

Design for a mobile application to extend the lifetime of household appliances in the circular kitchen of the future

Master's thesis in Master programme Interaction Design and Technologies

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MASTER'S THESIS ACEX30-18-84

**Design for a mobile application to extend the
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kitchen of the future**

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Gothenburg, Sweden 2021

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This masters project was initiated and is part of the ‘Circular Kitchen (CIK)’ research project, funded by EIT-Climate-KIC, conducted at the Dept. of Architecture and Civil Engineering, Division for Architectural Theory and Method.

Department of Architecture and Civil Engineering

Gothenburg, Sweden 2021

Abstract

The linear economic model, which is known as *throw-away economy* is where people consume single-use products and throw them away if no longer functional. Linear business models may be profitable in the short run, but over time, they will expose companies to market, operational, legal, and business risks. This thesis project answered the research question of *How to design for a mobile application that facilitates circularity in the usage of ATAG kitchen appliances and promotes users' sustainable behaviors* Around this key question, new mobile app features are created for a circular service. In the end, the thesis concludes the learnings after employing the interaction design research method research through design.

Keywords: Circular economy, Mobile app design, interaction design, research through design, prototype.

Acknowledgements

Our first acknowledgment goes to our academic supervisor Ulrike Rahe for the valuable guidance and constructive feedback throughout the study. We would also like to acknowledge ATAG Benelux and the company advisors Jan van Os and Vincent Hofstee. The information and workshop support was vital during our study. Furthermore, we would like to show our deep appreciation to our friends and families for their company and encouragement during this time.

Siqi Li, Lujia Peng, Gothenburg, June 2021

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1

Introduction

1.1 Background

Circular economy

Circular economy (CE) is a popular concept broadly discussed in the European Union. Initially introduced by Pearce and Turner [1], the *3R framework* (reduce, reuse, and recycle) has penetrated product developments and service design in countless ways. As the circular economy grows in momentum, it is imperative for companies to prepare for their transition based on insights into their circular performance and associated risks and opportunities [2]. In 2019, EU governments agreed to oblige manufacturers to make appliances more easily repairable and longer-lasting and the decision will be effective April 2021 [3]. For companies that manufacture kitchen appliances like ATAG Benelux, innovative circular models need to be investigated to reduce energy consumption, material waste, and pollution emission. The possibility of integrating different phases of the product lifecycle into the *3R framework* can be achieved by digital technologies like smart home [4], internet of things [5] and advanced sensors.

Digitalization help connect all stakeholders in the CE system and help quantify resource efficiency. Real-time big data approaches not only help optimize the processing chain when closing the loop but also bring the economical potential of CE, which helps rigorously track all the recoveries as well as costs and makes situations predictable [6].

When digitalizing the CE system, mobile apps can be considered as a good medium here when it concerns the end-users due to the following reasons: (1) Apps allow smartphone users to perform multiple tasks, which enables access to different services in different cycles. (2) Apps usually occupy more of the users' time than the web due to the mobility of smartphones. (3) Apps simplify the communications between staff and customers and enable direct messages (push notifications), hence improve customer engagement with the brand.

Stakeholders

The stakeholders in this project include the company ATAG Benelux and kitchen appliances users. ATAG Benelux is a market-leading supplier of kitchen appliances with over 2500 resellers in the Benelux. The Dutch company sells under the brands ATAG, Pelgrim, ETNA, and ASKO. All brands have high brand awareness in the

Benelux. ATAG sells its products through kitchen and electronics retailers and through the kitchen industry, which is a brand that values responsibility, innovation, and entrepreneurship.

ATAG connect App 2021

ATAG Connect Life is a mobile application that connects the daily cooking and eating moments with the kitchen appliances of ATAG, which includes features of remote control and notifications, inspirations of recipes, tips, and tricks about daily use and maintenance. In this project, we will design new CE features for this App.

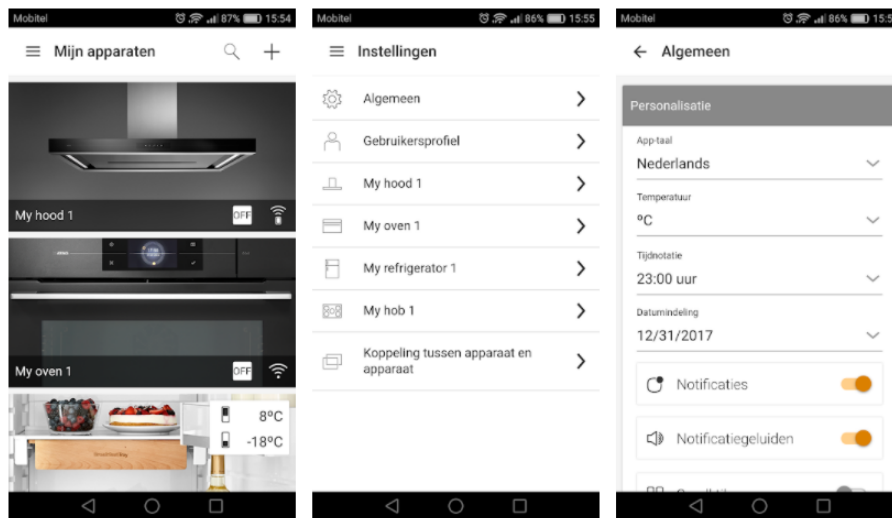


Figure 1.1: ATAG Benelux App, accessed May 2021

1.2 Aim and research question

The project aims to answer the research question of:

How to design a mobile application that facilitates circularity in the usage of ATAG kitchen appliances and promotes users' sustainable behaviors?

Around this key question, the project aims to work on implementing a circular model through the interaction design. Specifically, we breakdown the aim into two assignments: (1) To understand the interaction between the users and the appliance for closing the loop. (2) To design the interaction that concerns CE-loops between the users and the mobile application.

The design outcomes are a functional prototype of the mobile application, a project report that elaborates the design process, and a presentation.

2

Theory

In the following sections, theories used for this thesis project will be presented. The most overarching approach that explains the core process, the design thinking approach, will be presented first. In regards to CE and sustainability, theories about how to integrate circular frameworks in the interaction design are presented.

2.1 Research through design

Research through Design (RtD) is an approach to conduct researches with the aim of generating new knowledge by employing the design methods, practices, and processes [7]. Gaver (2012) [8] mentioned practice-based research better view theory as an annotation of design examples. RtD enables the researchers to envision what the world could be in the future, which is seen as a reflective practice: Through making designs as solutions, the researchers are reinterpreting the "wicked problem" in an iterative process. Frayling's *research through design* [9] also stresses how interaction designers can create meanings instead of all about doing the craftwork when engaging "wicked problems". The major criterion that he establishes to validate research in art and design is whether the research follows the cognitive tradition and generates new knowledge/understanding about design artifacts, other than the visuals. RtD allows interaction designers to make research contributions by making use of the real skills designers possess.

2.2 Design thinking

Design thinking is an ideology with a human-centered core. It is also an analytical process that engages a person to experiment, create and prototype models, gather feedback, and redesign, as stated by Razzouk, Rim, and Valerie Shute (2012) [10]. This process would be cyclical since designers usually jump back and forth between phases to evaluate and refine the design concept with increasing fidelity [11]. Design thinking helps designers quickly learn and iterate in order to reach innovative solutions [12].

2.3 Circular economy frameworks

Circular economy is the opposite of a linear economy (also known as *throwaway economy*) where people consume single-use products and throw them away if no longer functional [3]. Initially introduced by Pearce and Turner [1], *3R framework* (reduce, reuse, and recycle) has penetrated product development and service design in countless ways. As a result of ATAG's future vision, the circularity framework should be integrated into the mobile application design to ensure sustainable development in longer terms.

The main CE framework that this article refers to is the *butterfly diagram*. This diagram captures the flow of materials, nutrients, components, and products, whilst adding an element of financial value [13]. CE extends products' life by putting the resource back in the loop to make maximum use of it. According to Walter R. Stahel, using resources for the longest time possible could cut the nation's emissions by up to 70%, increase their workforces by 4% and greatly lessen waste [14]. The right side circles of the CE systems diagram, maintain/prolong, reuse/redistribute, refurbish/remanufacture, and recycle, are closely related to end-users. The closer it is to the end-user, as the more profitable it is to the environment, the more common it ought to be in the design. In the mobile App, these cycles can be transitioned to functions or features that users can directly use.

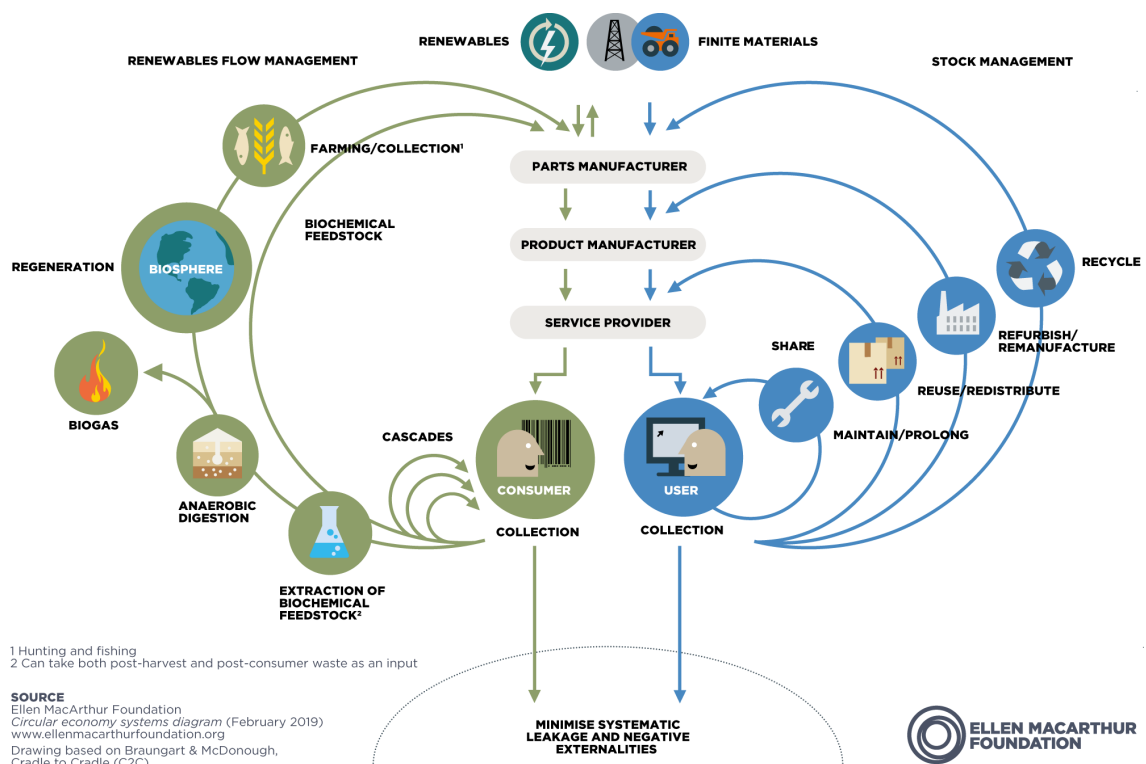


Figure 2.1: *Circular economy systems diagram*, Ellen MacArthur Foundation, adapted from Braungart & McDonough, Cradle to Cradle (C2C)

2.3.1 Maintain/prolong

The maintain/prolong loop is the most inner cycle that demonstrates the design strategy to extend the product's service life for as long as possible. This can be achieved through designing durability, maintenance, and repair [13]. This loop also deals with functional obsolescence, namely, when the products physically fail and need repair.

2.3.2 Reuse/redistribute

The reuse/redistribute cycle refers to materials or components in former products that can be reused or redistributed with little enhancements. After the first ownership, the product will soon be ready to serve the next user.

2.3.3 Refurbish/remanufacture

Refurbishing, also called reconditioning, means collecting unused products, components, or materials that can be refinished and sanitized to serve their original functions. It involves less work content than remanufacturing, but more than repairing. Remanufacturing is the rebuilding of a product to the specifications of the original manufactured product by combining or replacing reused, repaired, or completely new components. According to Lund(1996), remanufacturing belongs in between reusing and recycling, which is preferred to conventional recycling because it requires significantly less energy [15].

Both Appliance refurbishing and remanufacturing can save energy during the production process, hence minimize the impact on the environment. From the customer's perspective, refurbishing or remanufacturing an old appliance could be desirable from a financial standpoint.

2.3.4 Recycle

Recycle focuses on recirculating the materials by collecting, disassembling, processing discarded products to obtain secondary raw materials to further manufacturing new products. The product might lose the value of serving the original functions but would have other functioning purposes.

3

Methodology

3.1 Mixed method approach

To achieve the triangulation of methods, the research consists of both qualitative and quantitative methods to confirm the study's results. Using multiple methods also gains a better understanding of results, discover new perspectives, or develop new measurement tools [16]. The convergence of two different sets of results confirmed the study results, whilst the differences reveal new perspectives or phenomena. Though the mixed method approach increases time and cost for undertaking the study and its analyses [16], it makes the study results more convincing compared to only using one research method.

3.2 User research

Online Survey

A survey is a proactive way of gathering data [17]. It is a quantitative research method to gather numeric data. The aim of doing a survey is to investigate end-users using habits for kitchen appliances. Doing surveys in an early phase of the design process can obtain initial user perspectives and narrow down the question scope in the qualitative research phase.

Semi-structured Interviews

An interview is a qualitative research method that obtains semantic data through conversations. Semi-structured interview employs both closed- and open-ended questions, usually followed with questions of how or why. The information obtained from the interviews is usually multi-dimensional. The biggest advantage of SSI is that the dialogue can meander around the topics instead of adhering slavishly to verbatim questions as in a standardized survey, which may unexpectedly dig into unforeseen issues [18].

3.3 Analysis and ideation

Affinity diagram

An affinity diagram is a process to externalize and meaningfully organize data from research into logical groups [19] [17]. Affinity diagramming helps designers capture research-based insights, observations, concerns, or requirements into individual sticky notes so that the design implication of each can be fully considered on its own [17]. By clustering each sticky note into groups, key insights are inducted and the whole diagram explicitly shows which insight is most frequently mentioned and urgently in need of design tactics to improve the current product.

Persona

Personas are fictional characters that represent common users, which in the user-centered design process are critical to be understood. Personas are created based on qualitative and quantitative data from user research and answer the question “Who do we design for?”. Personas are often used to consolidate archetypal descriptions of user behaviour patterns into representative profiles, to humanize design focus, test scenarios, and aid design communication [17]. And in the ideation phase, personas facilitate empathy and communication, while their distinction creates useful design targets [17]. For the product team, Making use of Personas can predict the needs, behaviour, and possible reactions of users, as well as figure out the most relevant design task. However, creating personas is not an end in itself. They are more of a decision-guiding tool that facilitates identify challenges and common patterns.

User journey map

A user journey map visualizes an individual persona’s use of service as a descriptive narrative [20]. Each key moment when the individual is interacting with the product or service is visually presented in a user journey map, waiting to be evaluated and improved. It builds a story about people’s actions, feelings, perceptions, expectations, and frame of mind - including the positive, negative, and neutral moments [17]. The user journey map articulates a multifaceted user experience. Design opportunities are identified through the user journey to produce innovative design solutions that streamline the current user experience.

3.4 Prototyping

A prototype provides something as a design representation that can be evaluated before committing resources to build the real thing. An early version of the system that can be constructed much faster and is less expensive to make changes. Prototyping has become a principal technique of the iterative lifecycle [21].

The fidelity of a prototype reflects how “finished” it is perceived to be by users. Prototypes’ fidelity mainly varies in the area visuals, content, and interactivity. In this project, both low-fidelity prototypes and high-fidelity prototypes were used in the test sessions to determine if people can use the features. Figma was used as a tool to build interactive prototypes.

3.5 Evaluation

Heuristic evaluation

Heuristic evaluation is a usability inspection method to identify usability problems in the user interface (UI) design. The lo-fi prototype was evaluated using Jakob Nielsen's 10 general principles for interaction design [22] (see the 10 principles in Appendix).

Usability testing

Usability tests will be conducted after having sufficient details in the prototype. This method is used to measure the interaction between a user and a product thus assess the usability of the interaction design [20]. Participants of usability tests will be assigned to complete standardized, specific tasks. The usability tests will reveal defects in the user flow regarding efficiency, effectiveness, and satisfaction in a quantified context of use [23].

4

Process

The iterative design process (Figure 4.1) contains five phases, research, define, ideate, prototype and test. The last three steps were went through twice for two prototypes, and multiple iterations of changes and refinements.

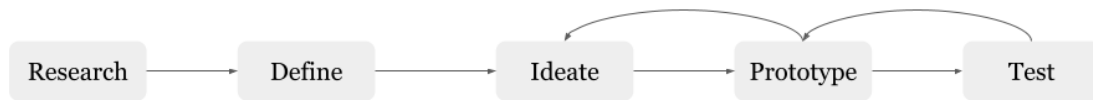


Figure 4.1: Design process overview

4.1 Desk research

Desk research is a research method to gather secondary data, which includes existing knowledge, studies, and researches. It is a necessary step to obtain inspirations in a defined study area and it can lead the research towards the initiative tracks to achieve goals and provide additional arguments [24]. Before conducting the user research, two kinds of desk research were carried out, the relative researches and competitive products, in order to get an overview of this domain.

4.1.1 Domain research

In the domain of designing for sustainable household appliances, some prior researchers have investigated different perspectives, yet the implementation still stays at an embryonic stage in many manufacturing companies [25]. In the following, we discuss prior research on possibilities to adopt CE in the household appliance industry and generate their distinct empirical and theoretical results, which deeply inspired this project.

Selvefors et al. [26] have studied how kitchen appliances can be designed to support

less energy-intensive use and conclude with design guidelines for reducing energy consumption. The circular design guidelines presented in this article are inspiring to this project. For example, one guideline mentions that *Communicate how functions, settings, and loads influence energy use*, which could be emphasized in this project.

Lilley et al. [27] have done a rigid user study about what are the factors that impact users' repair behaviour and what are the design solutions to support repair rather than disposal.

Wastling, T., Charnley, F., Moreno, M. (2018)[28] have done a literature review, case studies, and expert interviews to create the theoretical framework that encourages users circular behaviours.

Though the previous studies have investigated the circular economy implementation realm, they haven't explored the possibility to adapt the system in a possible digital solution at the end-users side, such as a mobile app.

This thesis project is grounded in the prior research and generates its unique contribution through design practice regarding implementing circular economy in kitchen appliances usage via the interface. Especially, it creates a full-scale service to engage different stakeholders and users in the circular economy, which is an under-exploration realm.

4.1.2 Competitive products analysis

Competitive research can be done when designers are previewing the landscape at the beginning [29], which also enables the design team to access the competitor's products from the perspective of a user and evaluate the usability as well portability [17]. To understand existing products in the current market, and what is working well and what is not, the team investigated the competitors' Apps and identified them as three categories: (1) Primary competitors: ATAG's direct competition, selling a similar product/service namely, kitchen appliances. (2) Secondary competitors: those who sell similar products or services but are not limited to kitchen appliances. (3) Tertiary competitors: those who are related in some ways, but don't sell the same products at all nor directly compete with ATAG in any way.

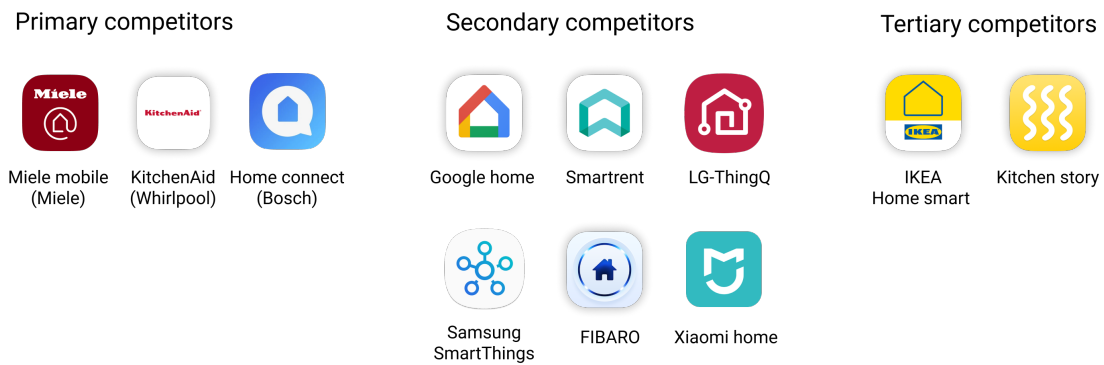


Figure 4.2: Competitors' Apps

When benchmarking the competitors, two parts were considered. One was the smart home part such as control, monitor, and automation features, the other was sustainable features and maintenance-related features. The tertiary ones were excluded here since appliances are not their main products.

	NAME	APP STORE / GOOGLE PLAY RATING	CONTROL & MONITOR	COOKING SUPPORT (eg. recipe, shopping list)	SUSTAINABILITY	ERROR DETECTION	NOTIFICATION	AUTOMATION	DEMO PRODUCTS
PRIMARY	Miele mobile	2.7 (51 reviews)	✓	✓					✓
	Kitchenaid	2.5 (1691 reviews)	✓	✓	—	—	✓	✓	
	Home connect	2.8 (135 reviews)	✓	✓	✓	✓	✓	✓	✓
SECONDARY	Googlehome	4.0 (1,031,183 reviews)	✓			—		✓	
	Smartrent	4.4 (675 reviews)	✓			✓	✓	✓	
	Fibaro	2.7 (766 reviews)	✓			✓	✓	✓	
	Smartthings	4.4 (670,725 reivevs)	✓		—		✓	✓	
	LG-ThinQ	4.2 (150,077 reviews)	✓			✓	✓		
	Mi Homes	4.4 (550,931 reviews)	✓	✓			✓	✓	

Figure 4.3: The feature comparison of competitors' Apps

Findings

In the table, the tick stands for the app *has the corresponding function*, while the dash means *to some extent relevant*. (1) There is no *demo product* in most of the competitors' Apps, which means people cannot access how the app works if they don't buy the products. (2) Barely these apps had sustainability features except *Bosch home connect*, its eco mode shows energy and water consumption. *Samsung Smart Thing* and *Kitchenaid* have something relevant because their automation features help automatically turn off the devices when people leave, which originally aims to shortcut actions but to some extent also help energy-saving. (3) Some products have the self-diagnose feature so the app allows for error detection. However, no

solutions were provided. In conclusion, not many competitors have considered the sustainability and error support part, and that is the point where ATAG's product can stand out.

4.2 User research

4.2.1 Online survey

As a start of the user research phase, an online questionnaire on the kitchen appliances using habit was handed out to people who lived in Europe, made with Google form. The questionnaire aimed to obtain a basic understanding of the kitchen appliances usage, which was about their cooking habits and behaviour patterns. Besides, the team also tried to dig out the potential pain points by asking how their user experience was in terms of maintenance and energy-saving. The importance of cleanliness and sustainability was also asked to be scaled. In the end, people's opinions on how an app could assist their kitchen usage were asked.

Planning the online survey This online survey contains mainly closed-ended questions, mostly multi choices questions. The questions were planned considering the following aspects - basic questions, current experience(regular use and maintenance), circular opportunities, and interactions. The survey started with a short introduction about the project's confidentiality and anonymity, and the approximate time to complete the survey. Following are the questions, such as multi choices questions, scoring questions, and comment questions. In the end, a short descriptive text enquires people's willingness to participate the future usability tests.

Conducting and analyzing the online survey 120 responses were received in total, a general understanding about what appliances people have in their kitchen and the corresponding using frequency. Among the respondents, 56.4% adults were under 30 and the others were above 30 years old. According to the result, Refrigerator and hobs were the two most used kitchen appliances. 61.5% of the respondents have experienced appliances breaking down. More than 75.2% would like to directly have their appliances fixed by professionals when they are broken. People also preferred digital instruction to paper instruction. When it comes to cleaning, 77.8% of the respondents thought regularly and properly cleaning would help extend the lifespan of the appliances. However, the average satisfaction degree of how they clean their kitchen appliances is 3.86 out of 5, only 24.8% gave themselves a 5. About the question related to having a mobile app that connects the kitchen appliances, 88.3% thought it would help more or less, Among those 23.9% who thought "it would definitely help". Besides, The two most wanted features of the app were safety instructions alerts (77.8%) and monitoring the appliances' status (76.1%).

4.2.2 Semi-structured interview

To supplement and add depth to the survey, specifically, to further probe the interviewee's personal perspectives about their daily kitchen appliance use, and what

they do with sustainability with more open discussions, semi-structured interviews were conducted. Since ATAG defines its target users as people who love to cook, 12 cooking enthusiasts aged from 24 to 66 were recruited and interviewed, one in Germany and the others in Sweden. They were selected with a standard of people who often post photos of self-made food on social media. These 12 volunteers were recruited through social media and the team's network, to cover diverse cooking lovers and distribute across the demographic ranges of the brand target group. The summary of interviewees can be seen in 4.1.

Case	Gender	Age	Marital status	Location
I-1	Male	24	Single	Sweden
I-2	Female	30	Married	Sweden
I-3	Female	26	Single	Sweden
I-4	Female	39	Single	Sweden
I-5	Female	29	Single	Sweden
I-6	Female	29	Single	Sweden
I-7	Male	31	Single	Sweden
I-8	Female	42	Married	Sweden
I-9	Male	26	Single	Germany
I-10	Male	34	Single	Sweden
I-11	Female	40	Married	Sweden
I-12	Female	66	Married	Sweden

Table 4.1: Summary table of SII interviewees

Planning SSI

Before each question, the moderator briefly introduced the project and what circular economy is. But the term "circular economy" wasn't brought up in any question. Instead, the relatively broad term was broken into different cycles and probe into each cycle, for example, instead of asking "what have you done about the circular economy?", the moderator asked "what have you done to extend the lifestyle of your kitchen appliance?" and "what have you done to save energy when you use the appliances?". This avoids the deviation caused by an inaccurate understanding and unfamiliarity of the term CE, besides, it helps the team dig out more pain points.

The questions were mainly about cooking habits, appliance management, repairing, circular opportunities, and interactivity. The questions started with the frequency and overall experience of the appliances use and closed with a discussion on their expectations of what potential experience could this App offer them (Question list see appendix A.3).

Conducting SSI

During the interviews, tips to effectively conduct SSI were taken into consideration: (1) Pilot test can help quickly identify the problems in the questions and hence makes the interview rephrase them to get more information. (2) Always start the conversation with a few simple questions such as "what do you have in your kitchen" to familiarize the interviewee with the topic. (3) Building rapport with the respondents [30]. A comfortable setting and appropriate language can help get rich, authentic, and detailed experiences from the respondents. When asking how well people clean their kitchen, judgemental discussions about themselves were avoided. Instead, the moderator asked "have you ever tried to clean up every corner?" to get a more descriptive response.

Analysis

An affinity diagram was used to analyze the information from interviews. Important insights were extracted from the interview transcript to individual sticky notes, which were color-coded for each interviewee. All the sticky notes were then inducted into different groups - *cooking habits, appliances ownership, opinions toward sustainability, cleaning behaviours, repair behaviour, energy-saving behaviours, lifetime-expanding behaviors, problems/frustrations, and expectations on App*. The summarized insights generated the following findings.

Results

Mobile Apps are the main source where people get recipes (7/12), including recipe apps and grocery apps. Along with that, YouTube and Google are the second popular channels.

People show different preferences about the formats of recipes. I-4 prefers text+images to video as he/she thinks it is easier to go back to the last step. I-10 enjoy videos more. I-1, however, prefer a combination of text+video+images. Recipes provide sociability. People may communicate with friends about the same recipe, or go online and comment under recipes they have tried. And some people create their own recipes.

Taking notes on paper (I-1,9,12) or mobile phone (I-7,8,11) are the most common two ways to memorize shopping lists of food ingredients. Two interviewees don't take any note of shopping lists, instead, they buy things that are easy to cook or match what's in the fridge. Besides, there is a need of sharing the shopping list between families. (I-8,12)

Comparing weekdays and weekend cooking, there are three types of habits:

- Same between weekdays and weekends (I-1,6,12)
- More at weekends (I-2,3,4,7,9,11)

- More on weekdays (I-8)

The meals cooked on weekends are more complicated or time-consuming to many interviewees, while some others prefer relaxing at weekends and order food delivery, eat out or eat at friends' homes more. People tend to "try something different" when not cooking at home.

Having everything being in order, social connection, and good cooking outcomes are the three most often mentioned factors that create positive feelings. Having something else to do while waiting improves the cooking experience.

When being asked if the estimated lifetime of the appliances is necessary information to know, the answer from most interviewees was "no". But it is "a good thing to know" for people who just moved into a new apartment with appliances according to one interviewee. On the contrary, people care more about how to take care of the appliances to make them last longer rather than lifetime information.

Smart appliances are common to many of them. Many have an open and positive attitude towards smart appliances, thinking they will bring convenience to their life. Keeping appliances clean is overall important to people, but they all have their own standards of "being clean" and "spending enough time". Some think the appliance is well cleaned as long as it doesn't affect the next use, while some others think the appliance needs to be cleaned from outside to inside and properly dried. They also reflected that the impact of proper cleaning is not usually visible. According to the interviewees, the big appliances don't break often. Once problems occur, people tend to have professionals take care of them or buying a new one. How they deal with the broken ones also depends on whether the product is under warranty. The net/filter in the extractor hood is the most common component that people would change by themselves. When changing, many people look at the manual book, otherwise, they tend to find instructions on search engines because of the missing instruction book. Only half of them take action to save energy during cooking. The actions include:

- Turn off appliances in time.
- Decrease the switching frequency (eg. fridge.)
- Temperature adjustment.
- Use eco modes.
- Make use of the space. (eg. oven)
- Don't put too many things in the fridge.

Those who don't take action explained that they don't think about energy when making food, or they want to but have no idea what to do. Some also think there is more the product designers and engineers can do than them in terms of saving energy. Some interviewees claimed that some actions (turn off appliances in time, lower oven temperature) are not for energy-saving purposes, but other factors like safety considerations or food taste. The eco-mode usually takes more time. Half of the interviewees do regular cleaning, intending to extend appliances' lifespan.

Four of them treat appliances with care, such as following the instructions, tighten screws, dry appliances before putting them into the cabinet. A few said they don't know how to do that exactly. Like what they do to save energy, they also turn off appliances if not using to expand appliances' service time. Most people gave a 4 or 5 out of 5 concerning the importance of sustainability in kitchen usage. Many regard functionality as prior to sustainability, for instance, they won't sacrifice time to sustainability when busy. Notably, people have different definitions for sustainability: some interpreted it as buying less new and more second-hand products, some considered it as a term for energy saving in daily usage, some considered sustainability as a broad term and thought it's the products manufacturers' responsibility rather than consumers to design their products to be more sustainable. Consumers have few actions to do, restricted by limited Eco modes and products. One interviewee claimed that kitchen appliances, especially big ones, are instinctively sustainable due to low update/renewal frequency and high durability. Problems mentioned during the interviews are: burnt, water overflows and left stains on the hob, forget crucial steps, noise, and smell, the inaccurate oven temperature, confusion about which mode to choose. Many people thought cleaning or tidying things up is frustrating. A few interviewees(I-1,5) thought making complicated food sometimes is frustrating, because "one step ruins all". Frustration also came from failing to arrange the cooking time if family members have to eat at a different time as well as Appliances aging. Besides, one was upset about having to use different apps for different appliances. Remote control, monitoring, and automation were the most wanted features according to the interviews. Planning for cooking hence serve the food at the same time is also mentioned three times. Here were the keywords that people have mentioned when talking about the most wanted feature of the mobile app.

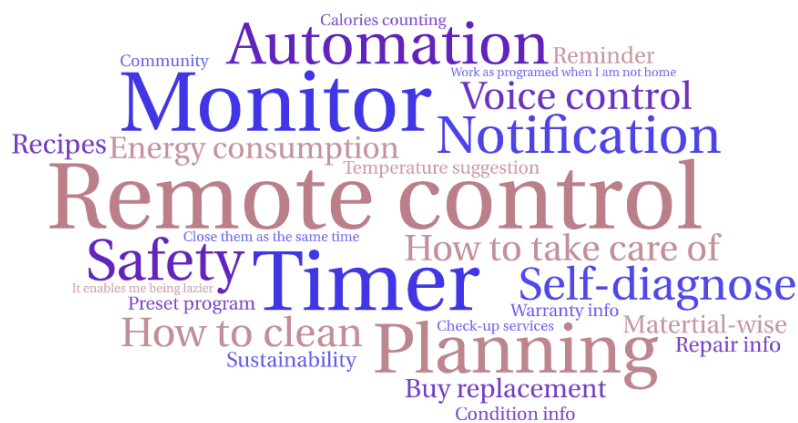


Figure 4.4: Keywords of the most wanted features during interviews

4.2.3 Summary of user research

An understanding of the confirmation and comprehension are gained through finding the intersection and disjoints of two different data results from qualitative and quan-

titative research4.5. The convergent findings form the confirmation, and together they explain detailed understanding of the phenomenon under study [16].

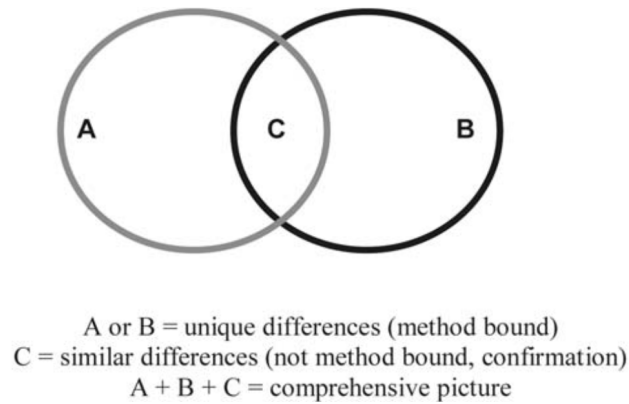


Figure 4.5: Confirmation and comprehension: Related concepts [16]

Confirmation of Results

Approximately 12 interviews and 120 online surveys were statistically and conceptually compared for confirmation. Statistically, the percentage of each essential question was compared to get confirmed results. Both the survey and interview results show that cooking Apps are the most popular channel to get recipes (54.7% of survey responses and 7/12 of interviewees' answers). And regarding the cleaning performance scoring, all of the user study participants scored about 4 out of 5, which means good but still has space for improvement. The most common behaviors to extend kitchen appliances' lifespan is regularly and properly cleaning for both user types of research (77.8% in surveys and 6/12 in interviews). When needing to repair an appliance, most people (over half of the participants) will search through the internet for instructions. And for the score of sustainability importance in daily kitchen appliances usage, most interviewees score it 4 to 5, and the average in surveys is 3.82 out of 5, which is similar.

Comprehension of Results

The most common problem during cooking in questionnaire results is "overcooked food", which is also frequently mentioned in interviews. But except for options given in the questionnaire, new problems were raised, like the oven's temperature and mode selection uncertainty. In the online surveys, respondents tend to skip the open-ended questions where they have to type answers. But in interviews, they can further explain and discuss by talking. Therefore, interviews gathered more detailed answers or discussions of open-ended topics. For the question "what have you done to save energy", people mentioned more in interviews besides the options in the survey, such as temperature adjustment, using Eco-modes, make better use of the appliance inner space, etc. Another interesting finding is that some interviewees stated some actions are not motivated by saving energy, but out of safety considerations or food

taste. For instance, some said they turn off the appliances in time because of safety concerns. And in interviews, those who don't take energy-saving actions explained that they have no idea what to do to achieve that.

Notably, there's a slight divergence when people are scoring their cleaning performance or sustainability importance. The average scores in interviews are higher than surveys average scores. On the one hand, the deviation was caused by the different sample sizes, which means survey results are probably more accurate due to the bigger sample size. On the other hand, since the answers to these two questions can reflect a person's values and affect the personal image, interviewees tend to propose more positive answers to make a better impression of themselves. On the other hand, the sample size of interviews is too low to demonstrate an authentic result.

People who are more enthusiastic about cooking show more caring for their appliances, and have higher expectations regarding the features of a potential App. However, when it comes to the expectation towards the app that connected to the appliances, there was a lack of "A bigger picture". People barely talked about the subsequent lifecycle of the appliance after their ownership. However, they showed strong interest in how the app could be smarter in daily use (eg. automation, smart control, etc).

Besides, Insufficient information for maintenance by themselves was reflected as a problem. Many people have tried to fix the appliance themselves when a problem occurs, searching on the internet for a solution is the common way to start. Besides, most people are aware that proper cleaning can extend the lifespan of products, but some reflected they don't know about techniques on how to properly cleaning the appliances.

In addition, a passive attitude towards what they can do was very common among the users. People thought there is too little they can do when it comes to saving energy in daily appliances use. Many believe the energy consumption mostly depends on how the product is designed, not how the product is used.

4.3 Define

This part aims to answer the question of *who are we designing for* and *what are the pain points during their appliance usage*. Besides, we dive into the special needs of the users.

4.3.1 Target group of ATAG

The case company ATAG holds a vision of "we love to cook". They have defined three personas that represent their customers: *social chef*, *semi-pro* and *pleasure seeker*. Based on the user research, a new persona *sustainable chef* was added.



Figure 4.6: Personas: (1)Social chief, (2)Semi-pro

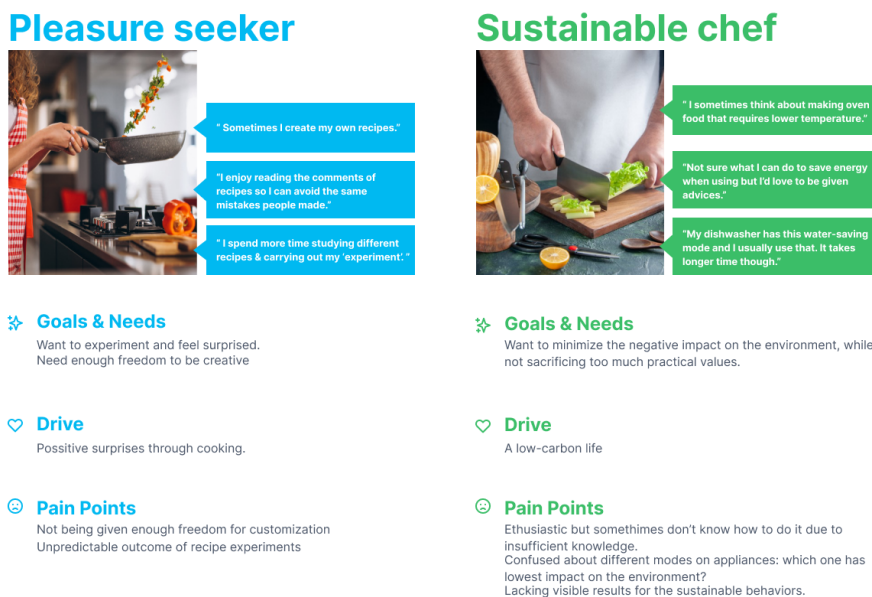


Figure 4.7: Personas: (3)Pleasure seeker, (4)Sustainable chief

The four personas are all cooking enthusiasts with differentiated needs, drives, which are defined in this phase to identify the pain points. In short, "want to get socially engaged in the kitchen" is the main feature of the *social chef*. *Semi-pro* emphasizes the improvement of techniques and is looking for challenges, while *pleasure seeker* tends to look for joy through creations and experiments. Besides, *Sustainable chef* values the impact on the environment she/he makes during the cooking process.

The four personas were a starting point of the following ideation, they consolidated the definition and characteristics of the target group. The four personas are demonstrated in Figure 4.7.

4.3.2 Target user of the new App

Although ATAG defined their customers as cooking enthusiasts, we don't think the target group of the new App should remain the same. Since the CE features would add a new selling point for the brand other than the original ones. Here we define the target users of the new App as people who use the ATAG appliance for now or likely in the future.

4.3.3 Consumption behavior analysis

To identify users' behaviors that cause wasteful energy consumption, the *Consumption behavior cycle* framework was utilized. This framework is stated by Selvefors, A., Pedersen, K. B., Rahe, U. (2011) that can be used as a guide for studying user actions and behavior. It helps direct and rationalize the user studies and thereby more efficiently gain insights on new possible product opportunities [31]. Users' unsustainable behaviors were summarized from the user research, specifically from the semi-structured interviews. The behaviors cover the whole life cycle of the product or system, from the users' need arising to the need ceased. The consumption cycle of kitchen appliances and unsustainable consumption behaviors are illustrated in Figure 4.8.

Five main issues regarding users' wasteful consumption were identified during the study: unclear to users about what is truly needed when a need to purchase or consume a product or service arises; users' unawareness of energy consumption when starting using a mode or product; their energy-wasting habits during active use; the accumulated damage to the product caused by insufficient cleaning, improper operation or lack of knowledge; and the barriers to maintain the product due to lack of knowledge or higher costs.

And since this project's main focus is the after-sale service that relates to the circular economy, the issue of the angularity about what is needed when the user is purchasing a product was discarded from this project's scope.

This framework articulates the former general user studies' insights to valid points that can directly facilitate further steps in a highly visualized way. Within this systematized consumption cycle analysis, solutions that may reduce the wasteful behaviors can then be found with close correspondence to each issue. When selecting suitable intervention approaches that stimulate users' positive actions to prevent the possible wasteful behaviors, three focuses were determined: increase knowledge, engage, and steer&spur. The initially generated design tactics are:

- Increase knowledge about prolonging the product' lifetime
 - Feedback on the current condition/energy consumption

- Assist them to choose the suitable mode
- Instructions on repair/accessory replacement/cleaning
- Engage the users in CE by persuasive design
 - Make the “buy-back” service process simple
 - Storytelling (eg. tell people how will their recycled products be used again)
- Steer&spur
 - Provide rewards to circular behaviors, for instance, coupons for using the recycle service ATAG offers

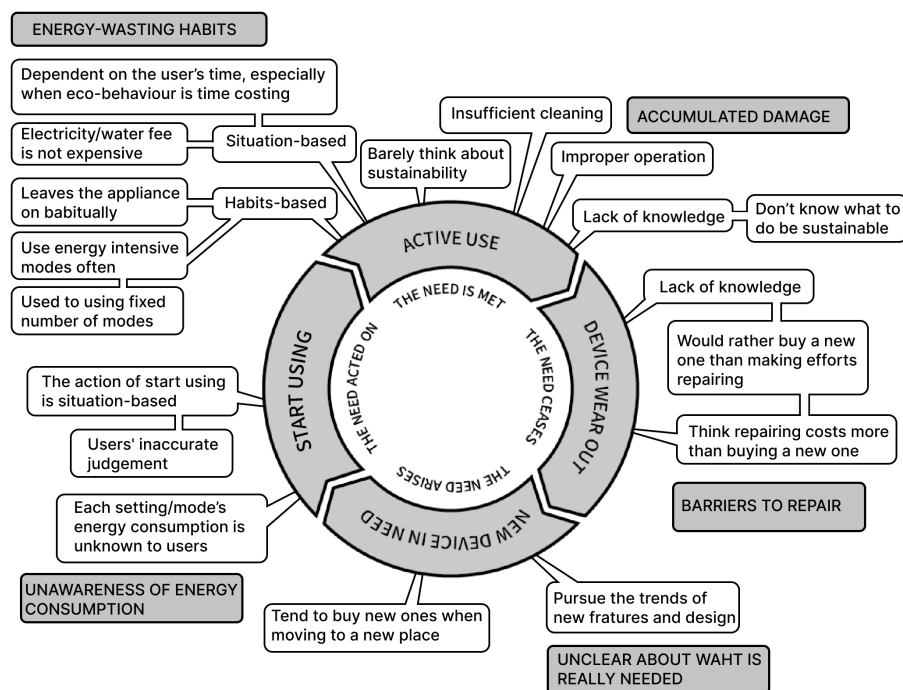


Figure 4.8: Identified user actions and habits from the consumption cycle, adopted from *DSCB-approach* by A. Selvefors et al. (2011) [31]

4.3.4 User journey Mapping

To identify the CE economy opportunities, the team went through the current three user journeys when the appliances are maintained/repared, reused, and refurbished, and created three user journey maps accordingly (see Appendix). The maps aim to demonstrate how the experience can be broken down into more detailed steps when people accomplish the tasks and eventually get their expectations fulfilled without the App to be designed. The users' mental model was considered and their possible pain points, as well as expectations, were identified. Accordingly, what opportunities are there were identified during their possible experience.

The maintain/repair map shows the journey users walkthrough from first being aware that there is a problem to finally getting it fixed. The reuse journey happens when the user is going to move out and sell the appliances. She first may start with cleaning, and then look up and decide on the price he is going to sell it for, followed by posting the information somewhere like the Facebook marketplace.

The refurbish journey happens when a manufacturer allows for a “buyback” service so the user can sell the old appliance back to the product manufacturer. But from this journey, the team realized that from the users perspective, instead of wondering how the refurbishment will be done by the manufacturer, they probably care more about how much refund will go to them, what is the price evaluation standard as well as the transparency and fairness of its process.

However, the journey being said is never the only one for each occasion. There is always an easier way to accomplish each task and some of the steps are skippable depending on different situations. But the longer and more twisty journeys were picked, the more pain points and design opportunities can be revealed.

The main findings of the three traditional journeys were concluded as: (a) Maintenance/repair information cannot be easily found when is needed. (b) Non-transparent repair process. The repair time and cost are usually vague. (c) Users have to do the information collection and comparison work manually.

4.4 Ideation round I

The ideation phase aimed to answer the following questions: 1) How to design an App for less energy-intensive use? 2) How to tackle the pain points identified in the three current journeys by involving ATAG’s App?

Design can influence people’s using behaviors of appliances hence support energy conversation [32]. Also, designers can make changes at different layers of Design to influence people’s preconditions for acting with technology, one of the categorizations defined a five-layer pattern as shown in Figure 4.9. In this project, our ideation will mainly focus on the bottom two layers: interaction functions and communication functions of the mobile app. Specifically, following the proposed guideline for supporting less energy-intensive use of appliances [32], five insights were concluded about how the mobile app that assists energy-saving behaviors could be designed: 1) **Levels**. Provide energy-saving mode with different levels of intensity for different purposes. 2) **Feedback and communicate**. Visualize energy consumption summary and how much could be saved 3) **Customization**. When using an automatic programme, allow the user to customize some steps. 4) **Nudging**. Nudge the user to make an energy-saving choice. 5) **Assist**. Give suggestions on mode/setting choices based on the user’s needs.

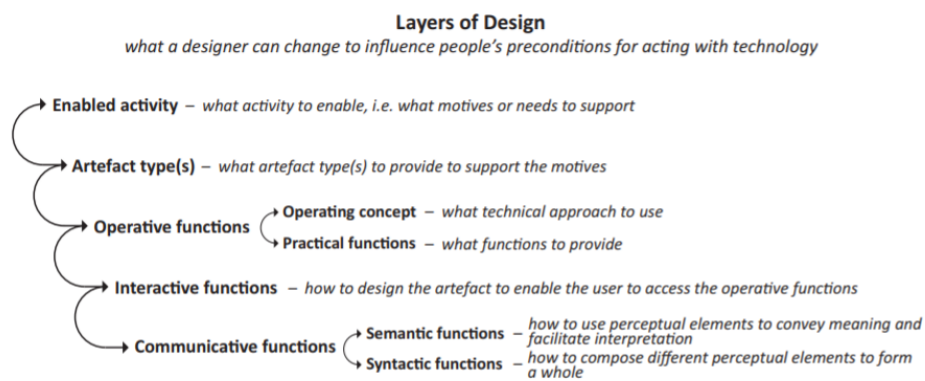


Figure 4.9: Different artefact-related aspects that affect people's preconditions for acting with technology [33]

To answer question 2), based on the identified opportunities in the three user journey maps, storyboards are created to speculate how the app could be properly involved in the circles. The team imagined that except managing and connect kitchen appliances, the app could also be a tool that facilitates self-check and repair booking service (Figure 4.10), as well as the taking back service (Figure 4.11).

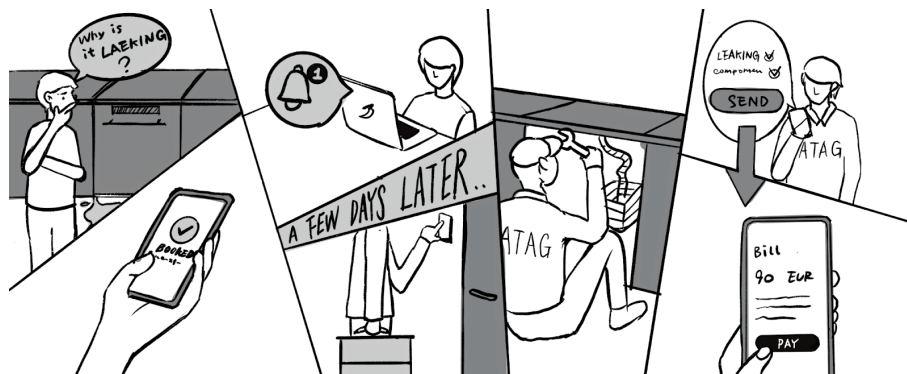


Figure 4.10: Storyboard:the repair circle

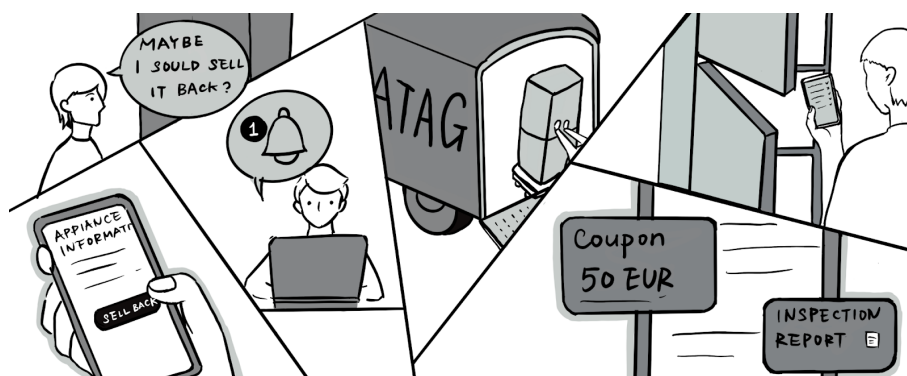


Figure 4.11: Storyboard:the sellback circle

4.5 Lo-fi prototyping

With the information architecture diagram as a basis, the lo-fi prototype started on Figma. It mainly covers two user flows - the repair service flow and the sell-back flow. Reflected on the circular cycles, the repair service belongs to the maintain/repair flow and the sell-back service is composed of the refurbishment and recycle flow. As shown in Figure 4.12, both repair and sell-back functions can be navigated from the appliance's page. However, the hierarchy of each function is determined by the usage frequency. Because of the high durability of kitchen appliances, people don't use the repair or sell-back functions as frequently as functions like remote control or monitor. Therefore they are one hierarchy lower than these functions. Except for the structure-wise consideration, the lo-fi prototype defines the interface layout, flows, and information.

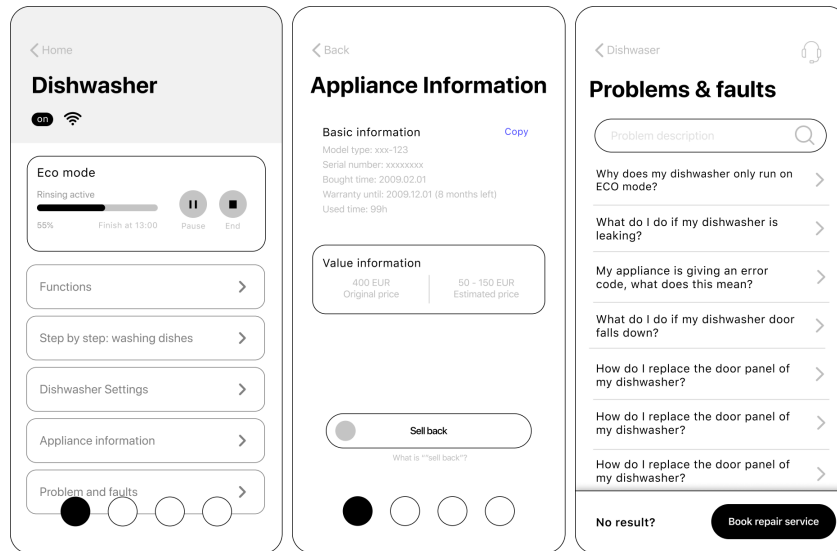


Figure 4.12: Lo-fi screens: Navigate to repair and sellback feature

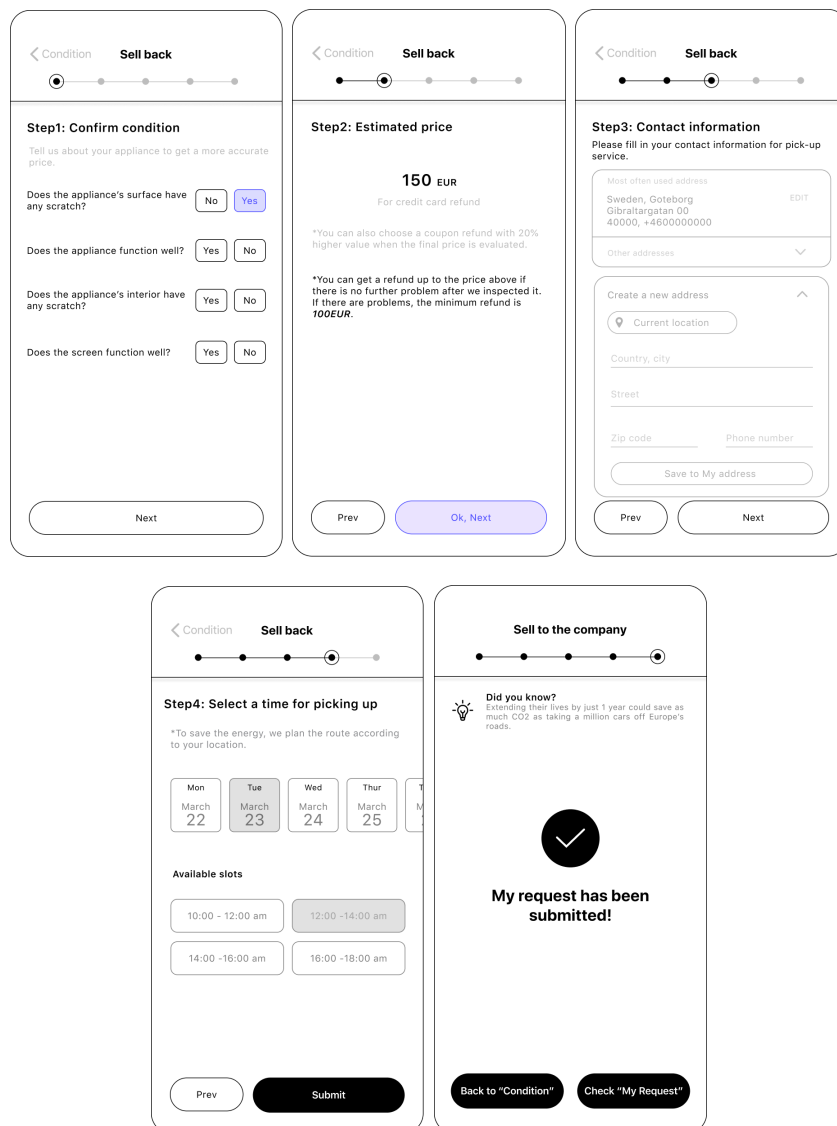


Figure 4.13: Lo-fi screens: the sellback flow

4.5.1 Lo-fi usability testing

Subsequently, the usability tests were conducted on the interactive low-tech prototype. Since the fidelity and quality of this prototype are relatively low, with missing pictures and less detailed information, participants will focus more on pitching the flows, instead of the look & feel, hence helps defect and issues in the current processes. A small sample size of participants (6 in total) was recruited from the target group, who have all participated in the survey (but not the interviews) before and were aware of the topic of this project. The reason for not involving the interview participants is to eliminate the bias when recruiting since the team already knows them and their habits.

All of the usability tests were carried out through remote meetings, where the par-

participant gets access to operate the virtual App prototype on the website and their screen and voices were shared and recorded. Each usability test was composed of three phases - firstly, the moderator introduces the project, the product, the testing process, and the consent; secondly, participants are assigned several short explicit tasks in the App and their behaviors are observed, feedback are recorded; lastly, some post-test interview questions are asked. The participants were encouraged to think aloud while conducting the four tasks as following:

1. Suppose that now the door of your dishwasher is leaking, and you are going to refer to the app and find out how to fix the problem.
2. Sell back your dishwasher to the company.
3. Check your "Sustainability credits".
4. Check the *Cleaning records* and describe how you interpret this page.

If the participant got stuck in a step, the moderator will intervene and provide some hints or instructions. The obstacles will be noted down and the moderator will ask the reason why the user doesn't know what to do or chooses the other paths. After each task, supplementary questions were asked to obtain the motivations and details of some in-App behaviors, for instance, "is there anything that you think is confusing in the process"? The data of the usability tests were then transcribed and extracted to keep only the most important insights. Another worksheet of lo-fi usability tests summary was created, in which the insights were pinpointed. Before summarizing the vital insights in the worksheet, the team has discussed the highlighted data one by one to decide whether it is a representative point. After the revision of the summarized data, refinements were made to improve the defective processes. And the sustainability credits and *cleaning records* feature were discarded according to the interpretation of the usability tests. "*I mean it looks like a good thing, but I might get a discount after several years' accumulation, and wait for several other years to use it.*" said one participant. Since credit-gaining resources are very limited in the current system, only from using the repair or sellback services, users can rarely get enough credits to exchange discounts. Additionally, kitchen appliances have a very high life expectancy ranging from 4 years to 23 years [34] and high durability, which means consumers will seldom use the repair and feature, and even lower needs to purchase new products to redeem the discounts. Therefore, this feature was eliminated in the following versions.

And the *cleaning record* feature was mainly restricted by technological limitations. Since this feature was developed within the scope of current appliance capabilities, no hypothetical features were added to achieve this cleaning monitoring function. The recording actions weren't automatic. Contrarily, they need users' manual operations to add the record, turn on notification, and it requires users' self-discipline to act right when seeing the cleaning reminder. Many participants expressed their doubts about such a function. One of them stated, "*Do I need to record it myself? Then I won't use this function, it's too troublesome. I understand its meaning though.*" Even though users can understand the intention of the cleaning record feature, they don't want to bear the burden of always keeping track of the cleaning

frequency. Another user mentioned that this feature is a departure from people's using habits, *"there's no conditional reflex to click a button after cleaning"*. Unless this recording work and cleaning work can all be done by the appliance or App, most users won't use this function. After thorough consideration, this feature should be removed from the current scope. However, the design of the information display and notification feature might inspire future development if more advanced sensors or curators emerge.

For the repair and sell-back features, a few usability flaws were identified. Regarding in-App **navigation**, the current back button inside the request-creating process creates confusion. According to the participants, it was ambiguous whether it means back to the last step or exit the process. Hence the team decided to add a short descriptive word "exit" beside the back button to declare its purpose. Besides, two participants had trouble finding the repair function on the appliance information page. They tried navigating to *My page* and didn't see it as expected. *"Didn't expect there to be a repair button in the dishwasher (page)"* claimed one participant. Another participant thought "it looks like I will enter the control function if I select those appliances on the home screen". To these users, it is more intuitive to have the repair or sell back function on *My page*. However, from a user habits aspect, it's highly comprehensible because most e-commerce platforms cultivated such a behavior model. In addition, users are used to performing order-related actions such as returning or changing orders on *My page*. Therefore, another entrance to manage and monitor the repair and sellback requests was added on *My page* with a high visual hierarchy to adapt to users' behavioral habits. Users can add a repair or sellback request on that page and monitor the process there.

Another topic that many issues occurred was **feedback**, especially when certain steps are completed in the app or the service flow. Most problems lay in the repair process display part. Except for obvious problems such as overlapped information and implicit phrasing, request procedure information feedback was discussed most often. In reality, most repair tasks can be done at the customer's home, but in other cases, the appliance needs to be taken to the company for repairing complex problems according to officers in ATAG. When being asked to assume the situation when the appliance has to be taken away to fix, people's opinions are divided. Some participants think the App should provide the longest-time guarantee to lessen their worries, while others think guaranteed time is unnecessary because of the uncertainty corresponding to different problems. But after an inner discussion, the design team came to the agreement that though customers' attitudes are important, the actual implementation is up to the company's deployment and business model in the future.

The discussions were triggered by the question *"Do you think it's necessary for you to know information about when the product can be sent back to you?"* Starting from this question, the topic extended to varied real-life situations in the discussion. Thus, some hidden problems that this flow hasn't specify were brought up. One participant said *"As a happy flow, the payment process is good enough. But if the payment fails, there will be more screens to do."* This participant also mentioned

the cancellation regulations stipulate users couldn't *cancel* the request if passing the valid dates, which might cause an awkward situation and cost loss on both sides. For instance, if the last valid cancellation day has passed, the customer couldn't cancel the repair service booking even if he/she has an emergency and will not be at home as scheduled. To solve extreme cases like this, a small but effective improvement was made - quick access to the customer service chat was placed on the top right of the screen in the form of an icon. This design decision was made with the consideration of two aspects. On the one hand, extreme cases rarely happen, so the supportive feature shouldn't impede the common flow or adding complexity to the original flow. On the other hand, the App should offer easy and accessible means for users to solve extreme cases. For example, the user can ask the online service staff to help cancel or change the appointment manually. In this way, a considerable amount of human resources can be saved by transitioning most of the service to the App while providing a smooth experience for customers.

4.5.2 Result and changes

As a result, the information architecture was modified (see Appendix). Also according to the users' feedback as well as our heuristic evaluation, three main changes (Figure 4.14) were made: (1) *Cleaning reminder* and *Sustainability credits* features were removed due to low tendency or frequency of use. (2) No more preliminary condition questions for the users in sellback flow. The reason for having the preliminary condition judgment was to give the user a more accurate price. However, for the appliances, the core part, which is the most valuable part, usually needs professional examination when the user sells it back. The pre-judge answers from the user don't influence the price offer that much. (3) Two entries: allow two ways to do the same things. During the tests, some participants found it not easy to quickly navigate to where they want when they were trying it for the first time.

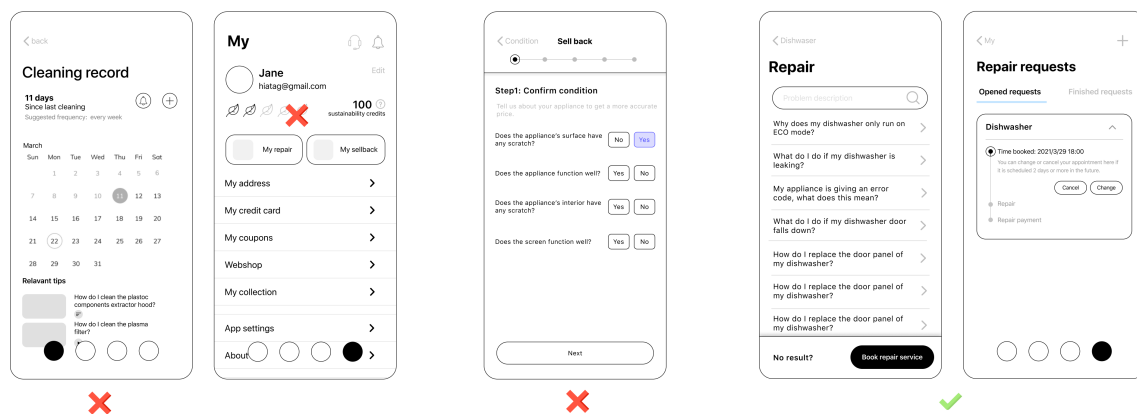


Figure 4.14: Changes after lo-fi prototype

4.6 Ideation round II

This section explains how the new feature subscription was came up.

It is not easy to create an innovative product just based on users' needs. To get more insights, designers sometimes envision the *future lifestyle* through a backcasting approach. Namely, to reframe the present and the future and bridge between them by designing interventions for the near future. In this project, a *sustainable future* is that the inner loops are more common than the outer loops. *The present* is the fact that ATAG already has a B2B subscription model. So for *the near future*, a new idea of a to C subscription service was generated.

A subscription service means that the supplier (ATAG) retains the ownership of the appliances and *selling the product as a service*. The users hence don't purchase the product at the original price but can still use the product through a more affordable monthly rent.

4.7 Stakeholder workshop with ATAG

As the pain points of the end-users were identified and broke down at the earlier stages, it is also essential to know what challenges are there from the company's perspective. The workshop aimed to figure out what forces are working against the three circular economy features (subscription/lease service, repair/maintenance service, sell-back service) and possible solutions to deal with the challenges. Due to the limited time, the group wrote down the barriers and discussed the solutions verbally. The subscription service was the main focus and took the longest time.

The participants for this 1-hour workshop include an innovation manager and a design manager from ATAG, as well as the two thesis members. The method *Barriers break down* [35] from the circular design guide is used to define the challenge and brainstorm the possible ideas.



Figure 4.15: *Barrier break down* worksheet from the workshop: subscription service

For the subscription(leasing) service, the participants mentioned that there is already a subscription B2B model. But for the use on an individual level, the barriers fall into 6 categories: (1) User's attachment. People prefer buying to renting sometimes because they don't feel attached enough to the leased products. (2) Product condition. Products could be unclean or damaged when they are returned. (3) Trust. Customer trust remains a crucial component in developing loyalty to the brand [36]. The two managers mentioned that they don't want the customers to think they pay too much for the subscription, neither think that it is more cumbersome to go through the related process or contract. (4) Transportation costs, There will be many deliveries that happen when the new subscription order is placed or when it reaches the deadline of the contract. How to arrange the delivery due to the consideration of sustainability and cost is a challenge. (5) Partnership. Alone by ATAG cannot make this subscription model work. Some partnership between other companies is in need. For example, the insurance company, logistic company, housing corporation, or cleaning company. (6) Marketing. It is also a challenge to identify for which customer this is a good solution and conduct the target marking. However, it was noticed that although the barriers were identified by the participants, it was not easy for them to brainstorm the solutions since the firm hasn't started transitioning to the circular model.

4.8 Evaluation and refinement

"*How to solve the barriers identified during the workshop and design the subscription service for individual use?*" is the main question that will be answered in this section. Considering the scope of the project, only the first four barriers mentioned in the last section will be further discussed.

How to make people feel more attached to their leased product?

Consumer-product attachment is also understood as the emotional bond consumer experiences with a durable product. One of the reasons that many people prefer to buy products than leasing one is because the emotional bond is much stronger when they have ownership of the product. To simulate the degree of customer-product attachment, the designers are suggested to design products that evoke enjoyment (by improving the usability, incorporating surprise into products, or supporting the accumulation of memories), or facilitates associations between the products and users, place, or events [37]. Other than this, another factor that stops people from leasing products is sometimes the leased products only allow for limited service, while with purchased ones people have more choices. For example, the Warranty issues.

For the subscription service in this app, the following features were refined: (a) Upgrade, Purchase, extend/terminate the contract. Users can easily upgrade their products to the newest model (might incur extra expense) without waiting for the old contract to end. In addition, they can purchase the product after a period of leasing, which makes full ownership. Moreover, the contract is also flexible to be extended. With the options being given, the usability is greatly improved, hence evoke enjoyment during the whole experience. (b) Energy consumption and carbon footprint tracking. This will strengthen the association between the products and users, as well as users and the "energy-saving" or "low-carbon life" events, which could hence increase the emotional bond. (c) The leased products allow for the same repair service as the purchased products have. So the users won't feel being constrained when using the leased products.

How to keep the condition of the product as good as possible?

People tend to take more care of the products they buy because the salvage value belongs to them. However, if it is a leased one, the user may spend less effort on maintenance since the salvage value belongs to the lessor company instead of herself. Murthy [38] pointed out 3 ways to deal with potential asset abuse problems for the lessor. Specifically, by charging a larger lease fee to cover the loss, providing maintenance service (a service lease or a full-service lease), and covering specific problems via provisions in the contract.

In the ATAG app case, the third way is used, by specifying the cleaning responsibility as well as penalties when the users place a subscription order on the webshop, and when they first access a subscribed product on the app. The idea is to encourage people to take their part of the responsibility by reminding them of the consequence.

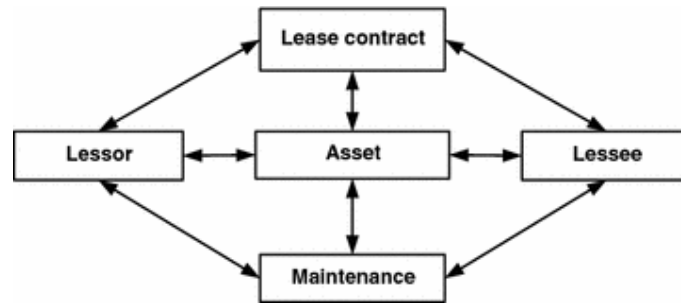


Figure 4.16: Key elements for maintenance of leased items [38]

How to reassure users about the subscription model?

Here the subscription means that the user pays a monthly fee to gain access to the appliances or related services. The two managers mentioned in the workshop that they don't want the customers to think that they are paying too much. In fact, The subscription model, in which that the supplier(eg. ATAG) retains the ownership of the products and "selling the product as a service" [13], is supposed to benefit all stakeholders that concerned and even the economy as a whole [14]. Because other than the benefits to the supplier, the consumers do not need to pay by themselves for any supply for the products or components that might be expensive. To reassure the users about the subscription model, communication and strategies are needed to raise the awareness that the subscription model actually helps people save money and time, and will finally contribute to sustainability.

Since the subscription ordering happens on the webshop, no prices will be shown in the app. But the app enables previewing the subscription functions by providing a demo product. Namely, users know what to expect there before they place a subscription order. The trust is built when they realize how convenient the subscription services are, and how little difference there is compared to buying a new product.

How to minimize cost of delivery out of both environmental and economical consideration?

The delivery needs to increase accordingly as the appliance subscription service arises, which brings both environmental and economical costs. But there are ways to minimize the cost, for example, the supplier can set more warehouses. For the app, since it allows for bookable services, the delivery routes can be arranged properly according to the time and distance to minimize the cost.

After analyzed the notes from the workshop as above, a more clear picture of how would the subscription service work between the end-user and the company was formed. The flow of how the subscription service works are visualized as Figure 4.17. The subscribed product is delivered from ATAG to the user after he/she placed a subscription order on ATAG's webshop. The App assists the user on the daily use as well as on supporting services like terminating the contract, upgrading to a new model, booking repair service, and providing cleaning tips. Products may be transferred between the user and ATAG. But it will finally go to the next user.

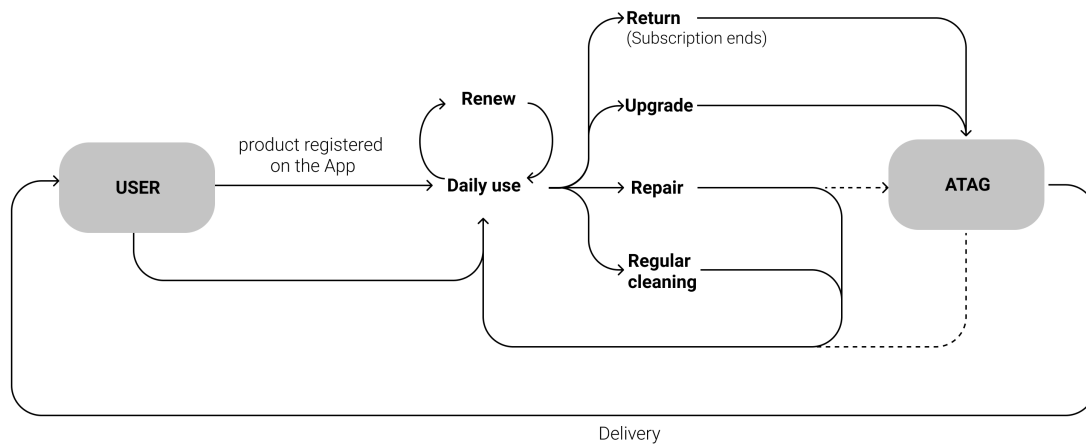


Figure 4.17: Subscription flow

4.9 Hi-fi prototype and usability testing

After implementing all the identified improvements above from the lo-fi tests and finishing all the hi-fi screens, the second round of usability tests was planned and conducted. There are 10 participants in total, each test session lasts 30-40 minutes. To eliminate the interference of previous knowledge about the app thus detect problems from the novice experience, the participants recruited here are those who have not been in the lo-fi test.

The Hi-fi usability testing aims to get feedback on the subscription flow, which included five tasks. After each task, there were several questions. The tests ended with a list of post-test questions. Specifically, the five tasks were: (1) Check the detailed information of a subscribed appliance. (2) Terminate the contract. (3) Extend the contract. (4) Upgrade the appliance. (5) View the energy consumption screen.

All the participants managed to complete all the tasks, In general, they thought the mobile app has made the subscription items easier to manage compared to if only with the website. However, some faced a few confusions and problems during the process. In summary, there were three main points as following that need refining:

Feedback. Since most of the features include a step-by-step process, it's important to display necessary information the user filled in/saw from previous steps to reduce the memory load.

The old energy consumption screen cannot effectively motivate energy-saving behaviors as expected. Some participants reflect the current screen may let them notice the consumption states of the appliances but that they still have no idea how much is too much or what to do to save energy, " *I see the numbers... but I don't know*

what I can do with the numbers".

Error prevention. Some confirmation information was missing for a few decision-making actions like payment or upgrading, like *"When I am at the confirmation screen, this is no model/price information that I can make the final check."*, which makes the users feel they do not have sufficient information to continue.

According to the feedback, the screens were refined.

5

Results

This chapter presents the results of this interaction design project. Namely, how the user experience and interface design solve the research question in multifaceted aspects. Features that aim to close the loops in different cycles will be explained and illustrated with the final design. The chapter starts with an overview of the whole service flow, and then followed with screens designed by us.

5.1 Overview

This App focuses on the after-sale services within the whole product consumption cycle, which implies that most App usage happens when they already have the appliances product, hence there are no shopping features involved in this app. Namely, it doesn't intend to replace the current online webshop, on the contrary, it means to supplement the "after-sale" services by supporting scenarios such as repair, sell-back, and subscription. In these different scenarios, the App facilitates users with trouble-shooting, encouraging users to reduce energy consumption. Elaborately, once the appliance is added/registered on the App (automatically is the product is purchased/subscribed directly from ATAG, also manually if the products are acquired from other channels, for example, second-hand market), customers can check the appliance information, access the services on the app. However, the purchasing action only happens on a webshop. In a few cases when purchase-related information is displayed, such as when seeing an electronic component in the repair instructions, a shortcut of "go to the webshop" will be provided. The user can navigate from this shortcut button to the in-App browser of the ATAG online webshop.

The service people are also pivotal stakeholders of this App, who follow up the requests once being placed. They will use a management platform to monitor the process, confirm the situation, and further send out technicians to diagnose the problem on-site. The information will be sync on both the enterprise's end and the customers' end. When a broken appliance is diagnosed for a certain problem by a technician, a problem diagnosis report will be logged in the system and presented on the customer end. It is noteworthy that, the enterprise end product is beyond the scope of this project. Only the customer end product will be further presented as the following.

5.2 Four tabs

We kept the old structure of the App but redesigned the UI. 5.1 shows how the four tabs look and feel.

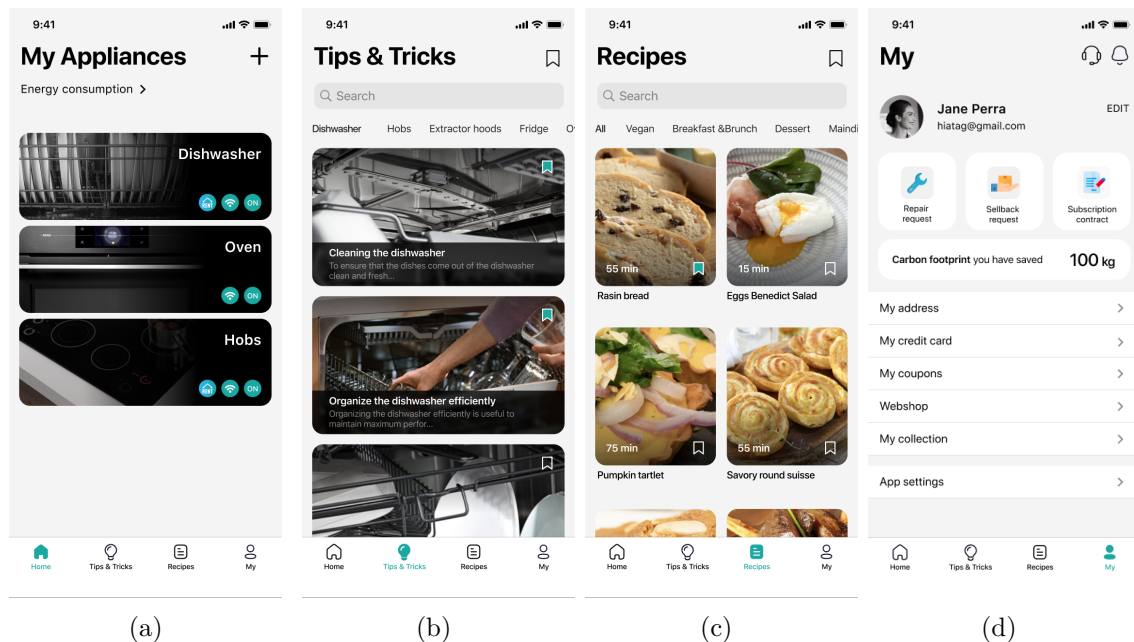


Figure 5.1: Four tabs: (a) Home (b) Tips and tricks (3) Recipe (4) My page

5.3 New features

Three circular features are designed to integrate on the App. On a basis of not interrupting the original structure, these new features provide easy and accessible customer services including repair, sellback, and subscription (lease and pay by months). Among them, the repair is an existing service, while sellback and subscription are newly designed.

5.3.1 Home appliance screen

Figure 5.2 shows the home screen and interface when the user click on a certain appliance.

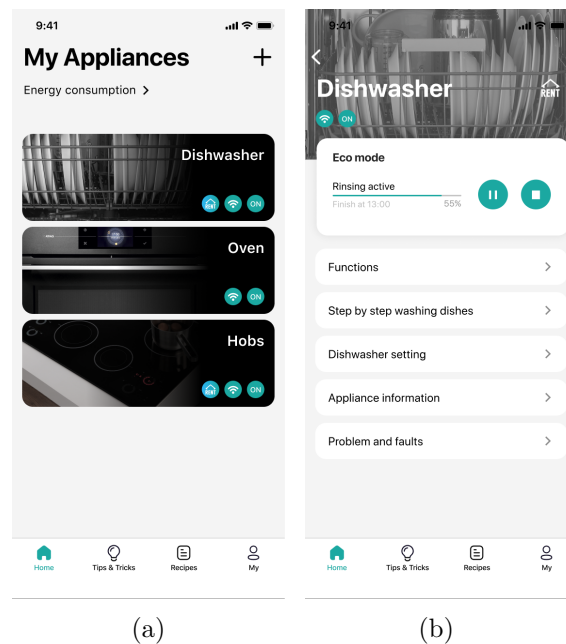


Figure 5.2: (a) Home screen (b) Dishwasher screen

5.3.2 Repair

Repair service is already available on ATAG's website (but not on the App), which includes two separate parts: *Use and Maintenance* and *Technician visit*. In the new App, the two separate parts are merged into one flow, specifically by encouraging the users to check the possible errors themselves, and then book a technician visit if the error is still not solved.

The instructions list for trouble-shooting (content from ATAG) aims to support users with diagnosing or repair by themselves, instead of reaching out to ATAG instantly when a problem occurs, due to that some minor problems could be solved by the users themselves if given enough information. If users couldn't find the matching solution or the solution doesn't work in some particular cases, there's a "book repair service" button to reserve professionals to visit. To complete the appointment, the users walk through the information filling-in process step by step. The interfaces are shown in Figure 5.3.

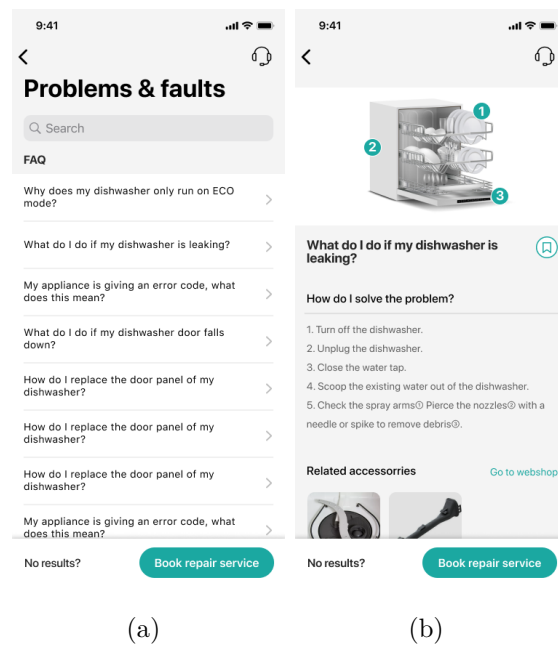


Figure 5.3: (a) Problem faults (b) Repair instruction

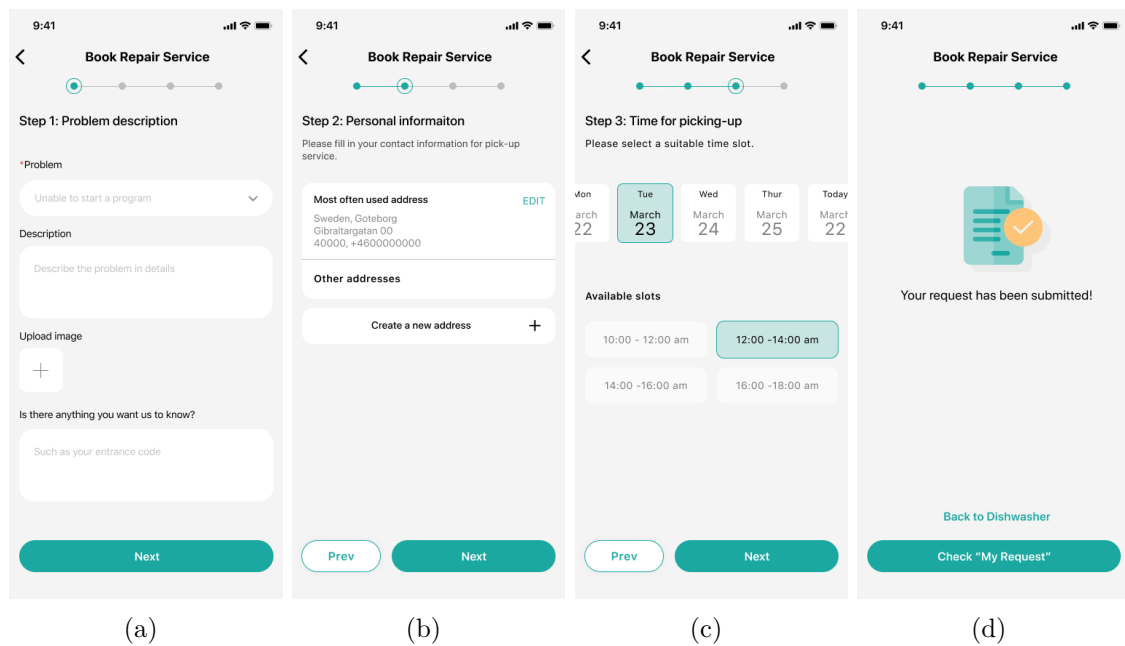


Figure 5.4: (a) Problem description page (b) Contact details page (c) Date selection page (d) Request successfully submitted

After filling in the reservation information including problem description, contact, address details and expected visiting time, the user can submit the repair request and wait for the technician to visit. On the submission screen, the user can easily navigate to the process tracking page by pressing the *check my request* button.

On the process-tracking page, the present stage of the repair flow is presented. If within two days ahead of the booked date, users can change or cancel the request. Otherwise, users will need to contact customer service to manually changing the appointment. After the technician's visit, the appliance will be repaired at home in most cases. Then the user needs to pay for the bill to finish the request case.

This feature corresponds to the maintenance cycle in the circular economy system diagram [13]. Through this cycle, the product and resources will go back to the users, but with a prolonged lifespan. It decreases new purchasing behaviours.

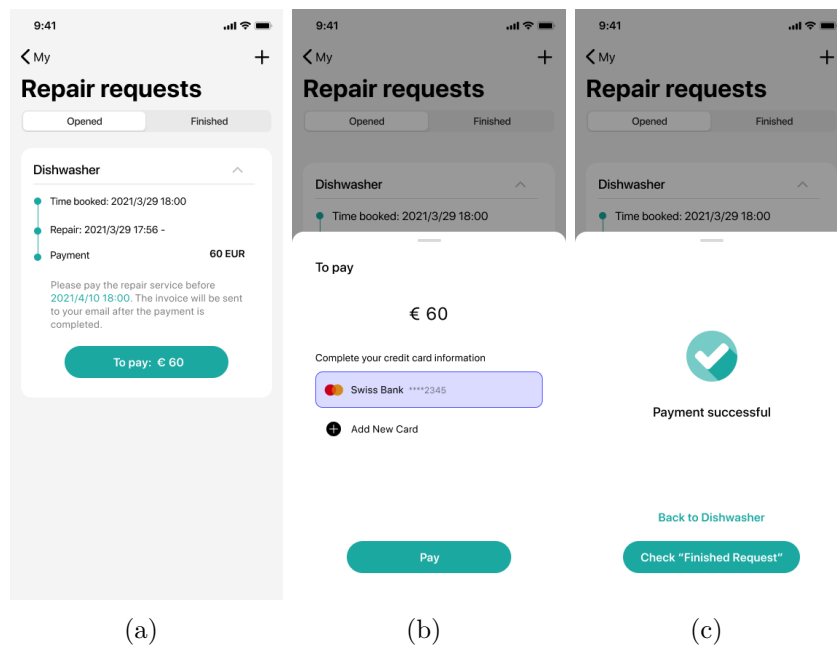


Figure 5.5: Check repair request: (a) Repair request process (b) Payment (c) payment success

5.3.3 Sellback

Sellback feature associates with two loops, the refurbish/remanufacture and the recycle loop, in the circular economy system [13]. On the customer end, they display in the same format, which is selling the product back to the same company to earn appropriate economic profits, in this case, brochures or refunds. The company end will evaluate whether the appliance should be refurbished or recycle based on its conditions. And the condition determines the price, namely, how much refund the user will get from selling it. After the evaluation, the appliance will be reoriented to the most suitable circular cycle, and continue its service time. The sellback feature enables better utilization of the products' surplus-value, through refurbishment on products or core components.

The sellback feature can be accessed at the appliance information page, see Figure 5.8. The value information card displays the original price when buying and the

estimated price based on the used time. Below the price information are the sellback button and a short line "what is sellback" in which users can find an explanation of this function.

To sell back the appliance (Figure 5.6), the user fills in the form similar to the repair flow. But instead of a visiting time, the user should choose a time for the technician to pick up the appliance. After completing the form, the sellback request will be submitted and the technician will come as scheduled. As is different from the repair service, in sellback flow the user is informed of the estimated price range before moving to the next step. The user can choose how the money is refunded, the amount refunded by coupon will be higher than the option of refunding to a credit card. However, this process doesn't require the user to decide on it immediately. The user can choose one of the refund avenues after the appliance is received and evaluated by the company.

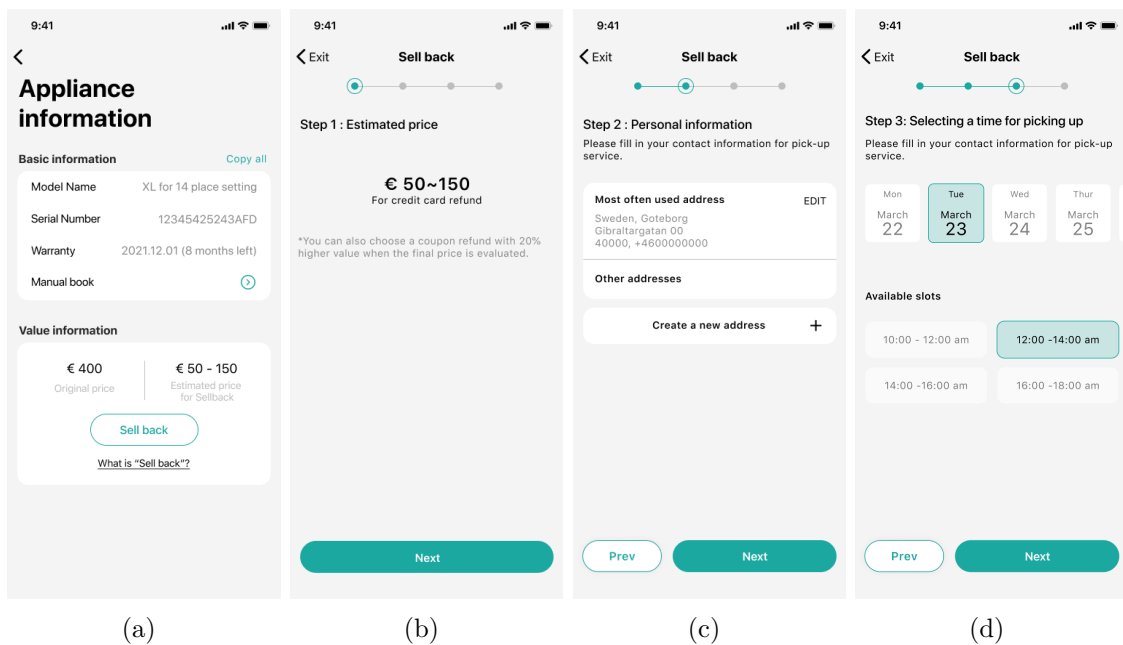


Figure 5.6: (a) Appliance information for subscribed products (b) Estimated price for selling back (c) Personal information (d) Selecting a date for picking up

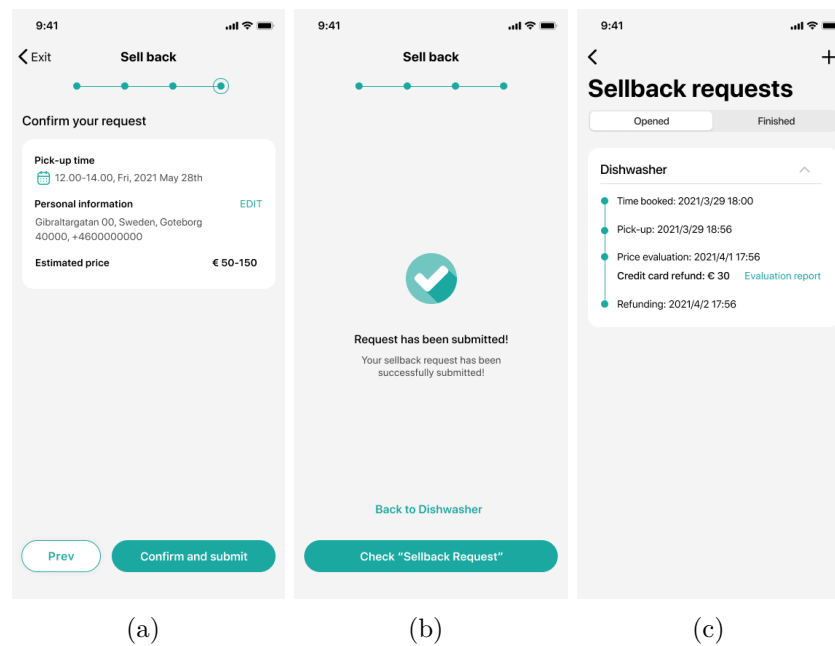


Figure 5.7: (a) Confirm the sellback request (b) Request successfully submitted (c) Check the sellback request

5.3.4 Subscription

Instead of ownership, in subscription service users lease the appliances and pay the rent by the month. During the subscription period, the repair service above still applies. The subscription feature aims to maximize the lifetime of products in the system.

To start a subscription, the user first goes to the webshop and place a leasing order by selecting the product he/she wants. After the order is placed, the appliance model type, the subscription duration, and the user's basic information will be declared in a digital lease contract. Besides, the appliance will be registered in the user's account and will be delivered to the user's home in a few days. From then on, all the follow-up services can be accessed on the App. Namely, the webshop is only for ordering new appliances, while the App serves for the day-to-day scenarios from controlling the appliance to repair.

After each lease, the appliance can be cleaned and reconditioned to continue its next duty. The subscription model makes better use of the resources and reduces unnecessary purchase behaviours, hence decrease waste. Besides, A subscribed product is available for the same service as a purchased product has.

To distinguish the subscribed product from purchased ones, the appliance card on the *my appliances* page is tagged with a small icon with a rent indication. Moreover, the *appliance information* screen for subscribed products (Figure 5.8) is different, too. Instead of value information specifying the estimated value of the used product,

contract information is presented. Underneath there is *other options*: upgrade and purchase.

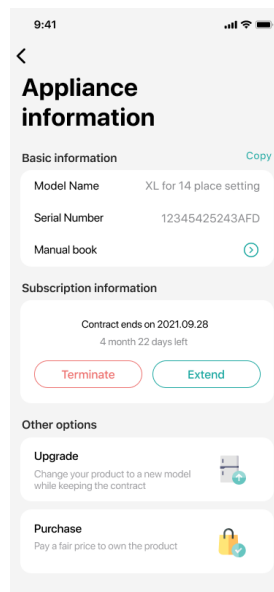


Figure 5.8: Appliance information screen for a subscribed product

When a user first accesses a subscribed product, there are onboarding screens (Figure 5.9) showing the responsibility information as he/she was told when placing the order on the webshop. Besides, there is also guide for new users.

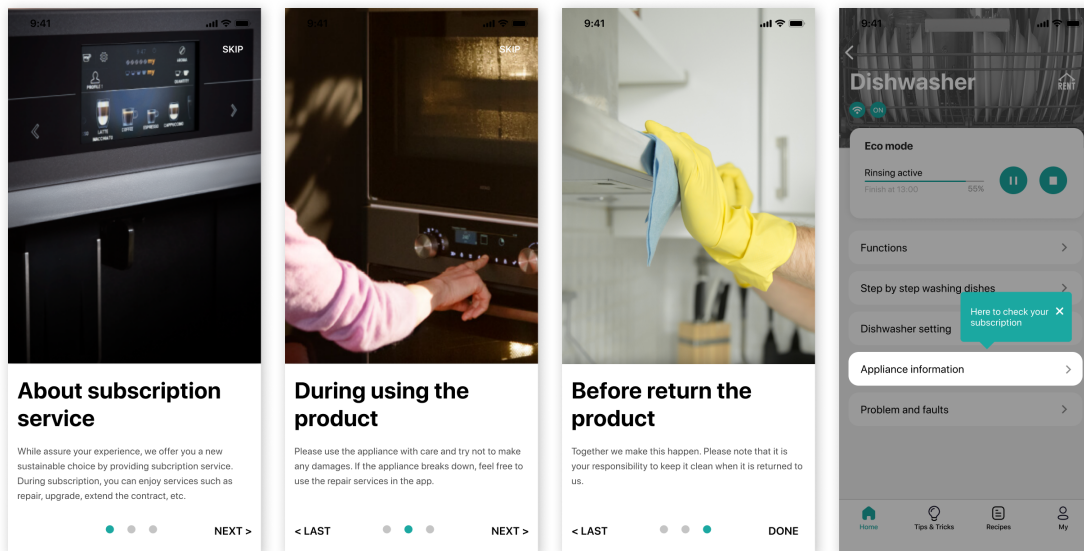


Figure 5.9: Onboarding screens for first-time accessing the subscribed product

Terminate contract

When the user no longer wants to have the appliance at home. A return process is

triggered by the *terminate* button on the appliance information page. When terminating the appliance ahead of the contract time, the user has to pay a compensation fee. This happens when the user gets a discount for placing an order for a longer time in the beginning. This progress can be seen in Figure 5.10. A terminate request status tracking will be displayed in *subscription contract* once the request is submitted. As always, users can change the booked pick-up time within a few days or cancel the request. In the contract list, the current status of a contract's request process is presented, which gives users a quick overview of what's going on. *Terminate contract* allows for two entrances. One is from the appliance information page, another is from *My page* where all the subscription contracts can be found, see Figure 5.11. By entering the subscription contract page and long-pressing one contract, the user can terminate multiple contracts at once (same for the *extend contract*). For novice users, there will be tips telling them what to do.

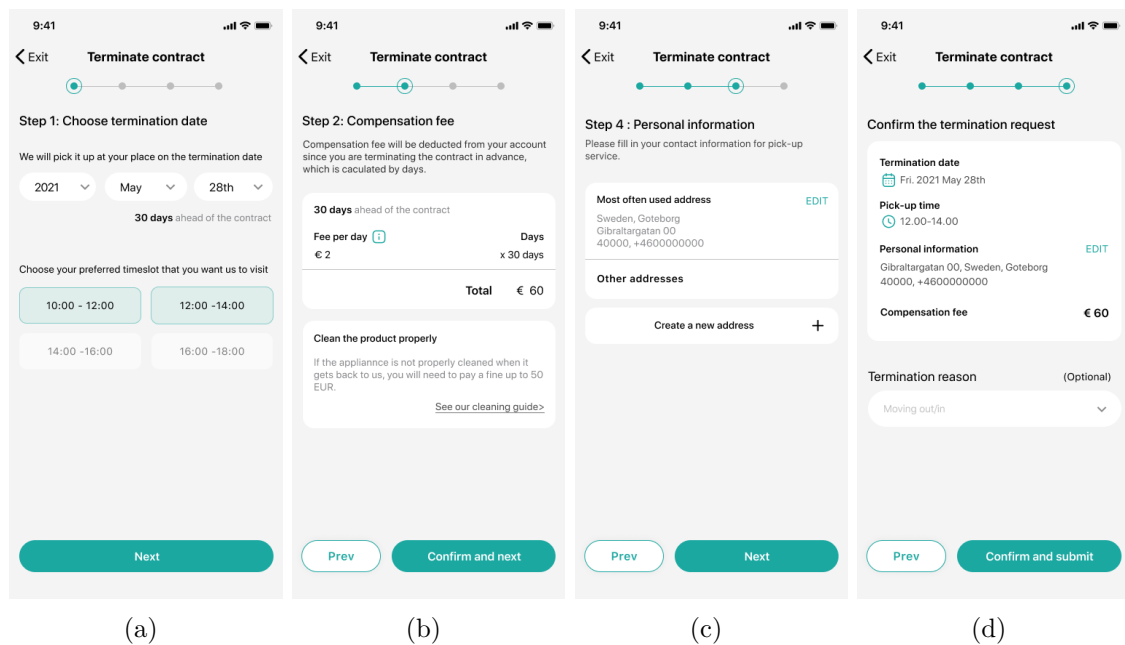


Figure 5.10: Terminate contract screens: (a) Select termination date (b) Compensation and fine description (c) Personal information (d) Confirm the termination request

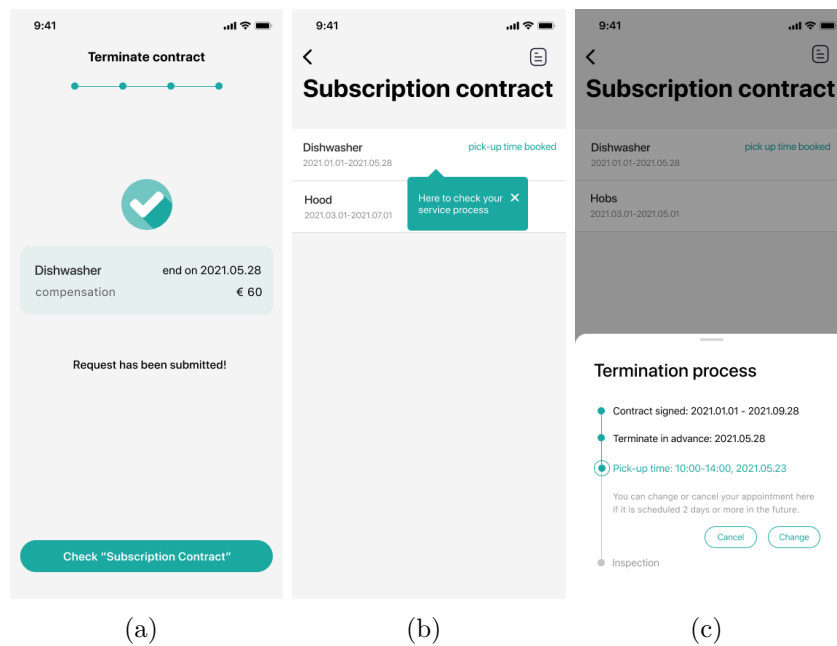


Figure 5.11: Check termination process: (a) Request successfully submitted (b) Subscription contract with on-going process (with a tip for first time users) (c) Termination progress display

Extend contract

Extending contracts is also possible. When extending an appliance contract, only two steps are needed - first selecting the date to extend to, secondly confirming the request. The expense will be displayed later accordingly. Extension summary can be checked in the *subscription bill*, where gathers all bills of the subscribed appliances. The extended ones will be marked with *extension* tags. The Figure 5.12 shows an exemplar for extending two appliances' contracts.

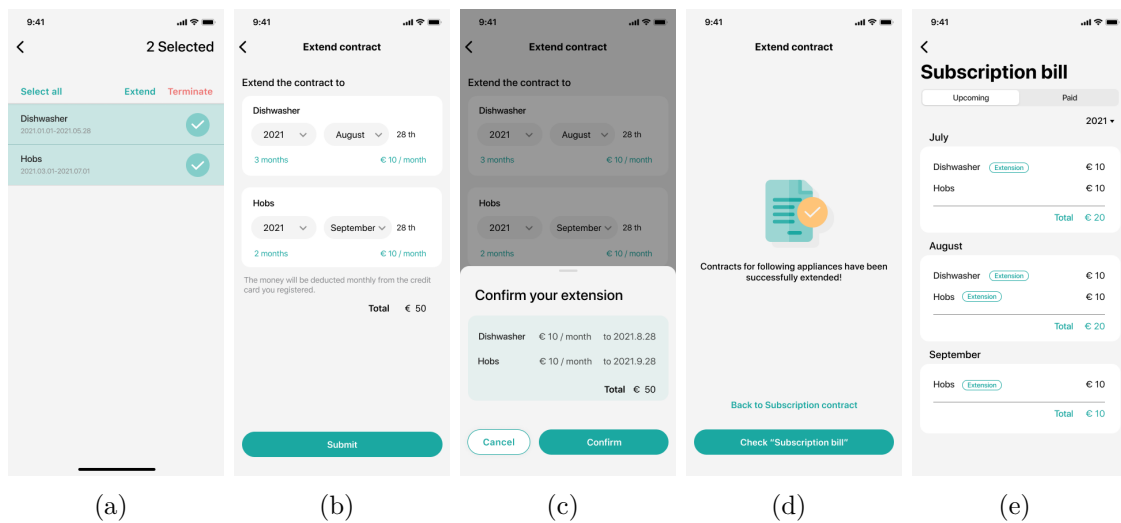


Figure 5.12: Extend contract screens: (a) Select appliances (b) Select extension date (c) Confirm the extension (d) Extension request successfully sent (e) Subscription bills

Upgrade

Users can also upgrade their subscribed appliance to the latest model at a reasonable price. This feature adds flexibility for those who want to try the newest product out. This function is accessed from the *appliance information* page. When upgrading an appliance, users first select a model, then select a date for the staff to bring the new appliance and take away the old one. Once completed, an upgrade request generates. The process tracking is also available on the *subscription contracts* screen. An example of upgrading a dishwasher is shown in Figure 5.13.

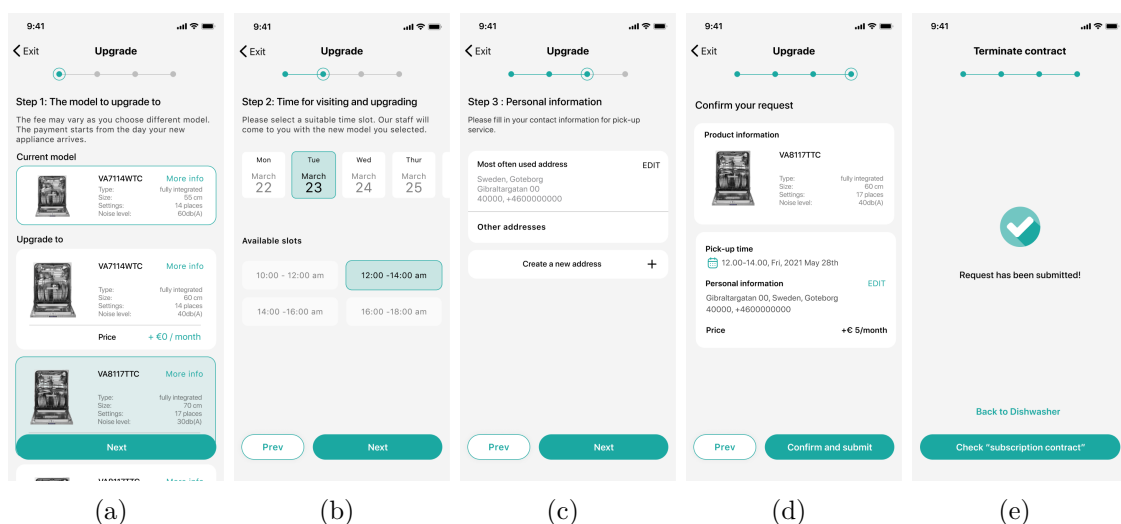


Figure 5.13: Upgrade screens: (a) Selecting appliances (b) Selecting a time to exchange the appliance (c) Fill in address (d) Confirming the information (e) Submitted

5.3.5 Energy consumption/carbon footprint tracking

To motivate users' sustainable behaviours, some new features were added. The most obvious one is the energy consumption visualization that presents how much energy, especially electricity, the user has used (Figure 5.14). The total energy consumption is displayed in the form of a bar chart. On top of the graph, the user can switch from three views - day, week, and month, to get different scopes of overviews. Below the bar graph, the energy consumption of each ATAG appliance is displayed. Users can quickly realize which of them is using too much electricity. And based on the consumption pattern, energy-saving tips and tricks are presented as followed. For instance, if the fridge is using too much energy above average, relevant tips will be provided such as how to arrange the fridge storage properly to save energy. According to our usability test results, this feature is very helpful to users who like to quantify their daily life or care more about the figures and costs.

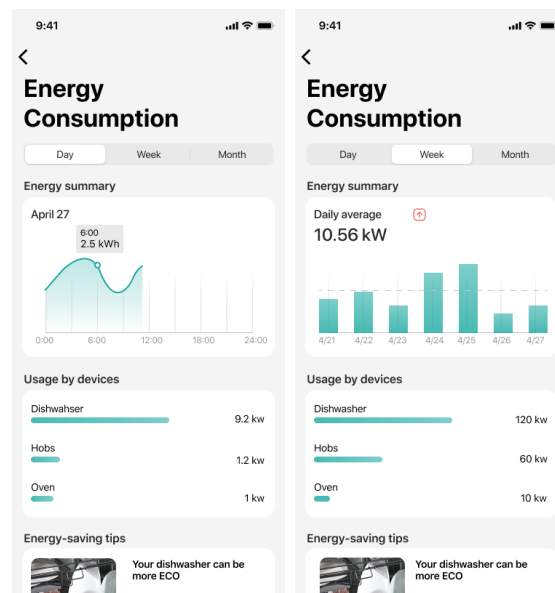


Figure 5.14: Screens: Energy consumption (daily/weekly)

Another circular feature is the *saved carbon footprint*, which can be found in *My*. A summary of saved carbon footprint is displayed in a small card (Figure 5.15). Users can switch from three different categories, corresponding to three ways to save carbon footprint, which are subscription, Using eco modes, and sellback & repair. *Saving* here means how much the users have saved compared to not using a certain service/function.

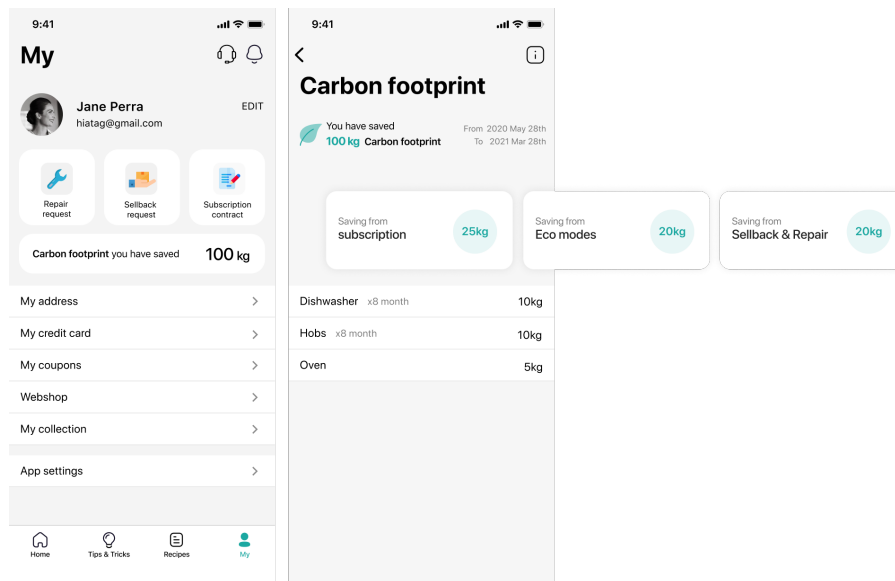


Figure 5.15: Screens: my page

6

Discussion

6.1 The process

Interviewees and participants

The interviewees and participants in this project were not constrained to ATAG customers. The reason was that according to the competitor analysis, Apps on the current market barely have CE features. So to seize more CE opportunities in people's kitchen appliance use, whether a person is an ATAG user was not considered as a requisite when recruiting participants in semi-structured interviews or usability tests. Moreover, considering that the kitchen is a necessity in modern life and almost everybody has one, such a service should include the whole society. Everyone exclusively is a potential user of the circular services ATAG will provide.

Scope and reflection

As the project aimed also to refine the old features, the original *ATAG connected life* App was thoroughly evaluated at the initial phase of the research, including a usability evaluation on all the interfaces. This also explained why cooking habits and recipe questions were asked in the survey and the interviews. However, as the research further developed, the team narrowed the scope and focused on designing new CE features instead of redesigning the whole App. Due to features such as remote control is considered to be irrelevant to CE, we decided not to refine and improve them. As a result, the old structure of the non-CE features was kept and only the UI was refined to create a unified product style.

Limitations due to COVID-19 pandemic

Due to the pandemic situation, the plan of going into people's kitchens and observing their behaviors could not be carried out. Besides, most of the interviews and usability tests were conducted through phone calls or online video meetings. This resulted in a lacked context that involves the user, thereby desired observation results were missing such as people's operations and understanding of the connection between the physical products and the digital system. However, The design team had done more preparations to ensure the quality of each semi-structured interview. For example, the question list was visible to the interviewees during the sessions, in case of an unsteady internet connection. In the usability tests, people's cursors were observed. Their hesitation or wandering was noted down and asked for a fur-

ther explanation after they finished each task. Thus, some unsaid problems hidden behind people's actions could be revealed too.

6.2 The design

Balance the flexibility and complexity

One of the main reasons that lead to care-free consumption habits is the motive of Marketers' profit maximization [39]. While circularity sometimes in most cases means sacrificing some profit for the near future. One of the insights is to simplify the steps and bring flexibility to the end-users when they access the services. However, this could meanwhile increase the complexity for the enterprise. For example, in the design, users can extend their subscription contracts but for a higher price each month as they want, which makes the company not able to plan ahead for a certain item, neither arrange the next user it would go to. This naturally brings more uncertainties. Although a more advanced algorithm for assigning the products could solve this problem, upgrading the system also costs a lot. Therefore, how much flexibility the users have heavily depends on the company's willingness to increase the complexity of the system.

IoT and CE

The Internet of Things(IoT) is the concept of connecting any device to the internet and other connected devices. The "things" could be embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. IoT could play a vital role in the future, for example, sensors can be installed in products to track lifecycles and processes of the services. The data monitoring will facilitate the maintenance and maximize the lifespan of the products. Although this project didn't concern any IoT solutions due to the scope, a trend was clear that IoT will accelerate the digitalization of the CE in the near future. For ATAG, IoT will be a facilitator of product-service solutions as suggested herein.

Potential impacts of promoting CE

It was pointed out by some researchers that promoting reuse and refurbishing could have unintended impacts such as delaying or crowding out innovation for inventing newer, more energy-efficient products. However, this could also be a strong argument that indicates the importance of exploring new CE opportunities. Taking ATAG as an example, by developing the subscription model alongside the traditional sales business, more financial flexibility could be allowed for the enterprise to adjust the enterprise structure and strategies, hence better looking for breakthrough opportunities.

6.3 Future work

Circular Economy communication with end users

The realization of CE needs the end-users to take their part of the responsibility. It

is of vital importance to communicate the concept, connotation, as well as influence with the end-users so that they will have an accurate understanding and further take actions. The user studies done in this project have found that people interpreted CE very differently. Many have been interpreting it simply as specific events or behaviors such as recycling or energy conservation. Many other end-users think there is too little that they can do about CE in appliance usage. Some believe the responsibility of circularity lies heavily on the product engineering and manufacturing sides. This project barely touched on how to make accurate communication of CE the concept itself. Instead, the broad concept was broke down into different circles with which the users are more familiar. In the future steps, strategies and tactics need to be considered to transform the terminologies people are familiar with to a consciousness of contributing to CE.

Modular design of appliances

Modular design improves the repairability of the product along its lifecycle, and eases processes for module assembly, disassembly, return, further refurbish, and reuse. However, for electric appliances, especially build-in ones, the users tend to be unable to do effective maintenance due to the technical barrier. In the future, appliances could enable more user-friendly maintenance work on the end-user side. One possible way is to separate the core modules and non-core modules to lower the risk and difficulties for users to repair or replace the components at home. Besides, modular design also allows for easy assembly and upgrading with new techniques in the remanufacturing process, thus avoid obsolescence.

A platform for Multi-brand appliance subscription

The project focuses on how the App could assist only ATAG in the transition from the linear model to a circular model. Based on the insight of facilitating the B2C subscription model by a mobile App, here the team pictured a large scope of a similar idea: An appliance subscription App that supports products from different brands. With more choices of different brands and appliances, this platform will be more attractive to the end-users, and the CE concept will be advocated to a larger range of people.

7

Conclusion

The project aims to answer the research question:

How to design for a mobile application that facilitates circularity in the usage of ATAG kitchen appliances and promotes users' sustainable behaviours?

The answer to the research question is based on an iterative design process including desk research, user research, design solution exploration, and evaluation. The finding is a list of tips including *finding CE opportunities, using nudges, utilize the app as an intermediate platform between customers and company,*

Finding CE opportunities through both desk research and field studies

Ideally, Many brilliant CE opportunities could be identified in each cycle. But before turning them into features of a mobile App, the pain points from field studies in both customers and company sides should be considered. Looking into the supply chain as well as talking to appliances users in their kitchen could reveal the most practical areas. Besides, the factors that evaluate the usability of mobile applications (simplicity, accuracy, time taken, features, attractiveness, and safety) [40] also exclude some inoperative and ineffective opportunities.

Nudging the users to take up their responsibility

The subscription model, which stands for *use instead of ownership* as disruptive thinking, has been previously embraced by many big firms as a B2B model. When it is applied in the individual term, the degradation incurred by improper use or carelessness could be a big obstacle. To raise the awareness of the customers about their responsibility for products throughout the products' service lives, hence making the transformation happen, some useful ways were identified to nudge the users:

- ***Specifying the responsibility and reminding the consequences***, which prompts individuals to reflect on the consequences of their actions. By clarifying the consequences (penalty or credits) of not following the instructions or not properly cleaning via provisions in the contract and on the onboarding screens, the users may feel more motivated to take up their part of the responsibility.
- ***Raising the visibility of users' actions***. This method is originally used

to leverage the *spotlight effect* which makes the user realize or even overestimate the impact of his or her behaviours, thus promoting behaviours. In this project, it was employed when designing the carbon footprint screen and energy consumption screen. Sometimes people don't change their behaviours only because they cannot see the influence they could make by changing. The mobile app is a good platform to visualize the data that provide valid feedback hence promote behaviour change and perception reinforcement.

- ***Subliminal Priming.*** Prolonged exposure to a stimulus can effectively activate non-conscious goals and trigger the desired behaviour more likely to be performed. Integrating the CE features on a daily used mobile App prime the circularity concept subliminally when people are using the App.

The App as preliminary support before the customers reaching to the company

Ideally, from the customers' perspective, the App helps achieve greater efficiency when customers access the services. and works as a preliminary trouble-shooting and guidance tool before the customers directly reach out to the company. Namely, when problems occur, the users should be firstly check in the App instead of directly turning to the company.

Reduce the misunderstanding of "there is little that I can do" by providing CE information and tips

Our research found that people seldom think about their responsibility beyond ownership. Providing information like "what happens next to your recycled product" by telling the story of how the enterprise will employ in subsequent steps of CE could draw the attention and invoke reflection of the end-users. Besides, giving tips for energy-saving to the user when certain behaviours are detected (eg. tips on energy consumption screen according to usage stats) is another useful way.

As communication providing a "preliminary knowledge", enabling options that are away from the traditional throw-away Consumption model is a start point. Services like sell-back, subscription can close the loop and properly pass corresponding responsibilities to the end-users.

Using financial reward, emotional rewards and flexibility as incentives

With the stated options triggering behavioural change, incentives further retain the level of motivation. Financial reward (eg. sell-back) is an effective prompt for novice users, while emotional reward (eg. getting a sense of achievement through the carbon footprint screen) is more effective as they grow up to intermediate users and experts. Besides, flexibility as one of the factors of usability can also promote loyalty.

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A

Appendix 1

A.1 Consent form



I have received information and clarification about the interview and research. I can cancel the recording and terminate the interview at any time. Any personal information I provide will be confidential. The interview and transcript from this will only be seen and handled by the responsible researchers.

Please tick the below:

I have been informed about the research

I have received answers to my questions

I agree for the interview to be recorded

Signature: _____

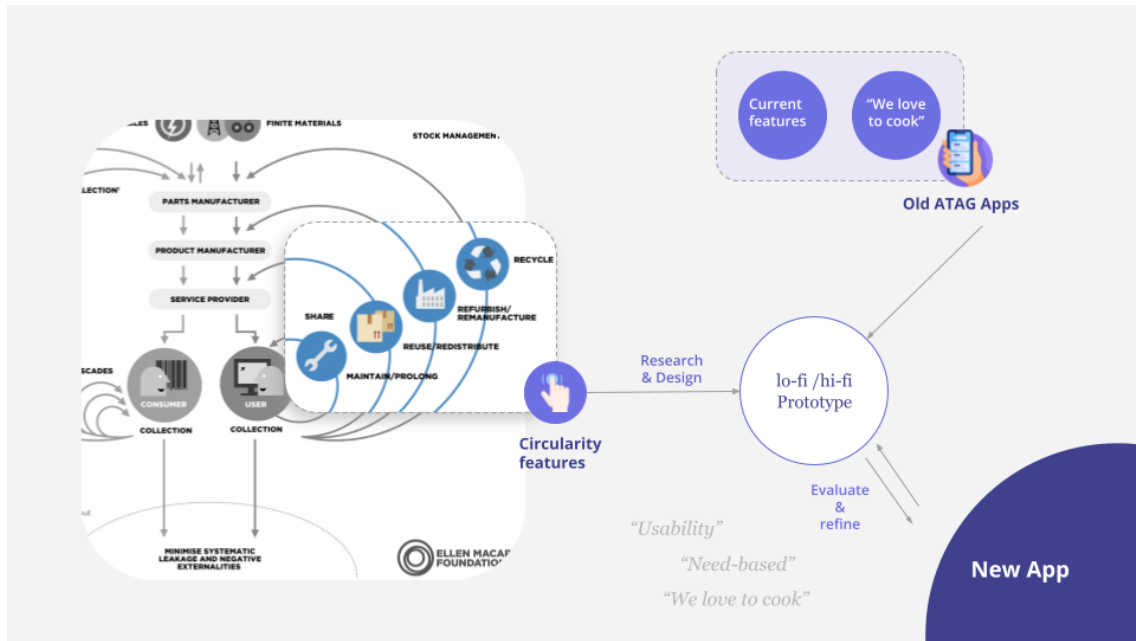
Date: _____

Full name: _____

Researchers: Siqi Li & Lujia Peng

Area of use: Master's thesis at Chalmers University of Technology & ATAG Benelux

A.2 Scope diagram



A.3 User research: Semi-structured interview

Questions

Cooking

In general

1. What kitchen appliances do you have in the kitchen?
 - a. What are the most often used and the least often used? why?
2. How often do you cook in your kitchen during the week?
 - a. Where do you get your meals when not cooking at home?
 - b. Do you cook more often during the weekend compared to weekdays?
 - c. Is there any difference between your weekdays' meals and weekend meals? How?
3. What do you enjoy the most when you use your kitchen? Why?
4. What do you enjoy the least when using your kitchen? why?
5. What frustrate you when you use your kitchen ? Why?

Recipes

6. Do you use recipes? where do you usually get recipes from? *Do you prefer text/image or videos?
7. How do you remember your shopping list when you buy the ingredients? *In your mind? on digital notes?...*
8. What cooking approach(eg. fry, steam, boiling, roast) do you use the most? why?

Problems

9. What problems/incidents have you ever encountered during the usage of kitchen appliances?
 - a. Among these problems, what happened the most often?
 - b. After that (problem), did you try anything to avoid it from happening again? Have you been extra cautious about (the problem)?

Cleaning

10. How important do you think keeping kitchen appliances clean is? please scale it from 0-5. why?
11. How often do you clean your kitchen appliances in general?
12. How do you do the cleaning? What kind of tools/ products you have used?
13. Do you think you spend appropriate time cleaning your appliances? why?
 - a. Do you think your cleaning covered every corner of the appliances?
 - b. Do you think your appliances work better after cleaning? or it's the same?

Management

14. Do you remember how long have you been using your appliances since you got them?
 - a. Is this information essential for you to know or be reminded of? Why?
15. Are you using any smart appliances now? What are they? How do you like the features?

Repair

16. Have your appliances ever broken down?
 - a. Which appliance and how it broke?
 - b. Did you have it fixed? or what did you do?
17. Have you ever changed any component of your appliance? (eg. the filter of the extractor hood)

- a. Have you ever referred to any instructions when doing this? where do you get the instructions?

Circular opportunities

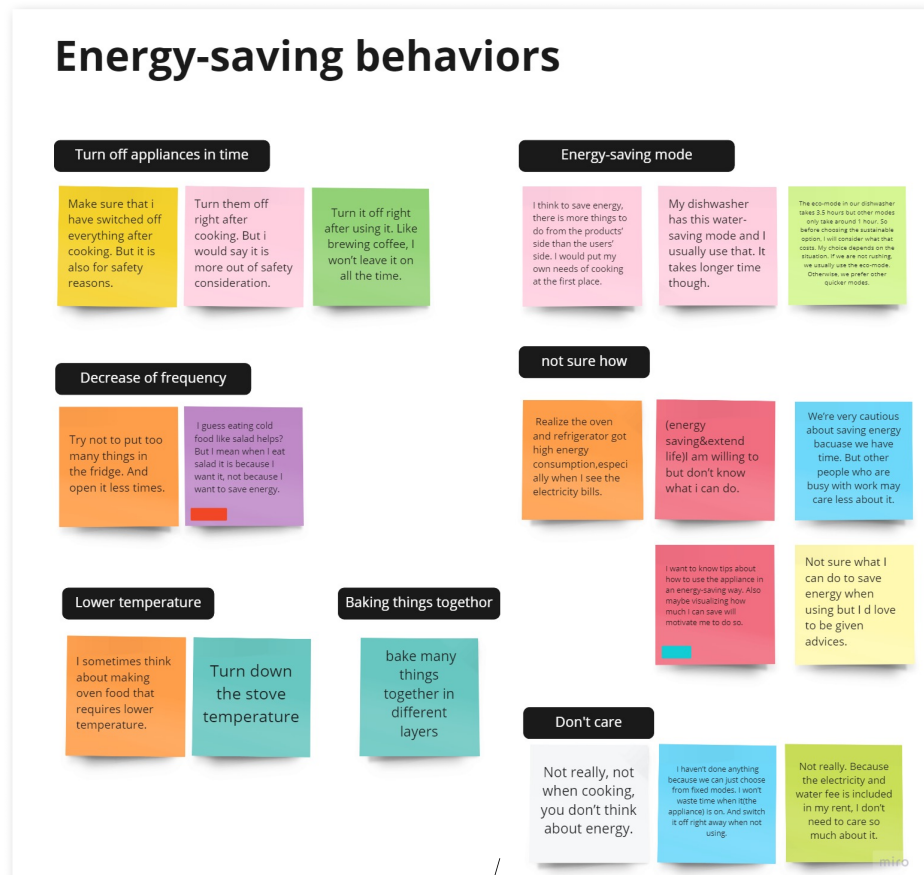
18. How important do you think sustainability is in kitchen appliance usage? Scale them from 0-5.
19. What have you done to extend the lifespan of your kitchen appliances?
20. What have you done to save energy when cooking?
21. What else do you think you can do about sustainability in your kitchen?

Interaction

Suppose you have a mobile application that helps you with kitchen appliances usage, We will have the following discussions around your expectation of this mobile app.

22. What are the features you want in this app? Please Name them.
 - a. Please list them from the most wanted to the least wanted. Why?

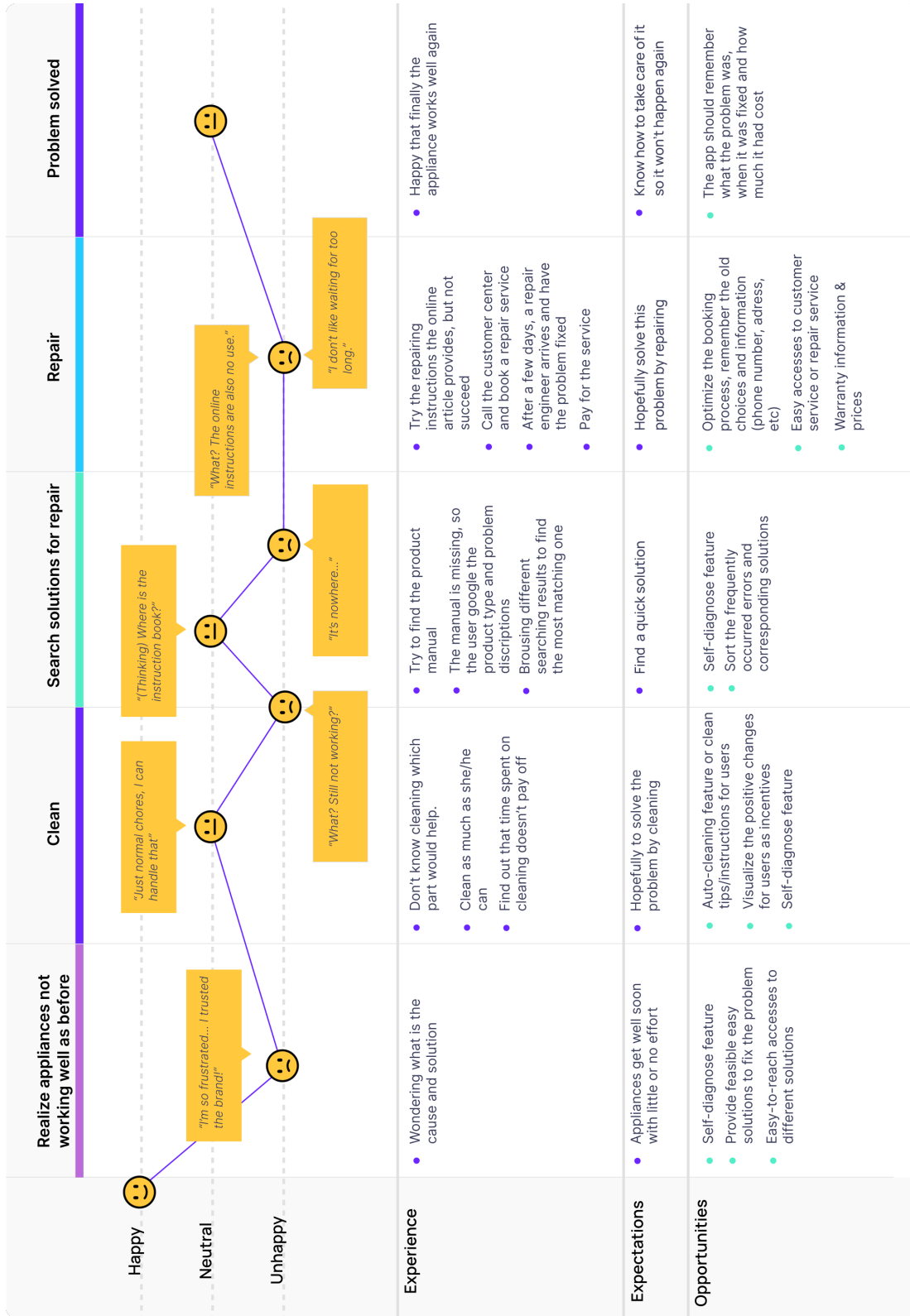
A.4 Interview results: Affinity Diagram (part)



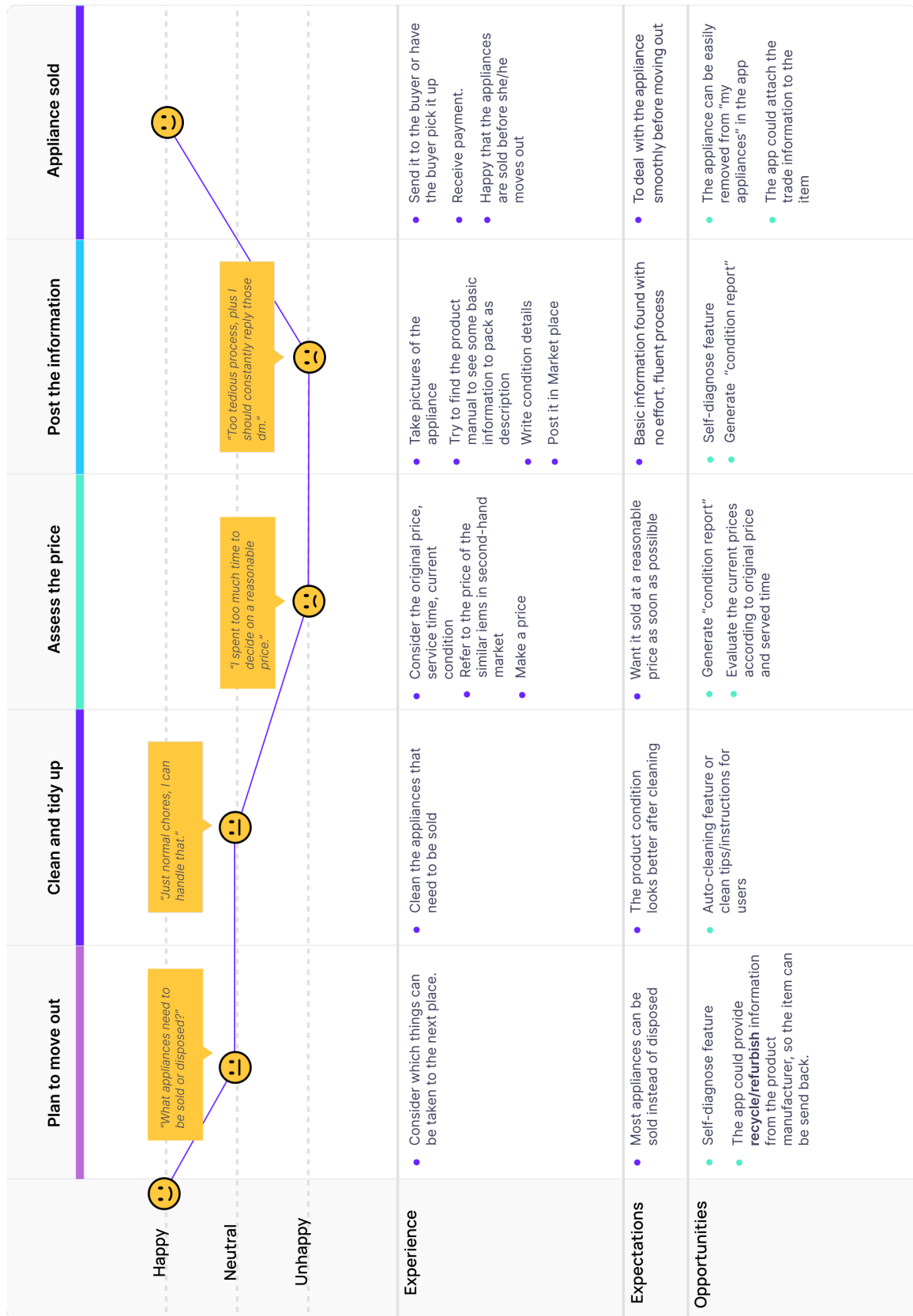


A.5 Define: User journey maps

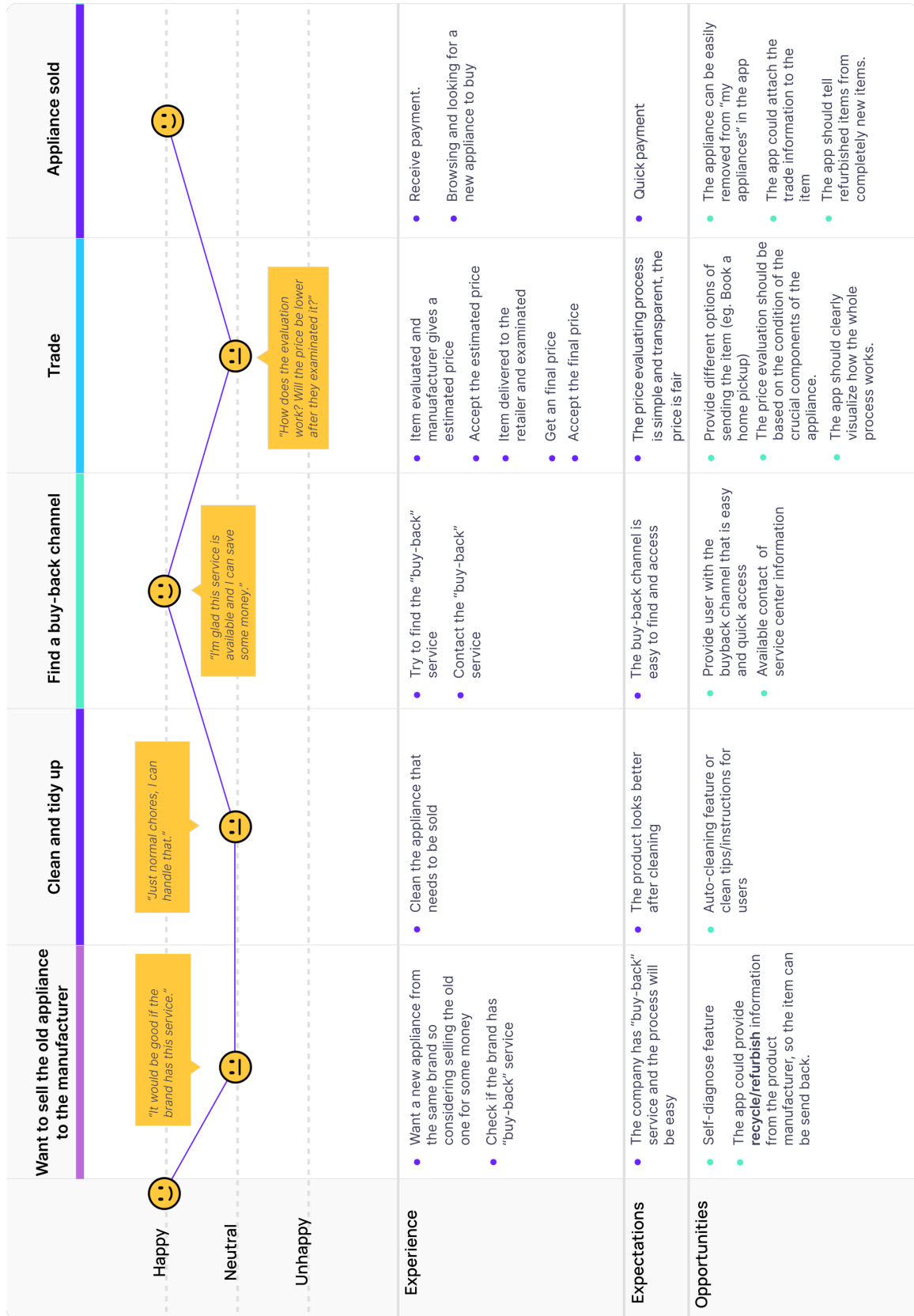
Maintain journey



Reuse journey



Refurbish journey



A.6 Heuristic evaluation: Jakob Nielsen's 10 general principles

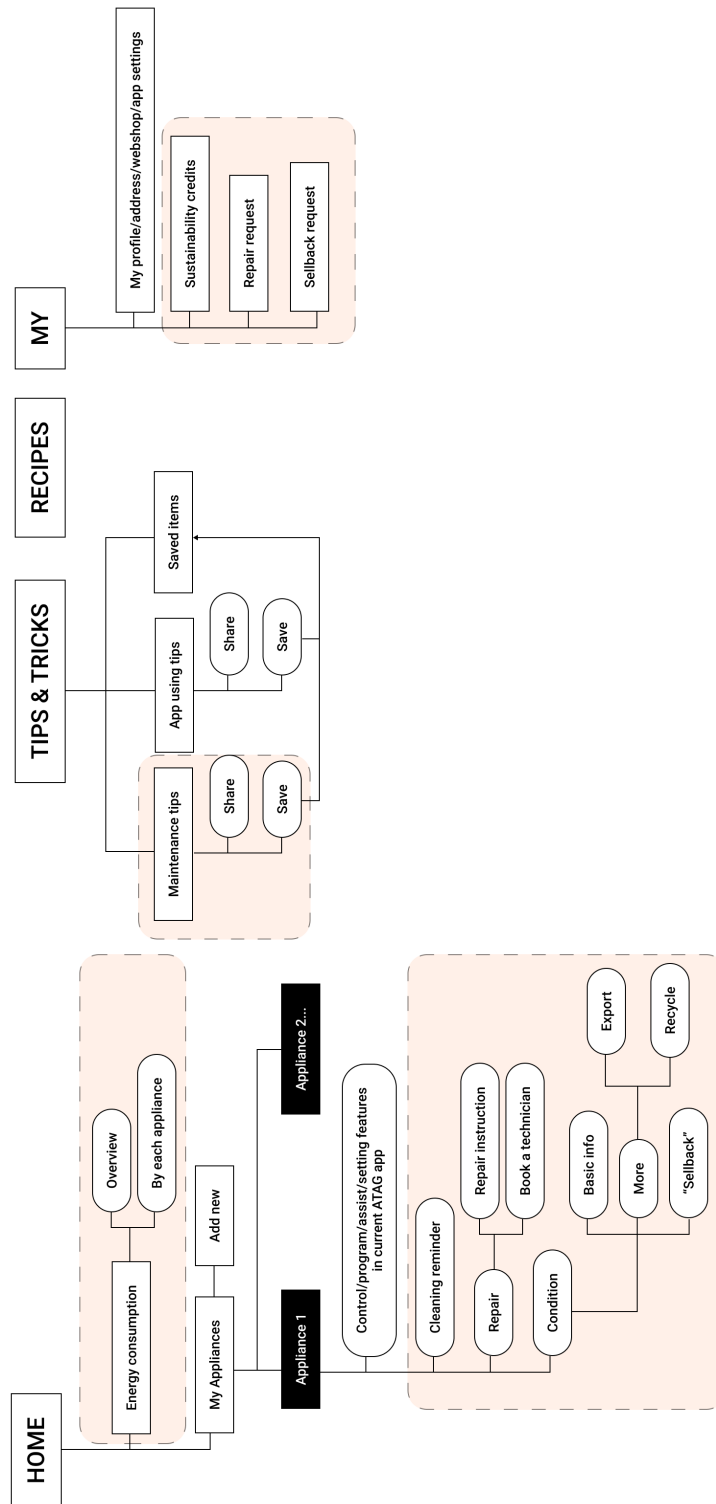
Jakob's Ten Usability Heuristics

by Nielsen Norman Group

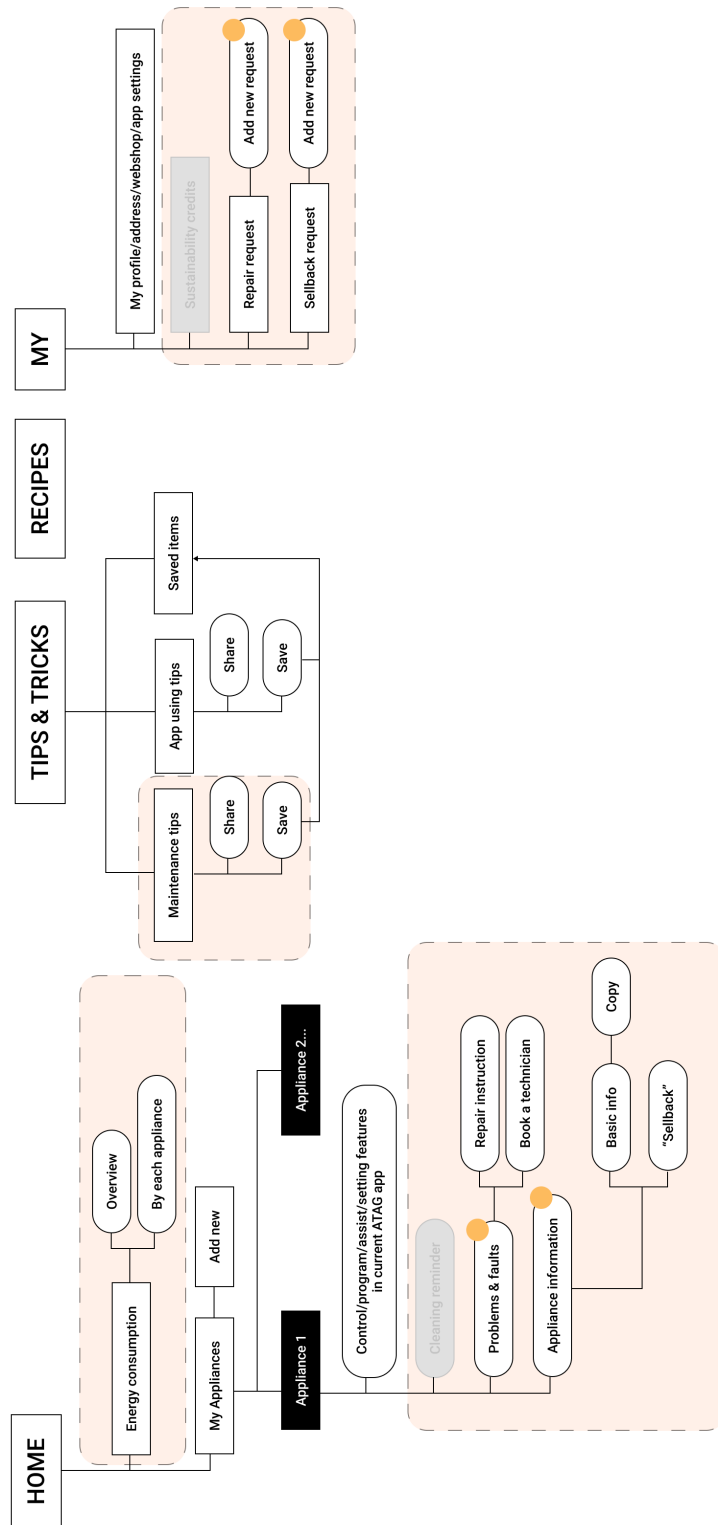
- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and standards
- Error prevention
- Recognition rather than recall
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help users recognize, diagnose, and recover from errors
- Help and documentation

A.7 Information architecture

Before Lo-fi tests



After Lo-fi tests



A.8 Stakeholder workshop: Barriers breakdown worksheets (repair service and sellback service)

Repair/maintain service

THE CIRCULAR DESIGN GUIDE

WORKSHEET

Barriers Breakdown

A4

This worksheet will allow you to explore:
 What forces are working against you?
 How will you deal with these challenges as they come up?

I WANT TO AVOID:
 For example: losing customers, using toxic materials, a shared product getting damaged etc.

I want to solve issues by my self	I want to have a quick solution	If I want a new component, I want to order it easy and quick for a fair price
in general, self service is a goal. Avoid that people call ATAG too soon	I want to avoid too high cost for the company	

BRAINSTORM SOME WAYS TO AVOID THIS

Make clear the app has added value for guidance

but also appropriate support, 24/7 chat box

IDEO

miro

Sellback service

Copyright © Ellen MacArthur Foundation 2015

THE CIRCULAR DESIGN GUIDE

WORKSHEET

Barriers Breakdown

A4

This worksheet will allow you to explore: What forces are working against you? How will you deal with these challenges as they come up?

I WANT TO AVOID:

For example: losing customers, using toxic materials, a shared product getting damaged etc.



BRAINSTORM SOME WAYS TO AVOID THIS

idea: able to upgrade the product while refurbishing. New software, new paper manual, so it feels new

some transparency needed: what is the price we pay to the customer, what is the refurbished price?

www.circular.designguide.com

IDEO

© 2015 IDEO

miro

A.9 Evaluation: Lo-fi usability testing

Task

Repair flow

Suppose that now the door of your dishwasher is leaking, and you are going to refer to the app and find out how to fix the problem.

1. Please find the repair function

(the user has found the self-repair instruction)

According to the self-repair instruction, it seems to be a problem that you can't fix all by yourself.

2. What would you do to book an appointment with a technician on this app?
 - 2.1 upload a picture of your leaking dishwasher.
 - 2.2 tell him the entrance code of your building.
3. Check your request
4. Change your appointment and reschedule it.
5. ***Several days passed, the technician arrived as scheduled. And after checking, it was taken with the technician to the company for repair. As you can see on this page, there's a pick-up time under repair, do you want a guarantee with a maximum time here like "the appliance will be sent back to you within 30 days"? Or do you think it's more suitable to not be given info about when it will be fixed since the time is not sure?
6. Pay the repair fee

Questions:

- Is there anything you think is confusing?
- How difficult do you think each task is? (1easy - 5difficult)
- What do you care most about when you send an appliance to be repaired?

Sellback flow

1. You are going to sell back your old dishwasher, How would you do it?
2. Now your appliance has been picked up and sent back to the company for further inspection, please find out where you can get the final price and accept a credit card refund.
 - 2.1 The final price is lower than the estimated one, what would you do to find out why?

Questions:

- Is there anything you think is confusing?
- How difficult do you think each task is? (1easy - 5difficult)
- If you get 20% more by choosing to get a coupon, will you feel motivated to do so?

Sustainability credit

Please go to my page and check your credit. What do you think of it? Is there anything you don't understand?

Clean

In the action list, there's a "cleaning record" function, please try it out and describe what you can do with this function.

Post-test interview questions

- How would you describe your overall experience with the product?
- What did you like the most about using this product?
- What did you like the least?
- What, if anything, surprised you about the experience?
- What, if anything, caused you frustration?

A.10 Evaluation: Hi-fi usability testing

Purpose

Test the subscription feature

Tasks

Check the info

1. Now here's the homepage, suppose you just subscribed a dishwasher, now you need to go to the app and check this appliance info. Describe functions you see and how you interpret them. (*What do you think of the purchase function?)

Terminate & Extend

2. Now suppose you are going to terminate the subscription ahead of the contract time. What would you do?
 - 2.1. Check the process when you finish submitting the request.
(Appliance -> Termination -> Check the process)
3. Now suppose you want to extend the subscription of **Dishwasher** (for 3 months) and **Hobs** (for 2 months). Back to the subscription contract screen, what would you do to extend the subscription? (Contract -> check the subscription bill)

Upgrade

We also have this upgrade service, in which you can change your appliance to a new model without waiting for the contract to end.

4. What would you do to upgrade the appliance? (Appliance -> Upgrade -> choose the model that the user wants to upgrade to -> check the process)

Energy consumption

5. what do you think of the energy consumption page? do you think you will use it? Do you think it will help you save energy?

Questions after each task:

- Is there anything you think is confusing?
- How difficult do you think each task is? (1easy - 5difficult)
- How useful do you think each function is? (1not useful at all - 5 very useful)

Post-test questions

- Among the different functions you just tried out, which one do you like the most? why?
- How would you describe your overall experience with the product?
 - What did you like the most about using this product?
 - What did you like the least?
 - If anything, surprised you about the experience?
 - If anything, caused you frustration?