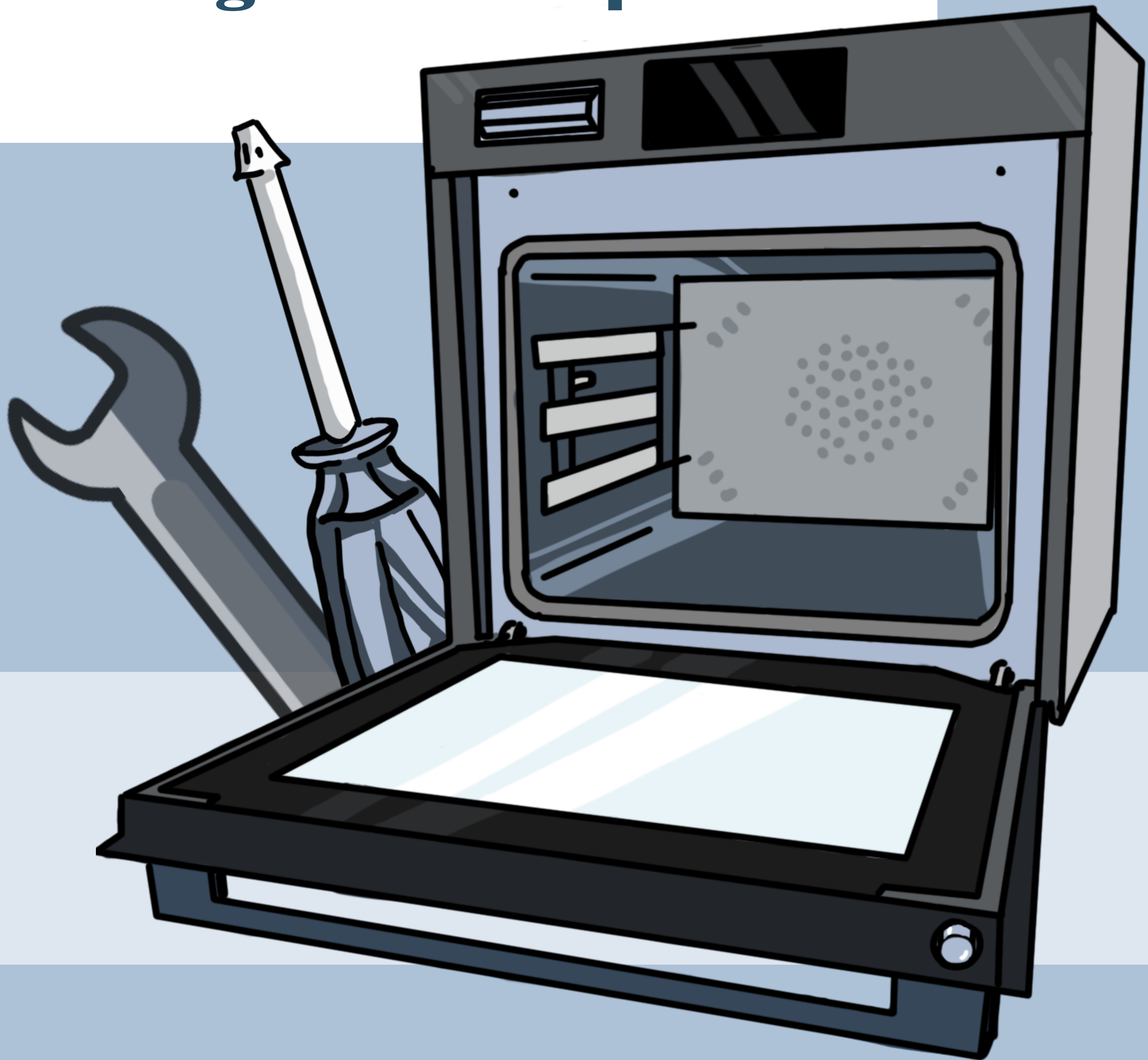
Designing to Motivate Repair:
Enhancing Consumers' Willingness to Repair the ATAG Oven.



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March 2026

Acknowledgements

This thesis marks the completion of my Master's degree in Integrated Product Design at the Technical University of Delft. Over the past months, I have enjoyed diving into this topic and have learned a great deal along the way, about project management, repair willingness, and, of course, ovens.

This project would not have been possible without the support of many people around me. First, I would like to thank my TU Delft supervisors, Lise and Ruth, for their time, guidance, and critical feedback. Your questions and insights pushed me to continuously sharpen my thinking and improve my work.

I am also grateful to Jan, my company mentor, for his positive mindset, his willingness to help me navigate the organisation, and for the time and openness he offered throughout the project.

To my friends and family: thank you for always thinking along with me, for listening to my endless reflections, and for reminding me to take a step back when needed.

A special thank you to Dion, Imara, Jannik, Niek, Stan, Thomas, Veerle, and Yoran. The daily life in the graduation workspace; with countless coffee breaks, walks around campus, and conversations in between, which made this period much more enjoyable. It truly felt like a journey we were going through together.

To my housemates, Sophie and Jonathan, thank you for the distractions, the listening ear, and the delicious food you made me during the more stressful phases of this project.

I would also like to thank the colleagues and regulars at jazz café the Bebop for the conversations, inspiration, and sometimes simply the distraction that helped clear my mind.

Thank you to Yvar, for letting me stay in Copenhagen for a week and giving me the opportunity to take a step back and recharge. Finally, to my parents: thank you for your unconditional support, encouragement, and trust throughout this entire journey.

Thank you all for helping me reach and complete this final chapter at TU Delft.

Enjoy reading my work!

Ayla

Delft, March 2026

Abstract

Extending the lifetime of household appliances is essential to reduce electronic waste and support a transition towards a circular economy. Despite this, many consumers remain reluctant to repair appliances when malfunctions occur, often opting for replacement instead. This thesis investigates how product design can increase consumers' willingness to repair household appliances, focusing on the ATAG oven.

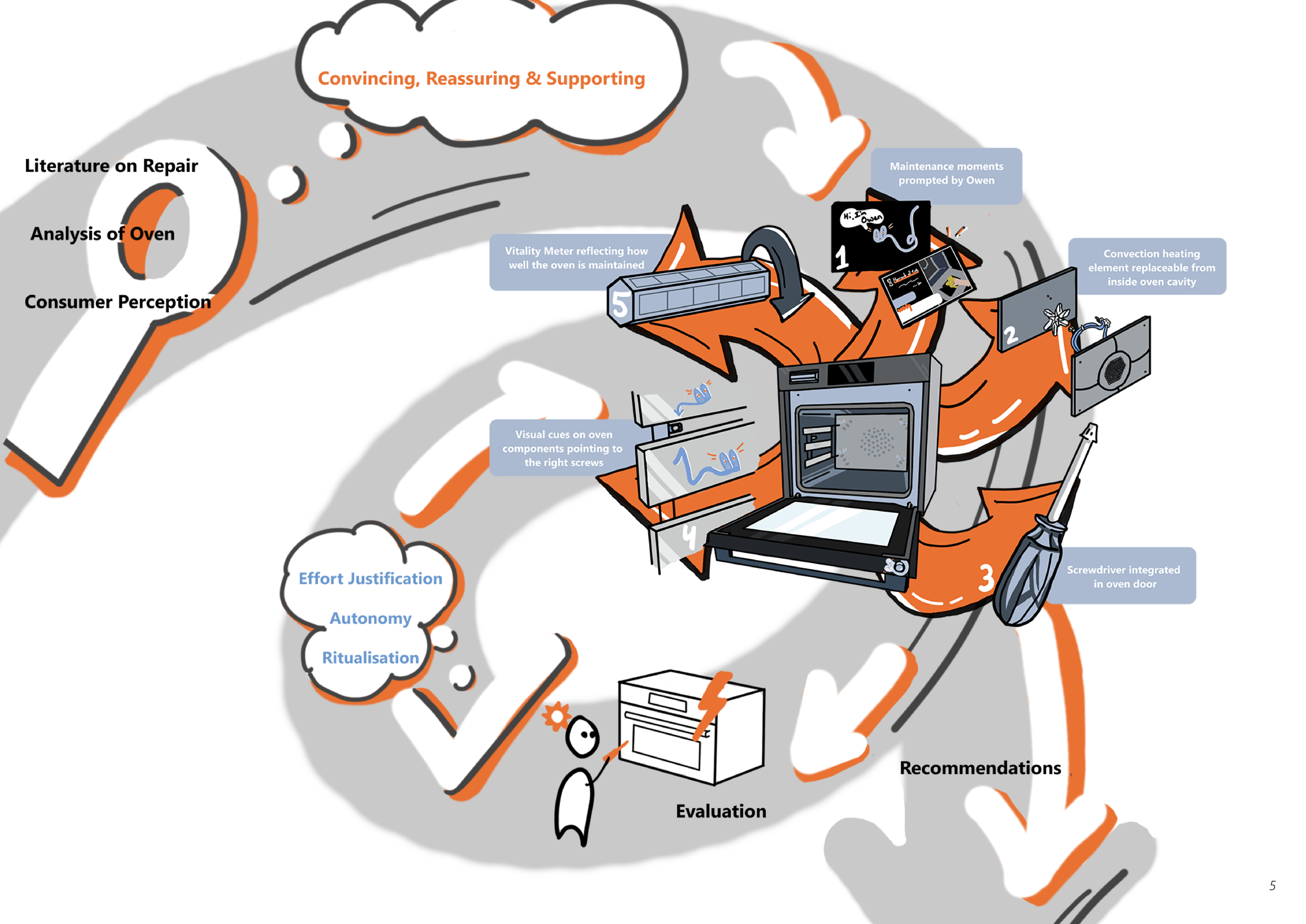
The research combines three complementary parts: a literature review on repair behaviour, a product analysis of the oven, and consumer research on perceptions of self-repair. The product analysis identified common malfunctions and disassembly sequences, while the consumer study revealed a strong polarisation between users willing and unwilling to repair. Two key factors emerged: effort justification and the perceived risk of causing further damage. Together, these insights indicate that design interventions should focus on convincing users that repair is worthwhile, reassuring them about potential risks, and supporting them throughout the process.

Based on these insights, the concept Moment of Care was developed. It integrates small, guided maintenance interactions into the product experience, making expected maintenance actions explicit and accessible. By structuring these into manageable steps, the concept clarifies what is required from users while gradually building familiarity and reducing perceived complexity.

A scenario-based evaluation indicates that this approach makes maintenance and repair more approachable and clarifies the user's role in product upkeep. Embedding such interactions into everyday use reframes repair as a normal part of ownership rather than a rare technical intervention, supporting longer product lifetimes and more circular appliance use.

Visual Summary

A visual summarising the project is displayed on the next page.


Convincing, Reassuring & Supporting
Literature on Repair
Analysis of Oven
Consumer Perception
Maintenance moments prompted by Owen
Hi, I'm Owen
Vitality Meter reflecting how well the oven is maintained
Convection heating element replaceable from inside oven cavity
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Chapter 1:

Introduction

The introduction outlines the problem statement, defines the scope of the project, introduces its key stakeholders, and presents the research questions.

1.1 Problem Statement

Overconsumption and the resulting excessive use of natural resources have a severe impact on the planet, primarily due to the vast amounts of CO_2 emissions they generate. As the global population continues to grow and individual consumption increases, environmental problems are worsening. In the Netherlands, the average person's largest environmental impact stems from material possessions (CE Delft, 2023).

Among these possessions, electrical and electronic devices, such as washing machines, ovens and smartphones, play a major role. This category, known as waste from electrical and electronic equipment (WEEE), is now the fastest-growing waste stream in the world (Bressanelli et al., 2020). What makes this even more alarming is that many of these products are thrown away long before their technical life has ended. Researchers refer to this as premature obsolescence (Magnier & Mugge, 2022a): a cycle in which products lose their appeal or perceived value far earlier than they lose their function.

To prevent this, a shift towards a more circular model is required. The Butterfly Diagram, in Figure 1, illustrates the principles of a circular economy, showing for both energy and material processes how to retain value. The innermost loop of the material diagram, reuse and repair, are the most effective strategies to extend product lifespans and thereby reducing environmental impact.

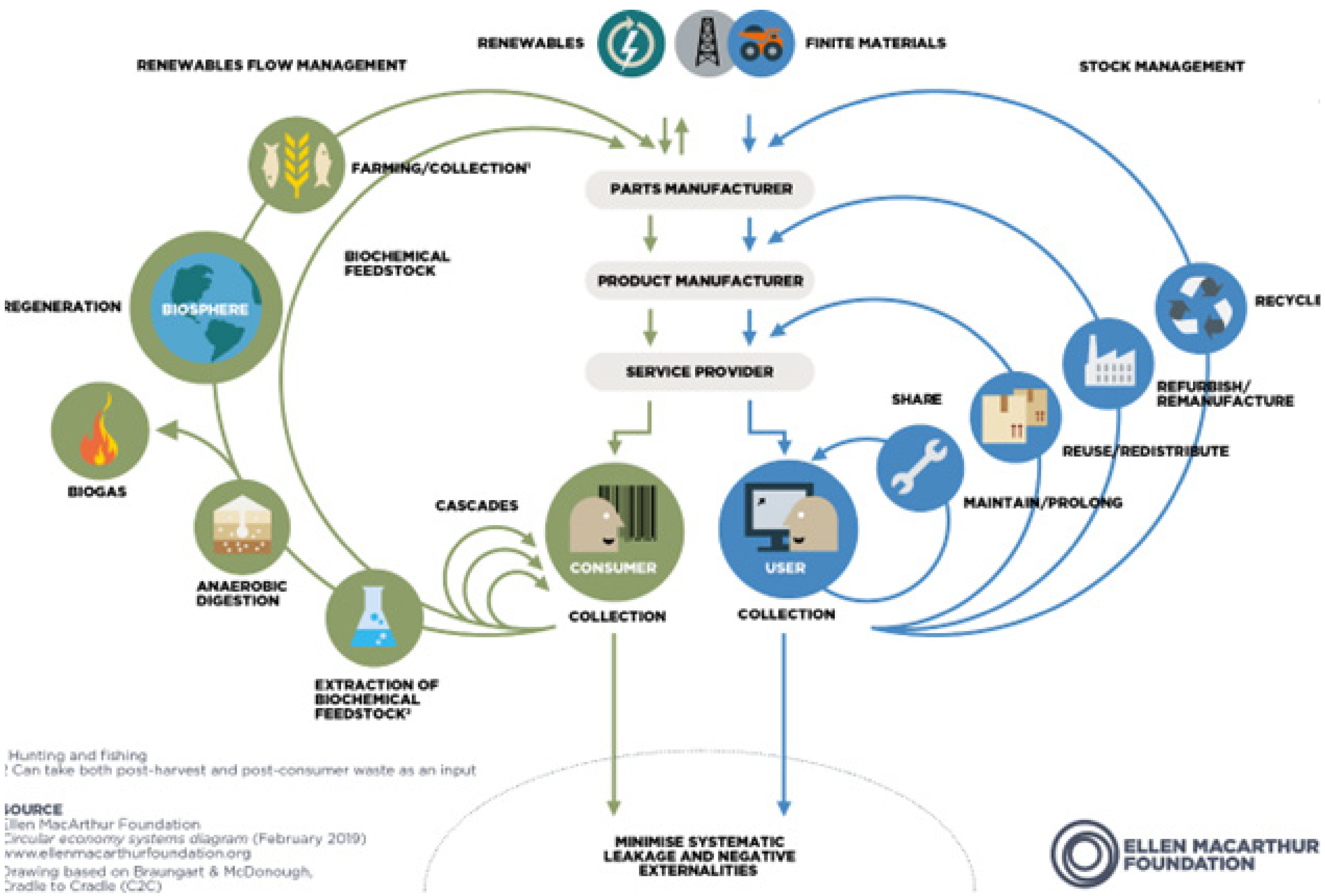


Figure 1: Butterfly Diagram (Ellen MacArthur Foundation, 2019)

In practise, these strategies face significant challenges. Many businesses still perceive repair as a threat to sales, while independent repair organisations struggle with limited access to spare parts and manuals.
In response to this, the European Union recently introduced the Right to Repair policy. From 2026 onwards companies are obliged to provide relevant repair information and spare parts, so consumers have the opportunity to repair their goods (Right to Repair: Making Repair Easier and More Appealing to Consumers | News | European Parliament, n.d.). Although this is a promising step towards a more circular economy, legislation alone does not guarantee behavioural change among consumers.

Despite its environmental and economic benefits, repair is rarely considered or pursued. Consumers often perceive repair services as inconvenient, expensive, and untrustworthy (Lefebvre, 2019). These negative perceptions, combined with the increasing complexity of products and lack of accessible repair information and spare parts, discourage consumers from choosing repair over replacement.

1.2 Project Scope

Convincing consumers to repair their products is crucial to support the transition towards a circular economy. This thesis focuses, therefore, on enhancing consumers' willingness to repair, with a specific focus on self-repair. The goal is to understand how consumers perceive repair, what barriers they face, and what motivates them to engage in repair practices. These insights are used to design an intervention which supports users in their self-repair journey. In this thesis willingness to self-repair is defined as the consumer's willingness to diagnose product problems and explore potential solutions independently.

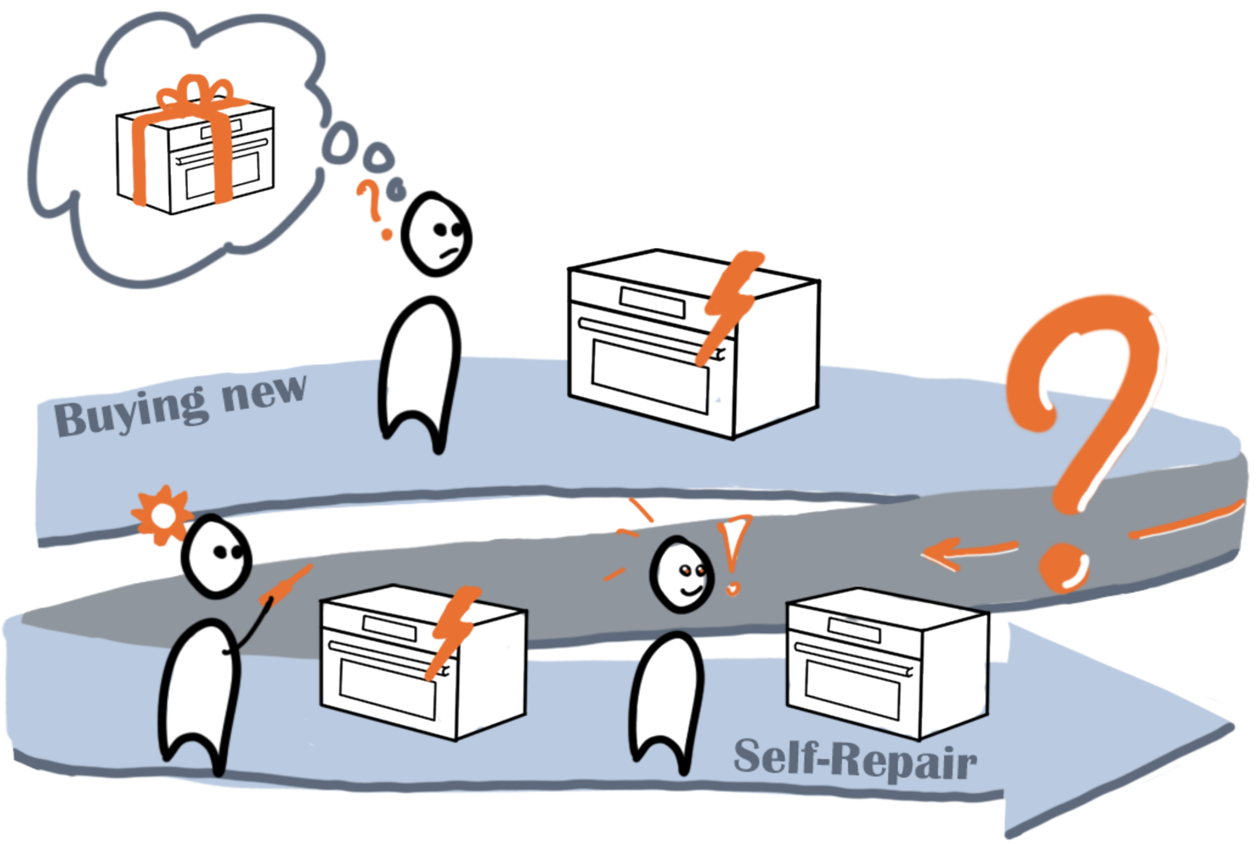


Figure 2: Project Scope

To make this research more applicable to the real world, this thesis is executed in collaboration with ATAG Benelux and focuses on the specific product category of the ATAG oven. The oven was selected because it is considered a complex product that many consumers are hesitant to repair. While most households own one, consumers are generally not fully dependent on it, making repair a more feasible option as immediate replacement is often unnecessary. The scope of the project is visualised in Figure 2.

1.3 Tackling Fixophobia

This project is part of the "Tackling Fixophobia" consortium, initiated by the NWO-KIC in 2024. The term Fixophobia refers to the reluctance of both consumers and value-chain actors to engage in repair practices. The consortium comprises five knowledge institutes and sixteen companies and organisations within the consumer electronics sector.

The overarching goal of the consortium is to enhance trust and engagement in repair across all actors in the value chain by stimulating interdisciplinary collaboration. Design-for-repair approaches frequently overlook behavioural and psychological factors, while existing legal structures still support a linear economy. Business models that make repair financially viable are also underexplored. This lack of interdisciplinary understanding limits progress towards systemic change. Together, these efforts aim to extend the lifespan of consumer electronics and contribute to a circular economy.

The project aims to generate both theoretical and practical tools that can promote repair adoption, leading to longer-lasting electronics, reduced resource use, and lower environmental impact.

1.4 ATAG Benelux

ATAG Benelux, a manufacturer of kitchen appliances and part of the Hisense Group, is one of the consortium partners and the direct client for this thesis. The company's participation reflects its ambition to strengthen its sustainable position in the market.

As Jan van Os, Manager of Innovation and Sustainability, explains:

"We feel responsible for making a positive impact. We are exploring ways to simplify repairs and reduce costs. As the only participant from the APPLiA trade association in this project, we also share our knowledge with other electronics brands."

By improving the accessibility and efficiency of repair services, ATAG Benelux aims to ensure that its premium products last longer and contribute to a more sustainable future for the entire sector.

1.5 Research Questions

To guide the research process, the following questions were formulated:

RQ1: *What are the main motivations and barriers consumers experience when deciding whether to repair or replace an oven?*

RQ2: *How do consumers perceive the economic, emotional, and environmental value of repairing an oven?*

RQ3: *How can design interventions support and sustain consumer repair behaviour for ovens?*

Research Questions 1 and 2 address consumers' perceptions and behaviours surrounding repair. These are explored through a survey designed to gather relevant insights. The outcomes will inform the development of design interventions addressing RQ3, which will be tested later in the project.

Part I – Analysis

This first part of the thesis explores the context of the project. It introduces ATAG and its current repair approach, followed by relevant literature on repair behaviour and barriers to repair.

The ATAG oven is then analysed to identify technical opportunities and constraints for repair, and consumer perspectives are explored through a quantitative survey. The insights from this analysis form the basis for the design phase.

Chapter 2:

ATAG

ATAG was founded in 1948 by Antoon Tijdink and Antoon van Goor in Ulft to meet post-war demand for simple cooking appliances. In 2000, it merged with Etna and Pelgrim to form ATAG Benelux. This expanded the brand and created a wide product portfolio.

As one of the service mechanics, explains:

"Etna products work well, Pelgrim adds some extra features, and ATAG is the premium brand with the latest innovations for people who love cooking or simply want the best."

In 2008, ATAG Benelux was acquired by the Slovenian company Gorenje, which was later taken over by the Chinese Hisense Group in 2018. Despite this international ownership, the brand ATAG remains within the Benelux, while similar products are internationally sold under the brand Asko, which is also part of Hisense.

2.1 Target Group

ATAG positions itself as a premium brand aimed at a financially stable audience aged roughly 35 to 60, typically homeowners in the Benelux region. The brand caters to passionate home chefs, ranging from semi-professionals who enjoy preparing elaborate meals, to social chefs who love hosting dinner parties, and fun chefs who experiment for enjoyment. The target group of ATAG is visualised in Figure 3.

To strengthen its relevance among younger audiences and increase brand recognition in the Randstad, ATAG opened the Life Experience Centre in Amsterdam. Here, the brand focuses on experience-based marketing through cooking classes, demonstrations, and dinners, showcasing what its products can do rather than simply displaying them. The Amsterdam office also develops ATAG's digital innovations, such as the Connect Life app and data-driven product improvements.

Although many rental homes also contain ATAG appliances, renters are not the main target group of ATAG and thus not the focus of this study, as they do not actively choose the brand and are not responsible for repairs or replacement.

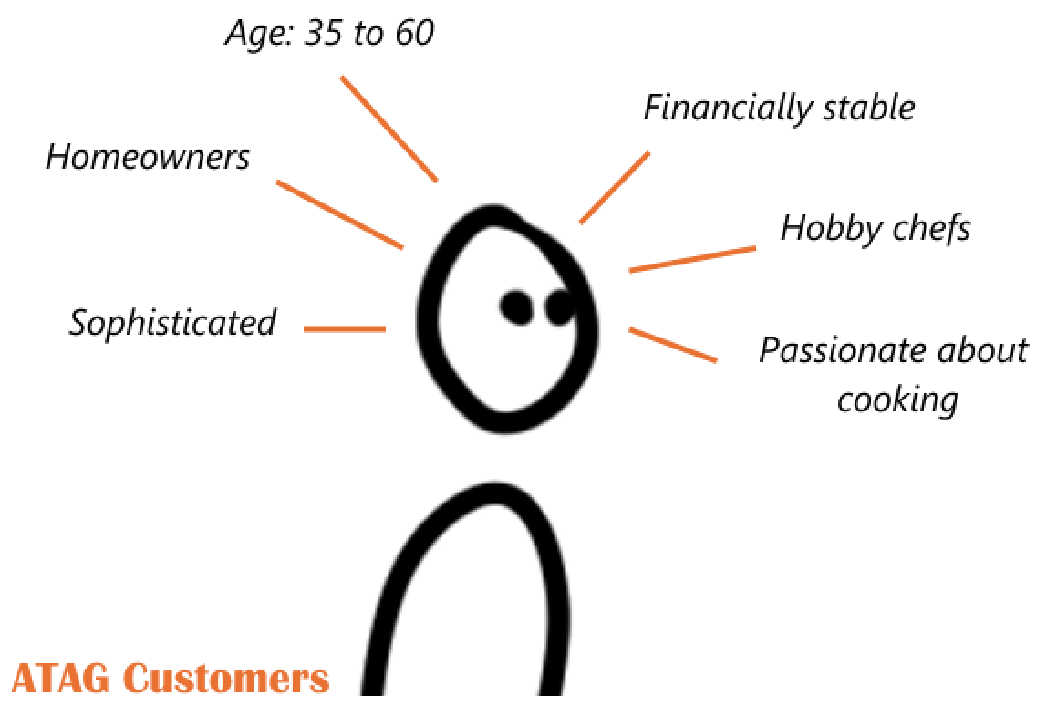


Figure 3: Target Group of ATAG

2.2 Innovations

As a premium label, ATAG continuously integrates the latest technologies into its products. The company is currently exploring emerging technologies such as Internet of Things (IoT) connectivity through its Connect Life app, AI-assisted cooking (for example, generating personalised recipes), Celsius-based cooking, and advanced appliances like elevate cooktops with integrated extraction systems or ovens featuring warming or vacuum drawers.

Through these innovations, ATAG not only aims to improve user experience but also to attract a younger, more tech-oriented audience who value both convenience and creativity in the kitchen.

2.3 Sustainable Practices

ATAG differentiates itself from competitors by placing a strong emphasis on sustainability and repairability. As a manufacturer of high-end products, the company believes that premium appliances should be built to last.

2.3.1 Warranty

When purchasing an ATAG product, consumers automatically receive a 2-year factory warranty that covers all repair, replacement, and service costs within the first two years after purchase.

Consumers can also register their product within 30 days of purchase to receive an additional 3 years of warranty, called Warranty Plus. During this period, all repair and replacement costs are covered, and consumers only pay 99 euros for the mechanic's visit.

If consumers register four or more ATAG products, the Warranty Plus is extended to 6 additional years under the same conditions, with all repair and replacement costs covered and only a 99-euro call-out fee to pay.

These different warranty options are shown in Figure 4.

Figure 4: Warranty Options

2.3.2 Repair Service

To ensure longevity, ATAG provides an extensive in-house repair service. During a field visit with one of the company's service mechanics, it became clear how efficiency and accessibility are central to ATAG's repair philosophy. The products are designed so that most defects can be fixed within 30 minutes, meaning components should be easily accessible and replaceable. This approach ultimately saves ATAG costs, as quicker repairs require fewer resources and service hours.

Figure 5 shows how the repair preparation works and the repair process is shown in Figure 6.

To further improve efficiency, ATAG's data engineers are developing a digital platform that link customer complaints to the actual defects identified by mechanics. This system aims to improve diagnostic accuracy and ensure that service technicians bring the right spare parts to each repair. Unnecessary service visits, such as those caused by misdiagnosed issues, not bringing the right spare parts, or user misunderstandings of the product, are a major source of expense. By predicting problems more accurately, or by enabling customers to resolve minor issues themselves, ATAG could significantly improve their service-system and reduce these unnecessary costs.

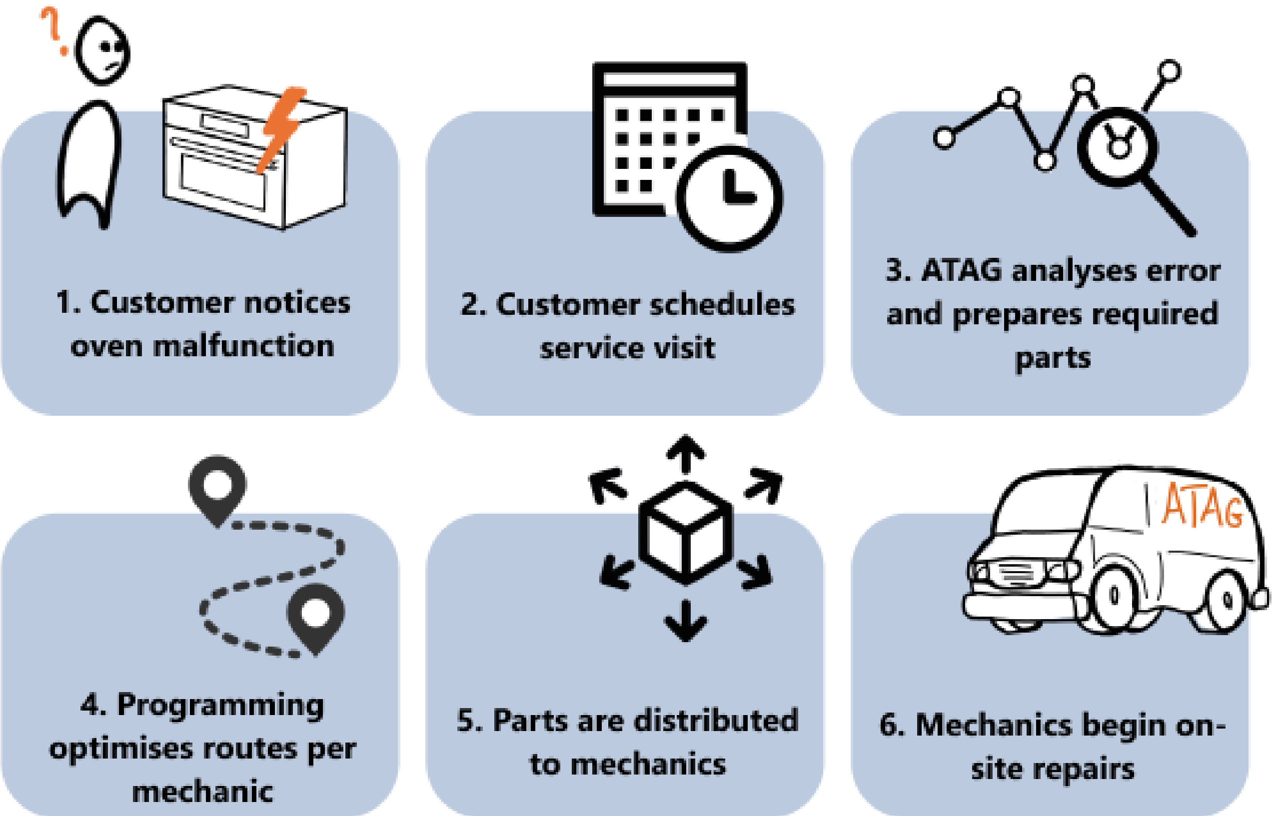


Figure 5: The Repair Preparation

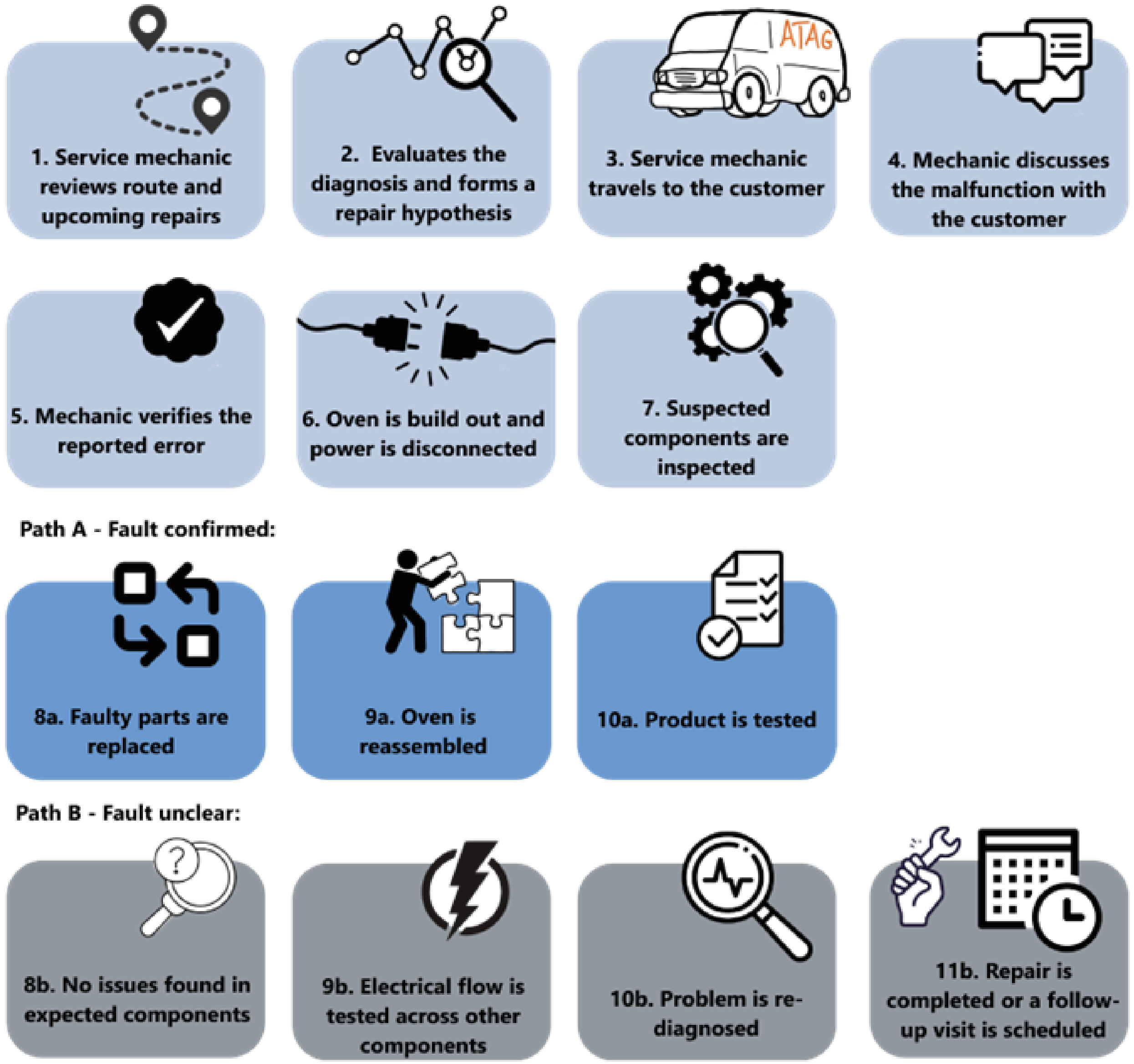


Figure 6: The Repair Process

2.3.3 Internal System & Customer Support

ATAG's internal system, GSD, serves as the company's technical database, containing manuals and detailed repair information for all ATAG Benelux products. This system supports service mechanics in diagnosing product issues more effectively. However, GSD is currently accessible only to ATAG employees, as it is considered too complex and insufficiently structured for public use. There is also concern about sharing detailed product information that might be of interest to competitors.

For consumers, ATAG provides a dedicated help section on its website to assist in diagnosing problems and performing minor repairs. However, the information is limited and not very comprehensive. This makes it difficult for consumers to identify or resolve issues independently.

In addition, ATAG offers spare parts for self-repair through the platform Maintainlife.com. Yet, this service is not clearly promoted on the main ATAG website, meaning that only highly motivated consumers are likely to find it. The available parts are limited to those that are considered safe and easy for users to replace.

An overview of these systems is provided in Figure 7.

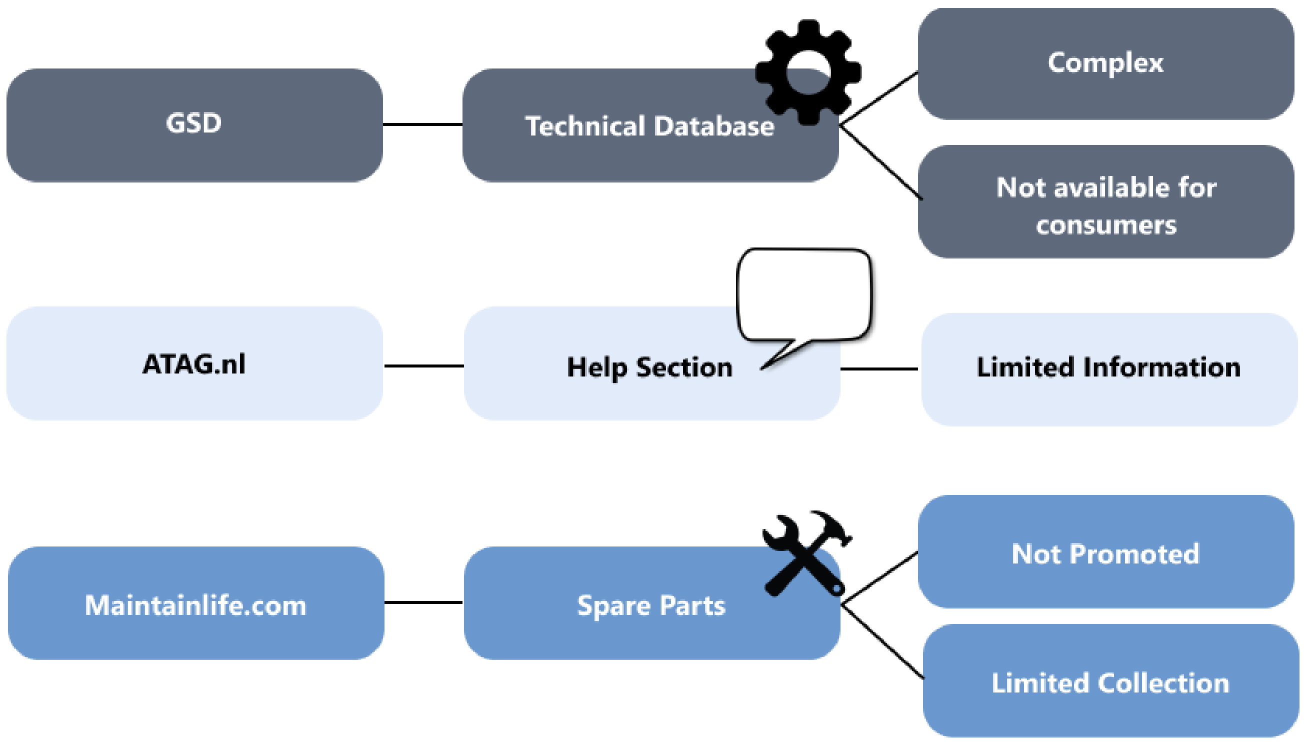


Figure 7: Overview of Internal & Customer Support Systems

2.3.4 The Self-Repair Dilemma

Within ATAG, there is an ongoing discussion about whether the company should encourage customers to repair their own products. On the one hand, promoting self-repair could reduce service costs, especially for minor issues. On the other hand, it raises concerns about liability if customers damage their appliances or injure themselves during a repair attempt. Clear guidance is needed to help customers understand which repairs they can safely perform, what tools or expertise are required, and when to contact ATAG's service.

For products under warranty, professional repair is recommended, while for older appliances, guided self-repair could be encouraged. Finding this balance between customer empowerment and company liability remains a key challenge for ATAG.

- *The intervention should appeal to financially stable homeowners in the Benelux, while also engaging a younger audience.*
- *The intervention should reflect ATAG's identity by offering a convenient, innovative, and creative experience.*
- *The intervention should contribute to a reduction in service visits.*
- *The intervention should support more accurate prediction of potential product issues.*
- *The intervention should empower customers to independently handle minor issues.*
- *The intervention should ensure that customers receive clear and accessible guidance during both problem identification and repair.*
- *The intervention should ensure that spare parts for ATAG products are easily obtainable.*
- *The intervention should provide clear communication to help customers recognise when professional service is required and when they can resolve issues themselves.*

Chapter 3:

Understanding Repair Behaviour

Before exploring how to enhance consumer willingness in repair, it is important to first establish background knowledge on the repair process, relevant behaviour models and the barriers consumers experience to repair.

3.1 The Repair Process Model of Svensson-Hoglund

Understanding how consumers decide whether to repair a product is essential when aiming to increase repair behaviour. Svensson-Hoglund et al. (2023) describe this decision-making process in the Repair Model, shown in Figure 8, which highlights several key decision points where consumers either continue or abandon the repair journey. Supporting consumers at these decision points could increase the likelihood that they complete the repair successfully.

3.1.1 Repair Attitude

The process typically begins with an event, the product breaking or malfunctioning. At this stage, the consumer's repair attitude, or their general perception of repair, plays a major role in determining whether they will even consider repair as an option.

Consumers often perceive electronic products, such as ovens, as unrepairable, leading to a low repair rate of 7–20% (Dorland & Jørgensen, 2025). Several factors underlie this perception. Previous repair experiences, or the absence thereof, strongly influence consumers' attitudes towards repair.

According to Prospect Theory, visualised in Figure 9, people tend to avoid risks because they experience losses more strongly than gains of the same size (Edwards, 1996). In the context of repair, this means that attempting to fix a product can feel risky. Consumers are often unable to accurately estimate whether or not a repair would be worthwhile (Van Den Berge, 2024), and a failed attempt can feel like a clear loss of time, effort, or money. Because this negative feeling weighs more heavily than the satisfaction of a successful repair, one bad experience can discourage consumers from trying again.

Perceived product complexity further amplifies this sense of risk. Dorland and Jørgensen (2025) found that consumers often consider electronic appliances, such as ovens, too complex to repair themselves. Combined with a lack of positive repair experiences, this perception reinforces feelings of uncertainty and discourages repair attempts.

Beyond perceived risk and complexity, the initial tendency to repair is influenced by product characteristics such as costs and perceived quality. When consumers associate a product with high quality or a substantial initial investment, they tend to expect greater longevity and are therefore more willing to repair it (Proske, 2023).

In the case of ovens, their relatively high purchase cost can increase consumers' willingness to consider repair. At the same time, ovens are often categorised as 'workhorse products', items valued mainly for their functionality rather than for any emotional connection. As a result, consumers may feel indifferent towards keeping the specific product itself, which can make repair seem less important for them.

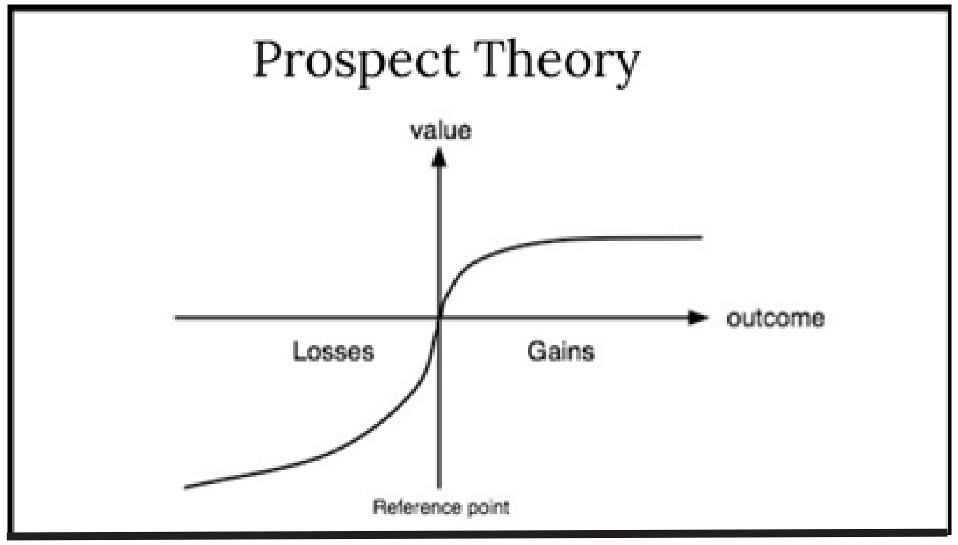


Figure 9: Prospect Theory (Edwards, 1996)

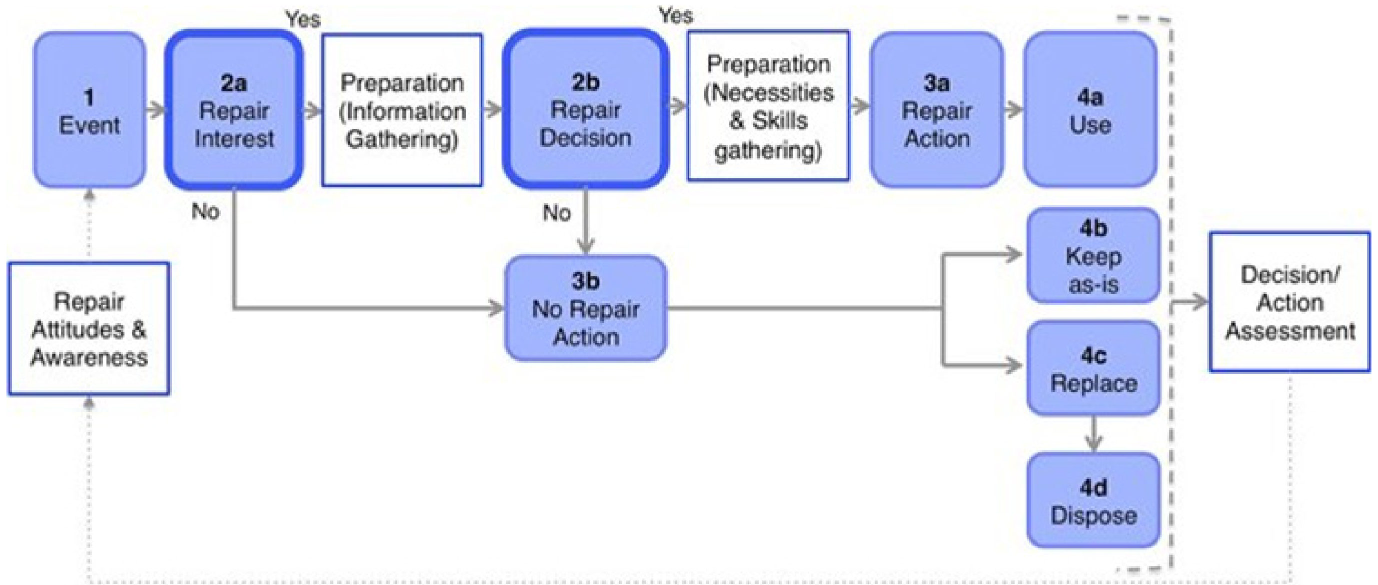


Figure 8: The Repair Process Model (Svensson-Hoglund et al., 2023)

- ***The intervention must strengthen consumers' belief that the oven is a repairable product.***
- ***The intervention must reduce consumers perceived risk of repairing the oven.***
- ***The intervention must reduce the perceived complexity of the oven.***
- ***The intervention should remind consumers of the high initial costs of the oven and encourage them to maintain it.***
- ***The intervention should foster an emotional connection between the consumer and the oven.***

3.1.2 Repair Interest

If the consumer shows interest in repairing the product, the next stage becomes a conscious process. They begin by assessing the feasibility of the repair; gathering information, inspecting the product, and forming hypotheses about what might be wrong and how it could be fixed. During this preparatory phase, consumers envision possible outcomes, benefits, trade-offs, and perceived risks associated with attempting the repair (Svensson-Hoglund et al., 2023).

In the case of an oven repair, they might start by observing the oven's behaviour and looking for signs of malfunction, such as error codes, unusual sounds, or failure to heat properly. If the product is still under warranty the consumer is likely to contact ATAG's service desk to report the issue and arrange an appointment with a mechanic. If not, and they believe there is a chance they can resolve the issue themselves, they may choose to investigate further. This could involve inspecting visible parts by opening the oven door or considering whether it is safe and feasible to disconnect the appliance from the electricity network for a closer examination. Consumers could search online for information, such as tutorials, repair manuals, or similar user experiences. As they gather insights, they begin to form a hypothesis about the cause and potential solution. This may involve identifying if specific spare parts or specialised tools are needed and assessing whether they possess the required knowledge or skills to carry out the repair themselves. Their final decision to proceed depends on factors such as how well they understand the problem, the accessibility of information about this issue, and practical considerations like perceived risk.

- ***The intervention must strengthen consumers' feelings of competence.***
- ***The intervention must support consumers to independently diagnose and resolve oven malfunctions.***

3.1.3 Repair Decision

Following this evaluation, the repair decision is made. Based on their assessment, consumers decide whether to proceed and start preparing the necessary skills, knowledge, tools, spare parts, financial resources, time, and if necessary, an appropriate workspace (Lefebvre, 2019).

For the ATAG oven, consumers can order spare parts through the maintainlife.com website and will need to gather the necessary tools if they don't already have them. Once they know when the spare parts will arrive, they can plan a suitable time to carry out the repair. They might ask someone for help, for instance, to move the built-in oven or to get advice from a friend who knows more about electronics. The final decision to proceed with the repair depends on factors such as part availability, cost, and personal skill level.

- ***The intervention should help consumers accurately estimate the time and resources required to carry out a repair.***

3.1.4 Repair Action

The final stage, repair action, involves performing the repair using the gathered tools and knowledge. The likelihood of success depends on factors such as ease of disassembly, task complexity, and the availability of repair support. Although the model assumes that completing the repair naturally results in product reuse, this is not always the case. If the repair attempt fails and the consumer decides to abandon it, the process ends without a successful outcome.

When the oven functions perfectly after replacing a small part, the user is likely to feel empowered. Conversely, if it still malfunctions after hours of effort, frustration may lead them to discard it altogether. These experiences shape their overall attitude towards repair and influence their willingness to attempt future repairs.

- ***The intervention should ensure that sufficient support is available to assist consumers during the repair process.***

3.2 The COM-B Model

Lots of research is already done on how humans make decisions, and which factors influence their behaviour. The following section analyses a prominent behavioural model from the literature; the COM-B model. This model was chosen as literature has proved the working for different types of contexts and in combination with the behavioural change wheel it provides us with very concrete interventions which are valuable to consider when aiming to encourage consumers to engage in repair.

The COM-B model proposes that behaviour (B) is the result of an interaction between capability (C), opportunity (O), and motivation (M). With capability meaning the individual's physical and psychological capacity to engage in the activity, including knowledge and skills. Opportunity is the external factors that make the behaviour possible, both physical (e.g., resources, environment) and social (e.g., norms, culture), and motivation consists of the internal processes that energise and direct behaviour, including reflective (conscious decision-making) and automatic (habitual, emotional) components.

Figure 10 shows the COM-B model of behaviour change at the centre of the Behavioural Change Wheel (Michie et al., 2011); a framework designed to help select suitable interventions for influencing behaviour. This makes it a particularly useful tool when aiming to design interventions that encourage repair.

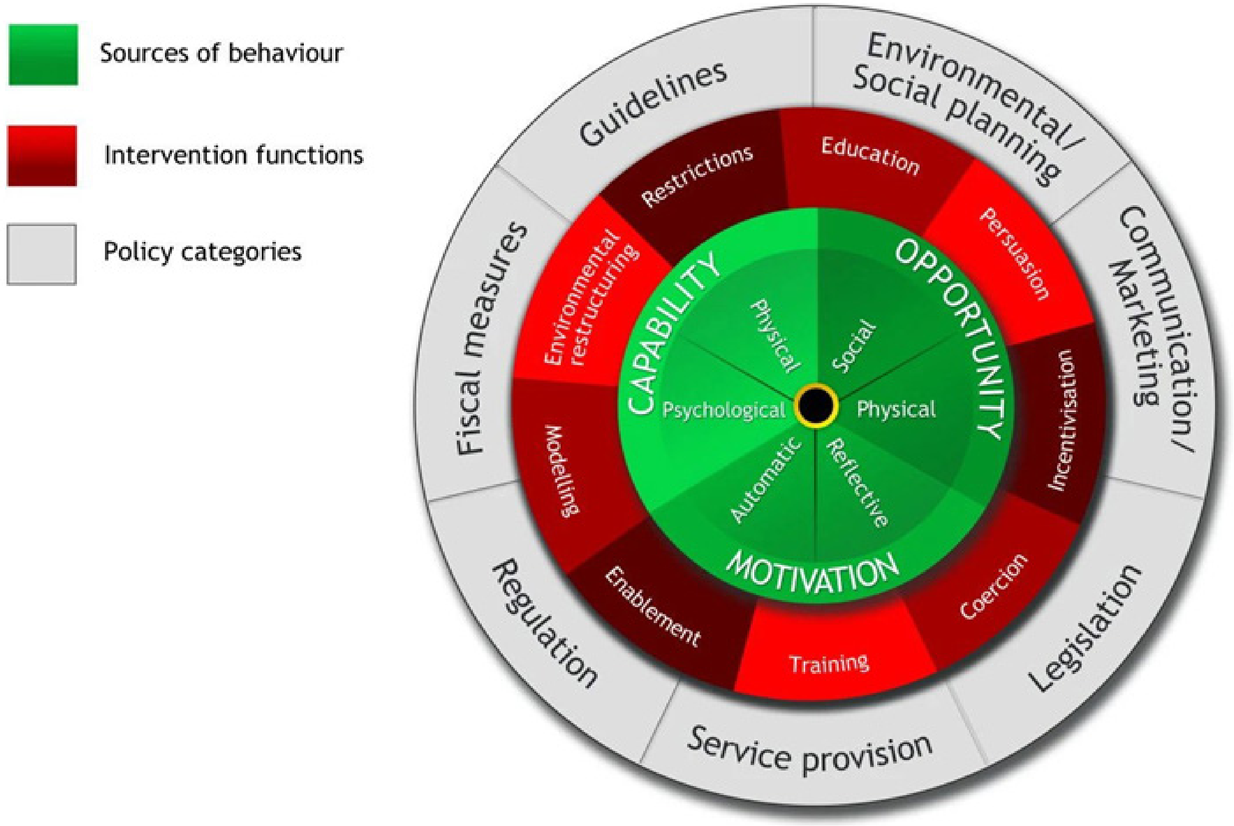


Figure 10: Behaviour Change Wheel

3.2.1 COM-B & Repair Behaviour

Applying the COM-B framework to repair behaviour enables an understanding of the user's decision-making process when confronted with a malfunctioning product. Each element of COM-B can be interpreted in the context of repair as follows:

- **Physical capability:** *possession of the necessary repair skills, physical strength (for large appliances), and the ability to reach product components.*
- **Psychological capability:** *understanding of the product and its components, ability to diagnose the problem, and knowledge on how to fix it.*
- **Reflective motivation:** *conscious beliefs about one's repair ability, environmental values, and perceived feasibility of repair.*
- **Automatic motivation:** *emotional and habitual responses, such as prior experiences with repair.*
- **Social opportunity:** *social influences such as peers who engage in repair, availability of information through repair communities, and the perceived repair-friendliness of products.*
- **Physical opportunity:** *access to tools, spare parts, and a suitable workspace to perform the repair.*

When applying the COM-B model to oven repair, several challenges emerge. Physically, some repairs require strength or the ability to safely remove the oven from its built-in position, which may discourage consumers from attempting the task. Psychologically, users need a basic understanding of how the oven functions, which components are involved, and how to diagnose a malfunction, for example recognising that failure to heat in a certain setting may indicate a specific heating element. Many consumers lack this knowledge and therefore doubt their ability to identify or solve the problem. This uncertainty affects reflective motivation, as ovens are often perceived as complex and potentially dangerous products, particularly for those without prior repair experience. Unlike smaller household items, ovens are rarely repaired in repair cafés, meaning consumers seldom observe others repairing them and may therefore doubt that repair is feasible. Physical opportunity also plays a role, as accessing the correct tools and spare parts is not always straightforward and they are not consistently standardised or readily offered by providers.

Overall, the COM-B model highlights that multiple capabilities, motivations and opportunities must align for consumers to attempt oven repair. The Behaviour Change Wheel suggests possible interventions to address these barriers, such as accessible training or step-by-step guidance, alongside improved access to tools and spare parts and clearer communication that repair is possible and supported.

► ***The intervention should make sure any possible physical difficulties should be clearly communicated beforehand.***

3.3 Barriers to Repair

When looking more specifically into literature on repair, research has identified a variety of barriers that influence whether consumers choose to repair their products. This section examines two well-known models, the Roskladka model and the Terzioglu model, that categorise and explain these barriers. Both models have informed the selection of the barriers most relevant to consumer willingness to repair. The goal is to determine which barriers are most significant for ATAG's target group; this will be further explored in the questionnaire described in Chapter 6.

3.3.1 Roskladka Model

The Roskladka model was developed through a combination of literature review and consumer interviews, identifying key psychological, social, and practical obstacles that hinder repair behaviour. It provides a structured framework for understanding how different types of barriers interact to influence repair decisions.

In the Roskladka model, Figure 11, barriers are categorised and visually prioritised, with those highlighted in green representing the most influential obstacles to repair behaviour. Roskladka et al. (2023) emphasise that willingness to repair is the most difficult aspect to influence, as it is shaped primarily by psychological factors rather than by more measurable or external elements such as convenience or technological feasibility. Since this thesis focuses specifically on increasing consumers' willingness to repair, the analysis concentrated mainly on this segment of the model, while also incorporating the most significant barriers from the model's other categories to ensure a comprehensive understanding of the factors that shape repair decisions.

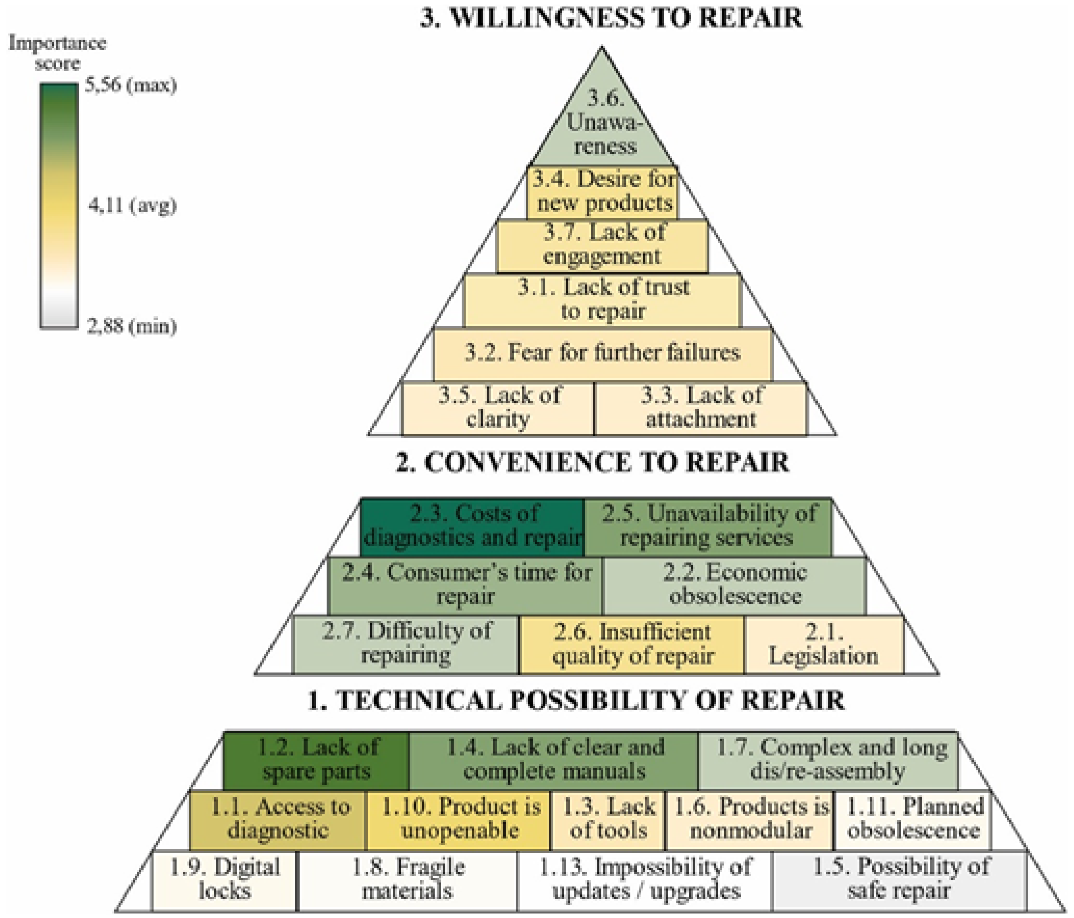


Figure 11: The Roskladka Model of Barriers to Repair (Roskladka et al., 2023).

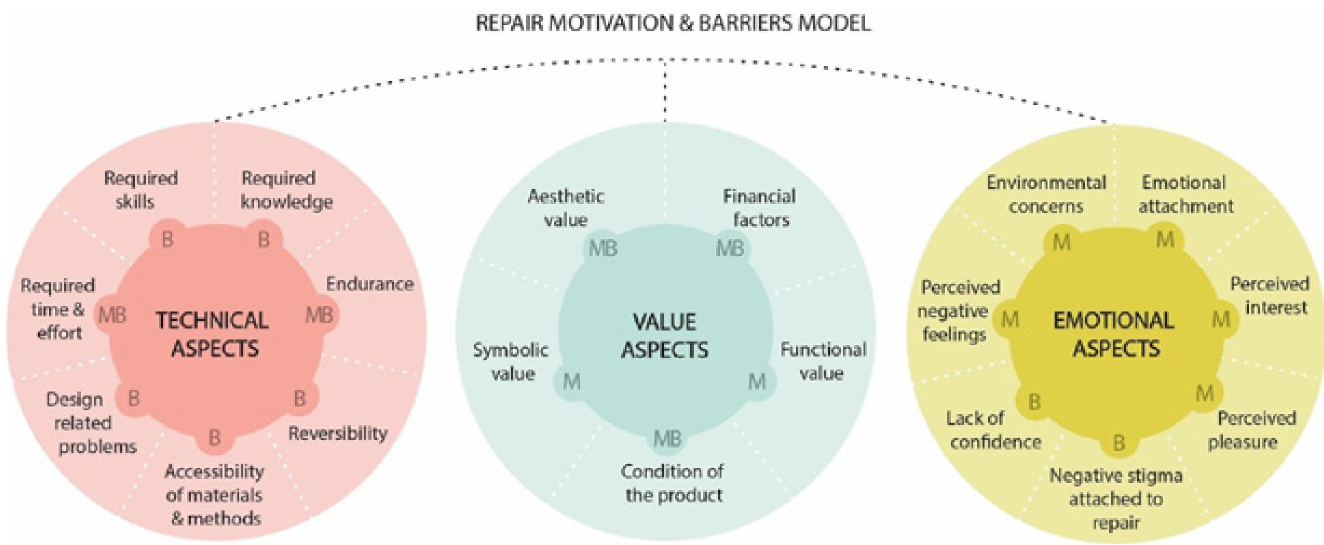


Figure 12: The Terzioglu Model of Barriers to Repair (Terzioğlu, 2021)

3.3.2 Terzioglu Model

The Terzioglu model, Figure 12, was created based on empirical surveys and case studies of consumer repair practices. It emphasises how practical factors, such as availability of tools, knowledge, and support systems, play an important role in whether people decide to repair.

It is divided into three main categories: technical aspects, value-related aspects, and emotional aspects. The emotional category is the most relevant for this thesis, as it closely matches the willingness-to-repair barriers identified by Roskladka et al. (2023) Many emotional factors in the model, such as perceived interest, pleasure, or negative feelings, overlap in meaning, so not all were included. Only the emotional aspects that clearly add unique insight into willingness to repair were used in the analysis, such as perceived pleasure and environmental concerns, which were translated into the themes fulfilling and environmentally friendly.

3.3.3 Barriers and Enablers for this specific project

This section outlines the barriers and enablers from the two models that are most relevant to this project. For now, all factors are assumed to be equally important in shaping consumers' willingness to repair their oven. Their actual importance will be evaluated through the questionnaire, which will be discussed in Chapter 6.

Time-Consuming

Repairs can take a considerable amount of time, depending on the type of issue, which may discourage consumers from starting.

Many people struggle to estimate how long a repair will take, especially with a product as complex as an oven, so they postpone it out of fear that it will become a major time commitment. This uncertainty makes it easier to delay the task rather than begin something that feels open-ended.

Expensive

High costs for spare parts, tools, or professional repair services can lower the perceived value of repairing a product.

Research shows that consumers are only willing to pay a small fraction of the original product price for a repair, partly because older or second-hand products are seen as less valuable (Laitala et al., 2021;Roskladka et al., 2023). In the case of ovens, repairs can quickly become costly, especially when professional help is required.

Complex

Technical difficulty or complicated repair procedures can intimidate users and lower repair likelihood.

The oven is often perceived as a complex appliance because it combines multiple functions, and electronic components such as heating elements and control systems. This complexity can make users hesitant to engage in repair activities.

Fulfilling

A successful repair experience can give consumers a strong sense of accomplishment, offering emotional rewards such as satisfaction, pride, and contentment.

This feeling of fulfilment often emerges after a successful repair, but it may also arise during the process when things go smoothly, fostering a sense of usefulness and competence. As a result, repair can be perceived as a meaningful and enjoyable activity. Because the oven is seen as a daring and complex product, the emotional payoff of repairing it successfully can be especially significant when the repair goes well.

Empowering

A successful repair experience can give consumers a strong sense of empowerment, increasing their confidence in their own abilities and making them feel more capable.

This boost in confidence can encourage them to attempt repairs on future products, as they now believe they possess the skills to handle similar challenges. For an oven, often perceived as a large and complex appliance, this empowering effect can be even more pronounced; users may feel that if they can repair an oven, they can likely repair many other products as well.

Frustrating

Repetitive or challenging repair steps can lead to annoyance and reduce a consumer's willingness to continue or attempt future repairs.

Consumers may experience frustration when they encounter setbacks such as unavailable spare parts, components that are difficult to access, or products that are not designed for easy disassembly. These obstacles can make the repair process feel tedious or discouraging. For ovens in particular, frustration may arise when users invest significant effort in dismantling the appliance only to struggle to identify the fault or find that the faulty component is inaccessible. Such experiences can strongly reduce motivation to repair.

Risk of Damaging the product

Consumers may worry that attempting a repair could worsen the problem, cause additional damage, or potentially void the product's warranty.

In the case of ovens, users may be particularly concerned that their repair attempt could invalidate the warranty or complicate future professional servicing. They might fear that if they later call a service technician, the repair could become more costly because of their initial intervention.

Physically Unsafe

Repair activities can pose risks of injury, particularly when tools, electrical components, or heat are involved.

Because an oven is an electrical appliance, consumers may fear the possibility of electrocution if the repair is performed incorrectly. They may also worry about injuring themselves on sharp internal components or other hazardous parts, which can further discourage them from attempting repairs.

Environmentally Friendly

Repairing a product rather than replacing it can be a more sustainable option, reducing waste and lowering the environmental impact associated with producing and disposing of appliances.

Because an oven contains numerous electronic components and materials that would otherwise end up as waste, repairing it can help extend its lifecycle. This can give consumers a sense of contributing positively to the environment, reinforcing the value of choosing repair over disposal.

Trustworthy

Consumers need confidence in the reliability of spare parts, tools, and repair instructions, as well as in the overall repair outcome, before they are willing to undertake a repair.

They must believe not only that the process is safe and feasible, but also that the repair will provide a durable, long-term solution rather than a temporary fix

Worth the Effort

Consumers are more likely to engage in repair when they perceive that the benefits outweigh the costs, time investment, and effort required.

At the outset of a repair, however, consumers often question whether the process will be worthwhile, especially since they have no guarantee that their efforts will lead to a successful outcome. This uncertainty can reduce their motivation to begin the repair in the first place.

Overall, these barriers and enablers provide valuable insight into the factors that may influence whether consumers choose to repair their ovens.

Although cost is frequently cited in the literature as the most influential barrier (Laitala et al., 2021; Roskladka et al., 2023), this concern is often more closely related to professional repair services. Given the focus on self-repair in this study, barriers such as time-consuming and complex are expected to be particularly relevant, as they reflect consumers' expectations of what the repair process entails. Emotional barriers, such as feeling empowered or frustrated, are also important to assess, as they reveal how consumers emotionally engage with the idea of performing repairs themselves. Finally, the barrier worth the effort represents a broader, overarching attitude toward repair. If many consumers perceive repair as not worth their effort, significant work remains to encourage more widespread adoption of repair practices.

- *The intervention should convince the consumer self-repair does not have to be time-consuming, expensive or complex.*
- *The intervention should convince the consumer they are not likely to damage the product fur-ther or do themselves any harm.*
- *The intervention should convince the consumer that self-repair can be fulfilling and empower-ing.*
- *The intervention should convince the consumer guided self-repair is trustworthy and worth the effort.*

3.4 Integrating the Models

While the COM-B model and the barriers to repair are from itself interesting to look at, it would be even more insightful when integrated into the Repair Process Model to see which factors and barriers play a role in which specific moment in the repair process.

Svensson-Höglund's repair process model, as shown in Figure 8, provides a sequential view of the repair journey, while the COM-B and barriers add depth to the psychological reasons behind each possible decision. When put together, these models can form a framework from which it is easy to identify when and how design interventions could most effectively support repair behaviour.

In this section firstly will be explained how the COM-B model is integrated in the repair process model, afterwards how the barriers are integrated in the repair process model and lastly what we can conclude from this integrated model.

3.4.1 Integrating the COM-B model in the Repair Process

Integrating the COM-B model in the Repair Process Model clarifies how behavioural factors influence key decision points in consumer repair.

Repair attitude and awareness (Svensson-Hoglund et al., 2023) correspond to automatic motivation in COM-B, as both reflect pre-existing, experience-based perceptions of repair. Together with reflective motivation, which emerges after product failure and relates to self-efficacy, environmental concern, and perceived repairability, these motivational factors strongly shape repair intention (Ozanne et al., 2025).

Social opportunity also influences repair intention (Ozanne et al., 2025) and is therefore positioned prior to repair interest in the model. Physical opportunity, physical capability, and psychological capability do not directly determine repair intention, but become decisive once the intention to repair is formed. After repair interest is established, consumers prepare by acquiring tools, parts, and information, reflecting physical opportunity. During repair execution, physical and psychological capabilities determine whether the repair can be successfully carried out. The integrated model is shown in Figure 13.

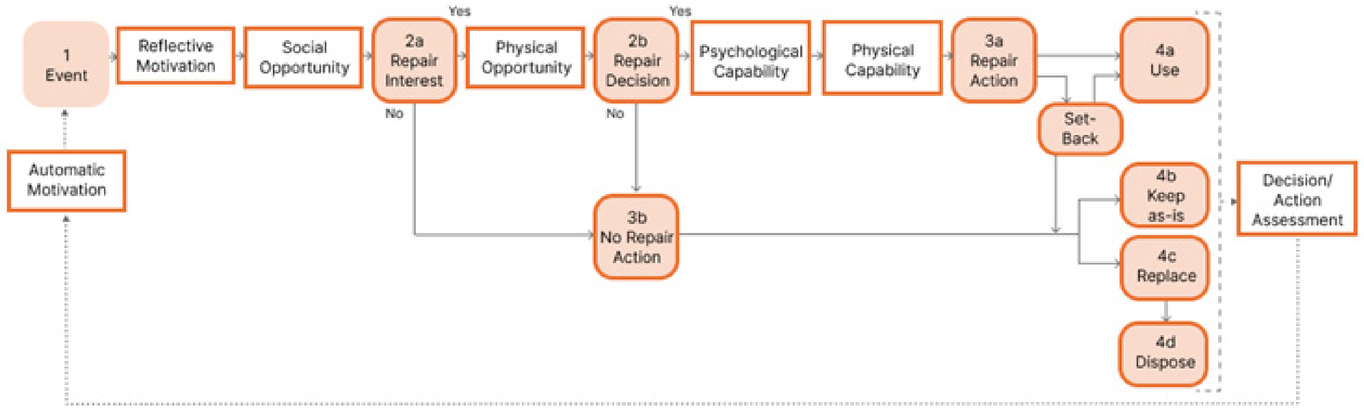


Figure 13: COM-B Model Integrated in the Repair Process Model

3.4.2 Integrating the Barriers in the Repair Process

Embedding barriers within the repair process highlights how consumers may opt out at distinct decision points. At the repair interest stage, barriers are primarily perceptual and motivational, shaped by prior experiences, beliefs about product repairability, and social influences. At the repair decision stage, barriers relate to anticipated costs, time investment, task complexity, and clarity of repair information. During repair execution, barriers emerge through setbacks, frustration, or increased perceived risk.

The outcome of the repair process influences future repair behaviour. Positive experiences can strengthen confidence and perceived feasibility of repair, while negative experiences reinforce perceptions of repair as difficult or unmanageable. The fully integrated model is shown in Figure 14.

3.4.3 Conclusions from the Integrated Model

This integrated model offers a clear overview of the key decision points and the reasoning underlying repair behaviour, helping designers and policymakers identify which COM-B components and barriers are most relevant at each stage.

The model shows three main decision moments: whether the consumer is interested in repair at all, whether they decide to proceed once they understand what the repair involves, and, if a setback occurs, whether they continue or abandon the process.

The first decision point is shaped by perceptions of repair and of the oven as a repairable product, with automatic motivation, largely influenced by past repair experiences, playing a central role. Although these past experiences cannot be changed, the intervention could encourage a more positive attitude towards repair through reinforcement.

Ideally, consumers should already associate the oven with repairability before any malfunction occurs, and when the malfunction does happen, an intervention should reassure them that repair is feasible and within their abilities. Normalising repair socially is also important, showing that others in their environment repair appliances too. Whether consumers associate repair with negative barriers or positive motivators strongly affects their initial interest, so

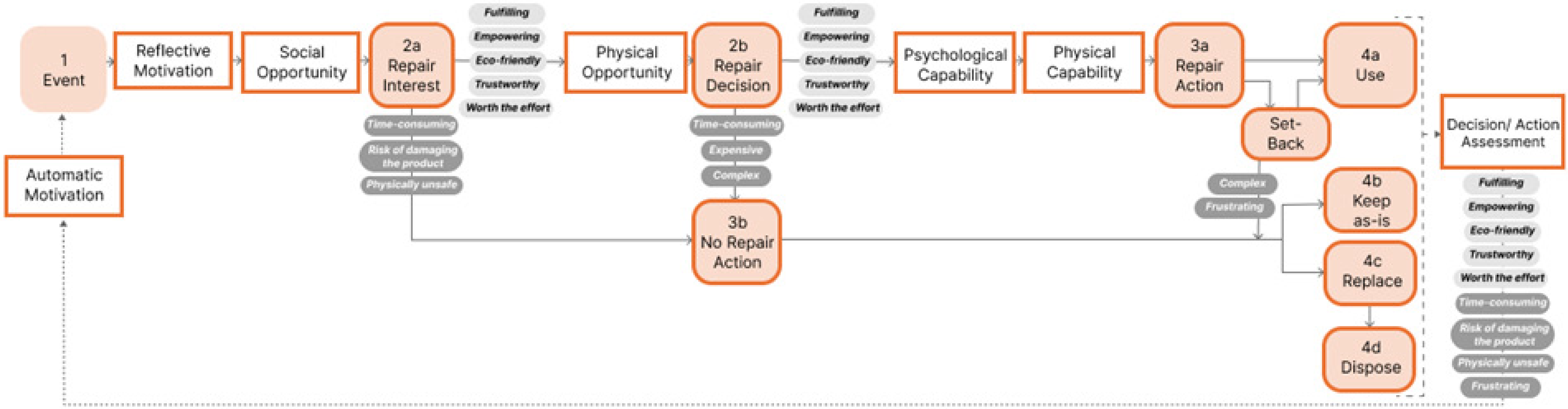


Figure 14: COM-B Model and Repair Barriers Integrated in the Repair Process Model

interventions should counter beliefs that repair is time-consuming, risky, or likely to cause further damage, while highlighting the fulfilment, empowerment, environmental benefits, and trustworthiness that repair can offer.

Once consumers show interest, they begin assessing their physical opportunity by looking at required tools, spare parts, skill level, time and cost. The intervention should help them gather this information and reassure them that the repair is within their capabilities. Without this support, factors such as time investment, expense or perceived complexity may still prompt them to opt out.

After deciding to proceed, they explore what exactly needs to be fixed and how to do it, making this a critical moment where guidance is essential. If setbacks occur, earlier barriers can resurface, and frustration or unexpected difficulty may lead consumers to abandon the repair; interventions at this point should calm the user, acknowledge their struggle, and provide clear next steps.
Every experience throughout the repair journey shapes consumers future perception of repair, the oven, and ATAG as a brand. These conclusions are visualised in Figure 15.

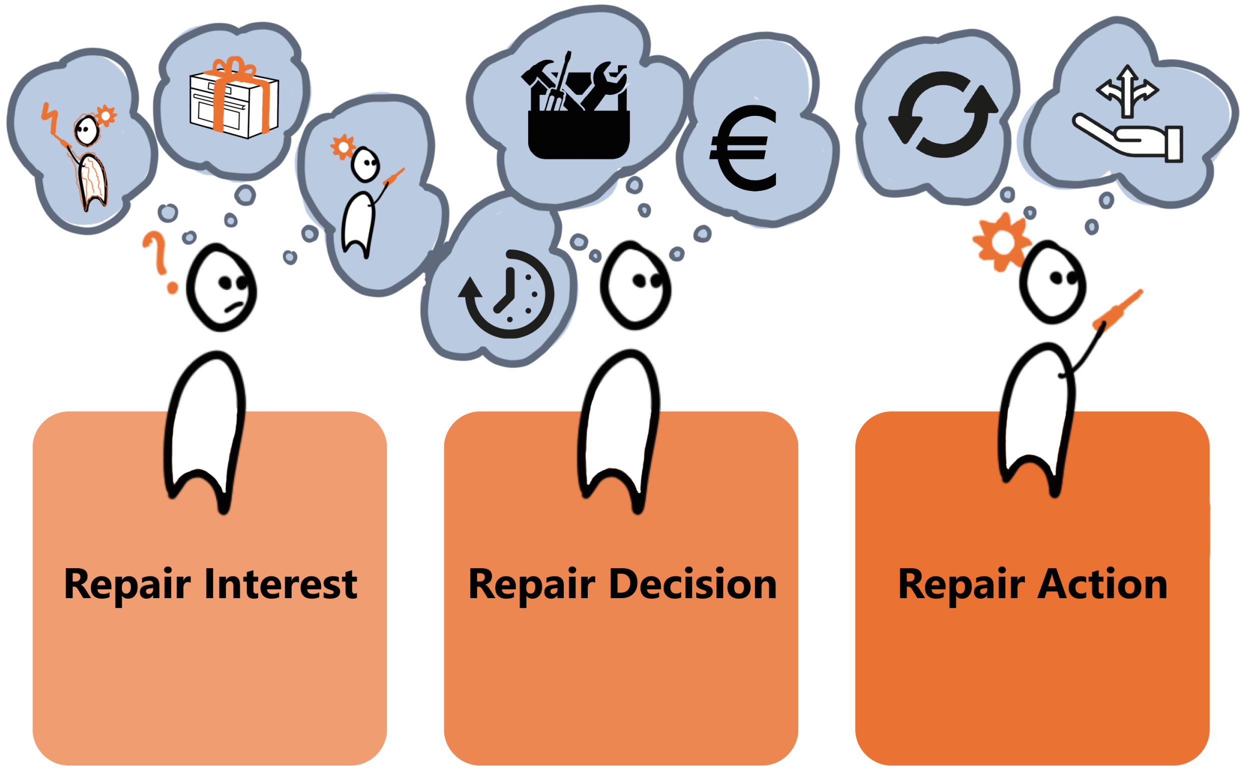


Figure 15: Visual Summary concluding on the Integrated Models

- ***The intervention should contribute to normalising self-repair behaviour for ovens.***
- ***The intervention should give clear information on the repair skills required to perform the repair.***
- ***When a set-back occurs, the intervention should calm the user down and give them advice on what to do next***

Chapter 4:

Repair Culture & Consumer Self-Repair

Having explored how repair decisions are made, this chapter examines how the broader cultural context influences these decisions. It discusses the current repair culture, the benefits of self-repair, and repair practices across different product categories.

4.1 A Culture of Non-Repair

Today, repair is not a commonly used practice and occupies only a small role. Jaeger-Erben et al. (2021) describe this as a culture of non-repair, where infrastructures and dominant values discourage the emergence of repair practices. It is of utmost importance that consumers are aware that repair is an option when product failure occurs, because individuals with low or no awareness and experience of repair will very unlikely engage in a repair activity.

4.1.1 Throw-Away Culture & Premature Obsolescence

Modern consumption is shaped by a throw-away mentality, in which the perceived value of products quickly declines once they are no longer new or fashionable. This psychological obsolescence, driven by marketing and rapid product cycles, encourages replacement rather than repair (Jaeger-Erben et al., 2021). Magnier & Mugge (2022b) found that a large proportion of products are replaced while still partially functional, and consumers are more likely to repair items which are completely broken.

4.1.2 Novelty Seeking & Social Stigma

The desire for novelty and innovation has become a socially supported norm, making repair and product longevity less desirable. In certain product categories, such as smartphones, the focus on novelty has a direct impact on the product lifetimes and reduces the number of repairs (Jaeger-Erben et al., 2021). Consumers weigh the value of their current product against that of a potential replacement. The perceived value of an owned product can decline over time due to malfunctions, wear and tear affecting its appearance, or a sense of satiation from repeated use (van den Berge et al., 2021).

4.1.3 Impracticality & Lack of Visibility

Repair is often seen as impractical because it requires time, effort, and skills that many consumers feel they lack. The financial and behavioural costs of repair can be high, discouraging people from attempting it (Jaeger-Erben et al., 2021). Repairs are also mostly done at home and remain invisible to others. Because repair is not visible, it fails to create social norms or recognition, which further weakens its role in society (Corsini et al., 2020).

Having the right support system is essential for successful repair. Individuals need adequate knowledge of the damage or functional loss that has occurred and a clear understanding of the extent to which it can be addressed, to set realistic expectations. Additionally, access to necessary resources, such as specialized tools, manuals, and high-quality spare parts, must be timely and reliable. A lack of these essential resources is a major barrier to repair, preventing individuals from effectively addressing product failures (Terzioğlu, 2021; Ackermann, 2018; Laitala et al., 2021).

4.1.4 Making Repair the Norm

Transforming repair from an exception into a common practice requires interventions at social, cultural, and practical levels. Currently, repair is often perceived as something consumers could do rather than something they should do. To shift this perception, repair needs to be more actively encouraged at a societal level, similar to how behaviours such as buying second-hand, eating less meat, and bringing reusable bags to supermarkets have become more normalised in recent years (Dávila, 2015) This research also indicates that simply lowering the practical barriers to repair does not necessarily lead to higher repair rates; instead, mainstreaming repair and improving its image plays a more decisive role in motivating consumers to choose repair.

Key strategies include increasing visibility and creating awareness around longevity. Policies, educational initiatives, and public repair events can help make repair more accessible and socially accepted (Jaeger-Erben et al., 2021).

In the context of this thesis, where the focus is on a single product, making repair the norm can begin with targeted interventions for that product. Consumers should be encouraged to see repair as the most logical option, supported by the understanding that the ATAG oven is commonly repaired by others.

Following Jaeger-Erben's recommendations, it is important to support consumers in developing the skills and confidence to attempt repair. Even focusing on a single product can serve as a model to demonstrate repairability, foster positive repair experiences, and gradually influence consumer attitudes, potentially extending to other products over time.

- ***The intervention should, when the product fails, make consumers aware that repair is a legitimate option.***
- ***The intervention should increase the visibility of repair to strengthen its social acceptance.***
- ***The intervention should emphasise that other users also repair the ATAG oven.***
- ***The intervention should make the repair experience rewarding.***
- ***The intervention should build consumer skills and self-efficacy to promote long-term engagement with repair.***

4.2 The Strength of Self-Repair

Within a dominant culture of replacement, motivating consumers to repair broken products is already challenging, let alone encouraging them to undertake repairs themselves. This challenge is particularly evident for durable household appliances such as ovens, which are often perceived as technically complex, opaque, and risky to handle. Nevertheless, self-repair offers a range of psychological and experiential benefits that make it a powerful lever for increasing willingness to repair. This section discusses how self-repair can reshape consumers' valuation of products, strengthen attachment, foster empowerment and learning, and ultimately reinforce future repair behaviour, thereby contributing to a more sustainable repair culture for products such as the ATAG oven.

4.2.1 Initial Motivation

The IKEA effect describes the phenomenon that consumers value products more when they have contributed labour to them (Norton et al., 2012). This effect is explained by effort justification: the more effort people invest in creating or restoring a product, the more they come to value the outcome. While IKEA demonstrates this principle through consumer assembly, the same mechanism applies to self-repair. Successfully repairing an oven can increase its perceived value, as the consumer has invested personal effort into restoring its functionality.

In addition, economic attachment also plays an important role. Economic attachment refers to the perceived monetary value of a product and the extent to which consumers see it as worth maintaining. When consumers perceive a product as expensive, they are generally more willing to invest time, care, and money in its upkeep and repair (Hernandez et al., 2020). For high-value appliances such as ovens, self-repair can therefore be appealing, particularly because it is often more affordable than professional repair. However, high product value can also act as a barrier: consumers may be reluctant to attempt self-repair out of fear of causing irreversible damage and increasing financial loss (Terzioğlu, 2021). This highlights that self-repair is only motivating when the perceived risks are sufficiently low.

- ***The intervention should make the consumer's personal effort in the repair process visible and meaningful.***
- ***The intervention must frame self-repair as a worthwhile investment of time and care.***
- ***The intervention must reduce perceived financial risk associated with self-repair.***

4.2.2 Product Attachment

Beyond economic considerations, self-repair can strengthen the emotional relationship between consumers and their products. Consumers are more inclined to repair products to which they feel emotionally attached. Such attachment can arise from sentimental value, intergenerational value, or aesthetic longevity, when a product is designed to outlast trends (Hernandez et al., 2020). Importantly, repair itself can actively foster this attachment. Engaging in repair and maintenance activities encourages users to form emotional bonds with their products, creating a reinforcing cycle in which each act of restoration increases personal meaning and perceived value (Korsunova et al., 2023; Hernandez et al., 2020).

Self-repair can also generate epistemic value, which refers to the curiosity, learning, and sense of novelty a product provides (van den Berge et al., 2021). Consumers' desire for novelty is a well-known driver of premature product replacement (Magnier & Mugge, 2022b). By repairing a product themselves, consumers can re-engage with it in a novel way, gaining new insights into its functioning or even customising it to their preferences. These repair-driven interactions can refresh the consumer–product relationship and further enhance emotional attachment (Szabó, 2025). For ovens, which are rarely perceived as emotionally expressive products, self-repair offers an opportunity to transform a purely functional appliance into something more personal and meaningful.

- ***The intervention must allow repair to function as a moment of re-engagement with the product.***

4.2.3 Empowerment through Self-Repair

A particularly important benefit of self-repair lies in its potential to foster consumer empowerment. Successful self-repair experiences can strengthen feelings of autonomy and competence, which are central psychological needs according to Self-Determination Theory (Deci & Ryan, 2000). When consumers are supported by clear, step-by-step guidance, self-repair can fulfil the need for competence by enabling them to solve technical problems. Successfully repaired products then act as signals of personal competence, leading to more positive evaluations of both the product and the self (Norton et al., 2012).

However, this empowering effect depends strongly on successful outcomes. Failed repair attempts can undermine self-confidence and discourage future repair behaviour. Norton et al. (2012) further show that self-repair is particularly rewarding for consumers whose sense of competence has been previously challenged, while it is less impactful when self-affirmation is already high. This underscores the importance of designing self-repair experiences that minimise failure and frustration.

Empowerment through self-repair is especially relevant in the context of consumer electronics and appliances, which have increasingly become "black boxes." As their internal workings are hidden from users, consumers' understanding of how products function has declined (Hernandez et al., 2020). Self-repair practices can counteract this trend by making product functionality more transparent and restoring technical knowledge. For ovens, guided self-repair can help clarify internal components and reduce dependence on external experts, supporting long-term engagement with repair.

- ***The intervention should minimise the likelihood of repair failure.***
- ***The intervention should make the internal functioning of the oven more transparent.***

4.2.4 Reinforcing Cycle

Positive repair experiences play a crucial role in shaping future repair behaviour. Many consumers do not initially consider repair a viable alternative to replacement (Jaeger-Erben et al., 2021). However, research by Korsunova et al. (2023) shows that successful personal repair experiences significantly increase the likelihood of considering repair again and foster openness towards repairing increasingly complex products. Prior experience and skills can be so empowering that even high-cost repair projects are perceived as enjoyable.

Moreover, self-repair experience improves consumers' ability to assess whether products are repairable in the first place. This diagnostic confidence reduces uncertainty and lowers psychological barriers to repair. By exposing consumers to positive self-repair experiences, individual beliefs about repair can be reshaped, which in turn may contribute to broader shifts in social norms and attitudes towards repair (van den Berge et al., 2023). For ovens, this suggests that one successful self-repair can have lasting effects on how consumers approach future breakdowns, making replacement or professional repair less of an automatic choice.

- ***The intervention should help consumers assess whether a fault is repairable before starting the repair.***

4.2.5 Conclusion

Taken together, these findings show that self-repair is not merely a cost-saving strategy, but a powerful mechanism that reshapes how consumers value, understand, and relate to their products. Self-repair can initiate a reinforcing cycle that increases long-term willingness to repair.

For high-value, long-lived appliances such as ovens, self-repair holds particular potential. Ovens combine strong economic attachment with high perceived risk and technical opacity, making them both promising and challenging candidates for self-repair. Enabling successful, low-risk self-repair for ovens therefore requires designs and systems that reduce perceived danger, support consumer competence, and frame repair as a meaningful and achievable interaction. These insights provide a foundation for exploring how self-repair of the ATAG oven can be deliberately designed to motivate repair behaviour and contribute to a more sustainable repair culture.

- ***The intervention must frame self-repair as an achievable and responsible action within every-day life.***

4.3 Repair Practices across Product Categories

Although repair is not the norm today, its acceptance varies across product categories. For example, repairing a car or bicycle is widely perceived as a normal and responsible action. Understanding why repair feel more natural in certain categories can help identify lessons for other products, such as ovens.

Cox et al. (2013) distinguishes three product categories: workhorse, investment, and up-to-date products. Workhorse products are primarily valued for their functionality and are expected to have a long lifespan; large household appliances, including ovens, fall into this category. Investment products include relatively expensive items such as watches or high-quality electronics that are more likely to be repaired, often due to the high initial cost and emotional attachment. Up-to-date products, in contrast, are closely linked to social identity and are more frequently replaced or upgraded due to trends or technological developments rather than malfunction.

Arias et al. (2024) found that consumers are more willing to repair products they perceive as functional, aesthetically pleasing, and valuable. Repair becomes particularly attractive when it restores or enhances functionality, either by fixing a malfunction or by improving the product beyond its original performance. This helps explain why repair is more accepted for certain product categories, as these products are more likely to be perceived as valuable and worth maintaining.

To further explore these dynamics, the following section discusses three product categories in which consumers are likely to consider repair. By examining the reasons underlying repair acceptance in these categories, lessons can be drawn to support strategies for increasing consumers' willingness to repair ovens.

4.3.1 Bicycle Repair

Bicycle repair is highly normalised, particularly in the Netherlands, reasons behind this are illustrated in Figure 16. Bicycles are commonly perceived as workhorse products: they are used frequently, owned for long periods of time, and typically replaced only when they no longer function adequately. Many consumers are able to repair their own bicycles, supported by a well-developed repair ecosystem consisting of local repair shops and widely accessible online tutorials.

Several factors contribute to the high acceptance of bicycle repair, including modular product design, mostly mechanical components, frequent daily use, relatively slow technological change, and the availability of affordable spare parts. In addition, bicycle repair is characterised by low perceived risk and high transparency, as components are visible and repair outcomes are immediately noticeable. These characteristics reduce uncertainty and build user confidence, helping to normalise self-repair behaviour.

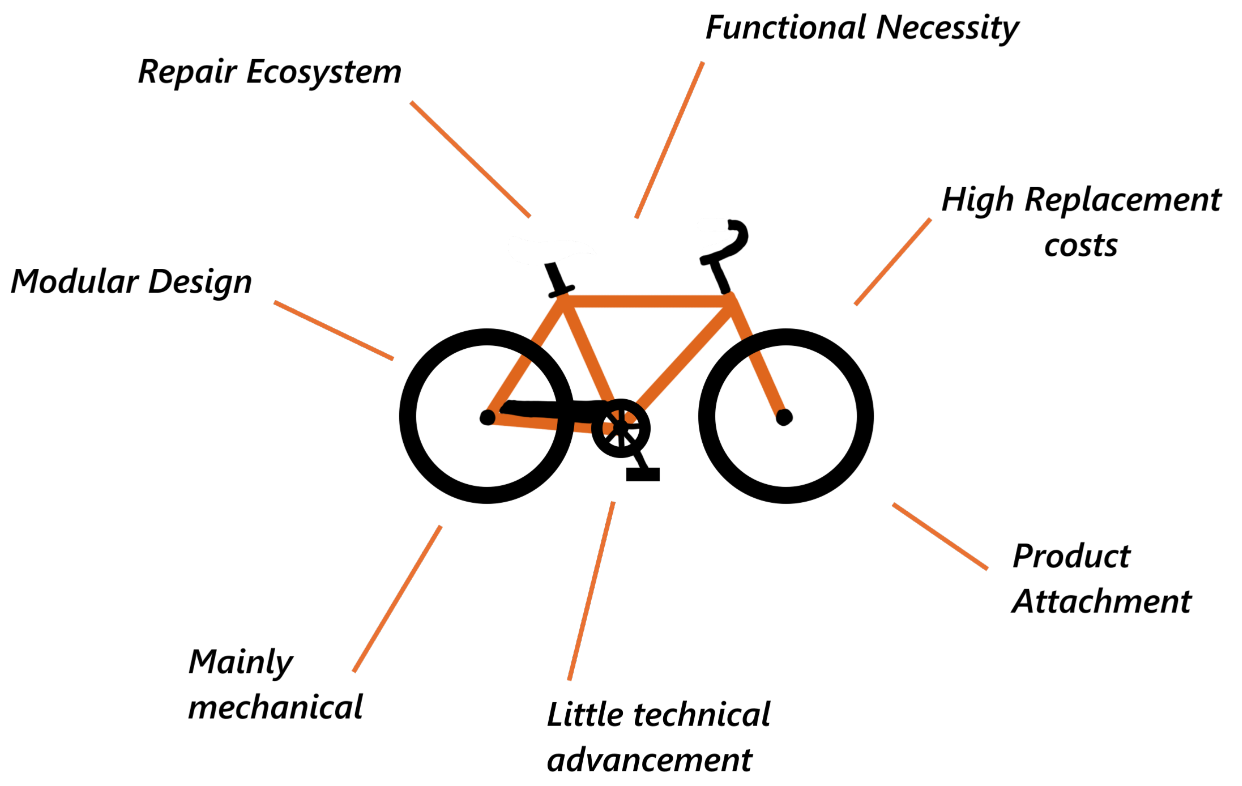


Figure 16: Reasoning behind Bicycle Repairability

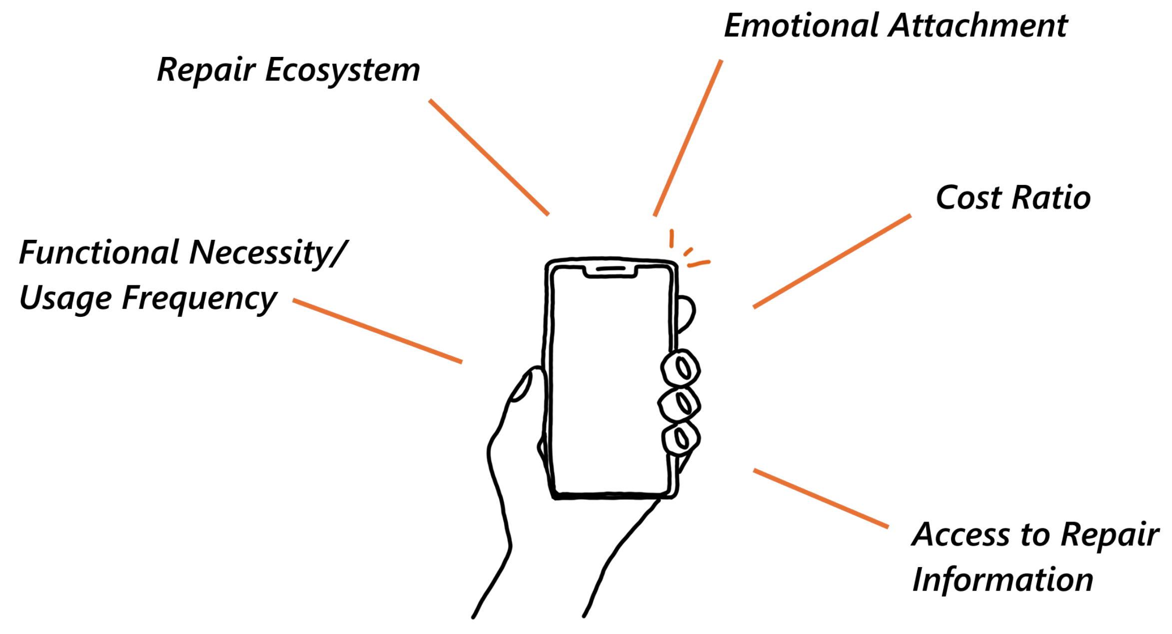


Figure 17: Reasoning behind Smartphone Repairability

4.3.2 Smartphone Repair

Smartphones are repaired less frequently than bicycles, yet still considerably more often than household appliances such as ovens, reasons behind this are illustrated in Figure 17. This can largely be attributed to the widespread availability of professional repair services, ranging from brand-affiliated stores to independent repair shops, as well as the strong personal attachment users tend to have to their devices. High usage frequency, functional necessity, and accessible repair information on platforms such as iFixit and YouTube further support repair behaviour.

In addition, smartphones are perceived as highly valuable products due to their cost and their central role in daily life, which increases consumers' willingness to invest time and money in repair. Although self-repair is often limited by product complexity, professional repair is socially normalised and trusted, reducing perceived risk and making repair a default option when malfunctions occur.

4.3.3 Clothing Repair

Clothing represents another product category in which repair is relatively common, reasons behind this are illustrated in Figure 18. Garment repairs are often simple, low-cost, and require only basic tools or skills, making them highly accessible to consumers. Emotional attachment, particularly to favourite or long-owned items, further motivates repair.

Beyond practicality, clothing repair is increasingly supported by cultural trends such as visible mending, which reframe repair as a creative and expressive practice rather than merely a functional task. This positive cultural framing lowers social barriers to repair and encourages consumers to engage in self-repair even when replacement would be inexpensive or easily available.

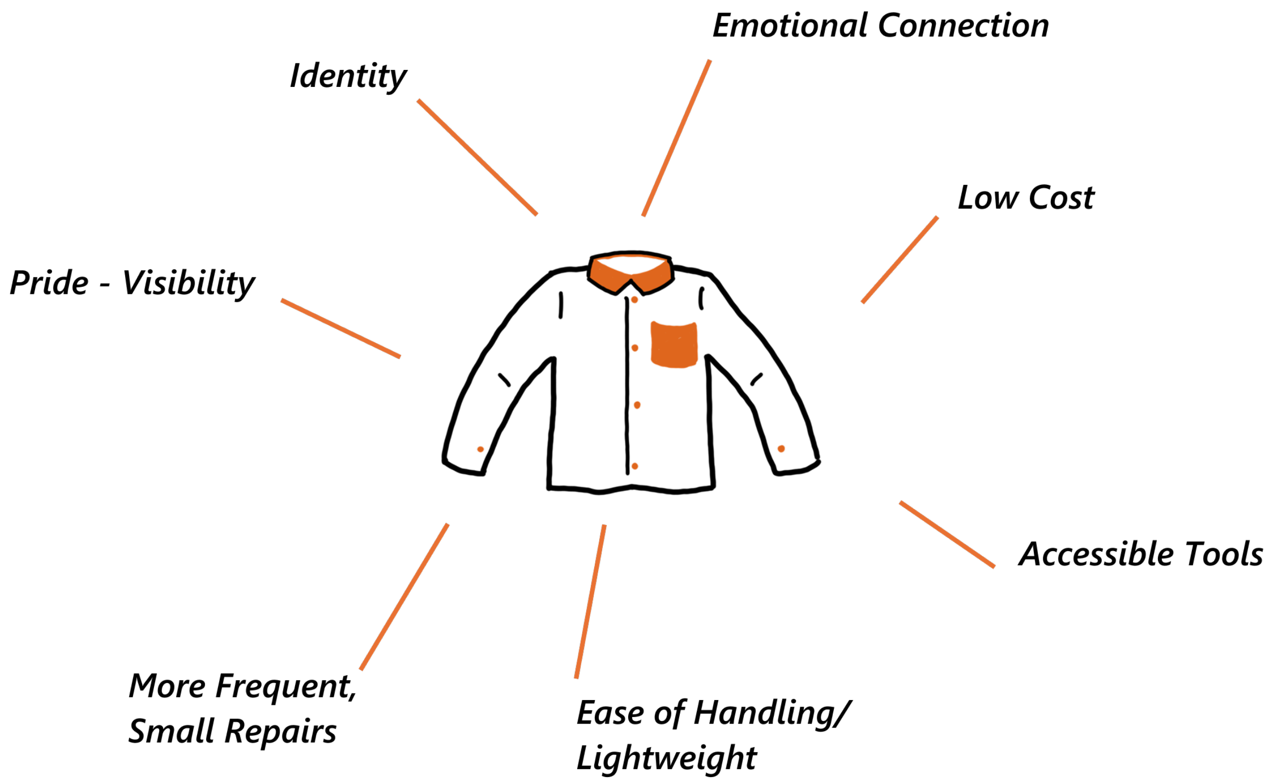


Figure 18: Reasoning behind Clothing Repairability

4.3.4 Oven Repair

When comparing bicycles, smartphones, and clothing to ovens, several key differences become apparent. In the first three categories, repair is supported by high perceived value, frequent use, and well-established repair ecosystems that provide consumers with accessible information, affordable services, and clear feedback on repair outcomes. Moreover, repair in these categories is culturally normalised or even positively framed, and the perceived risks associated with repair are relatively low or manageable.

Although ovens can be classified as workhorse products similar to bicycles, they lack many of these enabling conditions. Oven repair is associated with high perceived risk, low transparency of internal components, and limited consumer-facing guidance, which shifts responsibility almost entirely to professional technicians. As a result, consumers are less likely to consider self-repair and often disengage from the repair decision-making process altogether. These contrasts indicate that increasing willingness to repair ovens may require design interventions that reduce perceived risk, increase transparency, and strengthen the consumer's sense of competence and agency during the repair process.

► ***The intervention should reinforce the oven's value as a long-term product worth maintaining ra-ther than replacing.***

Chapter 5:

Analysis of the ATAG Oven

Having established a general understanding of the repair process and the prevailing repair culture, this chapter shifts focus to the ATAG oven. It presents the basic working principles of the oven, introduces ATAG ovens and their latest innovations, and identifies the most common malfunctions. In addition, the chapter includes a disassembly map of the ATAG oven, which forms the basis for a redesign proposal and provides guidance on which issues are suitable for self-repair.

5.1 Working Principle of the Oven

Before considering how an oven can be repaired, it is essential to understand its basic working principle. A typical oven uses three types of heating elements: an upper heating element, a lower heating element, and a convection heating element. This is shown in Figure 19.

The upper and lower elements are commonly used for grilling, while the convection heating element, widely used in the European kitchen, consists of a circular heating element combined with a fan that distributes hot air evenly throughout the oven cavity. All heating elements operate according to the same principle: they consist of a metal sheath containing a nichrome wire with high electrical resistance. When electricity passes through the wire, electrical energy is converted into heat. The wire is insulated with magnesium oxide powder, which efficiently conducts heat to the metal sheath while preventing direct contact between the wire and the sheath, Figure 20.

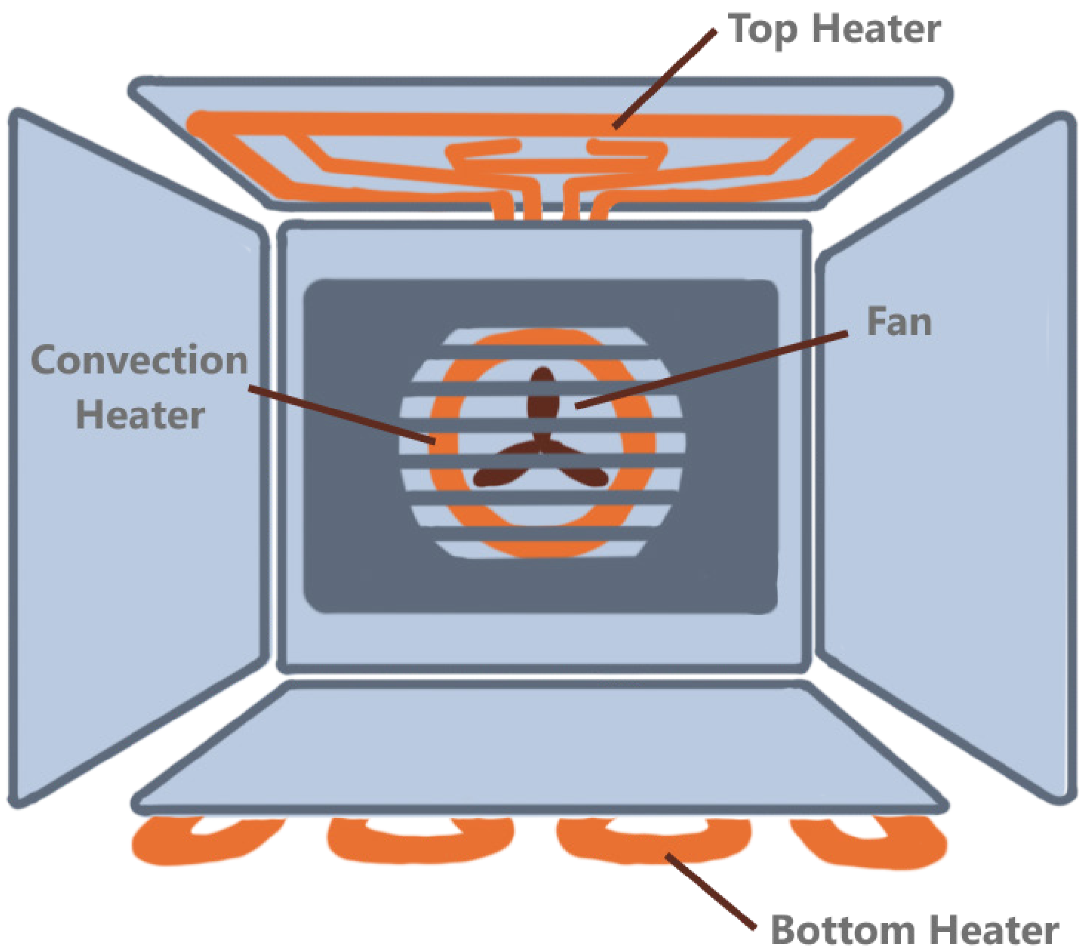


Figure 19: Layout of the Oven

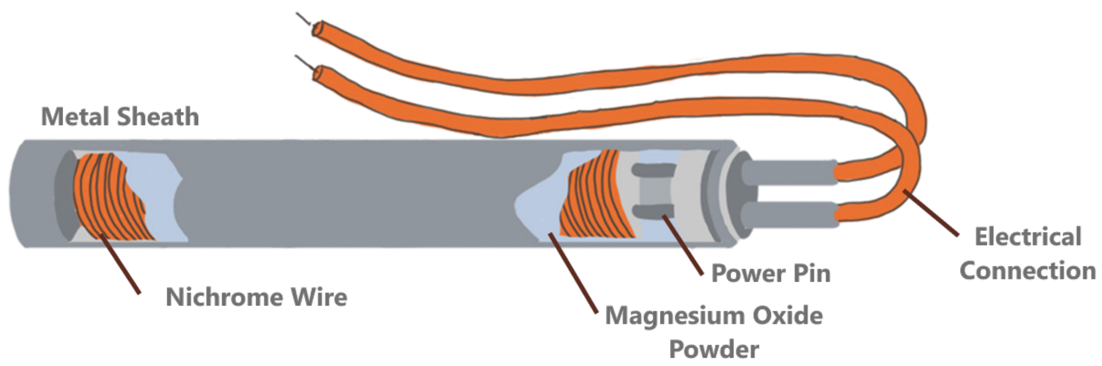


Figure 20: The Heating Element

5.1.1 Microwave Function

Some ovens also include a microwave function, which operates on a different and more complex principle. In this case, a magnetron converts electrical energy into microwaves, which are transmitted via an antenna into the oven cavity. These microwaves reflect off the interior walls and heat food as they pass through, with even heating achieved through a turntable or a fan, Figure 21. Due to the high power and potential safety risks of the magnetron and associated components, such as high-voltage capacitors that remain charged after unplugging, the risk of microwave leakage, and the presence of toxic materials in ceramic insulators, this thesis does not consider self-repair of the microwave function. Consumer self-repair is therefore limited to components that can be accessed while remaining safely away from microwave-related elements.

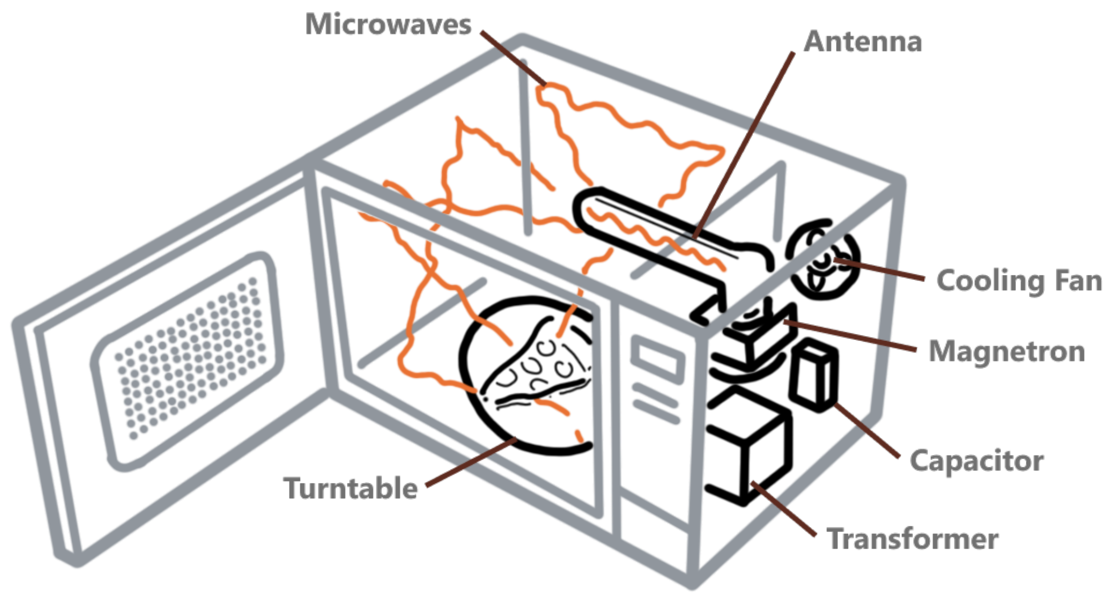


Figure 21: Microwave Components

5.1.2 Steam Function

Finally, ovens equipped with a steam function generate steam by heating water and distributing it through the oven cavity using a fan, adding another mode of heat transfer that relies on controlled airflow rather than direct radiation.

- ***The intervention should restrict consumers to touch or repair the microwave parts of the oven.***

5.2 Introduction to the ATAG ovens

ATAG offers a wide range of ovens, with a strong emphasis on multifunctionality and technological innovation. Its latest product line is the 5-in-1 oven, which combines five cooking modes: Conventional oven, microwave, steam, oven + microwave, and oven + steam, into a single appliance. In addition, this oven includes multiple cleaning programmes, a calibration function to ensure consistent cooking results, and connectivity to ATAG's Connected Life app, allowing users to control the oven remotely.

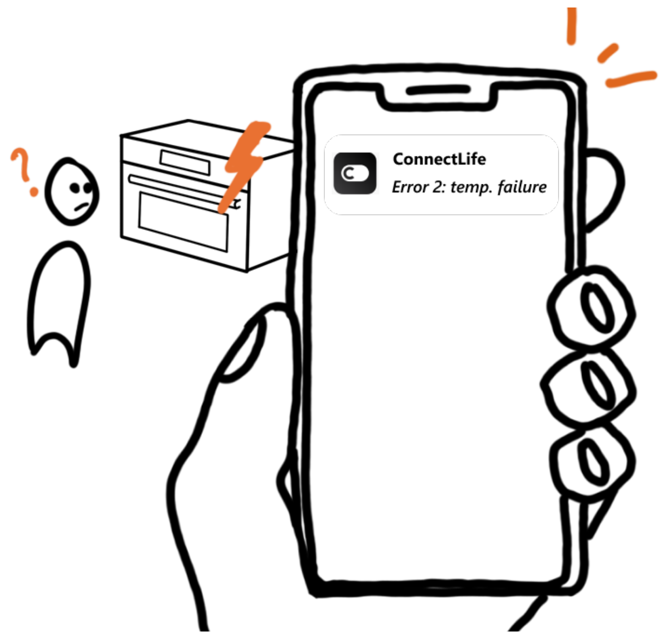


Figure 22: Self-Diagnosis Notification

While the connectivity through the app enables the collection of valuable user data, only a relatively small proportion of consumers actively connect their oven to the app. Nevertheless, ATAG is currently developing a self-diagnosis feature that detects malfunctions and communicates them to users via the app. Although this functionality is already available to app users, it is not yet fully reliable, as it does not function when failures occur within the oven's communicating components, such as the connection towards the app or the digital display. In addition, the system currently provides limited contextual information about the nature of the malfunction, presenting users only with an error code and prompting them to book an appointment with a service technician. As illustrated in Figure 22, the tone of the current message is dry and technical, which may reduce the likelihood that users read and fully understand the information presented. This suggests that the current form of communication does not fully support users in making sense of the malfunction.

- ***The intervention should encourage consumers to connect their oven to the app.***
- ***The intervention should make use of the diagnostic system within the smart technology of the oven.***
- ***The intervention should communicate malfunctions in a clear and actionable way at the moment of failure.***

5.3 Repair Challenges

As previously discussed, consumers should never attempt to repair the microwave function of their oven. The following paragraphs therefore explore which types of repairs could reasonably be carried out by consumers and which should remain the responsibility of a service technician. To do so, the most common malfunctions of ATAG ovens and the required disassembly process are discussed. This analysis leads to a proposal of repair tasks suitable for consumers, alongside a small redesign intended to make these repairs easier to perform.

5.3.1 Most Common Malfunctions

Finally, ovens equipped with a steam function generate steam by heating water To identify the most common malfunctions of ATAG ovens, two complementary sources were used. First, during a field trip, a service technician was interviewed about the failures he encounters most frequently in practice. This resulted in a ranked list of malfunctions, Figure 23, in which issues with the convection heating element were identified as by far the most common. While this experiential knowledge is valuable, it is inherently subjective and reflects the technician's personal encounters rather than a purely data-driven overview. To strengthen this insight, a second source was therefore consulted in the form of ATAG's service call-back rate data.

These call-back rate documents provide an overview of the reasons consumers contact the service desk over a five-year period, corresponding to ATAG's most common warranty length. Although the specific distribution of problems varies between oven models, two malfunction types consistently stand out across the data: failures of the power electronics (PCB's or control panel) and the convection heating element. A general overview was created

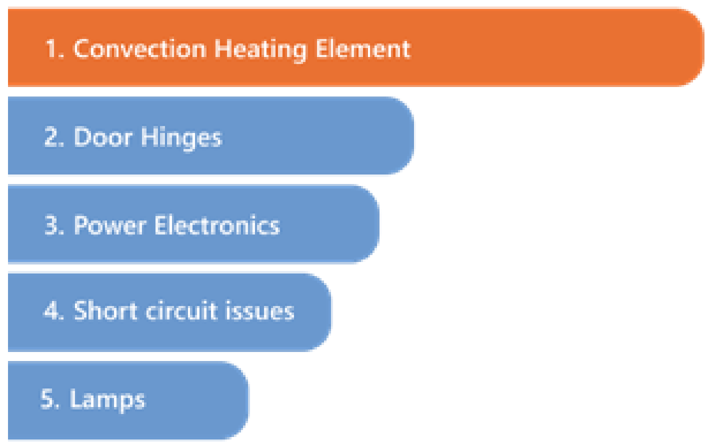


Figure 23: Most Common Malfunctions according to ATAG's service technician

by averaging the call rates across models, Figure 24, with the original model-specific graphs included in Appendix A. The data shows that in the first two years, most service calls relate to power electronics, accounting for approximately 6% of calls in the first year and 4% in the second, after which this percentage decreases sharply. From the third year onwards, failures of the convection heating element become dominant, rising from around 2.5% in year three to over 5% in year five. This pattern suggests that electronic issues tend to surface early in the product's lifespan, whereas heating element failures are more likely due to long-term use and material fatigue. This interpretation aligns with the technician's observations, who also identified the convection heating element as the most common oven malfunctions.

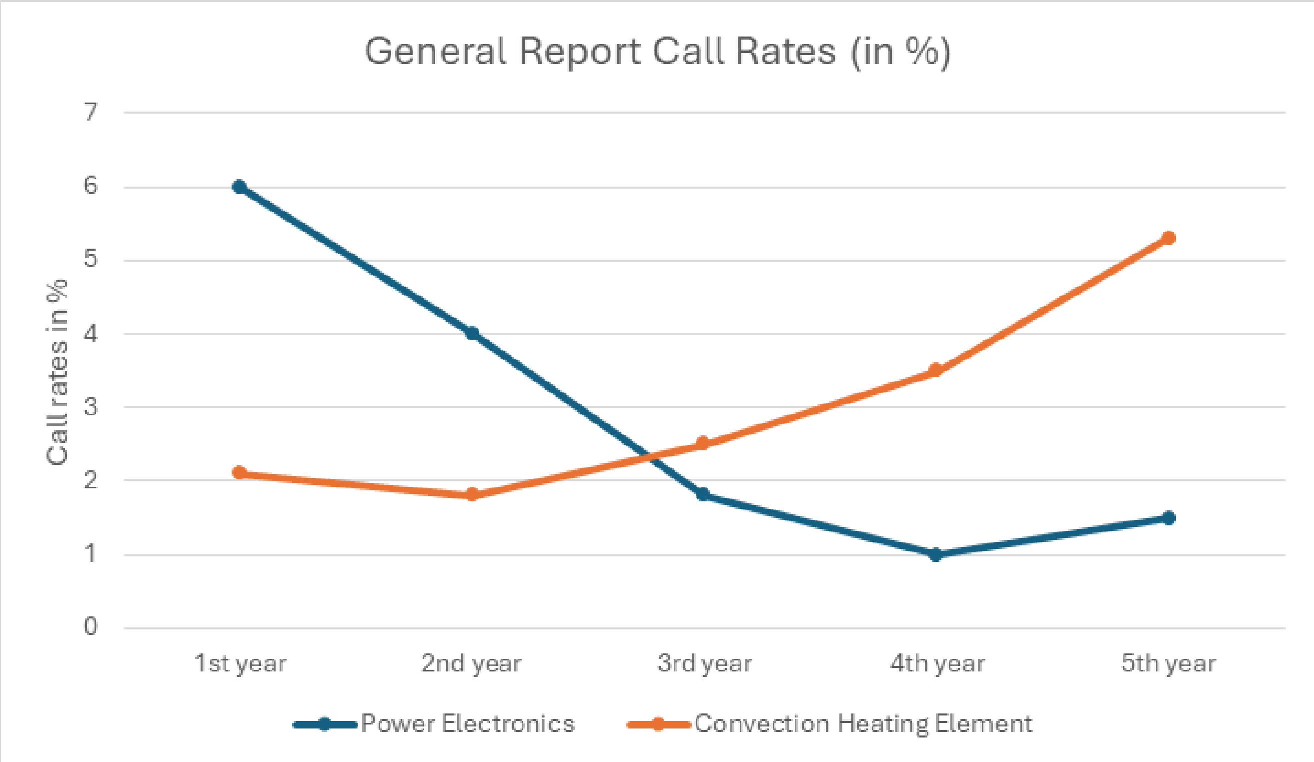


Figure 24: Oven Call-Back Rates for the Two Most Common Issues over the First 5 Years

5.4 Oven Disassembly

Having identified the components that most frequently malfunction, the next step was to examine how these components are arranged within the ATAG oven and what steps are required to access them. To support this analysis, a disassembly map was created.

The disassembly map is a method developed by Fazio (2021) that visually represents the component hierarchy and the most efficient sequence for removing parts. It also indicates the tools required and the level of force involved during disassembly, making it useful for assessing the feasibility of consumer self-repair. Pictures of the disassembly process are shown in Figure 25 and Figure 26.

The disassembly map, in Figure 27, is not complete and does not include all oven components; for instance, the heating elements are only partially represented. After several hours of disassembly, further access to the remaining components proved unclear. From a consumer self-repair perspective, these components can therefore be considered inaccessible within the current oven design. A more detailed explanation of the disassembly process and the construction of the map can be found in Appendix B.

Figure 25: Disassembled components of the oven

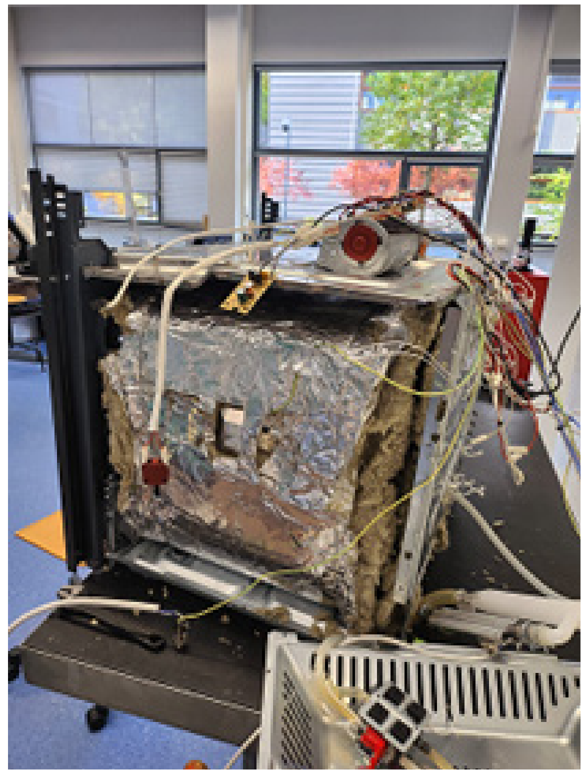


Figure 26: Oven after Disassembly

All components included in the map are numbered and visualised, with the required tools and difficulty of access indicated. Components on the left side of the map can be accessed from inside the oven chamber by opening the oven door. These parts are relatively easy to disassemble, as they do not expose consumers to visually complex elements such as printed circuit boards (PCBs) or a large number of fasteners. Accessible interior components include the oven door, protective lamp covers (excluding the lamps themselves), the inner wall, and the ventilation fan located behind it. Although the convection heating element can be reached from the inside, it cannot be removed from this side because the fastening screws are located at the back of the oven.

Components on the right side of the map (numbers 18–40) can only be accessed by removing the oven from its built-in position and detaching the top and rear panels. This significantly increases the difficulty of disassembly, as the oven must first be moved to a suitable workspace. In addition, the internal complexity is considerably higher due to the dense network of cables (Figure 26) connecting the components. Components marked in orange and red (Figure 27) were found to be particularly difficult to access and are therefore unsuitable for consumer self-repair in their current configuration. The components that were successfully disassembled are shown in Figure 25.

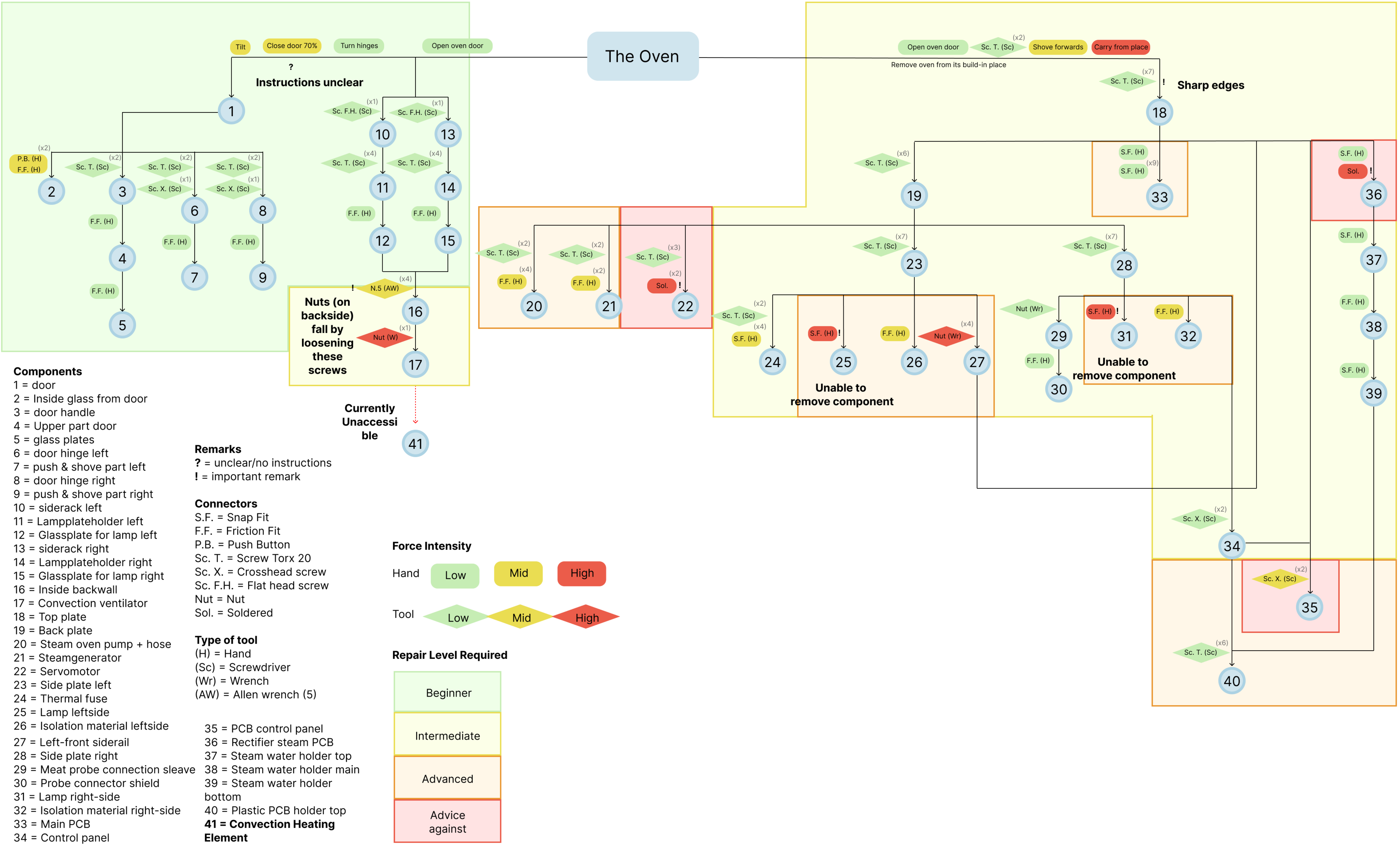


Figure 27: Disassembly Map of the Oven

5.4.1 Suitability for Self-Repair

Within the disassembly map, only the components indicated in green are considered suitable for consumer self-repair. This limitation is intentional, as removing the oven from its built-in position would require significant physical effort and introduce safety risks due to the weight of the appliance. In addition, certain internal components, such as microwave-related parts, should never be accessible to consumers, as they become reachable once the oven is removed from its housing.

As a result, the current oven design offers limited opportunities for self-repair, since only a small number of components can be accessed from within the oven cavity. At present, consumers can repair parts of the oven door or replace the side racks independently. Other components, including the convection heating element and the oven lamps, are reachable but cannot be disassembled from the inside. With minor design adaptations, these components could be made accessible for consumer self-repair.

The objective is therefore to enable safe self-repair of the oven door, lamps, and most importantly the convection heating element, without requiring removal of the oven from its built-in position.

The components designated for self-repair are listed in Figure 28. Additional components accessible from within the oven cavity (green in the disassembly map) are in principle also suitable for self-repair, but rarely malfunction as they mainly serve structural or separating functions rather than active technical functions.

This thesis focuses on the self-repair of the convection heating element, as it represents both the most common malfunction and the most complex repair among the selected components. The examples throughout this thesis therefore centre on the convection heating element, although similar principles could also be applied to the door hinges and oven lamps.

1. Convection Heating Element

2. Door Hinges

3. Lamps

Figure 28: Oven Components Suitable for Consumer Self-Repair

- ***The intervention must enable access to the convection heating element, door hinges and lamps without requiring removal of the oven from its built-in position.***
- ***The intervention must make the disassembly sequence of the convection heating element, door hinges and lamps intuitive and difficult to perform incorrectly.***
- ***The intervention must provide clear guidance on how to access and replace the convection heating element, door hinges and lamps.***
- ***The intervention must clearly indicate only the convection heating element, door hinges and lamps are intended for consumer self-repair.***
- ***The intervention should physically separate the consumer-repairable components from complex electronic systems.***

5.5 Redesign Proposition

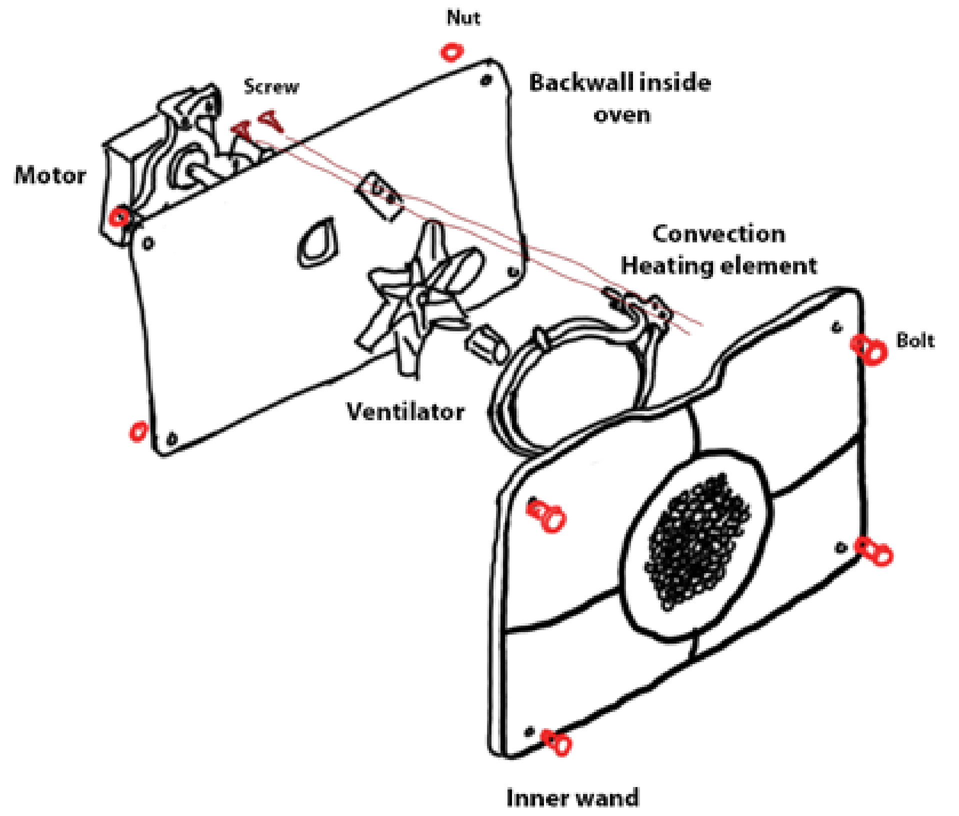


Figure 29: Current Oven Interior

An expert was consulted to assess the feasibility of enabling consumer self-repair through design adaptations. Making the convection heating element accessible and interchangeable from the inside of the oven was considered technically feasible, as this configuration existed in earlier oven designs produced in the Netherlands. In practice, this could be achieved by fastening the element with a limited number of screws inside the oven cavity. As this solution has already proven technically feasible and would only require minor adjustments to the fastening method, it was the only configuration explored in this research.

The current placement of the convection heating element, fastened from the back of the oven, shown in Figure 29, appears to be primarily driven by production efficiency. However, this configuration complicates professional repair, as service technicians must disassemble the appliance to access the component. Relocating the fastening mechanism to the inside would therefore enable consumer self-repair while also improving service efficiency, potentially reducing service time and costs for ATAG. Although this change may slightly increase production costs, these investments could likely be offset by savings in after-sales service. The inner wall positioned in front of the convection heating element and fan is marked with an exclamation point in the disassembly map. While this component is not inherently difficult to remove, its current fastening mechanism causes the nuts to fall into the insulation when the bolts are loosened from the back of the oven, visualised in Figure 31. As a result, reassembly becomes impossible without opening the rear of the appliance, highlighting the need for a fastening mechanism that allows the inner wall to be removed and reattached entirely from the inside.

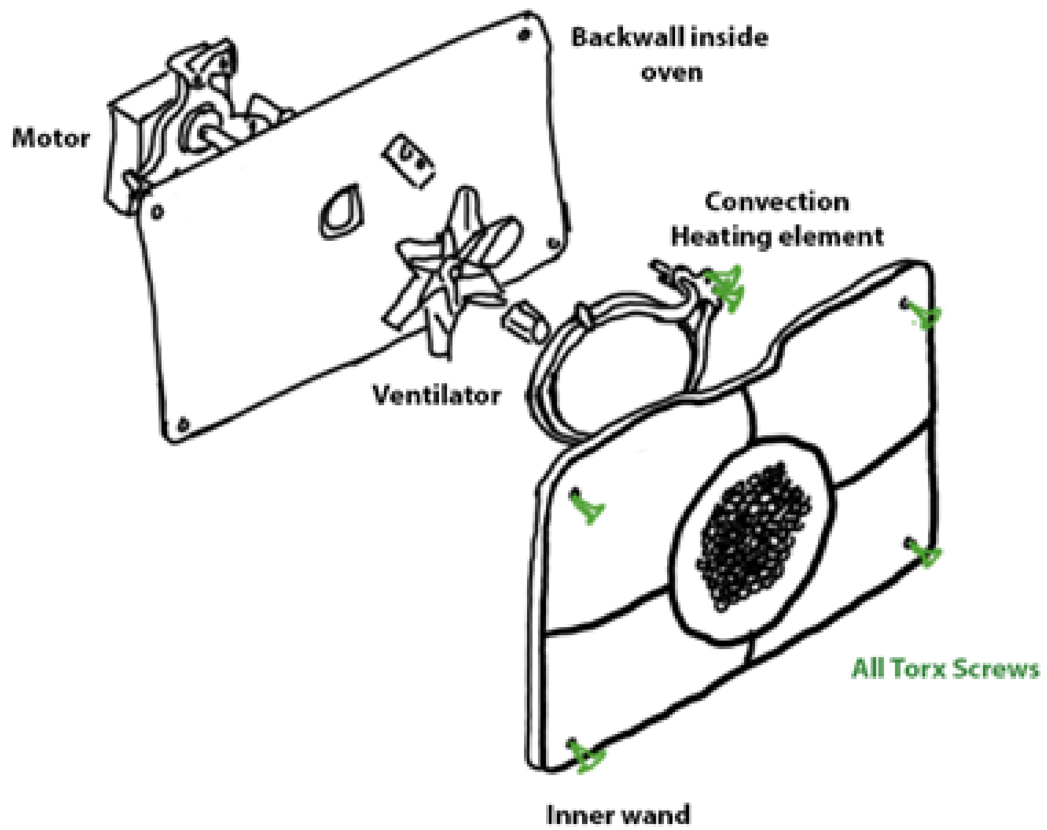


Figure 30: Redesigned Oven Interior

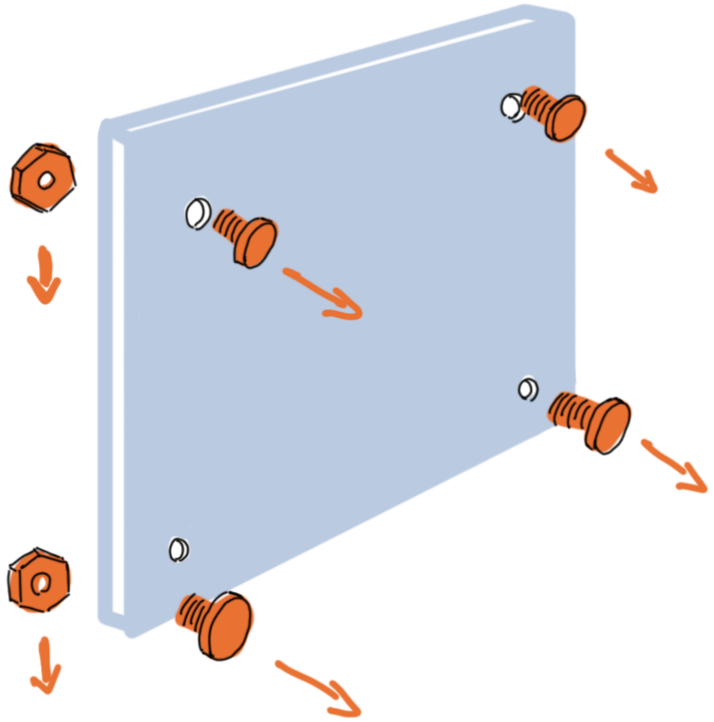


Figure 31: Problem with Inner Wall Re-assembly

The oven lamps should also be made replaceable from within the oven cavity. Although the lamps are visible and reachable from the inside, replacement currently requires removal of the oven from its housing and disassembly of the side panels. Other ATAG oven models already allow lamp replacement from the oven cavity using pull or twist fittings, demonstrating that safe consumer replacement is possible. However, the protective glass plates should only be removed when necessary, as repeated pressure could cause the glass to crack.

The oven door is already fully accessible from inside the oven and therefore requires no design modifications to support self-repair.

Finally, all fasteners used in self-repairable components should be standardised. Using identical Torx screws ensures that only one tool is required for repairs, lowering the threshold for consumer self-repair. Torx screws, shown in Figure 32, were selected as they better withstand vibrations and are more durable than Phillips head screws, according to the head of ATAG's service team.

An overview of the proposed redesign, illustrating the modified components and fastening mechanisms, is shown in Figure 30.


Figure 32: Torx Screws

- ***The intervention must ensure that all repairable components, and any components that must be removed in sequence to access them, can be disassembled and reassembled without opening the rear of the oven.***
- ***The intervention must limit the required tools to common household tools.***

Chapter 6:

Consumer Research

Having identified which oven components could be repaired by consumers and how the oven would need to be redesigned to enable this, it is important to examine consumers' actual willingness to repair their oven. The following chapter presents the consumer research conducted on willingness to repair ovens and discusses the results of the survey.

6.1 Survey

Although existing literature extensively addresses general barriers to repair (e.g. Roskladka et al. (2023); Terzioğlu (2021); Jaeger-Erben et al. (2021)), ovens are rarely discussed as a specific product category. The questionnaire was developed to gain product-specific insights into consumers' attitudes towards oven repair. In addition, the study explored consumers' openness to self-repair versus professional repair.

The survey focusses on the motivations and barriers participants experience and their thought on repairing the oven, to gain more insight into the first two research questions of this thesis.

RQ1: *What are the main motivations and barriers consumers experience when deciding whether to repair or replace an oven?*

RQ2: *How do consumers perceive the economic, emotional, and environmental value of repairing an oven?*

6.1.1 Method

This study was conducted as an exploratory survey administered online via Qualtrics. A cross-sectional survey design was chosen to capture self-reported attitudes and perceived barriers at a single point in time and to explore relationships between these variables. Participation was voluntary and anonymous. Data were collected in November 2025 through a questionnaire.

Participants

The questionnaire was distributed in Dutch to ensure accessibility for the target group, particularly older Dutch oven owners, and to minimise potential language-related barriers to participation.

Participants were initially recruited via ATAG's customer base, which provided access to the specific target group. This distribution channel resulted in 25 completed responses. To obtain a sufficiently large dataset for quantitative analysis, the questionnaire was subsequently distributed via the researcher's personal network using a convenience sampling approach. In total, 92 complete responses were collected.

Eligibility criteria required that participants owned their oven themselves, meaning the appliance was not part of a rental property, and that they were proficient in Dutch, as the questionnaire was administered in this language.

The final sample comprised 92 participants ranging in age from 23 to 84 years ($M = 50$, $SD=16.95$). Of these, 46 identified as male, 40 as female, and 6 did not specify their gender.

Measures

Prior to beginning the questionnaire, respondents were required to provide informed consent via a mandatory consent page. Afterwards, the questionnaire consisted of four more sections.

The first section of the questionnaire assessed respondents' willingness to repair their own oven and the perceived barriers associated with doing so. Willingness to perform specific repair and maintenance activities (e.g. replacing components or conducting basic maintenance tasks) was measured using self-developed items. In addition, eleven potential barriers to repair were assessed, reflecting practical, psychological and knowledge-related constraints identified in prior qualitative exploration. Most items in this section were measured on a seven-point Likert scale ranging from 1 (not willing at all) to 7 (very willing).

Eco-consciousness was measured using a reduced version of the New Ecological Paradigm (NEP) scale (Dunlap et al., 2000), as applied by Whitmarsh (2008). Items were rated on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

General willingness to repair consumer electronics was assessed using self-developed items rated on a seven-point Likert scale (1 = not willing at all, 7 = very willing).

Demographic information was collected at the end of the questionnaire, including age (open-ended), income level and highest completed level of education (multiple-choice).

Finally, product involvement was measured using the scale developed by Magnier et al. (2019). Items were rated on a seven-point Likert scale.

The complete questionnaire can be found in Appendix C.

Data Analysis

The data were analysed using IBM SPSS Statistics. In addition, Data Voyager was used exploratively to identify potential patterns and relationships within the dataset.

Prior to analysis, incomplete responses were screened. Responses in which substantial portions of the questionnaire were missing were excluded. However, cases in which only the demographic section was incomplete were retained, to preserve statistical power and ensure a sufficient sample size for analysis.

One extreme outlier was identified in the variable measuring willingness to pay for oven repair. A single respondent indicated a willingness to pay €8.000, which substantially exceeded plausible market values and was approximately four times the price of a high-end new oven. This value was treated as an outlier and removed from the analysis for that specific variable.

Statistical significance was determined using an alpha level of .05.

6.1.2 Results

The next sections contain the survey results.

Enablers & Barriers to Repair

Stepwise multiple regression analyses were conducted to identify which perceived enablers and perceived barriers significantly predict consumers' willingness to repair the oven. In the self-repair model, willingness to self-repair served as the dependent variable, with perceived repair enablers and barriers entered as predictors. As shown in Table 1, worth the effort ($p < .001$) and risk of damaging the product ($p = .010$) were the only significant predictors.

A similar stepwise regression analysis was performed for willingness to opt for professional repair. In this model, the enabler; worth the effort ($p < .001$) and barrier; expensive ($p = .007$) significantly predicted willingness to professionally repair the oven, shown in Table 2.

Although other enablers and barriers were included in both models, they did not explain additional variance in willingness to repair. This indicates that, for self-repair, willingness can largely be predicted by whether consumers perceive the repair as worth the effort and by their concern about causing damage, while for professional repair, the enabler worth the effort and barrier expensive are the dominant factors.

Table 1: Stepwise Multiple Regression Coefficients Barriers/Enablers Influencing WIllingness to Self-Repair

	B	SE	sig.
Worth the Effort	,720	,169	<,001
Risk of Damaging the Product	-,332	,126	,010

Table 2: Stepwise Multiple Regression Coefficients Barriers/Enablers Influencing WIllingness to Professional Repair

	B	SE	sig.
Worth the Effort	,528	,144	<,001
Expensive	-,384	,138	,007

In addition to examining how barriers influence willingness to repair, consumer perceptions of self-repair versus professional repair were compared. Perceived barriers for self- and professional repair are shown in Figure 33. Self-repair scored significantly higher on the barriers time-consuming, complex, frustrating, risk of damaging the product, and physically unsafe (all $p < .001$), whereas professional repair scored significantly higher on expensive ($p < .001$). The highest means were for expensive professional repair ($M = 5.48$) and complex self-repair ($M = 5.14$), while several barriers scored notably low for professional repair: complex ($M = 2.84$), risk of product damage ($M = 2.18$), and physically unsafe ($M = 1.67$).

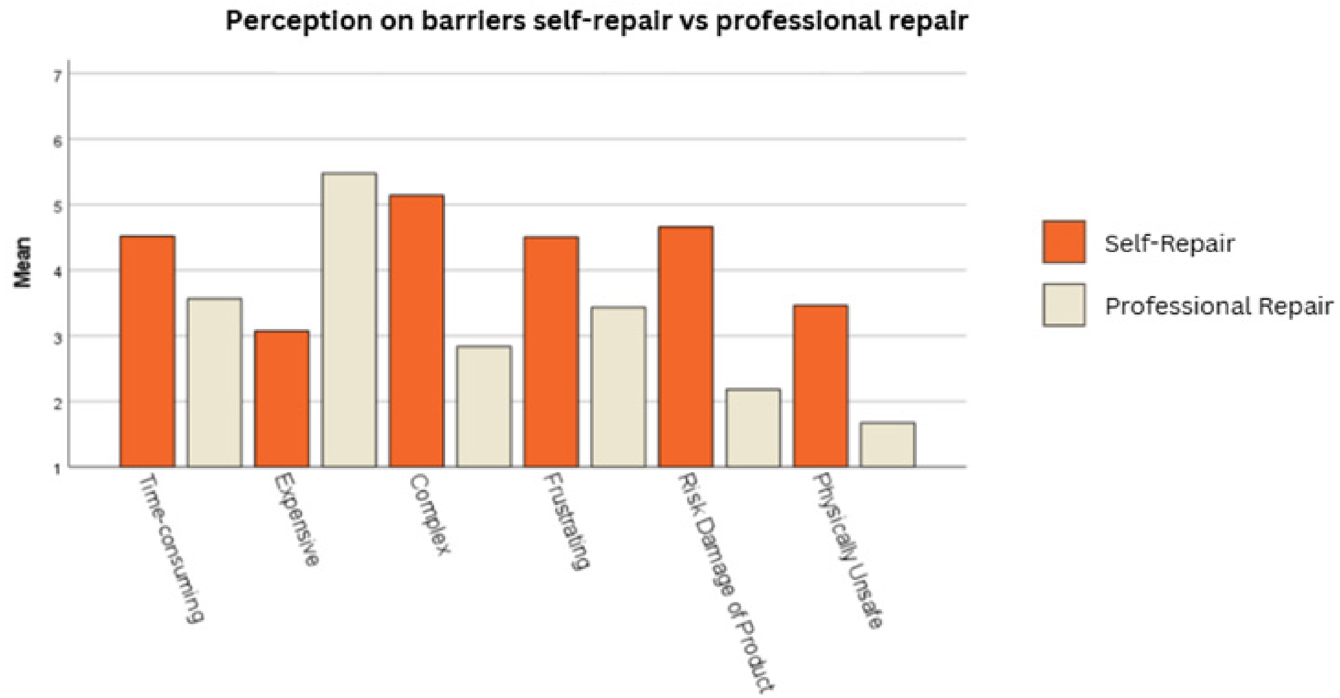


Figure 33: Consumers' Perception on Barriers to Repair (Self vs. Professional)

For enablers, the outcomes are shown in Figure 34. Fulfilling and empowering were rated higher for self-repair (both $p < .001$), and trustworthy was rated higher for professional repair ($p < .001$). No significant differences were found for environmentally friendly and worth the effort. The highest means were fulfilling for self-repair ($M = 5.29$), trustworthy for professional repair ($M = 5.85$), and worth the effort for both self- ($M = 5.20$) and professional repair ($M = 5.01$), while empowering professional repair scored lowest ($M = 2.80$). An overview of all means for barriers and enablers is provided in Appendix D.

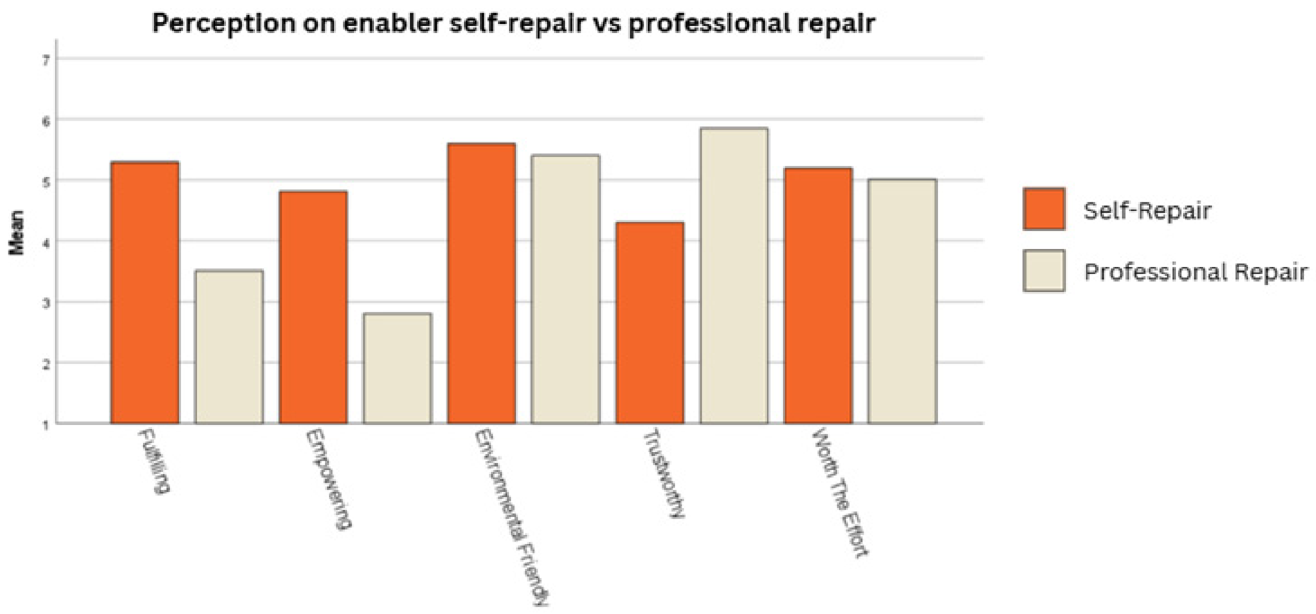


Figure 34: Consumers' Perception on Enablers to Repair (Self vs. Professional)

Maintenance Tasks

In addition, respondents' willingness to perform different types of maintenance and repair activities was examined to better understand which actions consumers are likely to undertake themselves. Figure 35 presents the mean willingness scores for each maintenance and repair task.

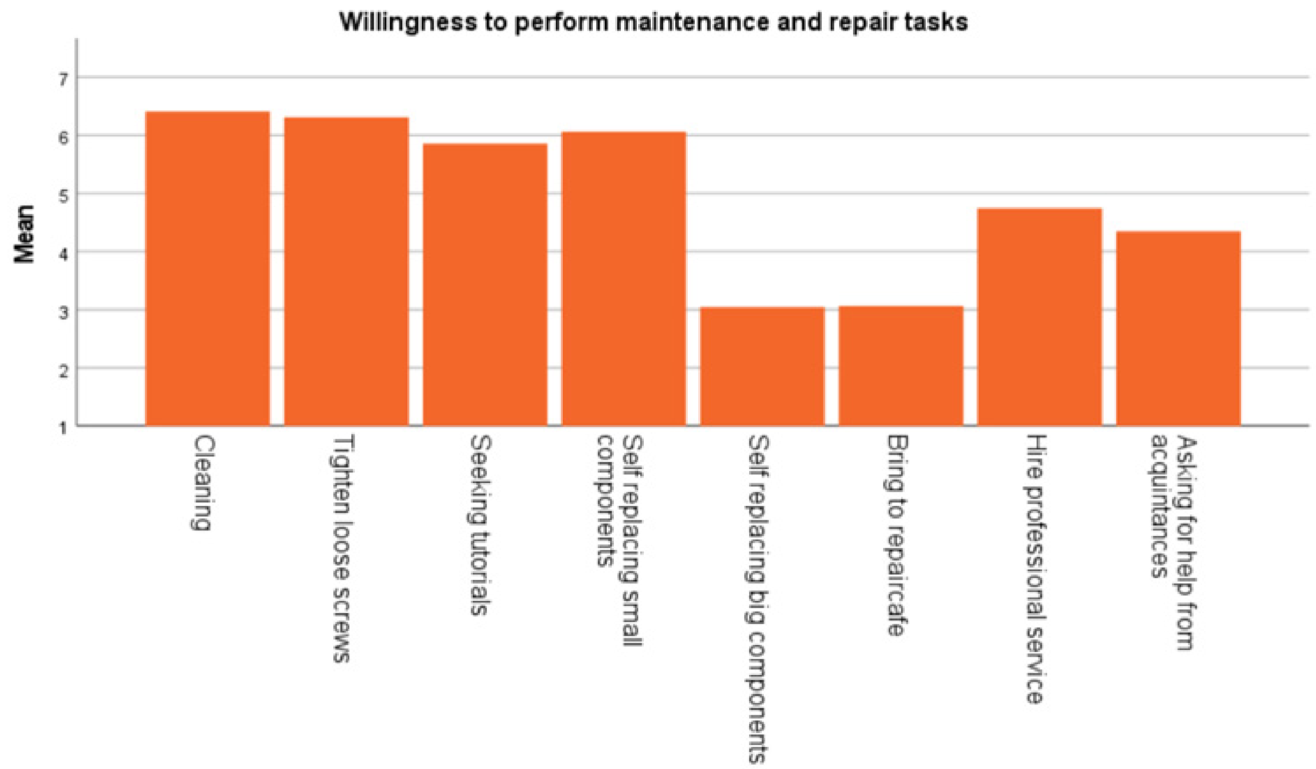


Figure 35: Consumers' Willingness to perform Maintenance Tasks

A one-sample t-test against the scale midpoint indicates that willingness scores for all tasks differ significantly from the midpoint, except for asking for help from acquaintances. This suggests that respondents are significantly willing to clean, tighten loose screws, seek tutorials, change small parts or hire a professional service for the repair of the oven. It also shows they are significantly not willing to change big components or bring the oven to a repair café. The full statistical results are reported in Appendix D.

Maximum Price

Participants were also asked to indicate the maximum price they would be willing to pay for repairing their oven. To explore this, the mean, median, and mode were analysed and are presented in Table 3. Both the median and the mode indicate a maximum acceptable repair cost of 150 euros. Professional repair easily approaches or exceeds this threshold, whereas self-repair, where consumers primarily pay for spare parts (e.g., €30–50 for a convection heating element), remains well below it.

It is notable that the mean is considerably higher than both the median and the mode. One extreme value of €8,000 was removed from the analysis as an outlier. However, several responses remained above €500, including two values of €1,000 and €1,500. As multiple responses fell within this higher range, they were not classified as outliers. Nevertheless, because these amounts are substantially higher than the median, they inflate the mean; a response of €1,000 has a disproportionately larger effect on the mean than a response of €100.

Table 3: Max. Oven Repair Costs

Mean	298
Mode	150
Median	150

Polarised Group

A notable pattern emerges in the data when examining consumers' willingness to engage in self-repair. The distribution of responses is highly polarised, as illustrated in Figure 36. Rather than approximating a normal distribution, responses cluster predominantly at the extremes of the scale, with most respondents indicating either a very low willingness to self-repair (1) or a very high willingness (7).

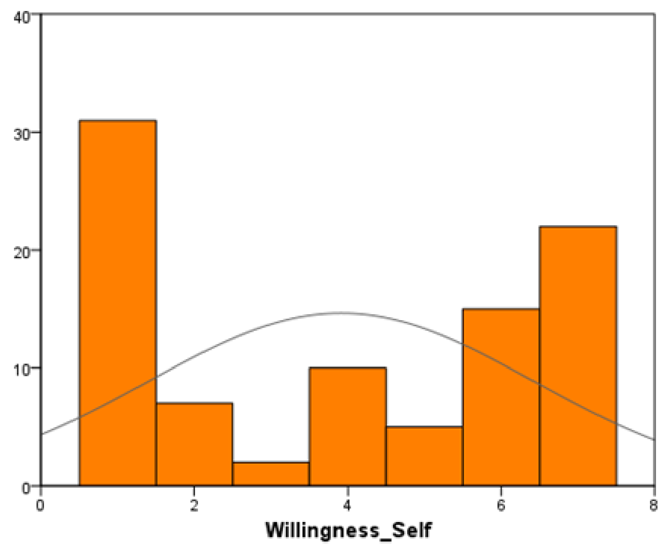


Figure 36: Distribution Participants' Willingness to Self-Repair

A similar, though less pronounced, pattern is observed for willingness to use professional repair services. While responses still exhibit two peaks at the lower and higher ends of the scale, the distribution is comparatively less polarised, shown in Figure 37. Statistical analysis indicates that both willingness to self-repair and willingness to use professional repair services are significant ($p < .001$).

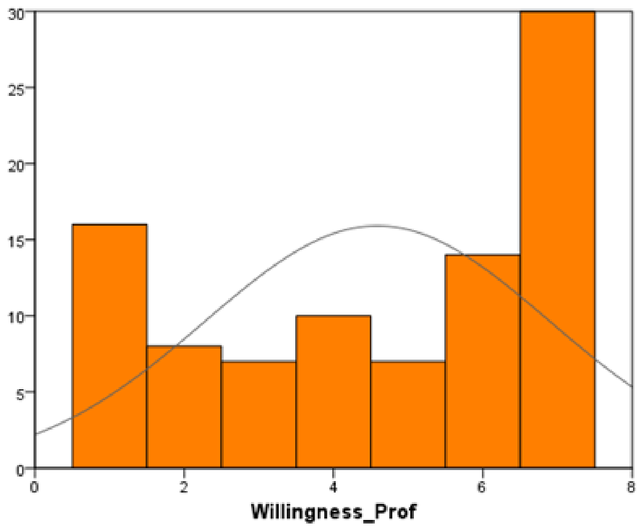


Figure 37: Distribution Participants' Willingness for Professional Repair

Demographic Differences

Finally, the data reveal a clear difference between men and women in their willingness to engage in self-repair. As shown in Figure 38, men report a higher overall willingness to self-repair compared to women. This difference is statistically significant ($p < .002$).

Age and education were also examined as potential factors influencing willingness to self-repair, but no significant differences were found, and they did not yield any notable insights.

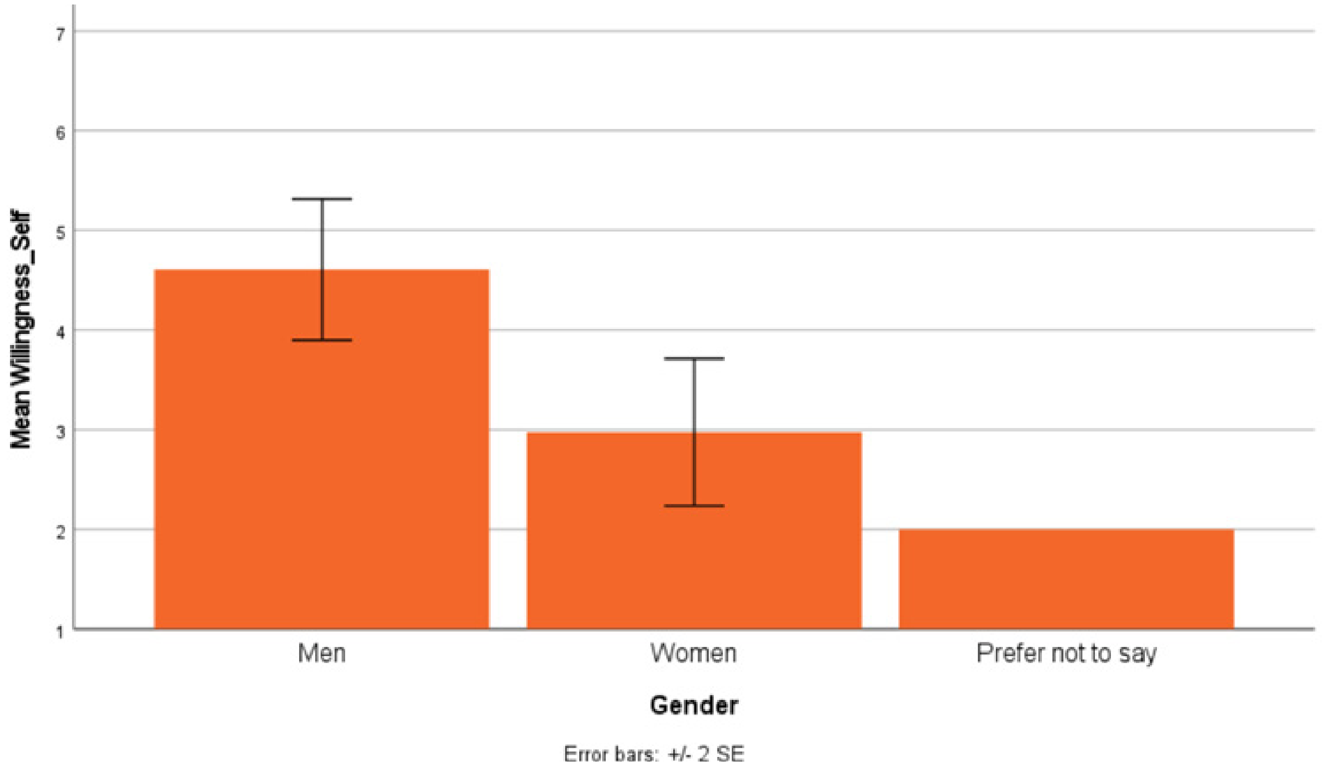


Figure 38: Willingness to Self-Repair with regards to Gender

6.1.3 Conclusion

The results of this consumer study demonstrate a pattern: self-repair is primarily a value judgement. The strongest predictor of willingness to repair an oven oneself is whether the repair is perceived as worth the effort, followed by the risk of damaging the product. Other factors, such as perceived complexity, safety concerns, time consumption and cost, correlate with willingness, but do not explain additional unique variance once these two dominant barriers are accounted for. This implies that their influence appears to be embedded within the two key barriers worth the effort and risk of damaging the product.

A similar pattern is observed for professional repair, where worth the effort and expensive emerge as the key predictors of willingness. In this context, perceived expenses remain a decisive barrier when consumers consider professional repair services.

Worth the Effort

The prominence of worth the effort aligns with existing literature describing repair decisions as shaped by behavioural and financial costs (Jaeger-Erben et al., 2021). When the required time, effort, inconvenience or financial investment are perceived as high, repair rates tend to decrease (Terzioglu, 2021; Ackermann et al., 2018). In this sense, the construct appears to function as an umbrella variable that integrates multiple considerations, effort, cost, and perceived difficulty, into a single evaluative judgement about whether repair is worthwhile, this is visualised in .

Interestingly, the present dataset shows relatively high mean scores for perceived worth (M = 5.2 for self-repair; M = 5.0 for professional repair). This suggests that consumers generally acknowledge the value of repair in principle. However, the data simultaneously show a clear polarisation in willingness to self-repair. This indicates that although repair may be conceptually valued, hesitation arises when individuals consider the practical implications of performing the repair themselves.

One possible explanation is that the evaluation of "worth" also reflects uncertainty about outcomes. If consumers doubt whether a repair will be successful, durable, or worth the investment of time

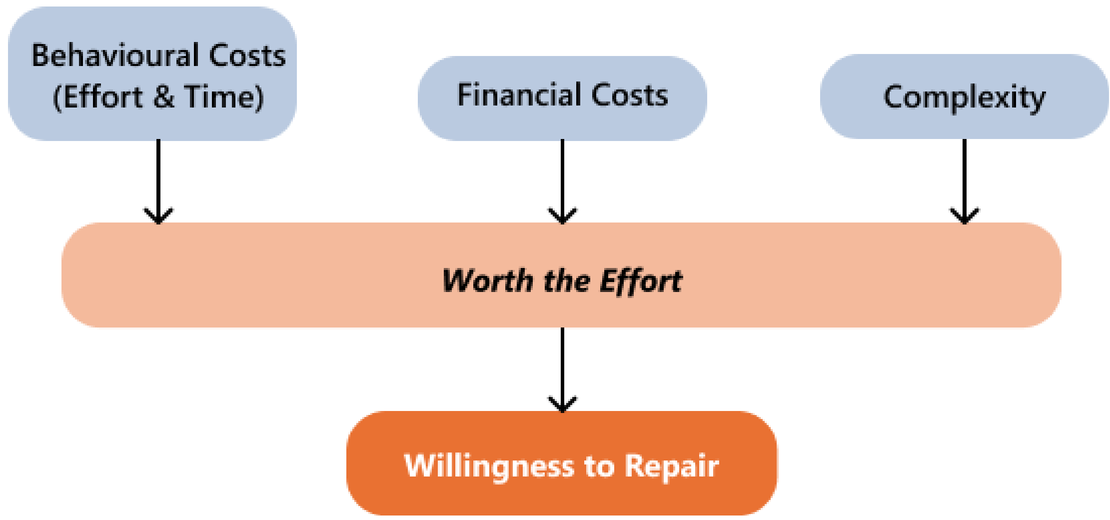


Figure 39: Visualisation of the Umbrella Term 'Worth the Effort

and effort, the perceived value decreases. In this sense, worth the effort may capture not only the expected labour involved but also confidence in the reliability of the repair outcome.

Risk of Damaging the Product

The second strongest predictor of self-repair willingness, risk of damaging the product, similarly echoes existing research. Several studies identify lack of confidence, fear of irreversible damage and perceived product inaccessibility as recurring barriers to repair (Nazlı, 2021; Roskladka et al., 2023; van den Berge et al., 2023; Jaeger-Erben et al., 2021). Modern product design often reinforces these perceptions through hidden fasteners, specialised tools or warranty seals that implicitly communicate that products are not intended to be opened by users.

The present findings confirm that perceived risk is not merely technical but also psychological. It reflects anticipated regret, uncertainty about personal competence and the fear of causing irreversible damage. Importantly, this barrier remains significant even when effort and cost are accounted for, suggesting that increasing consumer confidence could meaningfully increase repair willingness.

The oven context may further intensify this perception. Unlike smaller consumer electronics, ovens are high-voltage, built-in appliances associated with heat and potential safety hazards. These characteristics may amplify fears of damaging the product or creating unsafe situations, making confidence-building interventions particularly relevant.

Expensive

For professional repair, expense emerges as a decisive predictor, which strongly aligns with prior literature. Jaeger-Erben et al. (2021) identify perceived financial cost as a primary barrier to repair across multiple product categories. However, repair decisions are not purely rational calculations of cost. Consumers also compare the remaining utility value and trade value of their current product with the attractiveness of purchasing a new alternative.

Research by Laitala et al. (2021) shows that consistently low prices of new products create strong cost competition, making repair appear economically irrational. Consumers are often only willing to pay 19–30% of the replacement price for repair. For the ATAG oven, this would correspond to approximately €475–€750. However, the present study found the maximum acceptable repair price to be considerably lower, at €150. Despite this, a threshold of €150 still positions self-repair as financially viable.

From Barriers to Design Opportunities

To encourage self-repair of ovens, interventions should primarily address these dominant barriers.

- **Strengthen perceived value:** ***Emphasise longevity, sustainability, and financial savings to reinforce that repair is truly worth the effort.***
- **Reduce perceived risk:** ***Provide step-by-step guidance, reassurance, reversible actions, and visible support to increase confidence and lower fear of irreversible damage.***
- **Frame repair as manageable:** ***The data show high willingness for small-scale tasks (cleaning, tightening screws, replacing minor parts). Presenting repair as a series of low-threshold actions rather than a single complex intervention aligns with consumer preferences identified in literature.***
- **Leverage cost comparison:** ***As expense is decisive for professional repair but not self-repair, highlighting the financial advantage of self-repair creates a strategic positioning opportunity.***

The results also reveal a clear polarisation among respondents. The sample appears to consist of two distinct segments: one that is largely unwilling to engage in self-repair and another that is highly willing when repair is perceived as a viable option. The intervention will therefore focus primarily on the group that does not initially consider repair as an option. By addressing the psychological barriers that discourage this group from attempting repair, the intervention aims to broaden the range of consumers who perceive self-repair as a feasible choice.

Overall, the findings corroborate existing repair literature while adding nuance to the understanding of repair decisions. Rather than cost or complexity alone, willingness to repair appears to revolve around a broader perception of value, confidence and risk. For ovens, durable, high-investment appliances, repair willingness appears to exist in principle. The key challenge is therefore not convincing consumers that repair is desirable, but making it feel safe, manageable and unquestionably worthwhile.

6.1.4 Discussion

Initial Assumption

At the outset of this thesis, it was argued that time and complexity would be particularly relevant barriers for self-repair. The findings nuance this assumption. Rather than acting as standalone obstacles, they seem to function as components within a larger value judgement. This shifts the theoretical framing: instead of treating repair barriers as isolated attributes (complexity, time, cost), they may be better understood as contributors to an overarching perception of worth and risk.

In other words, consumers do not reject self-repair simply because it is complex. They reject it when the complexity, combined with risk and uncertainty, makes the effort feel unjustified.

Limitations of the Study

This study has several limitations that restrict the generalisability of the findings.

First, a substantial proportion of participants were recruited through personal networks. As a result, the sample partly skews younger than the typical ATAG target group. Younger respondents may be more sensitive to financial considerations due to lower disposable income, which could influence perceptions of repair costs.

Second, many respondents were located in or around Delft. Although TU Delft students were largely excluded because most do not own their own oven, the broader Delft region still has a relatively technical demographic profile. This may imply higher confidence in technical tasks and greater openness towards self-repair compared to the general Dutch population.

Finally, the study is based on a relatively small sample size (N = 92). While meaningful patterns emerge, the statistical power may be insufficient to detect smaller effects. Variables that did not reach significance in this analysis could still play a role in larger or more diverse samples. Smaller samples are also more sensitive to variability and may exaggerate polarisation effects. Consequently, while the results provide valuable insights into consumer repair perceptions, further research with larger and more representative samples would be needed to confirm the extent to which these findings apply to the broader Dutch population.

- ***The intervention should explicitly communicate why self-repair is worthwhile for the consumer.***
- ***The intervention must ensure that self-repair solutions remain below the €150 maximum acceptable repair price.***
- ***The intervention should frame self-repair as a series of small, manageable tasks rather than a complex or risky repair.***

Chapter 7:

Analytical Outcomes

This chapter concludes on the main findings during the analysis. The first two research questions are tackled, and other interesting findings are summarised. In the second part of this chapter the requirements are clustered into different themes, and a concise list has been made to further evaluate concept ideas.

7.1 Answering First Research Questions

Looking back at the research questions formulated at the start of the project, it becomes clear that the first two questions can now be addressed based on the findings.

RQ1: ***What are the main motivations and barriers consumers experience when deciding whether to repair or replace an oven?***

The findings show that consumers' decisions to repair or replace an oven are primarily driven by a small number of key considerations, which differ slightly between self-repair and professional repair, visualised in Figure 40.

For self-repair, the most influential factors are whether consumers perceive the repair as worth the effort and the risk of damaging the product. When consumers believe that repairing the oven themselves is worth the effort, their willingness to self-repair increases. In contrast, when they believe they may cause further damage, it significantly reduces their willingness to attempt self-repair. Although other factors, such as perceived product complexity, feelings of empowerment, encouragement, physical safety, environmental friendliness, and trustworthiness, are related to willingness to self-repair, their influence largely overlaps with the two dominant factors. As a result, these aspects play a secondary role in the decision to self-repair the oven.

For professional repair, consumers' willingness is mainly shaped by the cost of repair and whether the repair is perceived as worth the effort. Professional repair is more likely to be considered when consumers feel that the effort of arranging this is justified, while high repair costs act as a strong barrier. Other factors, including time consumption, product complexity, and feelings of empowerment, are associated with willingness to seek professional repair but do not independently explain the decision once cost and perceived effort are considered.

Overall, the results indicate that consumers' repair decisions are largely guided by practical cost–effort considerations and perceived risk.

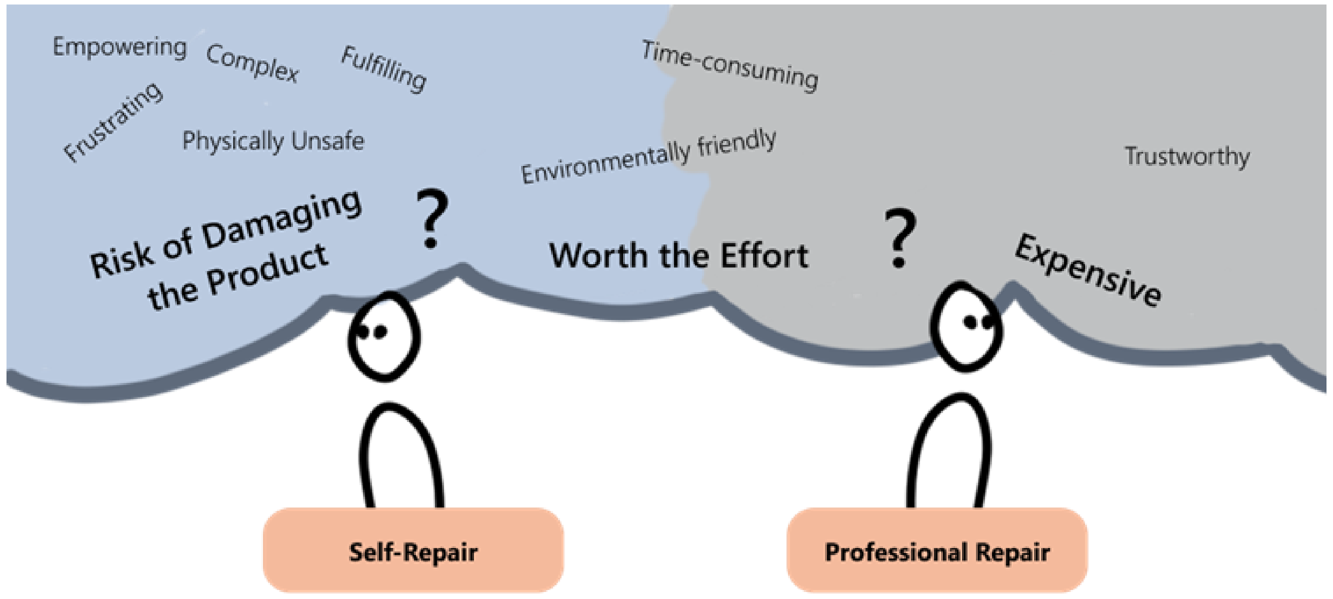


Figure 40: Visual Summary of Consumers' Key Considerations

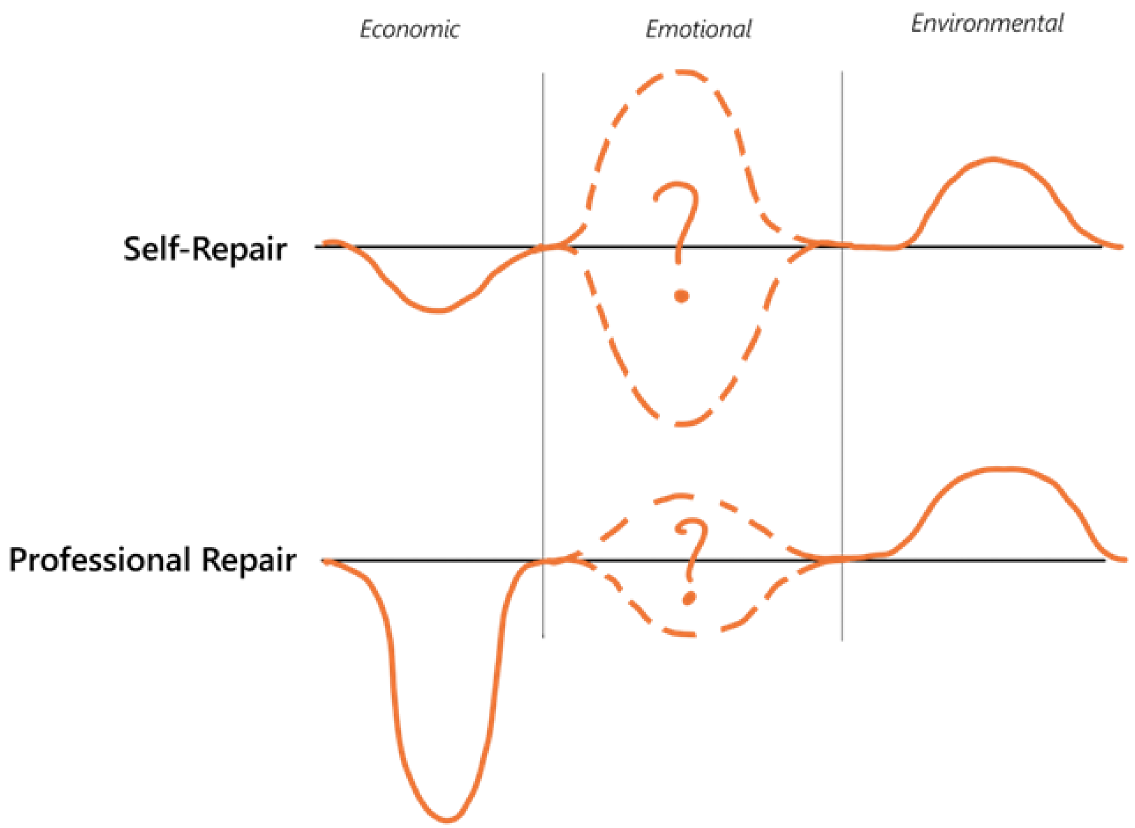


Figure 41: Visual Summary of Economic, Emotional & Environmental Value of Repair

RQ2: ***How do consumers perceive the economic, emotional, and environmental value of repairing an oven?***

The results show that consumers perceive oven repair as valuable across economic, emotional, and environmental dimensions, but view self-repair and professional repair differently, an overview is shown in Figure 41.

Professional repair is strongly associated with high costs, which reduces willingness to choose this option. In contrast, cost plays a less prominent role in decisions about self-repair. No significant relationship was found between perceived cost and willingness to self-repair, and consumers generally do not associate self-repair with being expensive. Most consumers indicated the maximum acceptable price for a repair would be between €50 and €150, suggesting a clear economic threshold beyond which repair is no longer considered worthwhile.

Emotionally, self-repair is experienced as more empowering but also more frustrating, while professional repair is seen as more trustworthy and reassuring, highlighting a trade-off between empowerment and comfort.

Both options are widely regarded as environmentally friendly. This indicates that consumers recognise the environmental benefits of repair, regardless of who performs it.

Overall, although repair is valued for its environmental benefits and potential emotional rewards, economic limits and emotional risks strongly shape consumers' repair decisions.

7.2 From Insights to Design Focus

Beyond answering the research questions, the analysis also provides insight into where design interventions can most effectively influence consumers' repair behaviour. The findings suggest that many consumers do not initially consider self-repair as a realistic option. This reluctance is primarily driven by three perceived barriers: doubts about whether the repair is worth the effort, concerns about potentially damaging the product, and uncertainty about how to proceed during the repair process.

At the same time, literature on consumer repair behaviour highlights that the repair process unfolds through several key decision points, typically described as repair interest, repair decision, and repair action. The barriers identified in the analysis correspond closely with these stages, indicating that different forms of support are required throughout the process.

To address these challenges, the design direction focuses on three complementary intervention principles. First, consumers need to be convinced that repairing the oven themselves is worthwhile and valuable enough to consider. Second, they must be reassured that the repair is feasible and does not involve excessive risk of damaging the product. Finally, they require continuous support during the repair process itself, particularly when encountering uncertainty or setbacks. These stages are shown in Figure 42.

These three principles, convincing, reassuring, and supporting, translate the analytical insights into a clear foundation for the design direction developed in the following chapters.

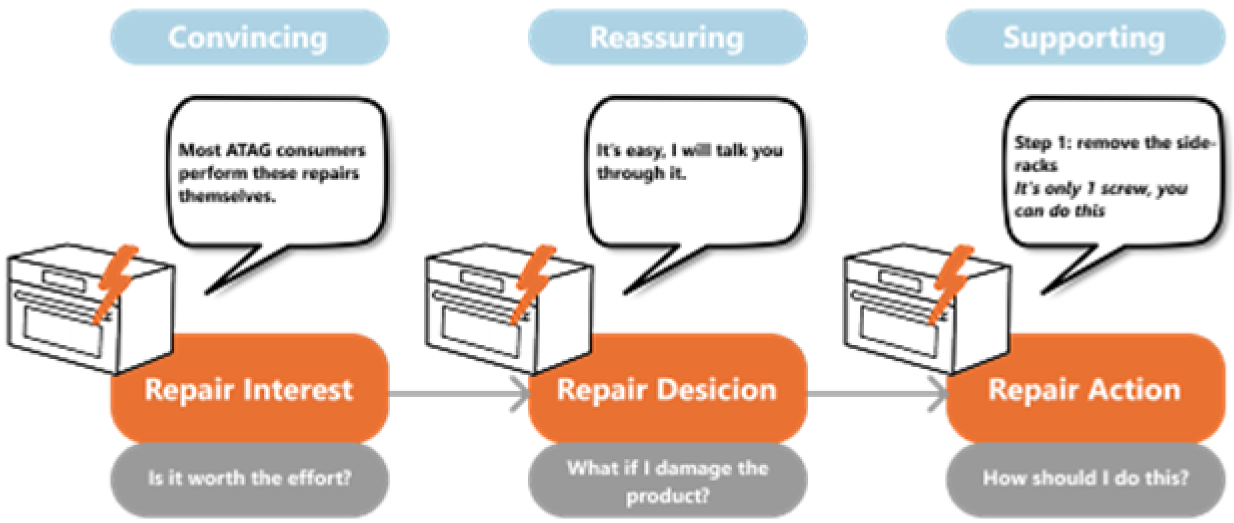


Figure 42: The Three Principles linked to the Key Decision Points

7.3 Requirements

Throughout the analysis, many requirements were formulated across different chapters. To improve clarity and usability, these requirements were consolidated and reorganised according to the three key design principles identified in the analysis: convincing, reassuring, and supporting.

In addition, two categories, technical feasibility and business integration, were included to address implementation considerations specific to ATAG. The complete set of requirements can be found in Appendix E. Figure 43, consisting of the condensed list of requirements presents the key requirements that will guide the design of the intervention, focusing on the essential motivational, psychological, and practical factors that support successful self-repair.

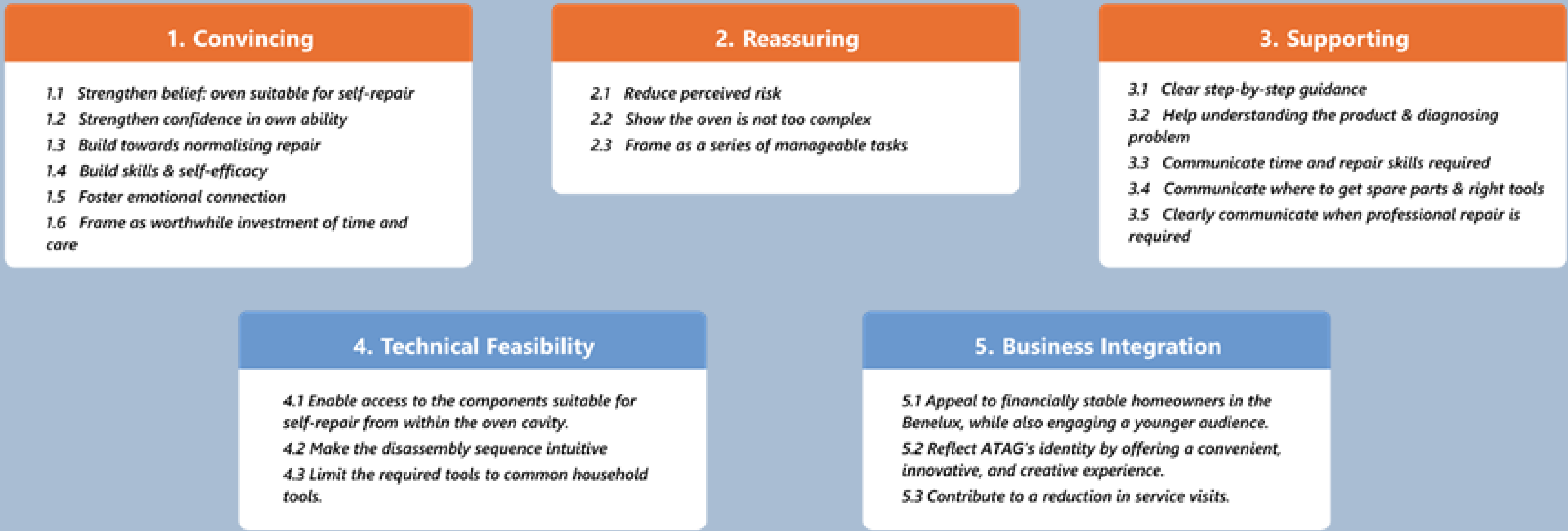


Figure 43: Condensed List of Requirements

Part II – Design

This second part of the thesis presents the design phase of the project. Based on the insights from the analysis, a design direction is established to guide the development of an intervention aimed at increasing consumers' willingness to repair the ATAG oven.

Different concept directions are explored during the ideation process, after which the most promising concept is further developed and presented as the final design.

Chapter 8:

Design Direction

The insights from the analysis are translated into a design direction that guides the ideation phase and the development of the final intervention.

Building on the outcomes of the analysis, the design direction focuses on enabling consumers in engaging with oven repairs by addressing the key psychological barriers identified in the research. This leads to the following design direction:

*"The intervention aims to enable consumers to perform **safe and accessible** oven repairs by **convincing** them of the **value of repair**, **reassuring** them about the **risks involved**, and **supporting** them throughout the repair process."*

Together, these principles aim to empower consumers to take ownership of the repair process and feel confident in resolving issues themselves.

Safe and accessible oven repairs focus on self-repair tasks that can be performed from inside the oven, without requiring the appliance to be removed or built out. These repairs are considered more feasible for consumers and lower the practical and psychological threshold to engage in self-repair.

The first objective is to **convince** consumers that repairing the oven themselves is worthwhile. Many consumers initially question whether the effort of repairing is justified. The intervention therefore aims to increase the perceived value of repair by highlighting its feasibility and benefits, encouraging consumers to consider self-repair as a viable option when a malfunction occurs.

The second objective is to **reassure** consumers that the repair can be performed safely and without excessive risk. Concerns about damaging the appliance were identified as a key barrier to self-repair. By reducing perceived and actual risks, and by clarifying uncertain repair steps, the intervention seeks to increase consumers' confidence in their ability to perform the repair successfully.

The final objective is to **support** consumers throughout the repair process itself. Guidance is particularly important when consumers encounter uncertainty or setbacks during repair. Providing clear and continuous support helps consumers navigate the repair process, understand the required actions, and reduces the likelihood that they abandon the repair.

Chapter 9:

Ideation Process

With the design direction and requirements established, the challenge shifted to transforming these into a tangible intervention, which can support the redesign of the interior from Chapter 5. The concept development unfolded through cycles of individual ideation, collaborative exploration, clustering, and critical evaluation.

Rather than describing each method in detail, this chapter focuses on the key transitions in the process, from idea generation to the selection and refinement of the final concept. Figure 44 visualises the whole ideation process.

9.1 Co-Creation Sessions

After the design space was initially explored through an individual ideation session, with particular attention to the various decision points in the repair process, co-creation sessions were held to generate diverse, innovative ideas. Conducting the individual session first provided a general overview of the most obvious ideas and helped identify opportunities for more unconventional or "out-of-the-box" concepts before guiding participants through the collaborative process.

The goal was to gather varied perspectives and explore a wide range of possibilities efficiently, moving beyond a single designer's input. Each session began with warm-up exercises to foster empathy for consumers facing oven breakdowns, followed by individual and group brainstorming phases using inspiration cards.

Three sessions were conducted, two in-person with TU Delft peers, shown in Figure 45, and one hybrid session with ATAG's digital team. Further details on the design of the sessions and the results obtained from each can be found in Appendix G.

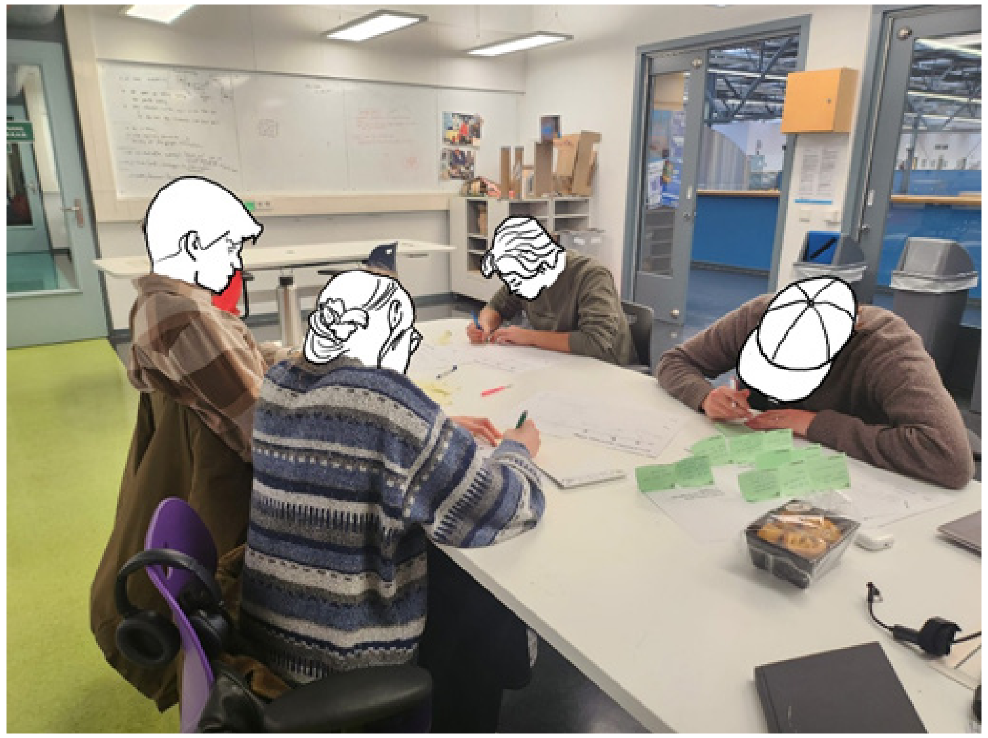


Figure 45: Co-Creation Session with TU Delft Peers

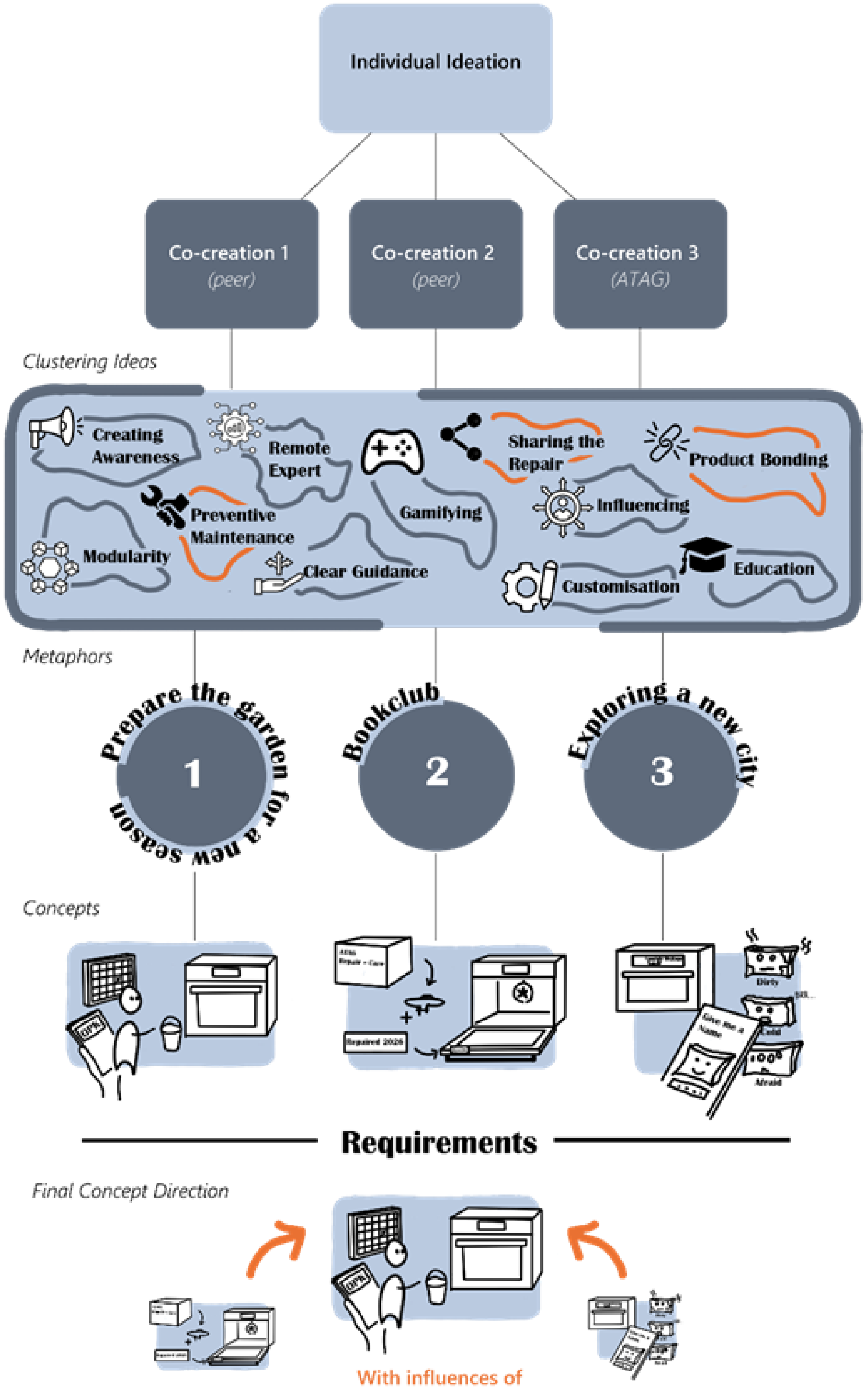


Figure 44: The Ideation Process

9.1.1 Clustering Ideas

The sessions generated numerous ideas, which were clustered to provide a clearer overview, Figure 46. The clusters are shown without a specific order, and the three clusters outlined in orange were selected for further development. Additional insights into the ideas that informed these clusters can be found in Appendix H.

From the analysis, preventive maintenance, sharing the repair, and product bonding emerged as the most promising themes for enhancing willingness to repair. Preventive maintenance and product bonding generated the most innovative ideas, while sharing the repair was selected for its social potential and strong alignment with literature emphasising the importance of normalising repair.

Preventive maintenance helps users become familiar with their device over time, reducing perceived complexity and building confidence in handling potential issues. Sharing the repair contributes to the normalisation of repair behaviour, as visible repair practices within a social context make repair more accepted and valued, while successful repairs can evoke pride. Product bonding strengthens emotional attachment to the appliance, increasing the likelihood that users will maintain and repair it rather than discard it.

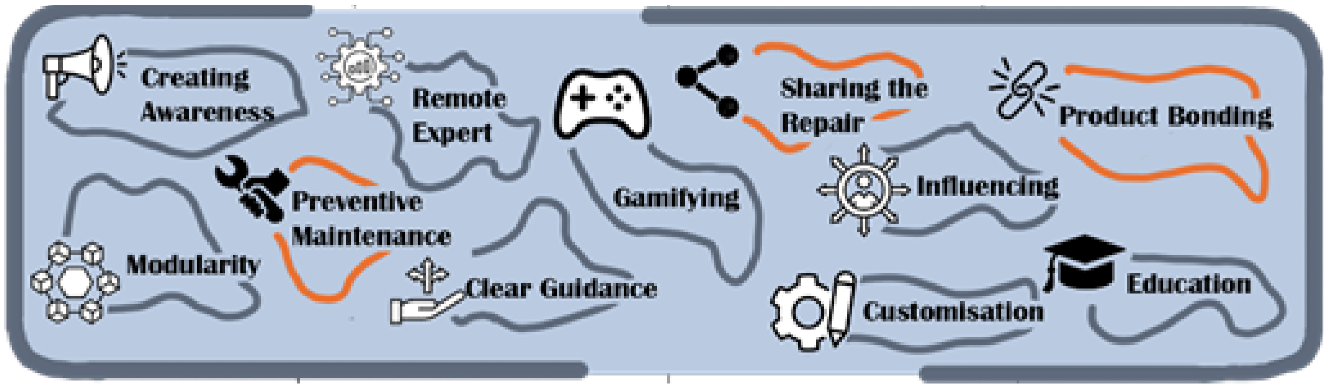


Figure 46: Overview of the Identified Clusters

9.2 Concept Creation

After generating a range of ideas and identifying the most promising clusters, the next ideation step involved linking these clusters to metaphors to highlight the most compelling concepts. These metaphors are visualised in Figure 47, while Appendix I provides further details on the metaphor-based brainstorming process, which served as the foundation for developing a concept direction for each cluster.

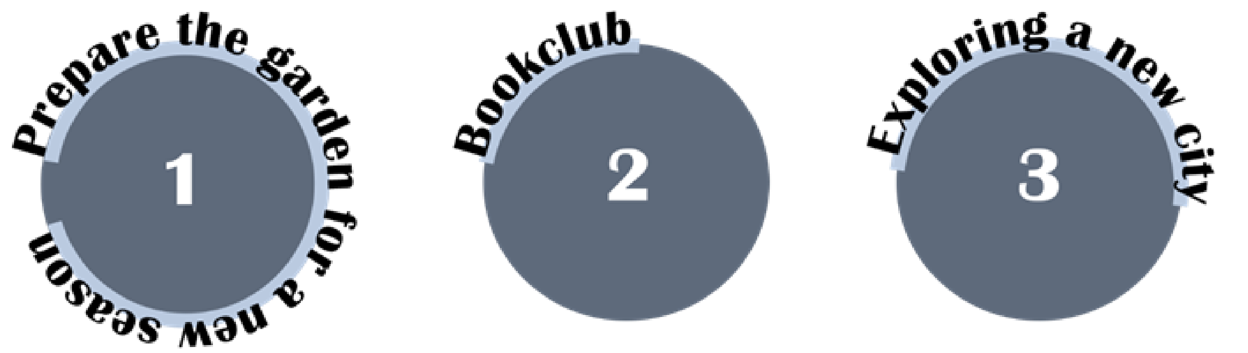


Figure 47: Metaphors used for Ideation

9.2.1 Concept Directions

Through this process three concept directions are made which are shown below. These concept directions are developed as interventions which support the redesign of the oven interior established in Chapter 5. More detailed information about these concept directions can be found in Appendix J.

The Oven Periodic Inspection

The OPK, Figure 48, introduces a biannual maintenance ritual, conducted in spring and autumn, combining a digital self-check with a short physical inspection by the user. During the digital check, the oven assesses the functioning of key components and signals potential failures; if necessary and suitable for self-repair, spare parts can be ordered directly via the app and due to the redesign

Figure 48: The Oven Periodic Inspection (OPK)

established in Chapter 5 the consumer could acces and interchange the convection heating element if it malfuctions. The physical check involves cleaning and inspecting accessible parts, increasing familiarity with the appliance's construction. The outcome is visualised through a "health bar". This concept seeks to normalise recurring care moments and embed maintenance within a structured, meaningful routine.

Repair to Share

Repair to Share, Figure 49, provides a tangible acknowledgement of self-repair by including a small, engraved plate with each ordered spare part. After completing the repair, users can attach the plate to the inside of the oven door, marking the moment without affecting the appliance's exterior aesthetics. The plate acts as a reminder of competence and accomplishment, reinforcing self-efficacy. The concept aims to normalise repair behaviour through pride, visibility, and non-digital reward.

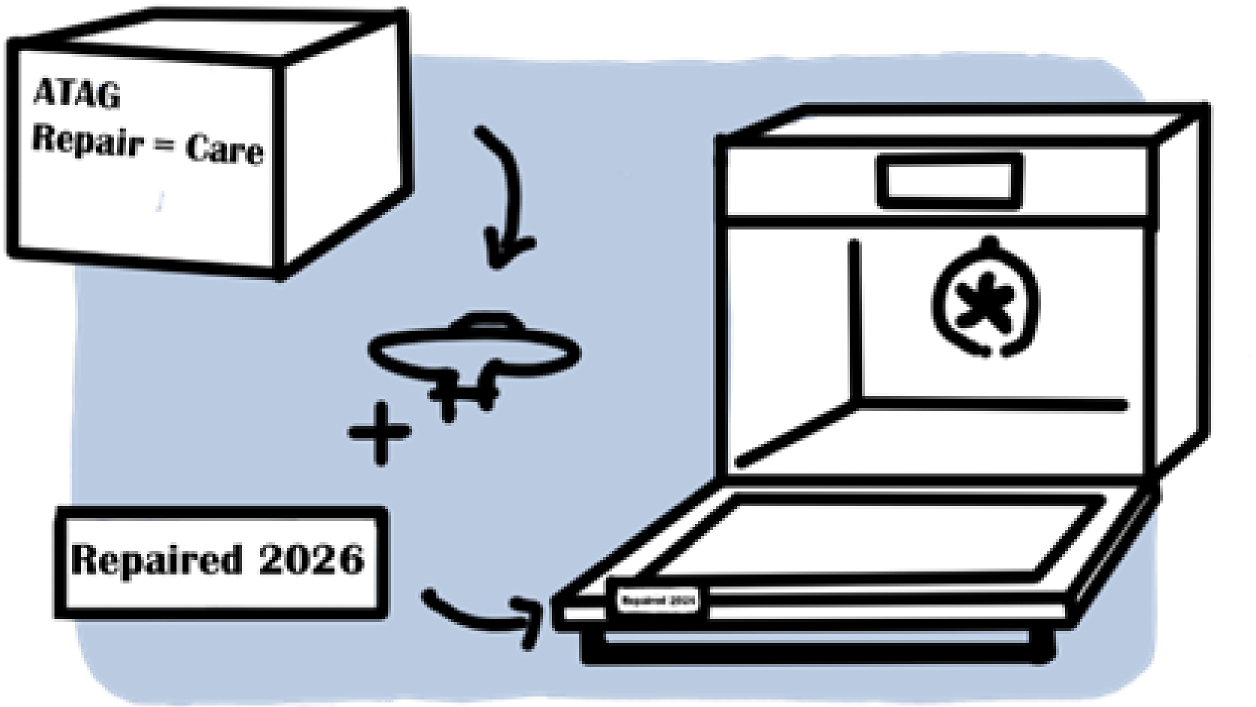


Figure 49: Repair to Share

Figure 50: The Ovengotchi

The Ovengotchi

Ovengotchi, Figure 50, represents the oven as a digital character that reflects the appliance's physical condition through emotions and behaviour. When maintenance or repair is needed, the character communicates this in accessible, non-technical language and guides the user step by step through the required actions. A visible mood indicator visualises the oven's overall state, reinforcing the link between care and performance. By inviting users to name the character and briefly "check in" during use, the concept aims to stimulate emotional attachment. The underlying intention is to lower psychological barriers to repair by translating technical issues into an intuitive and relational interaction.

9.3 Concept Assessment

The three concepts were evaluated using a Harris Profile, scoring them against the established requirements. However, not all requirements were included (see Figure 51). Most requirements from Section 3 (supporting) and Section 4 (technical feasibility) were excluded because the concepts are not yet developed in sufficient detail to assess aspects such as communication or technical implementation.

Based on the assessment, Oven Periodic Inspection (OPK) scored the highest, particularly on requirements related to building skills and confidence, making repair manageable, and normalising repair. Repair to Share scored lower overall but performed better on appealing to the target group and fostering an emotional connection with the product. Oventgotchi also performed relatively well, especially on reassuring users and strengthening product attachment, but scored lower on normalisation and fit with the target group.

9.3.1 Development of Final Concept

The final concept builds on Concept Direction 1: Oven Periodic Inspection (OPK), as it provides a structured and accessible pathway towards repair. Through periodic maintenance moments, users perform small, guided tasks that gradually build skills, confidence, and familiarity with the oven, helping them perceive it as a repairable product rather than a complex technical system.

The concept also integrates elements from the other directions.

From Oventgotchi, it adopts an emotional layer through a recognisable oven character and approachable language, making maintenance feel less intimidating.

From Repair to Share, it incorporates visibility and pride in repair, using a physical or visible element that highlights repair as an achievement and helps normalise it socially.

The development from this concept idea to the final concept involved multiple iterations and a group brainstorming session, moreover in Appendix K.

	OPK				Share the Repair				The Oventgotchi			
	-2	-1	1	2	-2	-1	1	2	-2	-1	1	2
Strengthen belief: oven suitable for self-repair			■			■					■	
Strenghten confidence in own ability			■	■		■					■	
Build towards normalising repair			■	■			■			■		
Reduce Perceived Risk			■			■					■	■
Build Skills & Self-Efficacy			■	■		■					■	
Show the oven is not too complex			■	■		■			■	■		
Frame as a series of manageable tasks			■	■		■					■	■
Foster emotional connection		■					■				■	■
Help understand product & diagnosing the problem			■			■					■	
Appeal to financially stable homeowners in Benelux			■				■		■	■		
Reflect ATAG's identity (convenient, innovative, creative)		■				■				■		

Figure 51: Assessing Concept Ideas through Harris Profile

Chapter 10:

Final Concept: ‘Moment of Care’

This chapter introduces the final concept: Moment of Care. It starts with providing a system overview of the Moment of Care concept, in which the key components and their interrelations are presented. This is followed by the rationale explaining the ritualising maintenance strategy to enhance consumers’ willingness to repair the oven. The chapter then examines the interactive elements in more detail, followed by a user journey illustrating how ‘Moment of Care’ is experienced over time.

10.1 System Overview

Figure 52 presents the system overview of the Moment of Care concept.

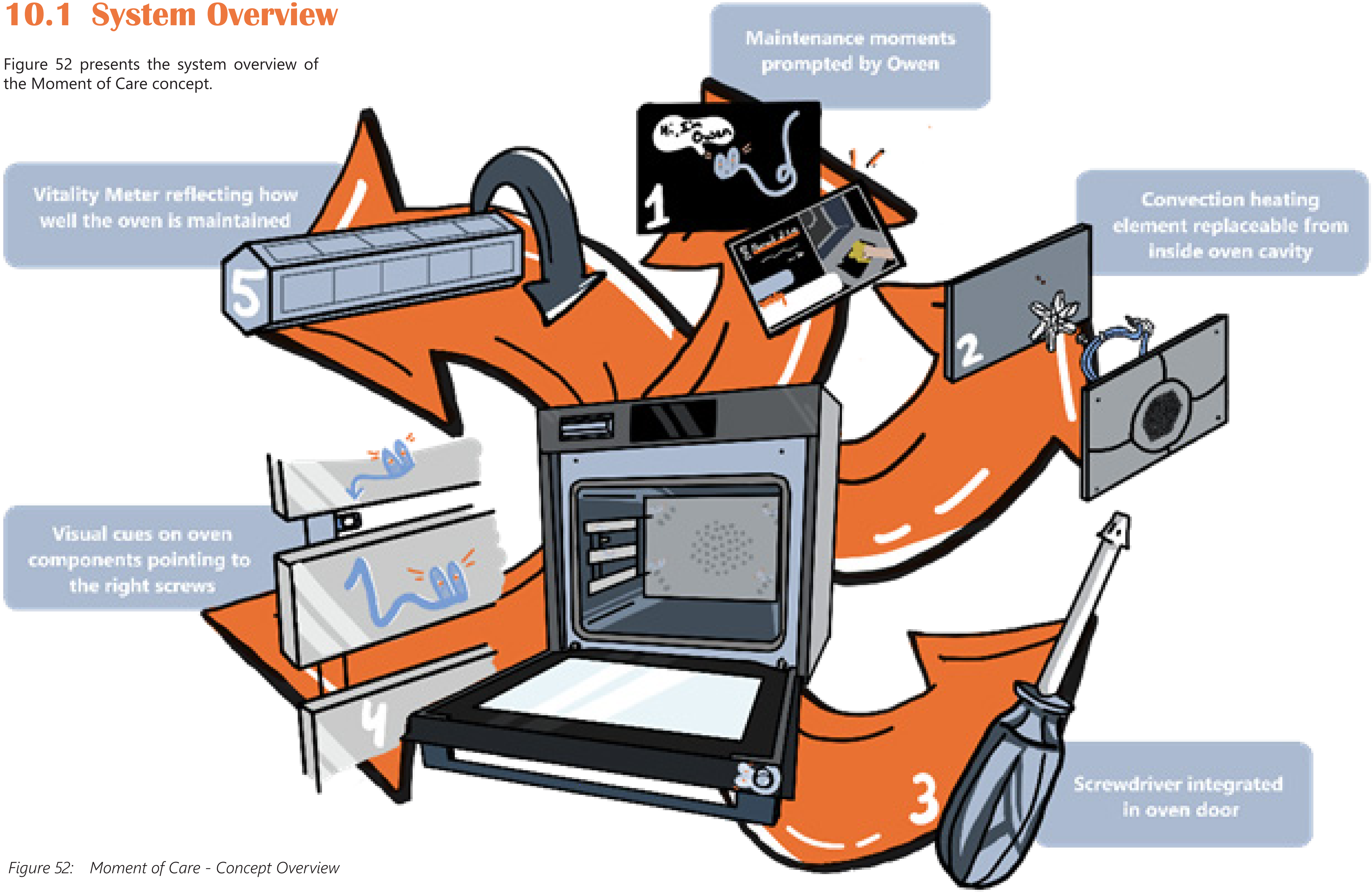


Figure 52: Moment of Care - Concept Overview

Moment of Care integrates recurring maintenance interactions into the everyday use of the oven to ritualise care and gradually lower the barrier to repair. Rather than appearing only when a malfunction occurs, the system is present throughout the product's lifetime. The next sections explain the different component of the concept, referring back to Figure 52.

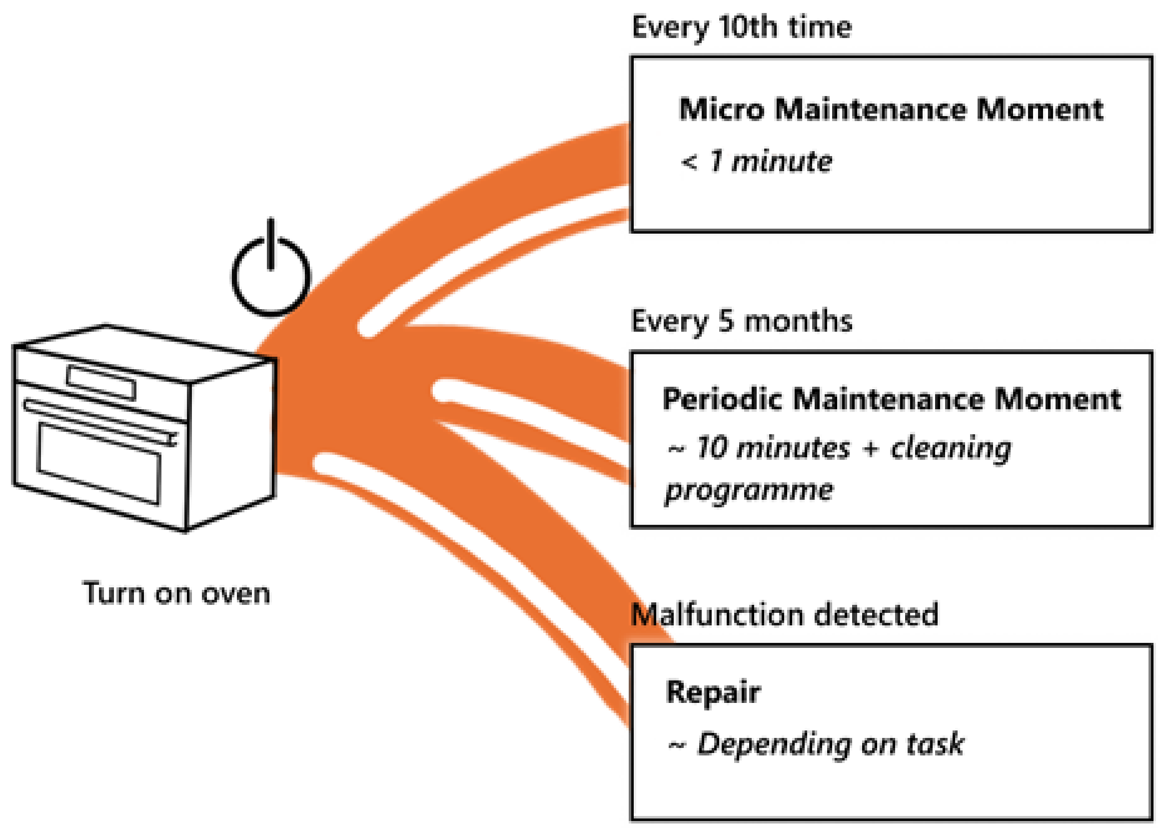


Figure 53: Timing of the Types of Pop-Ups

1. Maintenance Pop-Ups

Every tenth time the oven is turned on, a short maintenance prompt appears on the display. These micro-tasks typically take no longer than one minute and focus on cleaning or visually checking accessible components. When a user performs a check, they provide simple feedback through the interface (e.g., confirming whether a component looks intact or shows signs of wear). This input supports the oven's long-term self-diagnostic capabilities and allows ATAG to collect anonymised data on component degradation patterns, improving future product development and service insights.
Users are guided through these moments by Owen, a character embedded within the oven interface that functions as the system's communicative layer.

The step-by-step instructions combine concise text with clear visual guidance, including images of the relevant components. This ensures that users are not overwhelmed and can confidently complete each action.
In addition to the small recurring checks, the system introduces a larger "Moment of Care" approximately every four to five months, depending on usage frequency. This moment coincides with the oven's deep-clean programme. Before initiating the deep clean, users are guided through a slightly more elaborate maintenance check, such as temporarily removing side racks, components that must be removed for the cleaning cycle regardless. Users can choose to perform this extended care moment immediately, schedule it within the coming week, or receive reminders at a more convenient time.

The timing of the different type of Moment of Care pop-ups is shown in Figure 53.

2. Redesign Oven Interior

As established in Chapter 5, the oven is redesigned to make it more modular from inside the oven cavity.

3. Integrated Screwdriver

To further lower practical barriers, the only required tool, a Torx-20 screwdriver, is integrated directly into the oven door through a click mechanism, ensuring that users always have access to the appropriate tool when needed.

4. Visual Cues

The Owen character not only appears on the digital screen but is also reflected in visual cues on the oven components as maintenance and repair instructions, pointing towards the screws which consumers are supposed to interact with.

5. Vitality Meter

To give consumers more incentive to perform the maintenance moments, there is an analogue Vitality Meter integrated in the exterior of the oven to reflect how well the consumers keep up with the maintenance moments. The Vitality Meter gradually lowers if consumers ignore the maintenance tasks.

10.2 Repairing the oven

The system overview outlines the different elements of the concept and how maintenance moments occur. However, the main aim of the concept is to enhance consumers' willingness to self-repair. The maintenance moments primarily prepare users for potential repairs and encourage better care of the oven, reducing the likelihood of breakdowns. The following section therefore focuses on how Moment of Care supports the user when an actual malfunction occurs.

When a malfunction occurs, the oven's existing ATAG diagnostic system, discussed in Chapter 5, detects the issue and identifies the affected component. Instead of communicating this through a traditional error code, Moment of Care translates the malfunction into a structured interaction that visually resembles the recurring maintenance prompts, while clearly differentiated through colour and language.

The system informs the user which component is suspected to be malfunctioning and initiates a guided confirmation step. Users are asked to perform a short diagnostic check, such as activating a specific function or observing a visible component and provide feedback through the interface. This confirmation step combines the oven's internal diagnostic data with user input to verify the problem.

If the issue is suitable for self-repair, the system provides structured repair guidance following the same step-by-step format used during maintenance interactions. Required tools, estimated time, and necessary spare parts are clearly communicated. A QR code links directly to the correct replacement part on Maintainlife.com.

If the repair is not suitable for self-repair, the system communicates this explicitly and offers the option to schedule an appointment with an ATAG service technician. In both cases, the interaction maintains the same visual and structural logic as previous Moments of Care, ensuring continuity within the overall system.

Figure 54 visualises this process.

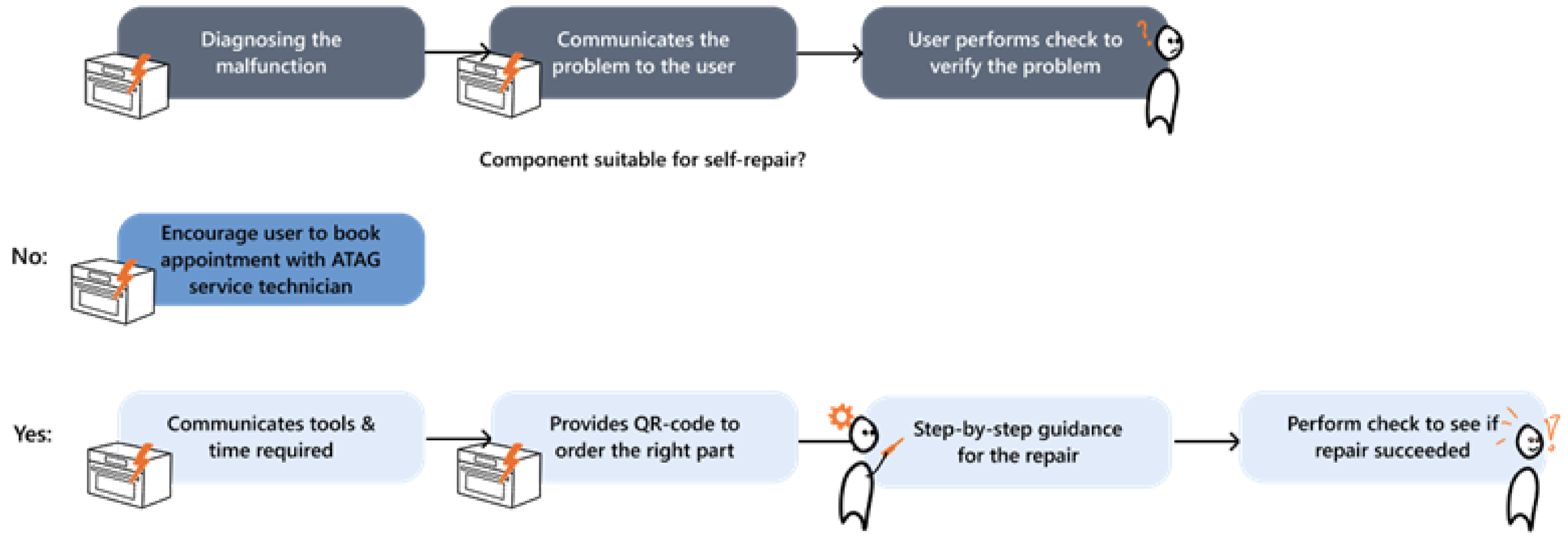


Figure 54: Overview of Steps if Malfunction occurs.

10.3 Concept Rationale

Moment of Care is designed to make regular maintenance a natural part of using the oven. Rather than intervening only when a malfunction occurs, the concept prepares consumers for repair throughout the product's lifespan by ritualising maintenance through small, guided care interactions. These recurring moments gradually increase users' familiarity with their oven and its components.

As users repeatedly perform small maintenance actions, they become more comfortable interacting with the appliance. These manageable tasks create opportunities for successful interactions with the product, strengthening users' sense of competence and self-efficacy. Research shows that successful repair experiences are crucial for building confidence and increasing future willingness to repair (Norton et al., 2012).

Beyond building competence, repeated care interactions also strengthen the emotional relationship between users and their product. Drawing on the IKEA effect (Norton et al., 2012), the concept assumes that effort leads to value: when users invest time and attention in caring for their oven, they are more likely to value it and feel responsible for its longevity. Research further shows that engaging in maintenance and repair strengthens emotional bonds with products, reinforcing a cycle in which each act of care increases how meaningful and valuable the product feels to the user (Korsunova et al., 2023; Hernandez et al., 2020). Self-repair can additionally create epistemic value through learning and novelty, which may counteract the desire for premature replacement (R. van den Berge et al., 2021; Szabó, 2025).

Together, increased familiarity, successful technical interactions, and stronger attachment reduce the perceived risk of engaging with the appliance. When repair becomes necessary, it no longer represents an unfamiliar and intimidating activity but an extension of previously performed care practices.

Through this cycle of ritualised maintenance, growing competence, emotional reinforcement, and reduced perceived risk, visualised in Figure 55, Moment of Care aims to increase consumers' willingness to engage in self-repair.

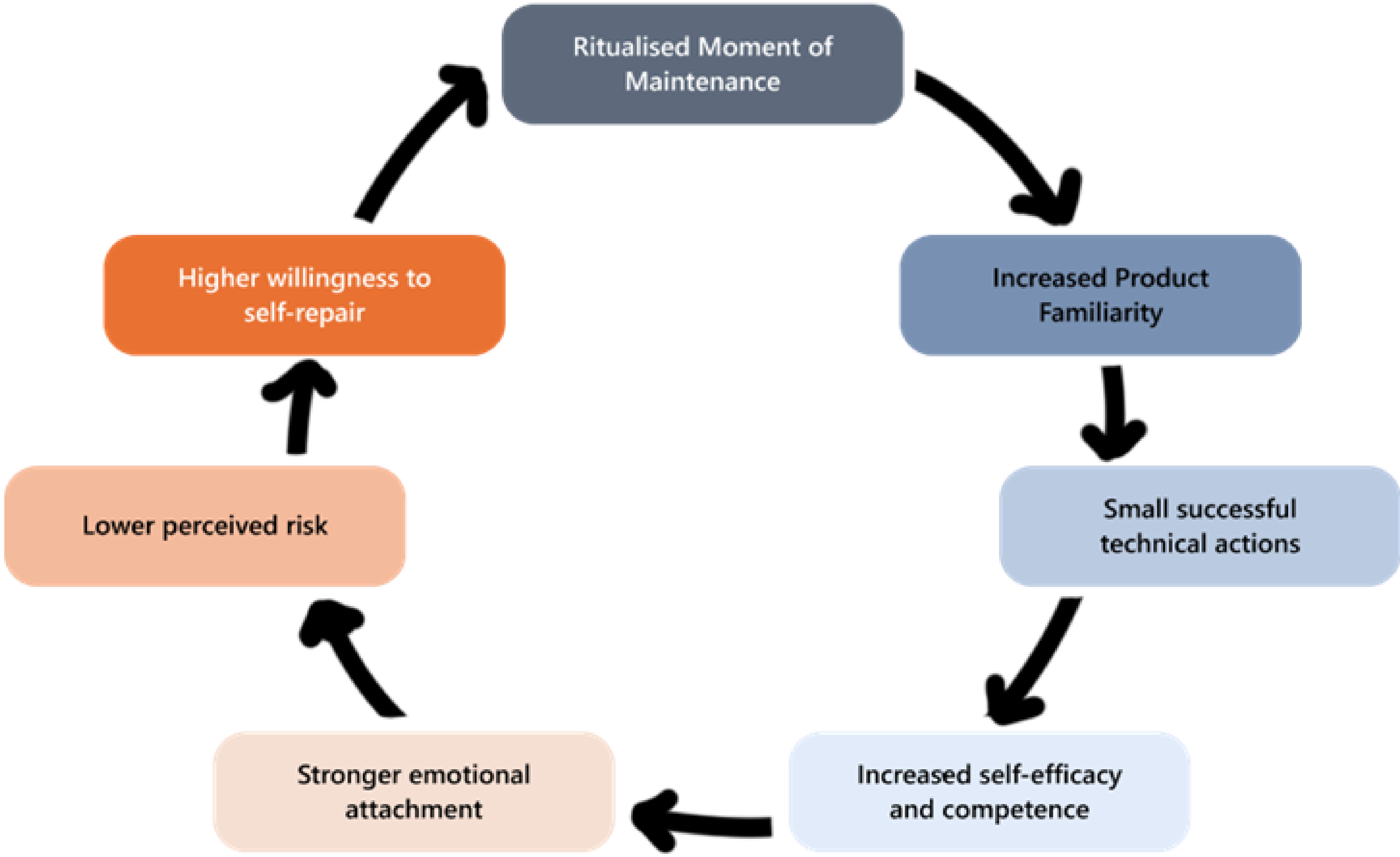


Figure 55: The Cycle of Ritualised Maintenance

10.4 Interactive Components

Moment of Care consists of multiple components which play an important role in how the consumer experiences the intervention. These components are divided into three sections: interaction rhytm & care moments, guidance and product bonding & feedback. These are discussed in the following paragraphs.

10.4.1 Interaction Rhythm & Care Moments

A central component of Moment of Care is the structured timing through which maintenance interactions are introduced.

Micro Maintenance Moments

Small maintenance prompts appear every tenth time the oven function is activated. By linking activation to usage frequency, the system adapts to individual usage patterns: users who cook more frequently and for longer periods of time encounter maintenance more often, while occasional users receive fewer prompts as their oven is less likely to get dirty.

These micro-maintenance moments focus on small care tasks that are easily overlooked, while Owen also reminds users after each use to wipe the oven once it has cooled down. Prompts appear when selecting a program, before heating begins, ensuring components are safe to handle. Each task takes approximately 30–60 seconds and involves simple cleaning or visual checks of accessible parts.

As shown in Figure 56, the pop-up clearly communicates:

- **the expected action (through image and concise text),**
- **the estimated time required,**
- **any necessary tools or materials,**
- **and a short explanation of the purpose of the task.**

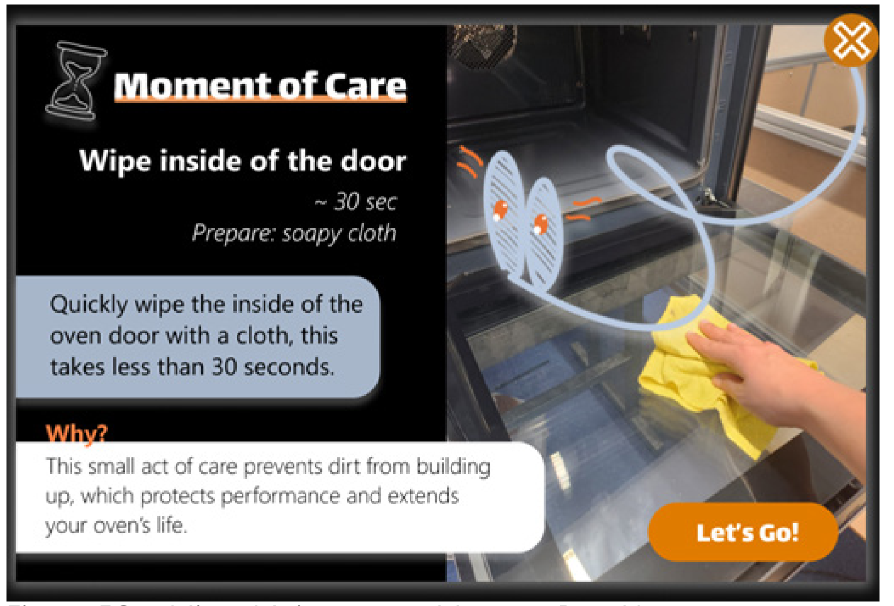


Figure 56: Micro Maintenance Moment Pop-Up

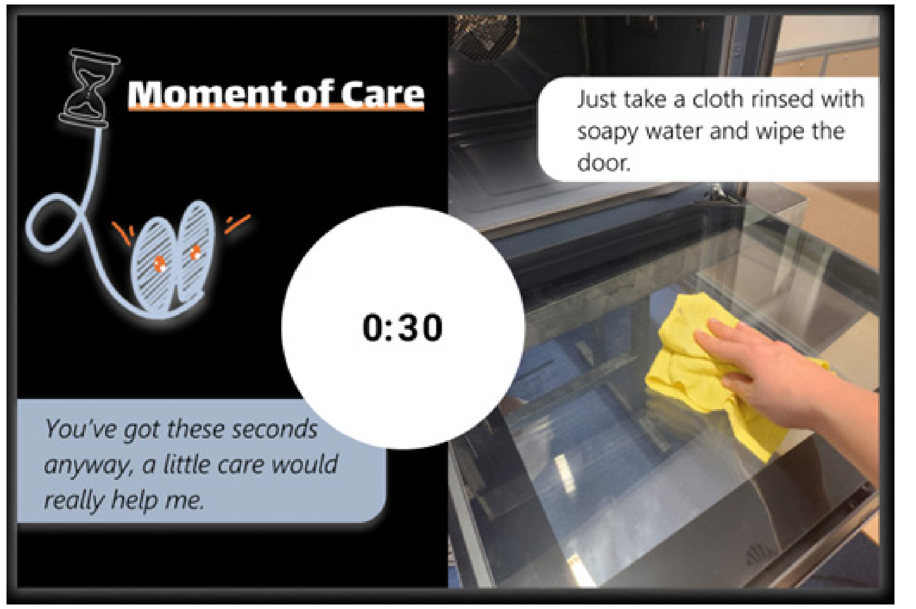


Figure 57: Micro Maintenance Moment Timer

The option to start the task is visually more prominent than the option to postpone it. Once initiated, a countdown timer corresponding to the indicated duration is displayed, shown in Figure 57. During this short interval, users remain within the task interface, after which they can proceed.

Periodic Care Moments

In addition to recurring micro-maintenance, the system introduces a larger "Moment of Care" approximately every four to five months, depending on usage frequency. This extended interaction coincides with the oven's integrated deep-clean programme.

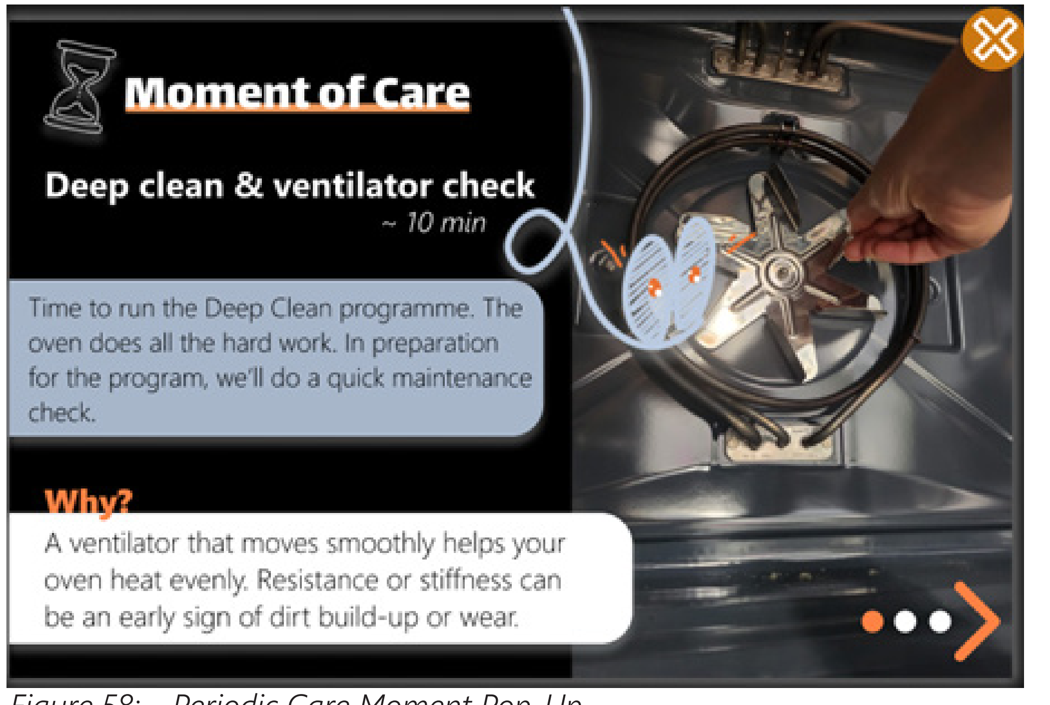


Figure 58: Periodic Care Moment Pop-Up

Before starting the cleaning cycle, users are guided through a more involved maintenance activity, such as removing and checking components that must be detached for the cleaning process regardless. These extended tasks require approximately ten minutes of active engagement, followed by the automated deep-clean cycle.

Because this interaction demands more time, users are given scheduling flexibility. They may:

- **perform the extended care moment immediately,**
- **schedule it within the coming week,**
- **or receive a reminder at a more convenient moment.**

The pop-up structure resembles that of the smaller maintenance prompts, including time indication and task explanation. However, instead of a countdown timer, users navigate through scrollable step-by-step instructions, moreover in Section 10.4.2. During these tasks, users may be asked to provide simple feedback on the condition of specific components, shown in Figure 59, (e.g., through a slider indicating perceived wear), contributing to long-term diagnostic insights.

Both small and extended care moments can be postponed. Repeated postponement affects the vitality meter, which is described in Section 10.4.3.

Oven Display Capability

The digital display of the oven must support high-resolution visuals and step-by-step guidance. Current ATAG models, including the 5-in-1 and 8 series, feature high quality colour TFT-touchscreen displays comparable to smartphone screens. This enables the presentation of detailed images, and interactive prompts. Consequently, no limitations are anticipated regarding the feasibility of conveying instructions through the oven display.

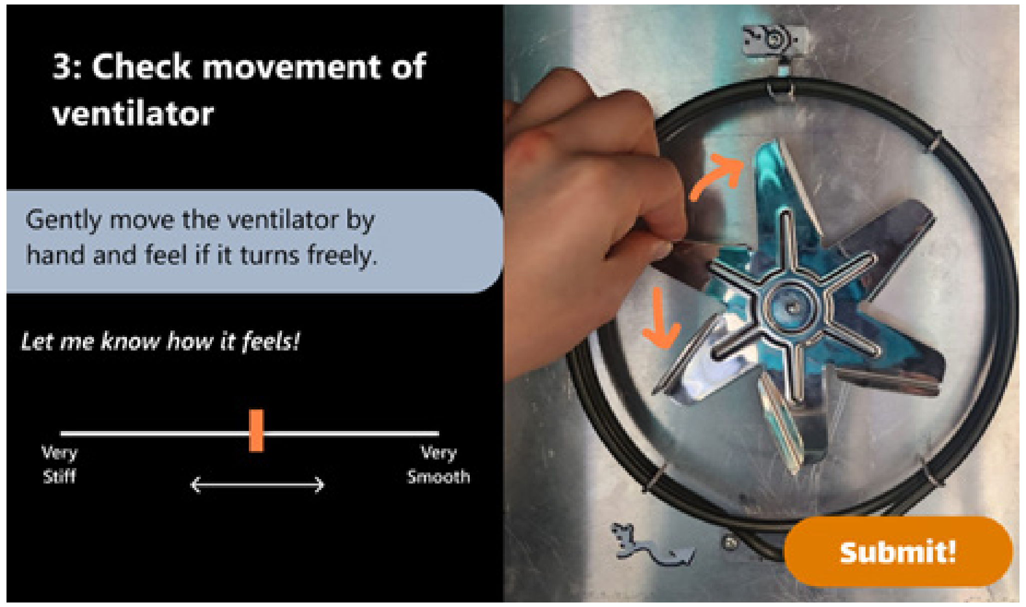


Figure 59: Periodic Care - Providing Feedback

10.4.2 Maintenance & Repair Guidance

Clear and consistent guidance is essential for both extended maintenance tasks and self-repair procedures. Within Moment of Care, guidance is delivered through a structured combination of visual and textual step-by-step instructions displayed on the oven screen.

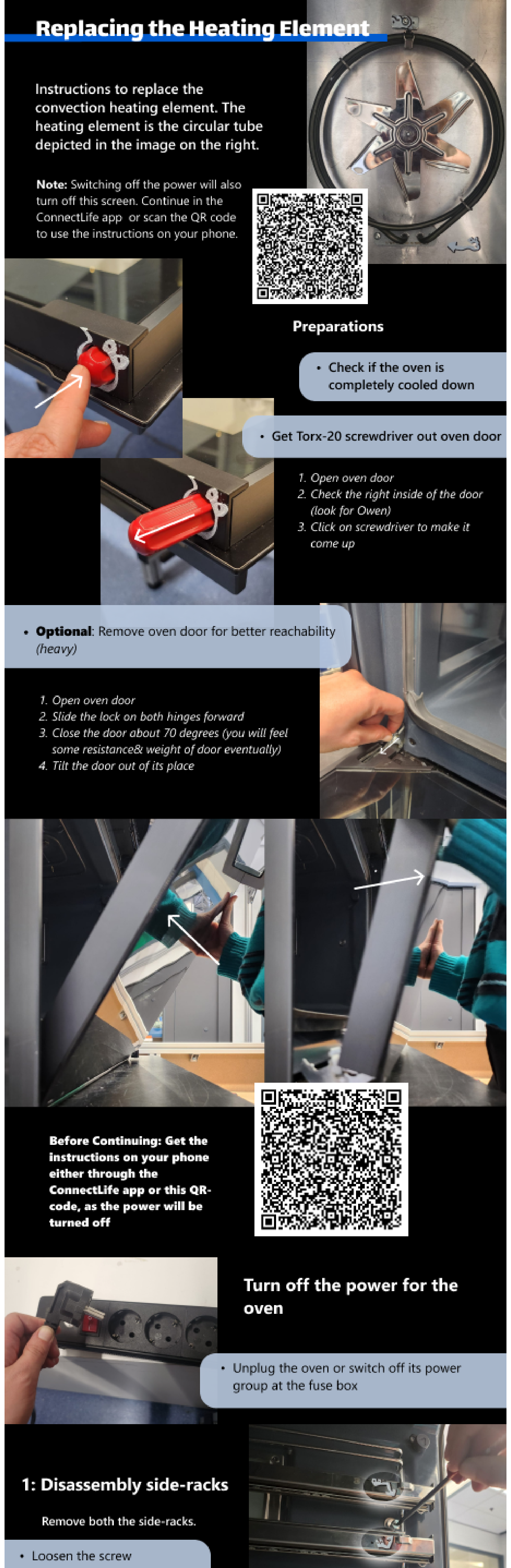
Step-by-Step Instructions

Instructions are presented as swipeable sequences consisting of still images accompanied by concise written explanations , see Figure 60 on the right (goes through to the next page). The size of the Figure currently reflects the screen size. This format was selected due to its compatibility with the oven's integrated display and its clarity within a confined interface environment. Each step focuses on a single action, reducing cognitive load and supporting task progression.

The visual material must correspond precisely to the physical product to prevent ambiguity. Images depict the actual components and their positioning within the oven, ensuring alignment between digital instruction and physical interaction.

Integrated Screwdriver

When a maintenance or repair task requires a tool, the first step directs the user to the integrated Torx-20 screwdriver. Pressing the top activates a click-release mechanism that makes the screwdriver accessible, visualised in Figure 61. By embedding the required tool directly in the appliance, users do not need external tools and can complete the tasks immediately.



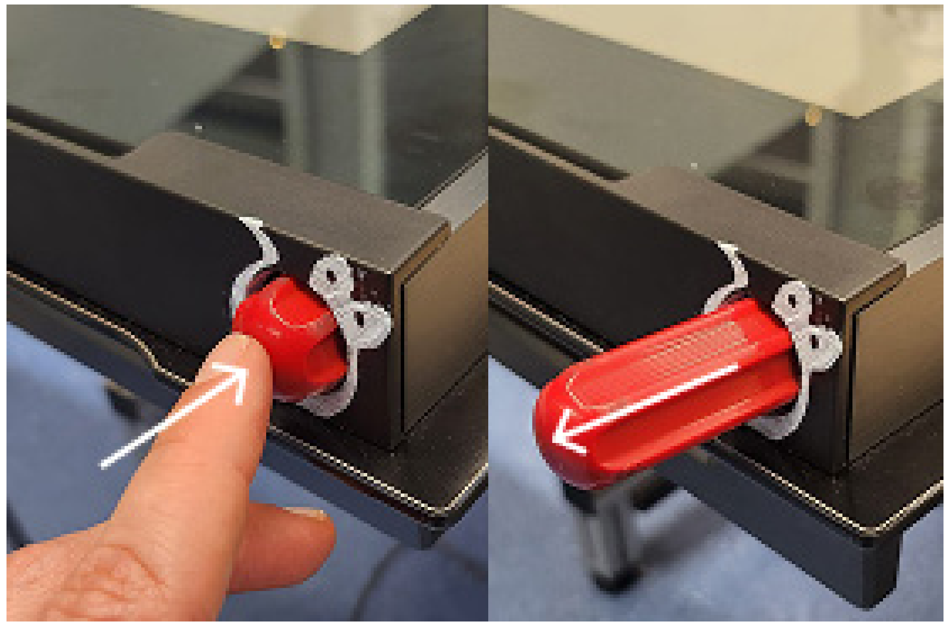


Figure 61: Integrated Screwdriver in Door

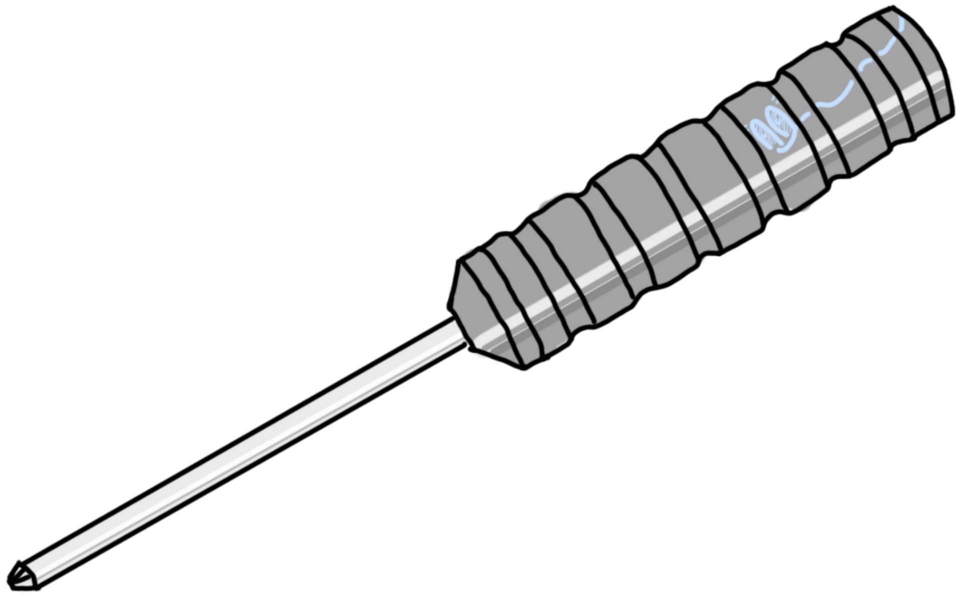


Figure 62: Screwdriver with Owen Cue

Due to the thermal environment of the oven door, the screwdriver must be constructed from heat-resistant materials. An all-metal stainless steel design ensures durability under repeated heating cycles. Visual cues linking the screwdriver to Owen can be applied through laser engraving and limited high-temperature powder coating, shown in Figure 62.

The screwdriver is stored using a spring-based click mechanism, similar to a retractable pen. Stainless steel springs and thermal-expansion tolerances ensure reliable operation, shown in Figure 63. Integrating the screwdriver requires a small cavity within the door frame but also symbolically communicates that repairability is intentionally built into the product.

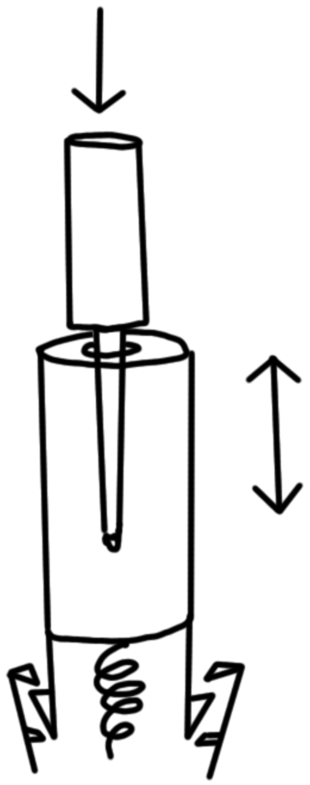


Figure 63: Screwdriver Click-System

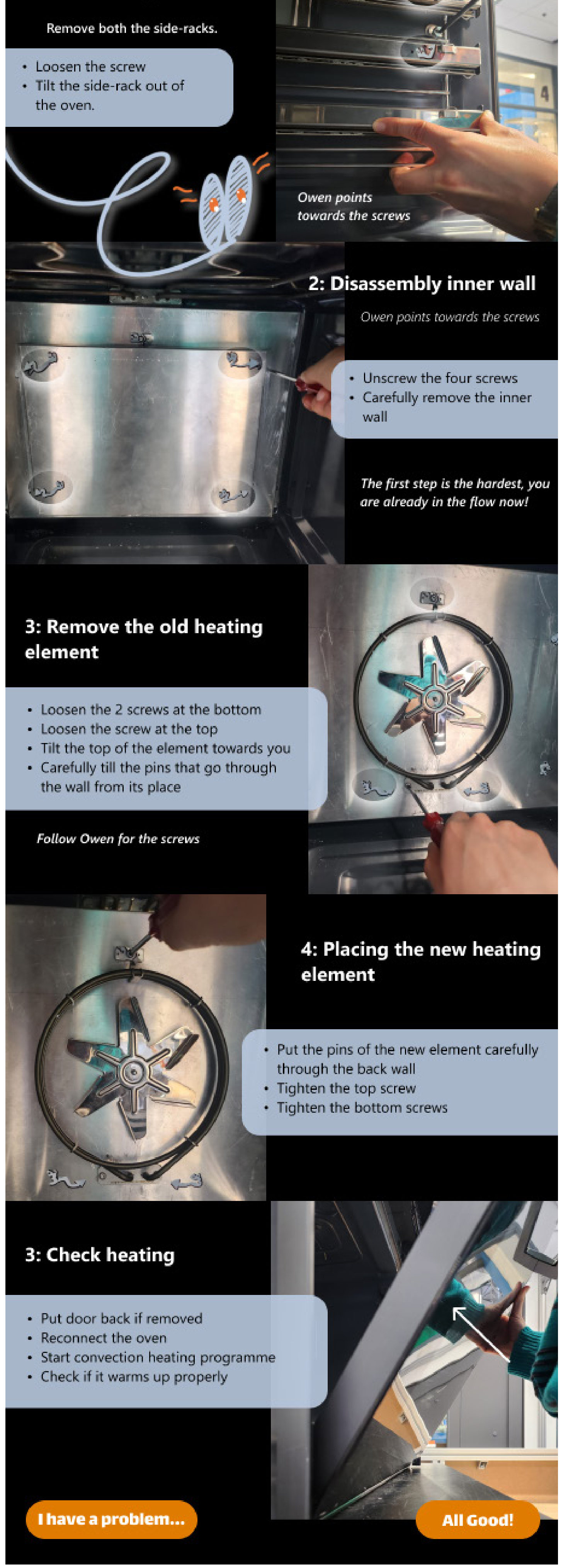


Figure 60: Scroll-through Repair Guidance

Visual Cues

In addition to on-screen guidance, physical visual cues are integrated into the oven interior. These cues indicate which screws and components are safe to access during maintenance and repair. The same visual cues are highlighted within the on-screen instructional images, establishing a direct correspondence between digital instruction and physical elements.

For frequently performed procedures, such as removing the inner wall to access internal components, the cues also establish a logical sequence. Subtle numbered references (1–2–3), integrated into the Owen styling across the side racks, inner wall, and back panel, guide users through the correct order of disassembly when required. Figure 64 visualises the visual cues on the side-racks.

Because these parts are exposed to temperatures up to 500°C, grease, and intensive cleaning, the manufacturing method must meet strict durability and hygiene requirements.

Vitreous enamel application is a suitable production method, as this coating is already widely used in oven cavity manufacturing due to its resistance to heat, thermal shock, chemicals, and wear, while also providing a smooth, hygienic surface. For example the inner wall of the oven, shown in Figure 65, is finished with a vitreous enamel coating; in fact, the entire oven interior is coated with vitreous enamel. The enamel forms a fused glass layer bonded to the steel substrate, ensuring hygiene smoothness and long-term durability under repeated heating cycles.

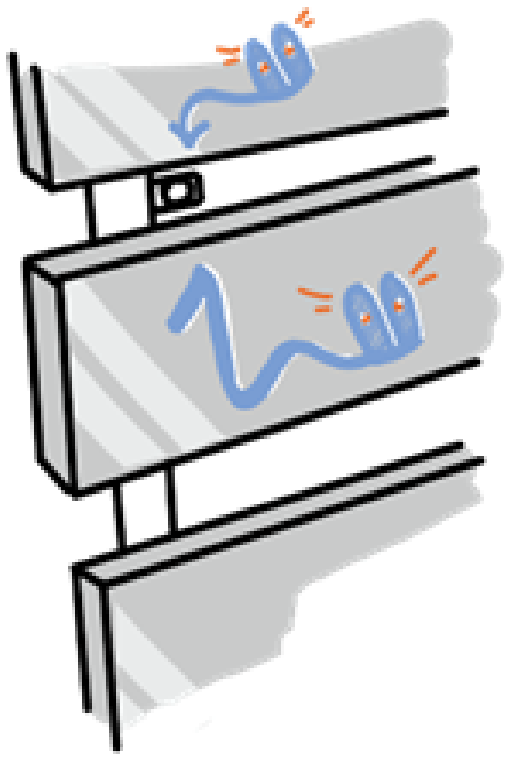


Figure 64: Visual cue 1 pointing towards the screw

Figure 65: Oven Inner Wall finished with Vitreous Enamel

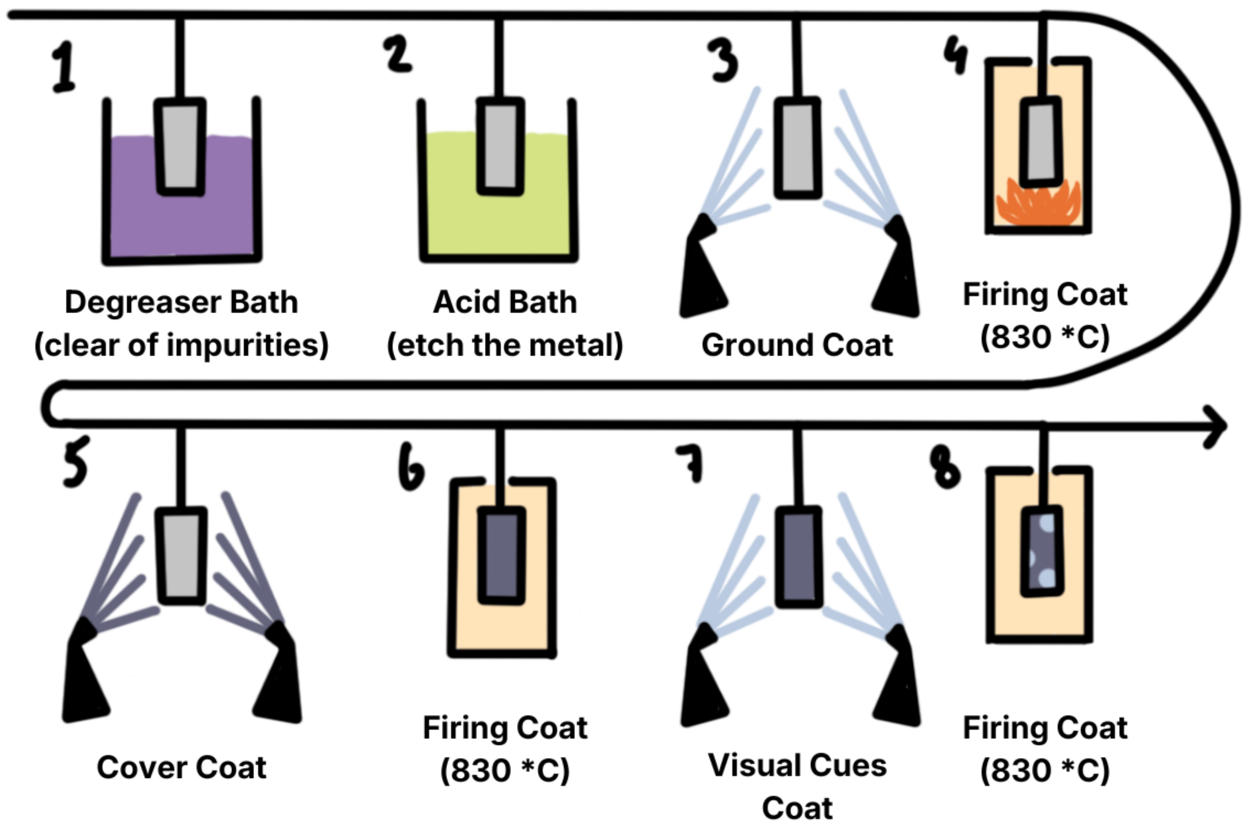


Figure 66: Vitreous Enamel Process; with extra visual cues coating

Figure 66 visualises the process of applying a vitreous enamel coating. Steps one to six are already part of the standard process for producing the oven interior, while steps seven and eight are added specifically to apply the visual cues. This would involve applying an additional coloured enamel layer to create contrast with the dark oven cavity. Although this may require masking techniques and a secondary firing stage, it aligns with existing production processes and therefore represents a feasible and durable solution for integrating the cues.

10.4.3 Feedback & Behavioural Reinforcement

In addition to guiding users through maintenance and repair tasks, Moment of Care incorporates feedback mechanisms that shape long-term interaction patterns and reinforce engagement with the system.

Owen as Communicative Agent

Owen functions as the communicative layer of the system. Embedded within the oven interface, the character accompanies all maintenance and repair interactions, providing instructions, explanations, and status updates. Figure 67 shows the onboarding screens where Moment of Care is introduced through Owen.

Through Owen, the oven addresses the user in a consistent and approachable tone. This character-based mediation distinguishes system communication from standard technical notifications and creates continuity across interactions. Owen's visual expressions adapt to the state of the appliance, for example signalling satisfaction after completed care actions or concern when maintenance is repeatedly postponed. Owen's different expressions are shown in Figure 68.

The Owen styling extends beyond the digital interface and is integrated into physical elements of the appliance, including the embedded screwdriver and the visual cues inside the oven. This consistent visual language strengthens the coherence between digital guidance and physical interaction.

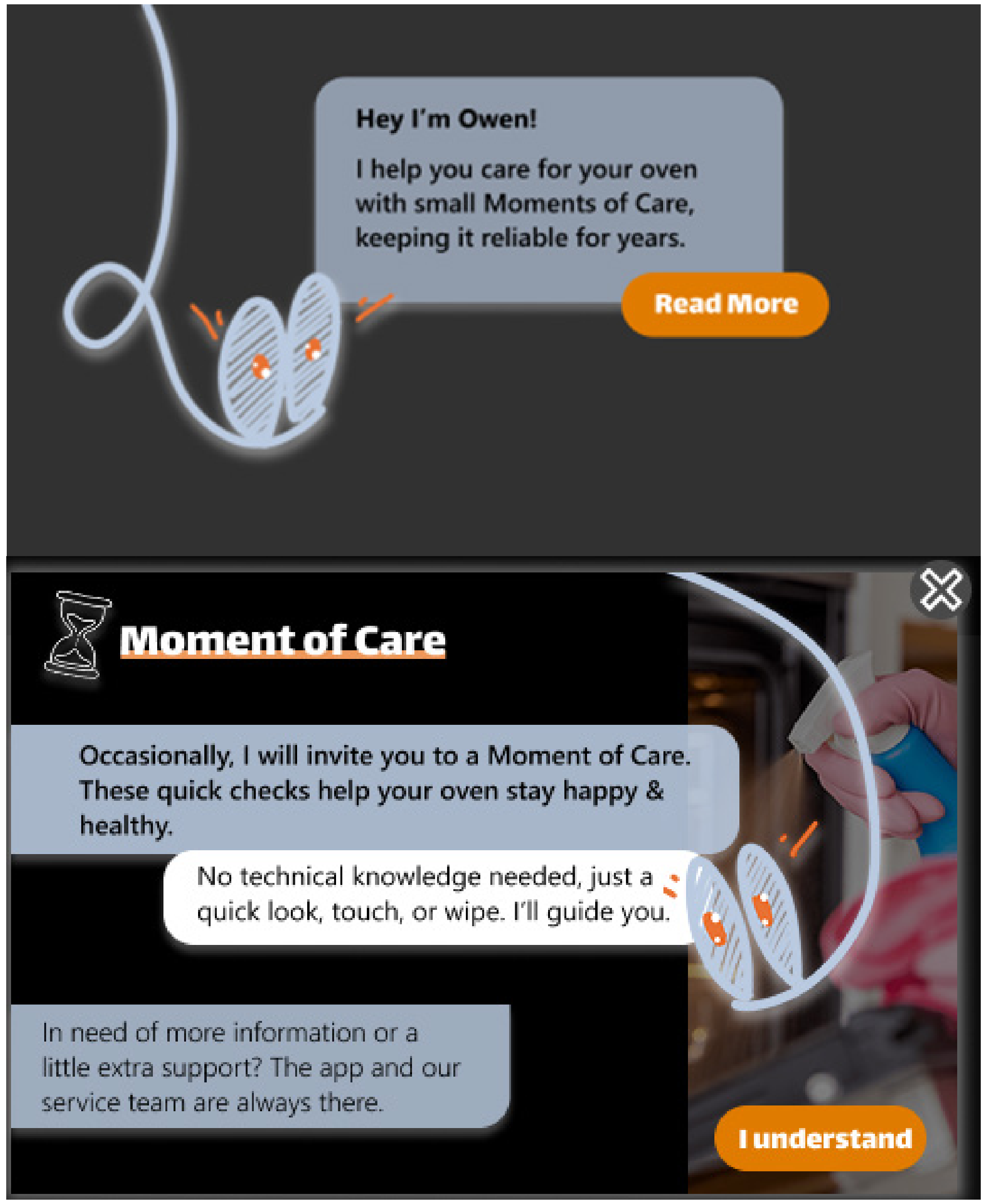


Figure 67: The Onboarding Screens

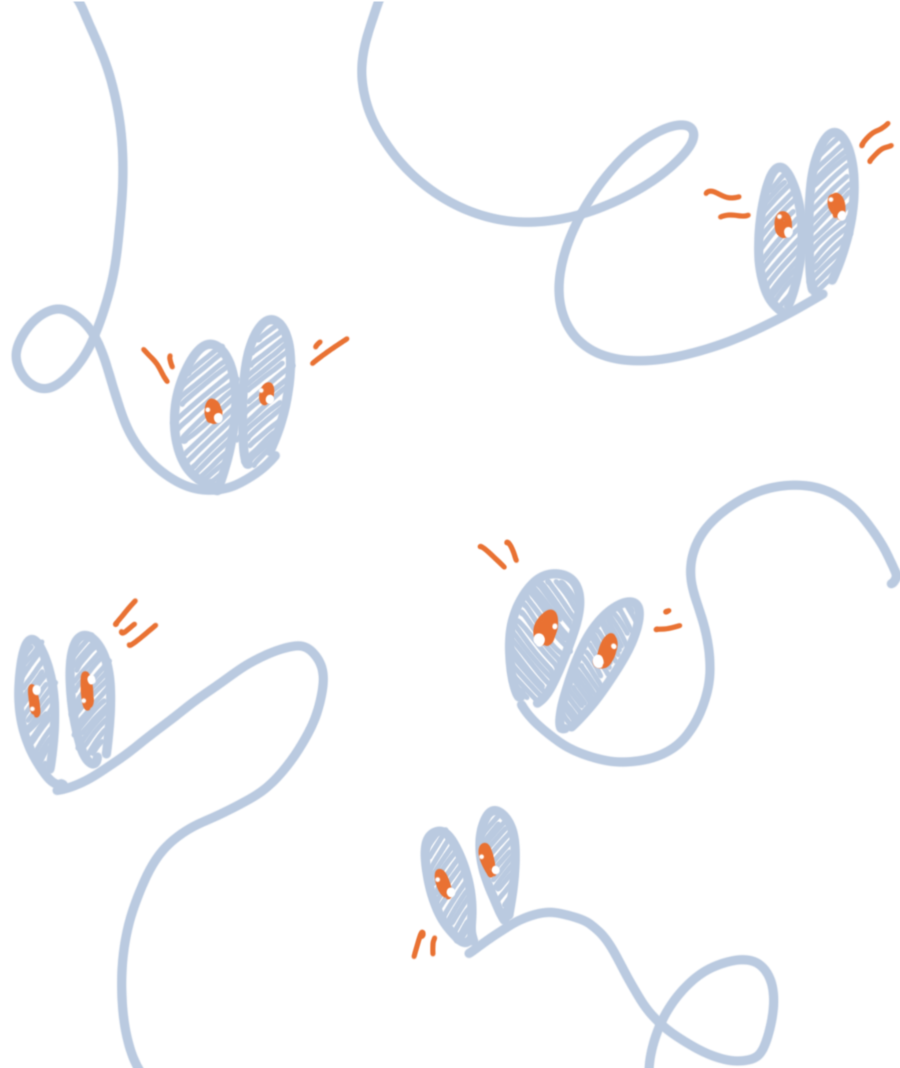


Figure 68: Owen's different expressions

The Vitality Meter

In parallel to character-based feedback, the system incorporates a vitality meter that reflects the current maintenance state of the oven. The meter decreases incrementally whenever a maintenance prompt appears. When a task is completed, the meter returns to its maximum level. If a task is postponed, the reduced level remains.

Users may ignore several consecutive prompts, with the vitality level decreasing stepwise. When the meter reaches 0%, after five times ignoring the task in a row, the oven will not initiate heating until a micro maintenance moment has been completed. At this stage, the system continues to present the pending task upon activation until it is performed.

The vitality meter is implemented as a physical analogue hexagonal indicator , shown in Figure 69, positioned next to the oven display. Its analogue format ensures continuous visibility and prevents the feedback mechanism from being dismissed or hidden. By remaining permanently present, the meter provides an ongoing indication of the appliance's maintenance status.

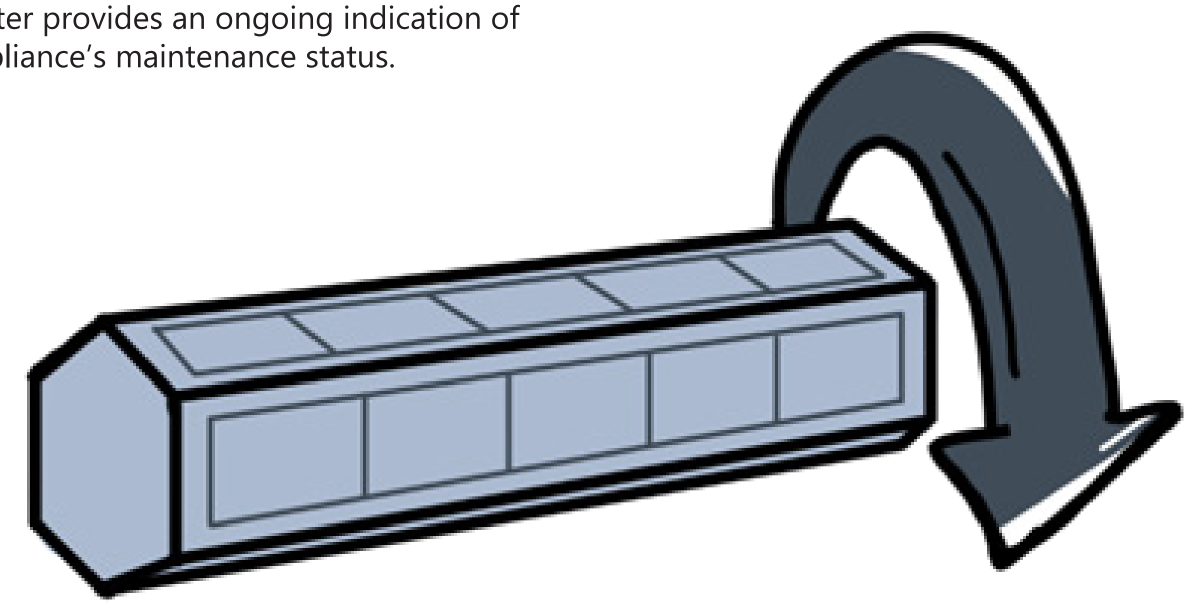


Figure 69: The Vitality Meter

10.5 User Journey

The user journeys illustrated in Figure 70, Figure 71, Figure 72 & Figure 73 outline the different interactions a user has with Moment of Care throughout the product's lifetime. It begins with the onboarding phase, representing the first time the oven is switched on, and the user is introduced to the system. The journey then presents an initial, micro maintenance moment initiated by the oven, followed by a periodic care moment after approximately five months of use. Finally, it depicts a malfunction scenario, demonstrating how Moment of Care guides the user step by step through the repair process.

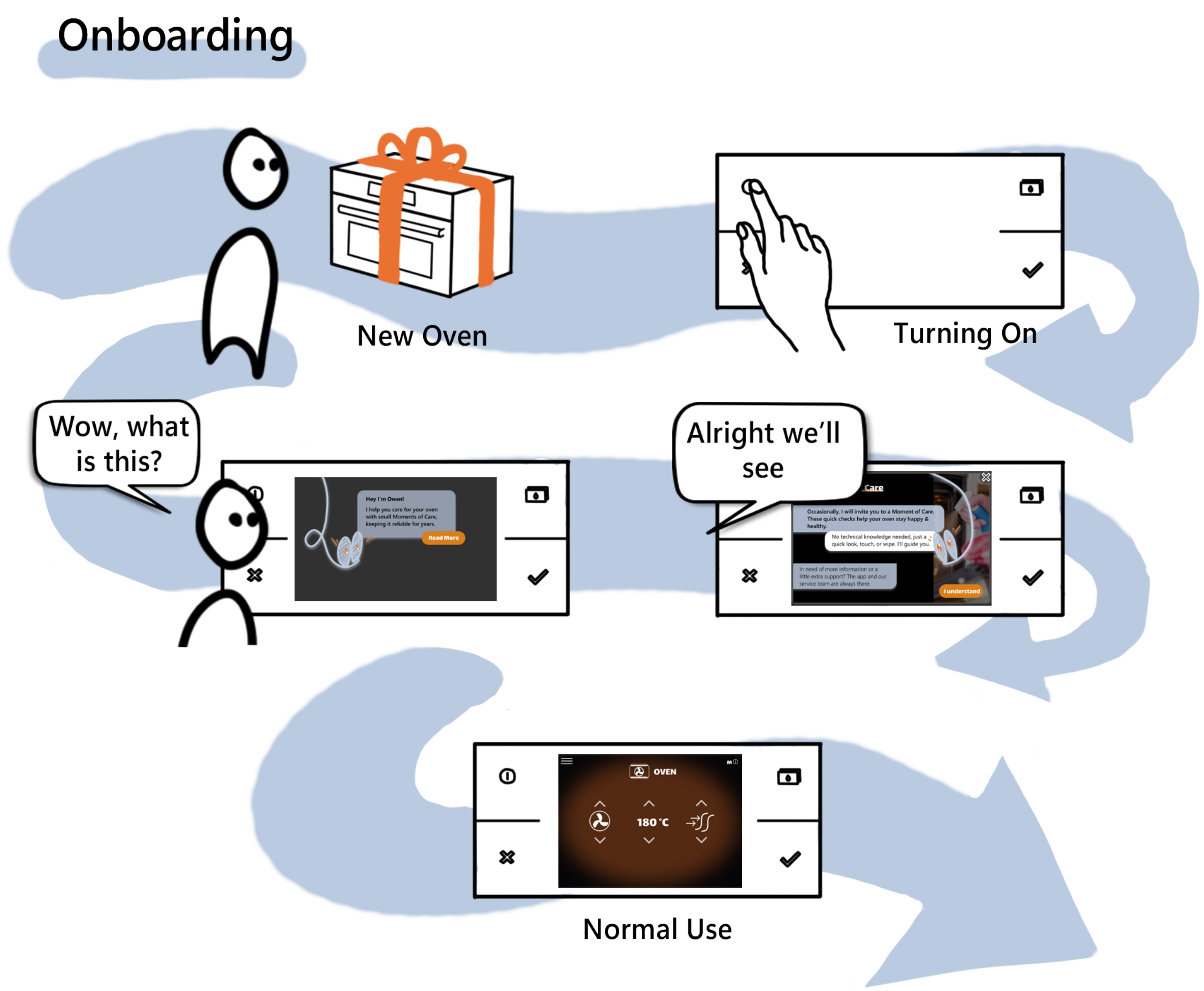


Figure 70: User Journey Onboarding Scenario

Micro Maintenance Moment

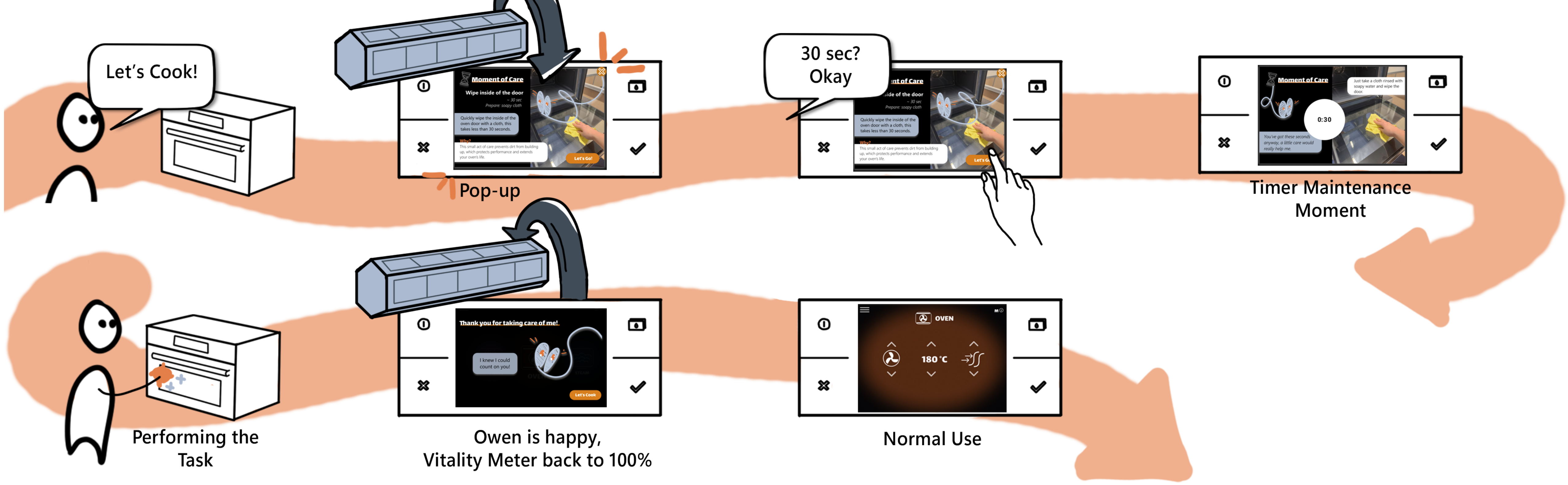


Figure 71: User Journey Micro Maintenance Moment

Periodic Maintenance Moment

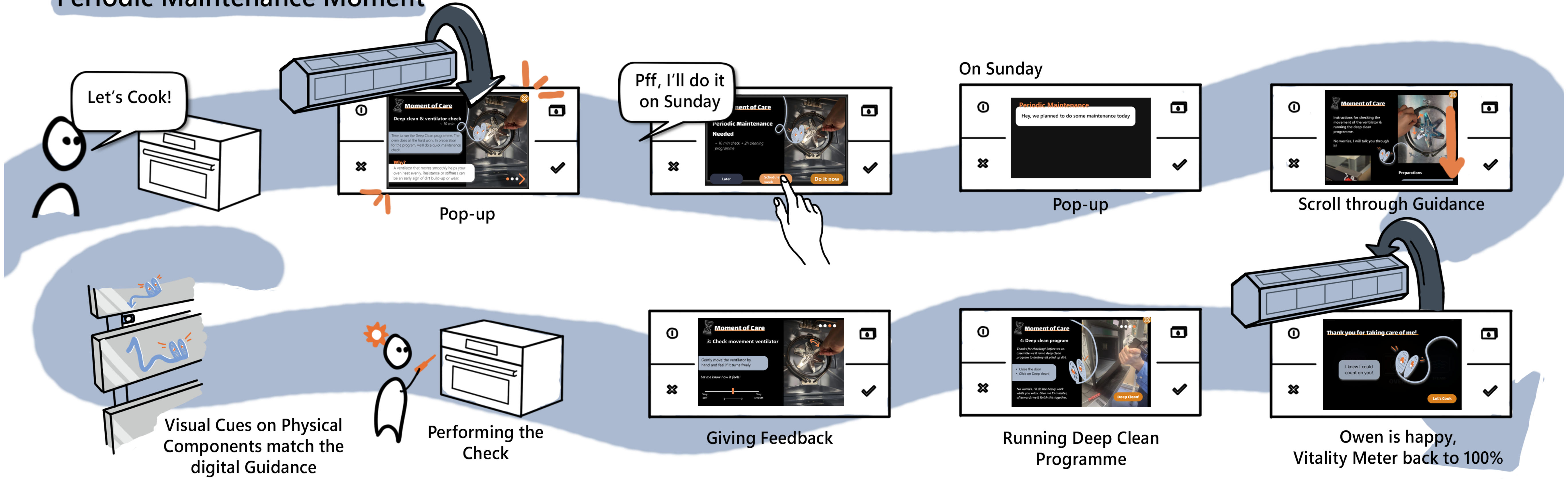


Figure 72: User Journey Periodic Maintenance Moment

Replacing the Convection Heating Element

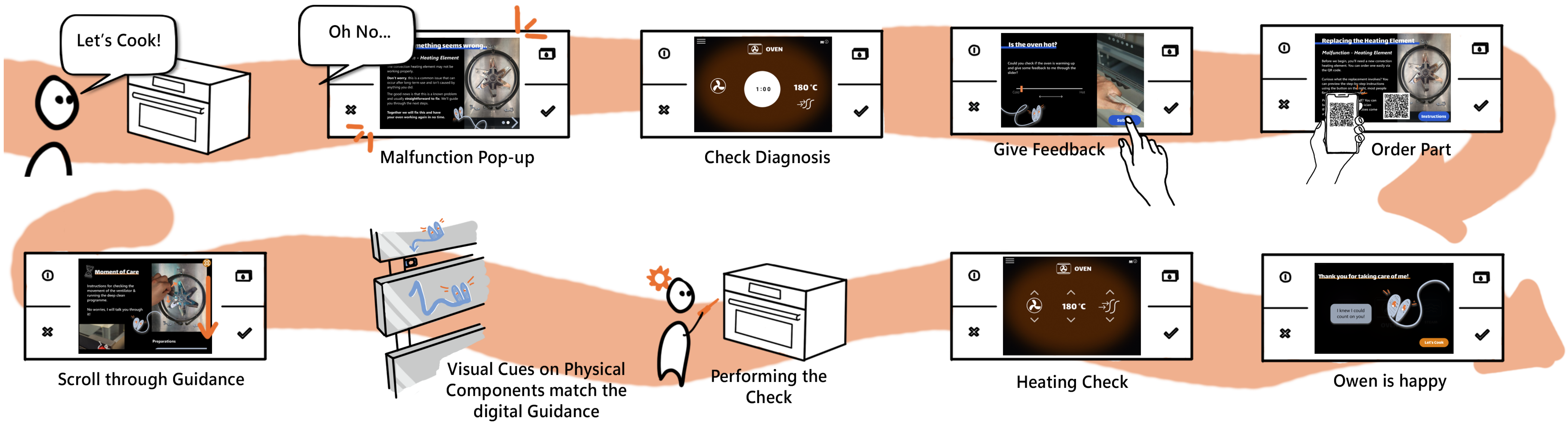


Figure 73: User Journey Repair Scenario

Part III – Evaluation

This final part of the thesis presents the evaluation of the design. First, the concept is assessed through user tests to examine how it influences consumers' willingness and ability to repair the oven. The findings from these tests are then reflected upon in a final conclusion and discussion. The thesis concludes with recommendations for further development of the concept, advice for ATAG, and suggestions for future research.

Chapter 11:

Evaluation of the Final Concept

The final concept has been evaluated to determine whether the design goal: enhancing consumers' willingness to repair, has been achieved. To do this both a physical and digital prototype have been created. The evaluation is done through user-testing leading to a conclusion regarding the strengths and weaknesses of the concept.

11.1 Goal of the Test

The evaluation aimed to assess how users respond to the Moment of Care intervention across different stages of product ownership. To structure this assessment, three main evaluation questions were formulated.

EQ1: Does Moment of Care convince users to perform maintenance and repair tasks?

- *How do users perceive the proposed maintenance and repair tasks?*
- *How do users respond to maintenance being initiated by the oven?*
- *How does the Vitality Meter influence user behaviour?*

EQ2: Does Moment of Care reassure the user the tasks are manageable?

- *Does Moment of Care lower the psychological threshold towards repair?*
- *Does Owen play a role in reassuring the users?*
- *Do the care moments contribute to a clearer understanding of how the oven functions?*
- *Can regular maintenance increase repair competence of the user?*

EQ3: Does Moment of Care provide sufficient support throughout the tasks?

- *Do the users feel capable of replacing the convection heating element themselves?*
- *Are the instructions clear?*
- *Do the visual cues adequately support the digital instructions?*

Overall, the evaluation explored whether Moment of Care would be perceived as a valuable addition to the oven and whether it aligns with ATAG's brand identity.

11.2 Prototyping

To create the whole experience of Moment of Care, both a physical and digital prototype were developed and combined into a single testing environment.

11.2.1 Physical Prototype

The physical prototype consisted of four main components: (1) the redesign of the oven's internal cavity, including the inner wall and convection heating element, (2) the visual cues, (3) the integrated screwdriver, and (4) the Vitality Meter.

Internal Cavity Redesign

The internal cavity was reconstructed by fabricating a new back plate and inner wall from aluminium sheets. Aluminium was chosen as it resembles actual oven materials, giving it a realistic look and feel. The sheets were bent to form a plate with raised edges at the top and bottom and Z-shaped flanges along the sides, shown in Figure 74. Holes were drilled into the side flanges to enable assembly.

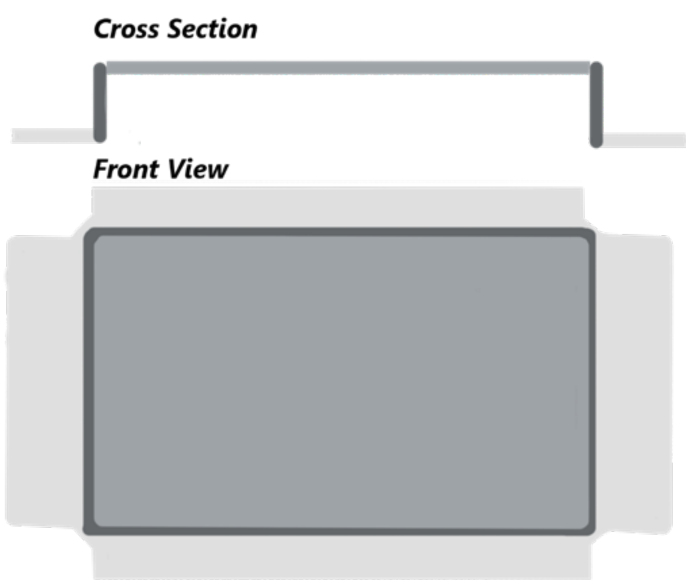


Figure 74: Z-shaped flangs aluminium sheets

The back plate was manufactured to fit precisely in the position of the oven's original inner wall, shown in Figure 75. Integrating the prototype into an existing ATAG oven enhanced realism and supported embodied interaction during testing.

The ventilator was mounted onto the new back plate using a central bolt, and the convection heating element was attached using three screws. A second, slightly smaller bent aluminium plate was installed over the assembly to function as a protective inner wall, an exploded view is visualised in Figure 76.

Because the back plate occupied the original position of the oven's inner wall, the existing side racks could be reinstalled. These rested on the bolts of the new back plate, preserving the original composition of the oven interior.

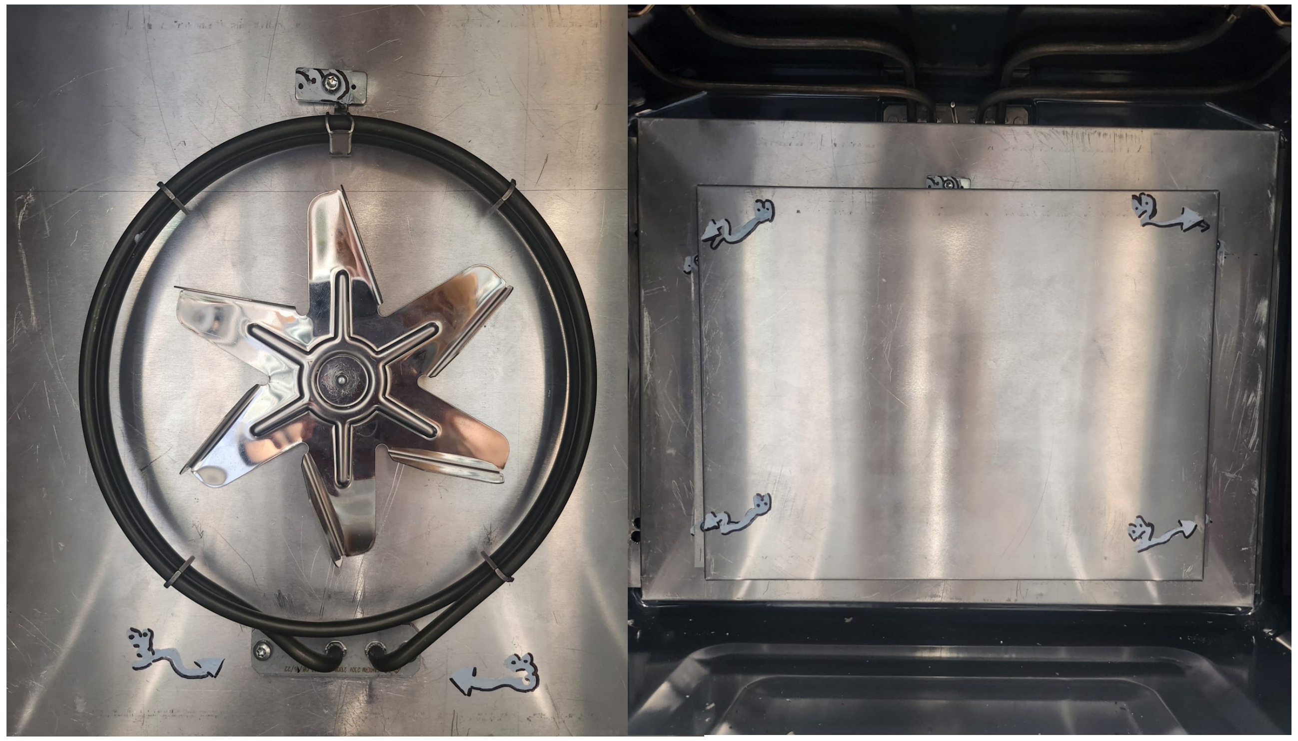


Figure 75: Physical Protoype Redesign Oven Cavity positioned within Oven

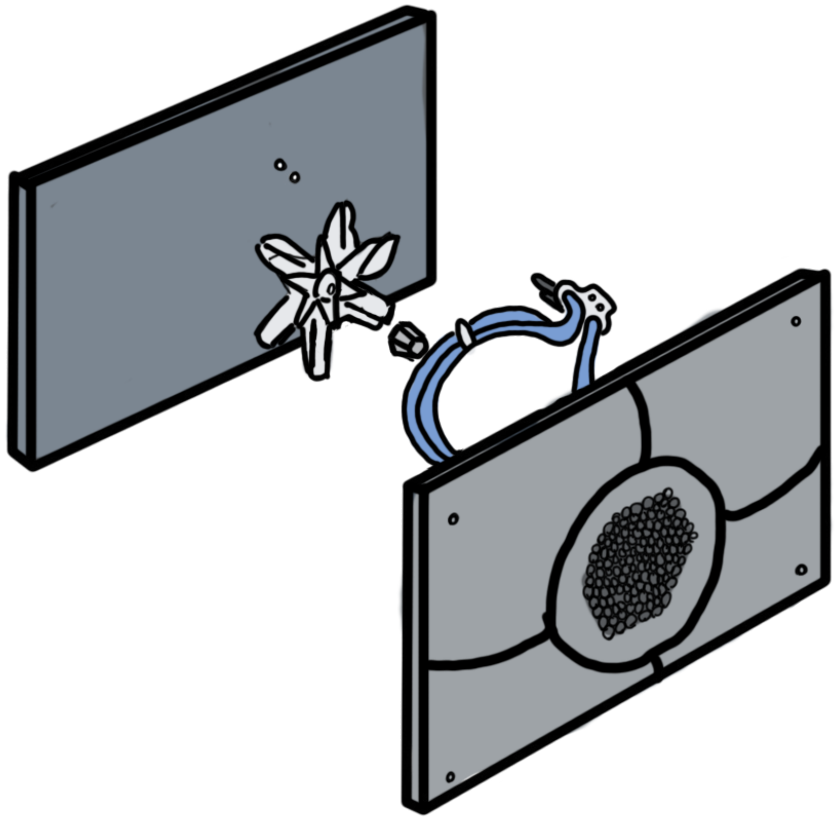


Figure 76: Exploded View Redesign Oven Cavity

Visual Cues

Visual cues were applied to the redesigned internal components, including the back plate, protective inner wall, side racks, and the oven door (at the location of the integrated screwdriver).

For the prototype, a combination of paint and modelling paste was used to create colour differentiation and surface relief, to mimic the layer of vitreous enamel. The result is shown in Figure 77.

Integrated Screwdriver

A cavity was drilled into the oven door to house the integrated screwdriver. The screwdriver was secured using a mechanical stop and marked with a visual cue to indicate its location, shown in Figure 78.

Due to time constraints, the mechanical click-release system was not implemented in the prototype. Instead, the location was clearly marked to evaluate whether users were able to find the screwdriver.

Vitality Meter

The Vitality Meter was prototyped using laser-cut MDF and powered by an Arduino, enabling physical movement between six discrete positions ranging from 100% to 0% in 20% increments.

The Arduino also triggered an attention-grabbing sound effect whenever the meter shifted position. The system was operated via two buttons controlled by the researcher: one button decreased the meter by one step (20%), while the other reset it to 100%.

The meter was housed in a laser-cut Perspex enclosure mounted on top of the oven, shown in . This enclosure also contained a smartphone used to simulate the oven display and present the digital Moment of Care interface. The laser-cut files and Arduino code can be found in Appendix M.

Figure 77: Visual Cues Prototype

Figure 78: Screwdriver in Door

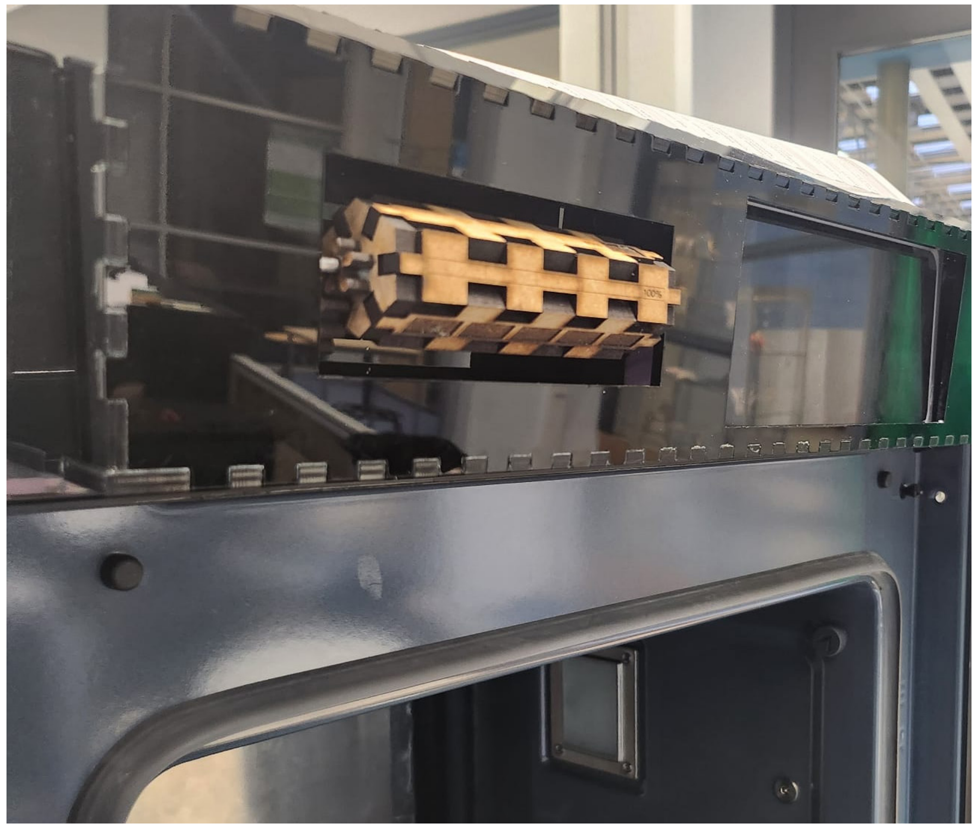


Figure 79: Vitality Meter in Lasercut Perplex

Hybrid Set-up

This hybrid setup allowed participants to both digitally navigate the oven interface while physically interacting with the oven interior, simulating a realistic repair experience.

11.2.2 Digital Prototype

The digital prototype was developed in Figma and simulated the oven interface. It included four scenario-based flows, shown in Figure 80.

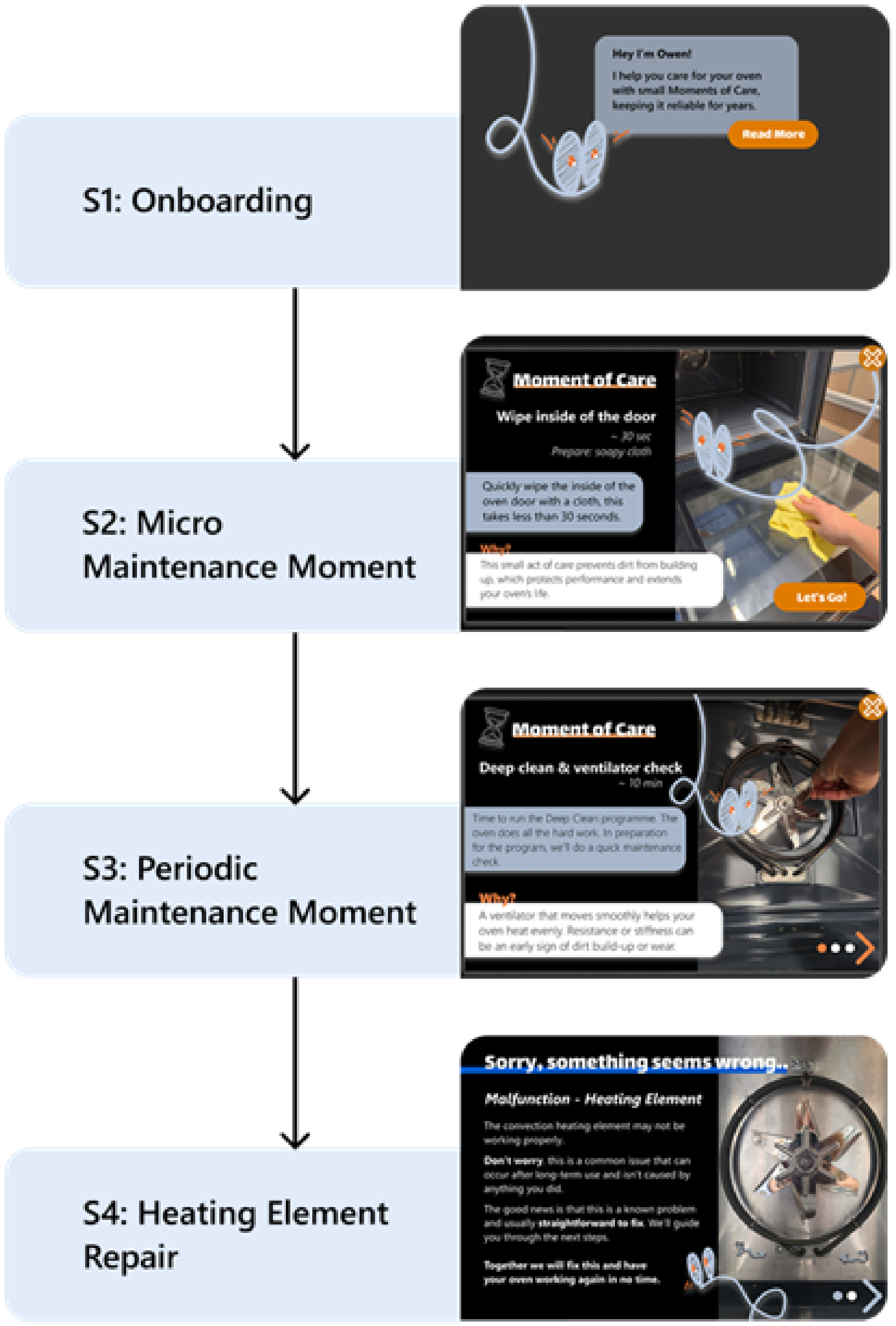


Figure 80: Overview of Scenario's

Participants could click through pop-ups, navigate menus, and interact with Owen through step-by-step guidance. The link towards the digital prototype can be found in Appendix N.

11.2.3 Prototype Fidelity & Limitations

The prototype aimed to simulate the Moment of Care concept within a realistic physical context, however, a few limitations affected its level of fidelity.

The oven was never switched-on during testing and did not generate real heat. It functioned solely as a physical environment to simulate interaction rather than as a fully operational appliance. This means that some aspects such as checking temperature and post-use cooling time were not represented.

In addition, the click-release mechanism for the integrated screwdriver was not functional. Participants were asked to locate the position inside the oven door where the screwdriver would normally be stored; however, the screwdriver itself was not placed inside the door, as it would have been difficult to remove without the click-release system.

Minor measurement mismatches in the reconstructed internal cavity made screwing more difficult than intended. The side racks did not fit securely and were often removed during testing, which reduced the realism of the oven interior.

11.3 User-Testing

The user test functioned as an early-stage concept evaluation, aimed at generating behavioural insights rather than achieving statistical generalisation. The study was exploratory in nature, meaning that it sought to uncover patterns, perceptions, and underlying motivations without testing predefined hypotheses or aiming for definitive conclusions.

Prior to conducting the user tests, a pilot test was carried out to evaluate whether the questions and tasks were clear and comprehensible. It also served as a full trial run of the procedure, allowing any remaining prototyping errors to be identified and resolved.

11.3.1 Participants

Eleven participants completed the user test, all following the same procedure. Due to the prototype's fixed installation at the IDE Applied Labs, testing was conducted on-site, which limited recruitment from ATAG's intended premium target group. Participants were therefore recruited through a personal network, resulting in a relatively young sample (20–26 years) with a roughly equal gender distribution, shown in Figure 81, consisting of TU Delft students from various faculties, medicine students and a small number of young professionals. Care was taken to avoid selecting participants with strong technical or repair-related affinities to better approximate the average ATAG consumer.

To assess participants perceived repair competence, they were asked to rate their own repair skills on a seven-point scale prior to the user test. Figure 82 indicates that participants generally rated their repair skills around the midpoint of the scale, with several noting that they considered themselves representative of the average Dutch consumer in terms of repair competence.

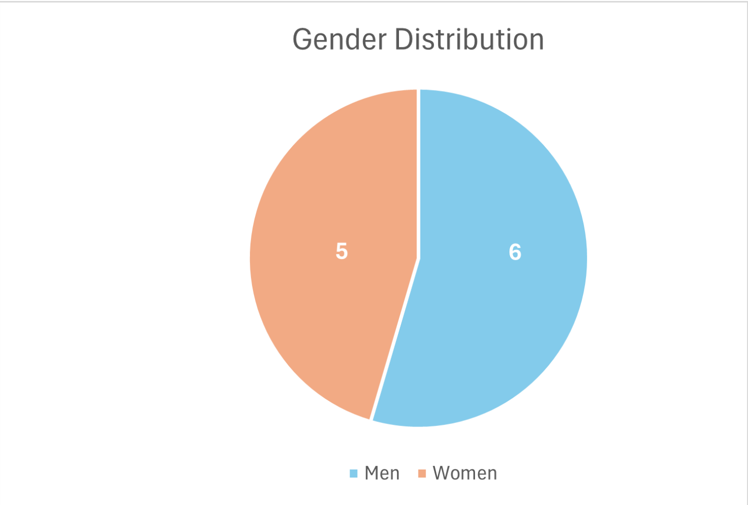


Figure 81: Gender Distribution Participants

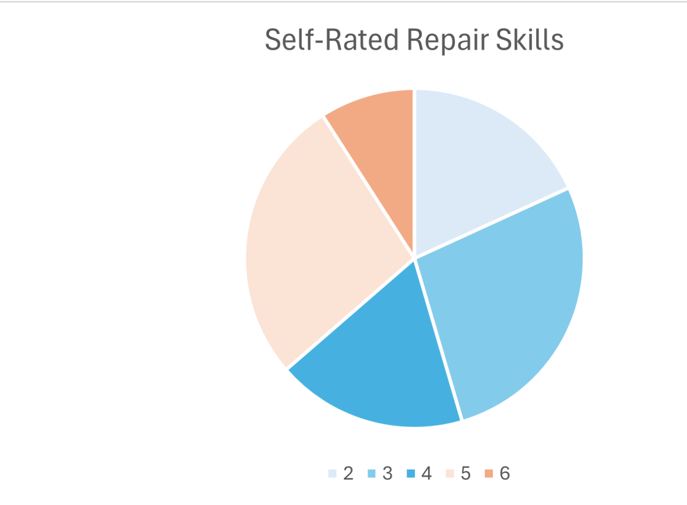


Figure 82: Participants' Repair Skills (scale 1-7)

Figure 83: Digital Prototype; Onboarding Screens

11.3.2 Method

Each participant went through four scenarios sequentially. They were instructed to think aloud during the interaction. After each scenario they were asked about their thoughts and experiences.

A revised version of the digital prototype was implemented between the two user-testing days (after participant 6) to ensure that subsequent tests would yield new feedback rather than repeating previously observed responses. Details of the iteration can be found in Appendix O.

Before starting, the participants signed an informed consent form.

Scenario 1 - Onboarding

Participants encountered the onboarding screen with Owen when turning on the oven for the first time. They read through the first introduction of Moment of Care, shown in Figure 83 & Figure 84.

Q1: What is your first reaction when you read this?
Q2: Is it clear to you what is expected of you? Why or why not?
Q3: How would you feel if you encountered this when purchasing an oven?

The goal was to evaluate whether introducing care from the beginning feels empowering or intrusive.

Figure 84: Onboarding Scenario in Test Setting

Scenario 2 - Micro Maintenance Moment

Participants switched on their three weeks old oven and were presented with a Micro Maintenance Moment pop-up, after which the Vitality Meter decreased to 80%. The pop-up instructed them to wipe the inside of the oven door for 30 seconds. If they selected the "Let's go" button, a 30-second timer started, during which they could complete the task. Afterwards, they received either a confirmation message or a disappointed Owen, depending on whether they had carried out the task. The pop-up is shown in Figure 85.

Q4: How do you experience this moment being initiated by the oven?
Q5: On a scale of 1 to 7, to what extent would you be inclined to actually carry out this task? (1 = definitely not, 7 = definitely yes), why?
Q6: When would you skip this moment?

The aim was to test whether small, low-effort tasks create engagement or irritation.

Figure 85: Digital Prototype; Micro Maintenance Moment Pop-Up

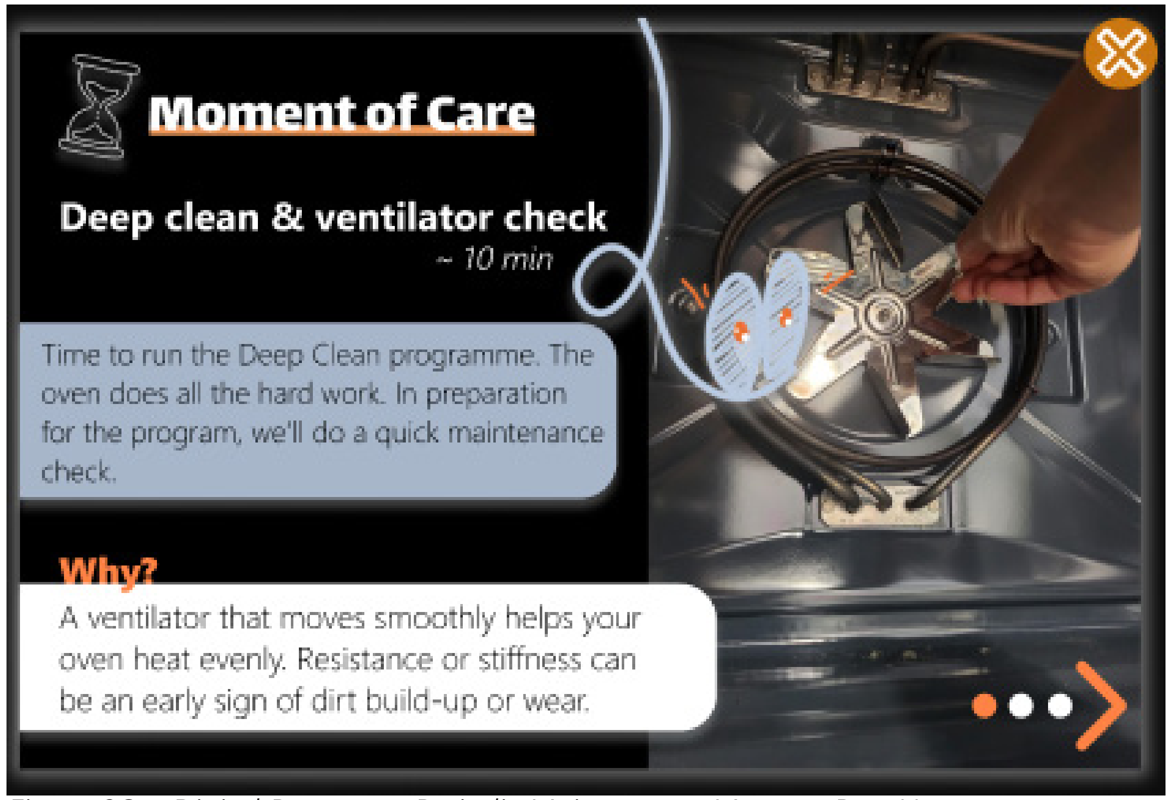


Figure 86: Digital Prototype; Periodic Maintenance Moment Pop-Up

Scenario 3 - Periodic Maintenance Moment

Participants were asked to imagine that they had owned the oven for five months and had ignored a recurring periodic maintenance pop-up four times in recent weeks. As a result, the Vitality Meter had gradually declined to 20%. They were presented with the periodic maintenance task, pop-up is shown in Figure 86, which instructed them to check the movement of the ventilator and run the oven's deep-clean programme.

To complete the ventilator check, participants could follow step-by-step guidance, including removing the side racks and the inner wall of the oven, shown in Figure 87. After providing feedback on the ventilator inspection, they were prompted to start the deep-clean programme. For practical reasons, the oven could remain disassembled for Scenario Four, although participants were asked to imagine that they would need to reassemble it.

Q7: What went through your mind when this larger task was proposed?
Q8: How much effort does this feel like to you?
Q9: To what extent would you postpone this? When would you stop postponing it?
Q10: On a scale of 1 to 7, to what extent do you feel confident that you could successfully complete this task? (1 = no confidence, 7 = full confidence)
Q11: What would be a reason for you to drop out, if you had already started?

The aim of this scenario was to assess perceived effort for larger maintenance tasks, confidence in completing more complex actions, thresholds for postponement, and reactions to a declining Vitality Meter.

Figure 87: Scenario 3 in Test Setting

Scenario 4 - Convection Heating Element Replacement

In the final scenario, participants encountered a pop-up indicating that the oven suspected a malfunction in the heating element, shown in Figure 88. They were asked to check whether the oven heated up when activating the element, to verify the system's diagnosis. When the oven failed to heat, participants were guided step-by-step to order a new heating element via a QR code and replace it, shown in Figure 88. After completing the replacement, they performed a heating check and reassembled the oven.

Q12: If your oven stopped heating without the Moment of Care system, what would you normally have done?
Q13: Without this system, how likely would repair be for you? (1–7)
Q14: With this system, how likely is repair for you? (1–7)
Q15: Did you feel better prepared to undertake the repair because you had previously carried out maintenance tasks? Why or why not?
Q16: What in this concept influences you most to choose repair?

This scenario directly evaluated participants' ability to carry out the repair and whether prior engagement with maintenance tasks influenced their perceived competence and willingness to repair.

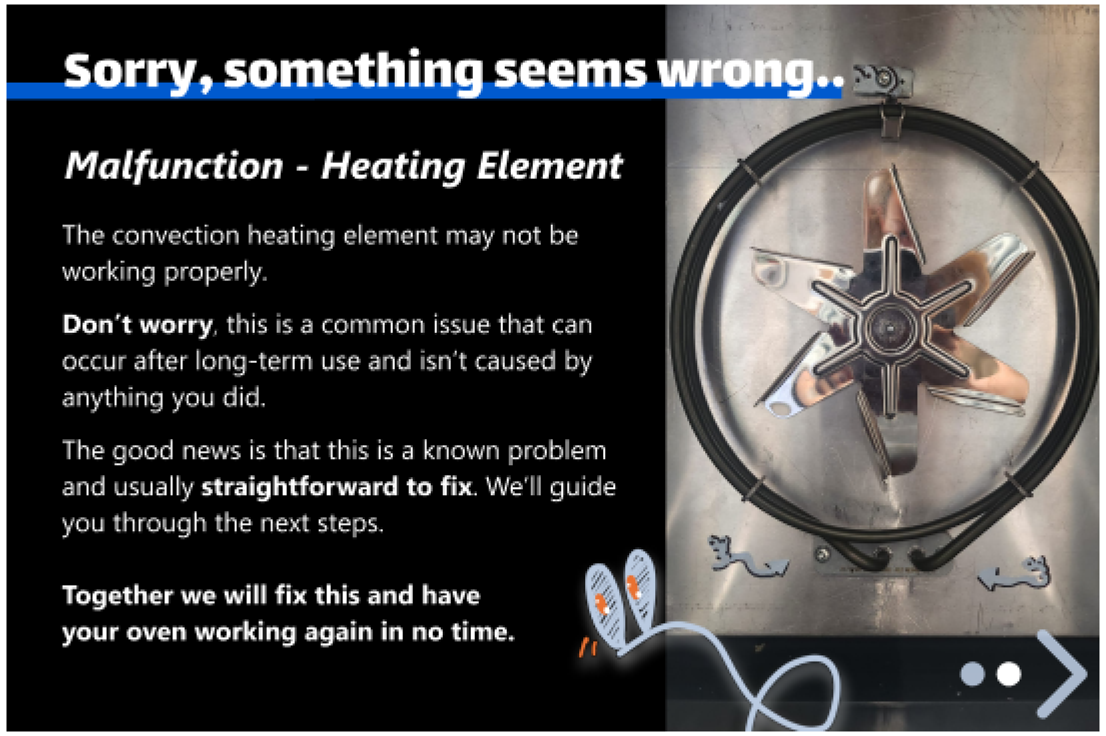


Figure 88: Digital Prototype; Malfunction Pop-Up

Reflection

Lastly, the users were asked a few more questions to reflect on the overall experience.

Q17: At which moment did you feel most motivated to take action?
Q18: Where did you lose motivation, and why
Q19: Does this system change how involved you feel with your oven?
Q20: If the vitality meter reaches 0, the oven will no longer heat until you complete a maintenance task. What do you think of this?
Q21: To what extent does this system feel like a choice versus an obligation?
Q22: If you owned this oven with the Moment of Care concept, would this system actually change your behaviour towards the oven? If so, in what way?
Q23: Do you have any further comments or remarks?

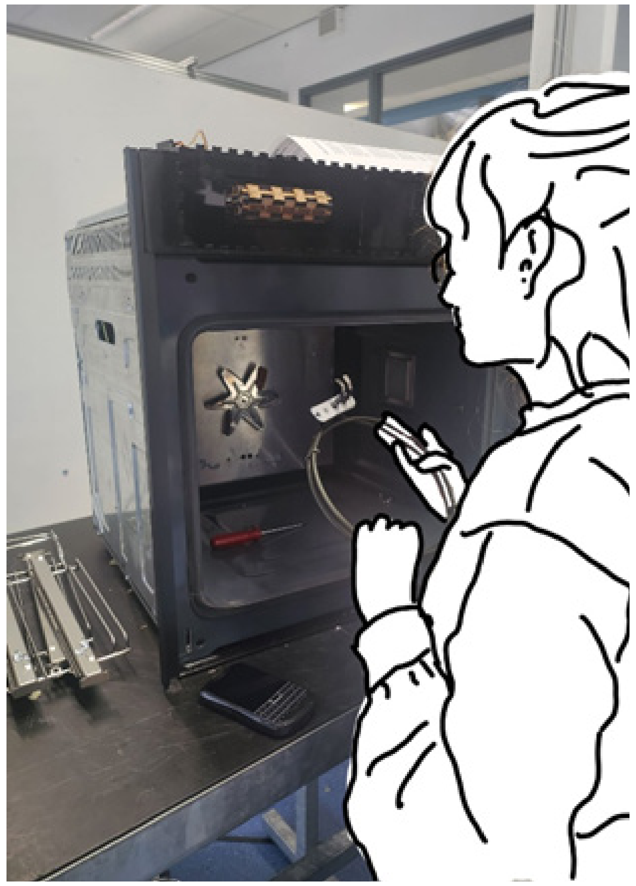


Figure 89: Repair Scenario in Test Setting

Data Analysis

To collect sufficient data from the user tests, detailed notes were taken during each session, and participants' responses were recorded in writing. While the original plan was to video record every session, technical limitations with the smartphone used for the digital prototype meant that not all sessions could be recorded, as the device was sometimes needed for the test itself.

All written statements, including general observations and responses to questions, were coded according to recurring themes: motivation, self-efficacy, autonomy, procrastination, emotional bonding, resistance, and the ritualising effect. Each relevant statement was examined to determine whether it supported or contradicted these themes. Based on the observations and responses, an overall attitude toward each scenario was derived for every participant. Each scenario was then assigned a score ranging from -2 to 2, allowing the creation of an overall attitude flow per participant.

For the Likert-scale questions, means and standard deviations were calculated to quantify participants' responses.

11.3.3 Results

In Table 4 the overall reaction of the participants on the different components of Moment of Care is shown.

Most participants responded positively to the onboarding of Moment of Care, shown in Figure 90. They generally perceived the concept as a valuable addition to the oven, supporting longevity and encouraging more mindful use. However, one participant reacted negatively, noting that receiving maintenance information during the first use of a new oven felt premature and of unclear value.

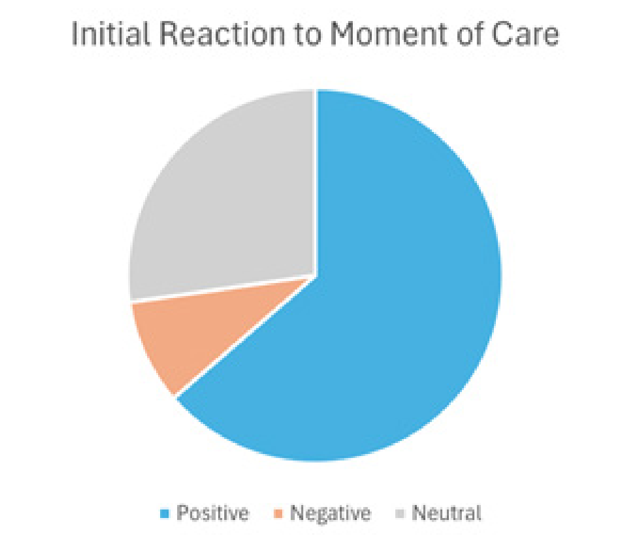
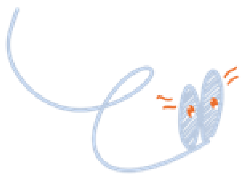
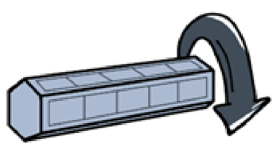
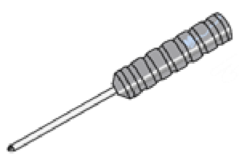
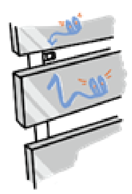


Figure 90: Participants Initial Reaction

Table 4: Overall Reaction Moment of Care Elements

Components	Overall Reaction	Note
	++	
	+/-	Goal sometimes unclear
	++	
	+	Can be more enhanced
	+	Overall positive, but at times limiting autonomy

Participants reported a relatively high willingness to perform micro-maintenance tasks (M = 5.09, SD = 1.31) and high self-efficacy for periodic maintenance (M = 6.18, SD = 0.94), shown in Figure 91. This confidence was reflected in the repair task, as all 11 participants successfully replaced the convection heating element.

The likelihood of self-repair also increased substantially with the Moment of Care concept, rising from M = 1.91 (SD = 1.16) without the system to M = 6.18 (SD = 0.57) a mean difference of 4.27 on a 7-point scale, shown in Figure 92, indicating that the system significantly increased participants' willingness to attempt a repair.

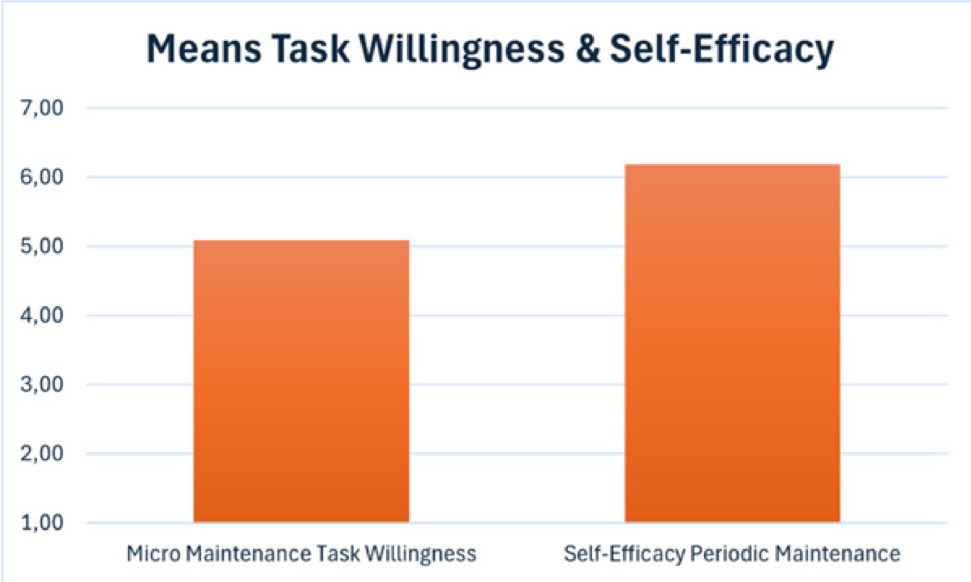


Figure 91: Means Willingness & Self-Efficacy for Maintenance Tasks

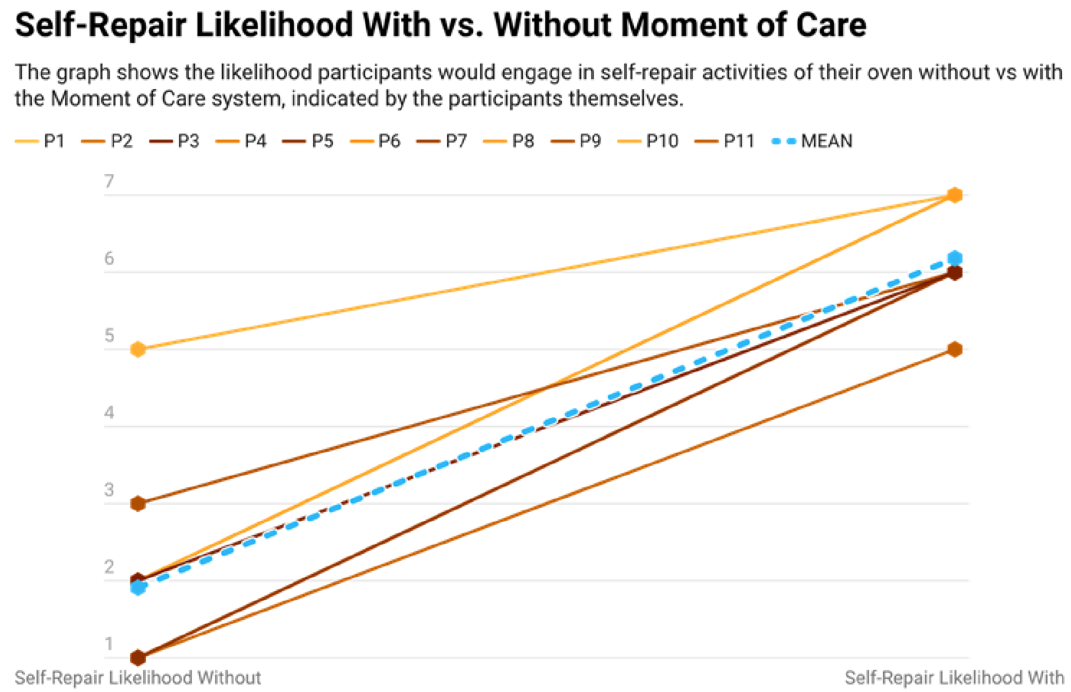


Figure 92: Self-Repair Likelihood Without vs With Moment of Care

Participants' attitudes across the scenarios, shown in Figure 93, show some variation. A dip occurs in Scenario 3, where some participants found the overall goal unclear, and in Scenario 4 when diagnosing the problem, as they were informed of the malfunction. Attitudes also decreased during the step of ordering the replacement part, as participants disliked waiting for the component to arrive and needing to find new motivation to complete the repair afterwards.

In contrast, attitudes towards the repair itself and the overall system were very positive. Many participants noted that the repair was easier than expected and that the maintenance moments helped prepare them for it.

Key Behavioural Drivers

Qualitative data from the evaluation sessions were thematically coded to better understand how the concept influenced participants' behaviour and decision-making. The analysis focused on patterns related to motivation, self-efficacy, autonomy, postponement, emotional bonding, resistance, and ritualisation. Table 5 summarises the main triggers and barriers for each theme, the coding itself can be found in Appendix P.

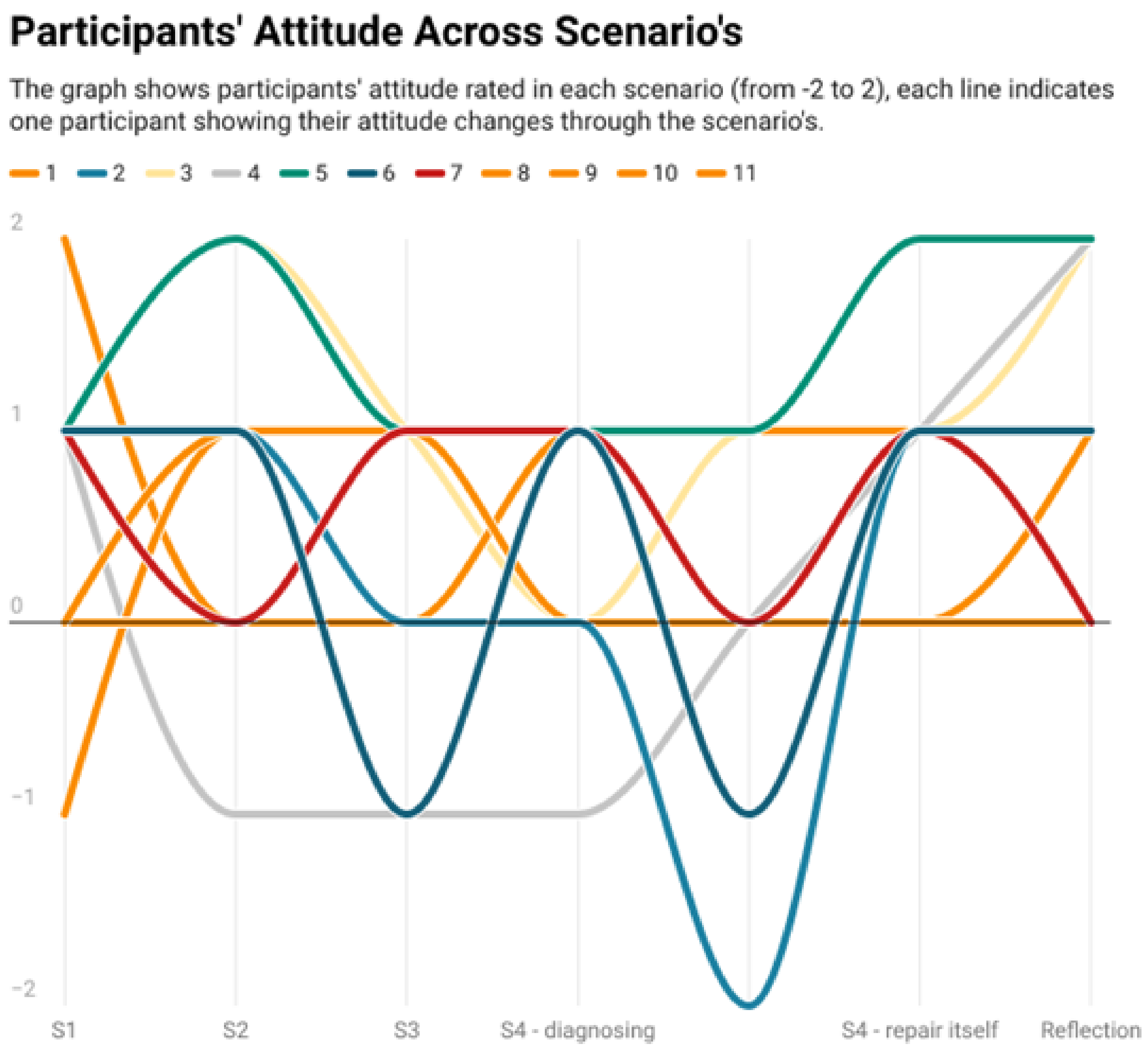


Figure 93: Participants' Attitude across the Test Scenario's

Table 5: Summary of Triggers & Barriers per Behavioural Driver

Theme	Triggers (Positive Drivers)	Barriers (Negative Drivers)
Motivation	• Starting the repair process (urgency to act) • Completing micro-maintenance tasks	• Waiting for ordered replacement part • Unclear purpose of some maintenance tasks
Self-Efficacy	• Familiarity with components through maintenance tasks • Clear instructions and visual guidance • Diagnosis already completed by the system	• Scepticism towards automated diagnosis • Fear of abandoning repair if first steps fail
Autonomy		• Unskippable timers • Inability to schedule tasks independently • Oven functionality restricted if maintenance is skipped
Postponement	• Tasks more likely performed when linked to repair	• Lack of time or low priority at the moment • Maintenance preferred during broader cleaning routines • Busy cooking situations or guests present
Emotional Bonding	• Owen makes the oven feel more alive • Better understanding of how the oven works • Increased awareness of user responsibility	• Too many notifications reduce positive engagement • System perceived as undermining user authority
Resistance		• Scepticism about system diagnosis • Automated maintenance scheduling perceived as intrusive
Ritualising Effect	• Maintenance familiarises users with disassembly • Increased confidence when performing the repair	

The analysis revealed several patterns that influenced participants' willingness to repair. First, the periodic maintenance tasks played an important role in strengthening self-efficacy. Nine out of eleven participants indicated that these moments helped them become familiar with the oven's components, making the eventual repair feel less intimidating. Even participants who did not explicitly mention component familiarity noted increased trust in the system and confidence in navigating the interface.

Motivation was strongly influenced by situational triggers. The malfunction itself created urgency and made participants feel capable of addressing the issue once the problem was diagnosed. In contrast, motivation decreased during stages that involved waiting, such as ordering the replacement part, or when the purpose of a task was unclear.

At the same time, several elements of the concept influenced participants' sense of autonomy. Features such as unskippable timers, frequent notifications, or the inability to plan maintenance tasks themselves were sometimes perceived as controlling. When participants felt that the system imposed actions rather than supported them, resistance increased.

Finally, the presence of the assistant character Owen contributed to a sense of emotional engagement with the system. Participants described the oven as feeling "more alive" and indicated that the interaction helped them better understand how the appliance works and what was expected from them as a user.

11.3.4 Conclusion

To conclude the evaluation tests, the evaluation questions are addressed. The answers are also visualised in Figure 94.

EQ1: *Does Moment of Care convince users to perform maintenance and repair tasks?*

Participants generally responded positively to the idea of the oven initiating maintenance moments, as this helped clarify what was expected from them as users. While the tasks themselves were not perceived as problematic, participants indicated that they might occasionally postpone them. However, this does not necessarily undermine the concept, as long as the overall level of maintenance increases. The vitality meter functioned as a helpful reminder for some participants by signalling that care was needed, although others tended to overlook it. In contrast, repair tasks were received very positively, as they directly addressed the problem of the oven malfunctioning and offered a clear benefit.

EQ2: *Does Moment of Care reassure the user the tasks are manageable?*

The concept also succeeded in reassuring participants that the tasks were manageable. This is reflected in the high self-efficacy score for periodic maintenance (M = 6.18, SD = 0.94). Additionally, nine out of eleven participants indicated that the recurring maintenance moments helped them better understand how the oven works, which in turn increased their confidence in performing repairs. The assistant character Owen played a role in providing reassurance and guidance, although some participants noted that the tone of interaction could occasionally be slightly toned down.

EQ3: *Does Moment of Care provide sufficient support throughout the tasks?*

The results suggest that the system provides sufficient support for users to perform the repair tasks. All participants successfully replaced the convection heating element, and the likelihood of self-repair with the system was high (M = 6.18). Following design iterations, the instructions were generally perceived as clear, however, it was noted that the readability of the instructions could be enhanced at points. The visual cues helped users connect the digital instructions to the physical components of the oven, although some participants indicated that these cues could be made more prominent.

Convincing	+	• Positive towards oven initiated maintenance tasks • Occassional postponments
Reassuring	++	• High self-efficacy • Ritualising effect
Supporting	+	• 100% succesfull repairs • Readability & visual cues can be enhanced

Figure 94: Visual Summary of Answers to Evaluation Questions

Several additional insights emerged from the evaluation that informed further design refinements. For example, restricting oven functionality after repeatedly ignoring maintenance tasks was perceived as limiting user autonomy. Participants also suggested allowing users to indicate when a task had already been completed to prevent unnecessary reminders. Finally, providing guidance on how to dispose of the old convection heating element would enhance feasibility.

11.3.5 Limitations

Several limitations of the user test should be acknowledged. First, the participants were younger than ATAG's intended premium target group, as the sample consisted mainly of students. This may have influenced the results, as students are often more open to experimentation with new systems and may have different financial sensitivities compared to the intended user group. Additionally, the testing context itself may have affected participant behaviour due to the observer effect. Although all participants successfully completed the tasks during the session, several indicated that they might have postponed or ignored some of them in a real-life situation. Finally, the study only captured short-term interactions with the concept, meaning that potential long-term behavioural changes could not be measured.

Chapter 12:

Discussion

This chapter interprets the evaluation findings in relation to established theory, assesses the concept's desirability, feasibility, and viability, and reflects on its generalisability and relevance to ATAG. The discussion concludes with a critical reflection on the concept and the research limitations.

12.1 Interpretation Findings in Relation to Theory

The evaluation findings reveal how psychological factors shape users' willingness to repair their ovens, offering insights that resonate with key behavioural theories. These findings are summarised in Figure 95.

Users demonstrated a strong need for perceived autonomy, with resistance arising when notifications felt intrusive or when control was lacking. This aligns with Self-Determination Theory (Deci & Ryan, 1985), highlighting autonomy and competence as fundamental psychological needs. Successful repairs fostered pride and satisfaction, reinforcing the role of competence in sustaining engagement, while forced actions diminished motivation.

Willingness to proceed with repairs was tied to users' confidence in the diagnosis and trust in the manufacturer. Clear communication about the problem and the safety of the proposed solution increased comfort levels, reflecting principles of the Uncertainty Reduction Theory (Berger & Calabrese, 1975). By reducing ambiguity, transparent explanations strengthened users' belief in their ability to complete the task.

Recurring maintenance interactions encouraged routine care. Participants said these moments could help them become more aware of how to take care of the product. This aligns with behavioural ritual theory (Rook, 1985), where repeated actions foster a sense of responsibility and ownership. Thus, "Moment of Care" may not only facilitate individual repairs but also normalise maintenance as part of everyday product use.

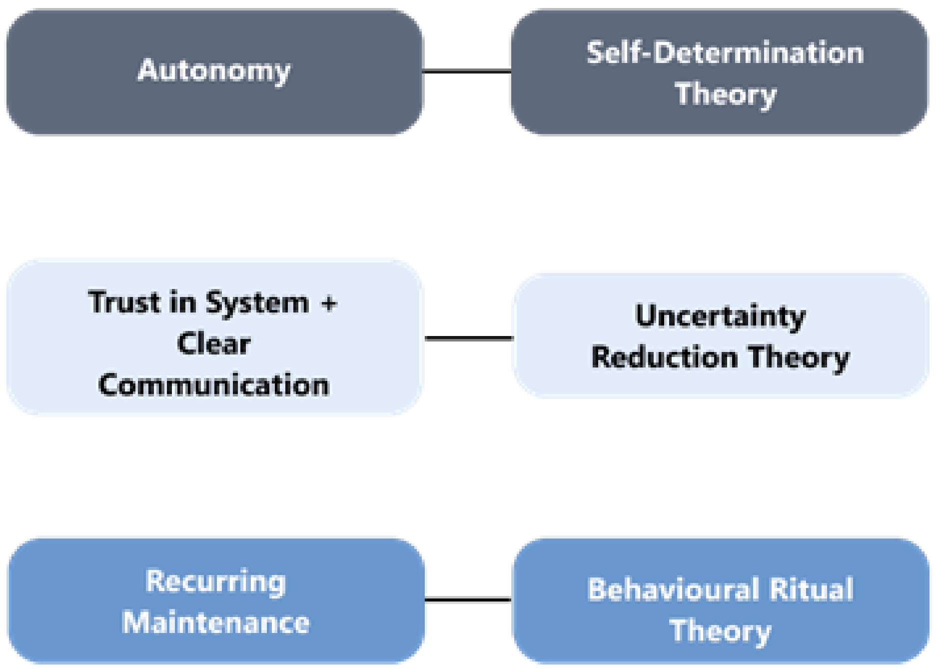


Figure 95: Visual Summary of Answers to Evaluation Questions

12.2 Desirability, Feasibility & Viability

To assess whether Moment of Care could realistically be implemented, the concept is evaluated in terms of desirability, feasibility, and viability. Together these dimensions indicate whether the concept is attractive for users, technically achievable, and economically sensible for ATAG.

12.2.1 Desirability

The desirability of Moment of Care depends on how users experience the interaction with maintenance prompts, guidance, and the Owen character. When perceived as supportive, these interactions can make maintenance and repair more approachable by providing clear explanations, reminders, and step-by-step instructions. However, the evaluation also revealed that prompts may feel intrusive if they reduce the user's sense of autonomy. The timing and communication style should therefore emphasise user control. In addition, the concept must align with ATAG's premium positioning: maintenance support should feel refined and effortless, reinforcing durability and sustainability while maintaining a high-quality user experience.

12.2.2 Feasibility

The concept builds on diagnostic capabilities already present in newer ATAG ovens, which detect malfunctions and communicate them through error codes. These codes often indicate general issues rather than specific faulty components.

For example, error code 2 indicates that the oven does not heat correctly. While this is often linked to the convection heating element, other causes may also be possible. Therefore, an additional diagnostic check would be needed before a consumer purchases replacement parts.

Rather than altering the detection system, Moment of Care translates existing fault information into accessible explanations and repair guidance. Because it builds on existing infrastructure, the technical implementation remains relatively straightforward. The concept does depend on the functioning of the oven's display, power supply, and connectivity, but these are unlikely to fail in the repair scenarios explored in this thesis.

12.2.3 Viability

Implementing Moment of Care would involve development costs, including software design and physical adaptations for the integrated screwdriver, visual cues and the Vitality Meter.

However, these costs may be offset by reduced service visits. For instance, convection heating element failures, the most common oven issue, reach call rates above 5% in post-warranty years, shown in Figure 96. With around 100,000 ovens sold annually, this could represent roughly 5,000 service visits each year.

If a portion of these cases were resolved through self-repair, significant service costs could be avoided. In addition, the concept could create strategic value by positioning ATAG as a brand that actively supports product longevity and repairability, strengthening brand perception and customer loyalty.

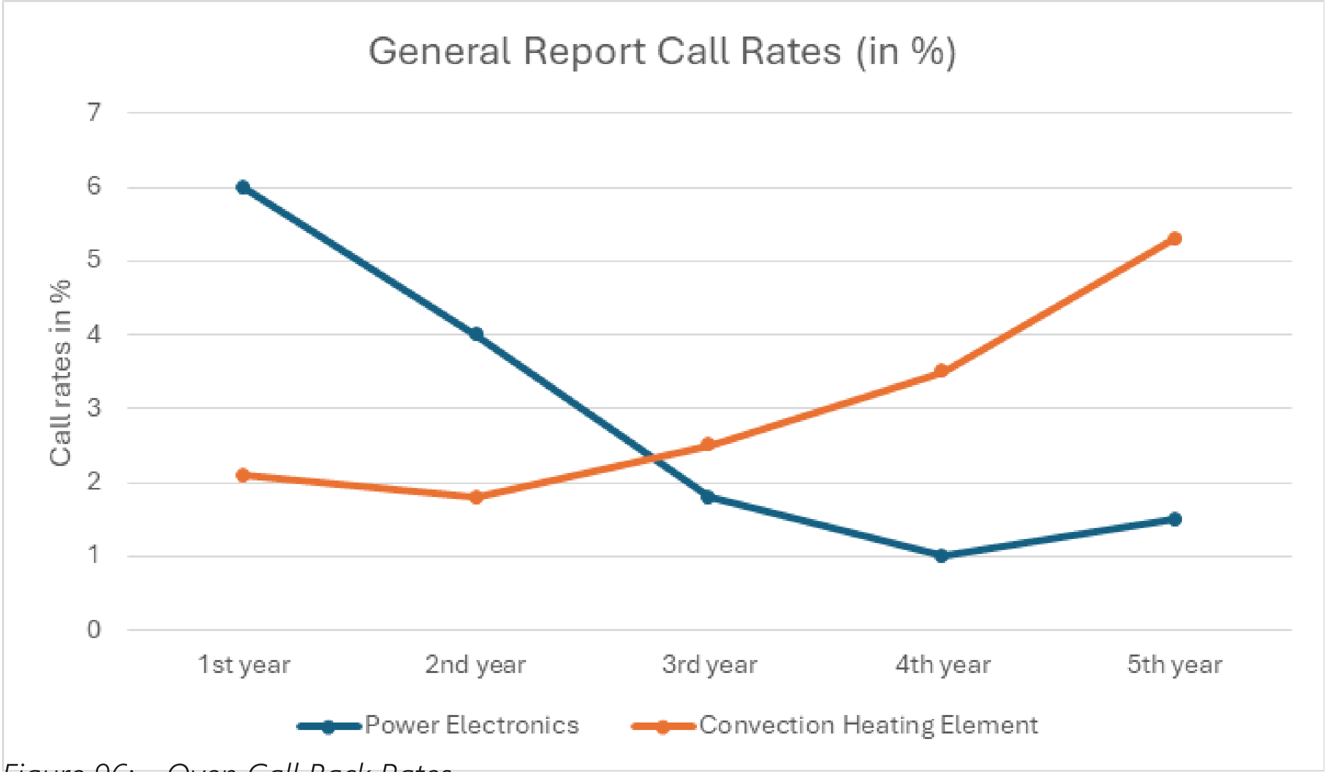


Figure 96: Oven Call Back Rates

12.3 Implications for Repair Behaviour & Generalisability

This research contributes to the repair literature by shifting focus from technical repairability to the psychological conditions that influence repair willingness and translating these insights into a concrete design intervention.

The findings suggest that routine repair behaviour can be influenced through product interaction, guided repair can reduce perceived complexity, and maintenance rituals can prepare consumers for future repairs.

By integrating repair guidance and maintenance rituals into the product experience and framing it as a manageable and manufacturer-supported activity, the concept helps shift repair from an exceptional activity to a normal part of product use.

12.4 Relevance for ATAG

For ATAG, Moment of Care aligns with strategic sustainability goals by promoting longer product lifespans and reducing waste. However, the shift toward user-led repairs introduces challenges, particularly around safety, warranty concerns, and potential misuse. Clear distinctions between consumer-repairable and professional repairs are essential to mitigate risks while empowering users.

Practical implementation would require investments in software development and design adaptations, such as visual repair cues, integrated tools and the vitality meter. Though these incur upfront costs, the long-term reduction in service visits, and the associated strategic benefits, could justify the expenditure. By fostering a culture of repair, ATAG can reinforce its commitment to durability, appealing to environmentally conscious consumers and differentiating its brand in a competitive market.

12.5 Critical Reflection on Concept

While the evaluation shows promise for the Moment of Care concept, several points require reflection. First, the concept introduces maintenance interactions in a premium appliance context where convenience is highly valued. However, some users may also perceive the ability to solve minor issues independently as a form of convenience, especially when it avoids waiting for service technicians. To see how users react on this the concept should be thoroughly tested with the right target group before implementation.

Second, care prompts must carefully balance guidance and autonomy. Participants appreciated being informed about maintenance but preferred retaining control over when to act. Designing notifications that support rather than interrupt the user experience will therefore be crucial.
Third, the long-term effectiveness of the concept remains uncertain. Although recurring maintenance moments may help normalise care behaviour, their ability to create lasting habits was not tested in this study and would benefit from longitudinal research.

Accessibility also emerges as a critical factor. The concept assumes a baseline level of digital literacy and physical capability, which may exclude some users. Future iterations should prioritise inclusivity, ensuring the intervention remains effective across diverse user groups.

12.6 Limitations of the Research

This study has several limitations that should be considered when interpreting the findings. First, the evaluation did not take place in real-life repair situations. Participants interacted with the concept through scenarios rather than experiencing an actual oven malfunction at home. The absence of real financial stakes, inconvenience, and emotional frustration may therefore have influenced their responses.

The research relied on self-reported intentions rather than observed long-term behaviour, risking an overestimation of users' willingness to engage in repairs. The participant sample was also younger than the intended target group of premium oven owners, which may have affected how participants perceived and interacted with the concept.

Additionally, the focus on premium ovens in the Benelux limits the generalisability of the findings, as attitudes toward repair may vary across cultural and economic contexts.

Finally, the limited timeframe of the project also restricted the number of design iterations. Further testing could refine the step-by-step guidance, particularly regarding the readability and clarity of instructions on the oven interface.

Despite these limitations, the study provides valuable insights into how design interventions can support and motivate repair behaviour, offering a promising foundation for further development and research.

Chapter 13:

Conclusion

The discussion provided a critical reflection on the Moment of Care concept and the research results. The key insights are synthesised below to answer the research questions and the overall research aim.

13.1 Answering Research Questions

RQ1: *What are the main motivations and barriers consumers experience when deciding whether to repair or replace an oven?*

Consumers' willingness to self-repair an oven is primarily determined by whether they think the repair will be worth the effort and the risk of further damaging the oven. When the repair is considered manageable and worth the effort, consumers are more willing to attempt it. On the other hand, high perceived complexity and uncertainty about how to proceed strongly reduce willingness to self-repair.

RQ2: *How do consumers perceive the economic, emotional, and environmental value of repairing an oven?*

Consumers generally perceive self-repair as environmentally beneficial, economically advantageous, and potentially empowering. Nevertheless, uncertainty and perceived risk can outweigh these positive values. The findings show that confidence in the diagnosis and trust in the manufacturer are important aspects to reduce these uncertainties and to enable consumers to proceed with the repair.

RQ3: *How can design interventions support and sustain consumer repair behaviour for ovens?*

By presenting repair as the normal and convenient solution, design can lower psychological barriers. Clear guidance, manageable tasks, and familiarisation with the product through recurring maintenance moments help reduce uncertainty and make repair behaviour more accessible. Design interventions should support consumers without restricting their autonomy. Users should remain in control while being guided through the repair process.

13.1.1 Key Insights

Three key insights emerged from the research.

First, **willingness to repair is largely shaped by effort justification**: consumers are more likely to repair when the perceived effort, time, and complexity are justified by the expected outcome.

Second, **autonomy is crucial**. Interventions that feel controlling or obligatory may reduce motivation, whereas supportive guidance increases willingness to engage in repair.

Third, **maintenance rituals can lower the repair threshold.** Regular interaction with the product familiarises consumers with its components and reduces the perceived complexity of repair tasks.

13.1.2 Answer to Research Aim

The aim of this thesis was to explore how design can increase consumers' willingness to self-repair an ATAG oven. The findings show that willingness to repair is mainly limited by perceived effort, uncertainty, and risk. Design can address these barriers by convincing consumers of the worth of self-repair and reassure and support them throughout the repair process. This is shown in Figure 97.

The Moment of Care concept demonstrates how product-integrated guidance and recurring maintenance interactions can normalise repair behaviour and make self-repair more accessible for consumers.

Although the research focused on ATAG ovens, these insights may also apply to other consumer electronics where repairs are relatively simple and supported by product diagnostics and connectivity.

Figure 97: Visualisation of Main Conclusion

Chapter 14:

Recommendations

The evaluation results informed the recommendations presented in this chapter. They are structured across three levels: improvements for the next design iteration, recommendations for ATAG, and directions for further research.

14.1 Future Design Iteration

The first section outlines suggested refinements to further develop the Moment of Care concept based on the evaluation findings.

14.1.1 Improved Cleaning Guidance

The micro maintenance moments alone are insufficient to maintain overall oven cleanliness. Owen should therefore also communicate recommended cleaning behaviour, such as wiping the oven interior and removing food residues after each use, shown in Figure 98. The micro maintenance tasks can then focus on specific areas that are easily overlooked during quick cleaning, such as the side racks or inner walls. In the future, these tasks could potentially be customised based on different oven uses (e.g., oven, microwave, or steam) and the resulting maintenance needs.

14.1.2 Better Alignment with Users' Schedules

To preserve user autonomy, users should be able to skip tasks if they have recently performed them. Additionally, periodic maintenance tasks should be flexible: users should be able to complete them immediately, schedule them within the coming week, or postpone the reminder. This is shown in Figure 99.

Figure 98: Owen Reminding Users to Clean more regurlarly

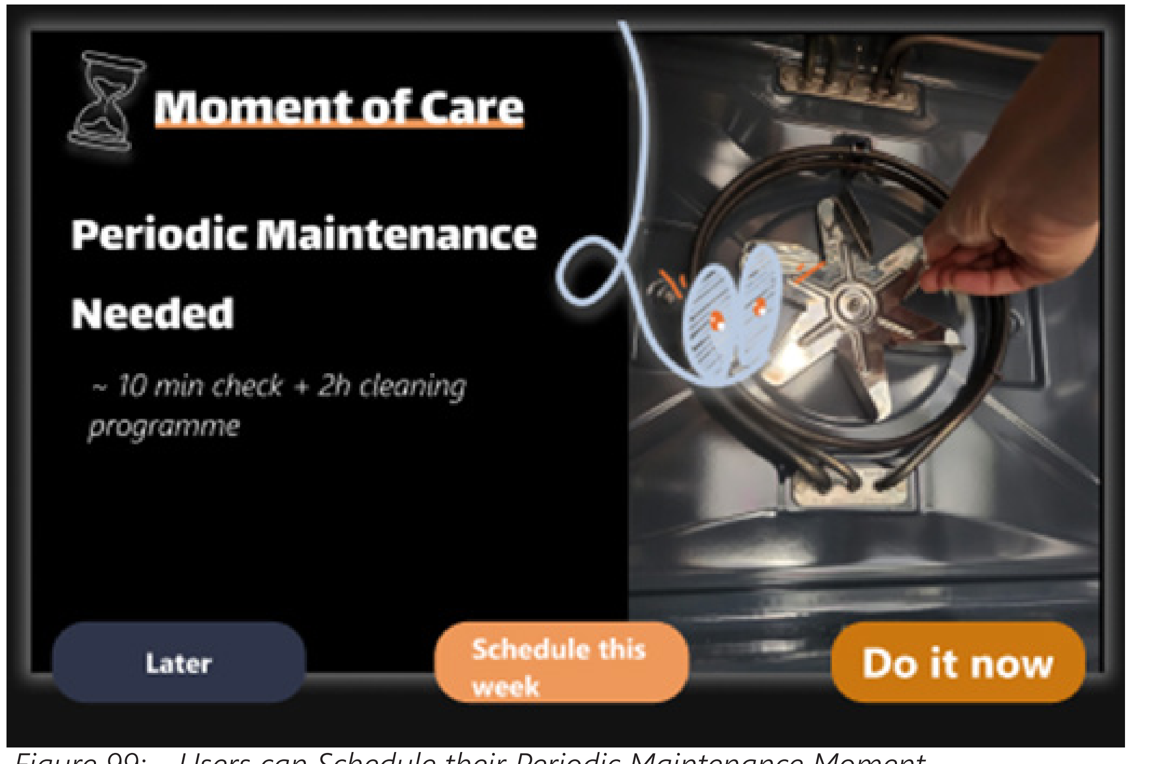


Figure 99: Users can Schedule their Periodic Maintenance Moment

14.1.3 Maintenance Meter

The Vitality Meter will be renamed the Maintenance Meter to more clearly communicate that it reflects how well the oven is maintained rather than its remaining lifetime. The meter will be integrated into the oven display instead of the physical interface to reduce manufacturing complexity and better match ATAG's design language. When the meter falls below 50%, it will remain visible through the always-on-screen to signal that maintenance is required shown in Figure 100. The previously proposed penalty of disabling the oven after repeated ignored tasks will be removed, as it conflicted with users' sense of autonomy. Instead, low maintenance levels will simply result in more frequent reminders.

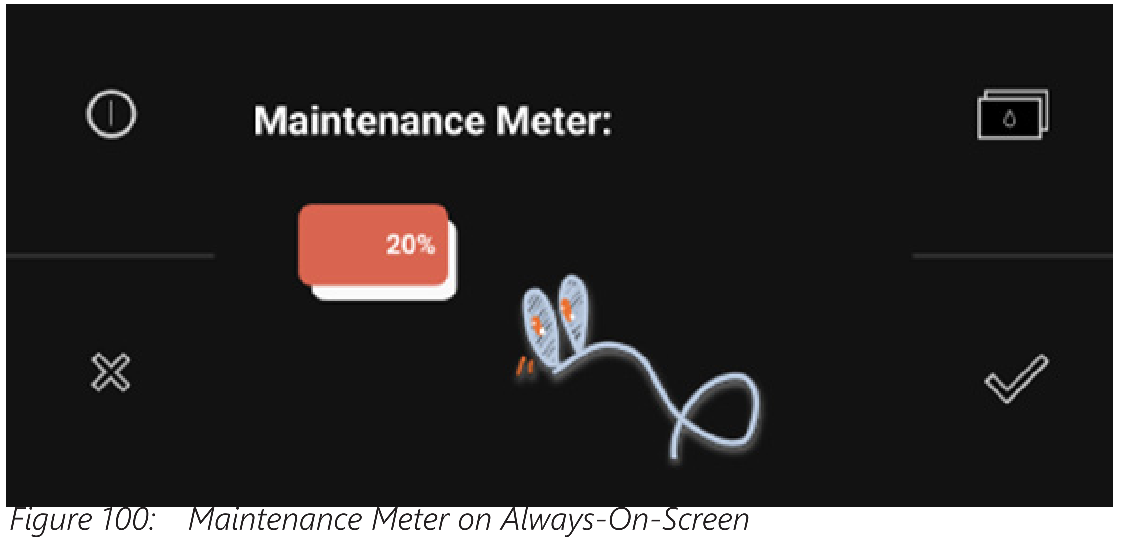


Figure 100: Maintenance Meter on Always-On-Screen

14.1.4 Enhanced Visual Cues

The evaluation tests showed that visual cues help users perform repair tasks confidently, but that the link between digital instructions and physical cues could be strengthened. The oven display should guide users to the physical cue through an Owen animation that moves toward the highlighted location in the photo on the oven display, visualised in Figure 102. By following this movement, users are directed to the relevant area of the component. When looking at the physical part inside the oven, the same cue is visible, enabling quick recognition of where to act. Strengthening this connection between digital guidance and physical cues can reduce uncertainty and make the repair process more intuitive, especially for users with limited technical experience.

14.1.5 Improved Pop-Up Visibility and Guidance

To ensure accessibility for a broader user group, interface text and visuals should be slightly larger to enhance readability. While this may require spreading information across more screens, the number of screens should remain somewhat limited to prevent cognitive overload.

14.1.6 Guidance on disposing Replaced Parts

Participants indicated uncertainty about what to do with the old heating element after replacement. Future iterations should therefore include guidance on how and where users can responsibly dispose of replaced components.

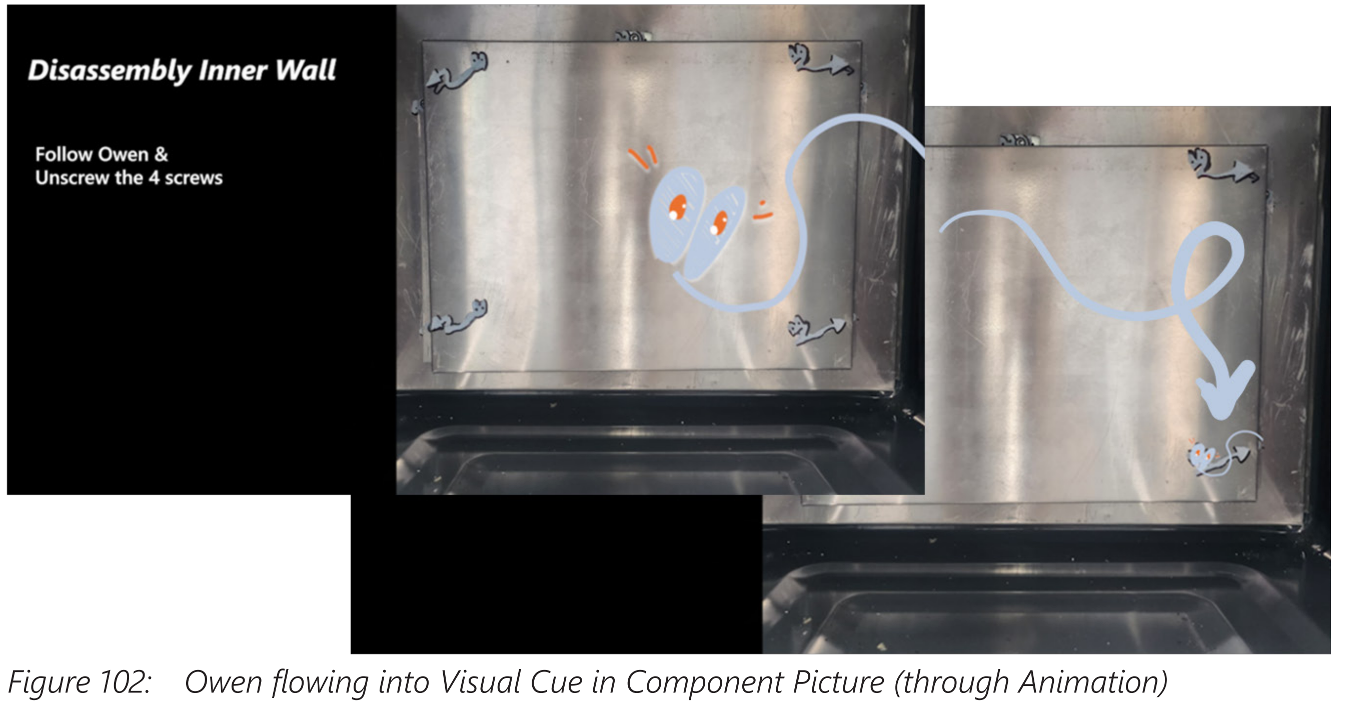


Figure 102: Owen flowing into Visual Cue in Component Picture (through Animation)

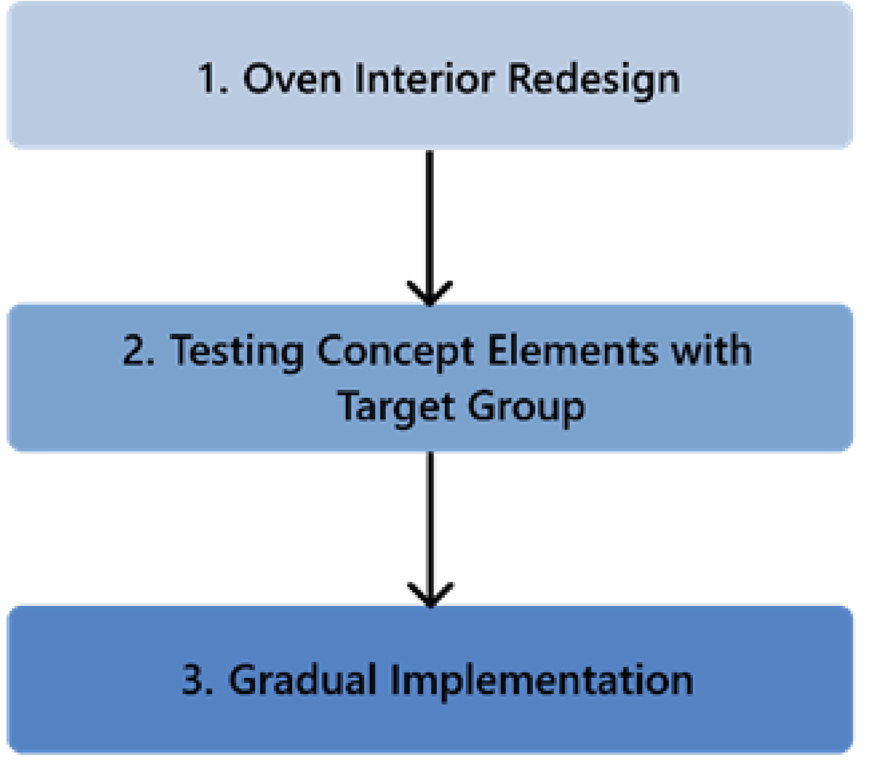


Figure 101: Recommendations Summary for ATAG

14.2 For ATAG

ATAG is recommended to implement the concept through a phased approach. First, the physical repairability of the oven should be improved by redesigning the interior so that the convection heating element can be replaced from within the oven cavity. This increases accessibility for consumers while also benefiting ATAG's service technicians.

This redesign provides the foundation for gradually introducing elements of the Moment of Care concept. Before full implementation, ATAG should test individual components of the concept with their customers. For example, it would be valuable to explore whether the system could function without micro maintenance moments, relying instead on periodic maintenance to build user confidence in performing repairs, or to evaluate how users respond to Owen providing maintenance guidance. Testing these elements separately allows ATAG to refine the concept and tailor aspects such as the frequency and form of care moments to their user base.

Such validation is important before broader implementation, ensuring the concept aligns with ATAG's brand as an innovative and premium experience. A summary of the recommendations for ATAG is shown in Figure 101.

14.3 Future Research

Future research should focus on validating the Moment of Care concept in real-life contexts and over longer periods of use. While this study explored users' perceptions through scenarios, longitudinal research with households using the system in practice could provide insights into whether micro-maintenance moments actually lead to more frequent maintenance and a higher willingness to repair.

Additionally, further research could investigate how different types of prompts influence user motivation. Variations in timing, tone, and level of guidance may affect whether users perceive maintenance prompts as supportive or intrusive. Understanding these nuances could help refine the interaction design of the system.

Finally, future research could examine whether the principles behind the Moment of Care concept can be applied to other household appliances. Investigating its transferability to products such as dishwashers or washing machines could reveal whether the approach can support broader strategies aimed at increasing consumer repair practices and product longevity.

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Appendices

The appendices provide additional material that supports the research and design process described in this thesis. They include detailed data, supplementary analyses, and supporting documentation referenced throughout the report.

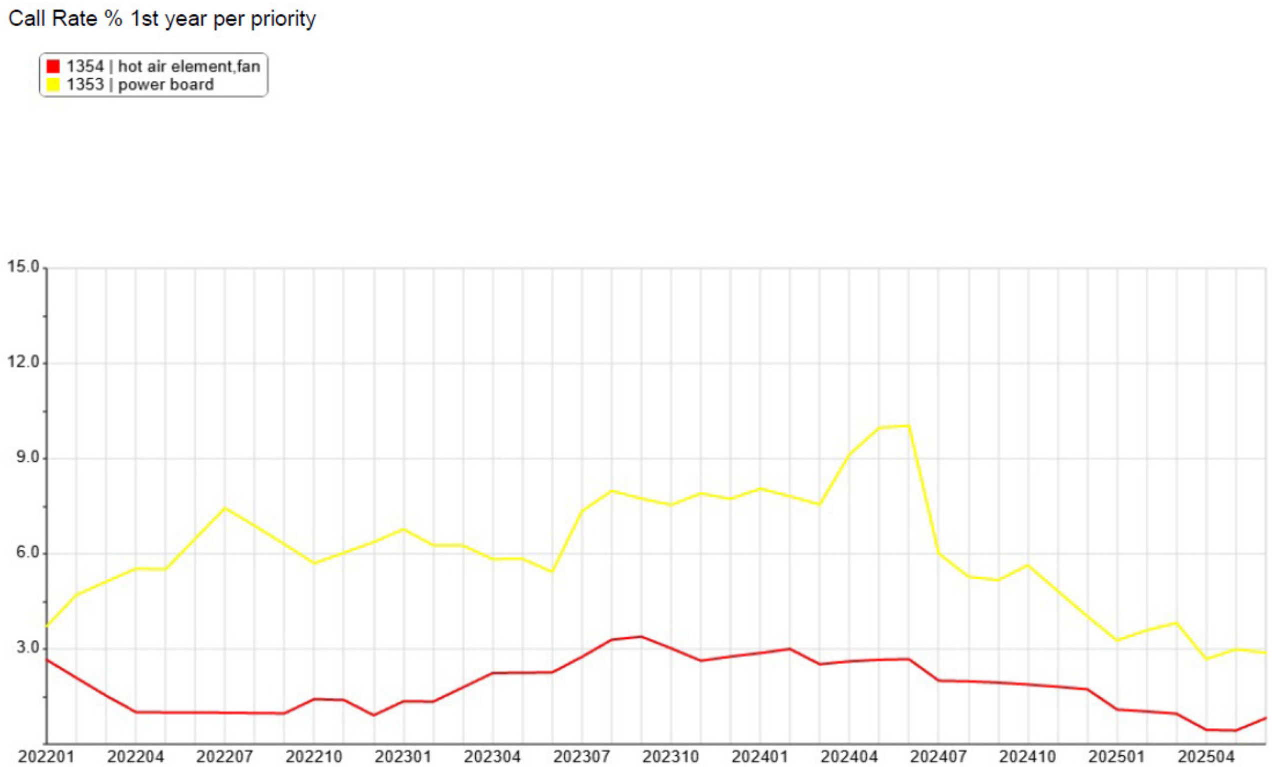
Appendix A — Call Back Rates ATAG Ovens

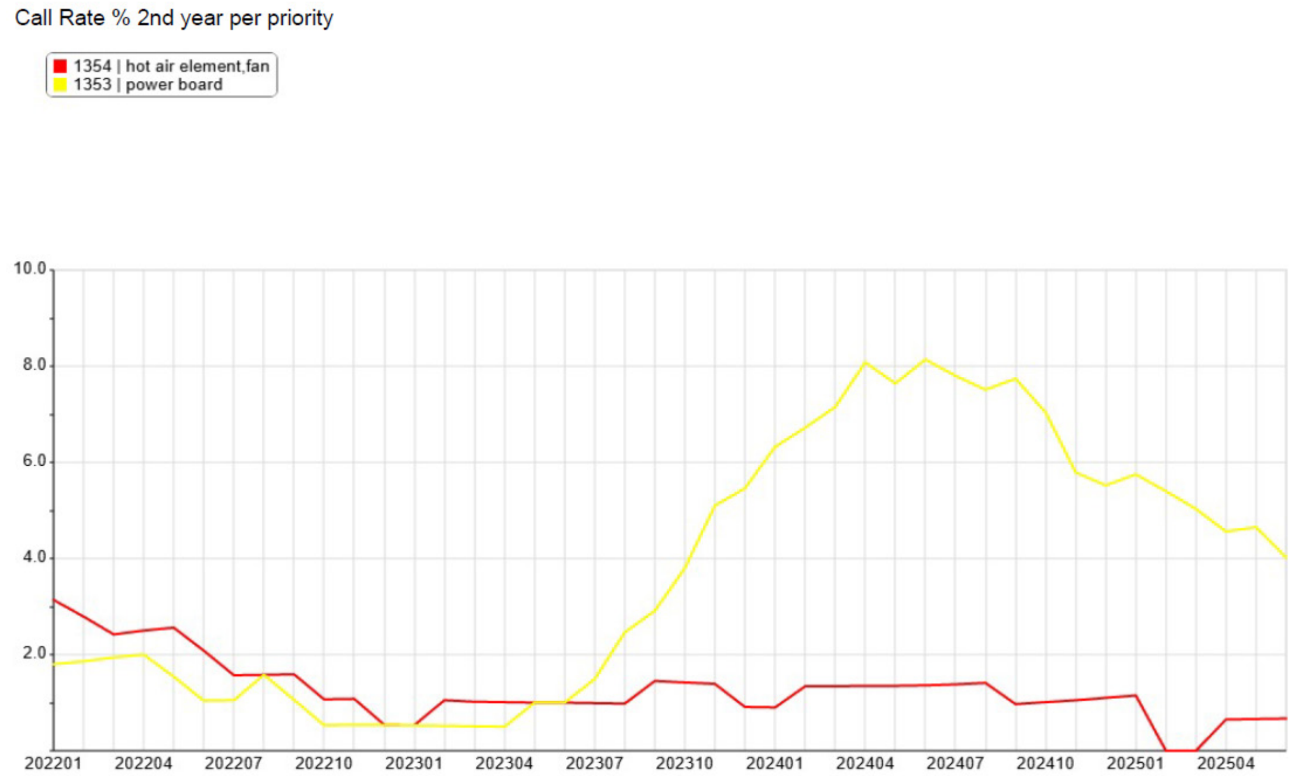
In the graphs in this appendix, the call rates for different oven models are presented. Each graph represents one year within the five-year warranty period and shows the two most common malfunctions: the convection heating element (hot air element) and the PCB (power board).

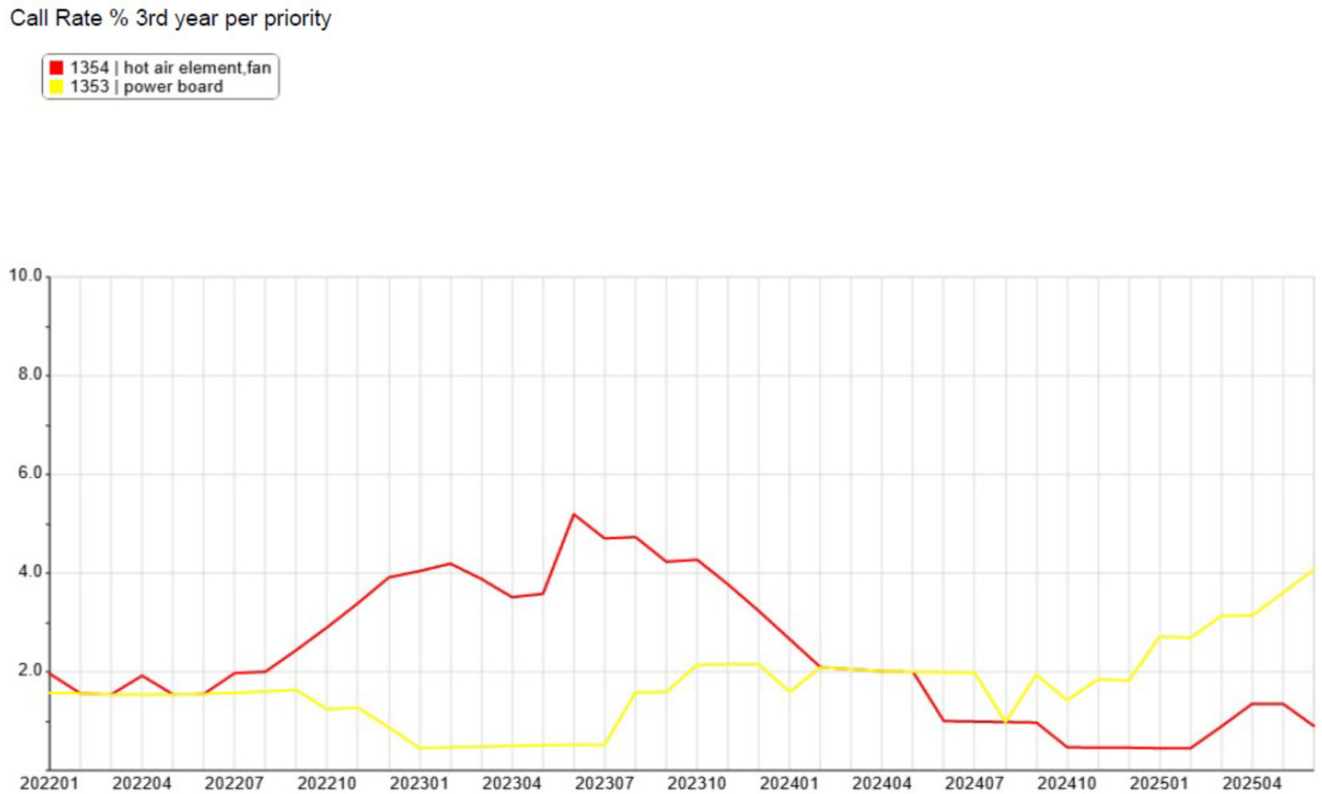
As the graphs illustrate variations between different oven models, and the aim of the analysis is to identify an overall trend, an average call rate was calculated for each year for both the convection heating element and the PCB. This resulted in the table shown in Table 1, which forms the basis for the graph presented in the main text, illustrating the overall trend of the most common malfunctions during the first five years of oven use.

Table 1: Average call back rate per year

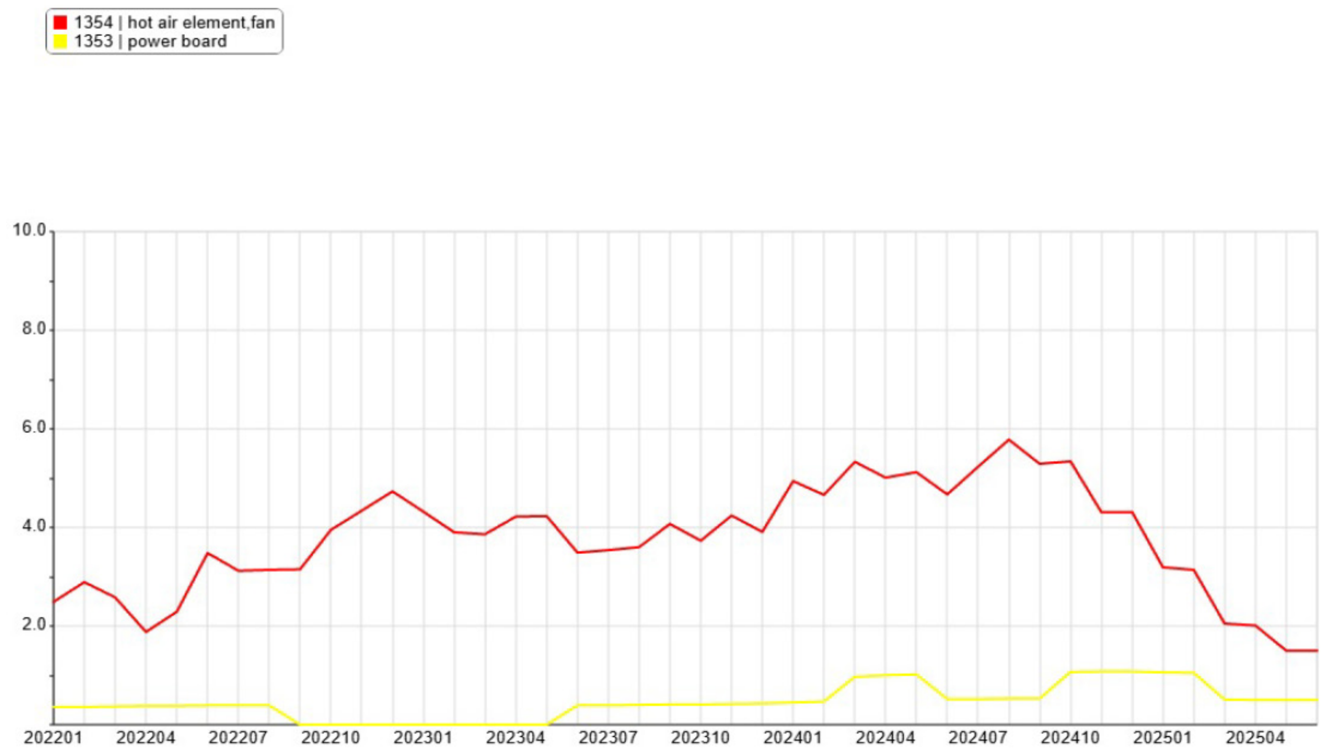
Element	1st year	2nd year	3rd year	4th year	5th year
Power Electronics	6	4	1,8	1	1,5
Convection Heating Element	2,1	1,8	2,5	3,5	5,3



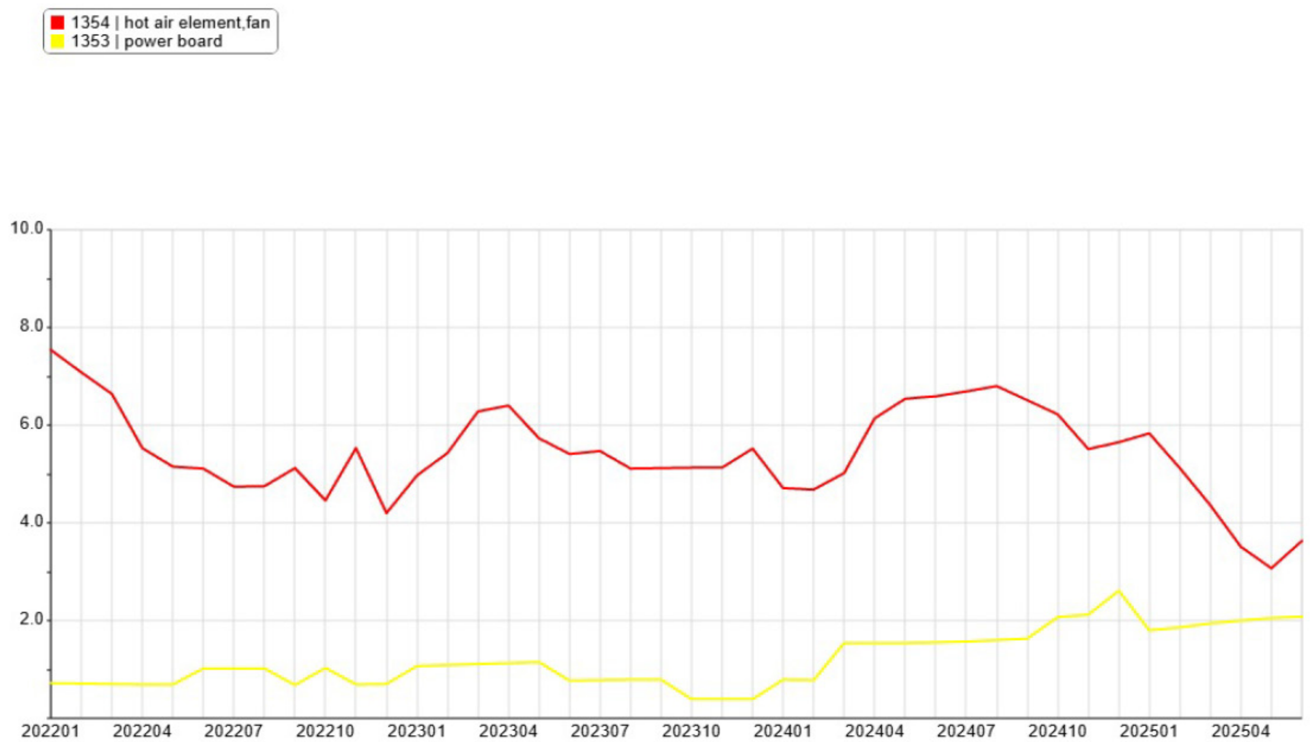




Call Rate % 4th year per priority



Call Rate % 5th year per priority



Appendix B — Making of the Disassembly Map

The oven used to create the disassembly map is the ATAG Combi-Steam Oven Pearl Grey (60 cm). This model includes advanced oven and steam functions but does not include a microwave function. A model without a microwave component was intentionally selected to reduce potential safety risks for the researcher during disassembly.

For the disassembly of the oven, a time limit of approximately four hours was set. This constraint was chosen because the scope of the project concerns consumer self-repair. If a task cannot reasonably be completed by the researcher within this timeframe, it is unlikely to be feasible or realistic to expect consumers to perform the repair themselves.

Not all reachable components were fully disassembled. The researcher deliberately avoided disconnecting certain cables and electrical connections due to the risk of damaging the oven or preventing it from functioning again after reassembly. As a result, additional components may technically be removable, but they were intentionally left attached to ensure a safer and more controlled disassembly process.

In addition, the inner back plates of the oven could not be removed during the disassembly process (see Figure 3B). This limited access to some internal components located behind these panels.

During the disassembly it was also observed that the insulation material inside the oven is highly irritative to the skin. Direct contact should therefore be avoided, and protective equipment such as gloves is recommended when handling or working near this material.

Figure 1B: All Successfully Disassembled Components

Figure 2B: Collection of Fastners

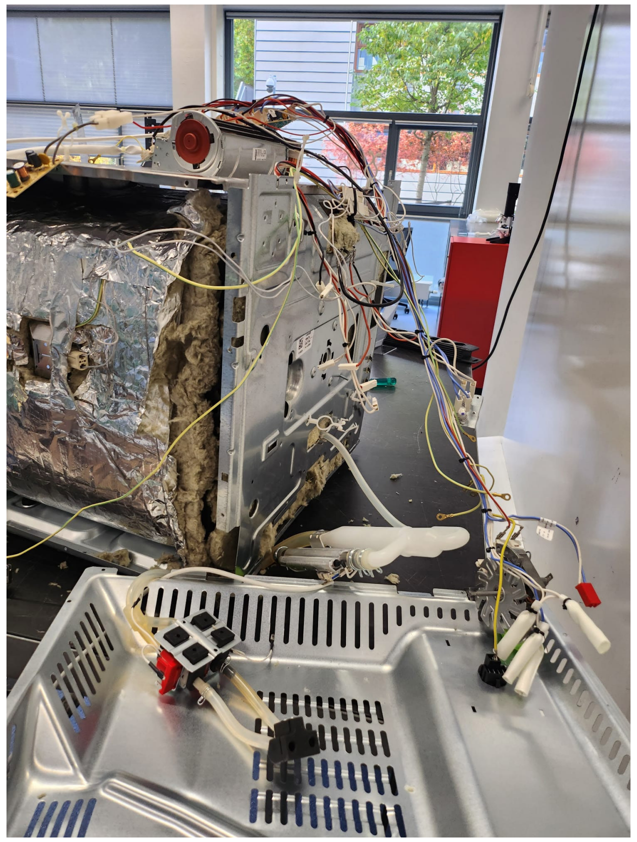


Figure 3B: Final Disassembled State of the Oven

Appendix C — The Questionnaire

This appendix presents the full questionnaire used for the consumer research. The questionnaire is written in Dutch, as it was distributed among Dutch citizens and the study aimed to avoid excluding participants who may not be proficient in English.

Welkom!

U wordt uitgenodigd om deel te nemen aan een onderzoek met de titel: "**Het vergroten van de bereidheid van consumenten om een ATAG-oven te repareren.**" Dit onderzoek wordt uitgevoerd door Ayla Dietvorst, masterstudent aan de TU Delft, in samenwerking met ATAG.

Het doel van dit onderzoek is om inzicht te krijgen in de **perceptie van consumenten op het repareren van ovens.** Het invullen duurt ongeveer **10 à 15 minuten**. De verzamelde gegevens worden gebruikt voor de ontwikkeling van een interventie die de bereidheid tot repareren vergroot, als onderdeel van de masterthesis van Ayla Dietvorst. Deze thesis zal worden gepubliceerd in de repository van de TU Delft.

We vragen u naar uw **reparatiegedrag en bereidheid** met betrekking tot zowel ovens als consumentenelektronica in het algemeen. Er zijn geen goede of foute antwoorden, we zijn simpelweg geïnteresseerd in uw perspectief.

Zoals bij elke onlineactiviteit is er altijd een klein risico op een datalek. We doen er echter alles aan om uw antwoorden vertrouwelijk te behandelen. De vragenlijst is volledig **anoniem**: we verzamelen geen IP-adressen, e-mailadressen of namen. We vragen wel enkele demografische gegevens (zoals leeftijd en geslacht) om een algemeen beeld van de respondenten te krijgen. De data wordt opgeslagen op de beveiligde netwerkopslag van de TU Delft en na afloop van het project (over ongeveer 5 maanden) verwijderd. Omdat de vragenlijst anoniem is, kunnen uw antwoorden niet meer worden verwijderd nadat u de enquête hebt verzonden.

Uw deelname is **volledig vrijwillig** en u kunt op elk moment stoppen. U bent vrij om vragen over te slaan.
Heeft u vragen over dit onderzoek, neem dan gerust contact op met de onderzoekers:
Ayla Dietvorst – A.Dietvorst@student.tudelft.nl
Lise Magnier (begeleider) – L.B.M.Magnier@tudelft.nl

Door door te klikken naar de volgende pagina, gaat u akkoord met deze introductietekst en geeft u toestemming voor het gebruik van uw gegevens uit deze vragenlijst zoals hierboven beschreven.

Ik heb de bovenstaande informatie doorgelezen en ga akkoord.

○ Ja

→

1. Reparatie van de oven

Dit onderdeel richt zich op uw perceptie en gedrag rondom het repareren van ovens.

1.1 Welke functies heeft uw huidige oven? (Selecteer alle opties die van toepassing zijn)

- ☐ Conventionele oven (boven/onderwarmte)
- ☐ Heteluchtoven
- ☐ Magnetronfunctie
- ☐ Stoomfunctie
- ☐ Slimme oven (Wi-Fi/app-bediening)
- ☐ Gasoven
- ☐ Ik heb geen oven
- ☐ Anders:

1.2 Welke prijscategorie omschrijft uw huidige oven het best?

- ○ Budget
- ○ Middenklasse
- ○ Premium
- ○ Weet ik niet

1.3 Hoe oud is uw huidige oven?

We begrijpen dat deze vraag lastig kan zijn, maar geef alstublieft uw beste inschatting. Indien u de oven van de vorige bewoners heeft overgenomen maak ook dan alstublieft een inschatting van hoe oud de oven zal zijn. Noteer enkel een getal in jaren.

Tijdsduur (in jaren)

1.4 Hoeveel jaar is uw vorige oven gebruikt voordat u deze heeft vervangen?

We begrijpen dat deze vraag lastig kan zijn, maar geef alstublieft uw beste inschatting. Schrijf nvt indien u uw vorige oven niet heeft vervangen maar u bijvoorbeeld bent wegverhuist of u geen eerdere oven hebt gehad.

Tijdsduur (in jaren)

1.5 In welke staat verkeerde uw vorige oven toen u deze verving?

	Zo goed als nieuw	Gebruikt	Nalatig onderhoud (vies)	Krassen of andere fysieke schade	Kleine onderdelen defect (lamp, deur, etc.)	Groot onderdeel defect (verwarmingsfunctie)	Volledig defect	Niet v toepas
Staat van voorgaande oven	○	○	○	○	○	○	○	○

1.6 Stel aankomende maand krijgt uw huidige oven een defect (waardoor u deze niet meer kunt gebruiken), zou u overwegen om deze te repareren?

We maken hierin onderscheid tussen zelf reparatie en door een professionele service laten repareren.

	Helemaal oneens						Helemaal mee eens
Ik zou overwegen de oven zelf te repareren	○	○	○	○	○	○	○
Ik zou overwegen de oven door een professionele service te laten repareren	○	○	○	○	○	○	○

1.8 Hoe bereid bent u om de volgende onderhouds- of reparatietaken aan uw oven uit te voeren?

	Helemaal niet bereid						Zeer bereid
Schoonmaken (bijv. afnemen, ontkalken, vet verwijderen)	○	○	○	○	○	○	○
Losse schroeven of bouten aandraaien	○	○	○	○	○	○	○
Online handleidingen of video's opzoeken om het probleem op te lossen	○	○	○	○	○	○	○
Kleine onderdelen zelf vervangen (bijv. knop, lampje)	○	○	○	○	○	○	○
Grote onderdelen zelf vervangen (bijv. verwarmingselement, ventilator)	○	○	○	○	○	○	○
Naar een reparatiecafé brengen	○	○	○	○	○	○	○
Een afspraak maken met een professionele reparatieservice	○	○	○	○	○	○	○
Hulp vragen aan een familielid, vriend of buur met reparatievaardigheden	○	○	○	○	○	○	○

1.9 Wat is het **maximale bedrag** dat u zou willen betalen voor de reparatie van uw oven (in plaats van de oven te vervangen)?

Noteer enkel een getal in hele euro's.

Bedrag (€) [ ]

1.10 Geef een indicatie tot in welke mate u de volgende aspecten associeert met het **zelf repareren van uw oven.**

Ik zie het **zelf repareren van de oven** als:

	Helemaal oneens						Helemaal mee eens
Tijdrovend	○	○	○	○	○	○	○
Duur	○	○	○	○	○	○	○
Complex	○	○	○	○	○	○	○
Voldoening gevend	○	○	○	○	○	○	○
Gevoel van zelfvertrouwen opwekkend	○	○	○	○	○	○	○
Frustrerend	○	○	○	○	○	○	○
Risicovol vanwege mogelijke schade aan het product	○	○	○	○	○	○	○
Fysiek onveilig	○	○	○	○	○	○	○
Milieuvriendelijk	○	○	○	○	○	○	○
Betrouwbaar resultaat opleverend	○	○	○	○	○	○	○
De moeite waard	○	○	○	○	○	○	○

1.11 Geef een indicatie tot in welke mate u de volgende aspecten associeert met **het repareren van een oven via een reparatieservice.**

Ik zie het repareren van een oven **via een reparatieservice** als:

	Helemaal oneens						Helemaal mee eens
Tijdrovend	○	○	○	○	○	○	○
Duur	○	○	○	○	○	○	○
Complex	○	○	○	○	○	○	○
Voldoening gevend	○	○	○	○	○	○	○
Gevoel van zelfvertrouwen opwekkend	○	○	○	○	○	○	○
Frustrerend	○	○	○	○	○	○	○
Risicovol vanwege mogelijke schade aan het product	○	○	○	○	○	○	○
Fysiek onveilig	○	○	○	○	○	○	○
Milieuvriendelijk	○	○	○	○	○	○	○
Betrouwbaar resultaat opleverend	○	○	○	○	○	○	○
De moeite waard	○	○	○	○	○	○	○

→

2. Betrokkenheid bij milieu

Dit onderdeel richt zich op uw perceptie op de milieukwesties.

2.1 In welke mate bent u het eens met de volgende stellingen?

	Helemaal oneens						Helemaal mee eens
Mensen hebben het recht om de natuur aan te passen aan hun eigen behoeften.	○	○	○	○	○	○	○
Mensen misbruiken de aarde ernstig.	○	○	○	○	○	○	○
Planten en dieren hebben evenveel recht om te bestaan als mensen.	○	○	○	○	○	○	○
De natuur is sterk genoeg om de gevolgen van moderne industriële samenlevingen op te vangen.	○	○	○	○	○	○	○
De mens is bedoeld om heerschappij te voeren over de natuur.	○	○	○	○	○	○	○
Het evenwicht van de natuur is erg kwetsbaar en raakt gemakkelijk verstoord.	○	○	○	○	○	○	○

→

3. Reparatiegedrag en -mentaliteit

Dit onderdeel richt zich op uw houding en gedrag ten opzichte van het repareren van consumentenelektronica. Consumentenelektronica zijn huishoudelijke apparaten die bedoeld zijn voor persoonlijk (dagelijks) gebruik, zoals wasmachines, stofzuigers, koffiemachines, ovens, mobiele telefoons, radio's, enzovoort.

3.1 Hoe bereid bent u om consumentenelektronica te repareren?

	Helemaal niet bereid						Zeer bereid
Repareren van consumentenelektronica	○	○	○	○	○	○	○

3.2 Hoeveel vertrouwen heeft u in uw eigen reparatievaardigheden voor consumentenelektronica?

	Helemaal geen vertrouwen						Zeer veel vertrouwen
Zelfvertrouwen in reparatievaardigheden	○	○	○	○	○	○	○

3.3 Hoe waarschijnlijk is het dat u consumentenelektronica zou repareren?

Hierin maken we onderscheid tussen zelf-reparatie en reparatie door een professionele service.

	Zeer onwaarschijnlijk						Zeer waarschijnlijk
Met zelf-reparatie	○	○	○	○	○	○	○
Met een professionele service	○	○	○	○	○	○	○

→

4. Demografische gegevens

Deze laatste sectie bevat slechts een paar vragen over uw demografische gegevens.

4.1 Wat is uw geboortejaar?

Noteer enkel een jaartal in getallen.

Geboortejaar [ ]

4.2 Wat is uw geslacht?

- ◯ Man
- ◯ Vrouw
- ◯ Non-binair
- ◯ Zeg ik liever niet

4.3 Wat is uw hoogst voltooide opleidingsniveau?

- ◯ Basisschool
- ◯ Middelbare school
- ◯ MBO
- ◯ HBO
- ◯ WO bachelor
- ◯ WO master
- ◯ PhD
- ◯ Anders

[ ]

4.4 Wat is uw maandelijkse huishoudinkomen (netto, na belastingen)?

- ◯ Minder dan €1.500
- ◯ €1.500 - €2.999
- ◯ €3.000 - €4.499
- ◯ €4.500 - €5.999
- ◯ €6.000 of meer
- ◯ Zeg ik liever niet

4.5 In welke mate bent u het eens met de volgende stellingen?

	Helemaal onees						Helemaal mee eens
Ik ben bijzonder geïnteresseerd in ovens.	◯	◯	◯	◯	◯	◯	◯
Over het algemeen ben ik sterk betrokken bij de aankoop van een oven voor persoonlijk gebruik.	◯	◯	◯	◯	◯	◯	◯

4.6 Hoevaak gebruikt u uw oven?

- ◯ Elke dag
- ◯ Een paar keer per week
- ◯ Eén keer per week
- ◯ Eén keer per twee weken
- ◯ Eén keer per drie weken
- ◯ Eén keer per maand
- ◯ Minder dan één keer per maand

→

Appendix D — Statistical Results

This Appendix shows some insight in the statistical results backing up the data depicted in Chapter 6.

First of all, before the stepwise regression was performed a regular regression analysis has been done on all barriers and enablers in correlation with both self-repair and professional repair. From these tests could be concluded that lots of barriers and enablers have a significant relationship with the willingness to repair, shown in Table 2 and Table 3. Because lots of barriers and enablers were proven to be significant a stepwise regression was performed from which the results are depicted in Chapter 6.

In Table 4 and Table 5 the differences of the means for the barriers and enablers of self-repair vs professional repair are calculated. Depicting the data the graphs in Chapter 6 are based on.

Table 4: Difference in Mean Calculations Barriers to Self-Repair - Professional Repair

Paired Samples Test

		Paired Differences							Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Timeconsuming_Self - Timeconsuming_Prof	,957	2,463	,257	,447	1,466	3,726	91	<,001	<,001
Pair 2	Expensive_Self - Expensive_Prof	-2,402	2,481	,259	-2,916	-1,888	-9,287	91	<,001	<,001
Pair 3	Complex_Self - Complex_Prof	2,304	2,305	,240	1,827	2,782	9,589	91	<,001	<,001
Pair 4	Frustrating_Self - Frustrating_Prof	1,076	1,985	,207	,665	1,487	5,200	91	<,001	<,001
Pair 5	RiskDamageProduct_Self - RiskDamageProduct_Prof	2,478	2,332	,243	1,995	2,961	10,192	91	<,001	<,001
Pair 6	FysicallyUnsafe_Self - FysicallyUnsafe_Prof	1,793	1,981	,207	1,383	2,204	8,684	91	<,001	<,001

Table 5: Difference in Mean Calculations Enablers to Self-Repair - Professional Repair

Paired Samples Test

		Paired Differences							Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Fulfilling_Self - Fulfilling_Prof	1,783	2,597	,271	1,245	2,320	6,584	91	<,001	<,001
Pair 2	Empowering_Self - Empowering_Prof	2,011	2,527	,263	1,488	2,534	7,633	91	<,001	<,001
Pair 3	EnvironmentalFriendly_Self - EnvironmentalFriendly_prof	,196	2,055	,214	-,230	,621	,913	91	,182	,364
Pair 4	Trustworthy_Self - Trustworthy_Prof	-1,543	2,186	,228	-1,996	-1,091	-6,773	91	<,001	<,001
Pair 5	WorthTheEffort_Self - WorthTheEffort_Prof	,185	1,933	,201	-,215	,585	,917	91	,181	,362

Table 2: Correlations of Barriers/Enablers to Repair with Willingness to Self-Repair

Correlations

		Tijdrovend_Zelf	Duur_Zelf	Complex_Zelf	VoldoeningGevend_Zelf	Zelfvertrouwen_Zelf	Frustrerend_Zelf	RisicovolSchade_Zelf	FysiekOnveilig_Zelf	Milieuvriendelijk_Zelf	Betrouwbaar_Zelf	MoeiteWaard_Zelf	Willingness_Self
Willingness_Self	Pearson Correlation	-,072	-,052	-,401**	,381**	,349**	-,173	-,352**	-,284**	,254*	,344**	,465**	1
	Sig. (2-tailed)	,498	,624	<,001	<,001	<,001	,100	<,001	,006	,015	<,001	<,001	
	N	92	92	92	92	92	92	92	92	92	92	92	92

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlations of Barriers/Enablers to Repair with Willingness to Professional Repair

Correlations

		Tijdrovend_Prof	Duur_Prof	Complex_Prof	VoldoeningGevend_Prof	Zelfvertrouwen_Prof	Frustrerend_Prof	RisicovolSchade_Prof	FysiekOnveilig_Prof	Milieuvriendelijk_Prof	Betrouwbaar_Prof	MoeiteWaard_Prof	Willingness_Prof
Willingness_Prof	Pearson Correlation	-,284**	-,406**	-,244*	,355**	,062	-,172	-,010	,030	,059	,201	,461**	1
	Sig. (2-tailed)	,006	<,001	,019	<,001	,559	,101	,927	,776	,576	,055	<,001	
	N	92	92	92	92	92	92	92	92	92	92	92	92

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6 shows the means of how willing consumers are to perform different types of maintenance tasks, this data is visualised in a graph in Chapter 6.

Figure 1D shows the distribution of the answers to the maximum price consumers would be willing to pay for a repair of their oven. As visible in the graph most consumers would pay till 200 euros, however, there are still quite some answers above 450 euros, explaining the high mean, compared to a median and mode of 150 euros.

Table 7 and Table 8 show the significance testing for the polarisation of the group for willingness to self-repair and for willingness to professional repair.

Figure 1D: Distribution in Maximum Price Consumers are Willing to Pay for a Repair

Table 6: Means of Maintenance Tasks

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Cleaning	92	6,41	1,159	,121
Loose Screws	92	6,32	1,342	,140
Tutorials	92	5,86	1,601	,167
Change Small Parts	92	6,07	1,474	,154
Change Big Parts	92	3,04	1,949	,203
Repaircafe	92	3,07	1,886	,197
Prof. Service	92	4,75	2,014	,210
Ask for help by acquaintances	92	4,35	1,907	,199

Table 7: Polarisation Significance Willingness to Self-Repair

ANOVA

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Willingness_Self	479,805	1	1,017	90	471,945	<,001

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Table 8: Polarisation Significance Willingness to Professional Repair

ANOVA

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Willingness_Prof	387,065	1	1,080	90	358,248	<,001

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Appendix E — Full List of Requirements

This Appendix contains the full list of requirements as derived from the analysis of this thesis. It has been restructured to fit the focal points throughout the thesis: convincing, reassuring and supporting. The requirements not fitting within these focal points are put into the section's technical feasibility or business integration. This full list is summarised in a condensed list of requirements in Chapter 7, with the key requirements which inform the design decisions.

1. Convincing (motivating users)

1.1. The intervention must strengthen consumers' belief that the oven is a repairable product.
1.2. The intervention should convince the consumer that self-repair can be fulfilling and empowering.
1.3. The intervention should convince the consumer guided self-repair is trustworthy and worth the effort.
1.4. The intervention should convince the consumer self-repair does not have to be time-consuming, expensive or complex.
1.5. The intervention should foster an emotional connection between the consumer and the oven.
1.6. The intervention should remind consumers of the high initial costs of the oven and encourage them to maintain it.
1.7. The intervention should contribute to normalising self-repair behaviour for ovens.
1.8. The intervention should increase the visibility of repair to strengthen its social acceptance.
1.9. The intervention should emphasise that other users also repair the ATAG oven.
1.10. The intervention should make the repair experience rewarding.
1.11. The intervention should make the consumer's personal effort in the repair process visible and meaningful.
1.12. The intervention must frame self-repair as a worthwhile investment of time and care.
1.13. The intervention must allow repair to function as a moment of re-engagement with the product.
1.14. The intervention should build consumer skills and self-efficacy to promote long-term engagement with repair.
1.15. The intervention should reinforce the oven's value as a long-term product worth maintaining rather than replacing.

2. Reassuring (reduce perceived risk)

2.1. The intervention must reduce consumers perceived risk of repairing the oven.
2.2. The intervention must reduce the perceived complexity of the oven.
2.3. The intervention should convince the consumer they are not likely to damage the product further or do themselves any harm.
2.4. The intervention must reduce perceived financial risk associated with self-repair.
2.5. The intervention must frame self-repair as an achievable and responsible action within everyday life.
2.6. The intervention should frame self-repair as a series of small, manageable tasks rather than a complex or risky repair.
2.7. When a set-back occurs, the intervention should calm the user down and advise them on what to do next.
2.8. The intervention should minimise the likelihood of repair failure.
2.9. The intervention should make sure any possible physical difficulties should be clearly communicated beforehand.

3. Supporting (help the user perform the repair)

3.1. The intervention should empower customers to independently handle minor issues.
3.2. The intervention must support consumers to independently diagnose and resolve oven malfunctions.
3.3. The intervention should ensure that customers receive clear and accessible guidance during both problem identification and repair.
3.4. The intervention should give clear information on the repair skills required to perform the repair.
3.5. The intervention should help consumers accurately estimate the time and resources required to carry out a repair.
3.6. The intervention should ensure that sufficient support is available to assist consumers during the repair process.
3.7. The intervention should provide clear communication to help customers recognise when professional service is required and when they can resolve issues themselves.
3.8. The intervention should communicate malfunctions in a clear and actionable way at the moment of failure.
3.9. The intervention should make the internal functioning of the oven more transparent.
3.10. The intervention should help consumers assess whether a fault is repairable before starting the repair.
3.11. The intervention should explicitly communicate why self-repair is worthwhile for the consumer.
3.12. The intervention should communicate where to get spare parts & the right tools.

4. Technical Feasibility – Product and system constraints

4.1. The intervention should restrict consumers to touch or repair the microwave parts of the oven.
4.2. The intervention must enable access to the convection heating element, door hinges and lamps without requiring removal of the oven from its built-in position.
4.3. The intervention must make the disassembly sequence of the convection heating element, door hinges and lamps intuitive and difficult to perform incorrectly.
4.4. The intervention must provide clear guidance on how to access and replace the convection heating element, door hinges and lamps.
4.5. The intervention must clearly indicate only the convection heating element, door hinges and lamps are intended for consumer self-repair.
4.6. The intervention should physically separate the consumer-repairable components from complex electronic systems.
4.7. The intervention must ensure that all repairable components, and any components that must be removed in sequence to access them, can be disassembled and reassembled without opening the rear of the oven.
4.8. The intervention must limit the required tools to common household tools.
4.9. The intervention must ensure that self-repair solutions remain below the €150 maximum acceptable repair price.

5. Business Integration – ATAG brand and service strategy

5.1. The intervention should appeal to financially stable homeowners in the Benelux, while also engaging a younger audience.
5.2. The intervention should reflect ATAG's identity by offering a convenient, innovative, and creative experience.
5.3. The intervention should contribute to a reduction in service visits.
5.4. The intervention should support more accurate prediction of potential product issues.
5.5. The intervention should ensure that spare parts for ATAG products are easily obtainable.
5.6. The intervention should encourage consumers to connect their oven to the app.
5.7. The intervention should make use of the diagnostic system within the smart technology of the oven.

Appendix F — Individual Ideation

The first step of the ideation process consists of an individual ideation, which was done as preparatory work for the co-creation sessions.

The individual ideation contained a brainstorm through the different key decision points of the repair process model, shown in Figure 1F. These insights were clustered on different themes, shown in Figure 2F. Lastly, a hidden assumption exercise was performed, shown in Figure 3F, to take a step beyond the obvious.

The hidden assumptions that were challenged were:

- **It will be a digital system**
- **It should be connected to the app and/ or the oven (using IoT)**
- **Consumers need motivation in the form of money or sales**
- **It will all rely on a list of instructions or instructions video**

The individual ideation session served as preparation for the subsequent co-creation sessions. It helped identify the most promising design opportunities in advance, allowing the facilitator to recognise when discussions during the co-creation sessions moved toward particularly relevant or interesting directions and to subtly steer the conversation accordingly.

Additionally, the session informed the development of the inspiration cards used during the workshops, ensuring that they contained elements likely to trigger meaningful associations and stimulate discussion among participants.

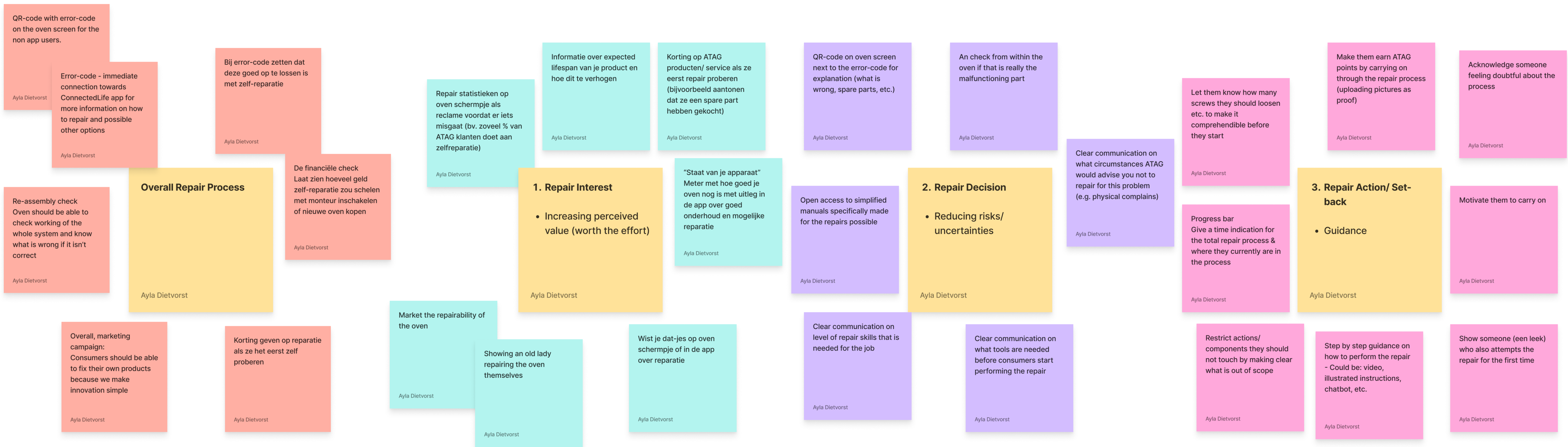


Figure 1F: Brainstorm using the Key Decision Points of the Repair Process

Access to instructions/ guide/ information

QR-code with error-code on the oven screen for the non app users.
Ayla Dietvorst

Error-code - immediate connection towards ConnectedLife app for more information on how to repair and possible other options

QR-code on oven screen next to the error-code for explanation (what is wrong, spare parts, etc.)

Open access to simplified manuals specifically made for the repairs possible
Ayla Dietvorst

Step by step guidance on how to perform the repair - Could be: video, illustrated instructions, chatbot, etc.
Ayla Dietvorst

Reassurence/ security

Re-assembly check
Oven should be able to check working of the whole system and know what is wrong if it isn't correct

An check from within the oven if that is really the malfunctioning part

Clear communication on level of repair skills that is needed for the job

Clear communication on what circumstances ATAG would advise you not to repair for this problem (e.g. physical complains)

Restrict actions/ components they should not touch by making clear what is out of scope
Ayla Dietvorst

Communicating the expected

Informatie over expected lifespan van je product en hoe dit te verhogen

"Staat van je apparaat"
Meter met hoe goed je oven nog is met uitleg in de app over goed onderhoud en mogelijke reparatie
Ayla Dietvorst

Clear communication on what tools are needed before consumers start performing the repair

Let them know how many screws they should loosen etc. to make it comprehendible before they start
Ayla Dietvorst

Progress bar
Give a time indication for the total repair process & where they currently are in the process
Ayla Dietvorst

Marketing

Overall, marketing campaign:
Consumers should be able to fix their own products because we make innovation simple
Ayla Dietvorst

Market the repairability of the oven

Wist je dat-jes op oven schermpje of in de app over reparatie
Ayla Dietvorst

Motivation

Acknowledge someone feeling doubtful about the process

Show someone (een leek) who also attempts the repair for the first time

Repair statistieken op oven schermpje als reclame voordat er iets misgaat (bv. zoveel % van ATAG klanten doet aan zelfreparatie)

Korting geven op reparatie als ze het eerst zelf proberen

Bij error-code zetten dat deze goed op te lossen is met zelf-reparatie
Ayla Dietvorst

Make them earn ATAG points by carrying on through the repair process (uploading pictures as proof)

Motivate them to carry on

Korting op ATAG producten/ service als ze eerst repair proberen (bijvoorbeeld aantonen dat ze een spare part hebben gekocht)

Showing an old lady repairing the oven themselves

De financiële check
Laat zien hoeveel geld zelf-reparatie zou schelen met monteur inschakelen of nieuwe oven kopen
Ayla Dietvorst

Figure 2F: Clustering of the brainstorm

Figure 3F: Hidden Assumptions Exercise

Appendix G — Co-Creation Sessions

Several co-creation sessions were organised to collaboratively explore ideas for increasing consumers' willingness to self-repair an oven. The sessions were designed to gradually guide participants from reflecting on their own repair behaviour to generating concrete design ideas. The structure balanced short reflective exercises with collaborative ideation activities.

Each session started with a short **ice-breaker,** in which participants shared an interesting fact or experience related to ovens or repair. This helped participants become comfortable discussing the topic. After this, the problem statement of the project was introduced: How can we enhance consumers' willingness to self-repair the oven?

To familiarise participants with the repair context, the session began with a **warm-up exercise** based on a simplified customer journey. Participants were asked to imagine that their oven had broken down and to describe what they would do and how they would feel during this process (see template in Figure 1G). This activity helped surface initial thoughts about repair behaviour, emotions, and barriers.

Next, a short **group discussion** explored existing repair practices. Participants reflected on questions such as which products they would be willing to repair and why, when they would give up on repair, and under what circumstances they might consider repairing an oven themselves. The discussion also addressed what type of support would make self-repair more feasible.

Following this discussion, participants conducted a short individual brainstorming session, during which they generated ideas and shared them aloud with the group. This was followed by a group ideation phase supported by inspiration cards, shown in Figure 2G, which were used to stimulate associations and encourage participants to explore different solution directions.

At the end of the session, participants voted on the most promising ideas, allowing the group to highlight concepts that were perceived as particularly valuable or feasible. The outcome of the first two co-creation session are visualised in Figure 3G and Figure 4G.

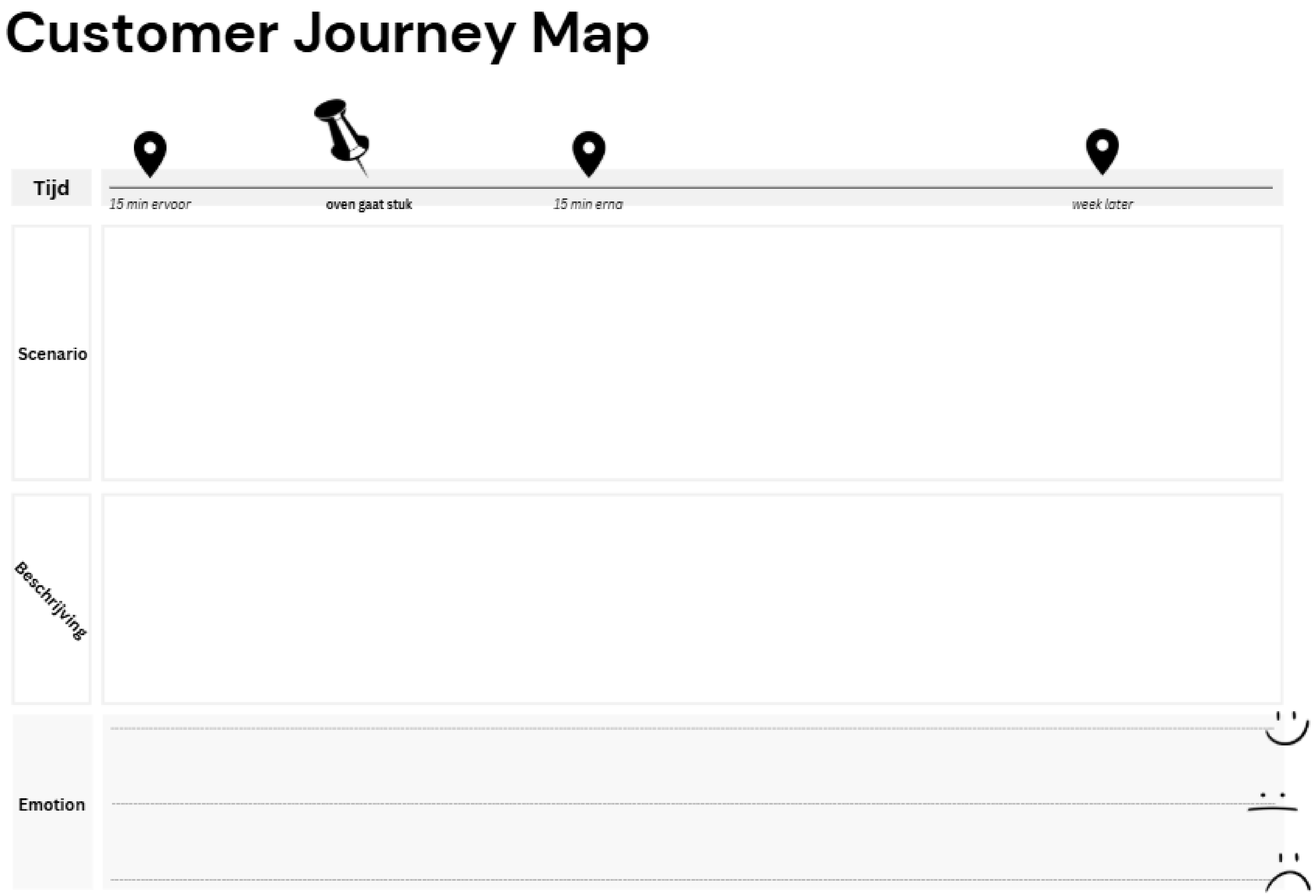


Figure 1G: Template Customer Journey Warm-up Activity

A separate co-creation session was conducted with ATAG employees, which differed slightly in format. As this session was conducted in a hybrid setting, the activities were facilitated digitally using FigJam instead of physical materials. In addition, the exercises were adapted to reflect the participants' professional familiarity with the topic.

In this session, the customer journey exercise focused more explicitly on the consumer's perspective, asking participants to reflect on how a user might experience a broken oven. The warm-up discussion included questions such as:

What kind of information would instantly make a broken oven feel less stressful?

What is the first thing you would expect a connected oven to do when it suddenly stops working?

The main ideation phase again used inspiration flip cards, although more time was allocated to this activity to allow participants to explore ideas in greater depth. The session concluded with voting and a short wrap-up discussion. The resulting ideas are visualised in Figure 5G.

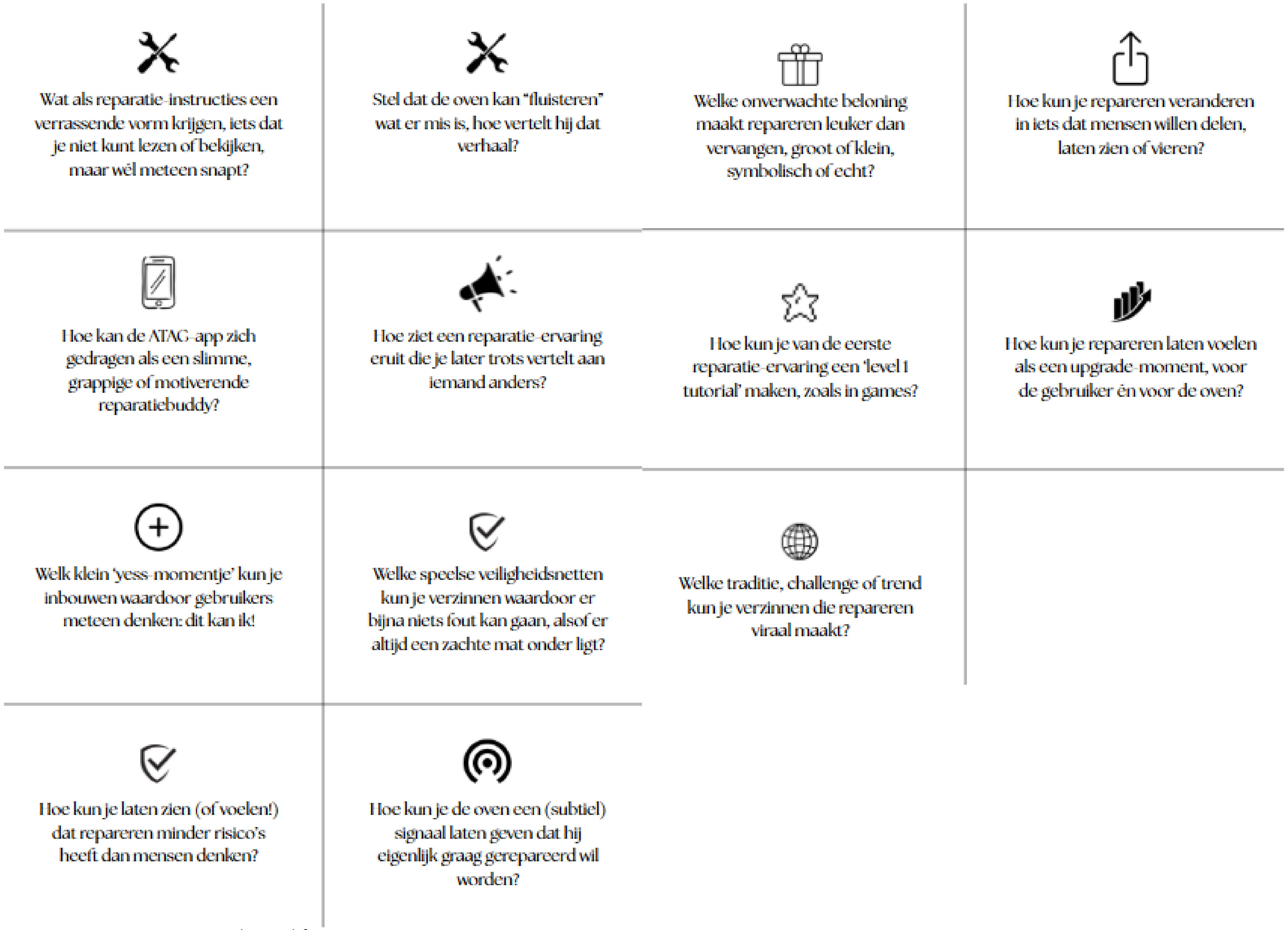


Figure 2G: Inspiration Cards used for Brainstorming

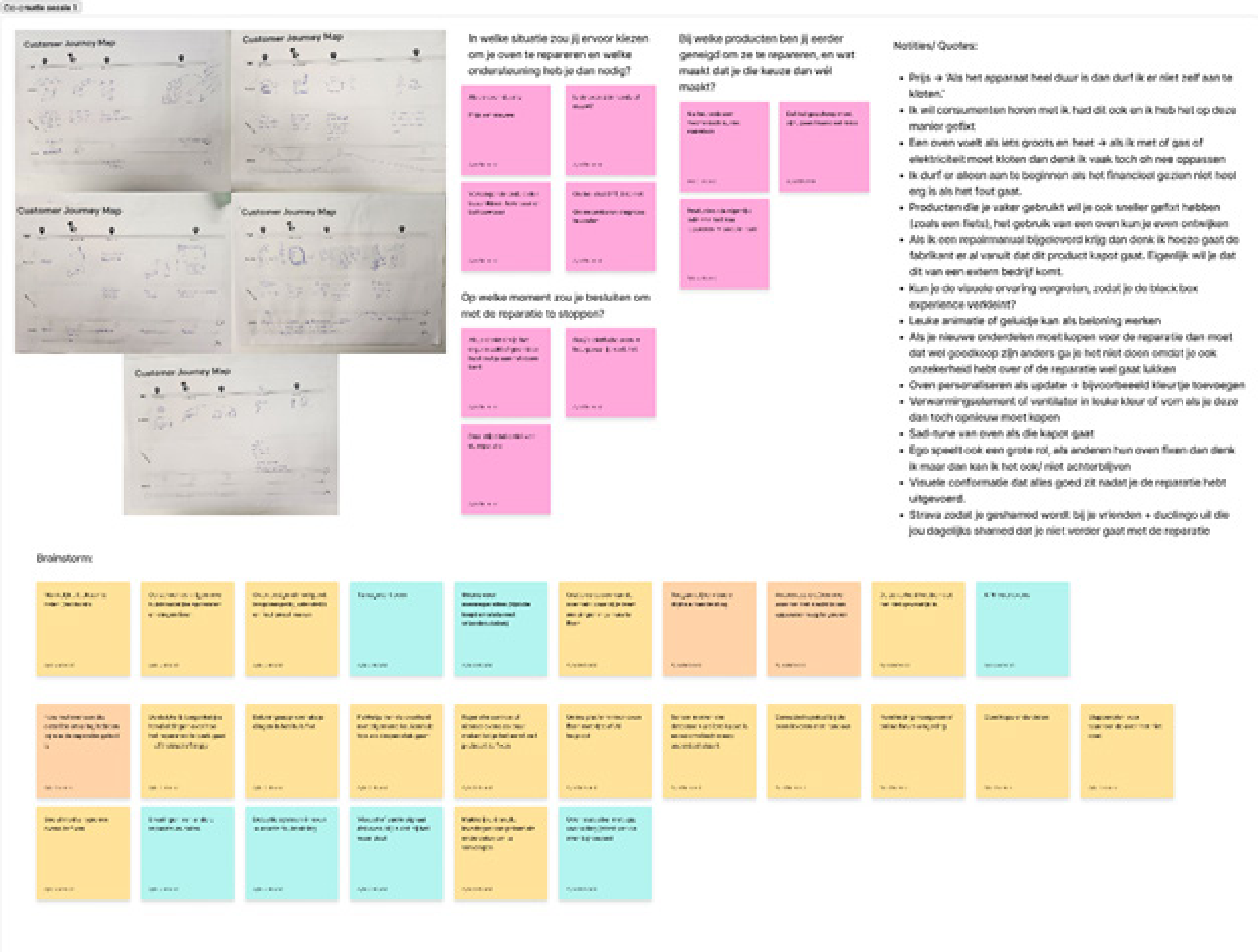


Figure 3G: Results of the first Co-Creation Session

Figure 4G: Results of the second Co-Creation Session

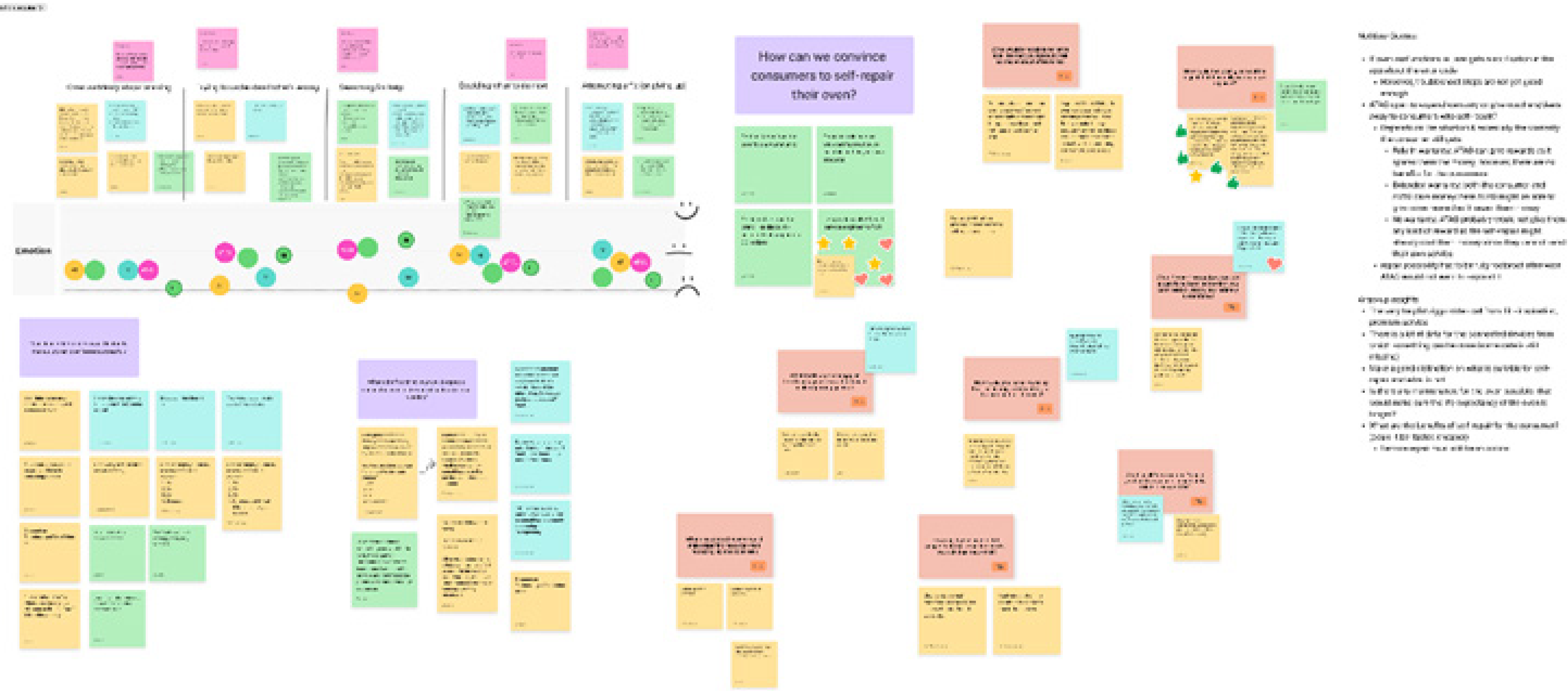


Figure 5G: Results of the third Co-Creation Session (the one with ATAG employees)

Appendix H — Clustering of Ideas

All ideas resulting from the co-creation sessions have been clustered, resulting in the following clusters: creating awareness, modularity, preventive maintenance, remote expert, clear guidance, gamifying, sharing the repair, influencin, product bonding, customisation and education.

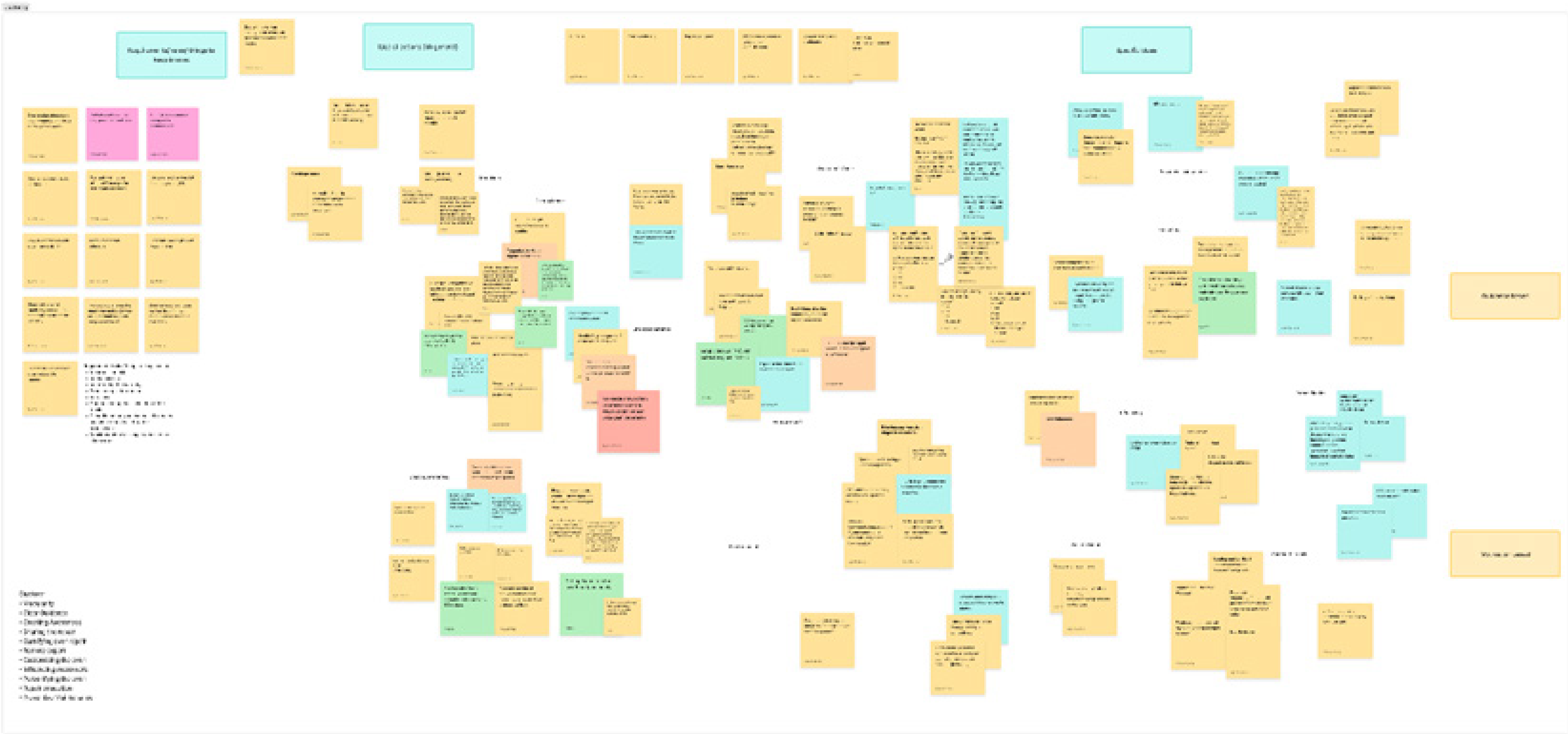


Figure 1H: Clustering of all Co-Creation ideas

Appendix I — Ideation through Metaphors

The three chosen clusters have been linked to a metaphor to encourage creative thinking. These metaphors are explored and with the use of force-fitting linked towards repairing the oven. In Figure 1I, Figure 2I and Figure 3I, these metaphors are explored and ideated on. This ideation lays the foundation of the three concept ideas.

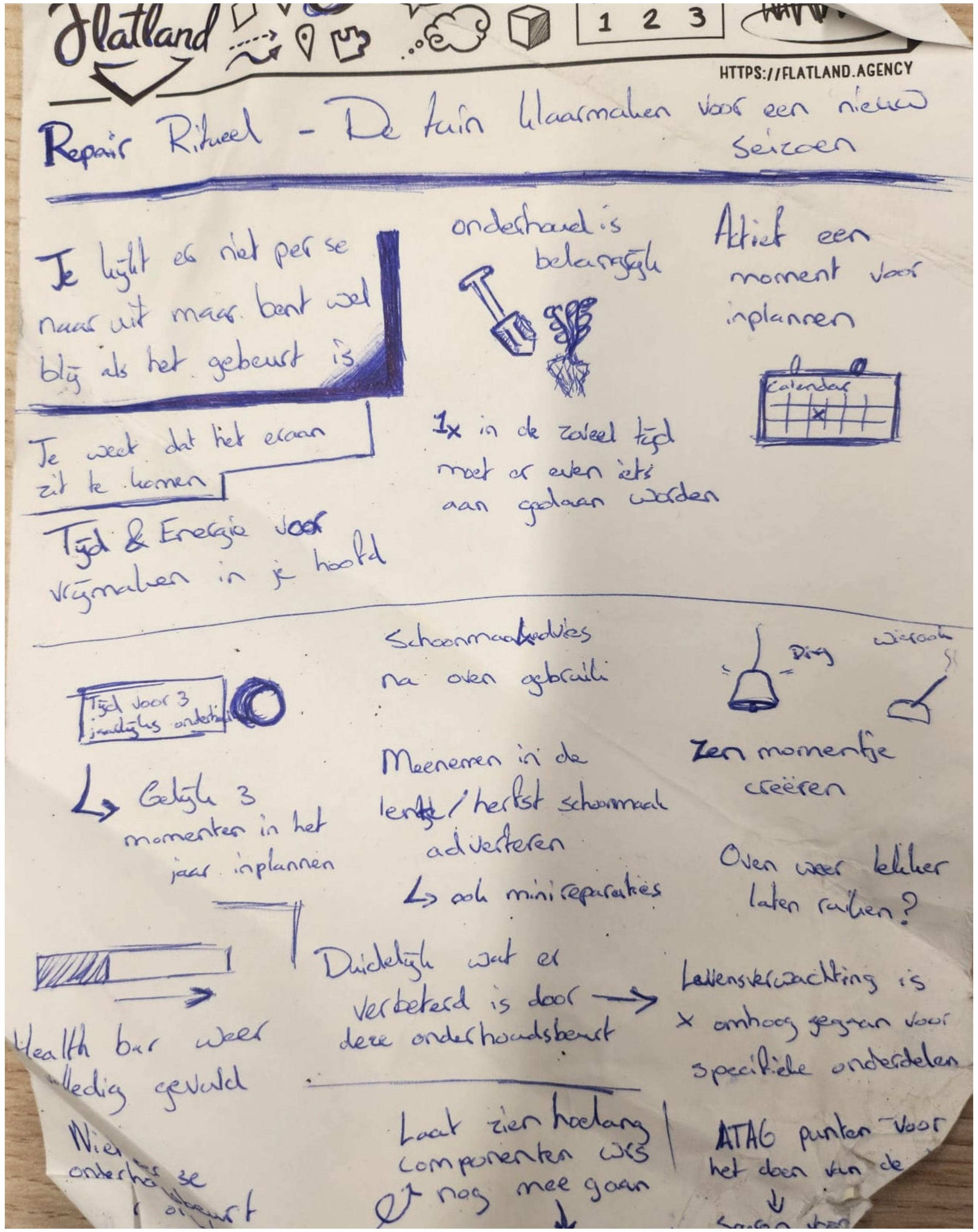


Figure 1I: Exploration of Metaphor: Prepping the Garden for a new Season

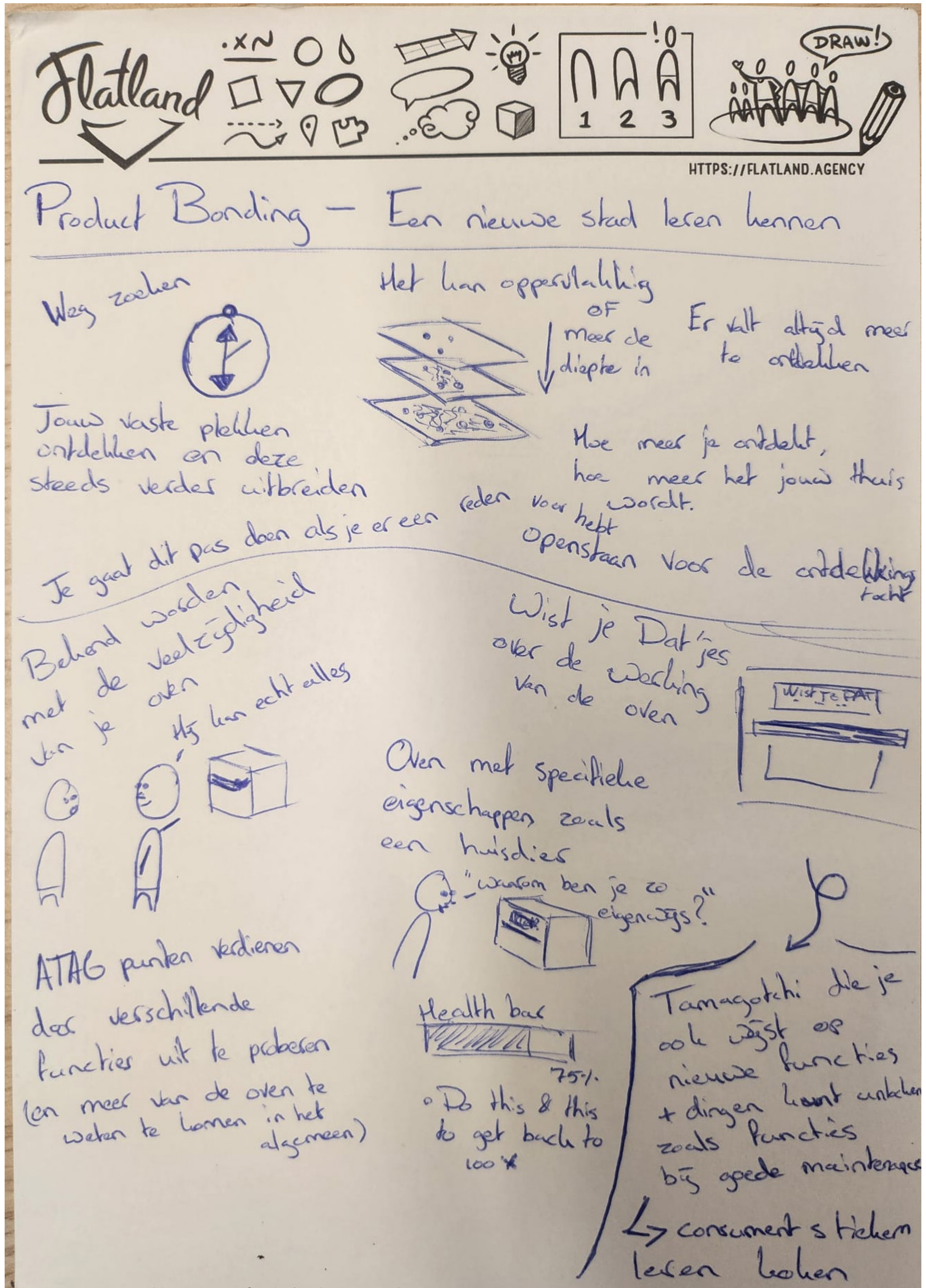


Figure 2I: Exploration of Metaphor: Exploring a new city

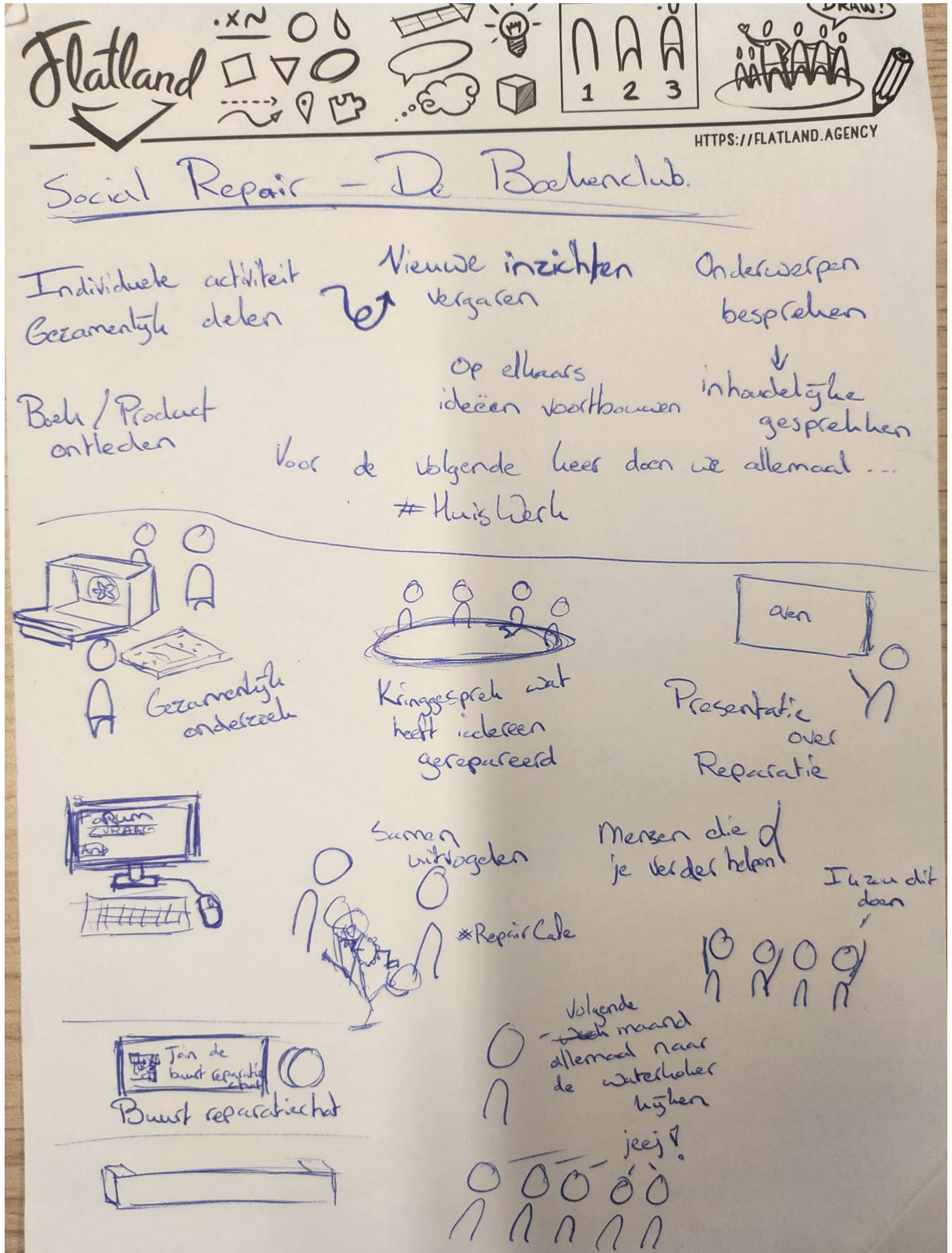


Figure 3I: Exploration of Metaphor: Bookclub

Appendix J — 3 Concept Ideas

This Appendix contains the three product ideas discussed in more detail.

The Oven Periodic Inspection

The check is performed twice a year, ideally in spring and autumn, and is designed to be short and manageable, taking approximately 15 minutes.

The OPK consists of two parts. The first is a digital check, carried out by the oven itself. Using its smart components, the oven assesses whether key parts are still functioning correctly, for instance by detecting unusual electrical resistance or early signs of wear that could indicate an upcoming failure. If a component shows signs of malfunction and is suitable for self-repair, the oven proposes ordering the appropriate spare part directly through the app.

The second part of the OPK is a physical check in which the consumer actively participates. This includes tasks such as removing the side sliders and thoroughly cleaning the oven interior. By physically engaging with the appliance, users become more familiar with its construction and condition, reducing psychological distance from the product.
The outcome of the OPK is communicated through a "health bar" that visualises the oven's overall condition. When the check is completed and no major issues are detected, the health bar returns to its maximum level. The ritual concludes with a positive action: baking something. This final step functions as a reward, reinforcing the idea that caring for the oven leads directly to enjoyment and use.

As an additional incentive, ATAG customers who perform the recommended six-monthly OPK could receive priority service in case a professional technician is ever needed. This introduces a tangible benefit for long-term care and encourages consistent participation. This concept focuses on product bonding, normalising regular check-ins and care, and embedding oven maintenance into a recurring, meaningful ritual.

Figure 1J: The Oven Periodic Inspection

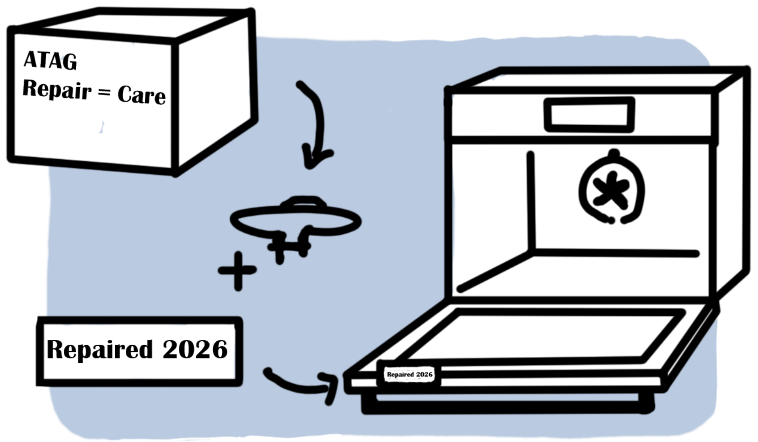


Figure 2J: Repair to Share

Repair to Share

When a consumer orders a spare part through the app for self-repair, the package includes a small metal or enamel plate engraved with the text:

"Repaired, not replaced – [year], by me."

After completing the repair, the consumer can easily attach this plate to the inside of the oven door. Placing it on the inside respects the premium, minimalist exterior of ATAG ovens and acknowledges that not every user wants visible repair statements on the outside of the product. However, the plate remains clearly noticeable whenever the oven is opened.

For the user, the plate acts as a lasting reminder of a successful repair experience, reinforcing pride and self-efficacy. For others, such as guests or family members, it can serve as a subtle conversation starter, opening up discussion about repair rather than replacement.

This concept aims to normalise repair behaviour, provide a meaningful non-digital reward for self-repair, and encourage social sharing of repair experiences.

The OvenGotchi

The oven is represented by a digital character that reflects the physical state of the appliance through emotions and behaviour. For example, the character appears “dirty” when the oven requires cleaning, “cold” when the convection heating element is malfunctioning, “afraid of the dark” when the oven light is broken, or “uncomfortable” when the door hinges no longer close properly.

Users can respond to these signals by performing the appropriate maintenance or repair tasks. Upon initial setup, the user gives the character a name, encouraging personal attachment. Each time the oven is switched on, the user briefly checks in on the character. A mood or happiness bar visualises the overall condition of the oven, reaching its maximum when all maintenance tasks are completed and the oven is actively used. In this state, the character communicates that it is “happy” because it can fulfil its purpose and be useful.

Beyond signalling issues, the Ovengotchi also supports everyday use. Through the existing Dishmaker functionality in the app, the character can suggest recipes, provide guidance during cooking, and offer advice on healthier cooking practices. When something goes wrong, the character acts as a guide, explaining the problem in accessible language and talking the user through the repair process step by step.

This concept aims to strengthen emotional product bonding, translate technical information into a form users intuitively understand, and lower the threshold for repair by making guidance feel friendly and supportive rather than technical or intimidating.

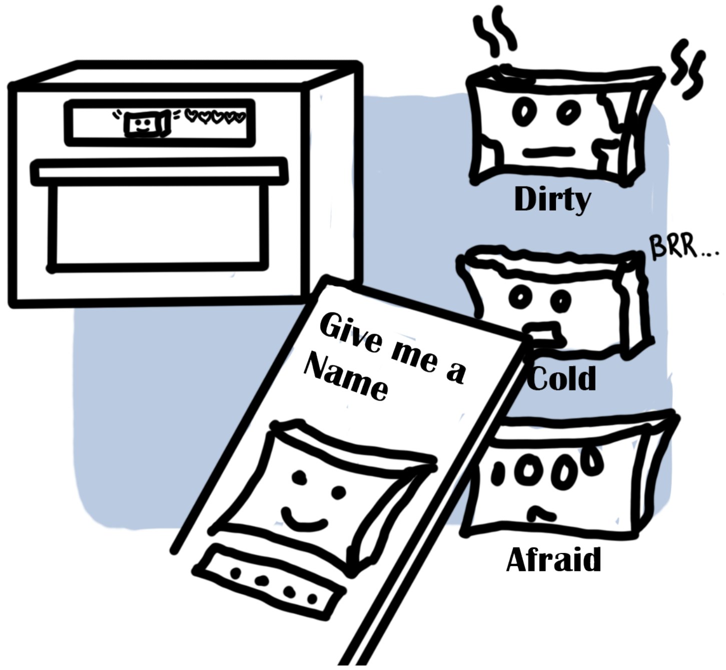


Figure 3J: The OvenGotchi

Appendix K — Brainstorm Session

To iterate on the final concept idea an extra brainstorm session was done in collaboration with three other students, Figure 3K. This session had two goals:

- Iteration on Owen to make it more fitting to the ATAG brand.
- Creating broad ideas for possible visual cues.

The session contained two exercises. The Owen and the visual cues brainstorm. For the Owen brainstorm post-its were used and participants were given a collage with pictures of the ATAG branding (Figure 1K). The visual cues brainstorm was done based on a template with different pictures of the oven on it, so participants could draw their ideas directly into the oven. This template is shown in Figure 2K.

Figure 3K: Brainstorm Session

Figure 1K: ATAG Branding Collage

Figure 2K: Visual Cues Pictures

Appendix L — Maintenance Tasks

The examples in the prototype only consist of one micro-maintenance moment and one periodic care moment. In this Appendix more examples are given of what the maintenance moments could entail and why we would ask these things of the consumer.

Micro-Maintenance Moments:

- Wipe the inside of the door
- Check the door seal
- Remove water from the steam dispenser
- Check if racks slide smoothly
- Wipe the control panel (touchscreen)
- Check ventilation sloths visually
- Listen to fan start-up sound
- Check door alignment
- Wipe cavity corners
- Check lighting -> does it light up the oven evenly
- Check fan cover on grease and blockage
- Check touchscreen responsiveness

Periodic Care Moments:

- Deep clean program (self cleaning feature) -> remove side racks (with one screw)
- Check tightening of a specific screw
- Remove inner wall to check movement of ventilator
- Remove and clean fan cover (inner wall)
- Remove side racks to clean the sides of the oven
- Remove and clean the lamp covers
- Remove door seal and clean underneath it

Appendix M — Physical Prototype

This Appendix shows the lasercut files, Figure 1M, and the Arduino code, Figure 2M, and set-up, Figure 3M, used for the physical prototype.

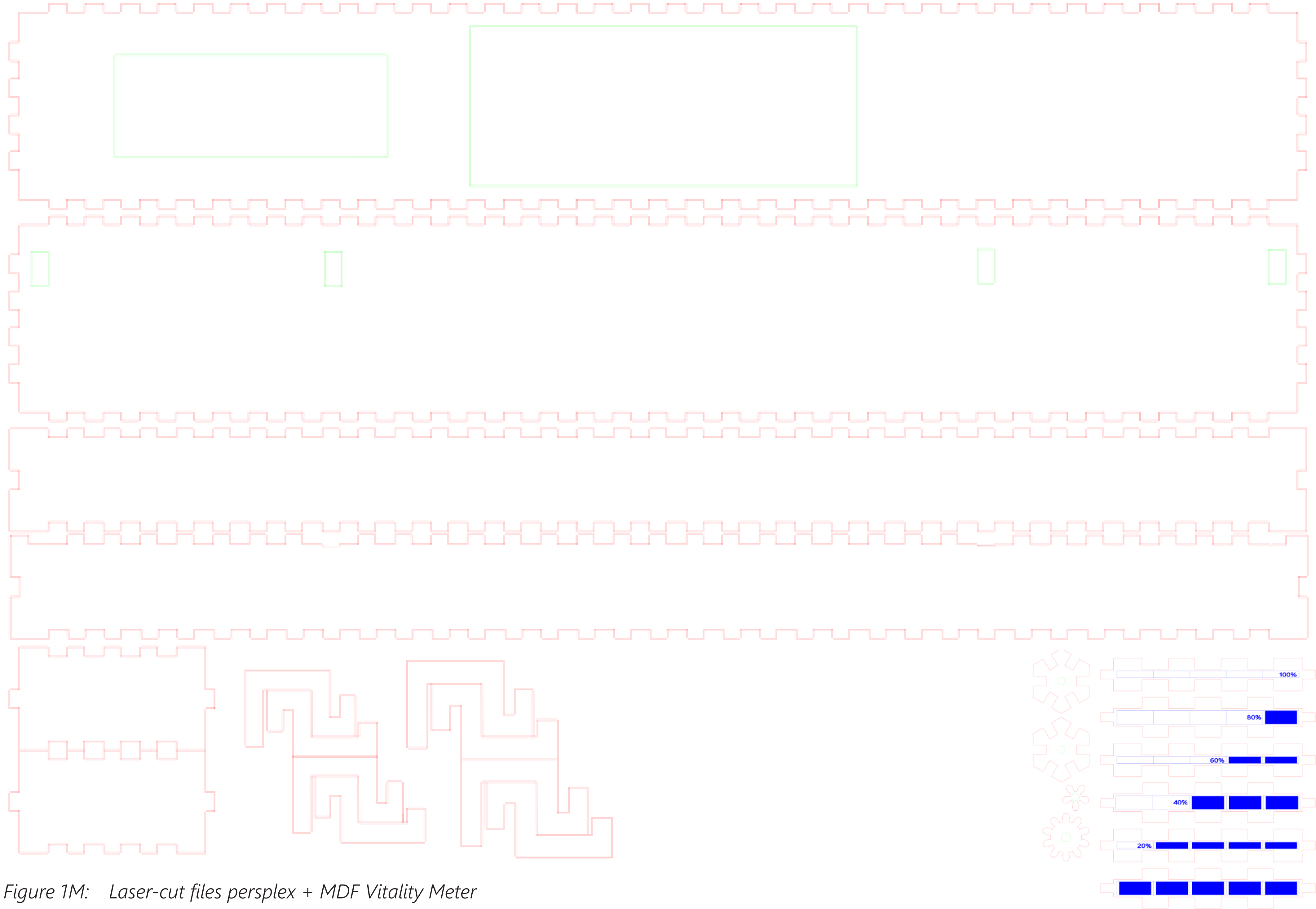


Figure 1M: Laser-cut files persplex + MDF Vitality Meter

Servomotor_30_graden | Arduino 1.8.10

Bestand Bewerken Schets Hulpmiddelen Help

Servomotor_30_graden

```
#include <Servo.h>

Servo vitalityServo;

// LOTUS pins
const int SERVO_PIN = 4;
const int BUTTON_NEXT = 2;
const int BUTTON_RESET = 3;

// Zes vaste posities
const int STEPS = 6;
const int stepAngles[STEPS] = {180, 150, 120, 90, 60, 30};

int currentStep = 0;

bool lastNextState = HIGH;
bool lastResetState = HIGH;

void setup() {
  vitalityServo.attach(SERVO_PIN);

  pinMode(BUTTON_NEXT, INPUT_PULLUP);
  pinMode(BUTTON_RESET, INPUT_PULLUP);

  vitalityServo.write(stepAngles[currentStep]);
}

void loop() {
  bool nextState = digitalRead(BUTTON_NEXT);
  bool resetState = digitalRead(BUTTON_RESET);

  if (lastNextState == HIGH && nextState == LOW) {
    if (currentStep < STEPS - 1) {
      currentStep++;
      vitalityServo.write(stepAngles[currentStep]);
    }
  }

  if (lastResetState == HIGH && resetState == LOW) {
    currentStep = 0;
    vitalityServo.write(stepAngles[currentStep]);
  }

  lastNextState = nextState;
  lastResetState = resetState;
}
```

Figure 2M: Arduino Code for Vitality Meter

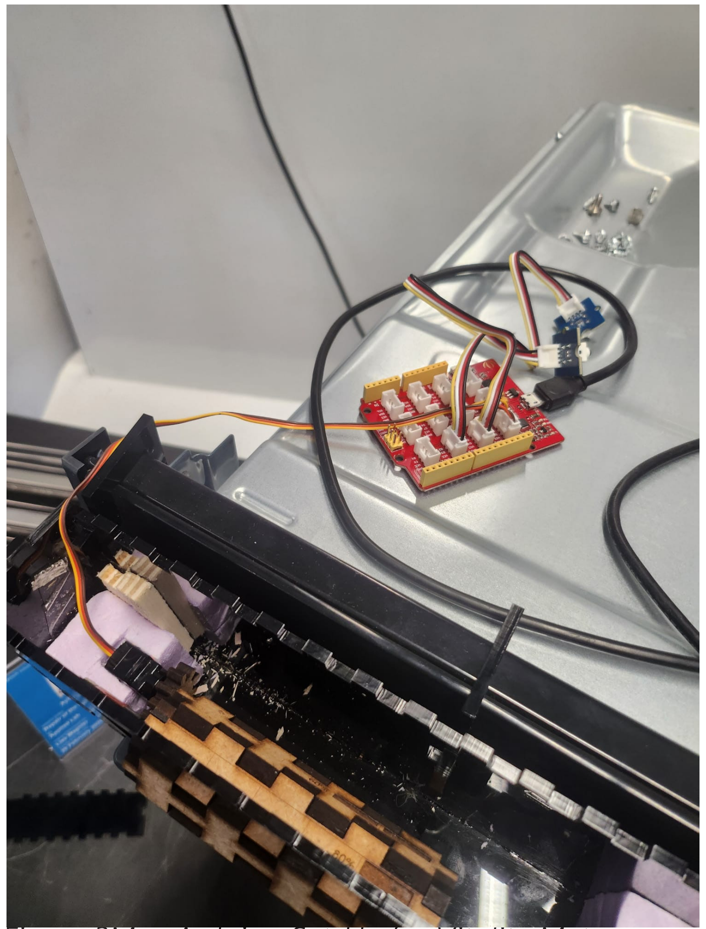


Figure 3M: Arduino Set-Up for Vitality Meter

Appendix N — Digital Prototype

This Appendix show the link to the digital prototype, consisting of different scenarios. Each scenario starts with the oven in turned off mode, therefore, it first needs to be turned on (with the button on the upper left). The prototype consists of pop-up which work on the basis of delays. Therefore, there might be short waiting periods before something happens.

Link to Digital Prototype!

Appendix O — Iteration throughout User-Testing

Between the two user test days, the digital prototype was iterated based on participant feedback. Timers in Scenario 3 were removed, shown in Figure 1O, as participants reacted negatively and felt as though they were being tested; in contrast, the timers in Scenario 2 were retained due to more mixed responses. Additionally, the step-by-step guidance in Scenario 3 was redesigned to a scroll-through format, similar to Scenario 4, shown in Figure 2O, allowing participants to maintain a clearer overview of the full process rather than viewing one step per slide. The instructional content was further improved by incorporating higher-quality and more informative photographs. Instructions related to locating the screwdriver and removing the oven door were clarified to reduce confusion. Finally, the QR code linking to mobile instructions was made more prominent and introduced earlier in the process, ensuring users could access guidance before turning off the power.

Figure 1O: Previous S3 with timers

Figure 2O: New S3 with scroll through guidance

Appendix P — Coding of User-Tests

This Appendix shows the coding of the evaluation tests based on the behavioural drivers; motivation, self-efficacy, autonomy, postponment, emotional bonding, resistance, ritualising effect.

This is the link the the coding of the Evaluation data, to access this link a TU Delft email account is required!