of repair. Key drivers of repair intention include economic considerations, where the cost-effectiveness of repair compared to replacement can influence behaviour, and environmental concerns, where a desire to reduce waste and move against the throwaway culture motivates consumers to repair. Emotional attachment to products and their functional importance also play significant roles in fostering repair behaviours. However, barriers such as the perceived inconvenience of repair tasks, lack of knowledge or skills, and difficulties in finding fitting spare parts can hinder repair engagement. Additionally, social influences, including the behaviour of peers and the presence of repair communities, can encourage repair activities.

To promote repair, strategies should focus on reducing the barriers to repair by simplifying maintenance, improving product design for ease of repair, offering accessible repair services and leveraging social norms to normalise repair behaviours. Addressing these factors can encourage longer product lifespans and contribute to more sustainable consumption practices (Fig. 4).

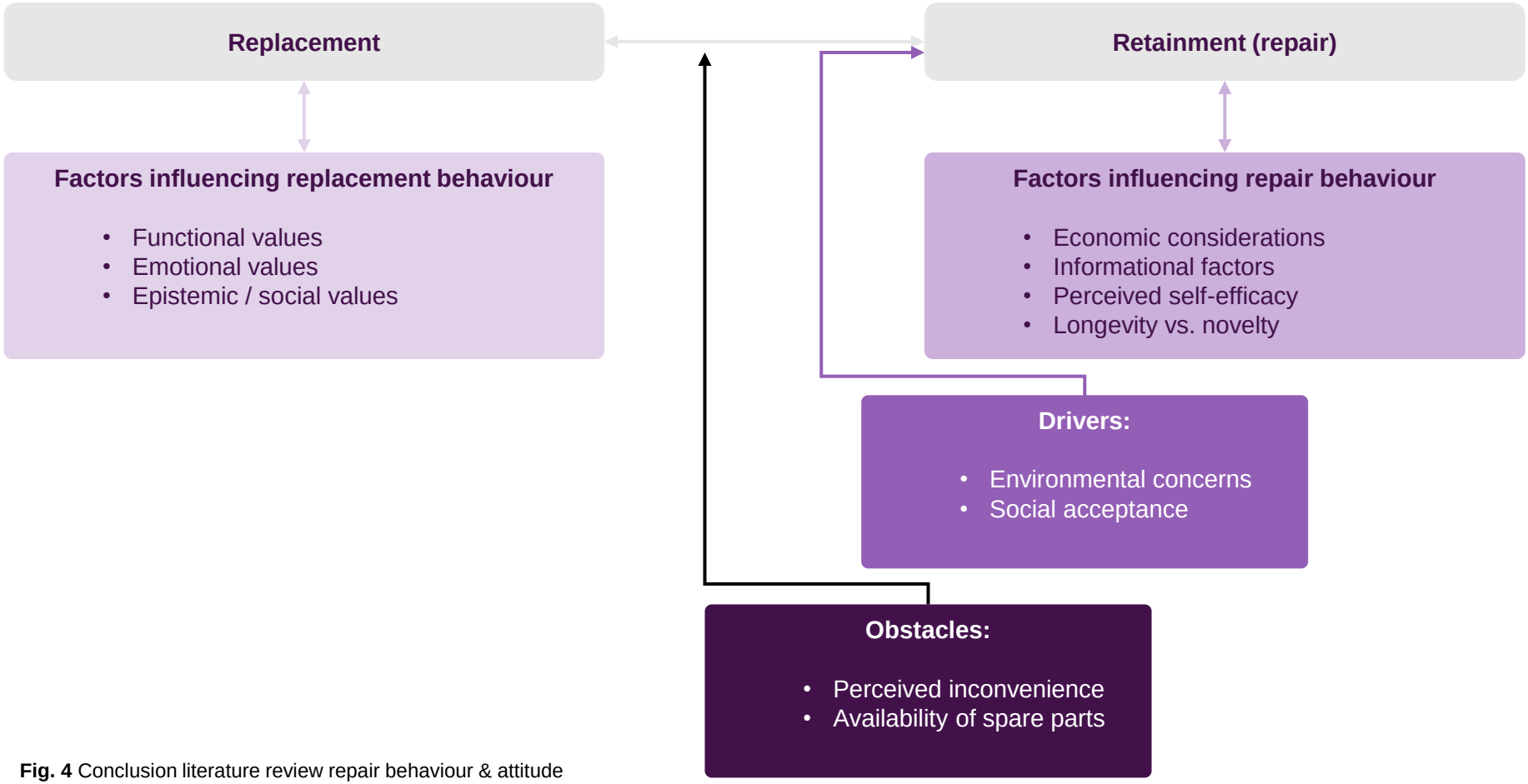


Fig. 4 Conclusion literature review repair behaviour & attitude

1.3 Research questions

As derived from the literature review, attitudes towards and behaviour around repair activities can be analysed by researching the trade-off between replacement and retention of a product (e.g. through repair practices) and through the way consumers view participating in repair activities influenced by various factors, drivers and obstacles. However, outcomes of the literature review are mostly theoretical and widely applicable insights on repair behaviour and attitude. As this thesis researches the way in which residents of Rotterdam can be stimulated in repairing their broken household devices, this research should be focused accordingly. In order to do so, sub-questions have been formulated to enrich the known context of the theme of this chapter (see Fig. 5).

Fig. 5 Theme 1 and its sub-questions

1.4 Method

Qualitative research will be done through interviewing residents on a spectrum from non-enthusiastic repairers to enthusiastic repairers. Fachbach et al. (2022) identify three primary categories of repair activities among consumers: (1) utilizing repair service providers, (2) engaging in self-repair (DIY), and (3) employing repair services offered by providers within a repair network. As the latter is not available in Rotterdam, target groups falling into the first two categories are researched, including a group not participating in repair activities at all. The research set-up is seen in Fig. 6.

Thematic analysis of the interviews will be done using the software QDA Miner Lite, where themes will be identified that present themself as interesting information giving answer to the sub-questions. A codebook is formulated by including insights seen in Fig. 4, after which all the interviews were read through to identify patterns. During the coding process the codebook is enriched further.

Fig. 6 Set-up qualitative research theme 1

1.5 Results

Respondents were gathered successfully with three respondents per target group (Fig. 7). Around half of the interviews took place in real life, the other half through video calling due to busy schedules of the respondents. As Fig. 5 already concluded, the set-up of theme 1 is divided into sub-questions. The results of these will be presented accordingly.

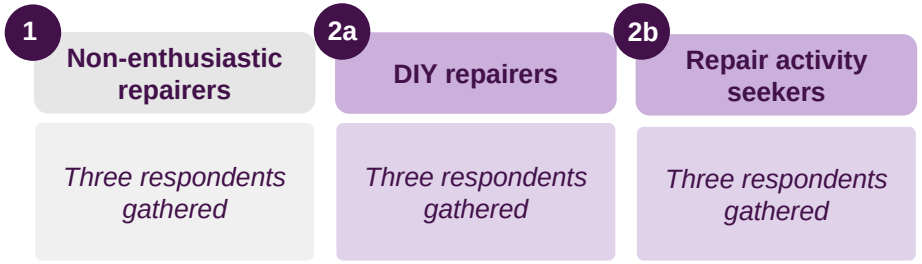


Fig. 7 Gathered respondents per target group

1.5.1 Current attitude towards repairing broken household appliances

In order to fully understand the attitude towards repair in Rotterdam, this theme includes several sub-themes, as visualised in Fig. 8. Results of the attitude will be structured accordingly (sections *1.5.1.1 – 1.5.1.4*).

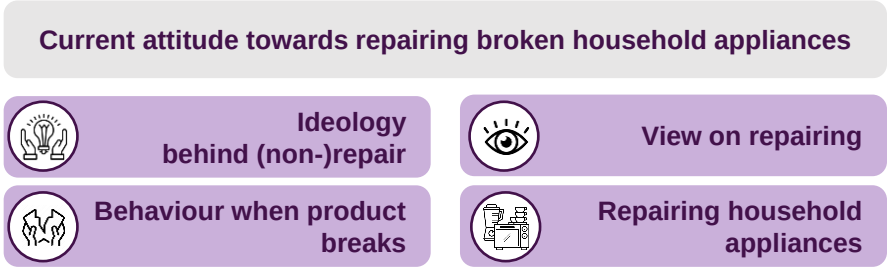
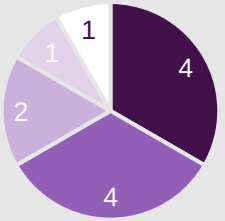


Fig. 8 Schema attitude towards repair

1.5.1.1 Ideology behind (non-)repair

The ideology behind repair among respondents mainly revolved around resistance to consumerism (Fig. 9). Many DIY repairers and Repair Café visitors reported being raised by parents or grandparents who frequently repaired household products, influencing their perspective on repair as a standard activity. Fig. 10 enriches the numeric findings by presenting several quotes.



Moving against consumerism	4
DIY repair	1
Repair café visitor	3
Part of how I was raised	4
DIY repair	2
Repair café visitor	2
Learning how devices work	2
DIY repair	2
Products have a right to exist	1
DIY repair	1
Everything is replaceable	1
Non-repair	1

Fig. 9 Ideology behind repair

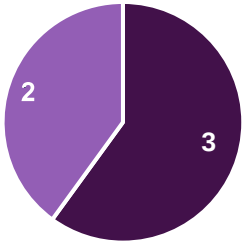
Moving against consumerism
“I've been moving very much against consumerism lately, because I think people are too lazy in repairing things or buying products of good quality” – DIY repair
“Well, it's the result of capitalist society, so anything we can make money with we do. So repair? No. And well you see the pollution” – Repair café visitor

Fig. 10 Quotes on ideology behind repair

Part of how I was raised
“I think that comes from my grandfather, he was an unreasonably smart man. He kind of pushed it. My father too, by the way, he was always doing repairs himself. But that was also the generation of the time. It wasn't all that obvious that you bought a new device.” – DIY repair
“And I was raised that way too. My father fixed everything, so for me it's very normal. It was just part of life.” – Repair café visitor

1.5.1.2 View on repair

The general image of repair remains negative, often perceived as dull and associated with lower-income groups (Fig. 11) (Fig. 12).



Dull and boring	**3**
DIY repair	**3**
For the poor	**2**
DIY repair	**2**

Fig. 11 View on repair

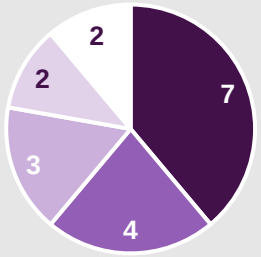
Interestingly, this perception was prevalent among DIY repairers, where some do not feel like showing off their repair behaviour.

Dull and boring
“But it is also dull and perhaps boring, because it all sounds very technical and complicated.”– DIY repair
“And it's not such a sexy activity. What did you do today? Well, I fixed my lamp.” – DIY repair
For the poor
“Look, if you are just wealthy or have an average income, you just have money to buy a new kettle. It is more a kind of why would you put effort into maintaining it when you do have the money for a new one?” – DIY repair

Fig. 12 Quotes on view on repair

1.5.1.3 Behaviour when product breaks

DIY repairers consistently attempt to fix broken appliances, while Repair Café visitors repair their items most of the time or seek professional assistance. In contrast, non-repairers tend to store broken appliances without taking further action (Fig. 13) (Fig. 14).

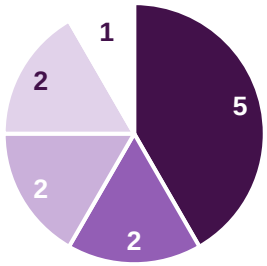


Always try to repair	7
Non-repair	1
DIY repair	4
Repair café visitor	2
Repair service / repair café	4
Repair café visitor	4
Replacing for new product	3
Non-repair	3
Never throw away	2
Repair café visitor	2
Save it, but don't repair	2
Non-repair	2

Fig. 13 Behaviour when product breaks

Always repair
"Well, then I think, oh what a shame, can I fix it?" – DIY repair
Seeking professional help
"I think about who could help me, which is often my husband. But then: I can ask him, but that can also take a very long time and I am very impatient. Like with that bike lock for example, I choose to go to a bike repair shop. I make an appointment and then I am calm." – Repair café visitor
Save it, but don't repair
"It stays in a cupboard for a long time." – Non-repair
"Because then I think, yes, it really is a waste to throw it all away. Until you clean out a closet or a room and see it again. That's when I think, yes, I'll throw it away now." – Non-repair

Fig. 14 Quotes on behaviour when product breaks



Electricity is difficult	5
Non-repair	1
DIY repair	2
Repair café visitor	2
Don't repair	2
Non-repair	2
Don't do it often	2
DIY repair	2
Always try to repair	2
DIY repair	2
Electricity is not that hard	1
DIY repair	1

Fig. 15 Repairing household appliances

1.5.1.4 Repairing household appliances

Through analysing the behaviour and attitude towards repairing household appliances, throughout all groups the perception was found that products including electricity are difficult. In the DIY repair group, respondents still thought electricity is more difficult, but mostly tried to repair it anyway (Fig. 15) (Fig. 16).

Electricity is difficult
“I'm not the handiest when it comes to electricity.” – DIY repair
“But electronics, no, that’s my limit.” – Repair café visitor

Don’t repair
“My husband also said, well just buy a new one. The old one is still there, so now I have two vacuum cleaners. So, what actually was wrong, I don't know. It's not 100% perfect anymore. So, we fall into the category that just buys something new.” – Non-repair

Always try to repair
“No, I always try. And if I can't figure it out, then I look for it in another way. I always enjoy taking a look."– DIY repair
“Look, if it's an electronic device, I'm going to try it. Most often there are repair manuals and they're often online. So, I look them up and will look what's going on.” – DIY repair

Fig. 16 Quotes on **r**epairing household appliances

1.5.2 Replacement-retainment trade off

The trade-off apparent during the choice of product replacement or retainment (e.g. through repair) can be explained by several factors, as explained in the literature review. Research conducted on this trade-off was done through analysing the count of certain motivating factors behind replacement and repair mentioned, therefore one respondent can present numerous examples that are valuable to the research (Fig. 17). In Fig. 18 on the next page, these counts are visualised and enriched with quotes in Fig. 19 and 20.

The primary motivation for replacement among non-repairers is functional, particularly when the appliance is no longer working effectively. Additionally, epistemic value, the desire for novel features, was a key driver of replacement behaviour. Emotional values and environmental concerns were more evenly distributed across groups, with these factors contributing significantly to the motivation for retainment. The decision to repair was often made when individuals perceived a functional benefit in prolonging the appliance’s lifespan.

Conditional factors, such as the effort required to either repair or replace an item, were found to be similar between the two decisions. Economic considerations played a crucial role, with respondents weighing the current value of the product against the cost of repair or purchasing a new item.

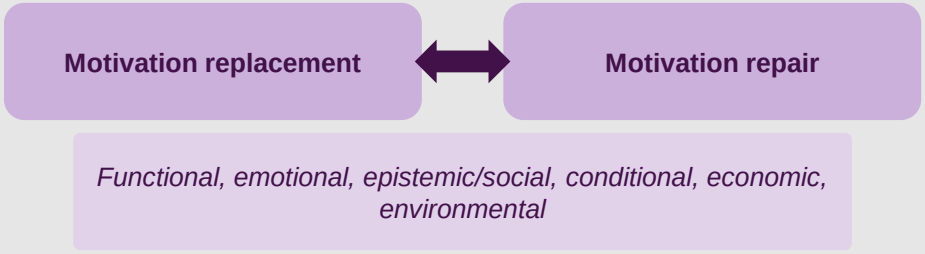


Fig. 17 Schema replacement-retainment trade-off

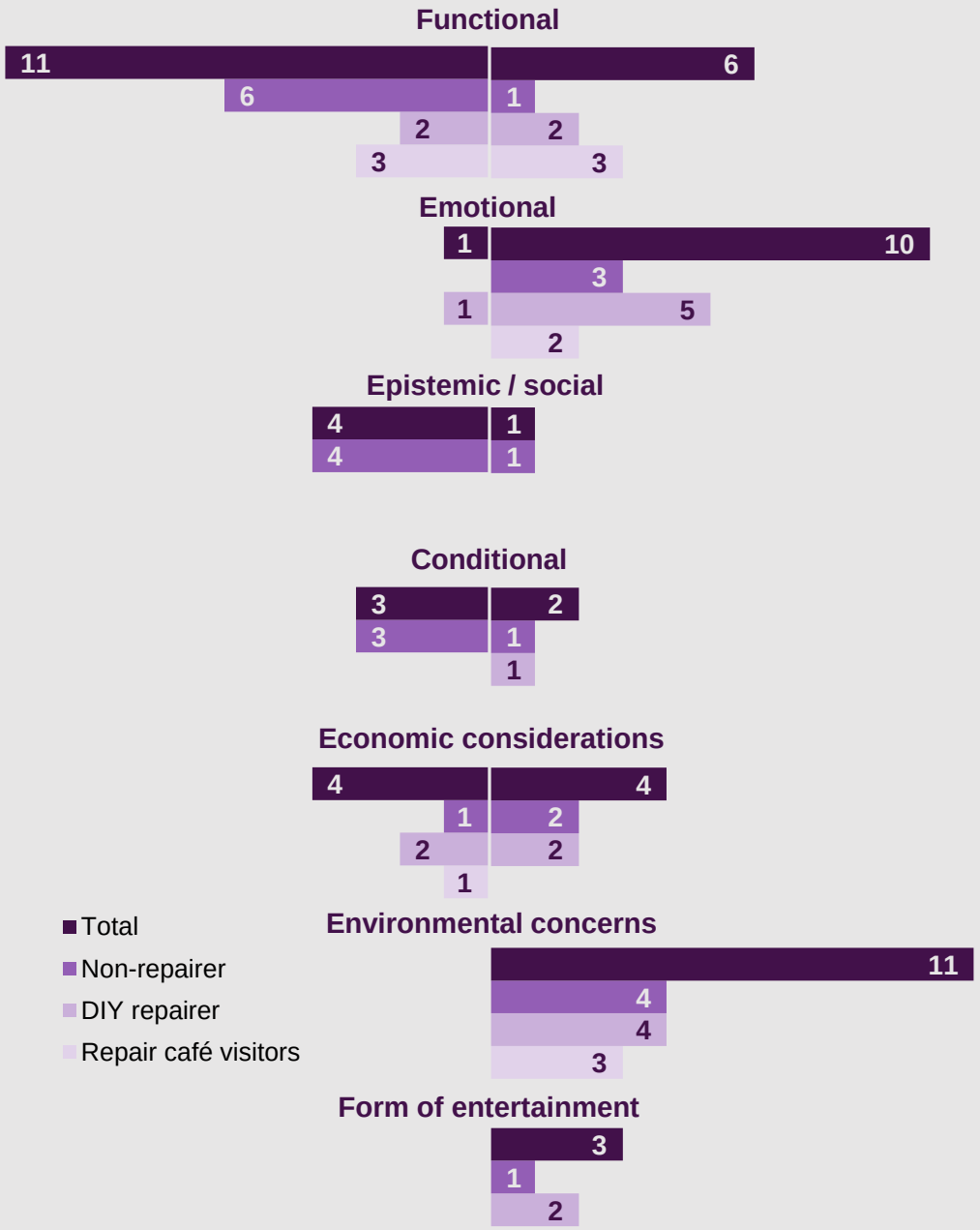


Fig. 18 Results motivations behind replacement and retainment

Functional
"The cord had already burned out and fixed once. I thought, this is a lost game. It is time for a new one." – DIY repair
"Maybe you're afraid that it will break again or something. Whereas if you buy a new one, you don't have that fear."– Non-repair
Economic considerations
"If it is a cheap product, and repair costs are almost as expensive as buying new, it just makes sense to buy new." – DIY repair
"There are already several costs incurred, because an engine has been replaced. Yet, if you replace the engine again, it remains cheaper. But still, it is a consideration that you make." – Non-repair
Epistemic value
"That has to do with whether there are similar devices, that can do it better. Or ones that have a new trick."– Non-repair

Fig. 19 Quotes on motivations behind replacement

Environmental concerns
"Because I think it's a terrible waste and I think it's terrible to throw things away."– Repair café visitor
Emotional
"Some things, you're attached to them in some way for whatever reason. Because it was my mother's, or you got it from someone. And then it's hard." – Non-repair
Funtional
"That lamp is still good. So, I see the value of something that is broken, I no longer see something that is no longer there. I am very aware that if something breaks, it can still be repaired." – DIY repair
Economic considerations
"It is always cheaper to repair. A screwdriver costs a few euros and if I can fix it with just that, it's cheaper than buying new."– DIY repair

Fig. 20 Quotes on motivations behind retainment

1.5.3 Motivators & obstacles for participating in repair activities

Analysing the motivations and obstacles for participating in repair activities was done through analysing this for both DIY repair and visiting Repair Café's separately and subsequently comparing them to the motivations and obstacles to replace broken products (Fig. 21). Here in both DIY repair and replacement, the motivations and obstacles were already explained in the previous section, so not much attention is given to these in this theme's section.

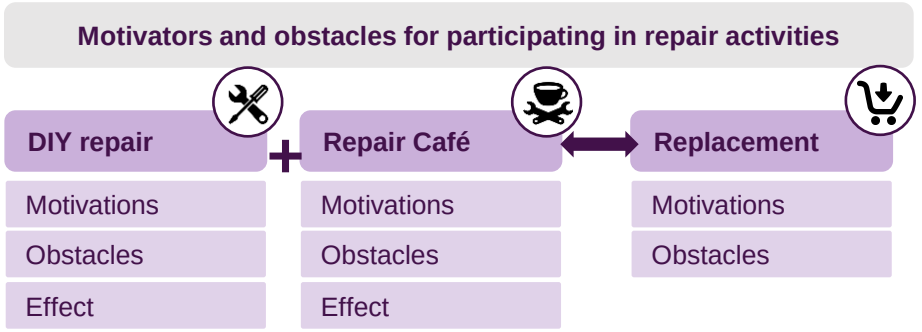
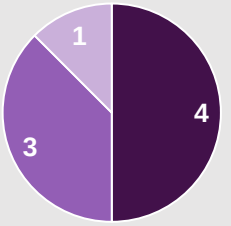


Fig. 21 Quotes on motivations behind retainment

1.5.3.1 DIY repair

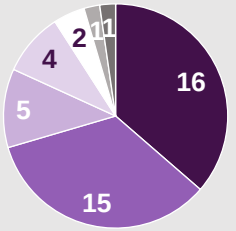
Key motivators for engaging in repair included environmental concerns, emotional attachment to products, and economic considerations (Fig. 18). Many respondents expressed a sense of pride and accomplishment after successfully repairing an item, with DIY repairers particularly highlighting an increased emotional attachment to their appliances post-repair (Fig. 22).

Despite these motivations, several obstacles hinder repair participation. The most commonly mentioned barriers included perceived inconvenience, lack of information, limited availability of repair services, and the unappealing image of repair activities. Informational barriers, such as a lack of awareness about available repair resources, were particularly prevalent among non-repairers (Fig. 23) (Fig. 24).



Feeling proud of achievement	4
Non-repairer	2
DIY repairer	2
More emotional attachment	3
Non-repairer	1
DIY repairer	2
Negative feeling when failing	1
DIY repairer	1

Fig. 22 Effect of DIY repair



Informational barriers	16
Non-repair	9
DIY repair	3
Repair café visitor	4
Perceived inconvenience	15
Non-repair	9
DIY repair	3
Repair café visitor	3
Perceived self-efficacy	5
Non-repair	1
Repair café visitor	4
Costs	4
Non-repair	1
DIY repair	2
Repair café visitor	1
I don't like doing it	2
Non-repair	1
Repair café visitor	1
I don't know where to go	1
Non-repair	1
Don't have the right tools	1
Non-repair	1

Fig. 23 Obstacles for DIY repair

Informational barriers	Perceived inconvenience
"Then I think, I better leave it alone, because I'll break more than I should." – Non-repair	*"Well, the effort you have to put into it. It's easier to just buy a new food processor than to repair it yourself."* – Non-repair
"And I knew vaguely how it should be repaired. But yes, I found that too complicated." – Repair café visitor	*"Well, actually, time. Time to sit down and think about it. Yes. That is a major obstacle."* – DIY repair

Fig. 24 Quotes on obstacles for DIY repair

1.5.3.2 Repair Café

Repair Café visitors emphasized gaining repair knowledge and the social aspect of repair as additional effects a Repair Café may have. The opportunity to repair together, engage with a community, and access expert guidance were important aspects that encouraged participation (Fig. 25). Motivational factors for visiting Repair Cafés are financial, as a repair here has no to little costs (Fig. 26).

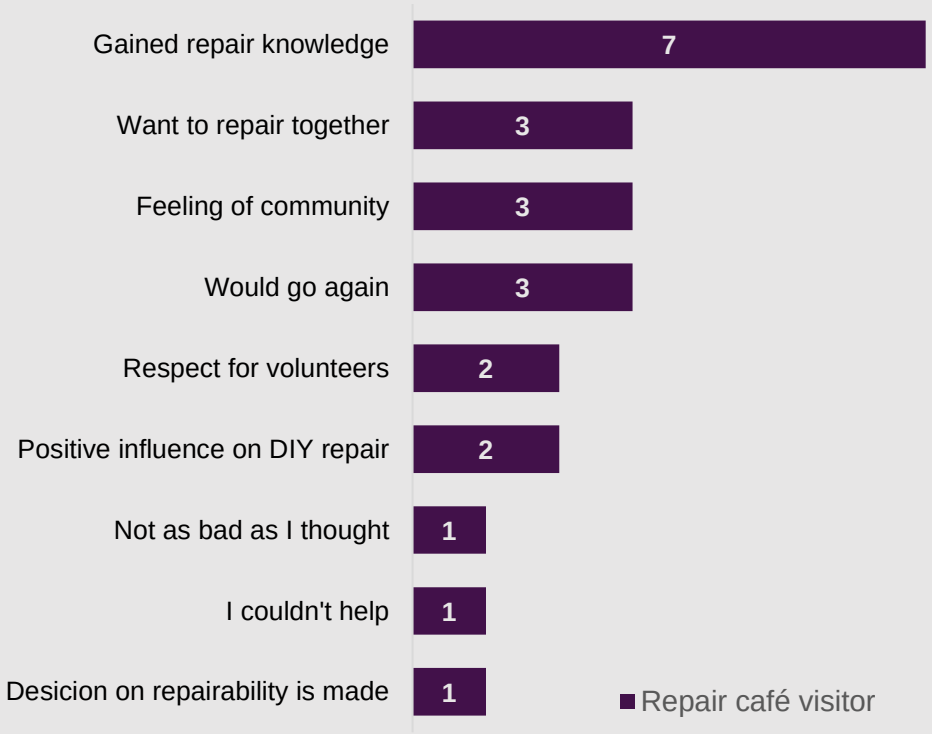
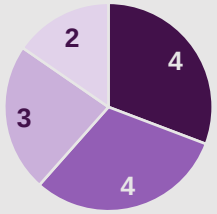


Fig. 25 Effect of attending a Repair Café

Fig. 26 Motivations and obstacles behind attending a Repair Café

Some respondents reported feeling uncomfortable at Repair Cafés, due to unfamiliarity with the environment or lack of technical knowledge (Fig. 26). Additionally, perceived inconvenience, limited availability and a lack of awareness on Repair Cafés further hindered participation or even acknowledgement (Fig. 27) (Fig.28).



Never been to or seen one	**4**
Non-repair	1
DIY repair	3
Not a trendy image	**4**
Non-repair	2
DIY repair	1
Repair café visitor	1
I have been to one	**3**
Repair café visitor	3
Not familiar with it	**2**
Non-repair	1
DIY repair	1

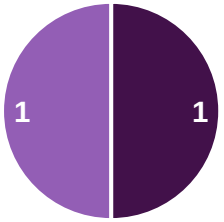
Fig. 27 Familiarity of Repair Cafés amongst respondents

I may feel awkward
"People do look at you."– Repair café visitor
"You come in and where are the people from the repair café? They are very busy repairing. So, you already feel uncomfortable and dependant, like, oh they have to do something for me."– Repair café visitor
Not knowing what to expect
"Going is quite an obstacle. Because you really have no idea how it works. And then I arrive there with a device. I really liked taking someone with me, because then you feel less uncomfortable."– Repair café visitor
Never been to or seen one
"No, I have never been to a repair café. But because I have never really seen one." – DIY repair
Not a trendy image
"A trendier image should be created around it or something."– DIY repair
"It is a nerdy environment, which I don't find appealing." – Non-repair

Fig. 28 Quotes on familiarity and obstacles of Repair Cafés

1.5.3.3 Replacement

The primary motivation for replacement among non-repairers is functional value, particularly when the appliance is no longer working effectively. Additionally, epistemic value, particularly the desire for novel features, was a key driver of replacement behaviour (Fig. 18). As not many obstacles for replacement were mentioned in a large quantity, no significant barriers were found for replacement (Fig. 29).



Costs	**1**
Non-repairer	1
Don't use the product very often	**1**
Non-repairer	1

Fig. 29 Obstacles to replace

1.5.4 Needs regarding repair

Respondents were asked to identified several needs regarding repair stimulation, only the ones mentioned more than once have been included in Table 1. Increasing awareness of repair services and their benefits was mentioned often, particularly among non-repairers. Improved accessibility to repair locations, including more widespread availability of Repair Cafés and affordable professional repair services, was also noted. Finally, respondents emphasized the importance of changing the perception of repair to make it more appealing and socially acceptable. Addressing these needs may contribute to greater engagement in repair activities and a reduction in unnecessary appliance replacement.

Table 1 Ideas for stimulation (answers with N > 1)

Ideas for stimulation	Count	Non	DIY	RC visitor
Creating awareness around repair option	10	6	1	3
Making repair (café) more attractive / cool	5	3	2	
Getting help in repair	3	2		1
Providing a toolkit	2		2	
Awareness of what gets thrown away	2		2	
Getting spare parts from e-waste	2		2	

1.6 Discussion

The results of this study align with existing literature on repair behaviour and consumer decision-making in the trade-off between replacement and retainment. Consistent with the findings of Magnier & Mugge (2022) and Echegaray (2015), this research confirms that functional, emotional, economic and epistemic values all influence repair decisions. The reluctance of non-repairers to engage in repair activities, despite recognizing their environmental benefits, supports previous research indicating that barriers such as perceived inconvenience (van den Berge et al., 2023) and lack of awareness (Jaeger-Elben et al., 2024) significantly hinder repair participation.

The ideological framing of repair as a movement against consumerism, mainly among DIY repairers and Repair Café visitors, highlights an ongoing shift in attitudes, yet the negative perception of repair as dull and outdated remains a significant cultural barrier (Jaeger-Elben et al., 2024). The tendency for non-repairers to store broken appliances without further action suggests a psychological tension between sustainability concerns and practical constraints, reinforcing Bolton & Alba's (2011) assertion that consumers experience guilt over premature disposal but struggle to take corrective action.

1.6 Conclusion repair behaviour & attitude

This study highlights the complex interplay of motivations and barriers that influence consumer decisions regarding household appliance repair, but also replacement. While environmental concerns, emotional attachment and financial benefits motivate repair activities, perceived inconvenience, lack of knowledge, and limited accessibility act as significant barriers. Repair Cafés offer a valuable platform for fostering repair behaviour by providing expertise and social support, yet awareness and accessibility issues hinder widespread adoption. Insights have been concluded in Fig. 30.

The findings suggest that addressing these barriers requires a multi-faceted approach, including increasing consumer awareness, improving access to repair services and reshaping the perception of repair to make it more attractive and socially accepted.

Motivators and obstacles for participating in repair activities

DIY repair

Motivations
- Emotional attachment to product
- Environmental concerns
- Functional: wanting to prolong product lifetime

Obstacles
- Perceived inconvenience
- Informational barriers

Effect
- More emotional attachment to product
- Proud feeling of achievement

Repair Café

Motivations
- Little / no costs

Obstacles
- Availability
- Familiarity / awareness of existence
- May feel uncomfortable
- Not a trendy image

Effect
- Gaining repair knowledge
- Feeling of community
- Would go again

Replacement

Motivations
- Functional: product is (partly) broken
- Novelty seeking

Obstacles

Did not find significant obstacle

Fig. 30 Conclusion motivations, obstacles and effect of DIY repair, Repair Cafés and replacement

Chapter 2:
Technical aspects to repair household appliances

2.1 Introduction

During the entire lifecycle of small household appliances, environmental challenges occur. The production is resource-intensive, requiring significant amounts of energy and materials like lithium, cobalt, and gold, which are increasingly scarce (Bakker et al., 2023). At the consumer stage, new difficulties emerge, as household appliances are typically designed with limited durability. Once they fail, the repairability of these products is often questionable, as disassembly can be difficult and obtaining the necessary spare parts can be challenging (Bakker et al., 2023). With the introduction of the right to repair movement as for 2025, there is hope that issues such as repairability and spare part availability will be addressed, encouraging manufacturers selling in the EU to design products with improved repairability.

Despite this, products manufactured before the right to repair legislation still face challenges related to repair and spare part access. And as the average lifespan of household appliances may be years, these appliances will still be around for a while. Challenges regarding repairability and spare parts will therefore still be a part of repair activities to this day and should be taken into account when addressing the main research question of this thesis. This chapter will dive into these technical challenges around repairing household appliances. It will do so by first reviewing existing literature on the repair process, challenges that may occur and how to mitigate them. To gather context-specific data on the process and its challenges, qualitative research will be executed by interviewing DIY repairers and repair professionals.

2.2 Literature review

The first part of this literature review explores the composition of e-waste in Rotterdam, detailing data collected through municipal recycling centres and district-wide residual waste composition tests conducted from 2020 to 2024 (Stichting OPEN, 2024; De Afval Spiegel, 2020-2024). This is followed by an analysis of the most common reasons for appliance breakdown, based on existing studies that highlight the functional reasons behind product replacement, with a particular emphasis on the potential for repair as a means to extend appliance life (Islam et al., 2021; Laitala et al., 2020). Finally, the review investigates the critical stages of the repair process, including fault detection, fault location, and fault isolation (Pozo Arcos et al., 2020; Cuthbert et al., 2016; Pozo Arcos et al., 2021). This review aims to synthesise these findings to inform strategies that can address both the repairability of products and the challenges during repair, ultimately contributing to reducing e-waste through more sustainable consumption practices.

2.2.1 Composition of e-waste in Rotterdam

Understanding the composition of e-waste and other household waste streams in Rotterdam is essential for developing targeted repair strategies. In 2024, approximately 1,946,836 kg of e-waste was collected through recycling centres, with an estimated 1% ending up in residual waste (Stichting OPEN, 2024). The municipality regularly conducts sample tests of residual waste composition across districts, analysing the various waste streams present (fig. 31).

In these tests, e-waste is categorised as electrical devices, with systematic reporting on the types of devices identified.

Over the period from 2020 to 2024, studies have specifically analysed the presence of small household appliances within these samples (De Afval Spiegel, 2020; 2021; 2022; 2023; 2024). Results show that small household appliances consistently contribute to a significant proportion of the e-waste stream, averaging 47% over the five-year period. However, there is limited data on the reasons for product failure within these samples, leaving a gap in understanding whether these appliances are discarded due to irreparable damage or other factors.

To develop effective repair strategies, it is necessary to investigate the underlying causes of appliance failures and examine the key factors that drive consumers to replace electronic devices.

2.2.2 Causes of household appliance failures

Failures in household appliances occur at different stages of the product life cycle, including production, transport and use. The causes of failure vary and may stem from product design, material choices, assembly methods, transport packaging, wear and tear from extensive use, incorrect usage, or accidental damage (Laitala et al., 2020). Among these stages, the use phase is the most common period during which breakdowns occur. Many failures during this phase could potentially be mitigated through proper maintenance and repairs (Laitala et al., 2020). However, inadequate maintenance is also a contributing factor to appliance failures, with some issues being easily preventable or repairable through simple actions such as filter replacements (Pozo Arcos et al., 2020).

Despite the potential for repairs, many household appliances remain unrepaired and are discarded instead. Unlike high-value electronic devices such as phones and laptops, which tend to have a higher repair rate due to their market value and relatively low repair costs, household appliances often lack the same incentives for repair (Islam et al., 2020b).

Fig. 31 Pictures of sample tests of the e-waste present in residual waste in Rotterdam

2.2.3 Product replacement and repairability

To gain insight into why consumers replace household appliances, Islam et al. (2021) conducted a literature review compiling key reasons for product replacement (Fig. 32). The findings indicate that the most common reasons are functional: "broken down" (30%) and "lack of advanced function" (27%). The first of these, replacing a device due to a breakdown, presents a key opportunity for repair initiatives. A similar survey by Eurobarometer supports this trend, with 38% of respondents citing product breakdown as the primary reason for replacement (Laitala et al., 2020).

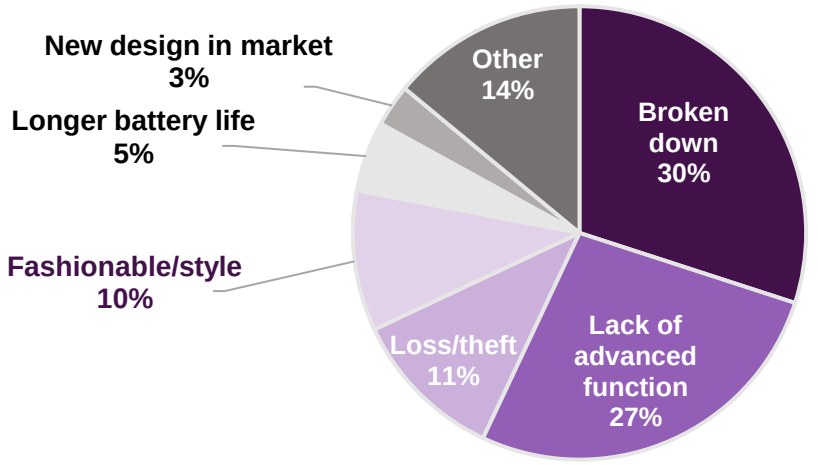


Fig. 32 Top reasons for product replacement (Islam et al., 2021)

If breakdown-related replacements could be reduced through accessible and cost-effective repairs, the lifespan of many household appliances could be extended, contributing to waste reduction and sustainability efforts (Laitala et al., 2020).

2.2.3 Repairing household appliances

A key factor limiting the repairability of household appliances is product design, particularly in the context of DIY repair (Pozo Arcos et al., 2020). Poor accessibility and visibility of internal components often challenge repairs, while complex automated systems further complicate fault diagnosis (Pozo Arcos et al., 2020). The repair process generally consists of three key stages: fault detection, fault location and fault isolation (Pozo Arcos et al., 2020). These phases are not always linear, with iterations between fault location and isolation being common (Pozo Arcos et al., 2021). The framework in Fig. 33 (Pozo Arcos et al., 2021) provides a structured overview of this repair process.

2.2.3.1 Fault detection

Fault detection represents the first stage of the repair process, involving the identification of the fault (Pozo Arcos et al., 2021). This step is crucial, as it determines the cause of product failure and informs subsequent actions (Pozo Arcos et al., 2023). Fault detection typically requires some level of disassembly (Pozo Arcos et al., 2020).

Two distinct diagnostic methods are commonly used. The first, trial and error, involves replacing potential components at fault one by one until the issue is resolved. This method requires logical thinking and some product knowledge, making it time-consuming and less precise. The second method, error code-based diagnosis, allows the product to communicate its

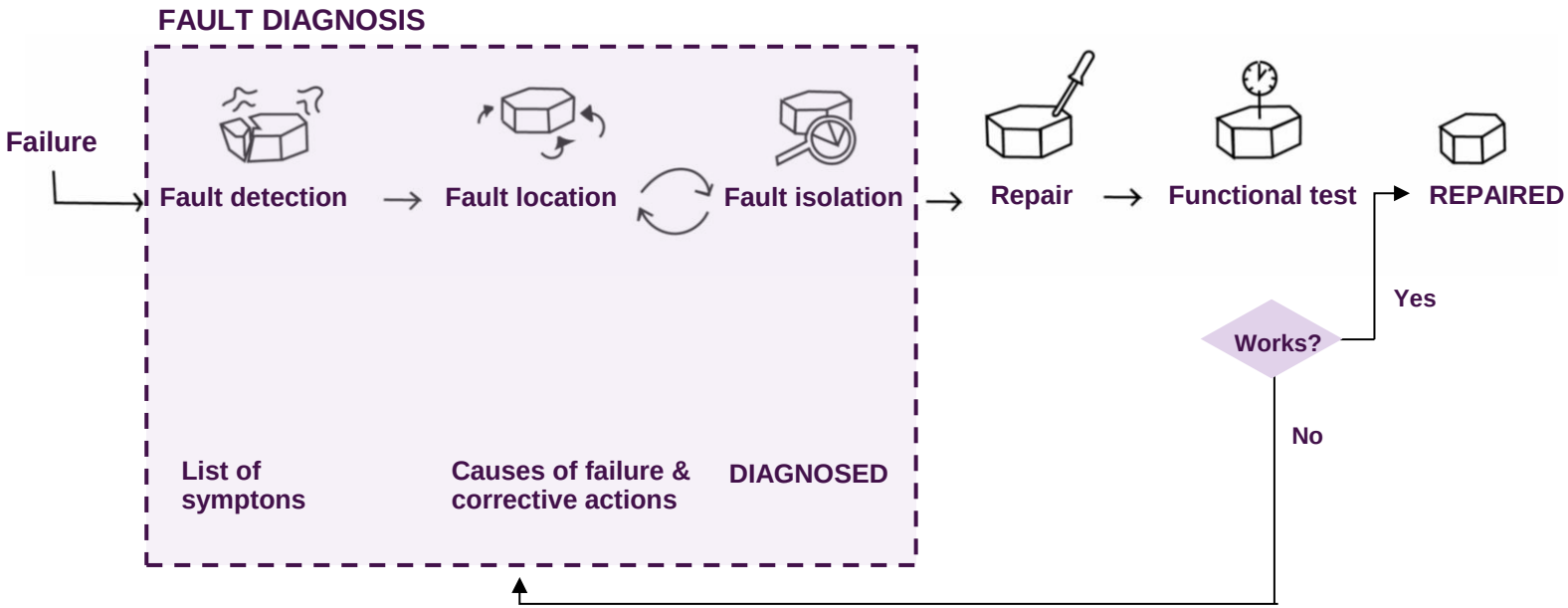


Fig. 33 The steps in a repair process (Pozo Arcos et al., 2021)

malfunction through an error code, simplifying the process and requiring minimal user expertise (Pozo Arcos et al., 2020). The effectiveness of these methods varies: trial and error is iterative and more challenging, whereas error codes provide a more straightforward solution. However, users do not have a choice, as error code functionality depends on the product's design (Pozo Arcos et al., 2020).

Product malfunctions can generally be communicated in five ways (Pozo Arcos et al., 2020):

(1) Under-performance
(2) Lack of response to commands
(3) Abnormal inbuilt signals
(4) Designed signals
(5) Intermittent performance

Error-coded symptoms, such as abnormal inbuilt and designed signals, are the easiest to diagnose, as they provide clear fault identification and corrective guidance (Pozo Arcos et al., 2020). In contrast, non-error code symptoms, such as under-performance, lack of response, and intermittent performance are more challenging to diagnose, often requiring trial-and-error approaches that are both time-consuming and dependent on the user's technical knowledge (Pozo Arcos et al., 2020).

Design features that facilitate fault detection include diagnostic feedback, transparent structures and easily accessible components. When such features are absent, users often face more complex detection processes that involve partial disassembly, making repairs more daunting, especially for those with limited experience (Pozo Arcos et al., 2021).

2.2.3.2 Fault Location

Once a fault is detected, the next step is identifying the specific component responsible for the malfunction. This process often requires disassembly to access and inspect internal parts. Products with complex housings or inaccessible components can significantly hinder this stage, particularly for inexperienced users (Pozo Arcos et al., 2021). While repair experience can improve confidence, it does not always guarantee an efficient approach to locating faults.

Design improvements, such as intuitive layouts, removable housings, and guided fault identification features, can enhance the fault location process. For instance, simplified disassembly mechanisms or visual indicators reduce frustration and enable users to locate faults more efficiently (Pozo Arcos et al., 2021).

2.2.3.3 Fault Isolation

Fault isolation is the final stage, where the exact defective component is pinpointed and corrective actions are implemented. This phase involves conducting actual repairs and subsequently reassembling the product (Pozo Arcos et al., 2020; Cuthbert et al., 2016; Pozo Arcos et al., 2018). Fault isolation can involve various actions (Pozo Arcos et al., 2020), including:


Visual inspection


Auditory inspection


Manual manipulation to assess function


Routine maintenance operations


Component replacement


Resetting the unit


Measuring electrical currents to check discontinuities


Following up on error codes

Minimal disassembly simplifies fault isolation, making inspection, testing and replacement more efficient (Pozo Arcos et al., 2021). Modular and accessible components further streamline this process, allowing users to isolate faults quickly and accurately. Conversely, highly integrated designs introduce additional complexity, prolonging fault isolation efforts (Pozo Arcos et al., 2021). Prioritising modularity and accessibility in product design can significantly improve repair outcomes, reducing the time and technical expertise required for successful fault isolation (Pozo Arcos et al., 2021).

2.2.4 Conclusion literature review

This literature review has provided a comprehensive overview of the e-waste landscape in Rotterdam and the underlying factors influencing appliance failure and replacement. It has shown that small household appliances make up a considerable portion of e-waste, yet little is known about the specific reasons these products are discarded. Existing studies suggest that many breakdowns occur during the use phase and are often repairable, but limitations frequently lead to premature disposal.

By unpacking the stages of the repair process, hence fault detection, location and isolation, the review highlights the technical and design-related barriers that hinder successful repair, particularly for inexperienced repairers (Fig. 34). These findings offer a valuable lens through which to explore the potential for improving repairability, repair experience and occurring challenges addressing the non-repairability of household appliances.

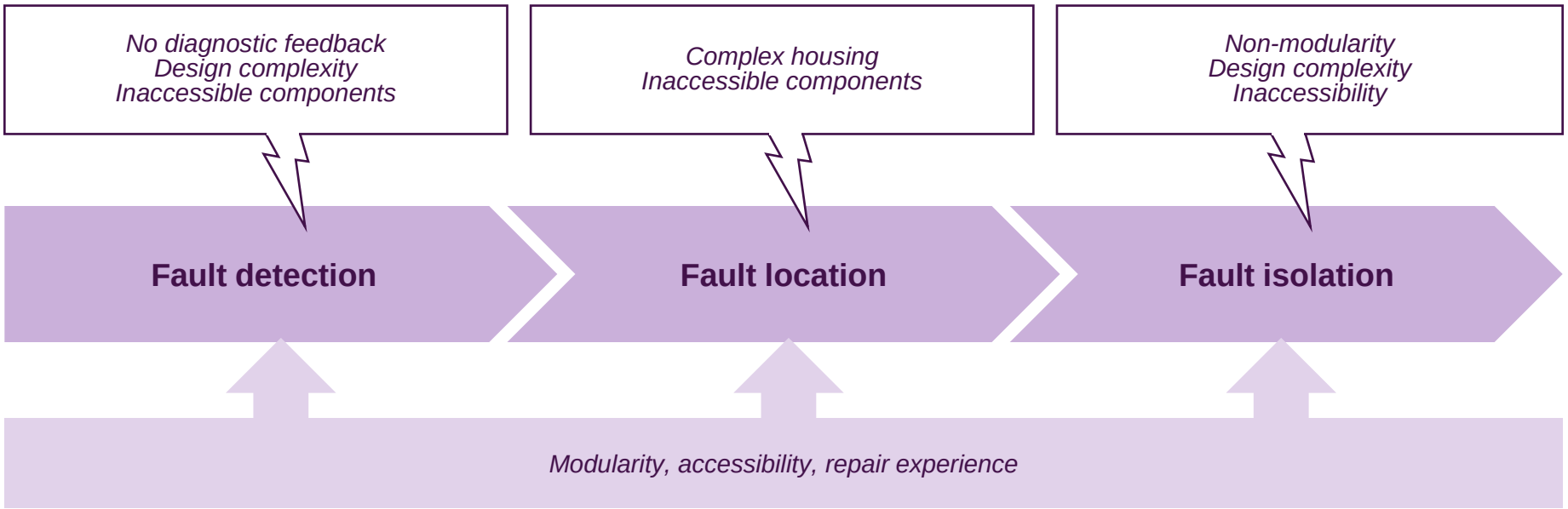


Fig. 34 Conclusion factors influencing the repair process

2.3 Research questions

As derived from the literature review, challenges are present regarding product design that influence a product's repairability. The repair process is explained and identified through three phases. This chapter wants to find answers to the technical aspects around repairing household appliances in Rotterdam, yet literature review shows not much information is available on the repair of these appliances specifically. To give answer to the second theme, sub-questions have been formulated (Fig. 35).

Technical aspects to household appliance repair
What does the repair process look like for small household appliances and what are the main challenges?
What are the (technical) needs when repairing household appliances?
What knowledge and skills are needed when repairing household appliances?
What are the main reasons for household appliances to break down?

Fig. 35 Sub research questions of theme 2

2.4 Method

Qualitative research will be done through interviewing three repair professionals acquired through visiting Repair Cafés and repair enthusiasts participating in DIY repair, who were also interviewed in theme 1. The research set-up is seen in Fig. 36.

2.5 Results

DIY repairers were gathered successfully, as Fig. 37 visualises. Professional repairers were gathered from three separate Repair Cafés, where two out of the three respondents were the initiators of the Repair Cafés. One out of three DIY repair interviews took place in real life, the others through video calling due to busy schedules of the respondents. All repair professional interviews took place in real life. As Fig. 35 already concluded, the set-up of theme 2 is divided into sub-questions. The results of these will be presented accordingly, hence section *2.5.1 – 2.5.4*.

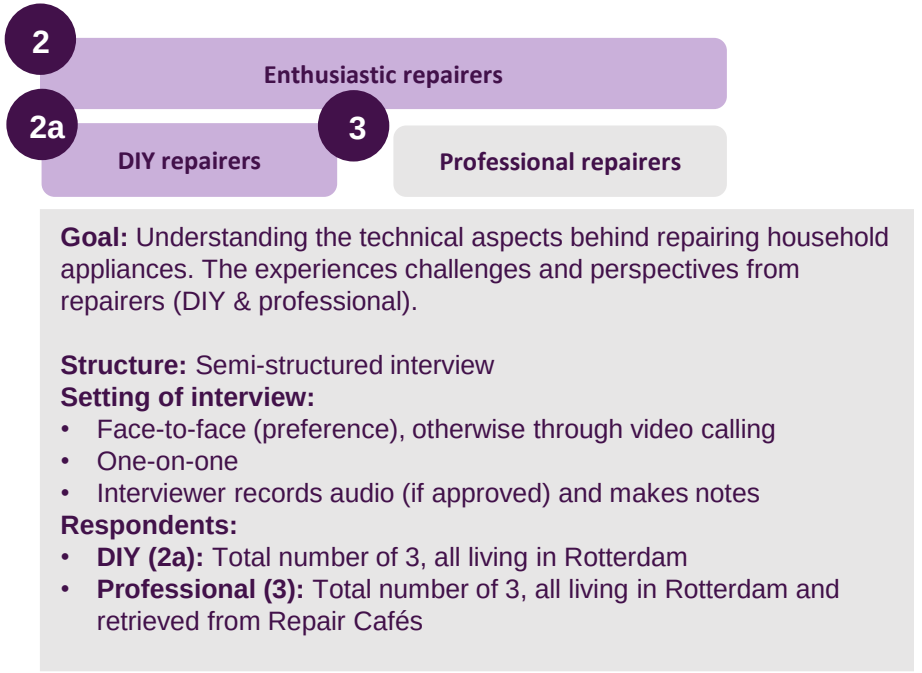


Fig. 36 Research setup theme 2

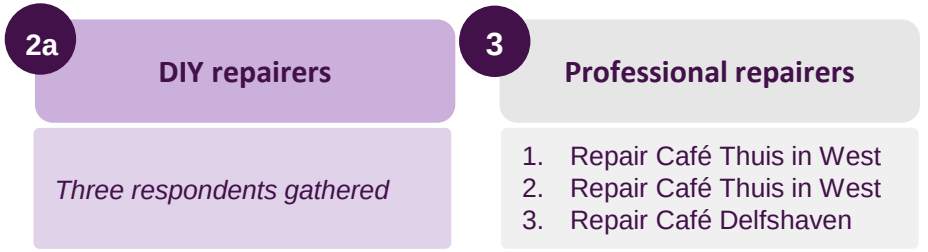


Fig. 37 Gathered respondents per target group

2.5.1 Repair process & challenges during the process

Respondents were asked to explain their personal repair process, Fig. 38 combines those answers for both DIY repairers and repair professionals. The steps have been placed chronologically to the extent in which it was possible. Interestingly, all DIY repairers collect their broken products and save it for a while before initiating repair. Almost all respondents spent time hypothesizing the error and all respondents mentioned initiating maintenance and cleaning action to fix the fault. Measuring electrical flow to find the component at fault was a tool for all repair professionals, yet only one DIY repairer used this method. Buying a spare part for replacing the component at fault was an initiated step for all respondents.

Challenges the respondent faced during the repair process (Fig. 39) were mostly mentioned through not finding the right spare parts, the hard to disassemble product and not knowing what is broken. For Repair Cafés specifically, frequently mentioned challenges were having too little space, also to store spare parts, not having enough time to finalize the repair and a lack of a certain skill and tool (Fig. 40). Fig. 41 enriches the numeral presented challenges by highlighting some quotes on the most common mentioned challenges.

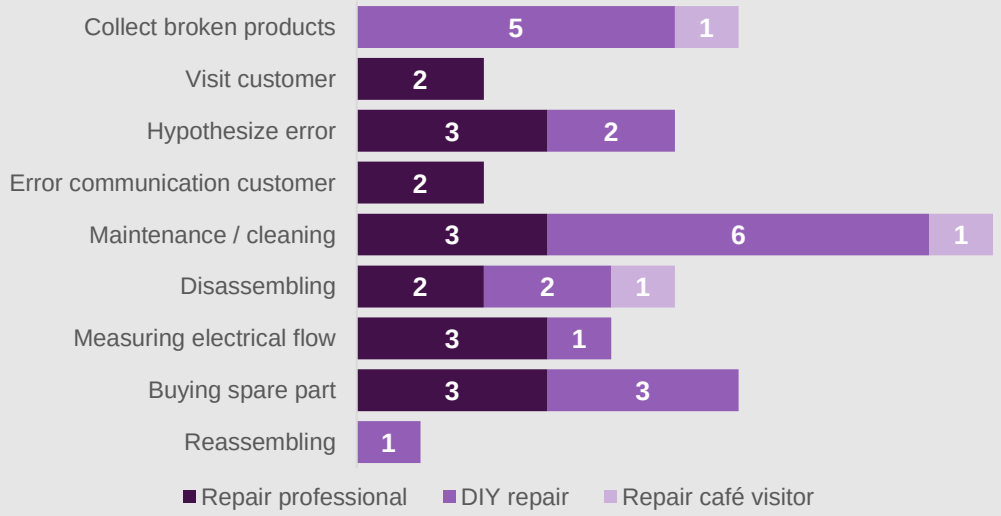
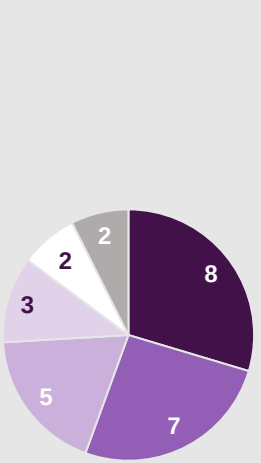


Fig. 38 Chronological steps in repair process



Not finding the right spare part	8
Repair professional	3
DIY repair	4
Repair café visitor	1
Product can hardly be disassembled	7
Repair professional	4
DIY repairer	3
Not knowing what is broken	5
Repair professional	1
DIY repair	3
Repair café visitor	1
Not having the right tools	3
DIY repair	3
Not having the right knowledge	2
DIY repair	1
Repair café visitor	1
Small / not visible product parts	2
Repair professional	2

Fig. 39 Challenges during the repair process

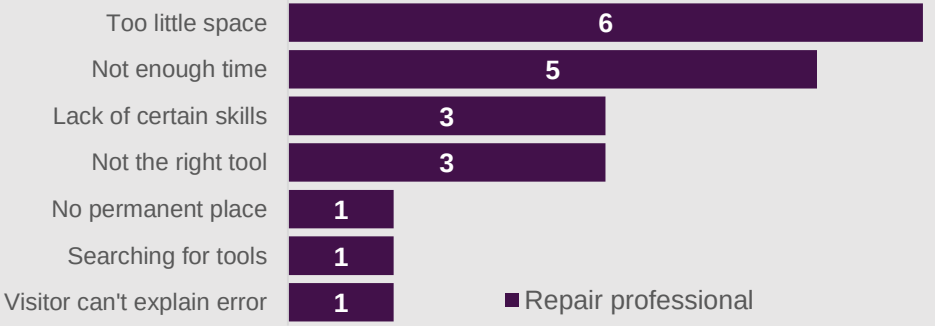


Fig. 40 Challenges in a Repair Café

Not finding the right spare part

“I’m working on my brother’s record player now, I have to order all kinds of components. If that comes in, you have to make time again to set it all out and get started. Otherwise you can easily spend weeks on it.”– DIY repair

“Now you can't even get them anymore. I looked on the internet. Can I replace it with a metal part of the same brand? It wasn't available, so, I had to buy new."– Repair café visitor

Product is hard to disassemble

“Well, some things are very easy to take apart, but there are also manufacturers who like to put things together that are not easy to take apart.” – Repair professional

Not knowing what is broken

“That you don't know what's broken. That at first, something doesn't work, and you don't know why."– DIY repair

Fig. 41 Quotes on most common challenges during the repair process

2.5.2 Technical needs

Results for finding out the technical needs can be categorized into two sections, namely needed tools and spare parts. The results for this section are categorized accordingly.

2.5.2.1 Tools

For Repair Cafés, a tool list is provided by the Repair Café organization, this list is seen in Appendix 1. One of both Repair Cafés from which volunteers were interviewed used this exact list and indicated using almost all the tools, except for larger tools intended for repairing wooden products, like furniture. The initiator of the second Repair Café indicated to have ignored the list, but purchased tools he needed more accurately. The tools mostly used are seen in the pictures of Fig. 42. Fig. 43 visualises some interesting quotes on tool usage during repair, where Repair Café volunteers said to sometimes miss the bulkier tools, but cannot be provided by the Repair Café due to space and non-permanency issues.

2.5.2.2 Spare parts

All respondents mentioned spare parts as important technical needs, where all repairers tried to save old products or spare parts for future repairs (Fig. 44). Some DIY repairers used 3D

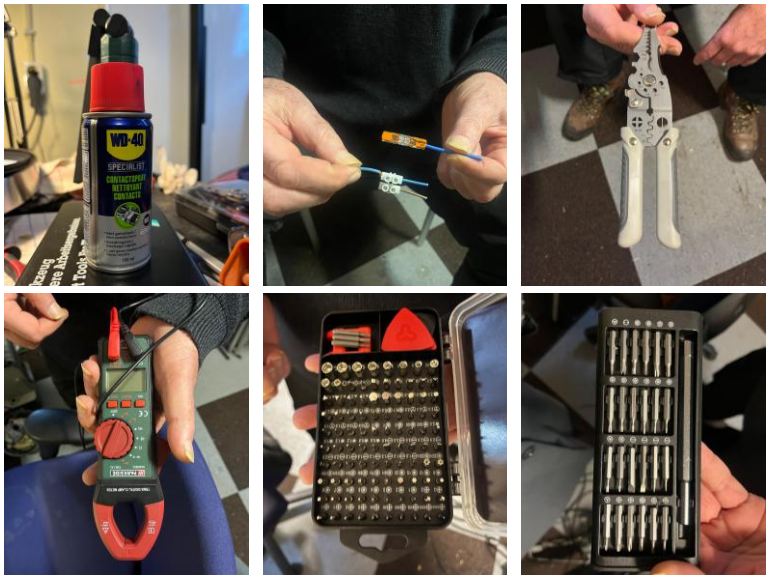


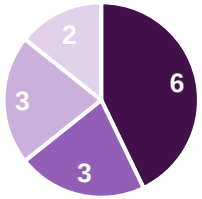
Fig. 42 Most needed tools for a specific Repair Café

“But one of the biggest things is that I, I would like to have a workbench with a vice. So that you can clamp something and work on it properly. But there is no space for that”

“On average we can fix almost everything. But if it's specific... We can't weld for example”

Fig. 43 Quotes on tool difficulties

printing techniques to gain spare parts and all repair professionals used AliExpress to search for fitting ones, as manufacturers seldom make them available. Interestingly, one repair professional mentioned getting permission from the municipality to gain spare parts from the e-waste as a valid solution (Fig. 45).



I save old devices for its spare parts	**6**
Repair professional	**3**
DIY repairer	**3**
3D printing spare parts	**3**
Repair professional	**1**
DIY repair	**2**
Buy at AliExpress	**3**
Repair professional	**3**
I save old spare parts	**2**
Repair professional	**1**
DIY repairer	**1**

Fig. 44 Answers on gaining spare parts

"Half of my workspace is used for storage, because you think it will come in handy someday, for a spare part or something like that."

"I recently had someone with a broken tank of his Senseo coffee machine. Before that, someone had come in with another broken Senseo that was beyond repair. I kept it because I thought it would come in handy. Well, problem solved"

"For example, it would be great if we could get permission from the municipality to shop at the e-waste bin. Perhaps people working at Repair Cafés could get a pass to specifically look for a part."

Fig. 45 Repair professionals on spare parts

2.5.3 Skills and knowledge needed

To gather insights on the skills and knowledge needed to participate in (DIY) repair activities, the respondents were asked what in their opinion makes a good repairer. Answers to this question are visualised in Fig. 46.

A strong indicator derived from these answers is having experience in doing repairs, mentioned by all respondents. Stating that a repair activity is a skill on its own, highlighted by the second strongest answer where all repair professionals stated that having repair knowledge is essential. Repair knowledge here is also explained through having some technical background (Fig. 47). Initiating repair using some common sense is the third mentioned indicator for what makes a good repairer.

Fig. 46 Answers to what makes a good repairer

Experience

"I buy secondhand very so that it still need to be refurbished a little bit. And because I've been doing that for, I don't know, six years, you get a little bit better at it." – DIY Repair

Repair knowledge

"Well, I can distinguish knowledge through my technical background. I then know which part is more responsible for the image or for the entire television and which part is more responsible for the sound." – Repair Professional

Common sense

"It's mostly common sense. You have to have your basic knowledge of course. If it's such a small nut, you can't go on it with those pliers. And you have to know something about how electricity works." – Repair Professional

Fig. 47 Quotes on what makes a good repairer

2.5.4 Reasons for household appliances breaking down

Only the repair professionals were asked about the main reasons for household appliances to break down, as they have seen a lot of different devices which are used by others and not themselves. Here, generally, three answers were given, hence bad maintenance, misuse and users not listening to fault indications (Fig. 48). The first two are mentioned more than once. Fig. 49 gives insights into examples presented by the repair professionals.

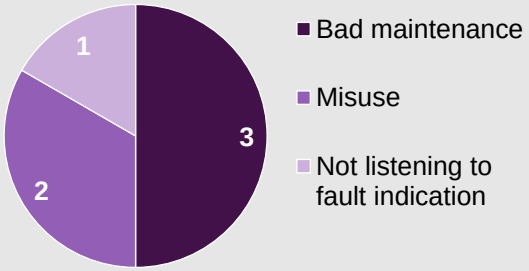


Fig. 48 Main reasons for household appliances breaking down

Bad maintenance

"And then I look and I immediately know. Has he ever cleaned those filters? Because of those particulate filters, when they get full, the engine doesn't get enough air to cool and then it burns. When then you take out a filter like that, you see it's completely clogged"

Misuse

"People sometimes use things in the wrong way. A regular household vacuum cleaner, which is used to suck up construction dust. Well, after that you can just throw it away"

Fig. 49 Quotes on main reasons for household appliances breaking down

2.6 Discussion

The results of theme 2 show a clear structure in the repair process, with shared steps such as hypothesising the fault, starting with cleaning or maintenance actions and replacing components. Challenges during repair were mostly related to hard-to-disassemble products, unclear faults and difficulty sourcing the right spare parts. For Repair Cafés specifically, limitations in space, tools and time were frequently mentioned.

While tools are generally present, bulky or specialised tools are often missing in Repair Cafés due to practical constraints. All respondents highlighted the importance of spare parts, and various strategies, such as collecting old devices, using 3D printing or sourcing from AliExpress to overcome limited availability. Searching spare parts from e-waste was an interesting recommendation from one of the repair professionals.

In terms of skills and knowledge, experience stood out as the strongest indicator of what makes a good repairer. Repair knowledge, whether from background or learned through practice, and common sense were also noted as stronger indicators. Finally, reasons for household appliances breaking down, as observed by professional repairers, mainly pointed to poor maintenance and product misuse.

2.7 Conclusion

As already researched by Pozo Arcos et al. (2020; 2021), the repair process consists of fault detection, location, and isolation. This structure was reflected in the interviews. However, a clear difference appeared between DIY and professional repairers. While all DIY respondents relied on observation and cleaning actions, professionals relied on measuring electrical flow to diagnose the component at fault. This may confirm that access to diagnostic tools and technical skills influences repair success.

Challenges such as inaccessible components, missing spare parts and limited working environments were frequently mentioned. Especially in Repair Cafés, space and tool availability were restricting factors. This confirmed barriers identified in Bakker et al. (2023) and emphasised the importance of the environment in which a repair takes place and not solely relies on product design. The repair process derived from the research and the challenges that may come up in different phases of this process are summarized in Fig. 50

All repairers saved old appliances for spare parts, and professionals often used non-sustainable) platforms like AliExpress to gain fitting spare parts. This underlines the ongoing issue of spare part availability, also highlighted by Forti et al. (2020). One of the most interesting findings is how repairers are creatively solving these limitations, for instance through 3D printing or looking for access to e-waste streams, highlighting the important role municipalities have in spare parts facilitation.

Finally, when asked what makes a good repairer, all respondents emphasised experience and common sense, framing repair not just as a technical task, but as a learned skill. This adds to the literature by highlighting the role of repair experience in order to establish successful repair during fault detection, location and isolation.

To conclude, this research confirmed that successful repair depends on more than solely product design. User skill, access to parts and tools and repair environments all play a key role, and must be considered in order to stimulate residents of Rotterdam in repairing their household appliances more often.

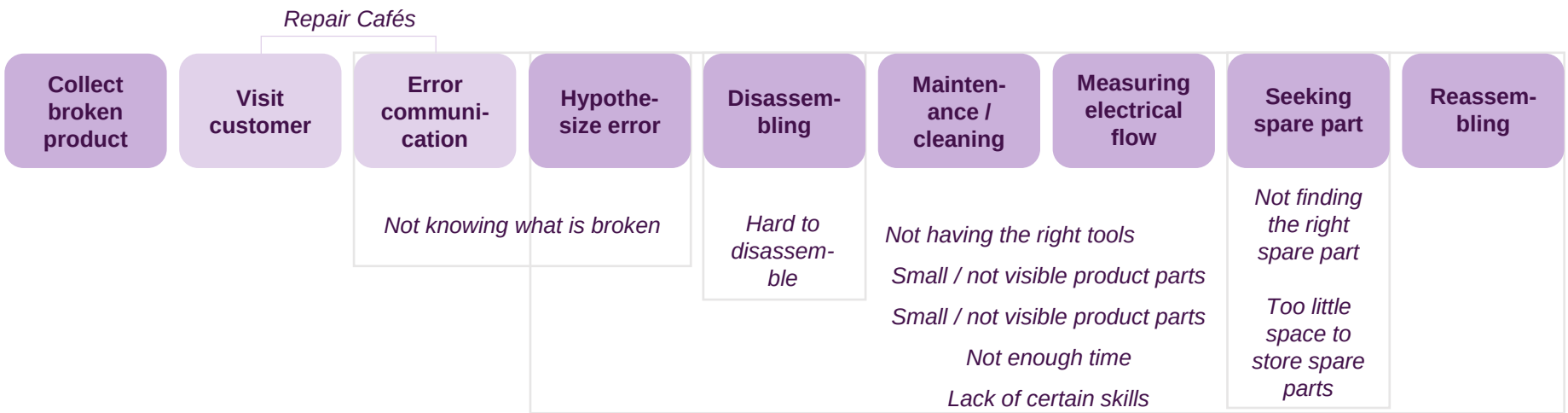


Fig. 50 The repair process derived from research and challenges that may arise

Chapter 3
Current repair ecosystem in Rotterdam

3.1 Introduction

As the previous two chapters have researched the context of this thesis' research through the lenses of the user and technology, this chapter will research repairability in Rotterdam through the lens of organisations facilitating a repair role for the city's residents. Repairing household appliances has become increasingly significant in addressing sustainability challenges, reducing waste, and promoting a circular economy. However, despite the growing possibilities and regulations in repairability, consumers still do not know where to go as results of chapter 1 have shown. Despite residents in Rotterdam not knowing where to go with their broken appliances, this does not mean these places do not exist.

Organisations such as Techniek Nederland, a trade association for technical service providers, play a key role in supporting repair ecosystems in the Netherlands. Their collaboration with the Ministry of Infrastructure and Water Management and the Centraal Register Techniek has led to the development of the Nationaal Reparateurs Register (NRR), which aims to professionalise repair services and make them more accessible to consumers (Bakker et al., 2023). Community initiatives like Repair Cafés also serve as crucial touchpoints in the repair facilitation, providing skill-sharing and collaborative solutions to repair challenges (Türkeli, et al., 2019 ; Hielscher, et al., 2021). Despite these promising efforts, systemic barriers persist. Consumers often perceive repair as inconvenient or costly, and manufacturers frequently cite safety concerns as reasons to limit access to spare parts (Bakker et al., 2023). This chapter aims at observing the status quo of the repair options Rotterdam offers, in order to identify gaps the solution may fill.

3.2 Literature review

Fachbach et al. (2022) identify three primary categories of repair activities among consumers: (1) utilizing repair service providers, (2) engaging in self-repair (DIY), and (3) employing repair services offered by providers within a repair network. Understanding the structure and dynamics between these activities and the values they create, is crucial in understanding the repair offer in Rotterdam. Repair ecosystems include various stakeholders such as certified repair services, repair communities (Repair Cafés), manufacturers, consumers, and policy-makers. These stakeholders contribute to the repair process, influencing the repairability of household appliances and the availability of repair services and spare parts. The literature review will shed light on the role policies currently have on players within the repair ecosystem. Besides, the review will highlight success factors and obstacles in visiting Repair Cafés found in literature as Repair Cafés play a large role in facilitating repair for household appliances. It will end with digital platforms that provide information for DIY repair practices.

3.2.1 The role of policies and regulations

The introduction of the right to repair legislation (set to take effect in 2025) and the EU Ecodesign Directive have the potential to reshape repair practices by requiring manufacturers to design products that are easier to repair, provide access to spare parts, and support repair services (Bakker et al., 2023) (Forti et al., 2020). The introduction of the right to repair directive is a crucial development shaping the repair ecosystem, from the design phase to the end-of-life for products. For manufacturers, the directive necessitates designing modular products that are easier and less expensive to repair, increasing the availability of spare parts, and supporting faster and more affordable repair processes

(Bakker et al., 2023). However, while the directive primarily targets manufacturers, its ripple effects influence independent repairers and consumers alike. Independent repairers may benefit from potential access to innovations like 3D printing for spare parts, which could significantly reduce repair costs (Bakker et al., 2023). Consumers, on the other hand, will need greater access to repair knowledge and skills, as simpler repairs can often be performed independently, while more complex or hazardous repairs may still require professional intervention (Bakker et al., 2023).

Also, all appliances sold in the European market need to adhere to the European Guidelines Ecodesign from 2009, which has mainly focused on energy labels for the last few years. Now, from 2025 on, manufacturers of phones and tablets need to take into account a different label as well, the reparity score. Other product groups will follow at a later time. The repairability label presents information on the feasibility to repair, the feasibility to disassemble, if special tools are needed for repair and if spare parts are easily available.

3.2.2 Collaborative & community-based repair initiatives

In many cities, community-based initiatives such as Repair Cafés, tool libraries, and DIY repair workshops have become an important part of the repair ecosystem. These initiatives often rely on volunteers or trained professionals to assist in repairing household appliances, contributing significantly to extending product lifespans (Cuthbert et al., 2016).

Repair Cafés have emerged as non-commercial community-driven initiatives aimed at facilitating the repair of household appliances. Repair Cafés originated in the Netherlands in 2009 and have since expanded globally, with over 2000 cafés in 37 countries as of April 2021 (RepairCafé, 2024). They serve as community spaces where individuals can bring broken items for repair, fostering a culture of sustainability. Repair Cafés empower individuals to engage in sustainable practices. From the consumer's perspective, success factors, yet also challenges can be identified in engaging in Repair Café activities (Moalem & Mosgaard, 2020).

3.2.2.1 Success factors of Repair Cafés

Success factors can be identified by various benefits.

Economic benefits

Economic benefits play a major role in attracting participants. Repair Cafés offer free repair services, allowing individuals, particularly those with limited financial resources, to extend the life of their products without incurring the costs of replacement or professional repairs (Pesch, et al., 2019).

Educational approach

Repair Cafés provide skill-sharing and learning opportunities. Consumers not only have their items repaired but can also learn repair techniques from volunteers, gaining practical knowledge that increases confidence and the ability to repair independently in the future (Türkeli, et al., 2019).

Feeling of community

Repair Cafés foster social interaction and a sense of community. Consumers benefit from collaborative repair activities in inclusive spaces, where they can connect with others, share experiences, and feel part of a collective effort to promote sustainability (Hielscher, et al., 2021).

3.2.2.2 Challenges faced by Repair Cafés

While Repair Cafés offer valuable benefits, several challenges persist that can hinder consumer participation and engagement.

From the consumer's perspective, these obstacles largely revolve around practical barriers, perceptions, and limitations in the repair experience.

Time constraints

This is particularly true for individuals with limited time, as repair activities often require scheduling visits, waiting for assistance and actively participating in the repair process.

Repair skills & knowledge

The skills and expertise of volunteers may not always align with the types of repairs needed, particularly for complex items such as electronics. From the perspective of the visitors, some individuals may lack the confidence, interest or creativity to engage in the repair process, even though Repair Cafés aim to educate participants. The perceived requirement for active participation can act as a deterrent for consumers who may prefer professional and passive repair services (Moalem & Mosgaard, 2020).

3.2.3 Digital facilitators for DIY repair practices

With increasing reliance on digital tools and platforms, technology has begun to play a large role in the repair ecosystem. Digital platforms allow for remote diagnostics, online repair guides, spare parts ordering and crowdsourced repair knowledge (Laitala et al., 2020). The integration of digital technologies into Rotterdam's repair ecosystem should be addressed accordingly. Digital sources used during the DIY repair process have been identified from the interviews conducted in chapter one. Platforms mentioned multiple times were Youtube and iFixit. A quite young and new player in the Netherlands is Jafix, which is a Dutch platform where users may gather repair information on their specific device and gain repair advice through the chatbot Handige Harry (Jafix, n.d.) (Fig. 52). As a Dutch platform which is gaining more attention in the repair business networks (De Kracht van Reparatie, 2025), it is expected to play a part in the repair ecosystem in Rotterdam as well.

Fig. 51 Digital platforms expected to play a role in the repair ecosystem of Rotterdam

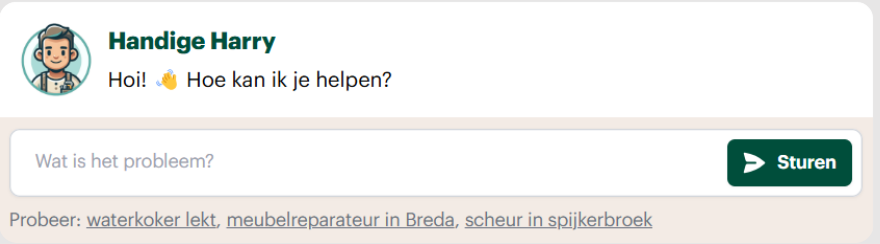


Fig. 52 Jafix' Handige Harry Repair chatbot

3.2.3.1 Success factors of iFixit

One of the most prominent digital repair platforms is iFixit, which is a company founded in 2003 with the mission to reduce e-waste by empowering individuals to repair their own devices. Through a combination of freely accessible repair guides, community-driven knowledge sharing and the sale of tools and parts, iFixit has developed into a global website visited by nearly 100 million users annually (Vizologi, 2018; Charter, 2018). By offering step-by-step guides for over 30.000 appliances, the platform has positioned itself as both a commercial enterprise and a social movement, challenging the throwaway culture encouraged by many electronics manufacturers (Mani & Yemen, 2022).

Digital prominence

IFixit's success largely stems from its ability to integrate community engagement, knowledge sharing and e-commerce.

Over half of the repair guides available on the platform are user-generated, underlining the participatory nature of its ecosystem (Vizologi, 2018; Connatser, 2024). This crowdsourced approach strengthens the platform's credibility and continuously expands its knowledge base.

User journey

IFixit has a comprehensive approach to repair. Users are not only guided through fault resolutions and repairs, but can also directly purchase the required tools and parts via the same platform, bridging the gap between information and action (Vizologi, 2018; Day, 2025). Additionally, educational partnerships with schools and universities allow iFixit to promote technical skills and repair literacy among younger generations, while generating alternative revenue streams (Vizologi, 2018).

3.2.3.2 Challenges faced by iFixit

Despite its strengths, iFixit faces several structural challenges.

Dependency on manufacturers

Collaborations with manufacturers have often proven problematic, as high part prices, restrictive agreements and designs that hinder disassembly continue to challenge repair efforts (Tamil, 2024; Connatser, 2024). These limitations reflect the broader resistance from manufacturers to support independent repair initiatives.

Spare parts unavailability

On top of this, iFixit remains partially dependent on Original Equipment Manufacturers (OEMs), which are the companies that design and produce the original products, for the supply of compatible spare parts. This reliance can restrict affordability and availability of repair activities, particularly when manufacturers choose not to cooperate or intentionally limit access to essential components (Suovanen, 2025; Day, 2025).

3.2.4 Conclusion literature review

This literature review has explored the multifaceted repair ecosystem in which consumers operate when dealing with broken household appliances. It has highlighted the increasing influence of European regulations, such as the Right to Repair and the Ecodesign Directive, in shaping manufacturer responsibilities and improving access to repair. Community-based initiatives like Repair Cafés were examined as vital actors in the local repair landscape, offering social, educational and economic value while also facing challenges related to accessibility and user engagement (Fig. 53). Finally, digital platforms, particularly iFixit, Youtube and Jafix, were reviewed as facilitators of DIY repair, enabling users to access repair knowledge, tools and community support (Fig. 53). Together, these insights establish a foundation for understanding the current repair offer in Rotterdam and inform the investigation into how different repair channels, hence professional, community-based and digital, are utilised and experienced by residents.

	Community-based repair initiatives	Digital repair facilitators
+	Economic benefits Educational approach Feeling of community	Digital prominence User journey
-	Time constraints Lack of skills & knowledge (volunteers & visitors)	Dependency on manufacturers Spare parts unavailability

Fig. 53 Conclusion benefits & challenges of Repair Cafés & iFixit found in literature

3.3 Research questions

As derived from the literature review, several main players of the repair ecosystem in Rotterdam can be identified, hence manufacturers, Repair Cafés and digital platforms such as Youtube, iFixit and Jafix. For the first theme, the current repair behaviour in Rotterdam was examined. The theme of this part will follow up on that research on how the current repair ecosystem facilitates repair behaviour. The interplay between the repair behaviour and the facilitation will be examined accordingly. It will do so by answering sub-questions, as seen in Fig. 54. These sub-questions will examine (the distribution of) the current repair offer and its strengths and weaknesses.

Current repair ecosystem in Rotterdam
What is the current offer for citizens of Rotterdam to visit when wanting to engage in repair activities and how is it distributed?
What are the strengths and weaknesses of the current repair offer?

Fig. 54 Theme 3 and its sub-questions

3.4 Method

To be able to give answers to the sub-questions, first, the current offer regarding Repair Cafés, repair services and digital platforms will be roughly examined on its existence and distribution and first insights will be examined. Hereafter, an empirical study will be conducted, where the role will be taken of the mystery guest. With three broken small household appliances, it will be observed how the repair ecosystem facilitates repair guidance. First, repair information will be retrieved from Youtube, iFixit and Jafix specifically to the product that is broken. Secondly, product specific repair information provided by the manufacturer of the broken household appliance will be observed. Lastly, three different Repair Cafés will be visited with the different broken household appliances. The schema of both parts of this research is visualised in Fig. 55, including the aspects that will be analysed.

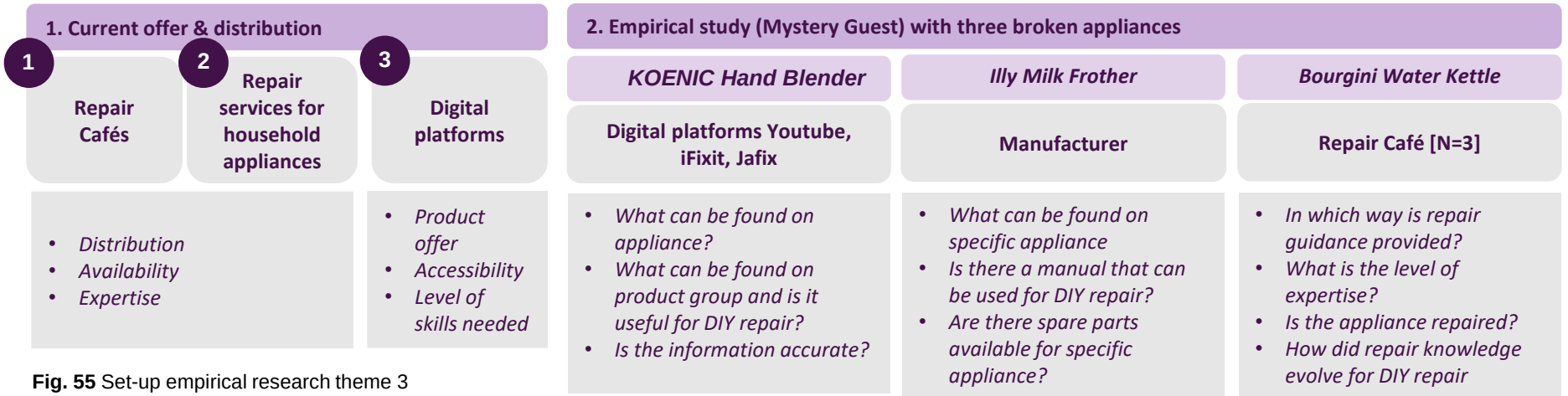


Fig. 55 Set-up empirical research theme 3

3.5 Results

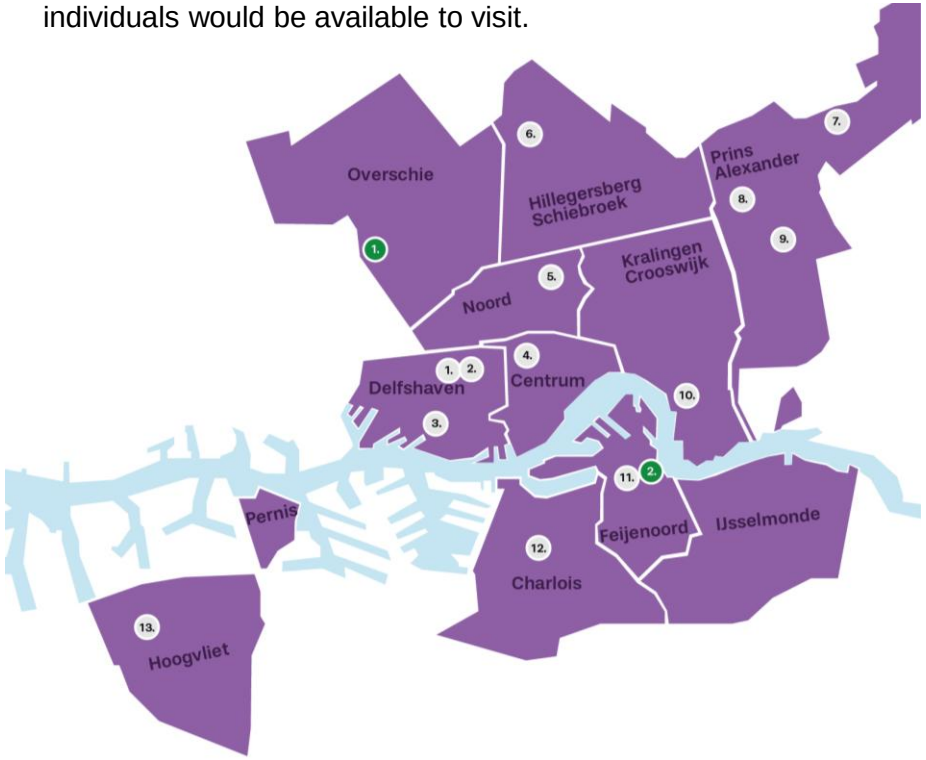
As Fig. 55 already concluded, the set-up of theme 3 is divided into several sub-researches. The results of these will be presented accordingly, hence section 3.5.1 and 3.5.2.

3.5.1 Current repair offer and distribution

The repair offer in Rotterdam was found online on the website of Repair Café Org (Repaircafe, n.d.), the Routeplanner that Rotterdam Circulair has set-up for residents to find circular initiatives in the city (Rotterdammers, n.d.), and finally through the Reparatieregsiter (Nationaal Reparateursregister, n.d.), which is a national platform where certified repair services within the Netherlands are communicated. Youtube, iFixit and Jafix were online examined as well, yet only through their own website (YouTube, n.d. ; iFixit: The Free Repair Manual, 2025 ; Jafix, n.d.).

3.5.1.1 Repair Cafés and certified repair services

Fig. 56 visualises the Repair Cafés and repair services on the map of Rotterdam. The offer in repair services is low. Only two certified professional repair services were identified in Rotterdam that initiate actual repair for household appliances. Regarding Repair Cafés, Rotterdam counts thirteen, distributed across ten districts. With Rotterdam counting 14 districts, the distribution is quite balanced. Higher concentrations of Repair Cafés are seen in the districts Delfshaven and Prins Alexander. On a city-wide scale, all Repair Cafés appear to be within reach for most residents. However, when browsing online images of the Repair Cafés, it becomes noticeable that the focus often lies on elderly participants, with spaces that appear somewhat dated (Fig. 57). Creating doubt on the broader appeal of these initiatives and whether they attract a diverse audience. The low appeal of attending a Repair Café for other target groups than mostly elderly can also be explained when looking at the days in which the most take place. Fig. 58 visualises an agenda view of all the Repair Cafés taking place in a month. Although individual timetables may seem limited, a combined agenda view reveals that on most weekdays, at least one Repair Café is available. However, the weekend offer is weaker, especially on Sundays, which may be a missed opportunity, as this is often when working individuals would be available to visit.



1	Thuis in West	**7**	RC Zevenkamp	**13**	RC Hoogvliet
2	Wijkpaleis	**8**	RC Lage Land		
3	RC Delfshaven	**9**	RC Prinsenhof	**1**	Stapservice B.V.
4	RC Oude Westen	**10**	RC De Esch	**2**	Stofzuigerhuis
5	RC Noord	**11**	RC Zuid		
6	RC Schiebroek	**12**	RC Charlois		

Fig. 56 Distribution of the repair offer in Rotterdam

Fig. 57 Browsed images of the repair offer in Rotterdam

1.	Monday	Tuesday	Wednesday	Thursday	Fri	Saturday	Sun
	Lage Land	De Esch	Thuis in West Delfshaven Zevenkamp De Esch	De Esch		Wijkpaleis Oude Westen Zuid	
2.	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Fri**	**Saturday**	**Sun**
	Lage Land Prinsenhof	De Esch	Pluspunt Thuis in West Delfshaven Zevenkamp De Esch	De Esch		Wijkpaleis Noord	
3.	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Fri**	**Saturday**	**Sun**
	Lage Land	De Esch	Thuis in West Delfshaven Zevenkamp De Esch Schiebroek	De Esch		Wijkpaleis Oude Westen	
4.	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Fri**	**Saturday**	**Sun**
	Lage Land Prinsenhof	De Esch	Thuis in West Delfshaven Zevenkamp De Esch Charlois	De Esch		Wijkpaleis Hoogvliet	

Fig. 58 Agenda view of all the hosted Repair Cafés in Rotterdam

A rough analysis was done on all separate Repair Cafés (Appendix 2). Here, it was analysed that the repair focus lies mainly on small electrical household appliances. Support is provided on a voluntary basis and is almost always free of charge. At the same time, most Repair Cafés struggle with a shortage of volunteers, which often limits how frequently they can operate. The visual identity of many websites and promotional materials appears outdated and perhaps unappealing to a larger audience.

3.5.1.2 Digital platforms

To assess how digital platforms facilitate DIY repair, YouTube, iFixit and Jafix were examined based on their product offer, accessibility and the level of repair knowledge required. The results are visualised in Table 2.

YouTube offers a wide variety of user-generated repair videos across all product categories. Its open setup allows users to search for specific faults or devices, but the lack of filtering and variation in quality can make finding useful content difficult. Still, the visual nature of videos lowers the barrier for those with limited repair skills.

IFixit focuses on electrical products and offers a broad range of guides, especially for small kitchen appliances. Users can search by type, brand andmodel, and can access step-by-step disassembly and replacement instructions. However, most content is not fault-specific and primarily visual-textual, making it less accessible for inexperienced users. The forum provides some scope for personal guidance.

Jafix combines user-submitted knowledge and in-house guides, though the offer for household appliances is limited. Most guides cover disassembly only and are supported by images and text. The standout feature is the 'Handige Harry' chatbot (Fig. 52), which aims to offer tailored support for specific devices and issues, suited for users with lower repair skills.

3.5.2 Empirical study

For the empirical study, the digital platforms and manufacturers were analysed online. The visited Repair Cafés were, in order of

Table 2 Analysis on digital platforms for repair information facilitation

Platform	Explanation	Product offer	Options	Accessibility	Level of skills needed
Youtube	Users can watch repairing video's uploaded by other videos. The forum is not repair-specific.	All types of products	• Search tab (open search, no filter) • Watch video • Comment on video, may getting a response	• Not all products and faults are on the forum • Open search tab can make it hard for users to find fitting video	Video makes it easier for user with low repairing skills to follow instructions
iFixit	Users can find guides and other information on repairing broken products which is uploaded by other users	All types of electrical products	• Product search (open search, yet also type, brand/model in one) • Disassembly & replacement guides • Tool information • Feature to buy parts • Forum to ask questions	• Information offer not fully enriched, yet still a lot of product information • Mostly disassembly guides available, not error specific • In the category of electrical household devices, mostly small kitchen devices available	Use of only pictures and text and information offer of mostly disassembly guides makes it harder for low-skilled repairers to repair own broken product. Forum on this website is a good way of receiving more personal guidance.
Jafix	Users can find guides on how to repair broken products, which are uploaded by Jafix and its users	All types of products, yet not a larger focus on electrical devices	• Product search (type, brand, model) • Find fitting repairing guides (mostly disassembly guides)	• Guide offer is small for electrical household devices (n=5) • Mostly disassembly guides	Use of only pictures and text and information offer of mostly disassembly guides makes it harder for low-skilled repairers to repair own broken product

visiting: Thuis in West, Repair Café Delfshaven and Het Wijkpaleis. Fig. 59 visualises which appliances were brought along to which Repair Café and what was the failure of the appliances.

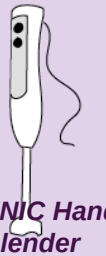
1 Thuis in West	2 Repair Café Delfshaven	3 Het Wijkpaleis
 *KOENIC Hand Blender*	 *Illy Milk Frother*	 *Bourgini Water Kettle*
Attachment no longer fits the body of the hand blender	*Magnet is no longer functioning, resulting in a non-spinning spiral*	*Lit no longer closes, resulting in a non-stop boiling water kettle*

Fig. 59 Information on broken household appliances brought to Repair Cafés

3.5.2.1 Digital platforms

Table 4 on the next page visualises all the insights on the empirical research for digital platforms X broken household appliances. YouTube offers a wide range of user-generated repair content, but the search results for all appliances were often insufficient. While some general repair videos were available, they lacked specific solutions or were in languages limiting accessibility. The open search engine allows for a broad search, but the absence of filtering tools can complicate the search, particularly for users with low repair knowledge.

IFixit provides more structured and detailed repair guides, focusing mainly on electrical appliances, particularly small kitchen devices. However, for none of the researched appliances, specific results were found. The platform offers disassembly and replacement guides, which can be useful for more experienced DIY repairers, though the lack of fault-specific guides makes it less accessible for beginners.

Jafix offered no relevant guides for the broken household appliances. While the platform's disassembly guides are somewhat helpful, its ‘Handige Harry’ chatbot, provided information on something completely unrelated to the product type and error communicated.

3.5.2.2 Manufacturers

The investigation into how manufacturers facilitate repair information and spare parts revealed different levels of support for the three appliances. The aspects observed were what kind of repair information and service was provided on the specific product type (1), whether there was a manual available and if it could facilitate DIY repair (2), and whether the manufacturer sold spare parts. The results are seen in Table 5 on the next page.

For the KOENIC Blender KHB 3121, manuals are available for download, but one is not working, and the other only provides basic product information. Spare parts are not offered directly by KOENIC, though alternative sellers provide compatible parts.

For the Illy Milk Frother F280E, there is no consumer repair or spare parts service provided by the manufacturer. While spare parts for milk frothers can be purchased from third-party suppliers, none of these are specifically designed to address the issue with this particular model.

Bourgini offers a product guide for the Water Kettle 23.4009, and spare parts are available. However, these parts are not specific to this model, and no other related information can be found through Google searches.

Table 4 Results empirical study digital platforms

	Youtube	iFixit	Jafix
Hand Blender	• **No exact match** found for KOENIC KHB 3121 • Some brand-level disassembly videos available, but with **different internal layouts** • **One relevant video** found in **Hindi**, limiting accessibility for Dutch users	• **No exact match** for KOENIC KHB 3121 • **Found 4 similar blenders** but no matches for this specific model • **General disassembly guides** available for blenders, but not specific to KOENIC • **Accuracy** of information is **low**, as guides are for different blender models	• **No exact match** for KOENIC Blender KHB 3121 • **No relevant results** found in product search under kitchen devices • Chatbot (Handige Harry) provided a **wrong result**, not related to the specific issue or product
Milk Frother	• **No relevant results** for Illy F280E • Some videos found for **other milk frother** brands with similar issues • Videos mainly **describe the issue** without offering repair solutions	• **No exact match** for Illy Milk Frother F280E • Guides **for other brands**, including only a teardown guide • **No repair-specific guides** found for the F280E model • **Accuracy** of information: **Low**, as only a teardown is available, not repair-focused	• **No exact match** for Illy Milk Frother F280E • **No relevant results** found in product search under kitchen devices • Chatbot (Handige Harry) **provided a wrong result**, not related to the magnetic problem
Water Kettle	• **No results** for Bourgini 23.4009 • Videos that do show up are about **different brands, types, or problems** • **No usable guidance** for DIY repair of this specific issue	• **No exact match** for Bourgini Water Kettle 23.4009 • 23 results found, but all for **different brands and types** • 3 guides available: 2 are **replacement guides**, and 1 is a **disassembly guide** (none are product-type specific) • Accuracy of information: **Limited**, as the guides are for other models and don't match the specific product	• **No exact match** for Bourgini water kettle 23.4009 • **No relevant results** found in product search under kitchen devices • Chatbot (Handige Harry) provided a **wrong result**

Table 5 Results on repair information and spare parts facilitation by manufacturers

	Koenic (hand blender)	Illy (milk frother)	Bourgini (water kettle)
Repair information / service on product type	• Only a basic product information sheet is available • No repair guidance found	• No repair service or DIY repair guidance provided by manufacturer	• No repair information found
Manual on product type	• One download link not working • Another contains minimal information, not suited for DIY repair	• No manual found that supports DIY repair	• Product guide available, but not suitable for DIY repair purposes
Spare part service	• Not offered by KOENIC • Some parts available via third-party sellers	• No official parts offered by Illy • Third-party parts available but not suitable for this issue or model	• Generic spare parts available, but not for this specific model

3.5.2.3 Repair Cafés

As Fig. 59 visualised, the different products individually were brought to different Repair Cafés. Observation of the Repair Cafés relied on how repair was guided and to which extent the repairer took the visitors along in the repair process (1), the level of expertise of the repairer and to which extent its skills could solve the fault (2), and whether the appliance could be repaired (3). Results are seen in Table 6.

At Thuis in West, the interaction was largely framed as a repair service rather than a collaborative activity. Visitor involvement had to be actively asked for, and although the repairer's communication was somewhat uncomfortable, it was understandable regarding his repair efforts. The fault was diagnosed quickly, yet the repair process led to further internal damage, after which the product was deemed irreparable and discarded at the e-waste.

The Repair Café in Delfshaven similarly approached repair as a service, yet with explicit attention to visitor education. The repairer demonstrated a high level of technical competence and offered clear explanations regarding the fault and its likely cause, including reflections on maintenance behaviour. Although the product could not be repaired during the session, the repairer actively searched for spare parts and suggested a viable alternative, purchasing a second-hand model to extract the necessary components.

At Het Wijkpaleis, it was intended to repair together, in line with the Repair Café's collaborative focus. In practice, however, the repairer preferred to work independently while offering explanations between actions. The repair approach was based on trial-and-error, which initially suggested limited technical knowledge. Nonetheless, the repairer was able to handcraft a replacement part, indicating a higher level of creativity and skill. The product was successfully repaired, although the fix proved temporary and failed again several months later.

Table 6 Results empirical study Repair Cafés in Rotterdam

	Thuis in West (hand blender)	**RC Delfshaven (milk frother)**	**Het Wijkpaleis (water kettle)**
Repair guidance	• Focus on offering a repair *service* • Had to pursue the repairer into teaching me how to do it • Communication was uncomfortable, yet understandable	• Focus on repair service, no place for repairing together • High focus on repair education, explanation on fault and spare part search	• The Repair Café has an intended focus on repairing together • Repairer preferred individual repair, yet wanted to explain what he did afterwards and in between actions
Level of expertise	• Fault was indicated quite quick and clear • Repair process made the product break down even more	• High repair knowledge and level of expertise • Repairer explained fault very thoroughly and communicated influence of (maintenance) behaviour on product	• The repair process was trial-and-error, which gave the feeling of a lower level of expertise • A spare part was made by hand, indicating a high level of creativity & skill
Repair service	• Product appeared to be unrepairable • Choice was made to discard product at e-waste	• Good guidance and service on repair, repairer searched online for needed spare part • Spare part could be purchased through buying similar old product second-hand	• Product was repaired after around 2 hours • After several months, the repaired part resulted in another break down

3.6 Conclusion

The repair offer in Rotterdam, although varied, remains limited in scope and coverage, particularly when it comes to professional repair services. The city hosts thirteen Repair Cafés, which are relatively well-distributed across the different districts and a small number of certified repair services (only two), with a focus on the repair of household appliances. While the Repair Cafés provide a valuable community-driven repair option, their reach and appeal are hindered by a number of factors. These include outdated promotional materials and limited operating hours. Furthermore, the volunteer shortage faced by these Cafés often limits their ability to operate regularly, affecting their accessibility. The weekend availability of Repair Cafés is particularly weak, with Sundays underrepresented on the schedule, missing an opportunity to attract working residents.

The empirical study on digital platforms, manufacturers, and Repair Cafés highlights a fragmented repair ecosystem in Rotterdam. Digital platforms such as YouTube, iFixit, and Jafix offer some resources for DIY repairs, but each has notable limitations. YouTube's vast range of user-generated content is not easily navigable, particularly for those with limited repair knowledge, due to the lack of filtering options and inconsistent content quality. iFixit, while offering more structured guides, fails to provide fault-specific information, which limits its utility for beginners. Jafix is also restricted in its offering, with a very low coverage in household appliances and most guides focusing on disassembly rather than repair. The chatbot feature often provided irrelevant advice. Manufacturer support for repairs and spare parts is inconsistent, with some brands offering basic manuals but no repair services, while others provide no support at all, forcing consumers to buy a replacement product or seek third-party solutions. In terms of Repair Cafés, the study reveals varied experiences: some locations focus on providing a repair service with limited visitor involvement, while others, such as Het Wijkpaleis, attempt a more collaborative approach. However, in most cases, the level of repair expertise and repair outcomes varies, with some appliances deemed irreparable.

Overall, these researches were also set-up to investigate the strengths and weaknesses of the different players of the repair ecosystem in Rotterdam. Table 7 on the next page concludes the strengths and weaknesses identified through conclusion of the two researches done in this theme.

Table 7 Identified strengths and weaknesses of the different players in the repair ecosystem of Rotterdam

Players	Strengths	Weaknesses
Repair Cafés	• Free services • Community-driven, fostering collaboration • Accessible in many districts (13 locations) • Focus on small household appliances	• Limited hours, weak weekend availability • Focus on elderly, outdated spaces • Volunteer shortages limit frequency • Outdated promotional materials • Success of repairs dependant on knowledge and skill level of repair volunteer
Certified repair services	• Professional expertise • Can handle complex repairs • Reliable and accountable	• Low availability (only 2 services) • Often costly • Limited accessibility
Manufacturers	• Official repair manuals and spare parts • Have insightful repair information for their own products	• Minimal or no repair information made • Spare parts sold more often by third parties, complicating repairs • Lack of DIY support for many products
Youtube	• Wide variety of user-generated content • Easily accessible anytime • Visual format lowers skill barriers	• Inconsistent content quality • Lack of filtering options makes finding useful videos difficult • Limited fault-specific content • Videos may be in foreign languages, limiting accessibility
iFixit	• Structured, detailed guides for electrical appliances • Step-by-step instructions • Forum support for user interaction	• Lacks fault-specific guides for certain products • Primarily visual-textual, harder for inexperienced users
Jafix	• Personalized repair support via ‘Handige Harry’ chatbot • Easy to follow disassembly guides	• Limited content for household appliances • Chatbot often provides irrelevant information • Less comprehensive than other platforms

Part 2: Define

The Define phase of the Double Diamond method is the phase where the insights gathered during the Discover phase are distilled and refined into a clear and actionable problem statement or design challenge. This phase shifts from divergent to convergent thinking (Fig. 60), as the focus shifts towards narrowing down the broad exploration and identifying the core challenges to address.

The Define phase aims to:

- ***Synthesize and analyse the data collected in the Discover phase***
- ***Identify the root problem or opportunity to focus on***
- ***Create a clear and focused problem statement or design challenge that will guide the subsequent solution***

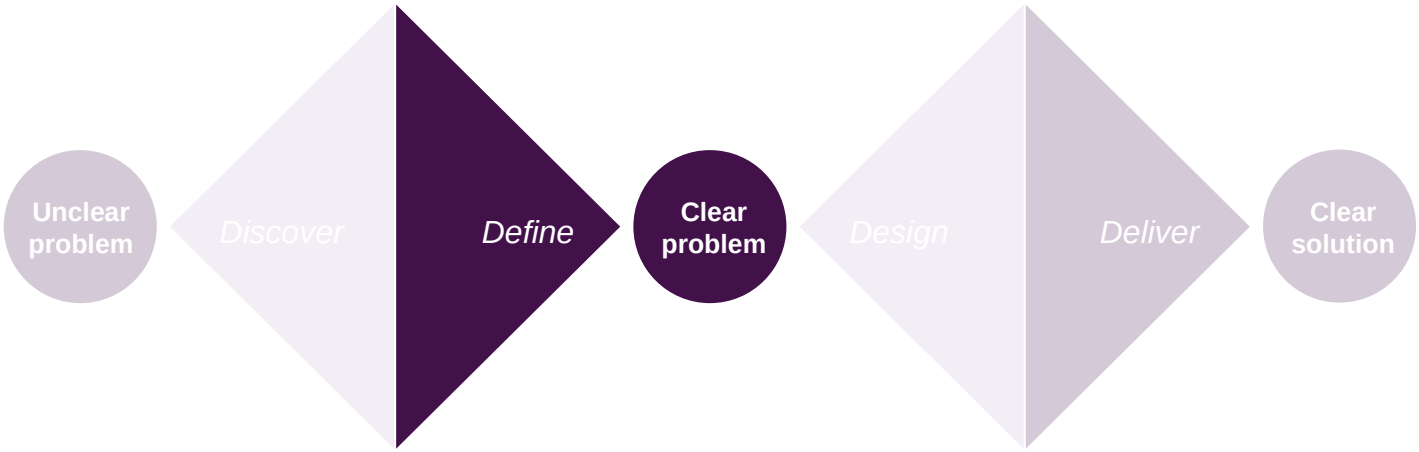


Fig 60. Define phase of the Double Diamond

Chapter 4
Synthesizing Insights

4.1 Introduction

During the Discover phase, research was done based on three dimensions, derived from the three pillars of design (Fig. 1). In the context of this thesis, these dimensions investigated current repair behaviour & culture in Rotterdam (Theme 1), technical aspects to repair household appliances (Theme 2) and current repair ecosystem in Rotterdam (Theme 3). As these separate researches have presented very rich insights on the different dimensions, it is important to put these together. By synthesizing the results, one conclusion will be derived from which the root problems can be identified. This chapter will focus on the synthesis of the results and follow up by stating design directions within the design context of this thesis (Fig. 61). It will end note by providing a list of wishes and requirements derived from all the research done in the Discover phase, which can be used for initiating the Design phase.

4.2 Synthesizing the insights

To recap on the research, Fig 62 - 64 on the next page visualise the main insights of the three themes.

Residents are often motivated by sustainability, emotional attachment or economic factors, but they are simultaneously confronted with unclear repair opportunities, lack of knowledge, limited access to tools or spare parts and inconsistent support. This mismatch between motivation and facilitation results in broken appliances being stored, discarded or replaced, even when residents might have preferred to repair (Fig. 62).

Technical challenges, such as difficult sourcing parts, missing tools or inaccessible product designs, further reinforce the gap between motivation and action. To gather fitting spare parts, many repairers rely on strategies such as gaining spare parts from old devices or ordering parts from unsustainable sources. Experience and common sense as indicators for what makes a good repairer indicates that repair is a learned skill and can therefore be a behaviour that can be encouraged and be acted upon (Fig. 63).

Repair Cafés offer a promising environment for social and skill-based learning, but their current set-up limits their reach. Limited opening hours, volunteer shortages and low public visibility reduce their ability to serve as a widely accessible repair facilitator. At the same time, online repair platforms and manufacturer support are fragmented or incomplete to offer a valid alternative. Especially for beginners, the lack of structured guidance or access to fault-specific help means repair often remains too difficult (Fig. 64).

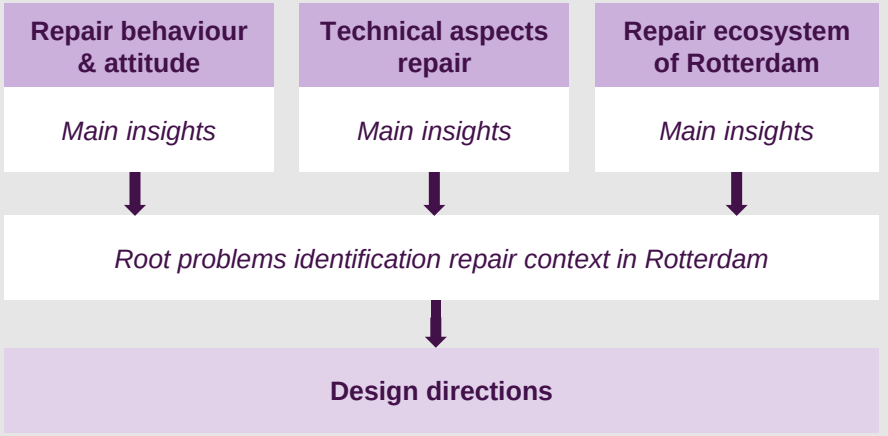


Fig. 61 Synthesizing the insights from all the themes into design directions

1. Current repair behaviour & culture in Rotterdam

All DIY repairers + repair professionals were raised with repairing

During trade-off
- Replacement decision influenced by functional, epistemic and economic factors
- Retainment decision influenced by environmental, emotional and functional factors

Main obstacles to repair: Informational barriers, perceived inconvenience

Main obstacles to go to Repair Café: May feel uncomfortable, not familiar with the concept / never heard of it or been to one, not a trendy image

Effect of repair: Feeling proud of achievement, more emotional attachment to repaired product

For stimulation: Creating awareness of repair options in Rotterdam, making repair more cool

Fig. 62 Main insights theme 1

2. Technical aspects of repairing household appliances

Repair process
- Maintenance step mostly performed, also buying spare part
- A lot of people collect broken products and keep them for a while

Challenges during process: Not finding spare part needed, disassembly problems, not knowing what is broken

Challenges Repair Café: Too little space, also to save spare parts / old devices, not having enough time

Skills / knowledge repairer: Experience in repair main indicator, some technical background and repair knowledge is helpful

Main reasons for products to break down: Bad maintenance, misuse

For stimulation: Getting spare parts from e waste

Fig. 63 Main insights theme 2

3. The repair ecosystem in Rotterdam

Repair offer & distribution
- Limited offer when looking at certified repair services (N=2)
- Good amount of Repair Cafés (N = 13), equally spread

Accessibility Repair Cafés
- Hosted in almost every district, creating access throughout the entire city
- A strong limitation in opening hours and days limits accessibility for working residents

Repair Cafés
- Difference in focus on repair as a service or repairing together
- Success of repair dependant on expertise level repairer

Digital platforms
- High skill level needed in repair when using digital guidance
- Limited (fault-specific) content

Manufacturers: Currently play a very small role in facilitating repair services and spare parts

Fig. 64 Main insights theme 3

4.2.1 Root problem(s)

What becomes clear is that Rotterdam's repair ecosystem does not yet function as an ecosystem. It is a collection of individual efforts, Repair Cafés, online guides and motivated residents. Yet, mentioned actors operate individually rather than in cohesion. There is no appealing starting point for residents who want to try repairing and limited access to repair information and spare parts hinder execution. Currently, the municipality of Rotterdam provides no strategy that ensures access for everyone and visibility across the city. Some root problems can be identified from the synthesis, these are visualised in Fig. 65.

4.2.2 Design challenge & directions

To move towards a mentality of solving the in the previous section stated problems, together with Rotterdam Circulair a design challenge is formulated which should address the problems stated in the previous section (Fig. 65).

To be able to further act on the design challenge, four design directions are identified which all partly address the design challenge. Together, these four directions offer a holistic approach to the systemic challenges uncovered in research of part 1 (Fig 65). The design directions are further described below.

*Focus on availability spare parts**

The difficulty in accessing fitting spare parts came out as a recurring challenge during repair, whether carried out by professional repairers or residents attempting DIY repairs. Professional and DIY repairers gain spare parts in an inefficient way by sourcing them in old appliances and in an unsustainable way through online marketplaces like AliExpress. This lack of reliable, local access limits the feasibility of repair, regardless of motivation or skill. By focusing on improving the availability of spare parts, Rotterdam Circulair can remove one of the most apparent challenge during repair.

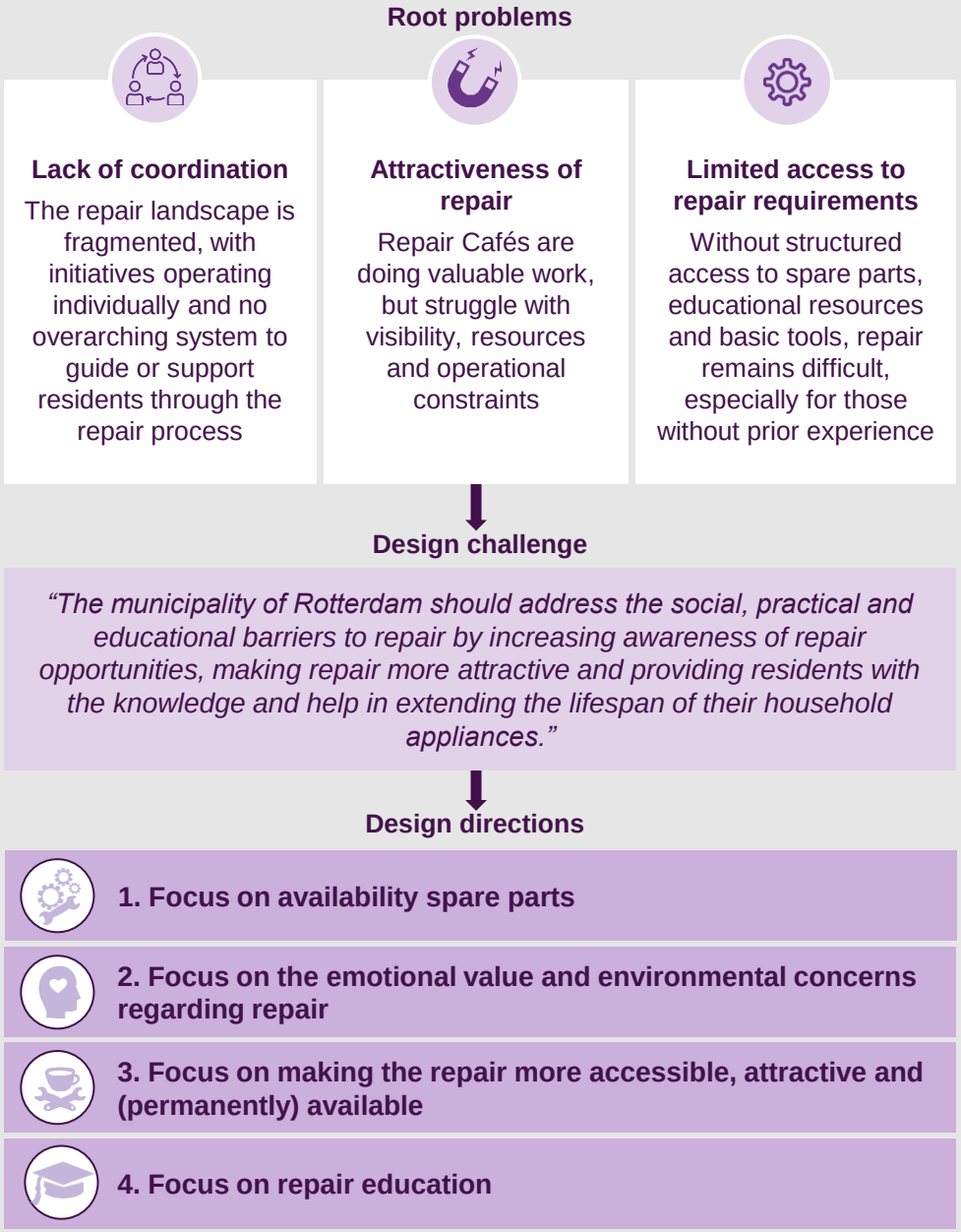


Fig. 65 Root problems, design challenges & direction derived through synthesizing

2. Focus on the emotional value and environmental concerns regarding repair

The motivational factors to repair instead of replace, came out to be emotional attachment to products and environment. Strengthening the narrative around repair as an act of care, for both products and the environment, can help in making repair more appealing.

3. Focus on making the repair more accessible, attractive and (permanently) available

The current repair ecosystem in Rotterdam is fragmented and difficult to navigate. Repair Cafés, while appreciated for their social and educational aspect, suffer from irregular availability, low visibility and limited capacity. At the same time, digital platforms and manufacturer support often lack clarity or coverage. Focusing on accessibility means not only expanding physical repair options across the city, but also ensuring that repair feels approachable, modern and rewarding for a larger audience. A more attractive and permanent repair infrastructure could serve as a visible alternative to replacement and shift the social norms around how residents treat broken appliances.

4. Focus on education

Experience in repair, common sense and having a background in technology were mentioned as indicators for what makes a good repairer. Repair can therefore be seen as an act of learning, often beginning in childhood. This insight highlights the long-term potential of investing in repair education, which can over time contribute to a broader shift in repair behaviour, making it not only more common but more culturally embedded.

** It is noted that during communication of the four design directions, the first one, focusing on the availability of spare parts, was seen as a feature to embed in the development of a different project, the HER. Here, the insight of gaining spare parts from the municipal e-waste will be implemented. The importance of the direction remains, yet a smaller focus is laid upon this design direction compared to the other three.*

4.4.3 List of wishes and requirements

Wishes and requirements were derived from all the results of the Discover phase and categorized according to the design directions. It is not made clear which ones present as wishes and requirements, to keep the Design phase still open.

1. Focus on availability spare parts

1.1 The solution should take into account the availability of spare parts
1.2 The solution should take into account the availability of spare parts in old household appliances
1.3 The solution should take into account the lack of space to have certain tools and safe old spare parts in Repair Cafés
1.4 The solution should take into account the possibility of 3D printing spare parts

2. Focus on the emotional value and environmental concerns regarding repair

2.1 The solution should focus on the emotional value of products
2.2 The solution should emphasize the effect repair can have of having more emotional attachment to a repaired product
2.3 The solution should emphasize the effect repair can have of gaining a proud feeling
2.4 The solution should emphasize the environmental attractiveness of repair in comparison to replacement
2.5 The solution should change the image of repair from dull / boring to something people want to participate in
2.6 The solution should focus on making repair a fun activity

3. Focus on making the repair more accessible, attractive and (permanently) available

3.1 The solution should focus on making the availability more attractive of repair activities
3.2 The solution should focus on making the accessibility more attractive of repair activities
3.3 The solution should create awareness about the existence of repair options in Rotterdam
3.4 The solution should emphasize the economic attractiveness of repair (cafés) in comparison to replacement
3.5 The solution should lower the effort and time that is put in participating in repair activities
3.6 The solution should make attending a Repair Café less uncomfortable
3.7 The solution should take into account the long duration of disassembling a household appliance
3.8 The solution should take into account the lack of having enough time for volunteers in Repair Cafés

4. Focus on repair education

4.1 The solution should create a repair proof generation in the future through education
4.2 The solution should focus on gaining repair knowledge
4.3 The solution should lower informational barriers during repair
4.4 The solution should take in account the (perception of) difficulty of working with electricity in the repair process
4.5 The solution should focus on lowering the threshold for one's first repair
4.6 The solution should consider experience in repair as a strong indicator for being good in repair
4.7 The solution should consider stimulating people to maintain their household appliances better and more often

Part 3: Design

The Design phase is the third phase of the Double Diamond method, where the focus shifts to generating, prototyping, and testing potential solutions to the problem defined in the Define phase. It is a divergent phase (Fig. 66), meaning it encourages exploring a wide range of ideas and possibilities. The Design phase is where ideas come to life, it emphasizes creativity, collaboration, and iteration to ensure that the best possible solution is prepared for the final phase, Deliver.

The Design phase is about:

- ***Exploring creative solutions to the design directions***
- ***Prototyping and testing these solutions to decide which one fits best***

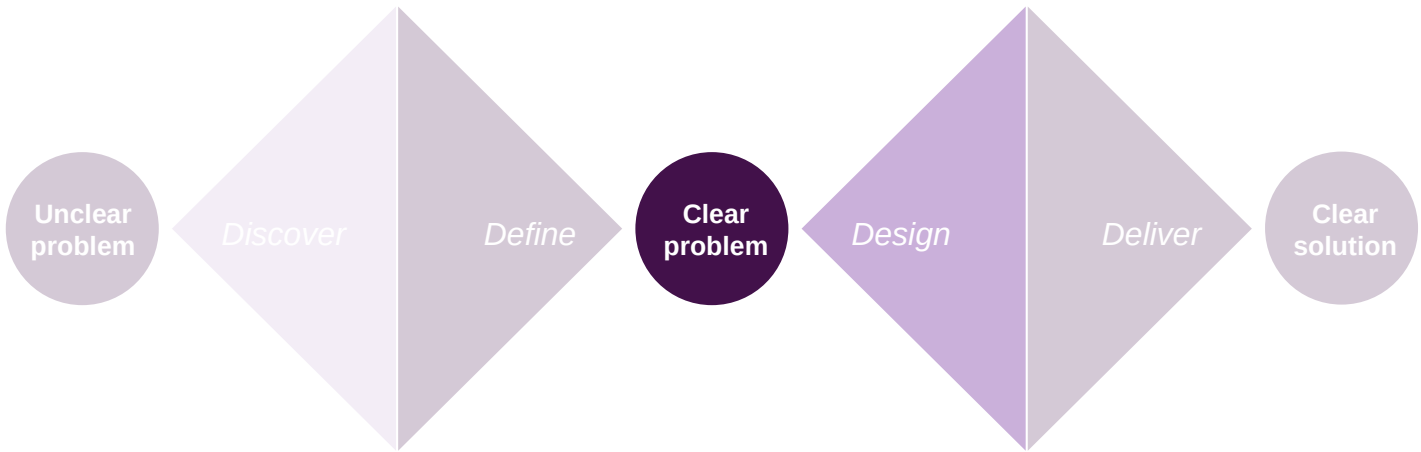


Fig. 66 Design phase of the Double Diamond

Chapter 5
Ideation

5.1 Starting the ideation phase

The ideation phase (Fig. 67) started off with the use of the design directions and the list of wishes and requirements. Here, a notable number of small ideas were explored through the method of how-might-we. Stating how-might-we questions can generate creative solutions while staying in line with the right design directions and problems. The how-might-we questions were gathered through analysing the design directions, challenge and list of wishes and requirements. Answering the how-might-we questions was done in collaboration with a person that was not known with the design context to heighten creativity and out-of-the box thinking and was done simultaneously, within a time frame of 60 seconds. By aligning different answers of the how-might-we questions in a way that felt logical, a total amount of 15 small design concepts were developed, only written out in a few sentences per concept (Appendix 3).

5.1.1 Five final concepts

Through conducting Harris Profiles on the 15 concepts, a number of five concepts was chosen for further development. The parameters of the Harris Profile were chosen based on the design directions and list of requirements, with the intent of including the most important ones while trying to spread them out equally across the design directions. Fig. 68 visualises these criteria and the outcomes of the conducted Harris Profiles for the chosen five concepts. Other concepts validated in the Harris Profile are seen in Appendix 4. The five chosen concepts were further developed through creating posters, with the goal of communicating the concepts in a co-creation session to employees of Rotterdam Circulair. To give insights into what design directions the concepts touch, a diagram is included on the poster, as seen in Fig. 69.

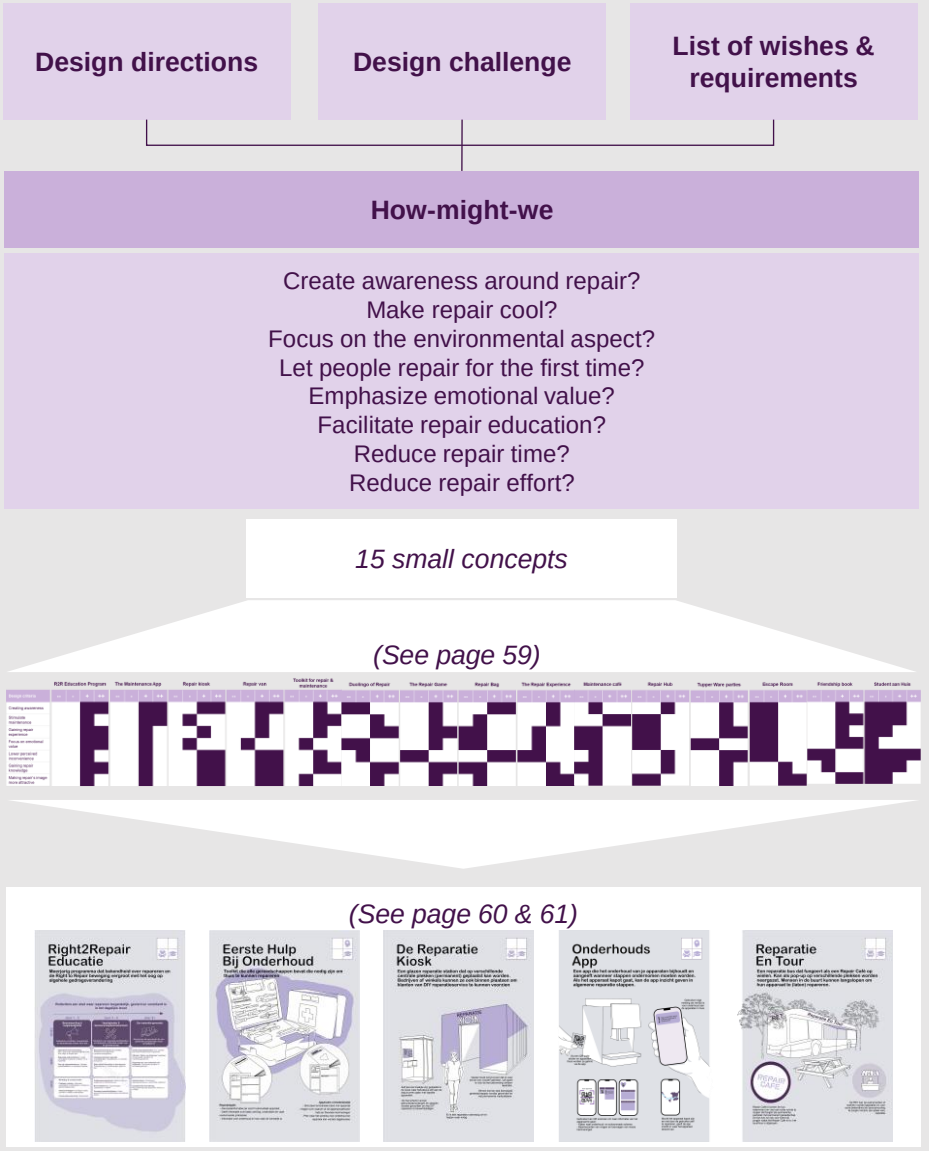


Fig. 67 Ideation process

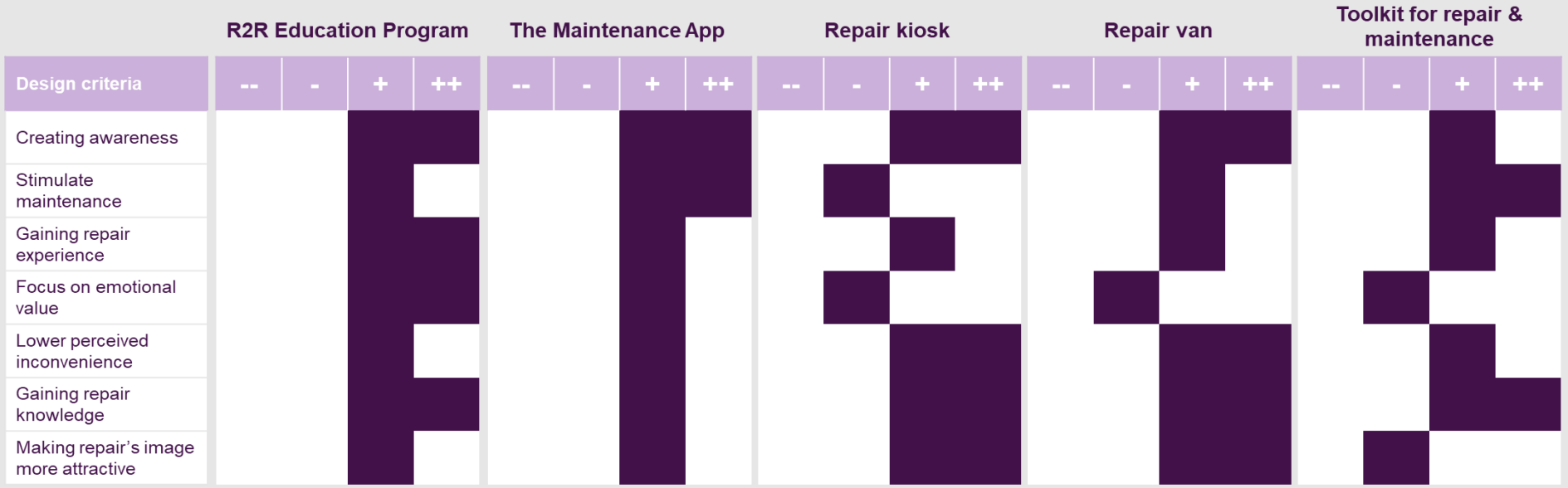


Fig. 68 Conducted Harris Profile on chosen five concepts

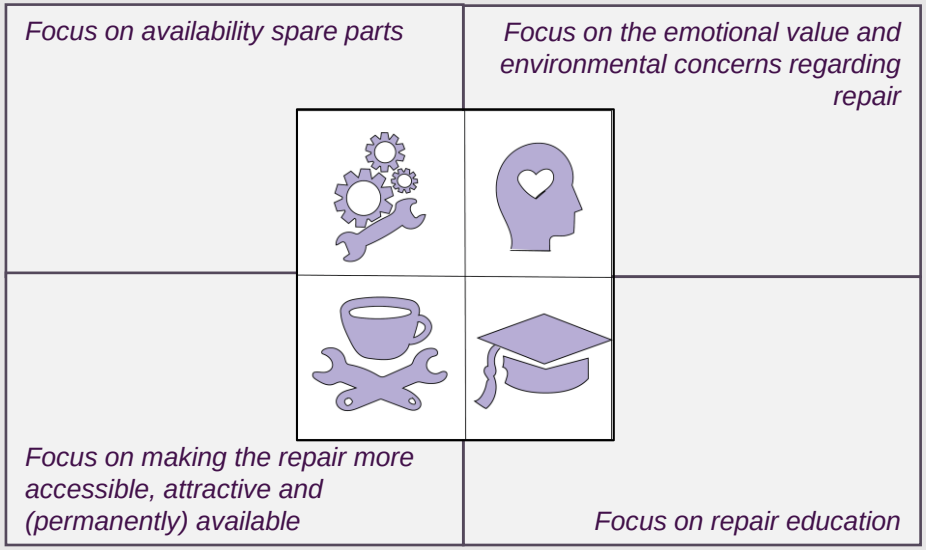


Fig. 69 Design direction diagram

5.1.1.1 The maintenance app

The maintenance app (Fig. 70) tracks the maintenance of household appliances. After the user has added its appliances to the app, the user is notified on when to do maintenance tasks. If the appliance breaks, the app gives insights into where the user can go for repair services. To enhance the emotional value of the appliance, the user can add stories and memories in the app.

5.1.1.2 Toolkit for repair & maintenance

The toolkit for repair and maintenance (in Dutch the EHBO kit), is a toolkit containing all the tools one might need for initiating DIY repair and maintenance (Fig. 71). To facilitate repair information, a repair guide is included which roughly presents insights on the most important things to know on repair. To enlarge the emotional value of the appliance, a friendship book is added where users can answer questions on their appliances and can share memories users might have with their appliance. In this friendship book, the user can add maintenance and repair tasks that are performed.

5.1.1.3 The Right2Repair education program

The Right2Repair education program is a multi-year program that creates awareness and knowledge on the Right to Repair movement and future consumer rights (Fig. 72). It has the end goal of making Rotterdam a city where repair is accessible, celebrated and anchored in daily life.

5.1.1.4 The Repair Kiosk

The Repair Kiosk is a small repair hub made out of glass that can be placed at several locations, such as crowded places, shops and companies (Fig. 73). The Repair Kiosk enables visitors to practice DIY repairs. The self service booth is attached to the kiosk, where visitors are guided in which steps to take in the repair process. Inside the kiosk some stationary workplaces enable visitors to initiate repairs, where all kinds of tools can be found. For guidance, a professional repairer is present.

1.5.1.1.5 The Repair En Tour

The Repair En Tour (RET) is an old city bus functioning as a Repair Café on wheels (Fig. 74). The bus can act as a pop-up to be placed at several locations. The goal of the bus is to enlarge awareness and knowledge on repair possibilities. Repair Cafés can reserve the bus, which can function as additional workspaces, enlarge opening hours or attract more visitors.

Fig. 70 Poster of the maintenance app

Fig. 71 Poster of the toolkit for repair & maintenance

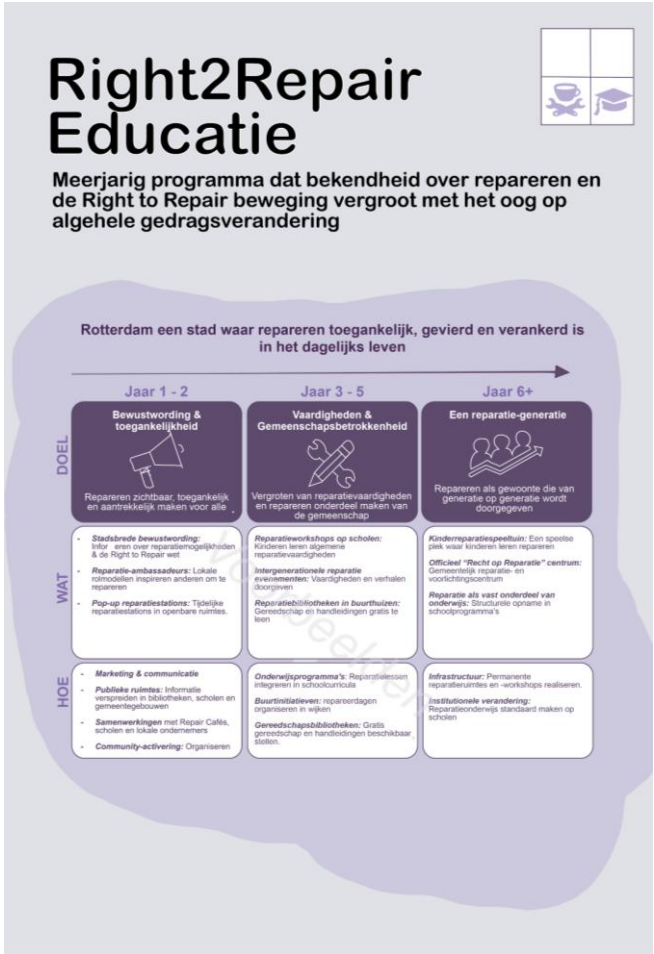


Fig. 72 Poster of the Right2Repair education program

Fig. 73 Poster of the Right2Repair education program

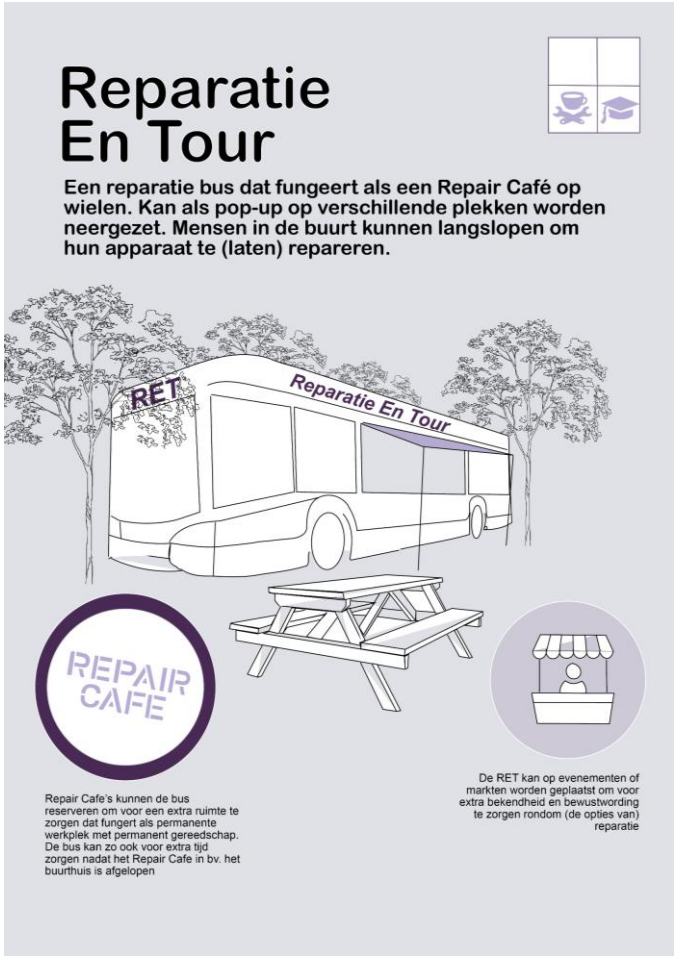


Fig. 74 Poster of the Repair En Tour (RET)

Chapter 6
Co-creation workshop

6.1 Introduction

A co-creation workshop was organised with four employees of Rotterdam Circulair working on the repair issue in Rotterdam in different ways. Two from a circular consumerism perspective, giving them the opportunity to speak on what already is going on in Rotterdam on a larger scale. One employee strives in making neighbourhoods more circular, giving the opportunity to speak of what is going on on a lower scale. The fourth participant works as an economist on repair in Rotterdam, giving a feasibility perspective to the conversation. The workshop had the goals to:

1) Get the repair team on board with the research insights and what Rotterdam may need for repair stimulation
2) Iterate and ultimately choose a final concept, with the perspective to what is possible within the reach of Rotterdam Circulair
3) Discus how the final concept can be linked to existing or future projects of Rotterdam Circulair or other departments within the municipality of Rotterdam

The day started with a short elaboration on the research insights, after which a gallery walk was facilitated with the posters of Fig. 70 - 74 hung in different areas in the room. Participants had the opportunity to walk around and at their own pace introduce themselves with the five concepts (Fig. 75). The participants were asked to give feedback on different coloured post-its (Fig. 76).

Fig. 75 Gallery walk during the co-creation workshop

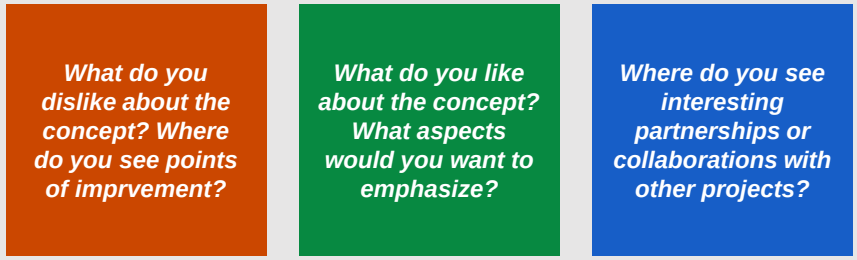


Fig. 76 Colour coded post-its for feedback on the concepts

After the gallery walk, a plenary discussion was held. With the entire group, reflection was done on the concepts while walking past them individually. Discussion topics revolved around the post-its on the poster (Fig. 77) and questions were asked on which concept would fit Rotterdam (Circulair) best and which collaborations could be interesting. After the discussion, everyone had the chance to vote their two favourites and why, with all the gathered insights in mind.

Fig. 77 Posters enriched with colour coded post-its

6.2 Results

All results of the feedback on the concepts are seen in Table 8 on the next page. The Maintenance App was thought of as a good solution for the problems derived from the research. However, it did not feel as a product that should be developed by a municipality, but to be initiated by Techniek Nederland, for example. The toolkit felt like a layered approach to tackle both DIY repair issues and stimulate emotional attachment. Yet, the idea of handing out tangible products made out of scarce materials felt too unsustainable and non-circular. The education program was seen as an interesting approach that suits the workflow of Rotterdam Circulair, however challenges may arise regarding the mandate of governmental agencies.

The chosen direction was the Repair En Tour as a leading concept, but with some features of the Repair Kiosk. The Repair En Tour felt like a good fit for the municipality and feasible to implement. Participants liked the concept due to its accessibility and approachability. However, attention needs to be paid to the management, planning and operationality. The Repair Kiosk's strengths were the encouragement of DIY repair and facilitating a fixed place, however, the role of the municipality feels more distant and management is difficult.

6.3 (Design) recommendations for further development

As mentioned in the previous section, the Repair En Tour was chosen to be the leading concept, with some aspects of the Repair Kiosk.

As attention needs to be paid to the management, funding and planning, it is valid to investigate other forms of the Repair En Tour instead of an old city bus. As for driving this bus, a separate driver's license is needed, this takes up a lot of unnecessary organisational effort. A potential alternative to the repair bus could be a mobile or semi-permanent stall, somewhere between the temporality of a city bus and the fixed nature of a kiosk. The planning of the RET needs to be examined, where an interesting collaboration can be facilitated with the pop-up recycling centres (PUR). The kiosk's focus on supporting DIY repair is interesting and could serve as inspiration for this concept. However, aspects such as management, funding, planning and communication require careful consideration to ensure the concept is well-integrated and effectively maintained.

Table 8 Results of Gallery Walk and plenary discussion co-creation workshop

	Strengths	Weaknesses	Collaborations (ooportunities)
The Maintenance App	• Stimulates maintenance and prolongs lifespan, resulting in less crowded Repair Cafés. • Very accessible	• Asks for many collaborations with manufacturers • Is different for each product type and brand • Hard to identify the role of the municipality	• Repairability score in EU regulations • Platform COSH • Techniek Nederland feels like a more valid initiator of this app
The toolkit for repair and maintenance	• Layered approach of stimulating DIY repair and emotional connection • Suits the business model of tool lease	• Not sustainable, as it takes valueble resources for production • Hard to stimulate use • A challenge to motivate people to come	• Create availability of the toolkits at community centres • Attach to other concept in lease form
R2R Education Program	• Suits the workflow of Rotterdam Circulair • Good to think about ambassadors • Interesting to do this for all aspects of circularity	• Hard to stimulate mandate at different government agencies to establish institutional change • Schools have a lot on their plate	• Klooi atelier • De Textiel Race • HMC, hogeschool Zadkine, Albeda • Community centres • Circulaire Wegwijzer
Repair Kiosk	• Encourage self-repair but in a familiar environment; a strong fit when it comes from companies • Visibility through glass provides inspiration • A fixed place where people know where to go	• Mainly intended for scheduled visits • Municipality's role feels more distant • Permanent staffing sounds expensive • Management is difficult • Needs permanent financial support, no strong business case yet	• Can be implemented at companies as a service • For companies within the repair coalition • Jafix • iFixit
Repair En Tour	• Fits well with the municipality • Ensures recognisability and attention • Accessible and approachable • Easy to implement by the municipality • Solves many problems of Repair Cafés • Strengthens mutual network	• Management, costs and staffing a point of attention • Needs structural planning so that residents know when the bus is where • Requires a lot of organisational strength and operational activities	• Can make the pop-up recycling centres more attractive • Proposal Citizens' Council climate: can be linked to the pumps • Can also be in the form of a stall

Part 4: Deliver

The Deliver phase is the final phase of the Double Diamond method. It focuses on refining, finalizing, and implementing the solution that has been developed and tested in the previous phase. The Deliver phase is convergent (Fig. 78), meaning the goal is to narrow down to a single, well-designed solution and successfully launch or implement it.

The Deliver phase is where everything comes together: the solution is finalized, launched, and evaluated. It is where the Discover, Define, and Design phases come together, translating all the insights and creativity into a practical and impactful outcome. It also sets the foundation for future improvements by incorporating feedback and performance monitoring.

The Deliver phase ensures that:

- ***The chosen solution is fully developed, functional, and ready for use.***
- ***It meets the needs of users and stakeholders as identified earlier in the process.***
- ***The solution is implemented or delivered in a way that maximizes its impact.***

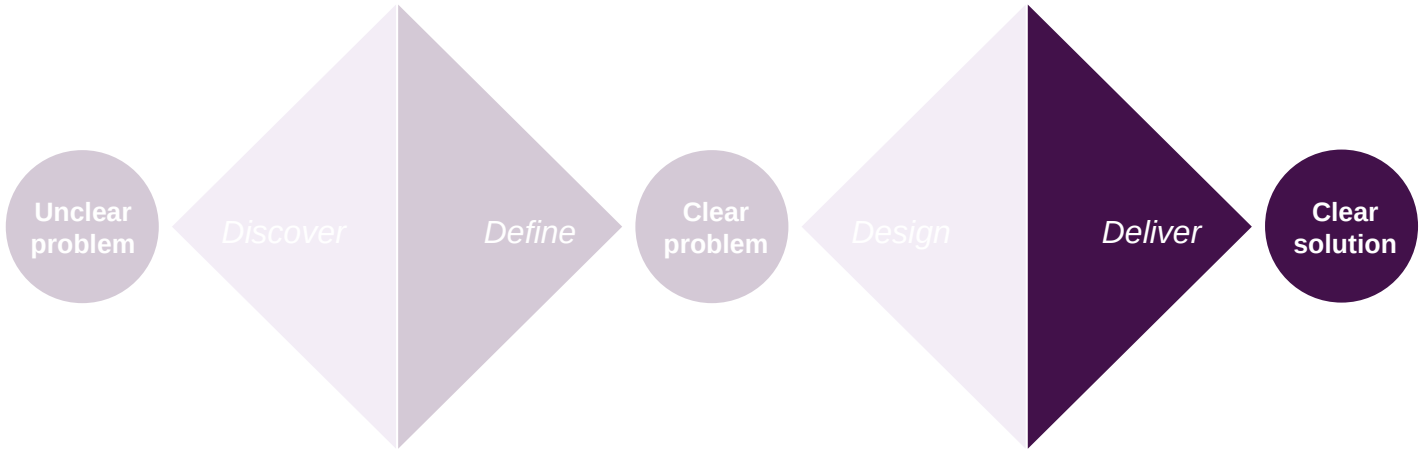


Fig. 78 Deliver phase of the Double Diamond

Chapter 7
Housing the concept

7.1 Introduction

One of the outcomes for further exploration was to investigate the possibilities of the form in which the RET can take place. This chapter will focus on providing insight into the chosen form and why.

7.2 The Mobiele Wijkhub

One of the strengths of the RET is that it is facilitated by the municipality. Within the municipality there are already a lot of resources in place. Investigating existing resources diminishes the financial efforts of the RET. The Mobiele Wijkhub (Fig. 80) is a mobile hub that can be placed into communities that do not have a community centre. It is an electrical van, with an inside seating area for six persons and a coffee corner (Fig. 81). The integration of a large screen presents itself as a good opportunity of presenting manuals and repair information of already mentioned digital platforms. The seating area within the van diminishes the threat bad weather can have on the feasibility of the concept.

Using the Mobiele Wijkhub as housing for the concept, a lot of the logistic issues are diminished. The Mobiele Wijkhub is organised by a separate team, participating in the planning, staffing and other logistics. By using this van, only communication and planning of the pop-up recycling centres (PUR) needs to be aligned with the planning of the Mobiele Wijkhub.

7.3 Reparatie op Wielen

As the previous name of the concept, the RET, was based on using an old city bus to facilitate mobile repair, a new name needs to be created for the concept. The concept is a relatively new idea in the context of Rotterdam, where a lot of residents do not know of repair facilitation in the city (see chapter 1). Therefore, the name should state what the concept entails, with its main feature of being a mobile repair hub. Therefore, the new name in Dutch will be Reparatie op Wielen, which translates to Repair on Wheels in English. In this thesis, the concept will be mentioned as Reparatie op Wielen or RoW.

Fig. 80 The outside of the Mobiele Wijkhub

Fig. 81 The inside of the Mobiele Wijkhub

Chapter 8
Collaboration with the repair ecosystem

8.1 Introduction

As the synthesis of the results had shown, Rotterdam is lacking a central point of support of where residents may go for repair activities. No clear collaboration between the different players of the repair ecosystem is facilitated and awareness on repair possibilities is low. This chapter will investigate the role of the Reparatie op Wielen within the repair ecosystem and where collaboration can be established. It will do so by first looking at the Reparatie op Wielen separately through a SWOT analysis. After the SWOT analysis, the players will be investigated again separately, whereafter the collaboration between the players can be analysed and established.

8.2 SWOT analysis Reparatie op Wielen

By creating a sense of what the RoW should focus on regarding its own strengths and weaknesses, the logical role of the RoW within the ecosystem can be determined. For further development, it is interesting to investigate the opportunities and threats. These insights can be used to make decisions on the collaboration which needs to be facilitated. During the co-creation workshop, strengths, weaknesses and opportunities were already elaborated on. This analysis is done more thoroughly (Fig. 82).

STRENGTHS	***WEAKNESSES***
• Good fit with resources and goals municipality, ensures stability • Ensures awareness and attention to repair option • Low threshold and accessible for everyone • Could create a better image around repair • Well-implementable for the municipality • Can strengthen repair network • Stimulates DIY repair • A semi-permanent placement ensures residents know where to go • More connection established in neighbourhood	• Organisational efforts still questionable • Needs a structural planning where visitors know where and when it is hosted • Unclear who will organise and own the RET • Financial support dependant on municipality • Dependant on weather forecast • DIY corner with interface dependant on chatbot of Jafix, which is currently not functioning correctly
OPPORTUNITIES	***THREATS***
• Can make the PURs more attractive, creating a repair village • Collaboration with PUR can facilitate direct spare parts from e-waste • Can be implemented at companies as a service • Can be used for schools to facilitate repair education • Collaboration Jafix for interface / input repair information • Collaboration iFixit for interface / input repair information • Can increase brand awareness of Rotterdam Circulair	• Safety issues may appear with electrical equipment • Non-profitability • Companies that do not facilitate the manuals for good input self-service repair • Not being able to find enough repair professionals • Can endanger position of other players in the repair ecosystem if RET is successfully facilitating free repairs for everyone

Fig. 82 SWOT analysis on Reparatie op Wielen

8.3 Positioning the RoW within the Ecosystem

The SWOT analysis has been used to identify how the RoW could be embedded within the repair ecosystem of Rotterdam. The analysis helps determine where the RoW can offer unique value, and where collaboration will be essential to prevent overlap and ensure efficiency.

Lowering the threshold for (first) repair

A major strength of the RoW lies in its low barrier to entry. With a physical presence close to where residents already bring their e-waste (the pop-up recycling centres), the concept offers an accessible first step into repair. It not only stimulates DIY repair behaviour, but also increases exposure to the idea that repair is a valid and supported option. By becoming visible and approachable in the neighbourhood, the RoW can actively shift perception and awareness around repair.

Collaboration with the pop-up recycling centres

From an organisational point of view, the RoW would benefit from structural planning. Collaboration with the PUR could offer a concrete solution here, as the PUR already operates from consistent locations and planning. This alignment reduces the need for standalone logistics, while offering predictable access to residents. If the partnership is structured well, the organisational load of the RoW could be significantly reduced, with key tasks such as coordination, promotion and operation naturally embedded within the PUR structure. Moreover, a close collaboration with the PUR could create opportunities for direct e-waste retrieval, allowing spare parts to be extracted for on-the-spot repair use.

Supporting, not competing

One of the most important insights from the SWOT is that the RoW should take a complementary position within the ecosystem. Since it will be facilitated by the municipality, its role is not to compete with existing initiatives, but to support them. By creating awareness on repair possibilities in Rotterdam and offering a clear entry point, the RoW can strengthen the network of local repairers and Repair Cafés and redirect residents to the services that best fit their needs.

8.4 Collaboration within the repair ecosystem

The SWOT analysis has provided valuable insights into the potential role of the Reparatie op Wielen (RoW) within the existing repair ecosystem. Its greatest strengths lie in lowering the threshold to repair, facilitating first repair experiences and raising awareness of repair as a viable option. By positioning the RoW as an entry point into the repair ecosystem, it can support rather than compete with existing players.

To guide future collaboration, all relevant actors were identified through the Discover phase and analysed for their strengths, weaknesses and the gaps they leave in enabling repair. These are visualised in Table 9. While each contributes in its own way, none fully addresses all aspects of promoting repair behaviour. This fragmentation strengthens the case for improved cooperation.

Consumers show growing interest in sustainability, yet lack the skills or knowledge to repair. Repair Cafés and digital platforms help bridge this gap but are limited by inconsistent access, low visibility, or lack of parts. Manufacturers and certified services offer expertise and original parts but are often costly. The second-hand market and environmental parks could supply spare parts, yet are not currently structured to actively support repair.

Table 9 Strengths, weaknesses and gap in repair facilitation of all the players within the repair ecosystem

Players	Strengths	Weaknesses	Gap in repair process
Consumers	• Interest in sustainability is growing • Influence achieving circularity goals	• Miss some repair knowledge and skills • Limited amount of time available	Due to lack of knowledge and skills it is difficult to identify the fault and how to repair
Repair Cafés	• Community feeling • Free or cheap repair service • Focus on education on repair	• Limited hours and locations • Low awareness • Dependent on volunteers and location • No guarantee on repairs • No access to official spare parts	• Not always a solution if the part needs to be replaced • No structural cooperation with manufacturers
Certified repair services	• Professional service with guarantees • Quick repairs • Accessibility to official spare parts	• Often expensive • Limited brands that are being repaired • Sometimes only use official parts	Threshold for consumers due to high costs in relation to lower price category household appliances
Manufacturers	• Own original parts and software support • Have product specific knowledge	• Often high costs for repairs • Limited availability of parts and manuals	• Can make independent repair difficult • Not all products are designed for repair
Digital platforms	• Free access to repair information • Community driven knowledge exchange • Receive a content boost due to R2R	• Not all parts are available • Difficult for beginners • May restrict access to manuals	• No support if repair fails • Parts may be hard to come by or expensive
Second-hand market	• Cheap second-hand spare parts • Enlarge lifecycle of existing products	• Product quality varies • Limited supply of specific products	Often focused on sales, not on actual repair support
pop-up recycling centres	• Accessible to everyone • Establish on the spot recycling	• Costs the municipality management, staff and money • Not yet very well known	• Only focus on throwing away • Can play an interesting role in facilitating spare parts from e-waste
Reparatie op Wielen	• Accessible to everyone • Getting in touch with (DIY) repair • Mobile / semi-permanent availability • Municipal support	• Role in relation to other players in the ecosystem still unclear • Requirements logistics and funding • Unclear who owns it	

RoW distinguishes itself through its low-barrier accessibility, mobile presence, and visibility in the neighbourhood, making it well-suited to stimulate first-time repair engagement. Collaboration should focus on aligning the gaps of one player with the strengths of another. For example, RoW could be integrated into the planning of pop-up recycling centres (PURs), enabling part retrieval from e-waste streams. Partnerships with manufacturers and digital platforms could enhance the self-repair component, while Repair Cafés and certified repair services may benefit from the increased awareness RoW can generate (Table 10).

8.5 Conclusion

By clearly defining the supporting role of the RoW as focusing on awareness, accessibility and first engagement in repair, it can strengthen the ecosystem without competing with existing services. This aligns with the municipality's broader ambition to support rather than displace existing actors, creating a more cohesive and effective repair landscape in Rotterdam. Collaboration actions can be facilitated as described in Table 10, yet potential collaboration between the players, influenced by the Reparatie op Wielen, needs to be clarified as well. Fig. 83 on page 71 visualises this collaboration as well in an ecosystem map. Distinguishes are made between facilitating DIY repair, repairing together or outsourcing repair as these services are dependent on the repair skills of consumers. Through colour coding, it is visualised which repairs can be done by who, based on the level of complexity of the repair.

Table 10 Collaboration between the RoW and other players in the repair ecosystem

	Repair Cafés	Repair services	Manufacturers	Digital platforms	Second hand sellers	PUR
Collaboration	• Increase awareness Take more simple repairs and maintenance • Facilitating educative workshop • Recruiting volunteers	• Increase awareness • Direct complex repairs • Can demonstrate repairs for educational reasons	• Increase awareness on Right to Repair movement • Collaborate on spare part delivery for (DIY) repairs	• Integrate digital manuals in way of working • Direct visitors to digital platforms for DIY repair purposes	• Direct visitors for spare parts • Stimulate visitors to sell still functioning products	• Visitors of PUR can decide to repair • Use e-waste for spare parts • Increase awareness of each other • Collaborate in logistics

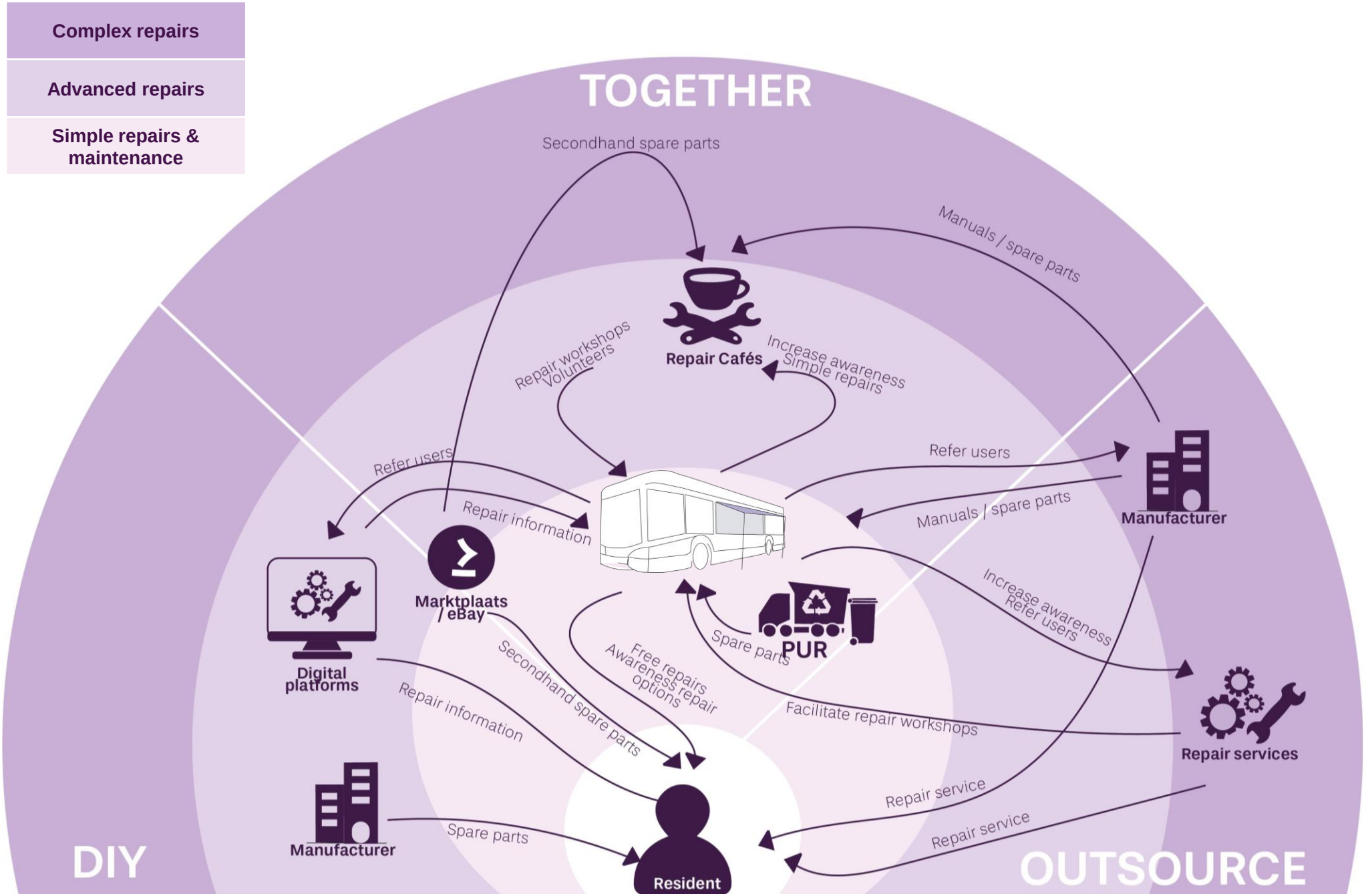


Fig. 83 Collaboration between the players of the repair ecosystem

Chapter 9
Activities of the Reparatie op Wielen

9.1 Introduction

The previous chapter examined the role of the RoW towards the other players in the repair ecosystem and how better collaboration is stimulated. This chapter will focus on the activities of the Reparatie op Wielen individually. The RoW takes up the role of being the entry model of repair and a facilitator of creating awareness on the other repair options in Rotterdam and online. To be able to do so, it has to be established what kind of repairs the RoW will take on, and which ones will be referred to other players.

9.2 What does the RoW repair, and what not?

To gain some additional insights on the further development of the Reparatie op Wielen, feedback sessions were hosted with the three professional repairers interviewed in the Discover phase. The repairers were individually asked on their view on the RoW and where on the repair spectrum it should act. On the latter, a spectrum was co-created with the type of repairs that can appear, and where the RoW should jump in (Fig. 84).

A diagnosis always needs to take place to determine what kind of repair needs to be initiated. Here, the error can be repairable or unrepairable. The device can be badly maintained or preventive maintenance needs to take place in order for the error to become evident. It can also occur that no error is present, but the user simply does not understand the appliance due to not properly reading the manual. The RoW will focus on facilitating the purple-coloured activities, hence the diagnosis, maintenance and device explanation. Appliances with unrepairable errors can directly be recycled at the pop-up recycling centre, yet for repairs, the visitor is referred to other repair services. As up until now it was

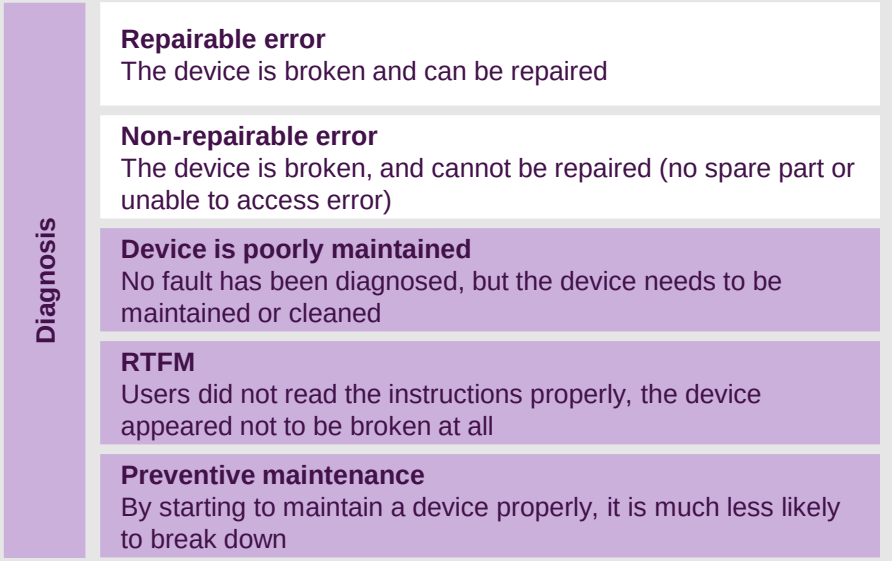


Fig. 84 Repair spectrum and the focus of the RoW

intended that the RoW included an interface facilitating DIY repair in self-repair corners. However, looking at the easier repair actions taken upon the RoW, this aspect has become unnecessary. Therefore, it is chosen to not include the self-repair corners any more. Yet, it is still advised to let the visitors interact with the repair process. This will be done more by actively using the screen present in the van. On this screen, manuals and digital platforms can be presented, educating the visitors on the possibilities at home.

9.2.1 The referral system

When looking at the entire referral process, it is important to take into account the perspective of the referred location. More efficiency is taken into account by providing a card for the visitor

to bring to the referred to repair location. This card both functions as a diagnostic and a referral card. On the diagnostic side (Fig. 85), the repairers will note their diagnosis and the steps they have already taken. This way, no double (diagnostic) actions need to be taken by the repairers of the referred location. On the referral side (Fig. 86), the agreed-on location will be communicated with its location and other general information.

If the appliances need repairs to be performed by a different player in the repair ecosystem, the visitor will be referred to the most suited options. For this action a large poster is created. The poster visualises a large map of Rotterdam with all the known repair places. Additional information is provided, sorted by the day in the week the repair service takes place (Fig. 87). A link to the Circulair Routeplanner developed by Rotterdam Circulair is included to create more awareness on its existence and to be able to guide residents to circular services in Rotterdam after visiting.

Fig. 85 Diagnostic card

Fig. 86 Referral card

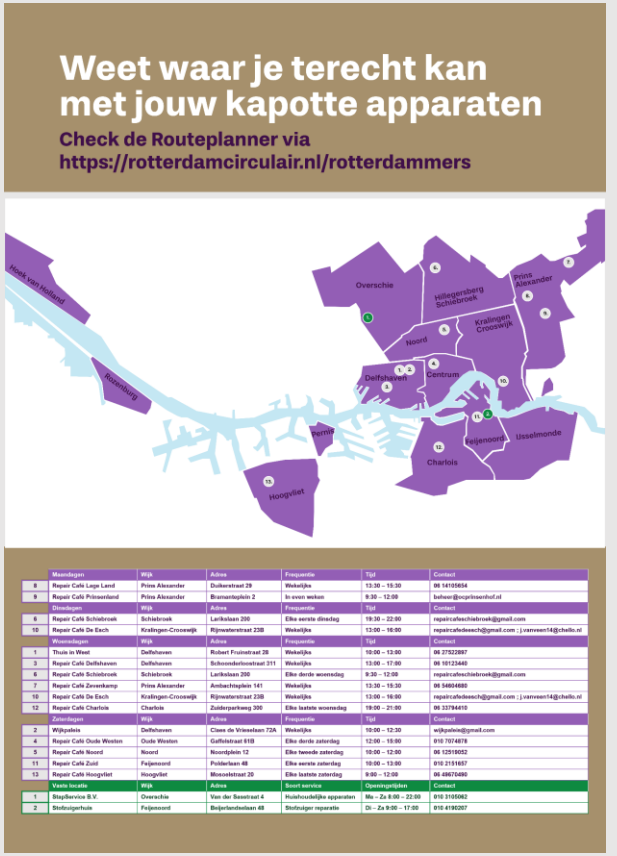


Fig. 87 Referral poster

9.3 Conclusion

This chapter dived into the activities to be executed by the RoW. It has highlighted which repairs are done and which are being referred. The referral system is explained and visualizations used for referring have been shared. To conclude the activities of the RoW, two storyboards have been created on the repair facilitation that takes place in the RoW and its referral process. Fig. 88 visualises a repair done in the RoW, Fig. 89 a referred and an unsuccessful repair.

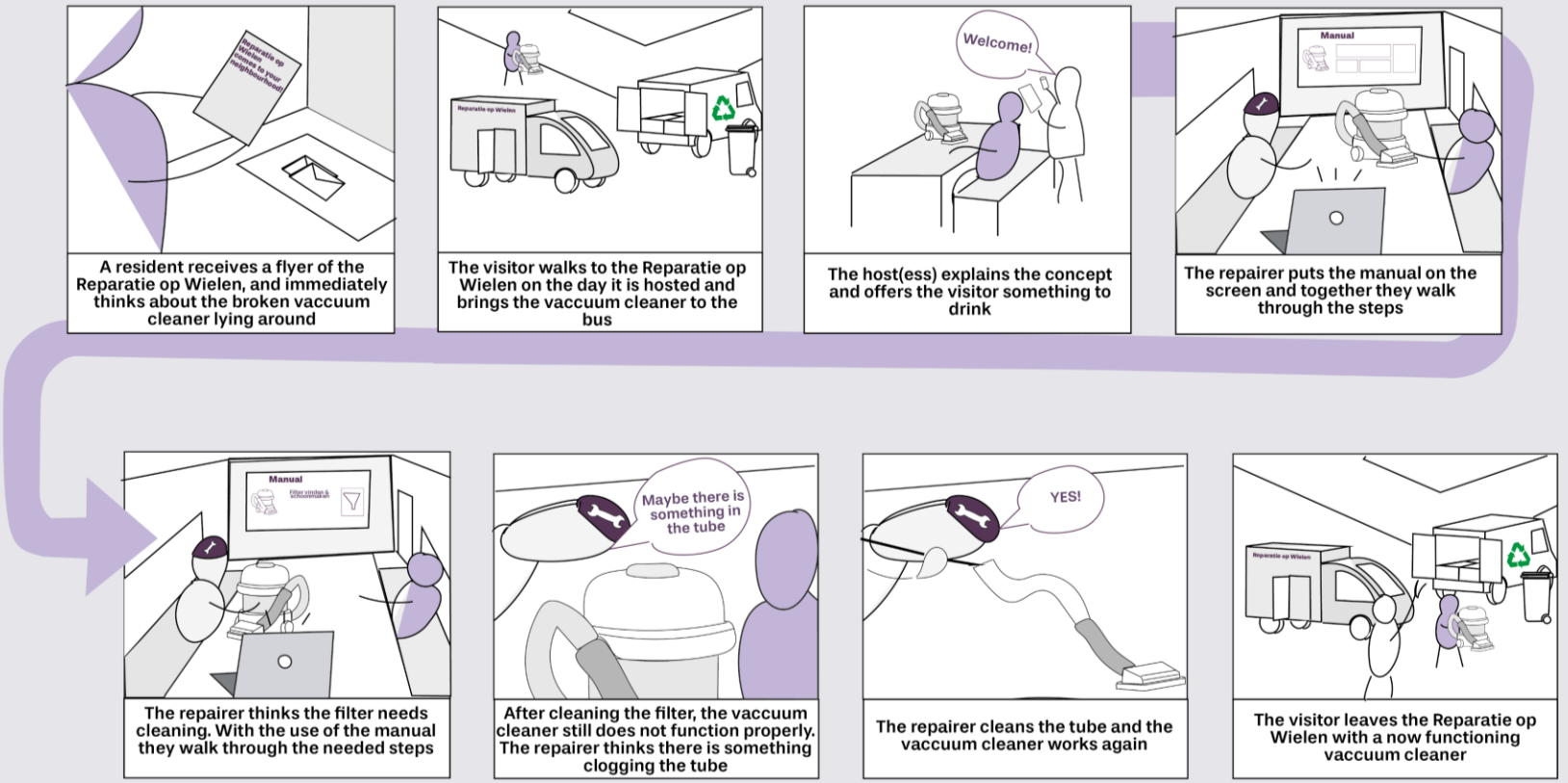


Fig. 88 Storyboard of a repair done in the Reparatie op Wielen

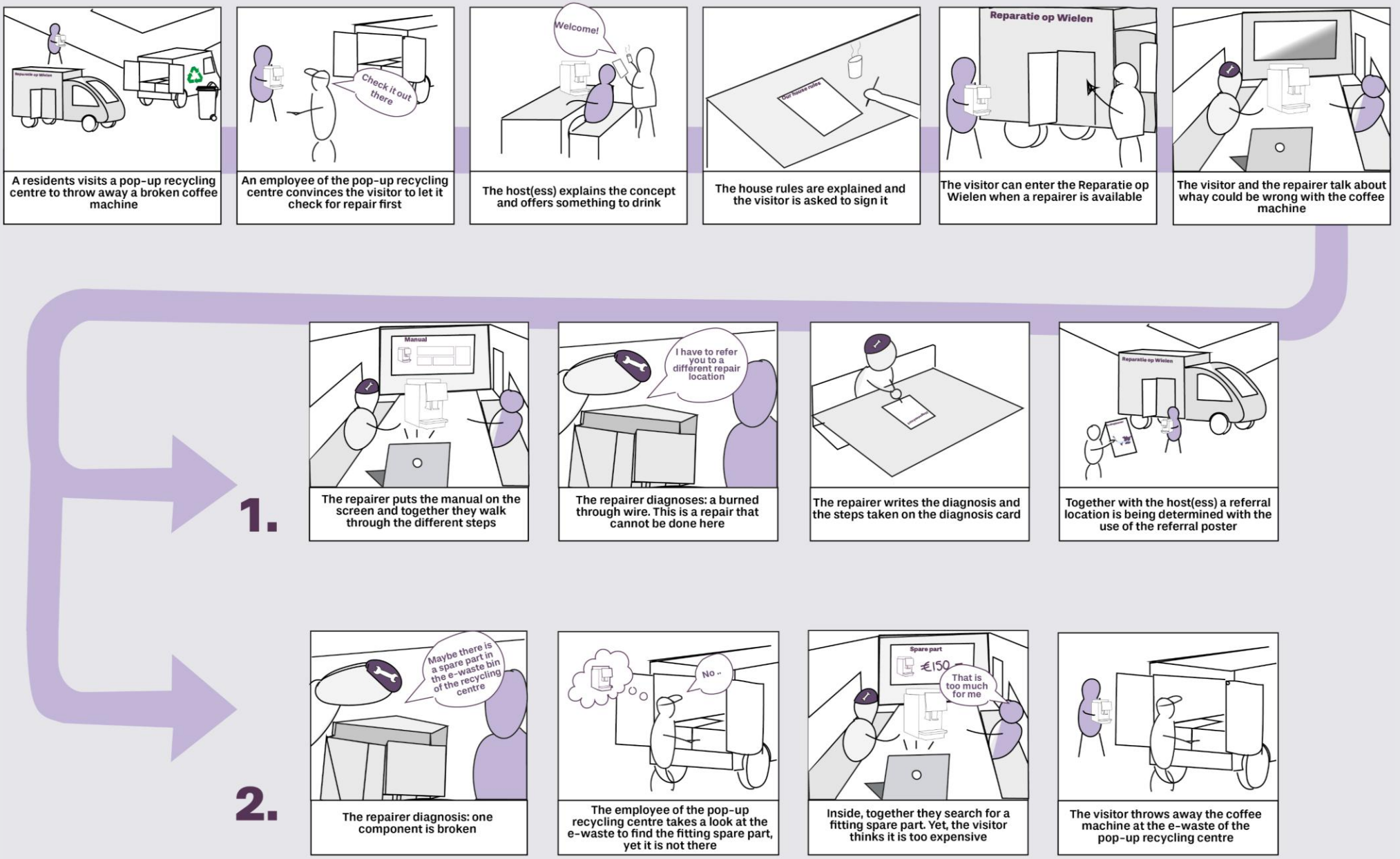


Fig. 89 Storyboard of a referred and an unsuccessful repair done in the Reparatie op Wielen

Chapter 10
Conducting a pilot

10.1 Introduction

The previous chapter discussed the established activities that are done by the Reparatie op Wielen. This chapter revolves around testing these activities and validating whether these are feasible, desirable and viable. A pilot was conducted in collaboration with a pop-up recycling centre in a neighbourhood in Rotterdam. The next sections will dive into the test plan, method, results and finally a conclusion including further design recommendations.

10.2 Test plan

A test plan has been developed before conducting the pilot to make sure all aspects of the Reparatie op Wielen are tested, including the stimulation on repair behaviour, as the research of this thesis states.

The pilot will test seven key aspects of the Reparatie op Wielen concept, which are further explained by the strategyzer test cards at the end of this section.

Outreach & visibility: does promotional marketing attract visitors?

Referral system: when and how should users be referred to other players in the repair ecosystem?

Diagnostic cards for referrals: do pre-diagnosis cards improve efficiency for Repair Cafés?

Required tools & equipment: which tools are needed for a mobile setup for maintenance and easy repairs?

Collaboration pop-up recycling centre: does placing RoW with PUR encourage repairs over disposal?

Lowering repair barriers: does the Reparatie op Wielen lower any barriers regarding repair?

Repair education: do visitors learn about the repair process and does it affect DIY repair?

10.2.1 Method

Strategyzer test cards (STCs) are made based on the objectives of the pilot. STCs are a tool to put guesses into verifiable assumptions (Jeffries, 2023). The STCs are made per objective (Table. 11 – 17).

Table 11 STC for outreach & visibility

Outreach & visibility
We believe that… Visitor engagement relies on communication beforehand. The Reparatie op Wielen as a stand itself will also attract visitors on the spot. Yet, by using marketing upfront, more people will visit compared to relying solely on spontaneous walk-ins. **To verify that, we will…** • Set up a Reparatie op Wielen stand in a public space • Distribute flyers and posters in advance in the residential area • Ask visitors how they have come to know of the Reparatie op Wielen (through marketing efforts or walk-ins) **And measure…** • Number of visitors • Number of people attending the Reparatie op Wielen through marketing materials • Number of people attending the Reparatie op Wielen through walk-ins **We are right if…** Most visitors mention the flyers or posters as the reason for their visit.

Table 12 STC for the referral system

Referral system
We believe that… Reparatie op Wielen should refer visitors to Repair Cafés or other services based on a clear decision framework (simple fixes at Reparatie op Wielen, complex repairs elsewhere). **To verify that, we will…** • Set up a Reparatie op Wielen stand and perform basic diagnostics and simple repairs • Log when and why people are referred to other services • Collect feedback from users on whether they find the referral system useful **And measure…** • Number of visitors who require referrals • User satisfaction with the referral process by both the visitor and host(ess) • Increase in knowledge on repair ecosystem in Rotterdam **We are right if…** • Less than half of repairs need to be referred to another repair service • Referred users report they found the process easy and logical • Users have gained more knowledge on the repair offer of Rotterdam

Table 13 STC Collaboration with pop-up recycling centre

Collaboration with pop-up recycling centre
We believe that… Placing the Reparatie op Wielen alongside the pop-up recycling centre will increase visitor engagement and divert items from waste disposal to repair. Also, we believe that spare parts from the e-waste can directly be used for on-the-spot repairs or diversion of repairs in repair cafes. **To verify that, we will…** • Set up Reparatie op Wielen at a pop-up recycling centre and record visitor interactions. • Track how many people reconsider disposing of an item and attempt a repair instead. • Track how many devices from the e-waste are used for repairs **And measure…** • Number of items repaired instead of discarded • Number of devices from the e-waste used for its spare parts **We are right if…** • Less than half of the repairs was actually intended to be thrown away • Some of the repairs used a spare part form the e-waste bin of the environmental

Table 14 STC for the required tools & equipment

Required tools & equipment
We believe that… The tools brought by the repairers are sufficient for Reparatie op Wielen for maintenance actions and mobile setting. **To verify that, we will…** • Ask the repairers to bring the tools they think they need • Collect feedback from staff on tool sufficiency **And measure…** • User and staff feedback on tool effectiveness. **We are right if…** • The required repairs can be handled with the toolset present • No more cases fail due to missing tools

Table 15 STC Diagnostic cards for referrals

Diagnostic cards for referrals
We believe that… A diagnostic card that records attempted repairs and findings will make referrals more effective and efficient. **To verify that, we will…** • Create a simple diagnostic card template • Use it for all Reparatie op Wielen visitors who require a referral • Gather feedback from Repair Cafés on its usefulness **And measure…** • Repairer satisfaction with clarity filling in the diagnostic card **We are right if…** • Visitors feel their repair process is streamlined by using the card • Repairers feel like the diagnostic cards is easy to fill in

Table 16 STC for lowering repair barriers

Lowering repair barriers
We believe that… Visitors to Reparatie op Wielen will feel that the service lowers barriers they previously had regarding repair. **To verify that, we will…** • Conduct surveys with visitors on barriers before attending the RoW • Conduct survey after attending the RoW **And measure…** • Visitors who felt a lowered barrier to repairing and which ones • Visitors who felt a higher barrier to repairing and which ones **We are right if…** Most visitors feel less barriers for future repairs

Table 17 STC Repair education

Repair education
We believe that… Visitors will gain knowledge about repair and maintenance that will encourage them to try repairs more often in the future. **To verify that, we will…** • Ask the level of repair knowledge before attending the RoW • Ask the confidence level of participating in DIY repair before attending the RoW • Ask the level of repair knowledge after attending the RoW • Ask confidence level for initiating DIY repair after attending the RoW **And measure…** • The difference in repair knowledge levels before and after attending the Reparatie op Wielen • The difference in repair confidence levels before and after attending the Reparatie op Wielen **We are right if…** • Visitors expressed increased repair knowledge • Visitors express increased confidence in participating in DIY repair and maintenance

To give clarity in the method of measuring all the objectives simultaneously, Fig. 90 visualises how it is done during the pilot. It is seen three methods are used: conducting surveys (before and after attending), through observation and through evaluation with the repairers.

Before attending

Survey 1

Outreach & visibility
- Attendance through walk-in
- Attendance through marketing efforts

Repair barriers
- Barriers DIY repair
- Barriers repair service

Repair education
- Repair knowledge
- Repair confidence

Referral system
- Knowledge on ecosystem

After attending

Survey 2

Repair barriers
- Barriers DIY repair
- Barriers repair service

Repair education
- Repair knowledge
- Repair confidence

Referral system
- Knowledge on ecosystem
- Visitor satisfaction

Observation

Collaboration PUR
- #products saved
- #spare parts retrieved

Evaluation with repairers

Required tools & equipment

Diagnostic cards for referrals

Fig. 90 Collaborative methods used to test different STCs

10.2.2 Setup & execution

The Reparatie op Wielen will be executed in the Mobiele Wijkhub, which includes a coffee corner, a large screen connected to a laptop and a sitting corner for six persons. On the outside, in the front of the van a larger table and two benches will be placed functioning as a waiting area. The Reparatie op Wielen will be placed in the district Crooswijk in Rotterdam on a semi-sunny Saturday. This place was chosen as then, a pop-up recycling centre is planned, where the collaboration between the two can be established and tested. During the day, the actions as visualised in the storyboards on Fig. 88 and 89 will be executed continuously.

10.2.3 Staff

A hostess will be present, attracting and welcoming the visitors, explaining the concept and referring the visitors to a suited repair service. Two repairers retrieved from Repair Cafés will be present in the Reparatie op Wielen. The repairers have been informed with the use of the storyboards what is expected from them.

10.2.4 Materials & workflow

The repairers are asked to bring the tools they think are needed for maintenance and small repair tasks. To provide interactive use of product guides, a larger screen is present, so that visitors can look together with the repairer for maintenance and repair information online or in manuals. Collapsible tables and benches are needed to put in front of the van, facilitating a welcoming and waiting area. An aggregate provides the repairers additional electricity used for the repair process. Promotional materials (Fig. 91) are spread a week in advance in the form of flyers and poster with clear and concise information on what can be expected of the Reparatie op Wielen. Environmental and financial values are included in the text, as these were identified as drivers behind repair intention in chapter 1.

10.3 Results

The day of the pilot was on a Saturday mid-march, with an average temperature 18 degrees Celsius and semi-sunny. The pilot including the pop-up recycling centre was from 12:00 - 15:00. The total visits of the Reparatie op Wielen was five. Here, six appliances were examined, as one visitor brought two coffee machines. Fachbach et al. (2022) identify primary categories of repair activities among consumers: (1) utilizing repair service providers, (2) engaging in self-repair (DIY), as applied in the research done in chapter 1 and 2. For executing the pilot properly this is done for the pilot as well, as the visitors were asked whether they had already participated in DIY repair practices or whether they already had utilized repair services. Table 18 presents these answers. Likely, it is to say the RoW had attracted visitors that can be categorized as DIY repairers, repair seekers, but also a non-enthusiast.

Fig. 91 Promotional material for flyers and posters

Table 18 Repair participations amongst visitors

	DIY participation	Repair service
1.	Yes, clothing	Repair Cafés
2.	No, I cannot do that	My phone at the MediaMarkt
3.	Not electricity, but easy fixes I try to do	Yes my phone
4.	I don't remember, so I don't think so	A Repair Café once
5.	No	No

Because of the nice weather, the repairs were done both inside the van and at the outside table. Pictures of the pilot are seen in Fig. 92. Before and after attending the RoW, the visitors were asked to fill in a survey with questions related to the STCs. Some general questions were asked after attending, where results show visitors had the feeling the RoW helped them (Table 19). Having a helpful referral and diagnosis (respondent 1 & 5) and now knowing what to do regarding DIY repair activities (respondent 2, 3 & 4) were the two mentioned answers. Given these answers, it is no surprise visitors would recommend the RoW to friends and family (Table 20). Points to improve the RoW were asked, where creating more awareness, having some general parts and getting help collecting appliances from home were mentioned (Table 21).

Table 19 Answers whether RoW has helped visitors

	Do you have the feeling RoW has helped you?
1.	Yes, I've been referred and the first diagnosis is made
2.	Yes, it gave me insight into what part needs to be replaced
3.	Yes, I came to throw away my microwave and after the service it became clear I only have to buy a new fuse of only 5 euro
4.	Yes, my devices were not repaired but I got advice and now know what to do
5.	Yes, they were very friendly and I have been referred to a Repair Café nearby. With the cards I don't need to remember everything that was wrong with my printer

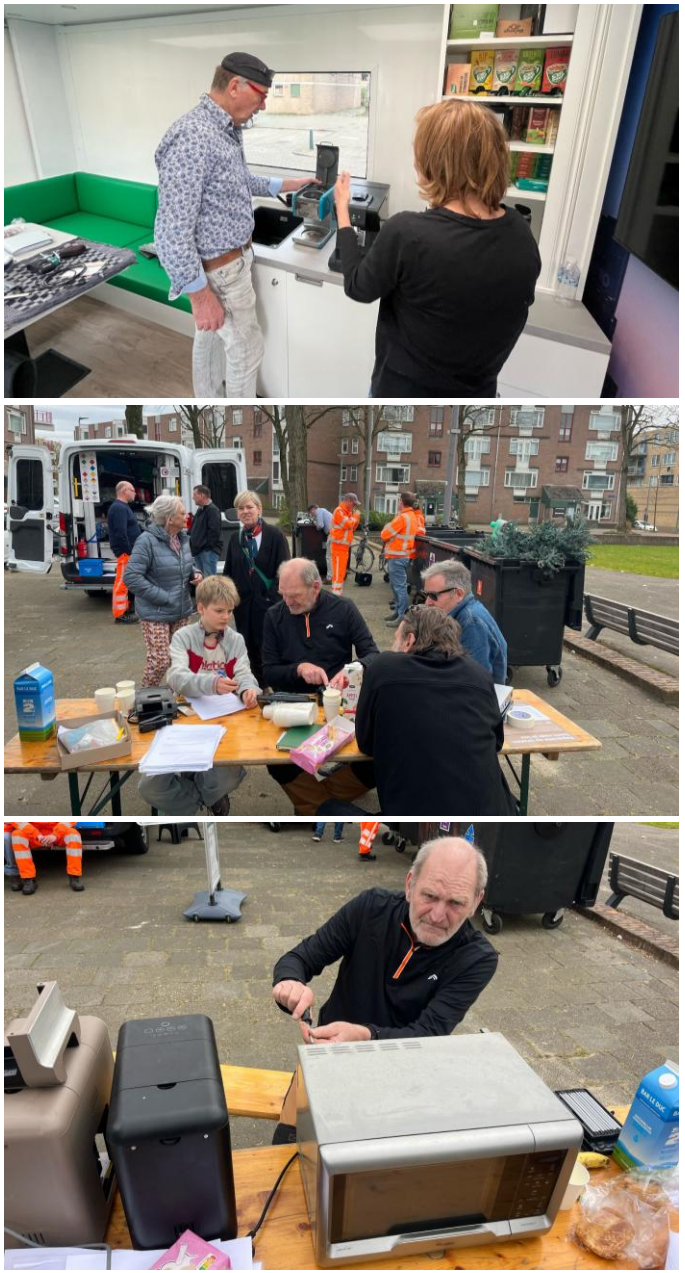


Fig. 92 Pictures of the conducted pilot inside and outside the van

Table 20 Answers whether to recommend RoW

	Would you recommend?
1.	Yes, it is easy and sympathetic
2.	Yes, because it really helps and I had fun!
3.	Yes
4.	Yes, I got quick advice
5.	Yes, it was fun with neighbours and help was friendly

Table 21 Answers on points of improvement

	Do you see points of improvement?
1.	Creating more awareness on existence of Reparatie op Wielen. Now it is mostly crowded at the pop-up recycling centre.
2.	Maybe some general parts, like batteries
3.	No, it was very quick and helpful
4.	No
5.	Getting help with collecting devices from home

10.3.1 Outreach & visibility

A total of five visitors were attracted by the Reparatie op Wielen. Here, three knew about the concept through flyering. Posters as promotional material were not mentioned. Interestingly, one visitor had heard of the RoW from someone else, implying the concept sparks curiosity and word of mouth. One visitor was attracted through the PUR. The test results regarding outreach and visibility (Fig. 93) highlight the importance of marketing materials beforehand, however the (more frequent) use of materials could be crucial in attracting more visitors, as the pilot only attracted five.

The use of active recruitment of visitors from the PUR did not result in an extensive amount of more visitors, however it was observed that curiosity amongst those visitors was sparked. Unfortunately, a lot of visitors of the PUR had already bought a replacement product for their broken one. This way, interest in repairing the broken one, was non-existent. Some of these visitors mentioned that had they known of the existence of the RoW, they would have acted otherwise. Communication on the RoW more upfront and more frequently could prevent these cases, such as a continuous and consistent planning of the RoW, as then residents rely more on the repairs done in their neighbourhood and can plan accordingly.

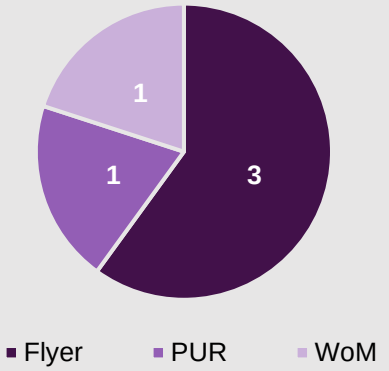


Fig. 93 How visitors got to know the RoW

10.3.2 Referral system

Amongst the total number of visitors, two of them needed a referral. Both of the visitors were referred to a Repair Café, yet a different one. The referrals worked really streamlined, where the repairers made the decision whether to refer or perform the repair. For the repairers, making this decision felt logical. The first referral was a coffee machine that needed a full disassembly. The logical decision was to refer the visitor to a Repair Café given the time. The other one was a visitor with a printer, where the reason for referral was the lack of a specific spare part. The visitor was guided by finding the right spare part online and advised to visit a Repair Café after receival of the part.

The referred visitors were asked afterwards about their referral experience (Table 22), the extent in understanding the referral poster (Table 23) and the extent in being prepared to visit the referred location (Table 24). Both referred visitors mentioned the feeling of a clear and satisfactory referral experience. The extent in which they understood the referral poster was very high, with an average of 6.5. The extent in which they were prepared to actually visit the referred to location was also high, with an average of 6.

The goal of the referral system was also to heighten the knowledge on the repair offer of Rotterdam amongst all visitors, even when not referred. This was tested by asking the visitors before and after attending whether they knew where to go for repair. Before attending the RoW, two visitors mentioned Repair Cafés, two mentioned repair services and one visitor did not know any locations (Table 25). After attending, four out of the five visitors mentioned they now know better where to go, mentioning the poster as the reason why (Table 26).

Table 22 Referral experience

	How did you experience the referral?
1.	Clear and to satisfaction. I know what I need to do.
5.	Yes, I was provided with good help and the cards made it clear for me what to do. Also comes in handy when in a few days I don't quite remember what was said.

Table 23 Understanding the referral poster

On a scale of 1-7, to what extent did you understand the referral poster?	
6 [5]	**7** [1]

Table 24 Visiting referred repair location

On a scale of 1-7, to what extent are you prepared to visit the referred to repair location?	
5 [5]	**7** [1]

Table 25 Repair offer knowledge before attending RoW

	Do you know where to go in Rotterdam for repair services?
1.	Yes, I know some Repair Cafés
2.	MediaMarkt and for furniture my parents. I don't know any more
3.	At Blaak for computers and phones. At Vlietlaan for TV
4.	Repair Café
5.	No

Table 26 Repair offer knowledge after attending RoW

	If you would want to use a repair service, do you now know better where to go in Rotterdam?
1.	Yes, I now know of more Repair Cafés due to the very insightful poster
2.	Yes, I made a picture of the poster with all the repair points
3.	Yes, I was attended on the different repair points on the map
4.	Looking for Repair Cafés on the internet
5.	Yes, because of the poster

10.3.4 Diagnostic cards for referrals

Results on the diagnostic cards were gathered through the perspective of the repairers. The repairer that did not do the referrals (coincidentally, the referrals were done by the same repairer) was asked to validate the filled in diagnostic cards. The filled in cards were both found to be clear and concise. The repairer that filled in the diagnostic cards was asked to evaluate them and if something was missing, coming up with some easy quick wins:

- As the diagnostic cards presented the diagnosis and the steps, no place for giving advice was present. Including that, could make the entire referral process more efficient
- Information on the appliance was asked at the top of the

diagnostic card, however missing the product type

As Table 22 visualised, when the referred respondents were being asked about the entire referral process experience, one respondent mentioned the cards as being helpful in communicating what needs to be done. As the visitor thought it a chance to not remember or remember correctly what was being said by the repairer of RoW.

10.3.5 Tools & equipment

Results on the required tools and equipment were gathered through evaluation with the repairers after the event. The repairers were asked beforehand to bring the tools they thought they would need. During the evaluation it became clear these were in fact the right tools. To sum these up: fine mechanical tools, fine electrical tools, mid-large mechanical tools, test equipment and a current meter. Having electricity was crucial, but could maybe run on the battery of the electrical van, this way an aggregate would not be necessary, yet would ensure electricity during the entire event. Question remains whether the battery of the van can facilitate this amount of electricity and still has enough capacity to drive back. The repairers mentioned they did use tools of the other if they forgot bringing it, but still would always prefer their own tools, questioning whether a permanent tool availability would be necessary. Both mentioned having a laptop and a screen, as present in the van, was very helpful.

Repairing in the van worked streamlined and it was appealing to have an opportunity to isolate oneself. The outside sitting area was a non-expected working area, but the nice weather presented it as a good one, sparking curiosity amongst residents walking by.

10.3.6 Collaboration with pop-up recycling centre

Putting the RoW together with the PUR visually appeared as a festive event, sparking curiosity from residents and people walking by. The area presented itself as a meeting place, giving neighbours the chance to get outside their house and interact with each other. This was a side-result that beforehand was not thought of, but came out to be a very vibrant side and success factor of the RoW in collaboration with the PUR. During evaluation with the coordinator of the PUR it came out that the outside table and coffee availability heightened this feeling of community as residents were more inclined to stay for a chat and a coffee.

However, the e-waste retrieved by the PUR still was a lot, around 80 kg. Only one visitor was attracted from the PUR to instead repair the broken appliances. This was done through active recruitment by the hostess of the RoW. The low flow of visitors from the PUR had to do with two factors. A lot of PUR visitors had already bought a replacement product, resulting in no interest in repairing their broken one. However, still curiosity was sparked and some visitors were disappointed they did not know, as they otherwise would not have done so. During evaluation with the coordinator of the PUR, it was said the PUR had similar problems at the start, where residents found out too late and had already thrown away their bulky waste in the average waste stream. Through constant planning and permanent placement in a few areas, this was solved over time. The coordinator of PUR hypothesized for the RoW it would work similarly.

The second factor influencing the low flow of visitors was due to the attitude and persuasiveness of the PUR employees. They did ask visitors whether they wanted to repair, but did not try to convince them or explain the concept, a factor appearing to be crucial in the collaboration between the two concepts. The coordinator of the PUR discussed this was similar to the placement of the PUR near a Repair Café, where over time employees would get into the right attitude and persuasiveness. However, as every PUR can gather different employees, it is advised to have one employee of the RoW solely working on recruiting visitors of the PUR to the RoW.

The collaboration was also facilitated to see whether the RoW could use spare parts from the e-waste stream. This was done in one case. Given this one repair utilizing, this took up 20% of all the repairs done. Needless to say, this quite large percentage was due to the low number of total repairs. Interestingly, the repairers were very interested in the e-waste collected and identified appliances they could use for repairs still to be done in their Repair Cafés.

10.3.6 Lowering repair barriers

The respondents were asked to answer questions on barriers they feel for DIY repair and utilizing a repair service. To measure whether the Reparatie op Wielen has an influence on these felt barriers, this was asked before and after attending the RoW. For DIY repair (Fig. 101) before attending, most respondents felt that not knowing how to repair and the fact that repairing takes time to be a barrier. After attending, both barriers were not mentioned anymore, meaning the RoW would have solved these. Interestingly, after attending the RoW, most respondents felt a heightened barrier in perceived self-efficacy, answering the barrier of “I don’t think I can do it”. Before attending one respondent had mentioned the barrier. Hence, the RoW may have a positive influence for visitors in knowing what a repair process looks like, yet could increase insecurities. When looking at Fig. 101 on the right side, it is seen that the felt barriers have in fact decreased for almost all respondents due to the RoW service.

The mentioned barriers respondents feel for utilizing repair services are seen in Fig. 102. Before attending, four respondents mentioned utilizing a repair service taking time as a barrier, whereas after attending this barrier was not mentioned anymore. The barriers of repair services costing money and not knowing where to go were mentioned before attending, and not anymore after attending. Interestingly, after attending the RoW, three respondents do not mention feeling a barrier anymore. Not surprisingly, the number of mentioned barriers has diminished per respondent after attending.

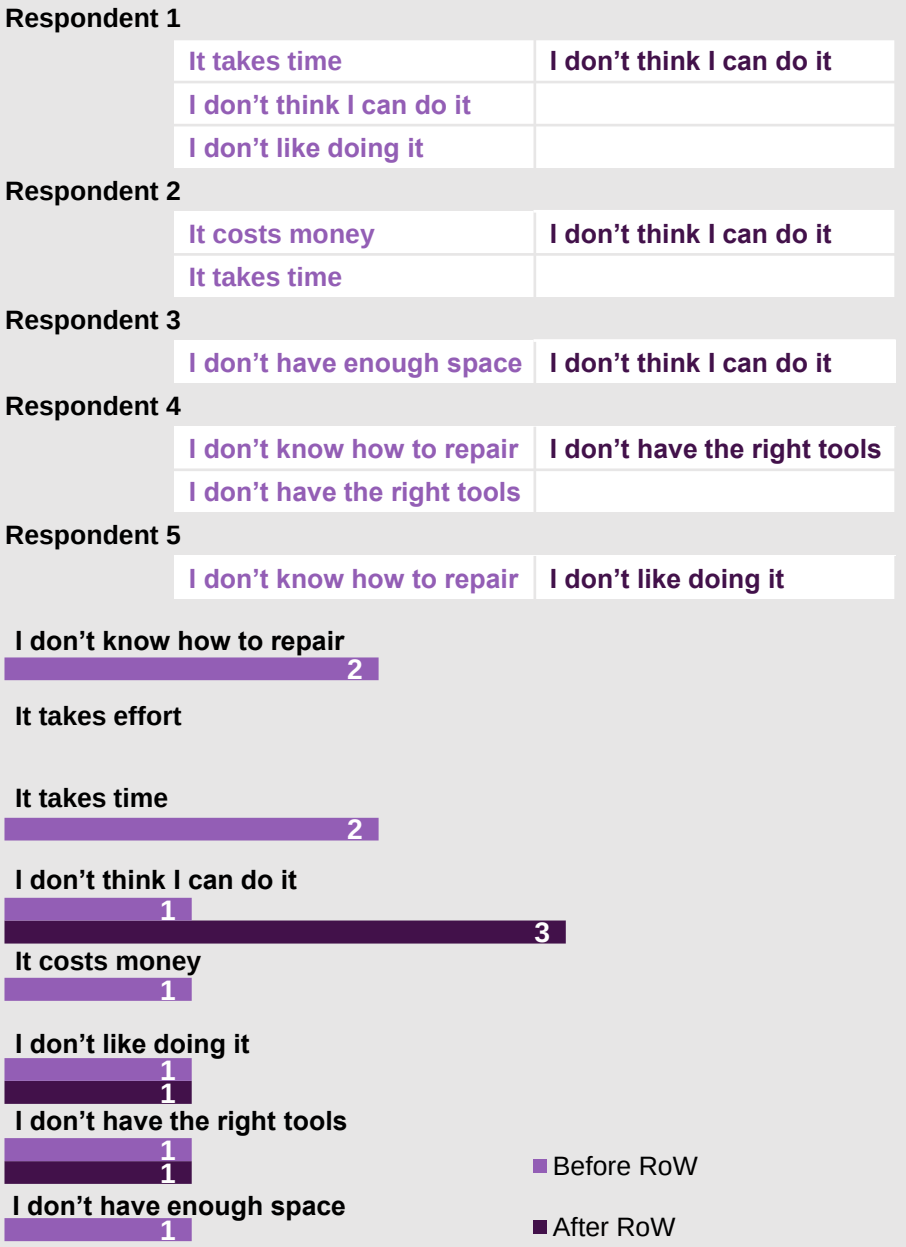


Fig. 94 Felt barriers for DIY repair before and after attending the Reparatie op Wielen

Respondent 1		
	It may feel awkward	**It may feel awkward**
	It takes time	
Respondent 2		
	It takes time	
Respondent 3		
	It costs money	
Respondent 4		
	It takes time	
	It takes effort	
	It costs money	
Respondent 5		
	I don’t know where to go	**It takes effort**
	It takes time	

Fig. 95 Felt barriers for utilizing repair services before and after attending the RoW

10.3.7 Repair education

The RoW facilitating repair education was measured by asking the respondents before and after attending the RoW to put their repair confidence and knowledge on a scale of 1 - 7. Here in both cases, 1 is very low, 7 very high. Table 27 and 28 show an overview on which respondents have answered where on the scale they perceive the repair confidence and knowledge before and after attending. To give insight into the growth per respondent, the respondent numbers are included, visualised as [1] - [5].

The average growth of both repair confidence and knowledge is 1.4. Before attending both averages were 3.2, after attending the Reparatie op Wielen 4.6. Both have not grown immensely, and a final average of 4.6 on a scale of 7 perhaps might not be enough to influence visitors to participate in DIY repair more often. These insights can be explained through evaluation with the repairers. When being asked how repairing together was done in the RoW, they stated the RoW is mainly for making diagnosis and not actually doing the repair, this way, repairing together cannot be facilitated in the best way. It was mentioned that around half of the respondents did help with the diagnosis and small disassembly's, yet the other half got sent with a referral or advice on how to self repair the next steps. To finalize the section with a positive, all visitors of the pilot felt an increase in both repair confidence and knowledge, even though it was not large.

Table 27 Measured repair confidence

	On a scale of 1-7, how much repair confidence do you have?				
Before	**1** [5]	**3** [1,4]	**4** [3]	**5** [2]	
After		**3** [5]	**4** [1]	**5** [3,4]	**6** [2]

Table 28 Measured repair knowledge

	On a scale of 1-7, how much repair knowledge do you have?			
Before	**1** [5]	**3** [1]	**4** [2,3,4]	
After			**4** [1,5]	**5** [2,3,4]

10.4 Conclusion of the pilot

The pilot of Reparatie op Wielen demonstrated early signs of success in offering low-threshold repair support and connecting residents to the broader repair ecosystem. Despite a modest visitor turnout, the initiative showed it could meaningfully support residents through diagnostics, simple repairs and effective referrals, confirming its value as an accessible entry point to repair. Visitors reported feeling helped and would recommend the service, indicating strong user appreciation. However, due to the low visitor turnout findings are still suggestive.

The referral process functioned clearly and efficiently, increasing residents' knowledge of where to go for further repair. Diagnostic cards were positively evaluated, though minor improvements were suggested for clarity and completeness. The tools and setup proved adequate, with the van and outdoor area supporting both practical repair and community visibility. Importantly, the collaboration with the pop-up recycling centre added a social layer to the experience, but revealed the need for better joint communication and visitor recruitment to increase effectiveness.

Barriers to both DIY and professional repair decreased after participation, though some insecurities regarding self-efficacy remained. Educational impact was positive but limited, reflecting the diagnostic-focused nature of the concept. These insights offer valuable direction for refining Reparatie op Wielen and increasing its visibility, impact, and educational reach over time.

10.4.1 Design changes & recommendations

Improvements need to be made to help maximize RoW's impact, the following are recommended:

Improve marketing & outreach: Increase awareness through social media, posters, and community engagement. A consistent and predictable communication plan should be created to encourage reliance on RoW's presence. It is advised to assign a dedicated team member to actively recruit PUR visitors on the spot. The next chapter will dive into these improvements as a part of the implementation plan.

Optimize electricity resources: it is recommended to test battery-powered electricity of the van to avoid reliance on an external power source.

Encourage DIY repair confidence: it needs to be ensured that visitors participate in small disassembly's or diagnostic steps, as this was done by only a part of the visitors. More hands-on repair activities need to be developed within RoW to reduce DIY repair insecurities. Also, activities can be hosted purely based on learning how to repair.

Modify the diagnostic cards: Evaluation with the repairers showed that a section for repair advice and product type need to be included. It is recommended to explore follow-up mechanisms with Repair Cafés to track referral outcomes. Moderation of the card is seen in Appendix 5.

Chapter 11
Implementing the Reparatie op Wielen

11.1 Introduction

To ensure that Reparatie op Wielen can be implemented in Rotterdam in a way that is both sustainable and institutionally embedded within the municipality, a detailed implementation plan has been developed. The plan offers guidance on how to organise the concept structurally, support it financially, communicate it effectively, measure its impact, and mitigate possible risks along the way. It concludes with a phased roadmap to guide its long-term rollout and integration. To steer the implementation process, a set of implementation objectives has been formulated. These objectives serve as a compass for the design and execution of activities, while also providing a structure for monitoring progress and ensuring that all efforts contribute to creating more accessible, visible and connected repair options for Rotterdam's residents. The implementation objectives are:

Extending the lifespan of household appliances
By helping residents preserve their appliances, unnecessary waste is avoided and material use becomes more efficient

Increasing repair awareness and behaviour
Many residents are unaware of the possibilities and benefits of repair. This objective aims to build awareness while also encouraging a behavioural shift from disposal to repair. Over time, this helps normalise repair as a natural response to product failure

Lowering the threshold for residents to engage in repair activities
Repair can feel inaccessible, time-consuming or complicated. By offering approachable, local and supported opportunities for residents to engage with repair, perceived barriers are addressed

Strengthening the repair ecosystem in Rotterdam
Rotterdam already has various repair players in place, but the ecosystem is fragmented. Connecting these actors is crucial in order to create a stronger, more accessible network where knowledge and services are shared

Fostering collaboration with the pop-up recycling centre
The pop-up recycling centre reaches residents at the moment of intended disposal. This creates a key opportunity to shift their mindset from disposal to repair. Through collaboration, both initiatives can amplify their impact and serve as a visible entry point to circular behaviour

11.2 Organisational structure

The organisational structure behind Reparatie op Wielen (RoW) details the roles, responsibilities and partnerships necessary for successful implementation and continuity of the concept. The RoW is an entry model to the wider repair ecosystem with further established collaboration, defining the roles and responsibilities within this ecosystem, ensures a more continuously coordinated network.

Through conducting a co-creation workshop, the organisational structure was created. This section dives into the conductance of the co-creation workshop, the organisational structure as a result and will further describe the actors within this structure and the collaborations it establishes.

11.2.1 Co-creation workshop for further implementation

The co-creation workshop was organised with the objectives to introduce the participants with the RoW and its coordination of the entire repair ecosystem. Other goals were to determine the collaborations that take place within the system, to determine the roles and responsibilities of each actor and, finally, to create the organisational structure behind the RoW. Participants were with a total of six and consisted of the coordinator of the pop-up recycling centre, an employee working on waste stream management and employees of Rotterdam Circulair, where two work on circular consumption and two on making neighbourhoods more circular. All participants could add to the discussion from their own perspective, creating a very insightful conversation as they all are from departments that are intended to be linked to the RoW in a way.

The session started with an introductory presentation, sharing the concept and the different aspects. Participants could react and give feedback. The already established collaborations with the PUR, the Mobiele Wijkhub and the Repair Cafés were shared and possibly needed staffing working on the Reparatie op Wielen (Fig. 97). These were a repair lead and a repair coordinator.

After the presentation, the participants were invited to collaboratively work on the organisational structure in the workform of three white papers that stand for what would fall under the responsibility of the municipality, Schoon & Circulaire stad and Repair Cafés in Rotterdam (Fig. 98). Schoon & Circulaire stad is the overarching department for the PUR, waste stream management and Rotterdam Circulair. The different players were printed out and participants had the opportunity to put all actors on the different papers. With the use of markers and post its, collaborations between and responsibilities of each actor could be determined. The project lead and repair coordinator could then be put in the right place, whereafter further profiles and responsibilities could be determined.

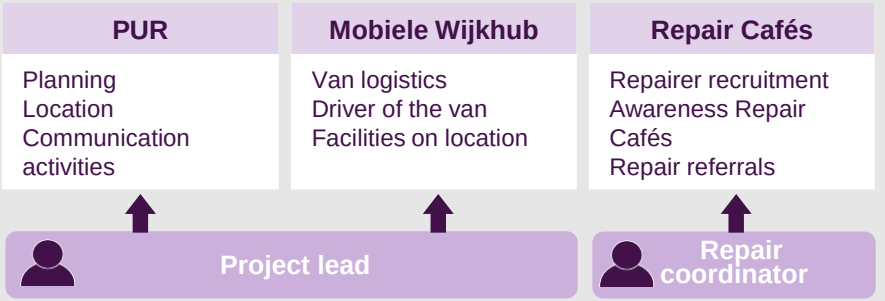


Fig. 97 Collaborations and staffing communicated during the co-creation session

Fig. 98 Creating the organisational structure in a co-creation workshop

11.2.2 The organisational structure

The organisational structure created in the co-creation workshop is visualised in Fig. 99. The structure is set-up through collaboration between existing actors. Each actor supports a specific aspect of the service, while maintaining alignment with the ambition of making circular easier in the context of fostering a repair culture in Rotterdam. The municipality plays a unifying and overarching role, while operational and communicative tasks are distributed among established partners: the PUR, Repair Cafés and the Mobiele Wijkhub. The structure is composed of four primary actors, each with defined roles (Fig. 99).

11.2.2.1 Coordination and ownership

The municipality of Rotterdam serves as the overarching stakeholder, as the initial department Schoon & Circulaire stad owns, coordinates and is responsible for the Reparatie op Wielen. The team of the RoW consists of a Repair Lead and a Repair Coordinator.

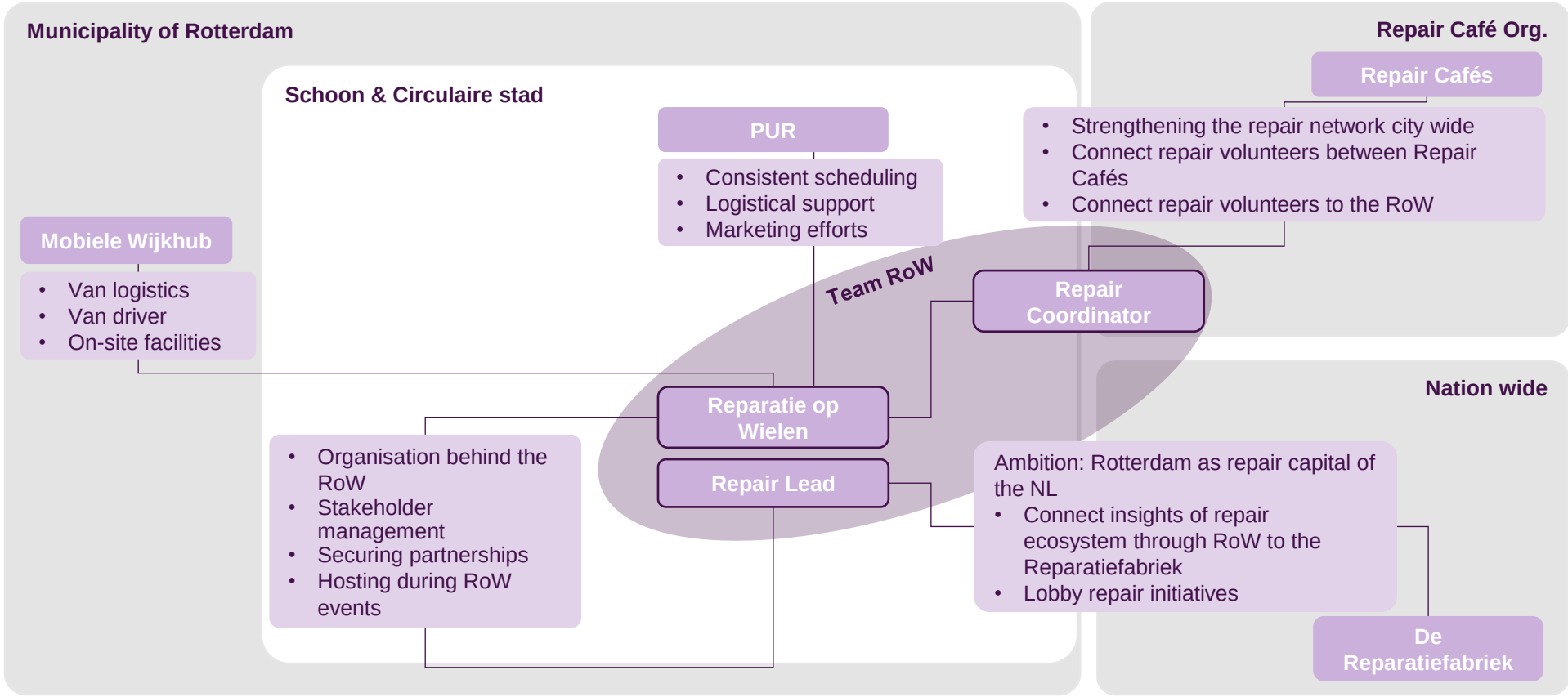


Fig. 99 Organisational structure behind the Reparatie op Wielen

A Repair Lead needs to be appointed, being responsible for the organisation of the RoW and hosting RoW events by welcoming the visitors. Internally, the Repair Lead will secure partnership and will manage all the stakeholder involved in organising the RoW, such as the Mobiele WijkHub and the PUR. Externally, the Repair Lead has the ambition of making Rotterdam the repair capital of the Netherlands. It will communicate everything that is going on regarding repair in Rotterdam to the Reparatiefabriek en lobby for more repair initiatives. The Repatiefabriek is a nationally organised repair coalition working on a viable business model that is nationally embedded, striving to make repair more affordable.

11.2.2.2 Strategic cooperation with Repair Cafés

To ensure both quality and continuity in repair support, the Reparatie op Wielen initiative is designed to collaborate closely with existing Repair Cafés in Rotterdam. This partnership serves two strategic purposes: they enable the recruitment of experienced and motivated repairers while simultaneously strengthening the network between Repair Cafés and repair volunteers in the city. Such cooperation fosters knowledge exchange between repairers and encourages visibility of Repair Café activities.

A Repair Coordinator needs to be appointed, overseeing all repair initiatives in Rotterdam, while establishing the cooperation within the repair ecosystem. The Repair Coordinator takes up the role of strengthening the repair network in Rotterdam, with a focus on Repair Cafés and will act as a spokesperson for the entire repair ecosystem. It can ensure personnel logistics by connecting repair volunteers amongst Repair Cafés and to the RoW. The person taking the role of the Repair Coordinator needs to already be somewhat embedded in the repair network and needs to take an external role in the context of the RoW and municipality.

11.2.2.3 PUR as an operational partner

The pop-up recycling centre (PUR) will act as RoW's main logistical and operational partner. The integration of RoW with PUR locations offers multiple advantages: consistent scheduling, logistical support, collaborative marketing efforts and visibility within neighbourhoods. PUR can provide predictable access to residents, allowing RoW to straddle along on existing planning, communication and community presence. Communication efforts include distributing flyers in target neighbourhoods, managing social media presence and engaging local community groups.

11.2.2.4 Logistical and operational partnership with the Mobiele Wijkhub

To reduce logistical demands and enhance operational efficiency, the Reparatie op Wielen collaborates closely with the team behind the Mobiele Wijkhub. As an initiative already embedded within the municipality, the Mobiele Wijkhub can provide its van for repair housing purposes of the RoW. This partnership allows the RoW to focus on its core repair activities, while relying on the Mobiele Wijkhub for the logistics behind the van, shelter and on-site facilities.

11.3 Financial overview

To gain an overview of the financial needs of the RoW, expected costs are outlined by calculating the start-up costs, which are fixed, and the operational costs, counted as costs per event. As the RoW is non profitable, besides municipal funding, no money inflow is accounted for.

11.3.1 Start-up costs

To be able to calculate the start-up costs, the needed materials were gathered by looking at the results of the pilot and the created material list of the Repair Café Organisation (Appendix 1). From this list, it was analysed which tools would be needed for maintenance tasks and smaller repairs. Table 28 visualises these materials, including the financial overview of the start-up costs. Here, a laptop and tent were not included in the material list. As it is expected from the repair coordinator to be present at all the events, it will be logical to use the coordinator's laptop for on the

spot digital guidance. The PUR already has a tent in place, which is large enough to house the outside area of the RoW and the employees of the PUR. As Table 29 shows, the fixed costs to set up the RoW are €563,66.

Table 29 Start-up costst for the RoW

Category	Type	Costs	Source
Tools	Compressor	**119,99**	HBM Machines
	Fine mechanical tools	**13,95**	Kabelshop
	Fine electric tools	**70**	Dustin Home
	Multimeter	**54,50**	Kabelshop
	Voltage tester handle	**6,84**	Manutan
	Pliers set	**20,95**	Kabelshop
	Multispray WD 40	**7,5**	Kabelshop
	Duct tape	**6,85**	Viking Direct
	Isolation tape	**2,95**	Viking Direct
Comms	Banner	**77,23**	Drukwerkdeal
	Sidewalk sign	**49,95**	Goodstore
	Referral poster A1 x 2	**37**	Drukwerkdeal
Outside	Collapsible sitting set	**95,95**	Deubax XL
Total fixed costs		**563,66**	

11.3.2 Operational costs

Calculating the operational costs of the RoW was done per event and comes down to a total of €1066,57 per event (Table 30). The amount is dependent on communication materials and personnel. Costs regarding the use of the Mobiele Wijhub do not need to be included, as these are not calculated through on the RoW.

Communication materials per event include the referral & diagnostic cards. Flyering efforts will be shared with the PUR, which take up a total amount of €499,13. In the operational financial overview, this is divided by two as these are shared costs.

Personnel wise, two repairers need to be present per event to do the initial maintenance and diagnostic tasks. The repairers only need to be working during event hours, which is on average three hours. The repair coordinator serves as host(ess) as well. In preparation for each event, it is estimated for the repair coordinator to need two hours, plus the additional three hours per event. Both the repairers and the repair coordinator will be hired outside of the municipality, which gives an average hourly payment of €70,-. A project lead will be appointed from inside the department Schoon & Circulaire Stad and will be measured based on FTEs, and not hourly payments.

Table 30 Operational costs for the RoW

Category	Type	Costs	Source
Person-nel	Repair coordinator x5 hours	**350**	Gemeente R'dam
	Two repairers x3 hours	**420**	Gemeente R'dam
Comms	Referral cards A5 x15	**18,50**	Drukwerkdeal
	Posters A3 x15	**28,50**	Drukwerkdeal
	Flyering activities	**249,57**	PUR
Total fixed costs		**1066,57**	

11.3.3 Budget and financial support municipality

The project will be financed by the Burgerberaad, which is a designated group of around 150 residents of Rotterdam that can make yearly advice on what Rotterdam needs in order to grow in a certain direction. One of its approved pieces of advice was to stimulate second-hand and repair in the city, for which budget has been set aside. As the Reparatie op Wielen stimulates repair, it can function based on a part of this budget. This total amount cannot be shared, yet it is to say the RoW would take up a really small amount of the budget.

11.4 Communication plan

The communication strategy for Reparatie op Wielen needs to subbert the wider ambition of making circular easier, yet to make the ambition more manageable for communication activities, some key objectives have been determined. Its primary purpose is to create awareness on the RoW and other repair activities, encourage participation in these and strengthen the visibility of the broader repair ecosystem. Effective communication needs to ensure that residents not only understand the service being offered but also feel motivated to take part in repair activities that are organised beyond the Reparatie op Wielen.

The key message of Reparatie op Wielen's communication activities should centre around lowering the threshold to repair, making repair more attractive and raising awareness on its existence and of repair initiatives beyond the RoW:

"Reparatie op Wielen brings repair within reach. By offering free, approachable help with small repairs, maintenance and diagnosis, it encourages residents to act before replacing. The service raises awareness of local repair options, connects people to existing initiatives, and shows that repair is not only possible, but worthwhile."

11.4.1 Target audience

The target audience of the communication plan primarily consists of residents of Rotterdam, with a particular focus on neighbourhoods where Reparatie op Wielen will be deployed. Special attention is given to reaching first-time repairers who may feel hesitant about repair, as well as residents who are already sustainability-minded but require accessible repair options.

11.4.2 Key activities both off- and online

Key activities within the communication strategy involve both offline and online methods to ensure a broad and inclusive reach (Fig. 100). Printed materials, such as flyers and posters, will be distributed in targeted neighbourhoods, community centres and other communal facilities. These materials will provide clear information about the purpose of Reparatie op Wielen, the types of services offered and the benefits of engaging in repair rather than disposal. On-site visibility will be reinforced through banners and signage, helping to attract attention.

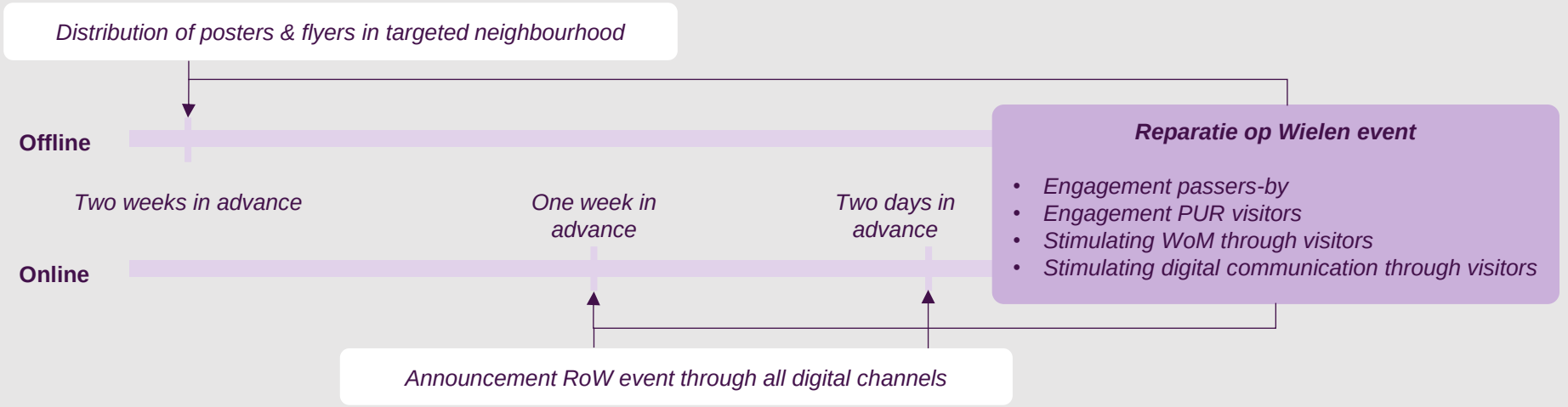


Fig. 100 Frequency communication before Reparatie op Wielen event

Digital communication will complement physical outreach by using the website, social media channels and digital newsletters of Schoon & Circulair Stad and Rotterdam Circulair. Event announcements will be shared both prior to and following RoW events. Residents who have visited the initiative will be encouraged to share their experiences through word-of-mouth and social media, this way organic growth will be maintained and trust will be strengthened among the wider community.

Timing is a crucial element of the communication plan. Flyers and posters should be distributed approximately two weeks before an event to ensure sufficient notice for residents, while digital communications follow a schedule of one announcement one week before the event, followed by a reminder two days prior. During events, immediate engagement with passers-by, especially visitors to the pop-up recycling centres, will be prioritised to draw attention to the RoW.

11.4.3 Tone of voice & visual identity

The tone of voice used in the communication of Reparatie op Wielen follows the broader communication style of the municipality of Rotterdam (Onze Stijl, n.d.). It aims to be reliable, accessible and inviting, using clear, concise and friendly language that residents can easily understand and relate to.

Messages begin with the core information, followed by relevant explanations, using everyday language rather than policy or technical jargon. Sentences are kept short and active, helping to keep the tone energetic and engaging. While the communication remains mostly informative, it is also warm, encouraging and action-oriented, especially when residents are invited to take part in repair activities.

Visual and verbal expressions avoid complex metaphors or wordplay that may cause confusion. Instead, they focus on clarity, inclusivity, and approachability, ensuring all Rotterdam residents, including those with lower literacy levels or a limited command of Dutch, can fully grasp the message and feel invited to take part.

Regarding the visual identity, the logo of the municipality of Rotterdam should be present (Fig. 101) and the use of four colours is allowed, namely green, white, black and grey (Fig. 102). Templates have been developed that are intended to be used for communication on the part of the municipality, making the overall visual identity more cohesive and easier in use (Fig. 103). It is seen in the formats that it includes more visualisation than text, making it easier for a larger audience to comprehend what is communicated.

Gemeente Rotterdam

Fig. 101 Logo of the municipality of Rotterdam

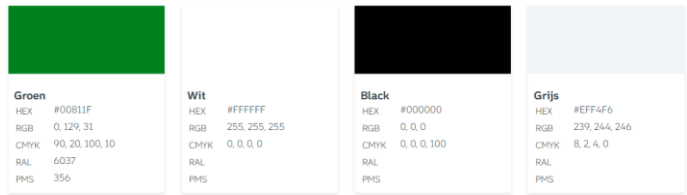


Fig. 102 To be used colours for communication activities

Fig. 103 To be used templates for communication activities

11.4.4 Communication responsibilities

The responsibility for executing the communication activities is shared. Schoon & Circulaire Stad will oversee the broader communication strategy and manage official channels, while the RoW team will be responsible for local promotion, material distribution and on-site engagement. The pop-up recycling centre teams will collaborate by promoting RoW to their visitors, and repair partners such as local Repair Cafés will be encouraged to amplify messaging through their networks.

11.5 Achieving impact

The DIN model, short for Doelen, Inspanningen, Netwerk, is a strategic framework used by Rotterdam Circulair to steer transitions. It provides structure in formulating clear goals (Doelen), defining concrete actions (Inspanningen) and identifying key partners (Netwerk) needed to achieve the intended impact. The model ensures that impact is not only defined but also actionable and supported. As discussed in the section risks & mitigation of this chapter, In order to keep stimulating municipal funding and improving the concept, it is important to monitor the impact the Reparatie op Wielen has on the implementation goals.

Within the context of this project, the DIN model is used to align the ambition of “making circular easier”, which is one of the goals set by Rotterdam Circulair in this model to stimulate circular behaviour amongst residents. The ER goals (Effect- and Result-goals) serve to operationalise the ambition of “making circular easier” by setting direction on specific impact areas. The ER goals of the DIN model are in line with the implementation goals as shared in the introduction of this chapter. SMART goals make the ER goals measurable, where the actions and network makes these goals actionable. Fig 104 on the next page visualises the worked-out DIN model for the Reparatie op Wielen.

11.6.1 Evaluation & monitoring

To ensure that the Reparatie op Wielen contributes to the established implementation goals (ER goals), continuous evaluation and monitoring need to be taken place. As visualised in the DIN model, the SMART goals have not been made measurable and are not quantified. Before being able to quantify the SMART goals for future monitoring, a baseline needs to be measured after the first year of implementation. Measuring the impact in achieving the implementation goals will be done in several ways (Fig. 105 on page 96).

Monitoring (un)repaired appliances through tally sheets

Measuring the SMART goals of extending the lifespan of household appliances will be done by the repairers during each Reparatie op Wielen event. A tally sheet will be present, on which the number of repaired appliances, referred repairs and non-established repairs that are recycled at the PUR, will be tracked. At the pop-up recycling centres, currently such a list is used as well to measure the collected waste, however this is done by weight. To measure impact of the RoW situated next to the PUR correctly, the PUR needs to measure collected e-waste per device. Besides the number of appliances collected, the tally sheet of the PUR should contain a part where the number of referrals from the PUR to the RoW is counted and checked. This tally sheet of the PUR will be used during every collaborative event and as the RoW host will have the role of directing PUR visitors to the RoW, the host is intended to use this tally sheet as well.

Questionnaires at fixed locations

The SMART goals of increasing repair awareness & behaviour and lowering the threshold to engage in repair activities are all measured through visitor surveys handed out by the host. To decrease monitoring fatigue, this will be done three times in the first year at the locations where the RoW is placed consistently. The first time as a baseline measurement, the second half way through the year and the final one at the end of the year. After the first year, this monitoring will be done twice a year, as then the final measurement of the previous year functions as a baseline measurement.

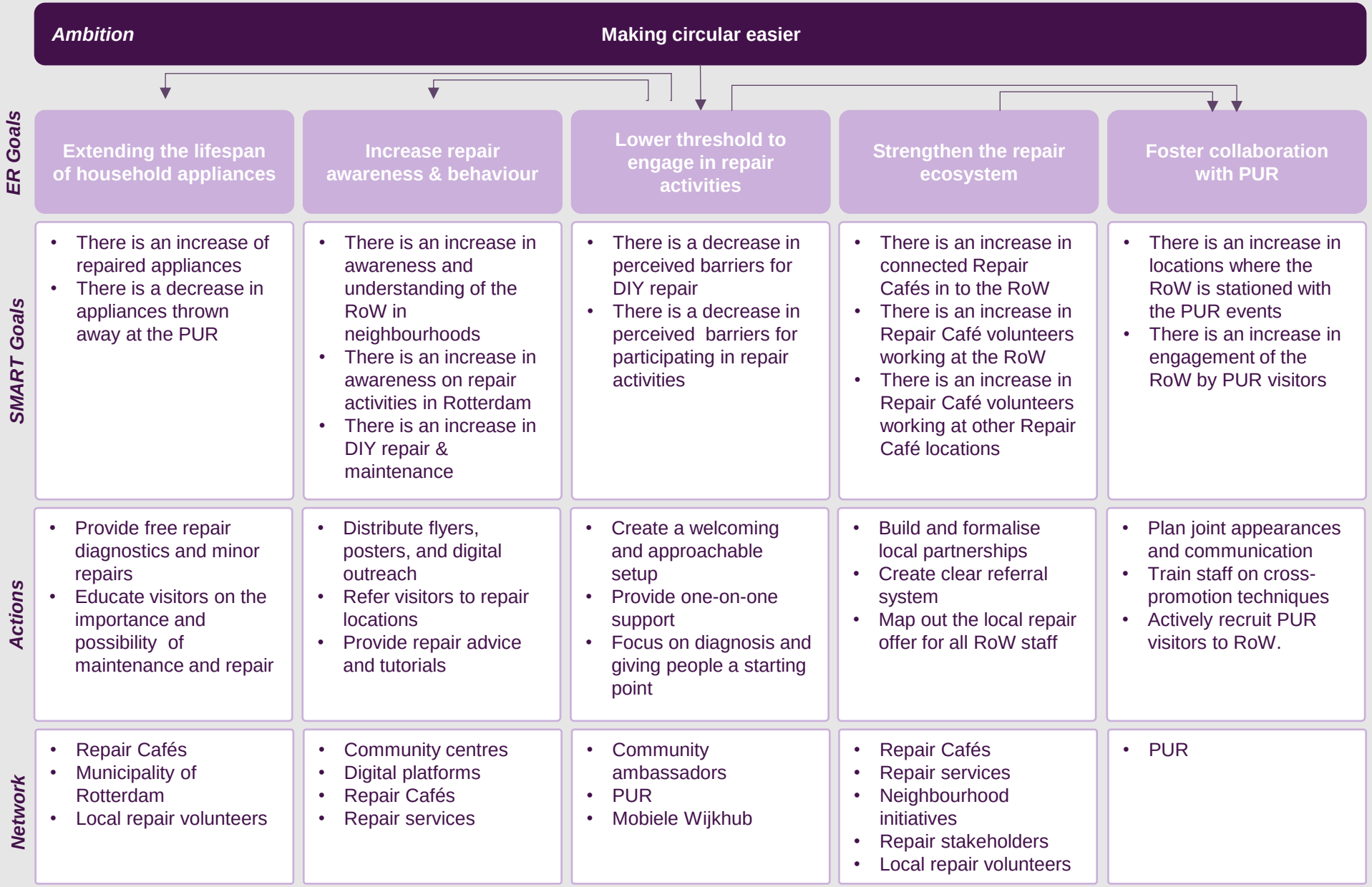


Fig. 104 DIN model for the Reparatie op Wielen

Monitoring by the repair coordinator

The SMART goal of strengthening the repair ecosystem will be measured by the repair coordinator, as this is the person that establishes the different relationships and partnerships amongst Repair Cafés and between Repair Cafés and the RoW.

Monitoring through reflexive monitoring

The Reparatie op Wielen functioning as a whole and the SMART goal of fostering collaboration with the PUR will be measured through reflexive monitoring, which is a way of monitoring done by a person outside of the project. Different aspects of the concept will be evaluated, such as the experience of the employees of the PUR, repairers at the RoW, the host and of the visitor on one non-specific day in the year.

Monitoring and evaluation of the communication strategy

The communication strategy as a whole is not part of the DIN model, however it has the intention to heighten repair awareness amongst residents. To monitor the communication activities, the visitor surveys that monitor repair attitude and behaviour will also include questions on how visitors became aware of RoW, helping to evaluate the effectiveness of different channels. The number of distributed materials, levels of social media engagement and visitor feedback will all be collected and analysed. Findings will be used to refine messaging, adjust timing and identify opportunities for stronger engagement in future activities.

By linking outcomes to the structure of the DIN model, this evaluation approach ensures that the implementation remains impact-driven, adaptive and grounded in real user experiences. By giving a yearly update on the impact amongst the different implementation goals, financing of the municipality can be assured when the correct impact is established.

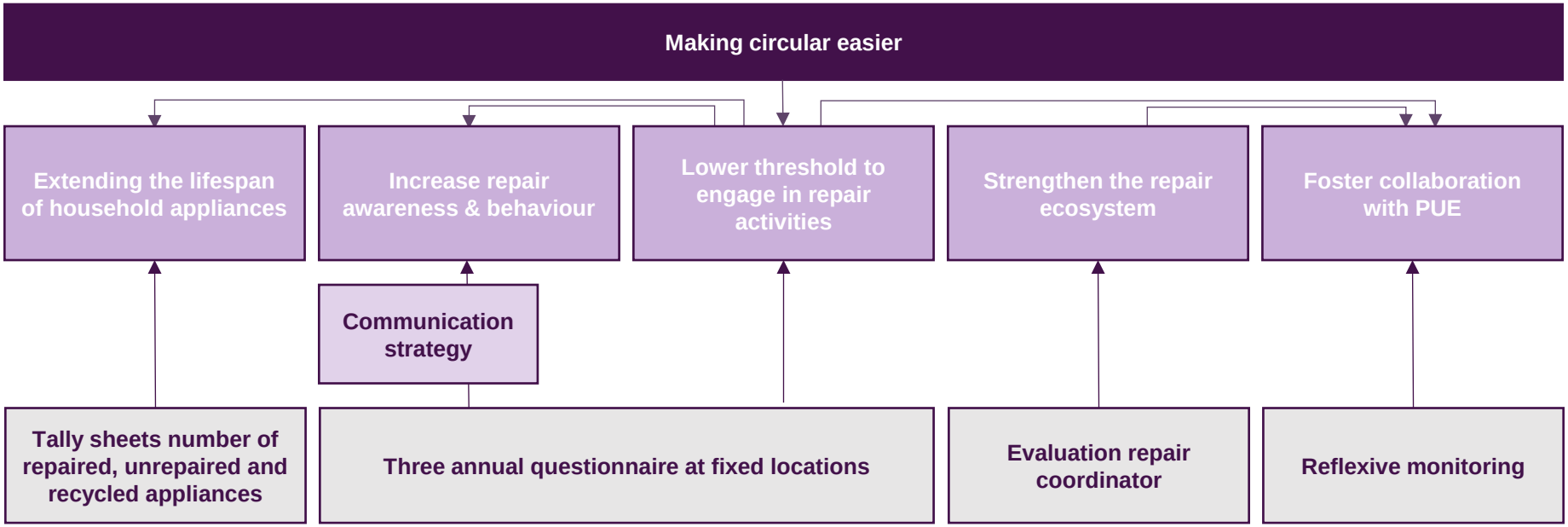


Fig. 105 Monitoring of the different implementation goals

11.2 Risk mitigation

While the Reparatie op Wielen (RoW) shows strong potential as a mobile repair initiative, several risks must be addressed to ensure successful and sustainable implementation. These risks have been identified through the SWOT analysis on Fig. 82 and pilot results, where each is paired with a targeted mitigation strategy. Fig. 106 on the next page explains all these risks and how to mitigate them.

11.7 Conclusion through an implementation roadmap

To conclude the implementation plan, a structured roadmap has been created to guide the preparation and long-term embedding of Reparatie op Wielen in Rotterdam (Fig. 107 on page 99). The roadmap visualises how the initiative supports the overarching ambition of making circular easier. It offers an integrated overview of all components discussed in this chapter, and serves both as a strategic guide and an operational planning tool to ensure that the Reparatie op Wielen is implemented in a way that is collaborative and measurable.

The implementation of Reparatie op Wielen requires coordinated action across multiple stakeholders. This roadmap summarizes all critical steps and roles needed to successfully initiate, test, scale and embed the service in Rotterdam. By linking clear actions to defined objectives and monitoring impact, it ensures that the concept remains grounded in practice while adaptable to future growth. The phased structure allows the municipality to pilot, learn and iterate, ensuring that the Reparatie op Wielen becomes not only a successful repair initiative, but a meaningful catalyst for repair behaviour in Rotterdam.

Risk	Mitigation strategy
Difficulty in securing enough skilled repairers A shortage of available repairers could undermine the continuity and quality of the RoW. As derived from research, several Repair Cafés have a shortage in volunteers, while others have a reasonable amount. This results in an unbalanced repairer availability across different Repair Cafés	A dedicated Repair Coordinator needs to be appointed to manage recruitment, scheduling and engagement. Building long-term partnerships with and between existing Repair Cafés can strengthen the wider network and create a shared pool of volunteers. In doing so, the RoW not only supports but also reinforces the repair ecosystem of Rotterdam. The repairers are further incentivized by gaining an hourly payment when working at the RoW events
Financial dependency on the municipality As a municipally facilitated initiative, the RoW is financially dependent on continued support. This dependency carries the risk of budgetary shifts or political change	To secure financial continuity, the RoW should consistently monitor its impact based on the implementation goals. By collecting feedback from residents, track outcomes and through constant evaluation, the RoW can provide data-driven justification for continued funding. This approach also supports ongoing improvement, making the concept more resilient over time
Low visitor turnout Limited visitor engagement reduces the RoW's impact, which could for instance have something to do with residents having already bought a replacement product	A consistent and predictable schedule, aligned with PUR events, can build familiarity and trust over time. In addition, communication tailored to local neighbourhoods, word-of-mouth and social outreach can increase awareness and anticipation of visits
Organisational overload Managing logistics, communication, staffing and materials across different partners can result in a financial overload, where the impact vs. input could be seen as unbalanced by the municipality	By aligning with existing initiatives such as the PUR and the Mobiele Wijkhub, the RoW can benefit from shared planning, communication and infrastructure. These partnerships help streamline operations, ensuring the RoW remains manageable. By appointing a dedicated repair lead, responsibility of the operations lies on one person, keeping the organisational practices clear and comprehensible
Dependency on the pop-up recycling centres The RoW is closely connected to the PUR, as the planning and locations of both events are aligned. For this reason, the RoW is directly dependent on the continuous success and support of the PUR	Creating awareness on the RoW as a standalone service as well could mitigate the risk of residents not knowing of the RoW without the existence of the PUR. To mitigate the risk of the RoW team not being ready to take over the logistical activities the PUR executes, it is important to keep close contact on this logistics already during collaborative events
Dependency on the Mobiele Wijkhub The success and frequency of RoW is dependent on the Mobiele Wijkhub's own planning, as it uses the Mobiele Wijkhub's van for repair use	With a team within Schoon & Circulaire Stad it was analysed which vans could be used for the same purpose in the case of the Mobiele Wijkhub being occupied. Here, it came out that the van of the Department of Enforcement can be used as well. Besides, for the HER currently a plan is created for mobile repair and reuse purposes at stationary environmental parks. The concept that will roll out of this could potentially be used for RoW purposes as well, if necessary

Fig. 106 RoW´s risks and its mitigation strategies

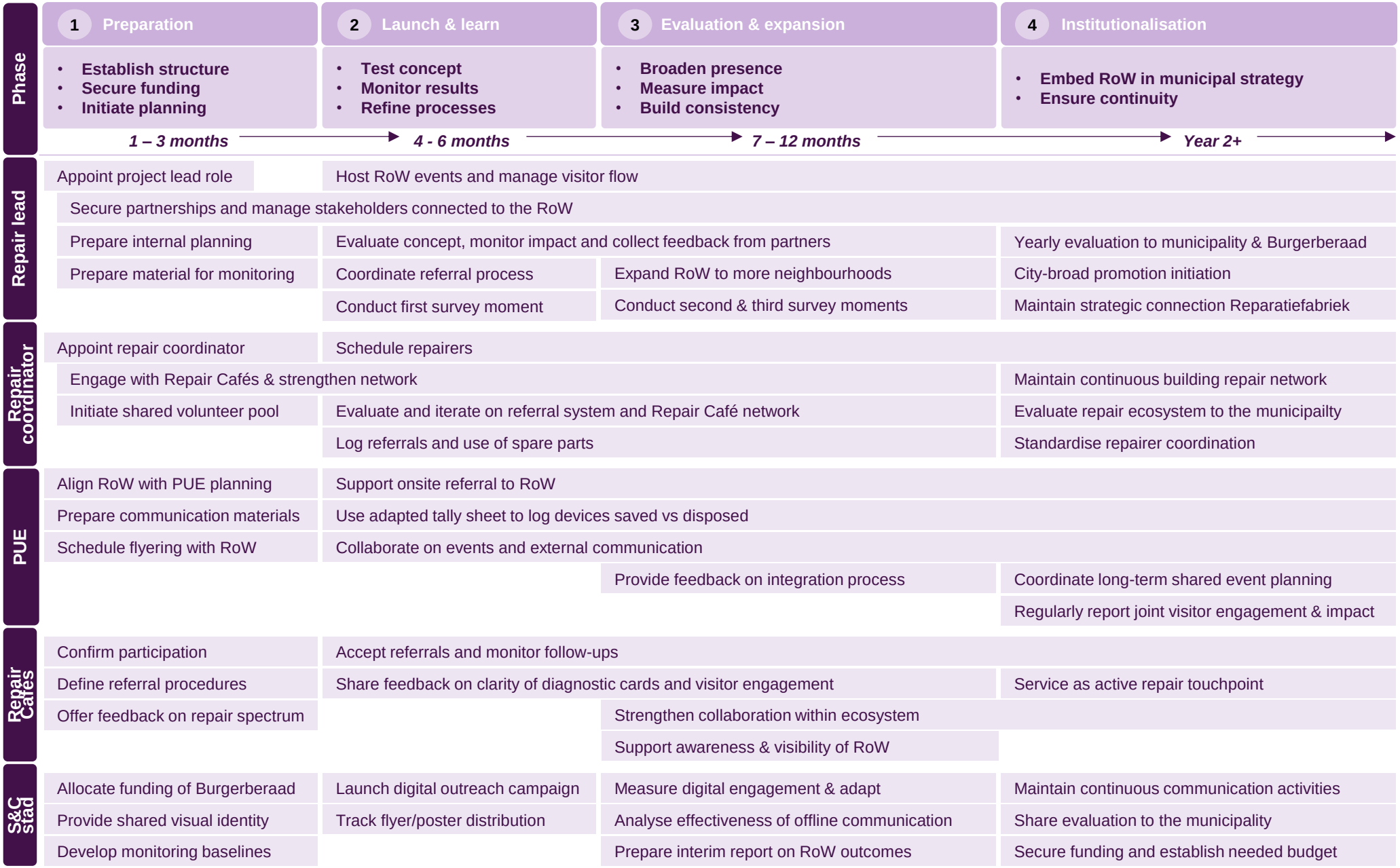


Fig. 107 Implementation roadmap for the Reparatie op Wielen

Chapter 12
The Reparatie op Wielen as an answer to the research question

12.1 Concluding the thesis

This thesis set out to answer the question: How can Rotterdam Circulair stimulate residents of Rotterdam to repair their broken household appliances? As a department of the municipality, Rotterdam Circulair strives to embed circular practices into everyday life, here, repair offers an important counterpoint to the dominant culture of disposal. However, for residents to actually engage in repair, structural, behavioural and practical barriers first needed to be addressed.

Through a three-part research approach, combining literature review, qualitative research and an empirical study, this thesis identified three core root problems limiting repair behaviour in Rotterdam.

1. *There is a lack of coordination.* The repair ecosystem is fragmented, with valuable initiatives such as Repair Cafés, and independent repair operating in isolation. There is currently no guiding framework or unified presence to connect these efforts or guide residents through the repair process.
2. *The attractiveness of repair remains limited.* While Repair Cafés fulfil a social and environmental function, they struggle with low visibility, volunteer shortages and inconsistent operations, making them difficult to rely on as a mainstream solution.
3. *Access to repair knowledge, tools and parts is insufficiently structured.* Especially for first-time or less confident repairers, the path to repair remains unclear, with little support in place to facilitate learning, reduce dependency on experts, or overcome technical and psychological barriers.

The concept of Reparatie op Wielen (RoW) emerged as a response that directly addresses these challenges. Developed through an iterative design process and co-created with municipal employees, repair professionals and community stakeholders. RoW acts as a mobile and accessible extension of the repair ecosystem. It is designed to offer approachable, neighbourhood-based repair support through small repairs and maintenance tasks, diagnostic services and referrals, all while connecting residents to the wider repair landscape in Rotterdam.

RoW brings structure where there is fragmentation, using its supporting nature to bridge gaps between existing initiatives, instead of competing with them. It lowers the threshold for participation by offering free and visible repair moments within walking distance of people's homes. It helps residents understand what repair entails, what can be done by themselves and where to go next. In doing so, the initiative not only stimulates individual repair actions but also strengthens the city's broader repair culture.

RoW presents a feasible, desirable and viable answer to the research question, enabling Rotterdam Circulair to foster repair behaviour in a way that is approachable, local and embedded in daily routines.

12.1.1 Feasibility of the RoW

The feasibility of Reparatie op Wielen is well supported by the pilot, co-creation processes and the structured implementation strategy developed. The pilot demonstrated that the concept can be operationalised in real-world settings, with repairs successfully conducted both inside and outside the van using standard tools. The process of diagnosing and referring appliances ran smoothly and was positively received by visitors, validating the practical structure of the repair spectrum co-created with Repair Café volunteers.

The feasibility is further reinforced through a clear organisational structure, developed collaboratively during a co-creation workshop with municipal actors. Roles such as the Repair Lead and Repair Coordinator are defined and embedded within existing systems such as the Mobiele Wijkhub and Schoon & Circulaire Stad. Risk mitigation strategies, such as back-up vans, coordination with the pop-up recycling centre (PUR) and repairer recruitment plans, strengthen the concept's resilience. Monitoring and evaluation mechanisms, including visitor surveys, tally sheets and reflexive monitoring, ensure the initiative remains adaptive and impact-driven during implementation.

12.1.2 Desirability of the RoW

The desirability of the initiative is evident through both its co-creative origin and the outcomes of the pilot. Out of five concept proposals presented during a facilitated co-creation workshop, Reparatie op Wielen was selected as the most promising by municipal employees working on the repair challenge. Residents who attended the pilot universally reported feeling helped, with reasons including new knowledge on DIY repair and clear referral advice. Participants indicated they would recommend the service.

The visible presence of the RoW next to the PUR generated spontaneous curiosity among passers-by, and the outside setup contributed to a vibrant, communal atmosphere. The collaboration with the PUR added social value by offering residents a reason to stay, interact and reflect on disposal behaviour. While visitor turnout was modest, evaluation highlighted that earlier and more frequent communication could address this.

The communication plan focuses on the ambition of lowering the threshold to engage in repair. The RoW's approachability make it an inviting and accessible entry point into the broader repair ecosystem.

12.1.3 Viability of the RoW

The long-term viability of the Reparatie op Wielen depends on its ability to demonstrate societal value while keeping operational costs manageable. Although the concept is municipally funded and non-commercial, its viability is supported by a clear financial plan. The start-up and per-event operational costs are modest compared to its potential impact, and funding is secured through the Burgerberaad, ensuring alignment with broader citizen-supported sustainability goals.

The DIN model ensures that the concept is embedded in an actionable framework, supported by SMART goals and networked collaborations. The initiative builds directly on the existing infrastructure of Repair Cafés and municipal services, making it cost-effective and easy to scale. By delivering measurable impact, such as reduced repair barriers, increased repair option awareness and appliance lifespan extension, the RoW can justify continued support and integration into city-wide sustainability policy.

The ability to adapt based on monitoring outcomes, combined with strong local partnerships and municipal alignment, ensures that the Reparatie op Wielen is not only viable as a pilot, but has the potential to become a permanent, scalable intervention that fosters repair behaviour.

12.2 Limitations of the research

While this thesis offers a comprehensive and practice-based exploration of how to stimulate repair behaviour in Rotterdam, some limitations must be acknowledged.

First, the qualitative researches done in the Discover phase of this thesis involved a small size of respondents. In total, 12 respondents were interviewed, falling equally into four target groups. The outcomes gave rich insights into the three pillars of the context (user, technology and organisations), however more insights could have been gathered or further justified if more respondents had been included.

Second, the pilot of the Reparatie op Wielen involved a small sample size, with only five visitors participating in the event. While the qualitative data provided valuable insights, it limits the generalisability of findings.

Third, although various perspectives were included, from municipal stakeholders to repairers and residents, perspectives of commercial repair providers and residents who do not identify with sustainable behaviour were less present. Their inclusion could have revealed additional barriers or opportunities for engagement.

Finally, while the concept of RoW was co-created and tested in a real-world setting, the research did not include a longitudinal study. As such, long-term behavioural change or structural shifts in the ecosystem could not be measured within the timeframe of this project.

12.3 Contribution to existing literature

This thesis contributes to the growing body of literature on repair practices, circular design and behavioural change within sustainability transitions. It offers a context-specific, practice-led exploration of repair behaviour in Rotterdam, a city with its own cultural, infrastructural and institutional characteristics. While much of the literature on repair is framed in general behavioural or product design terms, this thesis highlights the necessity of localised, place-based approaches. It demonstrates that circular behaviour and repair in particular, cannot be effectively stimulated without understanding the social, cultural and logistical conditions of a specific context.

By mapping the fragmented repair ecosystem in Rotterdam and identifying key system gaps, this thesis bridges abstract behavioural theory with concrete, locally tailored solutions. The co-creation and testing of Reparatie op Wielen shows how public services can be designed to align with real local needs, while also strengthening system-wide collaboration. Moreover, this work contributes to research on repair education and access by showing how structured, low-threshold interventions can lower barriers. In doing so, it expands the literature by positioning design as a strategic tool in the circular transition at city scale.

12.4 Recommendations for further development

Building on the findings of this thesis, several directions for further research are recommended.

First, a longitudinal study is needed to evaluate the longer-term impact of the Reparatie op Wielen on repair behaviour and awareness, including whether participants continue to repair and engage with the ecosystem over time.

Second, further research could investigate the potential of scaling RoW to different urban contexts or linking it with other circular initiatives such as reuse networks.

Finally, more research is needed into effective communication strategies to reach underrepresented groups and those less inclined to repair, to ensure inclusivity and maximise societal impact.

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Appendix 1
Toollist provided by Repair Café Org. (in Dutch)

Materialen (richtlijn) Elektrische apparaten

- Computer met toegang tot internet, om online gebruiksaanwijzingen of reparatiehand-leidingen te kunnen zoeken, bv. via Handleidingkwijt.com of via Repaircafe-forum.org
- Scheidingstransformator Set
- Schroevendraaiers in diverse maten, zowel kruiskop als plat
- Set horlogeschroevendraaiers
- Spanningzoeker Handvat 0,25” voor bitjes
- Set bitjes inbus, torx
- Set bitjes speciale maten
- Boormachine
- Hamer 400 gram en 100 gram
- Kunststof hamer terugslagvrij
- Kleine bankschroef zgn. machineklem
- Waterpomptang
- Combinatietang
- Zijkniptang
- Striptang
- Punttang div. maten
- Verlengsnoer met meerdere stopcontacten
- Onderdelenbakje
- Universeelmeter
- Soldeerbrander + soldeer + vet
- Soldeerbout 60w + soldeer
- Soldeertbout 15w
- Losse stekkers
- Stekkers met aangegoten snoer (met en zonder schakelaar)
- Losse schakelaartjes
- Kroonsteentjes
- Telefoonsnoer (zowel aansluit- als hoornsnoer)
- Telefoonstekkers
- Los snoer om apparaten aan te sluiten (+ aarde)
- Universeel smeermiddel
- Keukenrol
- Alcohol om schoon te maken
- Poetslapje
- Doos met overgebleven schroefjes
- Duct-tape
- Isolatietape
- Tie-wraps
- Stukjes VD-draad
- Bureaulamp (om bij te lichten bij priegelwerk)

Appendix 2
Analysis on all Repair Cafés in Rotterdam [1/2]

Table 31 Analysis on Repair Cafés and certified repair services in Rotterdam [1/2]

	Name	District	Expertise	Availability	Costs	Communication	Additional remarks
1	Thuis in West	Delfshaven	• Furniture • Household devices • Bikes	Every Wednesday from 11:00 – 13:00	Free, but open for donation	• Website • Facebook • Twitter • Instagram • Phone number • E-mail	• Professional repairs product for the visitor, while having a coffee
2	Wijkpaleis	Delfshaven	All types of products	Almost every Saturday from 10:00 – 12:30	Free, but open for donation	• Website • Facebook • Instagram • Phone number • E-mail	• Active on website and social media • Successful in attracting volunteers
3	Repair Café Delfshaven	Delfshaven	All types of products	Every Wednesday	Free	• Facebook • Twitter • Instagram • Phone number • E-mail	• Call in advance for making an appointment • Focus on repairing together
4	Repair Café Oude Westen	Centrum		1st & 3rd Saturday of the month from 13:00 – 17:00		• Facebook • Phone number • E-mail	
5	Repair Café Noord	Noord	Electrical devices Clothing	2nd Saturday of the month, from 10:00 – 12:00	Free	• Website • Facebook • Phone number • E-mail	• Products that are non-electrical and not clothing, can be repaired in consultation
6	Repair Café Schiebroek	Hillegersberg Schiebroek	Electrical devices Clothing	3rd Wednesday of the month, from 9:30 – 12:00	Free	• Website • E-mail	
7	Repair Café Zevenkamp	Prins-Alexander	Electrical devices	Every Wednesday from 13:30 – 15:30	Free	• Website • Phone number • E-mail	• Visitors arrange own equipment • Register in advance, yet no guarentee

Table 31 Analysis on Repair Cafés and certified repair services in Rotterdam [2/2]

	Name	District	Expertise	Availability	Costs	Communication	Additional remarks
8	Repair Café Lage Land	Prins-Alexander	All types of products	Every Monday from 13:30 – 15:30	Free	• Website • Facebook • Phone number • E-mail	• Lack of repairing time • Register in advance, yet no guarentee
9	Ontmoetings-centrum Prinsenhof	Prins-Alexander	Elektrical devices	2nd & 4th monday of the month	€2,- per visit	• Website • E-mail	
10	Repair Café De Esch	Kralingen Crooswijk	E-mail for information	Tuesdays – Thursdays from 13:00 – 16:00	No information	• E-mail	
11	Repair Café Zuid	Feijenoord	No information	1st Saturday of the month from 10;00 – 13:00	No information	• Webiste • Facebook • Phone number	• Visitor is asked to register broken product on website in advance
12	Repair Café Charlois	Charlois	All types of products	Last wednesday of the month from 19:00 – 21:00	Free	• Website • Phone number • E-mail • Facebook	• Due to lack of volunteers, open for only one day per month
13	Repair Café Hoogvliet	Hoogvliet	No information	Last Saturday of the month from 9:00 – 12:00	No information	• Phone number • E-mail	
1	StapService B.V.	Overschie	All types of electrical products	Mo – Sat 8:00 – 22:00	Price depends on product and service	• Website • Phone number • E-mail	• Licensed repair company • Experience for 20 years • Offer repair at home, at their workplace • Sell product parts & accessoiries (also online)
2	Stofzuigerhuis	Feijenoord	Vaccuum cleaners	Tue – Sat 9:00 – 17:00	Price depends on product and service	• Website • Phone number	• Licensed repair company • Repairs vaccuum cleaners and sells licensed spare parts

Appendix 3
The 15 small concepts

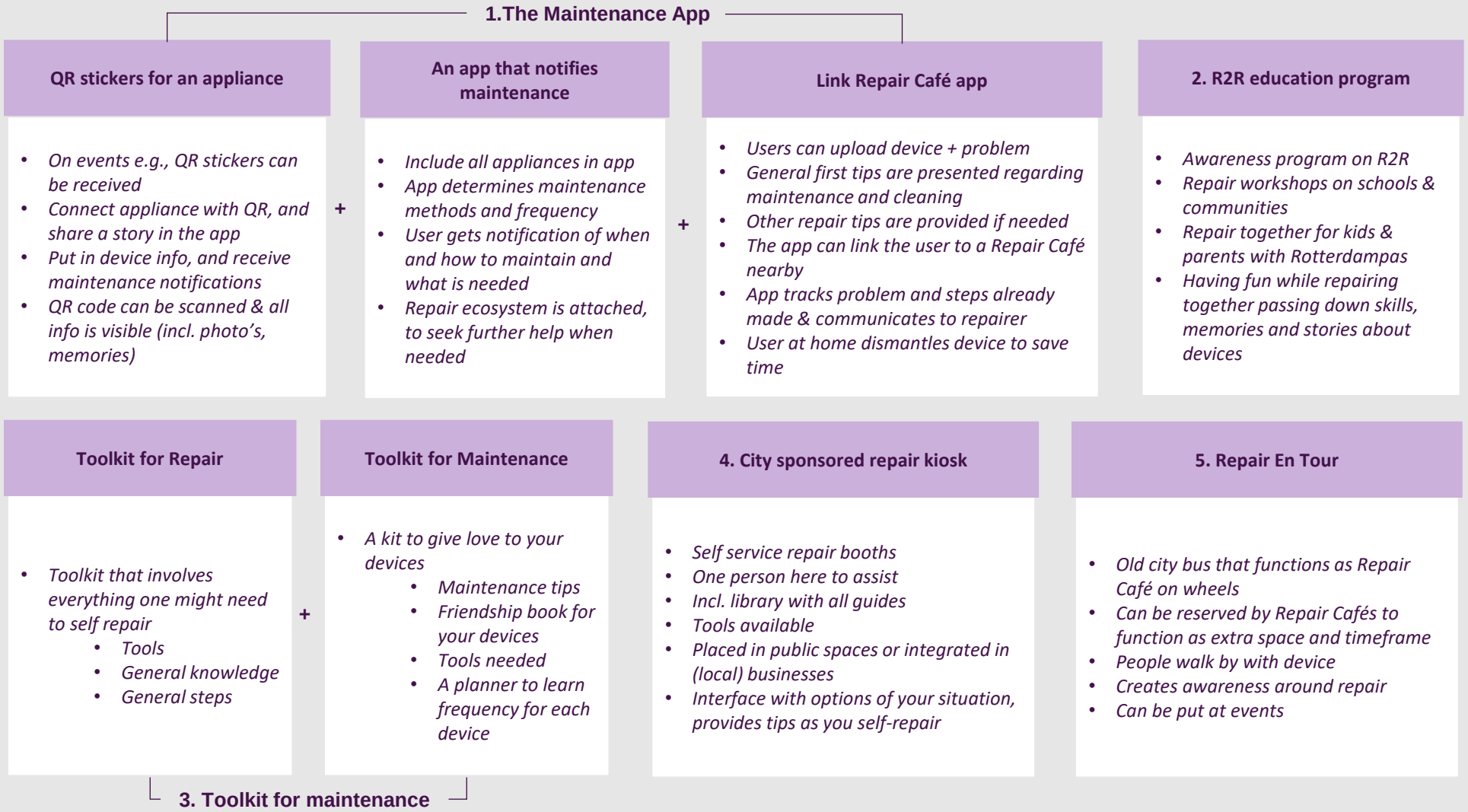


Fig. 108 The concepts that were chosen and how some of them have come together

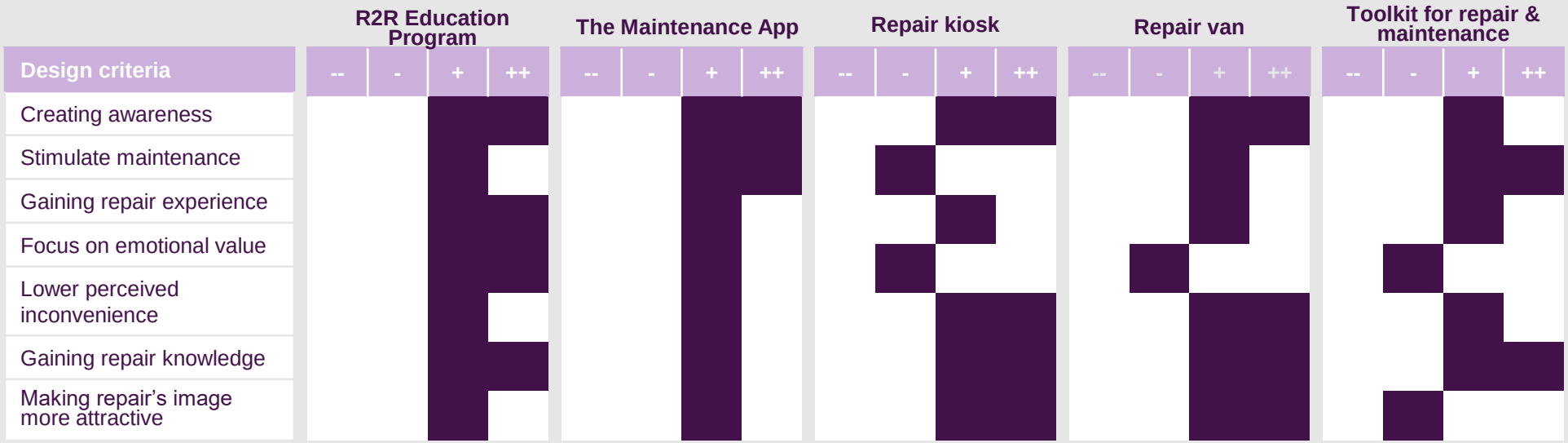
Repair and care badge system	Repair hub	The Maintenance Café	The Repair Game
Every time a user maintains / cleans, badges are earned. With these badges, free spare parts can be gathered from the e-waste pile. Or gain discount on manufactured spare parts	*A trendy place with good coffee, nice music and good art where people can bring their appliances for maintenance or repair tasks. Get tips or let repair while getting a coffee. Intended for repair to be a nice weekend activity*	*To diminish crowdyness at Repair Cafés, a certain maintenance café is put in communities as well. Here, only small repairs and maintenance tasks can be done with guidance of a specialist. Learn to do it so DIY maintenance is stimulated.*	*A board game where together you have to play against the game. The game presents itself with imitated repair situations and together you have to solve it the right way in the given time.*

The Repair Bag	Duolingo for repair	The Repair Experience	Escape Room
When you want something to be repaired, you can let it collect by the municipality. Place your appliance in a special bag and put it outside for collection. If repair is not possible, municipality can gain spare parts and throw away the additional pieces at the e-waste	*An app with multiple levels that users have to play every day to maintain their streak* • *Digitally imitated repair situations* • *Learn what to do in every situation* • *Difficulty level higher with each level*	*Create enthusiasm around repair by creating a Repair Experience (like Heineken Experience). As an interactive museum , visitors can walk around and interact with different aspects of repair (e.g. 3D printing, disassembly, creating spare parts by yourself, electricity skills)*	*An interactive game set-up in an escape room. Solve riddles around a broken appliance and try to find the right tools and spare parts.*

Tupper Ware Parties	Friendship Book	Student aan Huis
A group can organize a Tupper ware party at home, but than for repair. A repair professional comes by and let's the group get acquainted with the basic repair skills and knowledge. People can bring their own broken products and with guidance repair them .	*A (free) handed out friendship book. Users can add their devices and are stimulated to answer (personal) questions about their device. Include pictures, anecdotes, memories, and decorate with stickers, etc. Other people, such as family members, can include additional memories and stories.*	*For a student income, students with technical knowledge can come by a user's house and take a look at the broken device. If possible, repair and maintenance tasks can be done. If it is too difficult, the repair ecosystem can be advised.*

Fig. 109 The concepts that were not chosen through the Harris Profile

Appendix 4
Harris Profiles conducted on 15 small concepts



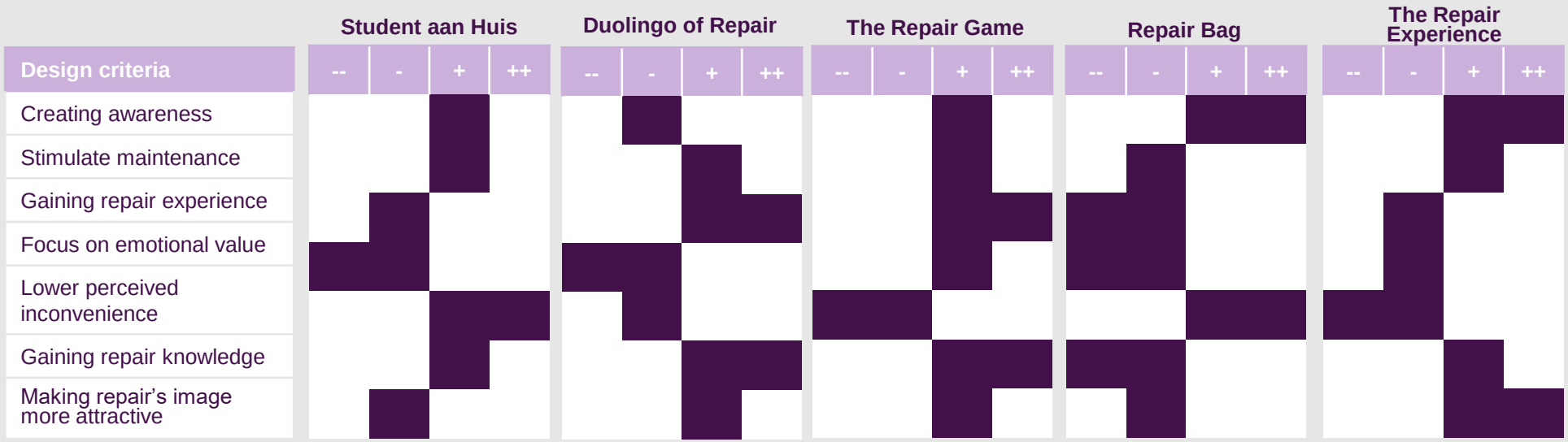


Fig. 110 All Harris Profiles conducted [1/2]

112

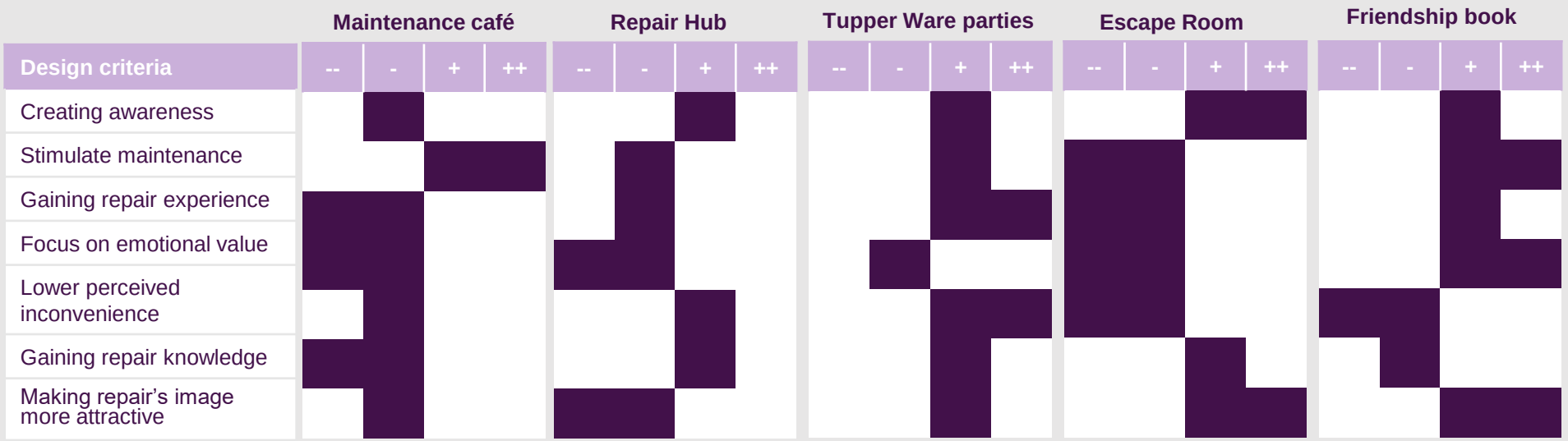


Fig. 110 All Harris Profiles conducted [2/2]

Appendix 5
Adjustments made to the diagnostic card

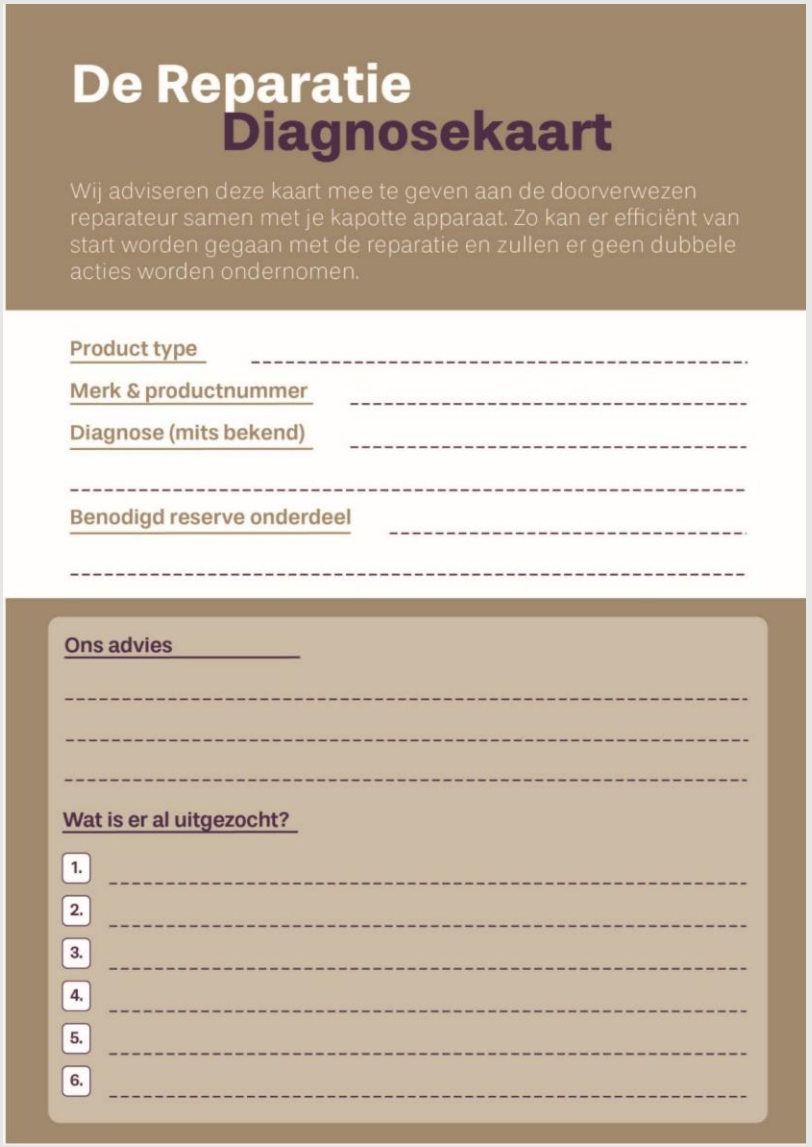


Fig. 111 Moderated diagnostic card after pilot evaluation with the repairers

Appendix 6
Approved Project brief
p. 115 – 117

TUDelft

DESIGN FOR our future

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	Pfaff 7498	IDE master(s)	IPD ☐ Dfi ☐ SPD ✓
Initials	ND	2nd non-IDE master	
Given name	Nora	Individual programme (date of approval)	
Student number	4853911	Medisign	☐
		HPM	☐

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

Chair	Bart Bluemink	dept./section	MOD
mentor	Tobias Hebbink	dept./section	MOD
2nd mentor	Virpi Heybroek		
client:	Rotterdam Circulair		
city:	Rotterdam	country:	Netherlands
optional comments	Bart Bluemink has experience in larger scale strategy designs, where he has done reserach in B2B constructions. Tobias Hebbink has experience around topics where strategic design within organisations and ecosystems are researched. These are two views I need in my project.		

! 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)

Bart Bluemink

Digitaal ondertekend door Bart Bluemink
Datum: 2024.12.19 10:14:08 +01'00'

Name	Bart Bluemink	Date		Signature	5/12/2024

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)

K. Veldman Digitally signed by K. Veldman Date: 2024.12.19 19:30:19 +01'00'

Name K. Veldman Date 19 Dec 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: 2025.01.07 11:10:46 +01'00'

Name Monique von Morgen Date 7 Jan 2024 Signature

DESIGN FOR our future

TUDelft

Personal Project Brief – IDE Master Graduation Project

Name student Nora Pfaff Student number 4,853,911

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Optimalisation of Rotterdam's Circular Repair Ecosystem

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)

The project is situated in the domain of Circular Economy, with a focus on circular business models within the Rotterdam Circular Repair Ecosystem. Rotterdam Circulair, a municipal organisation supporting circular initiatives, acts as a key stakeholder, along with existing circular businesses, government agencies, and other organizations.Currently, Rotterdam Circulair has no clear view on everything that is going on in the city regarding repair, which is an important part in achieving circularity. Which repair companies already do exist? How do other companies participate? What does this ecosystem look like in the city of Rotterdam? What is the product flow? Are companies aware and already participating in designing for repair?

The main interests at stake are:
- Rotterdam Circulair: gaining insight on the current repair ecosystem in Rotterdam, what is needed to optimize the repair sector and knowing its role regarding the ecosystem
- Municipality of Rotterdam: Achieving the city's circularity goals by optimizing the repair sector
- Circular/repair businesses: getting help from Rotterdam Circulair and new business opportunities
- Consumers: being more inclined to repair devices when broken, instead of throwing it away

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

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)

Rotterdam Circulair struggles to identify its role towards the repair sector and its ecosystem as a whole and does not have full insight in what exactly is going on in this industry and where help is needed from the municipality. A clear overview is needed to how the repair ecosystem is functioning at the moment and how repair chains have developed from one company to the next. With this overview, Rotterdam Circulair can identify gaps in repair chains, where new initiatives may start in order to optimise this sector.

Opportunities for added value include:
- Optimizing the current repair ecosystem and chains
- Identifying gaps in current repair chains, which can result in new initiatives (supported) by Rotterdam Circulair
- Identify the role of Rotterdam Circulair towards the repair ecosystem of Rotterdam

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 a roadmap that enables Rotterdam Circulair to understand and act upon the current repair ecosystem and repair chains in Rotterdam.

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)

- Literature review on circular ecosystems and material chains: How to map a ecosystem, how to reflect and to act on it as a municipal organization? How to perfect repair chains on a larger city scale, what are its main obstacles, challenges and opportunities?
- Researching the current situation: What does the current repair ecosystem of Rotterdam look like? What is the logic, is it efficient, how can it improve and what do we want to work towards? In what way does the municipality of Rotterdam currently approach it? What do the repair flows generally look like, and where do they get stuck?
- Field research: What are the key players within the ecosystem when looking at the repair sector? How do these key players experience their role, what obstacles to they feel and where would they need help from Rotterdam Circulair?
- Future vision Rotterdam Circulair: What is the role Rotterdam Circulair must play when looking at the current situation, problems and things going right within the ecosystem?
- Roadmap Rotterdam Circulair: Where does Rotterdam Circulair need to work towards to establish the future vision? What horizons and steps are logical within this timeframe?

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	5 Dec 2024
Mid-term evaluation	13 Feb 2025
Green light meeting	10 Apr 2025
Graduation ceremony	8 May 2025

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)

I am passionate about sustainability and circularity and I am sure I want to work in this field as a designer / consultant in this area after graduation.This projects will give me an immense insight into the current state of circular ecosystems and businesses, which will be very insightful for my career. I believe that by creating insight in the current situation of the circular ecosystem and material chains, I will contribute something of great value to Rotterdam Circulair, the city of Rotterdam and hopefully beyond in the circular industry. During my studies we have had to work with stakeholder mapping a lot, but it was mostly in one company's context, which created value for that one company. I hope to learn a lot from the mapping of the ecosystem and investigating how to facilitate an ecosystem as a whole, with so many different stakeholder values