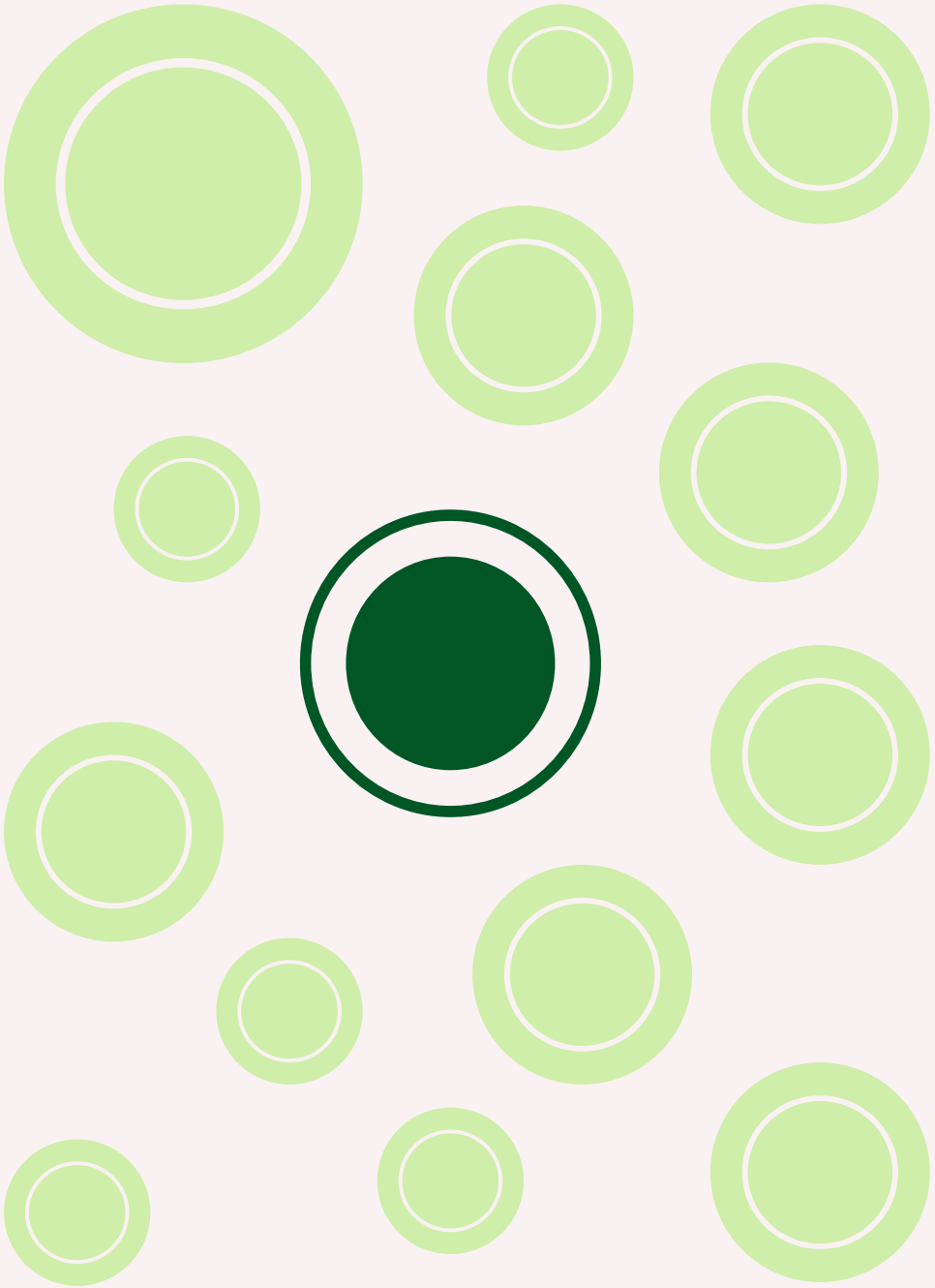
Designing dishwashing as a service at Oslo Airport terminal

Design for Interaction - Master Graduation Thesis

By María Gil Falcón



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Master Graduation Thesis

Designing Dishwashing as a service at Oslo Airport terminal

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ABSTRACT

This thesis focuses on developing a centralised dishwashing service with the goal of reducing the amount of disposable tableware waste generated at Avinor Oslo Airport. Moreover, the project aims to help Avinor Oslo Airport achieve its objective of becoming a zero-waste airport by 2030 (Avinor, 2023c).

The research process followed the Triple-diamond model (Design Council, 2024), facilitating a structured approach through mainly three phases: Understand, Ideate, and Develop. The 'Understand' involves the study of the literature review, analysis of existing practices, field research, and stakeholder interviews to gain an understanding of the context. During the 'Ideate' phase three concepts were developed and evaluated through iterative testing and feedback. Finally, at the 'Develop' phase, the final concept, Green Circles, is developed. Green Circles is a centralised dishwashing service for reusable takeaway containers, that allows passengers to drop the containers at drop-off machines at the boarding gates and airport exists.

The implementation of Green Circles is expected to significantly reduce single-use tableware waste at Avinor Oslo Airport. The study highlights the importance of stakeholder engagement, convenient passenger experience, and efficient operational integration. Broader implications suggest that similar services could be adopted in other airports, contributing to the aviation industry's sustainability efforts, such as those proposed by TULIPS (TULIPS, 2020).

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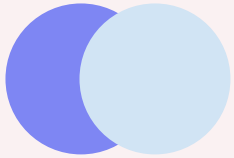
Introduction



This chapter serves as an introduction to the project, providing an overview of its context. Moreover, it introduces the research questions that drive the thesis and project approach.

1.1 Project introduction

Bellow, the context of the project is introduced.

Avinor Oslo Airport

Avinor Oslo Airport (Figure 1) is the **biggest airport in Norway**, welcoming 25 million passengers in 2023 (Statista, 2024).. The top nationalities among these passengers are Norwegian, Swedish, and British (Avinor, 2023a). Characterized by a **modern aesthetic** featuring wooden elements, the airport offers **36 dining options** where passengers can enjoy a variety of meals. However, the prevalence of takeaway has contributed to a significant environmental challenge, resulting in an estimated 160 tons of waste from disposable tableware annually (Avinor, 2023c).

Figure 1. Avinor Oslo Airport (Source: Avinor Oslo lufthavn)

Zero-waste horizons

To reduce its environmental impact, Avinor Oslo Airport has formulated a series of zero-waste horizons **for 2030,** as shown in Figure 2 (Avinor, 2023c). The overarching objective of the 2030 horizon is to reduce the waste generated by daily operations by 50% compared to 2022. Moreover, the overall ambition is to implement efficient waste management practices and foster a culture of waste prevention and reuse. The focus of this thesis project relies on the "**zero disposable items used**" goal. As an ultimate objective, Oslo Airport's goal is to eliminate the use of single-use within office spaces, workplaces, and dining areas. However, this thesis focuses on reducing the single-use items that come from the serving units of the airports' terminals, as this is where most of the disposable item's waste is generated (Avinor, 2023c). Consequently, the thesis project aims to create a centralised dishwashing service at the airport to minimise the use of single-use articles by passengers and encourage serving units to adopt more sustainable practices.

Additionally, Oslo Airport seeks to move higher on the **R-ladder** (see Figure 3). The R-ladder illustrates various circular strategies to move towards a more sustainable model (Potting et al., 2017). Strategies with lower circularity are situated at the lower part of the graph, while those with higher circularity are positioned at the upper part. The R-ladder provides a framework for prioritizing waste management approaches. In this thesis, the emphasis will primarily be on strategies from R3 and beyond, like re-use, reduce, or rethink.

HORIZON 2030: Zero disposable items used

Goal
Reduce the total amount of waste related to daily operations by 50% by 2030, compared to 2022.

Overall ambition
Ensure efficient, seamless waste management at the airport and create a culture of waste prevention and reuse

We are working for, that by 2030 in all of Oslo Airport...

- Zero usable items are discarded
- Zero food waste
- Zero disposable items used
- Zero incorrect sorting
- Zero vision for residual waste

HORIZON 2030+: No waste, only resources in circulation

Figure 2. Oslo Airport 2030 Horizons (Source: (Avinor, 2023c)

TULIPS

TULIPS is a project that facilitates the **transition to low-carbon mobility** and improves **sustainability at airports** in Europe (TULIPS, 2020a). Its main objective is to achieve zero emissions and zero waste airports by 2030, along with climate-neutral aviation by 2050. For this, TULIPS promotes innovative technologies and concepts that can support a transition towards green airports. To demonstrate that the transition is possible, various airports and institutions are partnering with the project (Figure 4). Among them, Avinor and TU Delft can be found. TULIPS has identified seven main challenges (TULIPS, 2020). These challenges have been organized into 12 workpackages, each with a unique goal. This thesis focuses on workpackage number 6 Circular Airports, which relies on implementing a circular management system and reducing operational waste generated by consumers and passengers.

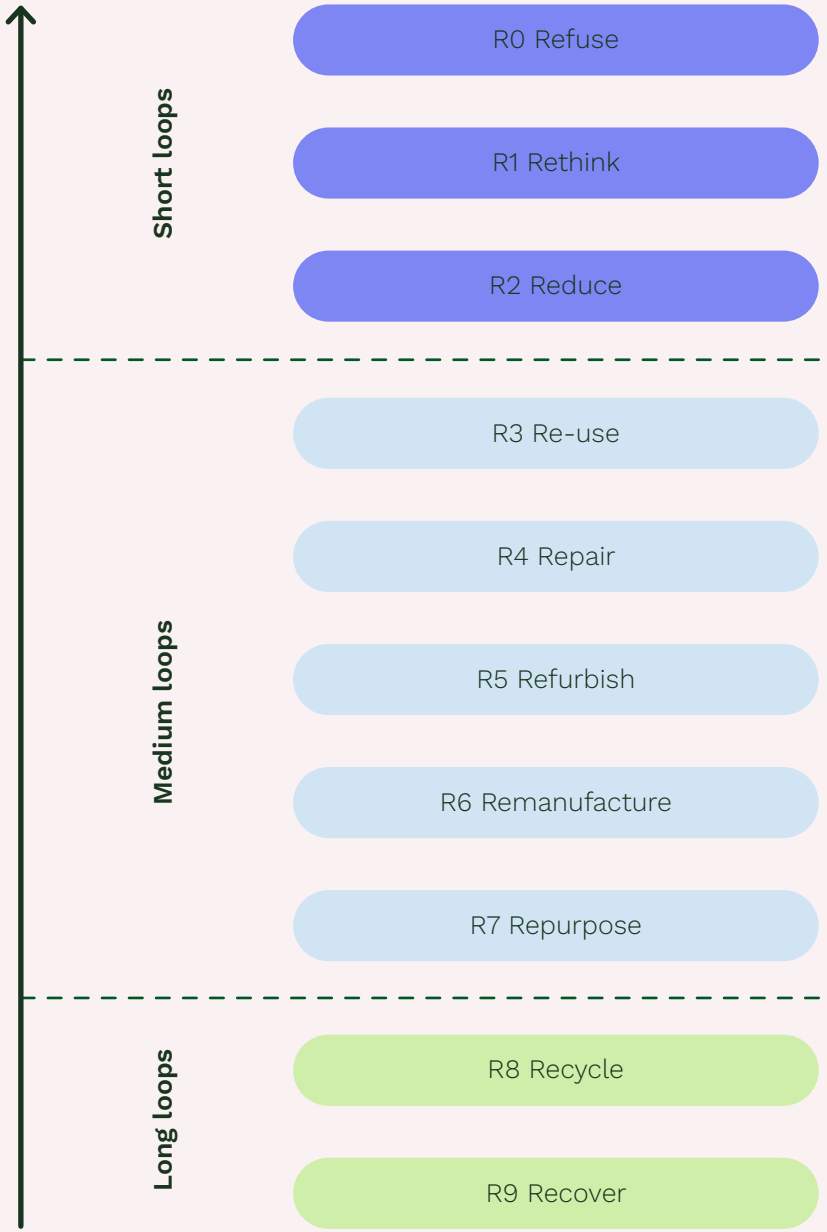


Figure 3. R-Ladder

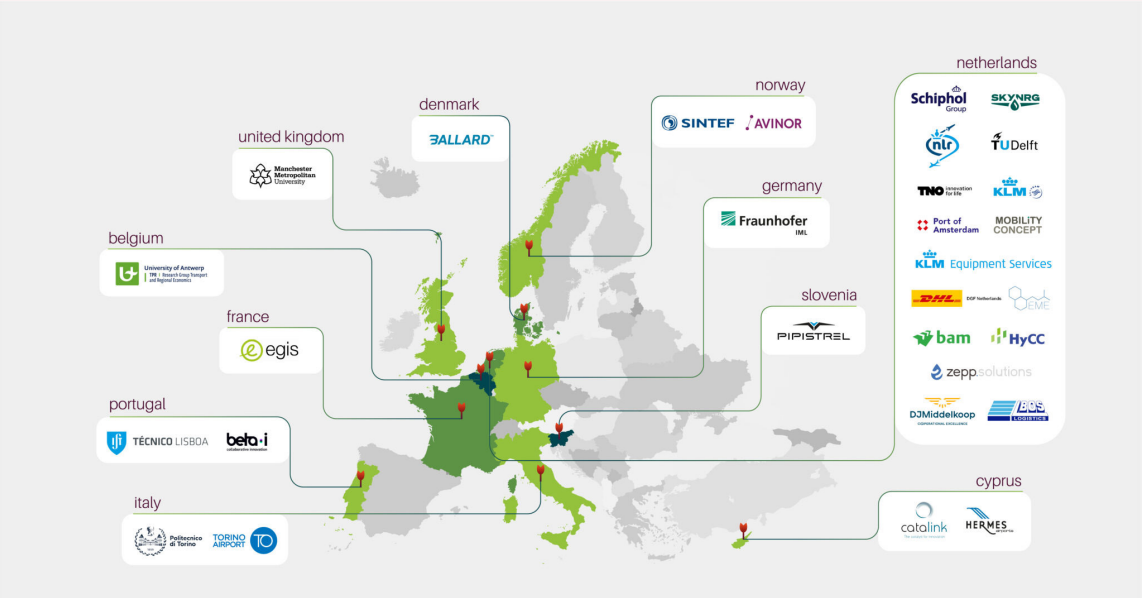


Figure 4. TULIPS Partners (Source: Tulips)

1.2 Design Brief

This part covers the problem statement and desired design direction, research questions, key stakeholders and the scope of the project.

1.2.1 Problem statement and desired design direction

Avinor Oslo Airport faces a significant waste challenge due to the **extensive use of disposable tableware** at the airport's terminal. The airport generates around 160 tons of waste from disposable tableware annually. However, 90% of all this disposable tableware is used within the premises of serving units (Avinor, 2022). Therefore, this thesis aims to address the excessive waste generated by disposable tableware.

In response to this environmental challenge, Oslo Airport is seeking solutions. Oslo Airport wants to explore the possibility of implementing a circular service that significantly reduces the use of single-use serving articles in the terminal, through the implementation of a **centralised dishwashing service**. Additional opportunities include enhancing consumers' dining experience while fostering a sense of environmental responsibility and developing strategies for behavioural change among both passengers and business units. Nevertheless, challenges include the need to understand why businesses with installed dishwashers still use single-use items or how the integration into day-to-day operations (times, routes, and redistribution) will work.

1.2.2 Research questions

This research aims to explore implementing a centralised dishwashing service to address the waste generated by single-use tableware within the terminal. As there is a lack of comprehensive understanding regarding the necessary requirements, operational implications, and stakeholder preferences related to such a service, this study aims to bridge this gap by addressing the following research questions:

MAIN RESEARCH QUESTION 1

Is it feasible to set up a centralised dishwashing service?

- What are the needs of commercial units and what equipment is required to support the implementation of a centralised dishwashing service?
- How can this service work in day-to-day operations?

MAIN RESEARCH QUESTION 2

How can this service be used to tackle single-use take-away?

- Why do business units use single-use tableware for guests staying on the premises?
- What are the factors influencing passengers' preference for single-use articles?

1.2.3 Stakeholders

Given the diverse stakeholders involved in the project, each possessing unique **interests** and **levels of influence** as shown in Figure 5, it seemed reasonable to clarify their role in this thesis. This allows to identify key players, understand their perspectives, and anticipate potential challenges or opportunities.

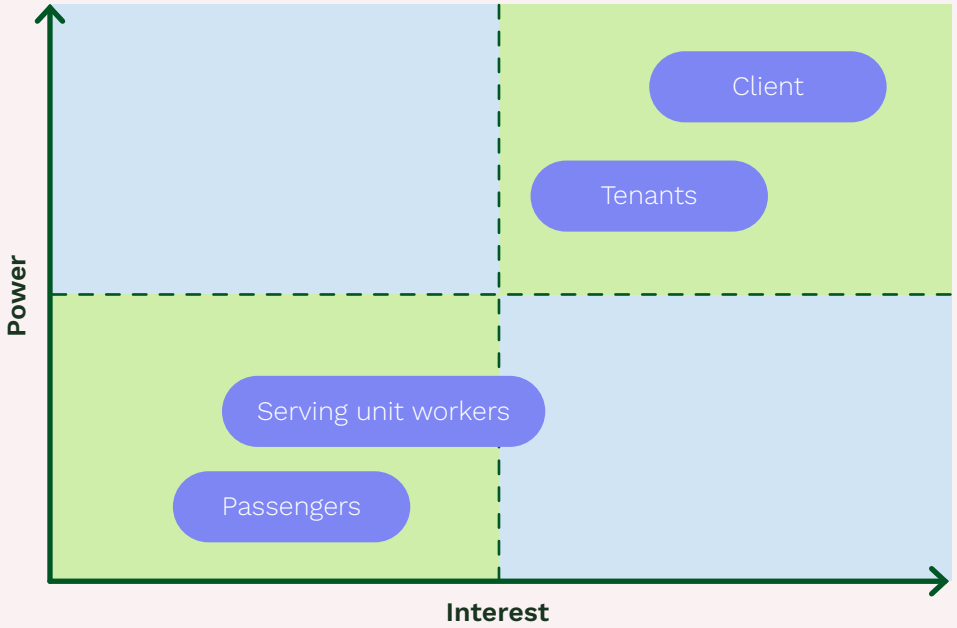


Figure 5. Stakeholder power-interest matrix

The roles of the stakeholders are:

Operating companies (Tenants):
The tenants are the companies that operate the different serving units at the airport. They need to follow the needs of each brand and also follow the rules imposed by Avinor.

Avinor Oslo Airport (Client):
Avinor Oslo Airport is the primary stakeholder and client for this project. They are interested in reducing the environmental impact of single-use serving articles within the terminal. Additionally, Avinor plays a pivotal role in addressing the financial considerations associated with the implementation of the service and acts as the landlord of the operating companies or tenants.

Serving Units (Restaurants, Cafes, Kiosks) workers:
These are the employees who work within the airport terminal at units that provide food and beverages to passengers. They have direct contact with passengers and are the ones that provide the disposable options to them. Moreover serving unit workers need to follow the rules of their operating company and brand.

Passengers:
Passengers are the end-users of the airport facilities and services. Their behaviours, preferences, and satisfaction levels are crucial factors to consider in the implementation of any new service, as they will directly interact with the reusable tableware.

1.2.4 Scope

The project focuses on the **Food and Beverage units** (F&B units) located in both the terminal's pre-security and post-security areas, particularly those using single-use tableware, as these units are the primary contributors to single-use tableware waste. Moreover, the scope includes passengers who order food at the terminal, since the waste is generated after their dining experience at the airport.

1.3 Project approach

The **Triple-diamond model** was selected to guide this project's development due to its effectiveness in fostering innovative solutions for complex problems (Design Council, 2024). This model, as shown in Figure 6, provides a structured framework that visually guides each stage of the design process, ensuring a comprehensive and holistic approach.

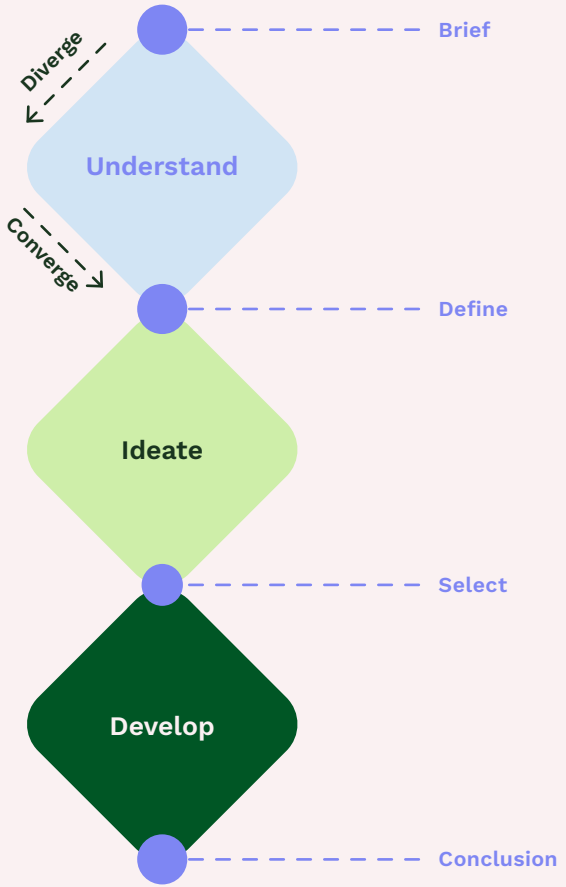


Figure 6. Triple diamond approach

The ‘Understand’ stage collects insights to gain a comprehensive understanding of the problem. The ‘Ideate’ stage consist of generating multiple ideas and concepts. Finally, during the ‘Develop’ phase the final concept is refined. Figure 7 presents an overview of the activities conducted in each diamond.

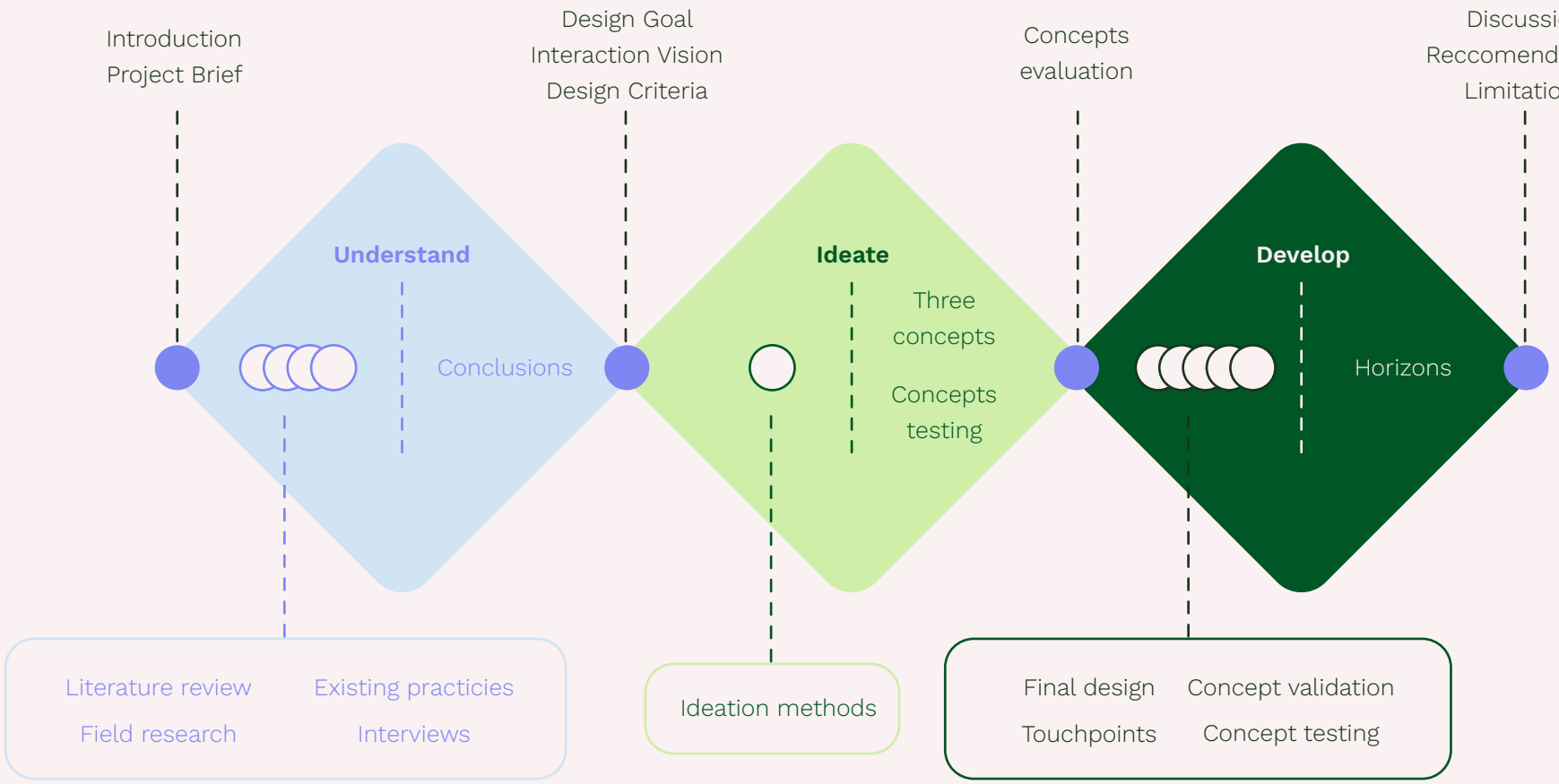
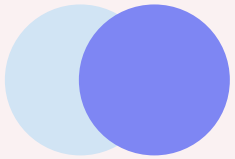


Figure 7. Triple diamond content overciew

Chapter 2

Understand



This chapter is focused on collecting insights to gain a comprehensive understanding of the problem. This involves gathering valuable information from various sources to develop a holistic perspective, including a literature review, analysis of existing practices, field research, and stakeholder interviews.

2.1 Literature review

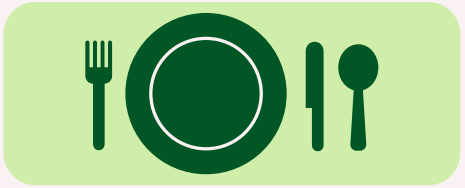
The literature review explored various aspects related to **disposable tableware** and **sustainable behaviour**. The goal was to gather insights that helped to answer the **research questions** framed in section 1.2.2. Thus, it examines why serving units and passengers use single-use items, exploring their preferences for such articles. Additionally, it studies behaviour change interventions to provide a foundation for future design decisions and identifies the needs of serving units and logistical operations by analysing existing practices. Employing Google Scholar, a search was conducted to gather academic articles and publications on the above-mentioned topics.

2.1.1 Disposable tableware

Disposable tableware refers to items designed for **single-use purposes**, including a wide range of products such as cutlery, dishes, straws, food and beverage containers, cups, wrappers, and plastic bags, among others (Dybka-Stępień et al., 2021). As shown in Figure 8, disposable tableware can be mainly grouped by functionality, material and susceptibility to biodegradation (Dybka-Stępień et al., 2021). The most significant **environmental impact** for all varieties of disposable tableware is the production phase, encompassing both material and product manufacturing, mainly due to the raw material extraction and processing and energy and water consumption (Lewis et al., 2021).

Additionally, the **end-of-life treatment** of disposable tableware causes adverse effects on the environment (Lewis et al., 2021). Disposable tableware faces various end-of-life scenarios depending on the material, each with distinct environmental implications. For instance, compostable tableware, when disposed of with food waste, is suitable for industrial composting, enriching the soil and reducing methane emissions. Conversely, tableware made of fossil-based plastics can be disposed of at landfills, which releases harmful chemicals and microplastics into the environment while generating methane. Moreover, products made from materials such as polystyrene (PS) or polyethene (PE) and other non-biodegradable materials are typically suitable for incineration, which while offering energy generation, still emits pollutants and greenhouse gases (Lewis et al., 2021). In the case of Norway, residual waste, including all kinds of disposable tableware, is sent to incineration to generate heat for district heating systems (Norwegian Environment Agency, 2019).

Ultimately, the **use of single-use items** by business units for takeaway meals and packaging is driven by factors like easy storage, transportation, and the growing consumption of ready-to-eat food (Müller & Süßbauer, 2022). Nevertheless, the negative environmental impact of single-use articles suggests the need for a shift towards more circular tableware options. Through prioritising sustainable alternatives, dedicating resources to waste reduction initiatives and raising awareness, the environmental impact of single-use items can be minimised.



Susceptibility to biodegradation

- Biogradable
- Non-biodegradable

Function

- Cups
- Glasses
- Cutlery (spoon, forks, knives, choopsticks, straws, stirrers)
- Tableware (plates, bowls, trays)
- Menu & pizza boxes, wrappers
- Foils

Material

- Paper, cardboard, wood
- Plastics
- Bio-plastics
- Carbohydrates
- Proteins
- Lipids, waxes
- Composites

Figure 8. Disposable tableware categories (Dybka-Stępień et al., 2021)

2.1.2 Factors influencing preference for disposable tableware

Understanding the **motivations** behind consumers' and businesses' preference for single-use tableware is crucial in developing targeted solutions, crafting effective behavioural change strategies, and fostering better stakeholder engagement. Through the review of the literature, several key factors emerged as significant influencers on the preference for disposable tableware. These factors, illustrated in Figure 9 & 10, encapsulate the main takeaways into why consumers and business units opt for single-use items.

Convenience

(Chang & Hung, 2023)

- Disposable items are seen as **easier** and **faster** to use, particularly for on-the-go situations.
- Single-use tableware **eliminates** the need for **washing** and **storing** reusable items, saving on labour and space.

Hygiene

(Lewis et al., 2021)

- Single-use items can be perceived as more hygienic, reducing the risk of **cross-contamination**.
- Businesses may opt for single-use tableware to comply with health and safety **regulations**.

Cost

(Chang & Hung, 2023)

- In some cases, establishments set **cheaper** prices for customers who order takeaway, reinforcing the perception among consumers that single-use articles are the most cost-effective choice, even in the absence of explicit discounts.
- Single-use tableware can often be more cost-effective compared to investing in reusable alternatives, particularly in industries with **high turnover rates** such as fast-food restaurants or catering services.

Factors influencing consumers

Factors influencing businesses

Figure 9. Factors influencing preference for disposable tableware 1

Portion control (Lewis et al., 2021)

Pre-packaged single-use items like portion cups can ensure **consistent serving sizes**. Moreover, single-use items can minimise food waste when different portion sizes are offered to customers.

Customisation and Branding (Müller & Süßbauer, 2022)

Single-use tableware offers the opportunity for customisation and branding, allowing businesses to showcase their **logos** and create a unique dining experience for consumers.

Social norms (Loschelder et al., 2019)

The existence of societal norms that promote the acceptance of using disposable items among consumers, as it seems **right to use them** for reasons of convenience or hygiene.

Lack of Awareness (Ertz et al., 2017)

Consumers might not be fully aware of the **environmental impact** of single-use items or the availability of sustainable alternatives.

Figure 10. Factors influencing preference for disposable tableware 2

2.1.3 Behavioural change

Shifting consumer and business behaviours away from single-use items towards more sustainable practices represents an important challenge for contemporary society (Loschelder et al., 2019). As a consequence, several **behavioural models** have been developed to design successful behavioural change interventions. For example, this includes the SHIFT framework, which intends to tackle the attitude–behaviour gap that illustrates the common discrepancy between what consumers think and what they do (White et al., 2019). Moreover, there is the Theory of Planned Behaviour (TPB), (Ajzen & Madden, 1986), built upon Ajzen and Fishbein's Theory of Reasoned Action (TRA). This played a significant role in explaining and predicting (un)sustainable behaviours, offering valuable insights into the factors influencing consumer intentions and actions. However, since these models neglect the full range of potential influences, it was needed to create a system that covered multiple interventions (Michie et al., 2011). Thus, the COM-B system was designed (Michie et al., 2011).

The COM-B model studies how capability, opportunity, and motivation generate behaviour (Michie et al., 2011), illustrated in Figure 11. **Capability** refers to an individual's psychological and physical capacity to perform an activity, including the required knowledge and skills. **Motivation** is the mental process that guides and directs behaviour. It encompasses habits, emotional responses and analytical decision-making. Finally, **opportunity** includes the external factors that enable or prompt behaviour. Furthermore, the COM-B model offers the opportunity to link these three elements with policies and interventions, which is reflected in the Behavioural Change Wheel (BCW), shown in Figure 12. This uncovers the potential of identifying the most successful interventions while considering also its context.

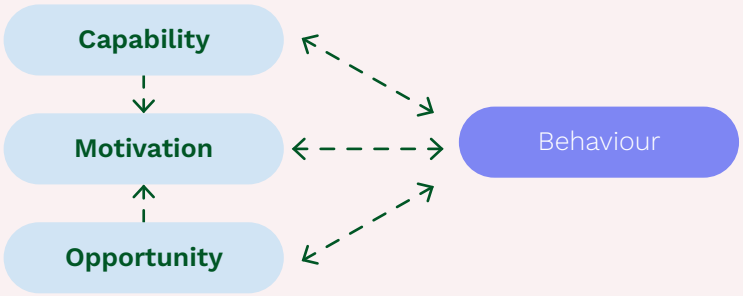


Figure 11. Sources of behaviour. The COM-B system (Michie et al., 2011)

The interventions gathered in the BCW include:

- **Environmental restructuring**: Motivation to choose sustainable options is greatly influenced by the perception of the environment. One strategy is creating situations that encourage the use of reusable containers and complicate access to single-use ones (Ertz et al., 2017).
- **Restrictions**: Rules and control-based measurements (Chang & Hung, 2023). which in the context of this thesis may be established by either the Norwegian government or Avinor. This can involve prohibiting the use of single-use articles in certain contexts.
- **Education**: Encouraging individuals to make informed choices, like promoting initiatives that raise awareness about the environmental impacts of single-use items and the benefits of adopting reusable alternatives (Dybka-Stępień et al., 2021).
- **Persuasion:** Using communication to evoke positive or negative feelings or inspire action (Michie et al., 2011). For instance, using marketing campaigns that raise negative feeling about single-use.
- **Incentivisation**: Using rewards. Businesses can offer price incentives for customers who bring their containers or opt for reusable options (Ertz et al., 2017).
- **Coercion**: This consist on generating expectation of cost or punishment. For example, introducing fees for the use of single-use or raise their cost (Chang & Hung, 2023).
- **Training**: Teaching skills (Michie et al., 2011). Train businesses' staff to incentive consumers to choose reusable options.
- **Enablement**: Prioritising reusables by making them the default option, with single-use available upon request, reinforces the message that reuse is the preferred choice (Ertz et al., 2017).
- **Modelling:** Setting an example for people to imitate (Michie et al., 2011), like using on influencers that opt to use reusable tableware.

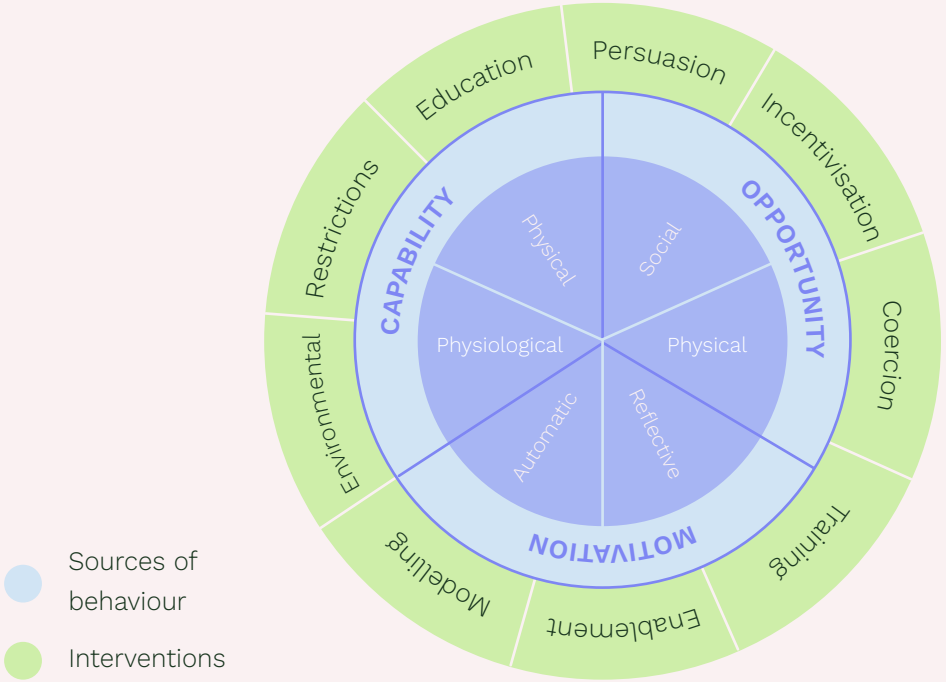


Figure 12. Adaptation Behaviour Change Wheel (Michie et al., 2011)

By exploring the elements that shape behaviour, intriguing questions emerge. For instance, it is interesting to think about which factors are the most important **influence on passengers' choices** between single-use and reusable tableware and which interventions would be more effective in the airport environment. Through exploring behavioural change interventions, it becomes evident that a versatile approach is necessary to develop **meaningful and long-lasting solutions**. Environmental interventions emphasize the importance of creating circumstances that facilitate the adoption of reusable options, while incentivisation, restrictions and enablement interventions highlight the power of promoting and prioritizing reusable items. Restrictions strongly guide behaviour through rules and educational initiatives play an essential role in educating and empowering individuals to make environmentally conscious choices.

2.1.4 Conlcusions literature review

In conclusion, the literature review has uncovered various strategies that can guide consumers towards more sustainable behaviours, such as reducing the reliance on disposable tableware. Building on the collected insights, several valuable considerations arise to guide **future design steps**, such as in the design criteria or conceptualisation phase (see Figure 13). Further exploration is needed to investigate the motivation driving passengers' and serving units' preferences for disposable tableware, particularly given the unique dynamics of airport environments. The exploration should encompass the perceptions of convenience, cost, social norms and environmental impact. The COM-B offers a structured approach to address these inquiries. Furthermore, engaging with several stakeholders, including passengers, F&B units and Avinor Oslo Airport, will be critical for the service's success. How the service can be designed to align the various interests and needs is a critical question for the coming phases.

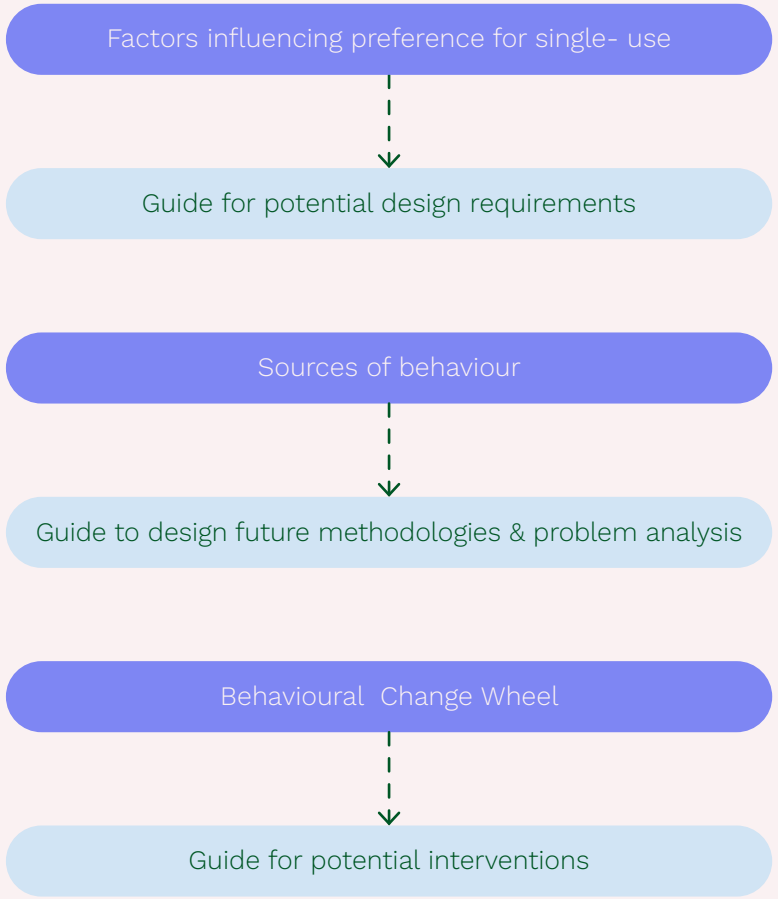


Figure 13. Takeawys form litureture review for future steps

2.2 Existing practices

To develop a successful centralised dishwashing service, several existing practices have been examined (see Figure 14). These practices were selected because they present aspects intrinsically related to the functionality of centralised dishwashing, such as **logistics** explanations or **consumer and business perspectives**. The objective is to gain insights into both **successful elements** and **challenges** encountered in these cases, which are gathered in Figures 15, 18, 19 & 22. Therefore, the 'positive elements' (or aspects that worked) and 'challenges' (or aspects that the organisations struggled with) were extracted from the interviews or reports that explain each case. This knowledge will help to guide future design decisions and to develop more informed solutions.

Figure 14. Analysed existing practices overview

Singapore Changi Airport

In 2017, Singapore Changi Airport built an 890 m2 centralised dishwashing facility in the basement of one of the terminals of the airport, depicted in Figure 16 (Changui Airport Group, 2018). Operated by GreatSolutions, this service provided serving units with the opportunity to delegate their responsibilities related to cleaning soiled tableware. The service comprised four dishwashing lines that were managed by four workers and it is open 24 hours and was in operation until the COVID-19 pandemic. Apart from online research into the program, insights were gathered from communication with the airport's Manager of Environment & Sustainability, who provided valuable details about the challenges encountered during the service's operation.

Positive elements

- The **proximity** of the facility reduces travel time for tableware collection and delivery, thereby enhancing serving unit productivity.
- Delegating this task **liberates resources**, including space and manpower, which can be directed towards revenue-generating plans such as expanding seating capacity.

Challenges

- Feedback from the participating units indicates challenges related to **breakage and losses** of dishes during transportation to and from the facility, impacting the economic benefits of using the centralised dishwashing service.
- Operational obstacles include decreased efficiency when dealing with **premium or irregularly shaped dishes** at the facility, as well as space constraints for storing and unpacking dirty dishes.
- Some units perceived the service as a **supplement**, opting to utilise it primarily when manpower within the unit is insufficient.

Figure 15. Positive elements and challenges Singapure Changi Airport

Figure 16. Centralised diswashing sy CHANGI stem (Source: Changi Airport group)

IMM Mall in Singapore

The centralised dishwashing service at IMM Mall in Singapore (Yong Chuan, 2016), operated by GreatSolutions, was initiated in late 2015 to boost productivity in labour-intensive jobs. It includes seven -automated dishwashing lines, each line, run by four workers. In total, it can clean up to 5000 pieces of tableware in an hour. The service works as follows and it is illustrated in Figure 17:

1. Restaurants deposit their soiled **tableware** into **boxes** and trolleys.
2. Workers retrieve the trolleys and **transport** them to the centralised washing facility
3. The **dishwashing process** begins, with the dirty items placed on a conveyor belt for soaking, washing, rinsing, and drying.
4. Workers conduct **inspections** to ensure the cleanliness of the tableware before putting the bags in the boxes.
5. Clean tableware is then **delivered back** to the restaurants by workers.

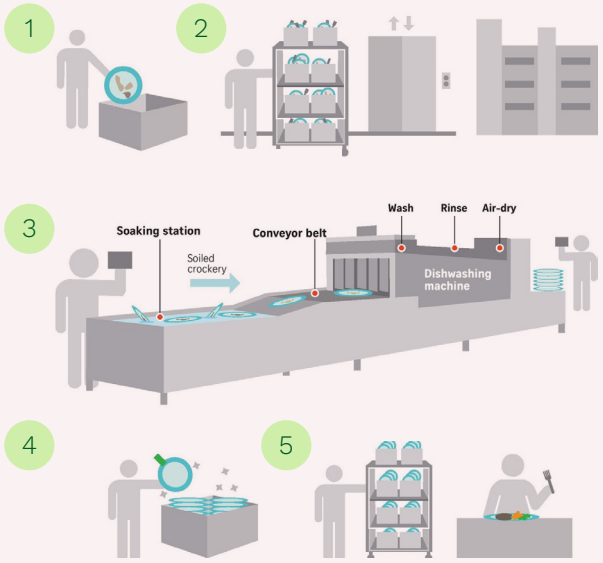


Figure 17. Centralised dishwashing service IMM Mall (Source: The Straits times)

Positive elements

- **Manpower and space** are saved, consequently, those resources can be used to generate income.

Challenges

- Because of the absence of a service corridor that connects the restaurants and the facility, many **obstacles** need to be overcome while transporting the tableware.

- Certain restaurants have already made investments in equipment or have existing **contractual agreements**, leading to their decision not to participate in the service.

Figure 18. Positive elements and challenges Singapure IMM Mall

Portland International Airport

Portland International Airport observed the difficulty in minimising waste at airports, caused by the limited availability of sustainable alternatives and passengers' preference for convenience. Thus, in 2017 they implemented their **Green Plate** and **HB Box** initiatives (Figure 20) (Portland Airport, 2017), aiming to decrease the use of single-use disposable to-go tableware. The programmes operated until the COVID-19 pandemic. For the Green Plate initiative, the focus was on the pre-security area, where it was noticed that 80% of passengers sit at the serving units to enjoy the food and that the takeaway food is mainly ordered by airport employees. For the HB-Box the focus was on engaging airport employees in the use of reusable lunch containers. Complementing the online research conducted on the programmes, a **45-minute interview** was conducted with the airport's Environmental Specialist. The interview transcript can be found in Appendix A, along with documents provided by Portland airport.

Positive elements

- The **selection** of participating units was based on convenience, with preference given to those connected to shared kitchens **adjacent to dishwashing facilities**. This streamlined the process and facilitated cooperation from the participating units.
- Participating restaurants experienced **cost savings** by reducing expenditures on disposable serving items.
- The initiative accommodated the **branding needs** of individual restaurants by offering dish colours that matched their branding. This customization helped alleviate concerns about the loss of branding associated with disposable items and effectively returned the tableware.
- The airport supplied each unit with **sufficient dishes to last an entire day** without needing replacements, even on the busiest days. This measure instils confidence in the units, alleviating concerns about potential shortages if the tableware return process encounters issues.

Challenges

- The airport made efforts to make the programme clear to passengers through **signage** in various locations and by using staff to provide information. Posters on tables were more effective in conveying information than posters on walls.
- Approximately 50% of the HB Boxes were **lost** during the initiative. Consequently, if the program is reinstated, implementing a deposit system appears to be a logical step forward.
- The **main costs** were originated from hiring extra janitorial staff. Additionally, it was observed that a higher-than-anticipated amount of funds went towards purchasing additional cutlery.
- **Ownership** of the GreenPlate initiative presents a challenge. It was solely owned by the airport, however, the airport aims to transition to a co-ownership model with the participating serving units to alleviate costs

Figure 19. Positive elements and challenges Portland Interational Airport

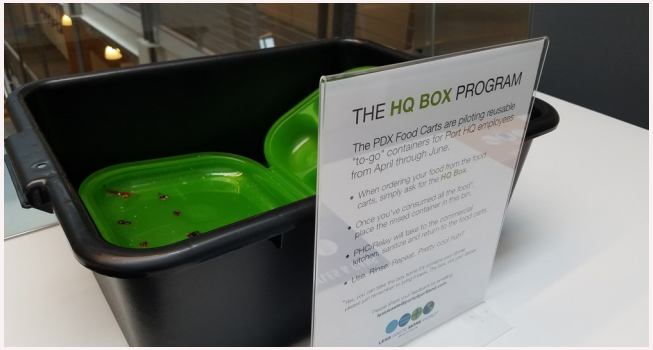


Figure 20. Portland International Airport Green Plate and HQ Box initiative (Source: Port of Portland)

Dutch festivals

In 2022, Lab Vlieland and the Green Deal Circular Festivals initiated a pilot programme to make single-use items obsolete at festivals (see Figure 21) (Van Daele et al., 2022). The pilot encompassed three festivals: DGTL, Castlefest, and Into The Great Wide Open and the insights shown in Figure 22 were gathered regarding visitor's perspectives on the system's operation.

Figure 21. Reusable tableware at Ducth festivals (Source: reuse Mission)

Positive elements

- Extra waste bins were positioned near the drop-off points to prompt visitors to **dispose of food scraps** and napkins from their plates.

Challenges

- Visitors encountered difficulty returning reusable tableware due to limited and poorly **visible drop-off points**.
- **Insufficient information** regarding the concept of the food stalls and discreet signage confused visitors about what to do with the reusable tableware.
- The used **terminology**, such as recycling station, did not seem to be appropriate.

Figure 22. Positive elements and challenges Dutch festivals

2.2.1 Conclusions

Analysing diverse practices across various contexts uncovers a range of results, ranging from enhanced **productivity** to **logistical complexities**. Positive elements, such as streamlining processes and reducing costs, offer invaluable guidance for upcoming phases, shedding light on effective strategies and practices to be replicated. Contrarily, challenges, like breakage and loss of dishes, confusion among users due to insufficient information and poorly visible drop-off points, underline the need for careful planning and attention to detail in overcoming obstacles. These challenges stress key points that cannot be overlooked in potential concepts, highlighting areas for improvement and refinement. As an overarching conclusion, various main takeaways have been framed, which are shown in Figure 23.

Branding and workflow

The designed solution should consider the serving units' branding needs and provide them with options adapted to their current way of working to cause minimal disruptions.

Signage

Information signage should be clear and provide enough information for users not to be confused. However, it should be considered that, in an airport, people may be in a hurry and not read the information in depth.

Drop-off points

In a concept requiring users to return tableware to drop-off points, the points should be visible and convenient. Moreover, in this case, strategies that motivate users to return the tableware should be applied.

Infrastructure

For developing a successful solution, the proper infrastructure should be implemented. For instance, carts adapted to transport the tableware without damaging it or convenient drop-off points.

Figure 23. Main takeaways Existing practices

2.3 Field research

Field research was conducted at Avinor Oslo Airport (Figures 25 & 26) to explore the **motivations** driving the use of single-use items by both F&B units and passengers. This occurs during a total of **eight days**, structured into two distinct phases (See Figure 24). Initially, over four days, the emphasis was on gaining preliminary insights into the operational dynamics of serving units and passengers' ordering preferences. This phase involved conducting interviews and observations to grasp the fundamental aspects of the situation. Subsequently, approximately one month later, an additional four-day period was dedicated to further exploring passengers' motivation and behaviour regarding ordering single-use items and the operational routines of serving units. This phase aimed to deepen the understanding acquired during the initial phase and extract additional insights. This phase included context mapping and ethnographic research.

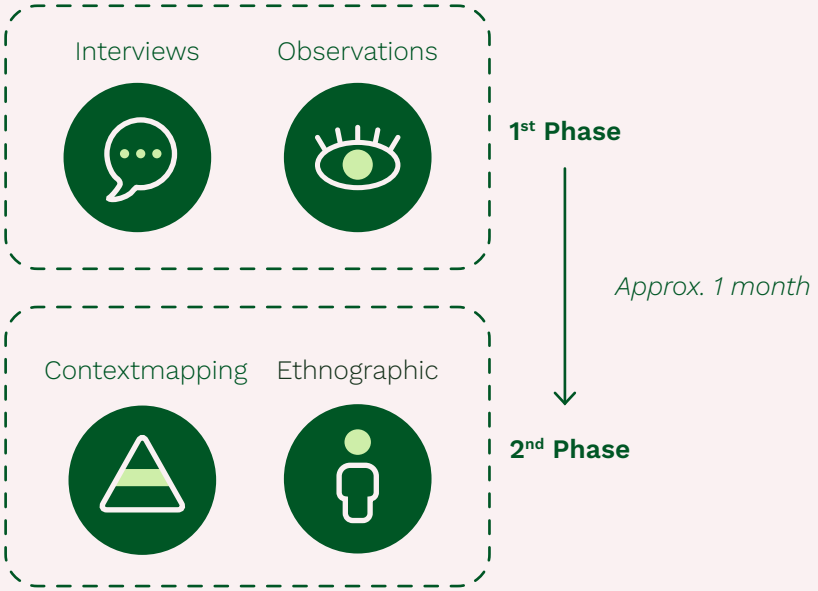


Figure 24. Overview methods field research

Arrivals

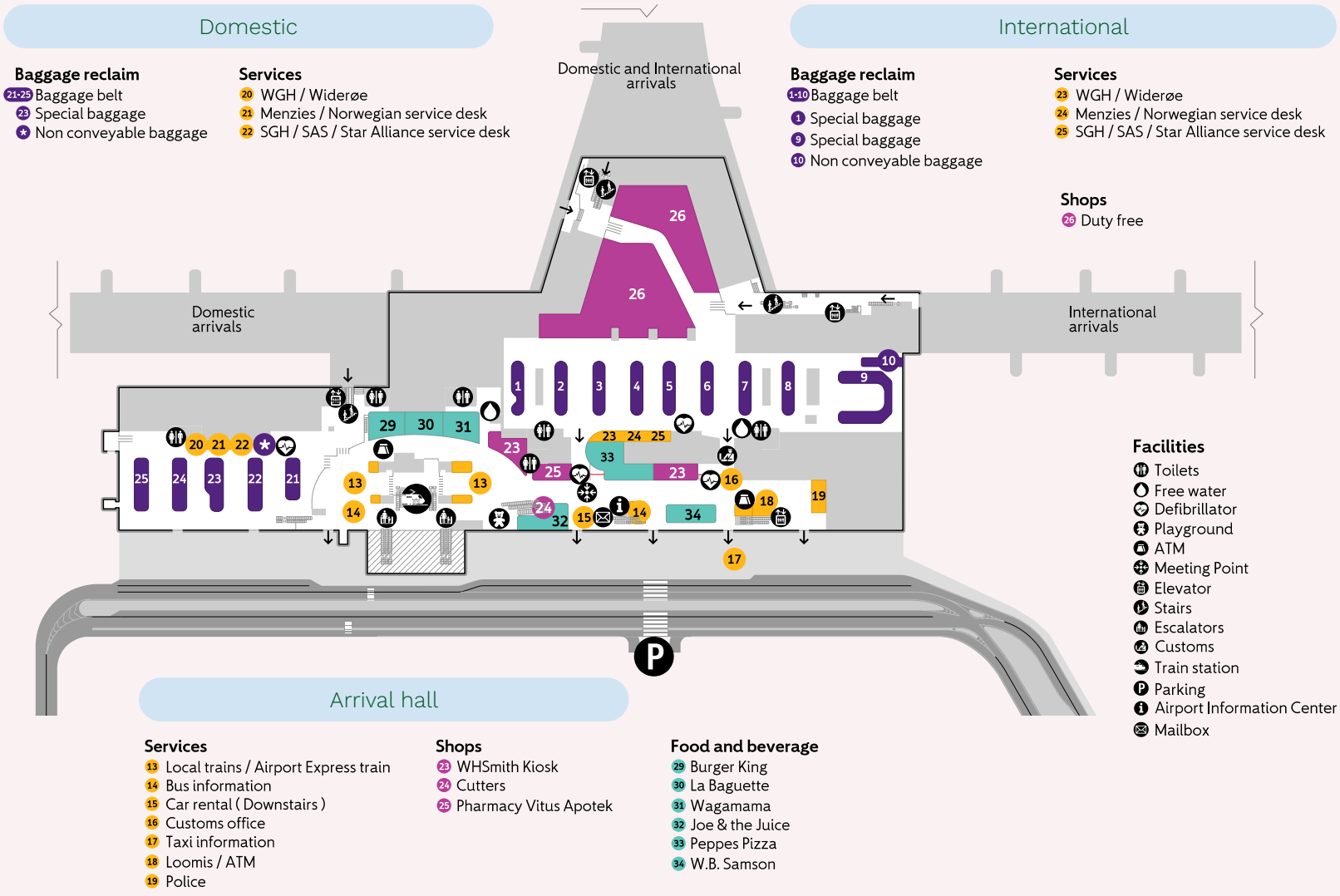


Figure 25. Avinor Oslo Airport Arrivals (Source: Avinor)

Departures

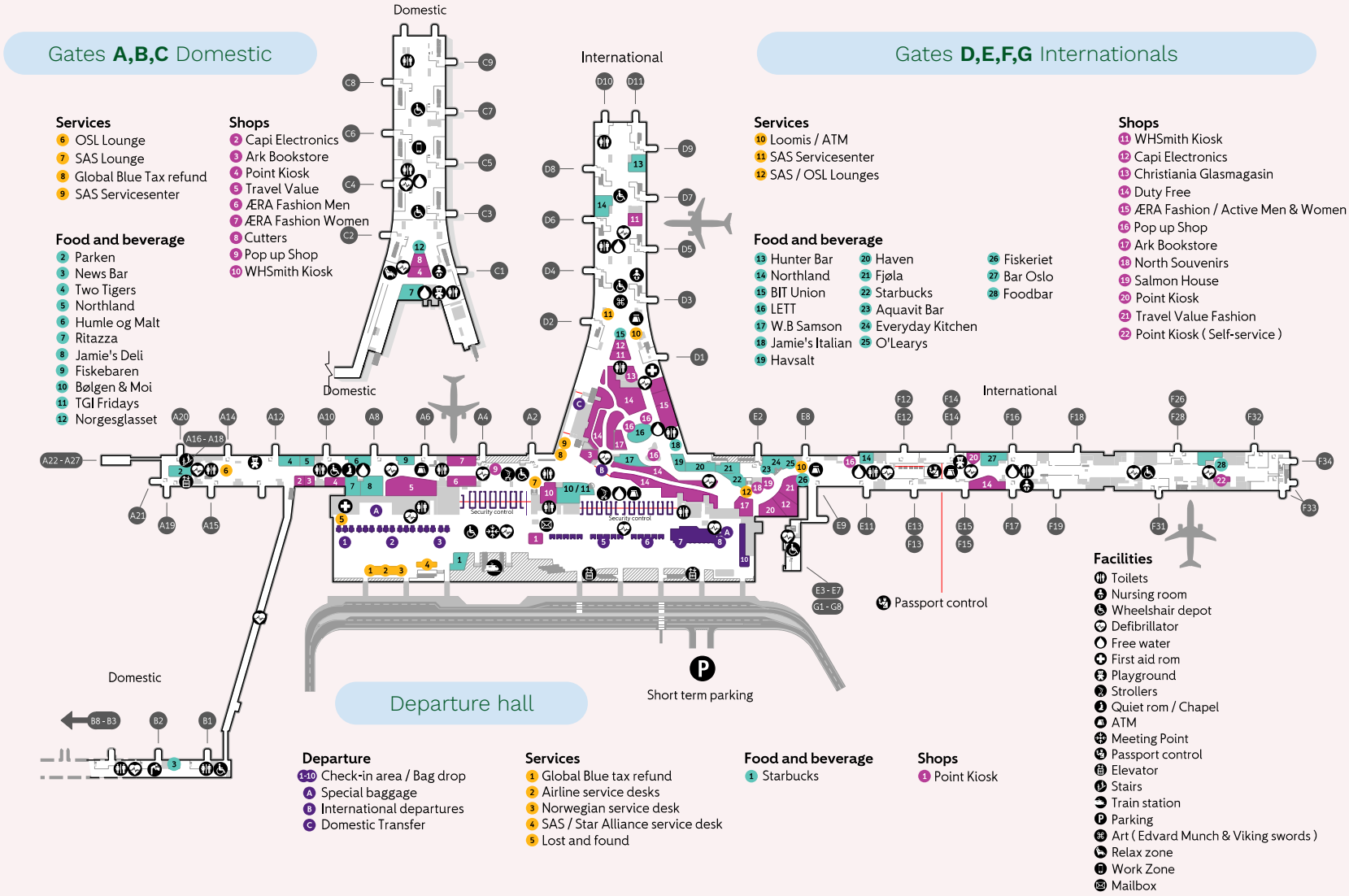


Figure 26. Avinor Oslo Airport Departures (Source: Avinor)

2.3.1 Research questions

The methodology employed during the field research was tailored to address the research questions defined in section 1.2 Research Questions. To understand why business units opt for single-use tableware for guests staying on the premises, interviews with the units and observations were used. For investigating the factors influencing passengers' preference for single-use items, interviews with passengers, observations and contextmapping activities were adopted. These methodologies will provide an overview of how the service can be used to tackle single-use takeaways. Furthermore, to assess the feasibility of developing a centralised dishwashing service a combination of interviews and ethnographic research was done.

MAIN RESEARCH QUESTION 1

How can this service be used to tackle single-use take-away?

- Why do business units use single-use tableware for guests staying on the premises?
- What are the factors influencing passengers' preference for single-use articles?

MAIN RESEARCH QUESTION 2

Is it feasible to set up a centralised dishwashing service?

- What are the needs of commercial units and what equipment is required to support the implementation of a centralised dishwashing service?
- How can this service work in day-to-day operations?

2.3.2 Data collection

F&B units' interviews

Short -structured interviews were conducted with staff at the serving units, since due to their busy schedules in-depth interviews were not possible. **Two rounds** of interviews were conducted, as illustrated in Figure 27.

The **first round** covered 34 out of 36 serving units (some units could be found twice in the terminal and shared the same management, which is why it was not necessary to visit all). Each interview lasted around five minutes. Questions in this round focused on topics such as the number of dishwashers available, their capacity, and the use and management of disposable tableware. The **second round** consisted of 10 minutes interviews that aimed to gather more detailed insights into the quantity of tableware used, dishwashing routines, peak times during the day, and interaction with passengers. For this round, seven units were selected based on their dishwashing capacity, proficiency in managing reusable tableware, and availability.

Figure 27. F&B units interviews' details

Passengers' interviews

Five short **-structured interviews** of around 5 minutes each were conducted with passengers (Figure 28). The interviewed passengers were individuals dining at a service unit, and the purpose was to get to know their motivations for ordering disposable or reusable items. These questions aim to understand **customers' preferences and behaviours** regarding the use of disposable and reusable tableware, including factors influencing their choices, perceptions of dining experiences, willingness to use reusable items and awareness of disposal practices.

Figure 28. Passengers' interviews details

Observations

Observations of the 34 units interviewed were conducted over a period of two days. The goal was to obtain an overview of the **practices** among units related to tableware, such use the type used, and the passenger behaviour, like the tableware preference. The gathered information is shown in Figures 29. Moreover, photos were taken to register the findings. Results can be found in Appendix B.

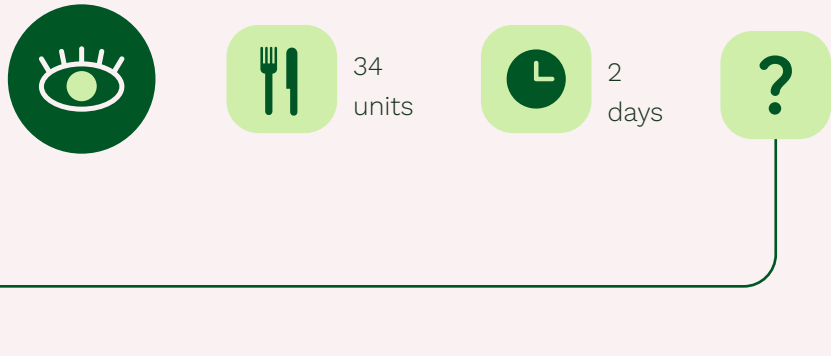


Figure 29. Gathered information during observations

Contextmapping

Due to time constraints during the passengers' interviews and the need for deeper insights into **passenger behaviour and motivations**, contextmapping was chosen as a method to facilitate passengers in expressing thoughts and ideas about single-use items. This approach allows individuals to share opinions based on past experiences, even if they haven't directly encountered the situation before (Sanders & Stappers, 2012).

Customised to the airport setting, the context mapping sessions were simplified to last around 15 minutes. However, the session could be adapted to last less or more time to ensure passengers could engage comfortably. Sessions were conducted **at the gates**, as passengers waiting in these areas typically have more time. Figures 30 & 31 provide an overview of the sessions set-up. A total of **14 passengers** participated, interviewing them individually. It was decided to stop at this number as a saturation point was reached. Ten sessions were held at **Avinor Oslo Airport**, focusing especially on passengers awaiting domestic flights, considering the airport's predominantly Norwegian demographic. Additionally, to broaden perspectives and achieve saturation in results, four sessions were conducted at **Rotterdam The Hague Airport**. Passengers from the EU were selected, as they represent the second-largest group of passengers at the airport, following non-EU European passengers (Avinor, 2023a).

PARTICIPANT	AGE RANGE	DEMONYM
1	18-30	Norwegian
2	31-40	Norwegian
3	31-40	Norwegian
4	41-65	Norwegian
5	18-30	EU
6	41-65	EU
7	18-30	EU
8	41-65	Norweigian
9	18-30	EU
10	18-30	Norwegian
11	31-40	EU
12	31-40	EU
13	31-40	EU
14	18-30	EU

Figure 31. Contextmapping participants demographic

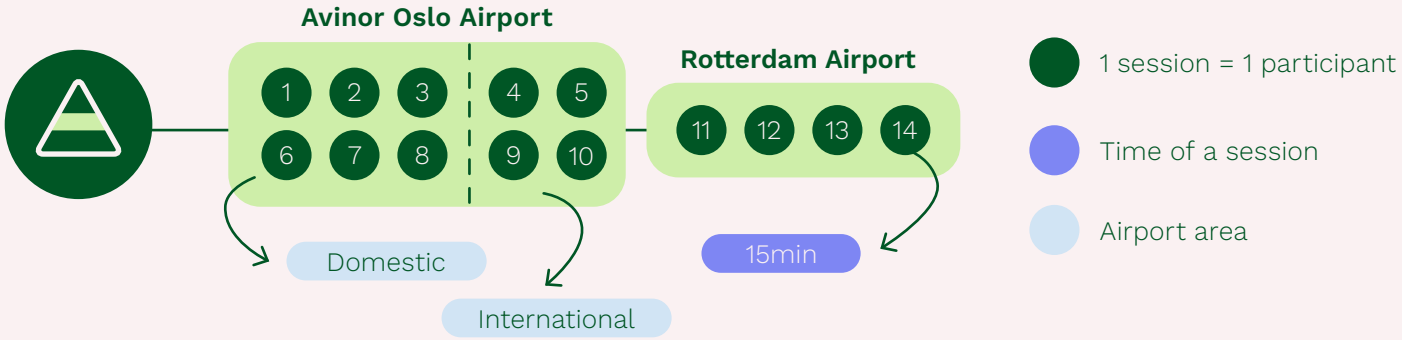


Figure 30. Summary contextmapping set-up

During the session, two main activities were conducted. Following the path of expression outlined in Figure 32, the **first activity** involved reflecting on past or present experiences related to ordering behaviours in the airport, while the **second activity** focussed on envisioning the future. For the first activity, the objective was to understand the primary **motivations** driving passenger ordering behaviour. Passengers were presented with three scenarios depicting different ordering behaviours (see Figure 33). They were then asked to select images and words that best represented the motivations behind each decision and subsequently, they explained their choices. This activity was designed in alignment with the COM-B model, with the selection of images and words aimed at capturing motivations, capabilities, and opportunities. In addition, the second activity aimed to uncover passengers' **concerns and opportunities** regarding the potential banning of single-use tableware at the airport. This activity took the form of a discussion. In Appendix C it can be found the context mapping material, including the triggering set of images and words and the activity page given to the passengers to capture their thoughts. A pilot was conducted the week before the airport's sessions at the TU Delft IDE faculty, to test the triggers, the time spent and the set-up of each activity.

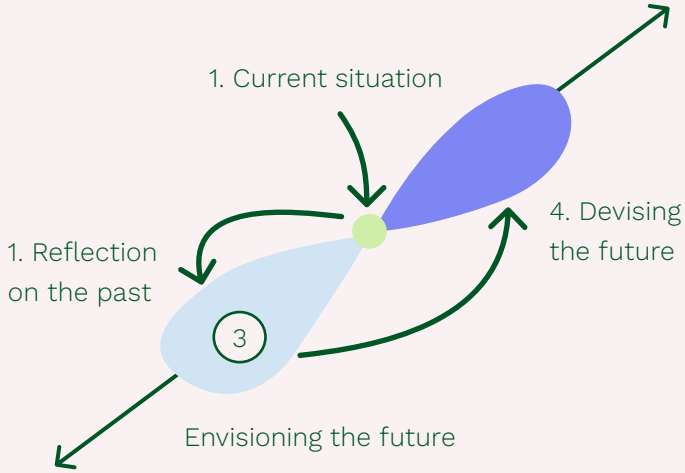


Figure 32. Path of expression (Sanders & Stappers, 2012)

Figure 33. Scenarios activity 1 Contextmapping

Ethnographic research

Ethnographic research was conducted to gain deeper insights into the **needs of the serving** units and their **daily operations** concerning reusable and disposable tableware (Figure 35). It involved observing how serving unit workers behave during their working routine to understand their interactions with their environment (e.g., kitchen, washing area, unit premises, colleagues). To achieve this, **half a day** (four hours) was spent working on a serving unit that claimed to have enough capacity to wash all the reusable tableware provided to consumers. During this time, the conducted tasks included washing tableware, as shown in Figure 34, and collecting soiled tableware from the tables. The shift manager of the unit supervised all the tasks done, offering valuable insights into the daily routines associated with these tasks. After finishing the shift, notes were taken to collect the gain insights.

Figure 34. Ethnographic research, washing tableware

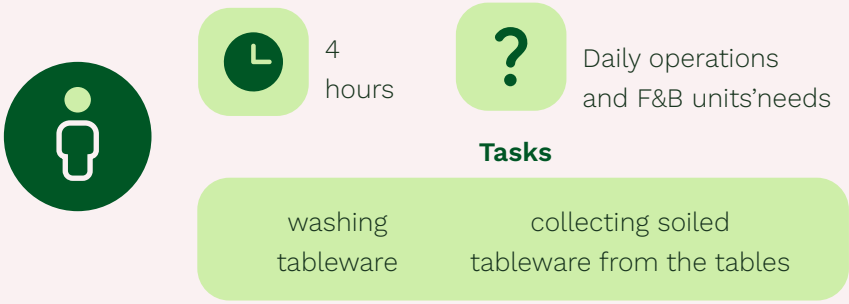


Figure 35. Overview ethnographic research

2.3.3 Data Analysis & Results

Once the data collection was concluded, the gathered information from each method was analysed.

Observations & interviews results

The collected information was eximined by mapping all the relevant notes, quotes and observations in a table in the online database software airTable and a Figma Board. First, every piece of information was coded by labelling it. For example, a photo of a disposable container could be labelled with 'Plastic container'. Second, the generated codes were clustered manually to organise the information, creating a clear overview of the knowledge acquired. This was used to obtain insights and conclusions. Figure 36 depicts the analysis process.

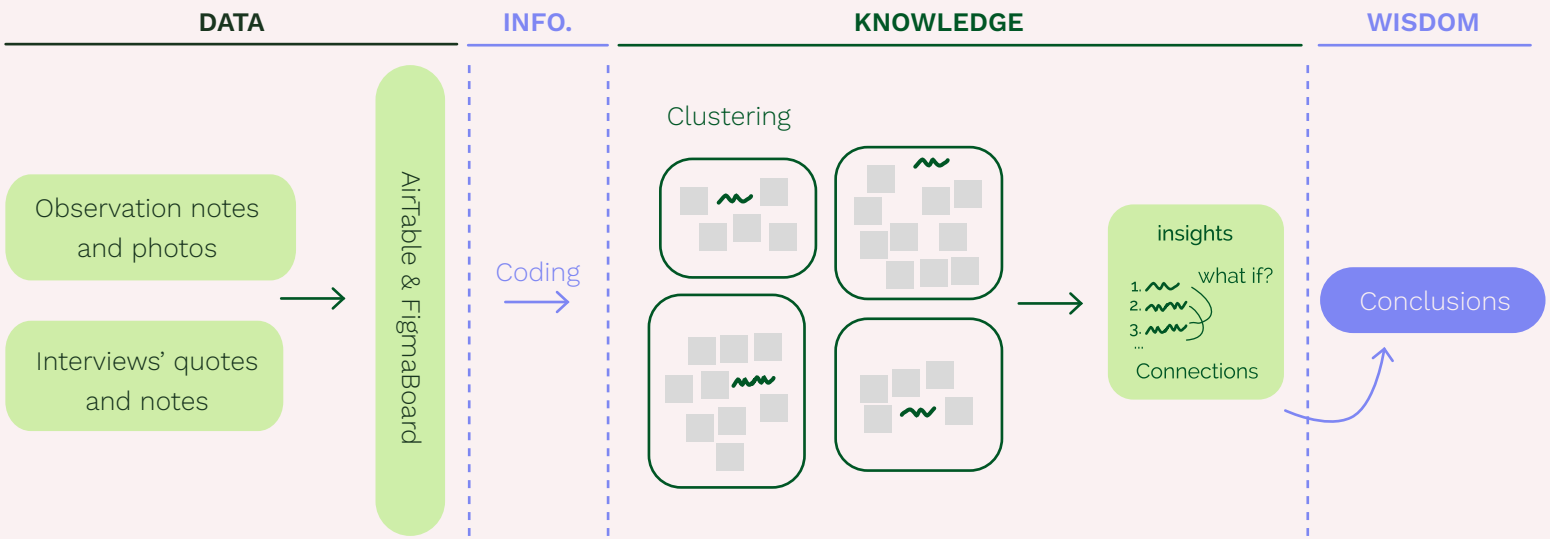


Figure 36. Analysis process observations and interviews

These are the results:

Passenger behaviour

Insights collected from

Convenience is vital, with travellers prioritising ease while on the move, particularly considering the **uncertainty** of time constraints inherent in travel. Many passengers interviewed claimed to experience **time pressure**, especially when ordering food, often checking the flight departure time frequently. Furthermore, it was observed that passengers occasionally mistakenly disposed of disposable options with paper waste instead of general waste, despite the signs of the trash bins.

F&B units' concerns

F&B units expressed concerns regarding the adoption of a dishwashing service. First, **economic** concerns were raised. Units may need to invest in additional tableware to replace disposable items or the items taken to be washed. Moreover, concerns about **losing control** over tableware accessibility emerged, as workers feared the centralised service might not provide them with clean tableware when needed. Likewise, there was a noticeable **unwillingness** among workers to embrace change, expressing to be used to the existing system and doubting the feasibility of transitioning to a different option. Finally, units emphasised the importance of maintaining their **brand identity** in tableware designs, highlighting the branding opportunity provided by paper cups.

Dishwashing capacity

Every interviewed unit, irrespective of whether they exclusively use disposable options, is equipped with **at least one dishwasher.** This is because units need dishwashers not only to clean the reusable tableware but also to clean their kitchen equipment. Of the 34 units interviewed, 21 stated to have **enough capacity** to wash all the used reusable tableware during a working day. Nevertheless, six units serving reusable tableware acknowledged occasional **capacity constraints**, leading them to rely on disposable options to relieve workload pressures. Moreover, one unit acknowledged using the dishwasher of the unit nearby since they do not have one on their own. Lastly, it was discovered that the dishwashing capacity **fluctuates** based on factors like time of day or season, occasionally surpassing the capacity during peak passenger periods, such as weekends or summer.

Dishwashing equipment and routine

The dishwashing equipment and procedures **vary across units**, as illustrated in Figure 38, with the number of dishwashers ranging from one to three, depending on the unit's size. These dishwashers serve **specific purposes**, including cleaning beer and wine glasses separately and accommodating various tableware in larger or smaller capacities. Routine dishwashing activities are scheduled differently among units, influenced by factors like unit size and the types of tableware in use, determining the timing and frequency of dishwasher operation.

Tableware used by the F&B units

F&B units present **unique designs** for their reusable tableware, varying from brand to brand (see Figures 37). Moreover, serving units often opt to use a mix between reusable and disposable, to offer passengers the option of taking away. Furthermore, tableware usage varies widely among units, driven by factors including their size, season, and time of day. Additionally, it was noted that numerous units sell **pre-prepared meals** packaged in disposable containers, often arriving from the central kitchen in this way.

Figure 37. Different types of tableware

Figure 38. Dishwashing equipment

Contextmapping results

As mentioned before, the contextmapping consisted in two activities (Figure 39). The first contextmapping activity, the analysis consisted of identifying the primary triggers used by passengers to describe their motivations for each scenario and their corresponding meanings (see Figure 41). For the second activity, the concerns and opportunities expressed by passengers were organised into clusters. The results were the following, with Figure 40 showing the most used triggers.

ACTIVITY ONE
Current scenarios

+

ACTIVITY TWO
Future scenarios

Figure 39. Contextmapping activities

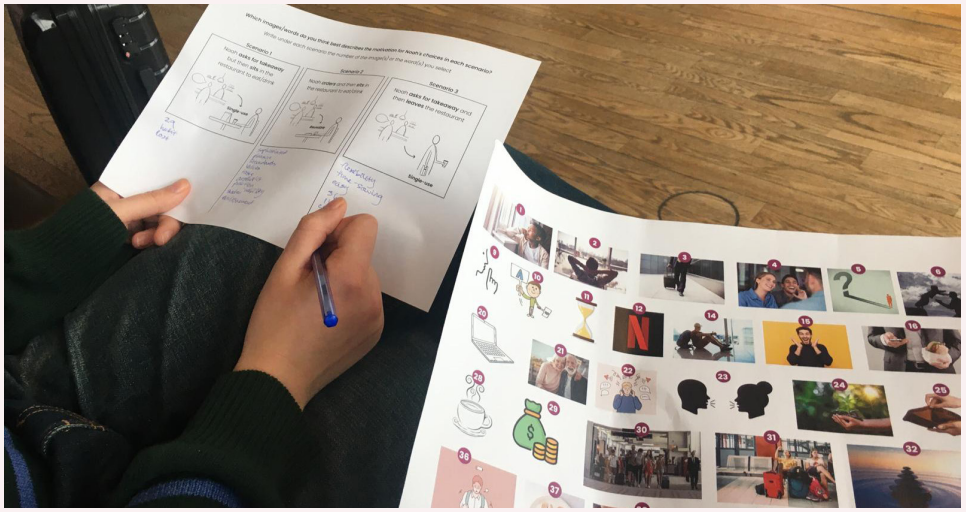
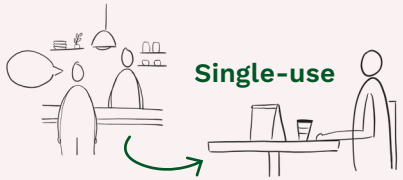


Figure 41. Dishwashing equipment

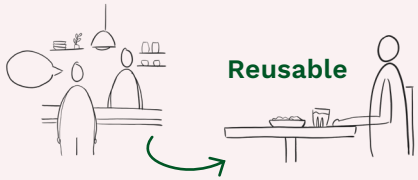
SCENARIO 1
Noah **asks for takeaway** but then **sits** in the restaurant to eat/drink



Cost

Habit

SCENARIO 2
Noah **orders** and then **sits** in the restaurant to eat/drink



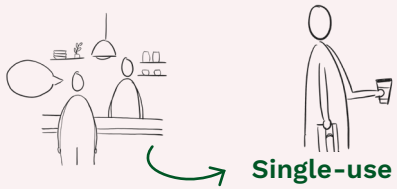
Pleasure

Sustainability

Taste

Environment

SCENARIO 3
Noah **asks for takeaway** and then **leaves** the restaurant



Time-pressure

Time-saving

Solo-travel

Figure 40. Dishwashing equipment

In **scenario one**, the prominent triggers indicate that passengers frequently experience uncertainty regarding the time available for dining at the unit's premises. Additionally, participants highlighted the affordability of takeaway options as a motivating factor for choosing them. Moreover, some participants noted that ordering a takeaway is often a habit.

Scenario two's predominant triggers indicate that individuals opting to dine at the premises with reusable items are aware of it being a more sustainable alternative. Furthermore, participants suggest that the pleasant restaurant environment and concerns about food taste also motivate this behaviour, thinking that food tends to taste better when served in reusable tableware. Additionally, participants preferred sitting at the serving unit when travelling with children.

In the **third scenario**, participants mentioned leaving the serving unit after ordering takeaway could be due to time constraints and the need for convenience while engaging in other activities. They highlighted triggers that represent feeling rushed and preferring time-saving options. Moreover, they believed that this behaviour is particularly common among solo travellers.

From the results of the **second activity**, several key insights emerged (Figure 42 illustrates the scenario presented to passengers). Passengers' concerns primarily revolve around practical issues such as the loss of convenience and the freedom to move around the airport, hygiene concerns, and potential impacts on the serving units like the loss of guests. Passengers also express worries about the adaptation process and possible price increases. However, amidst these concerns, opportunities were identified, acknowledging the environmental benefits and proposing solutions such as utilising cups or containers brought from home, providing easily portable container options, establishing designated drop-off points for used tableware, or implementing a deposit system. Overall, while there are apprehensions about the transition, there is also recognition of the potential benefits, indicating a willingness to embrace sustainable alternatives with the right support and infrastructure in place.

Figure 42. Activity 2 Contextmapping main results

Ethnographic research results

To analyse the raw data gathered during the ethnographic research, notes were coded to facilitate the categorisation of insights, enabling easier identification of opportunities and patterns.

First, it was found that while dishwashing capacity seemed sufficient, **space constraints** posed significant challenges, resulting in items being left on the floor. The limited space in the dishwashing area created difficulties in managing soiled and clean tableware alongside operating dishwashers efficiently.

Furthermore, it was observed that the **boxes** utilised for collecting and transporting tableware (Figure 43) from the table were not optimally suited for the task. Originally designed for storing food, these boxes do not allow an efficient collection of soiled tableware. Thus, it represents an improvised solution because guests often do not place soiled tableware in the designated collection points of the unit. This behaviour is believed to be caused by the **lack of visibility and signage** indicating the trash points. Challenges arose in arranging the tableware optimally, handling the weight

of full boxes after cleaning just a few tables, and transporting delicate items like wine glasses. This emphasised the need for better-designed equipment tailored to the collection and transport of tableware.

In addition, it was observed that a significant amount of **food** remained on the used dishes. This interferes with the task of collecting dishes from the tables, complicating the placement of the tableware on the boxes. Moreover, it also affected the dishwashing process, as the remaining food in the bowls needed to be disposed of before washing them. To effectively manage this, it was important to have a trash bin near the washing area for the disposal of food leftovers.

Figure 43. Boxes used to collect soiled tableware

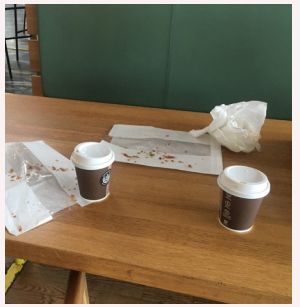
Lastly, fluctuations were observed in the **quantity of dishes** and kitchen equipment requiring cleaning throughout the day. At times, there was a need to wait until several tableware items accumulated before running the dishwasher, while during other periods, the cleaning process flowed more smoothly. The unit operated three **dishwashers**, each serving a specific purpose: one for beer glasses, one for wine glasses, and one for bowls, cups, dishes and trays. In the time spent, the beer and wine dishwashers were not run. However, the dishwasher for washing bowls, cups, etc... was run constantly, approximately once every 5 minutes.

2.3.4 Conclusions Field Research

From the field research, multiple main takeaways emerged, shown in Figure 44 & 45:

Sufficient dishwashing capacity

It was observed that most units have sufficient dishwashing capacity, each equipped with at least one dishwasher, regardless of their reliance on disposable options. With many units already possessing the capacity to wash all tableware, the challenge lies in determining **which units** should be integrated into the centralised dishwashing service and the **optimal facility location** for accessibility and effectiveness. This raises the question of possibly needing various dishwashing points instead of only one.



Kiosks

Kiosks stand out as significant contributors of disposable tableware **waste** due to their lack of premises.

Figure 44. Conclusions Field Research 1

Branding

Maintaining brand identity through tableware remains crucial for units to distinguish themselves.

Passenger Behaviour

Time constraints frequently influence their choice between dining in or opting for takeaway, with factors like affordability and convenience being also crucial. Moreover, they recognise that opting for takeaway sometimes comes from **habit** or that serving units in single-use containers occasionally serve directly in single-use. Concerns about **convenience** and potential cost increases underscore the importance of addressing these factors in the ideation process. Nevertheless, despite the concerns, passengers also acknowledge opportunities. Environmental advantages, encouraging the use of personal cups or containers, deposit systems and drop-off points for used tableware, demonstrate passengers' willingness to change.

Logistics

The field research also revealed challenges related to **space limitations** within the units' dishwashing facilities and **variations** in dishwashing routines over the day. Additionally, difficulties in transporting soiled tableware were noted. These findings emphasised the importance of addressing practical concerns and providing adequate support for the transition to a centralised dishwashing service.

Figure 45. Conclusions Field Research 2

2.4 Interviews with F&B units' managers

Except for three independently operating units, the airport's serving units are primarily managed by four distinct companies, each holding **decision-making power** over operational matters. Understanding their perspectives and gaining insights into aspects of the centralised dishwashing service is crucial. This includes sustainability measures, dishwashing equipment, tableware choices, and perceived challenges associated with implementing such a service. Engaging with these stakeholders aims to gather insights to implement an effective dishwashing solution tailored to the operating companies.

Online interview sessions lasting one hour were conducted with managers representing two of the largest tenants at Avinor slo Airport, in collaboration with two other students. The interviewees included the Food & Beverage manager from Company A, which manages nine serving units and the Quality & Sustainability manager from Company B, which manages 26 units. Both individuals serve as a contact for sustainability matters within their respective operating units. Figure 46 depicts an overview of the set-up. The transcripts of the interviews can be found in Appendix A.

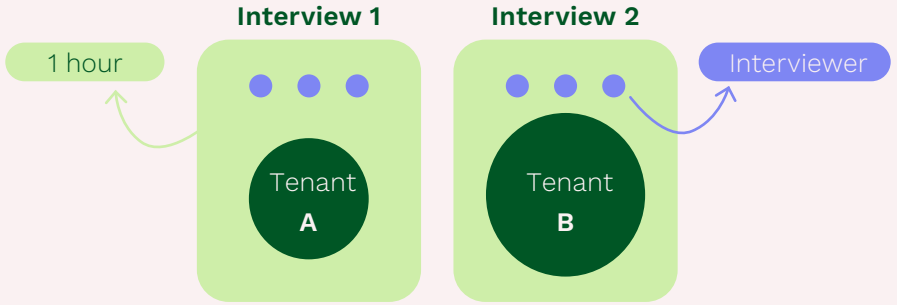


Figure 46. Interviews with F&B units' managers set-up

2.4.1 Results

The Data, Information, Knowledge, and Wisdom scheme (or **DIKW**) guided the data analysis process (Figure 47), facilitating the transformation of raw data, consisting of quotes from the interviews, into information (Sanders & Stappers, 2012). Subsequently, the information was grouped, leading to valuable insights and knowledge. The knowledge obtained from this analysis will guide the development of future concepts, culminating in the application of wisdom derived from the analysed data.

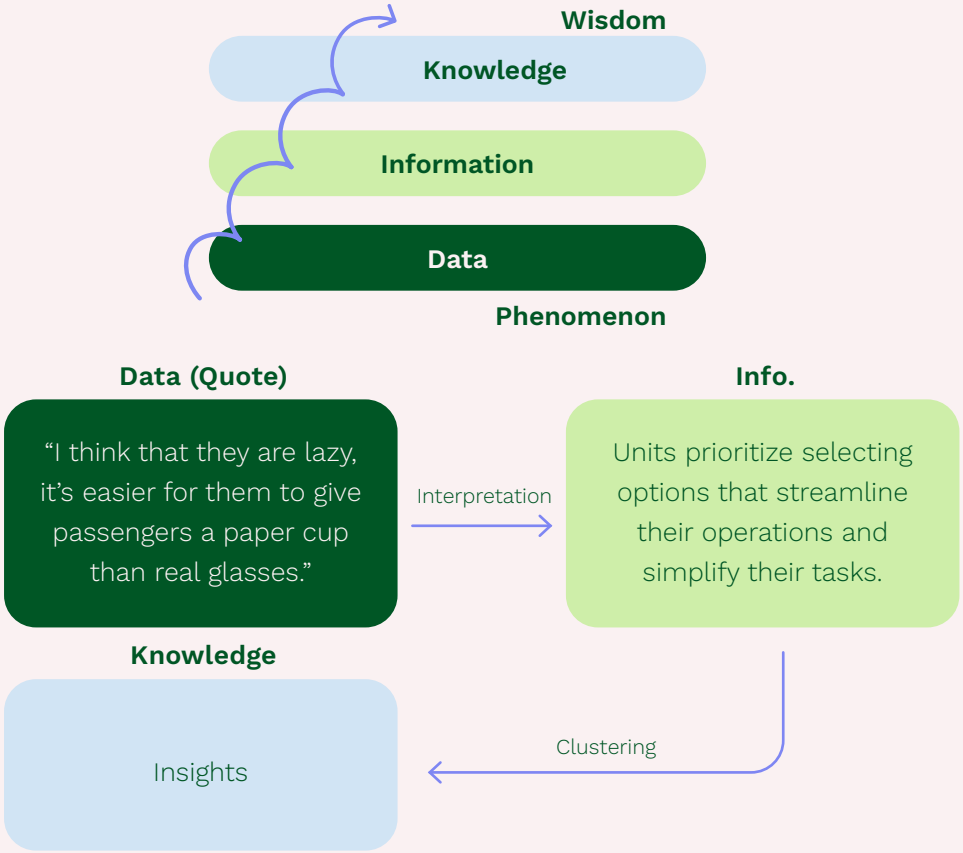


Figure 47. DIKW scheme (Sanders & Stappers, 2012)

The analysed data revealed that the managers possess strong concerns related to the development of a centralised service. The concerns primarily revolve around the potential need to **invest** in additional tableware and the challenge of ensuring the accurate **return** of items to their designated units. Additionally, there is a perception that workers tend to prioritize options that **streamline operations** and simplify tasks, which may explain the prevalent use of single-use items despite the available capacity for reusable alternatives.

In terms of tableware management, it was noted that **franchises** typically provide lists outlining the required tableware. However, for other units, the responsibility for tableware selection falls on the operating companies, which try to distinguish themselves from others through distinct designs. Furthermore, the use of **branded cups** was highlighted as economically advantageous, as the promoting brand compensates the serving unit for the usage of their branded cups.

Moreover, **dishwashers** are recognised as vital equipment for efficient passenger service, their selection varying based on factors such as the unit's concept (e.g., kiosk or high-quality restaurant), revenue, and size. Units are also obliged to comply with **Avinor regulations**, which stipulate the provision of takeaway options to passengers. However, efforts to adopt more **sustainable practices** are being taken, with proposed solutions including the exploration of biodegradable packaging alternatives to replace plastic bags. Additionally, offering customers the choice of reusable cups with deposits was discussed as a potential solution. Finally, it was noted that passengers tend to adopt more sustainable practices in downtown units of the same brand, suggesting that the airport environment presents unique challenges for fostering sustainable behaviour.

2.4.2 Conclusions

The insights gathered from the data highlight several critical **considerations** for the transition towards a centralised service. Understanding managers' concerns about investment costs suggests a need to explore cost-effective solutions that align with units' revenue objectives. Additionally, recognising workers' emphasis on operational efficiency stresses the importance of designing solutions that integrate seamlessly into existing workflows, ensuring minimal disruption. Moreover, the varying tableware designs between units raise questions about standardisation and collaboration between the different units, to optimise the distribution of tableware. Figure 48 shows the main takeaways.

Costs

A centralised washing service is associated with additional costs. For example, buying more tableware. Moreover, replacing branded cups means an economical loss.

"Brands are paying us money for using their brands."

Tenant A

Streamline operations

Unit's workers prefer options that simplify task. Thus, they use single-use items despite available reusable alternatives to reduce their workload.

"They have really much to do and they find easier solutions for themselves."

Tenant A

Branding

Preserve the brand identity of the different units is a crucial aspect. Branded tableware and unique design enhances the visibility of the units and helps to attract passengers.

"All different places want their own, they want to look special and apart."

Tenant B

Challenges in Airport Environment

Tenants observe a significant difference between customer behaviour in city and airport units. This highlights the need to adapt the service to the needs of passengers.

"It's easier to do these things in our in restaurants downtown because people have more time, they are relaxed."

Tenant B

Figure 48. Takeaways unit's managers interviews

2.5 Conclusions Chapter 2

In this section, the Research Questions (RQ) introduced at the beginning of the section are answered. The symbols under the questions tell from which part each RQ answer comes from (see Figure 49).

RQ1: IS IT FEASIBLE TO SET UP A CENTRALISED DISHWASHING SERVICE?

The existing practices demonstrated successful implementations of a centralised dishwashing service. They showed that centralised dishwashing services can effectively streamline operations, save resources, and reduce environmental impact. However, challenges such as tableware breakage and space constraints need to be addressed through careful planning and investment in appropriate infrastructure. Furthermore, it could be interesting to deliberate whether a single centralised dishwashing facility is the most appropriate solution or if multiple facilities would lead to a more effective outcome.

RQ 1.1: What are the needs of commercial units and what equipment is required to support the implementation of a centralised dishwashing service?

Commercial units require a range of equipment and support systems to effectively participate in a centralised dishwashing service. Firstly, efficient transportation systems are necessary to move soiled tableware to the centralised facility. Additionally, the dishwashing facility should be equipped with the correct dishwashing equipment, adapted to clean the tableware that is decided to be part of the service. Adequate storage space for both clean and dirty items is also crucial to facilitate smooth operations. Furthermore, is necessary to ensure timely refills and to consider the impact of potential changes in the unit's branding.

RQ 1.2: How can this service work in day-to-day operations?

Day-to-day operations involve a systematic process that begins with restaurants/passengers depositing soiled tableware into designated containers or trolleys. Workers then transport these containers to the centralised washing facility where the dishwashing process begins. Clean tableware is sorted, packed, and returned to the restaurants for reuse. Adaptability in the frequency of collecting and returning tableware is essential to accommodate the diverse needs of individual units, considering that each unit may require tableware at different times. Furthermore, the operational dynamics must be mindful of passenger interactions to ensure minimal disruption to the overall airport experience. Implementing dynamic route planning can enhance efficiency, allowing for real-time adjustments based on demand fluctuations, especially as the service scales up.

Figure 49. Legend of symbols for conclusions

RQ2: HOW CAN THIS SERVICE BE USED TO TACKLE SINGLE-USE TAKE-AWAY?

This service can tackle single-use items through various approaches. For instance, it could concentrate on substituting disposable tableware with reusable alternatives, thereby reducing the overall volume of single-use items. Alternatively, the service could support F&B units by handling the washing of existing reusable tableware, thereby easing the burden on unit workers and facilitating the adoption of reusable options. Moreover, the service can play a role in promoting the adoption of reusable alternatives among passengers, thereby contributing to a reduction in the consumption of single-use items.

RQ 2.1: Why do business units use single-use tableware for guests staying on the premises?

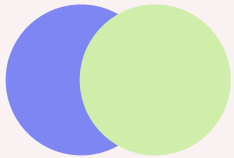
F&B establishments often choose single-use tableware for passengers staying on the premises due to various factors. First, despite having sufficient dishwashing capacity, some units choose disposable options to streamline operations and simplify tasks, particularly during peak periods of customer demand. The convenience and perceived economic benefits of using single-use items contribute to their widespread adoption, allowing units to focus on serving customers efficiently without thinking about the dishwashing responsibilities. Secondly, certain units, such as kiosks, lack dedicated premises for on-site dining, requiring the use of disposable items exclusively. Additionally, some units may face occasional capacity constraints and consequently rely on disposable options to fulfil orders efficiently. Lastly, passengers may request takeaway but then choose to dine on-site.

RQ 2.2: What are the factors influencing passengers' preference for single-use articles?

Passengers' preference for single-use articles is influenced by a combination of factors, including convenience, time constraints, affordability, and habit. Travellers prioritise ease and convenience, particularly when faced with time constraints inherent in travel scenarios. Moreover, affordability plays a significant role, as passengers perceive single-use items as more cost-effective compared to reusable alternatives. The habitual nature of ordering takeaway items also influences passenger behaviour, with many individuals opting for familiar choices and routines during their travels.

Chapter 3

Define



In this chapter, a design proposal, based on the outcomes and conclusions of the previous chapter, is presented. It includes a problem definition of the current situation, a Design Goal, an Interaction Vision and Design Criteria.

3.1 Problem definition

In the present scenario, the widespread adoption of single-use tableware in serving units at the terminal of Oslo Airport illustrates a significant **environmental challenge**. Despite having adequate dishwashing capacity in some cases, F&B units still heavily rely on disposable items. The problem arises from a variety of factors, including peak periods of customer demand, convenience, and economic benefits. The development of a centralised dishwashing service requires the adoption of a **holistic approach**, tailored to the needs of F&B establishments and passengers to succeed. This involves understanding the operational and logistical challenges faced by F&B units, including factors such as workflow management and branding considerations. Thus, it is necessary that Avinor support solutions that not only streamline operations but also promote sustainable practices without compromising efficiency and convenience.

The **COM-B model** (Michie et al., 2011) guided a deeper analysis of the problem. By using this model, it was possible to analyse the problem systematically, and understand the factors that currently shape the behaviour of passsengers and serving units (see Figure 50). Thus, tailored interventions can be devised to promote the desired behaviour effectively.

Motivation

F&B units' motivations are often driven by prioritising factors such as convenience, cost-effectiveness, and operational efficiency, leading them to favour disposable items over reusable alternatives. In contrast, passengers prioritise convenience in their dining choices, especially given the time constraints and uncertainties associated with travel. As a result, Oslo Airport should promote solutions that enhance the likelihood of stakeholders **choosing reusable** options.

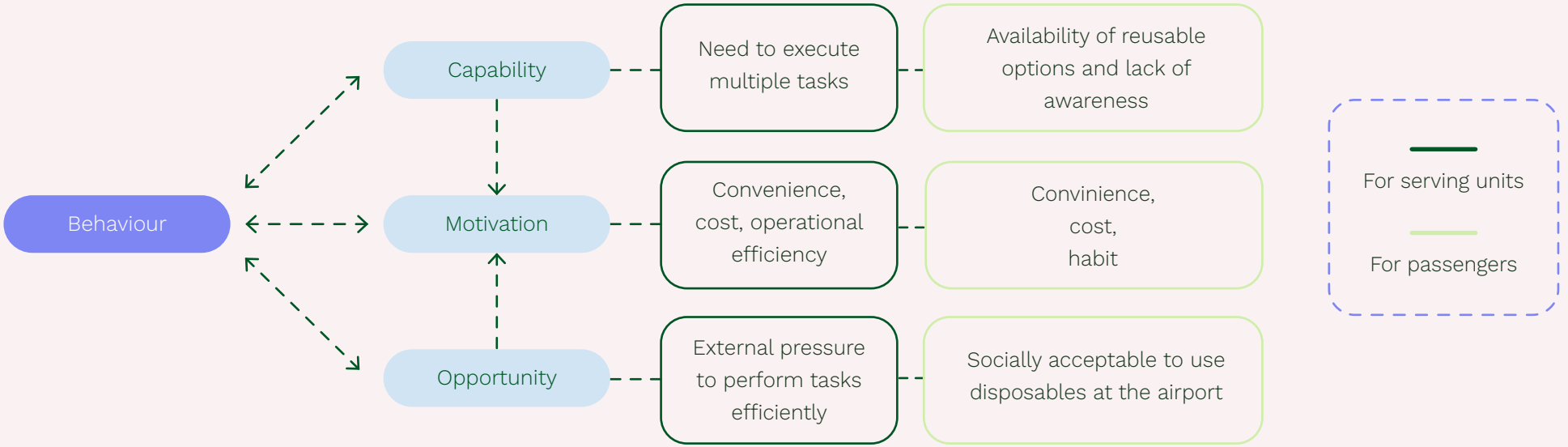


Figure 50. Overview problem definition following COM-B model

Opportunity

Various **external factors** prompt passengers and F&B units to use single-use. For example, social pressures and expectations within the F&B industry and among passengers. Workers in F&B establishments often feel pressured to rely on disposable tableware to streamline operations and prioritise customer service efficiency. Moreover, F&B establishments may perceive barriers in maintaining operational control over dishwashing operations due to the lack of resources or in maintaining brand identity. Likewise, passengers have come to accept the use of disposable tableware as a convenient choice, gradually forming a **habitual preference** for this option. To promote behaviour change, interventions must target normative beliefs by reshaping perceptions regarding the **social acceptability** and desirability of reusable tableware. The role of Avinor in motivating stakeholders to adapt to new norms will be pivotal in fostering the broad adoption of reusable options.

Capabilities

Stakeholders' capabilities of adopting sustainable practices are influenced by various factors. F&B establishments may not find themselves able to perform all the tasks while working at the unit, and thus prioritise options that reduce their burdens. Passengers' capabilities are influenced by factors such as the **availability** of reusable options, ease of use, and **awareness** of sustainable practices. Therefore, Oslo Airport should address these barriers by providing adequate support, infrastructure, and knowledge to empower stakeholders to embrace sustainable habits. Moreover, offering incentives and clear contextual cues can encourage stakeholders' sense of control, ultimately cultivating a culture of waste prevention and reuse as stated in Avinor's 2030 horizon.

3.2 Design Goal

Based on the defined problem, a design goal (Figure 51) has been formulated to express the **desired impact** intended to be achieved with the future design concept.

To develop a dishwashing service that reduces the reliance on single-use serving articles and prioritises convenience for the serving units and passengers at Oslo Airport terminal

Convenience involves streamlining operations for serving units and providing a effortless service for passengers.

Figure 51. Design Goal

3.3 Interaction Vision

The interaction vision illustrates the **intended qualities** of the interaction with the final concept and is expressed through a metaphor. The interaction vision (Figure 52) is the following:

"The interaction with the concept should feel like using a fast pass in an amusement park"

Design qualities

Efficiency

Similar to how a fast pass lane ensures rapid movement and **minimal wait times**, the interaction with the design should prioritise efficiency and convenience. It should ensure that the F&B units and passengers can complete tasks with **speed and ease**.

Seamless Integration

Similar to how a fast pass lane seamlessly merges with the overall traffic flow, the design should seamlessly blend into workers' workflows and routines. It should ensure smooth navigation **without disrupting** the flow of other elements.

Delight

Like the satisfaction experienced when using a Fast Pass, the interaction design should evoke a sense of delight in users due to the convenience and efficiency of the service. This ensures a **lasting positive impression** on users and potentially increases their willingness to use it again in the future.

Navigation

Like the **clear signage** and directions provided for fast pass lanes, the interaction with the design should offer clear cues and guidance to help users navigate the service effectively.

Figure 52. Interaction Vision qualities

3.4 Design Criteria

According to the design goal and the desired qualities, design requirements have been formulated to ensure that the future concept contains characteristics that make it successful (Figure 53).

These criteria will serve as the basis for evaluating future concepts, which is why the **requirements** were ranked based on their significance to the design goal.

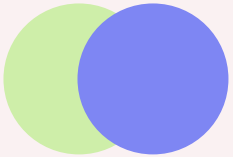
Level of importance: + (top) to - (bottom)

Design Criteria	Design Requirements
SUSTAINABILITY	(1) The concept minimises waste generation of single-use tableware by promoting reusable alternatives (2) The concept promotes the use of reusable alternatives among passengers. (3) The concept spreads awareness about the positive environmental impact of choosing reusable options.
USER EXPERIENCE	(1) Passengers find the concept intuitive, convenient, and easy to use, leading to high satisfaction and positive feedback. (2) By delegating responsibilities to the service, the concept lightens the workload for serving units. (3) The concept allows serving units to maintain their brand image.
COST-EFFECTIVENESS	(1) The concept should be affordable for Avinor Oslo Airport. (2) The concept should not decrease revenue for units compared to the current system, maintaining or increasing profitability. (3) The concept should offer affordable pricing options for passengers, ensuring accessibility.
SCALABILITY	(1) The concept should be able to handle increased demand caused during peak hours without significant disruptions, maintaining consistent service quality.
INTEGRATION	(1) The concept should cause minimal or no disruptions for passengers travelling in the terminal, ensuring a smooth and seamless experience throughout their journey. (2) The concept should cause minimal or no disruptions in the workflow of units' workers, seamlessly integrating with existing flows. (3) It is feasible to implement the service by 2030
FLEXIBILITY	(1) The concept should provide units with options adapted to their current model. (2) The concept should provide passengers with alternatives that can be adapted to multiple ordering behaviours.

Figure 53. Design Criteria

Chapter 4

Ideate



This chapter focuses on idea generation, concept development, and prototyping based on the research findings presented in the preceding chapter.

4.1 Ideation

This section delineates the methodology and outcomes of the ideation phase. Broadly, the ideation phase comprises distinct activities characterised by divergent thinking and exploration. These activities aimed to establish initial rough concepts, which will be refined into the final concept presented in the next chapter.

4.1.1 Co-creation session

For the second visit to Avinor Oslo Airport, a co-creative session of **1.5 hours** was organised. The session was jointly facilitated with another student working on a graduation project aimed at reducing packaging waste at the airport. The participants were split based on the project's relevance, with a total of five individuals participating. **Group 1**, focusing on packaging waste, consisted of a representative from warehouse transport and another from the client, Avinor. **Group 2**, dedicated to dishwashing as a service, comprised a representative from a serving unit, the Quality & Sustainability manager from one operating company, and the general manager from another For an overview of the session set-up see Figure 55.

Both groups began by reframing the given brief to challenge assumptions and expand their perspectives. This initial step was followed by interactive brainstorming activities, where multiple ideas were generated collaboratively (Figure 54). Subsequently, each group was tasked with developing one concept in greater detail. To conclude the session, both groups presented their work to each other, facilitating feedback exchange and gaining fresh perspectives from their counterparts. The ideas generated are detailed in Appendix D.

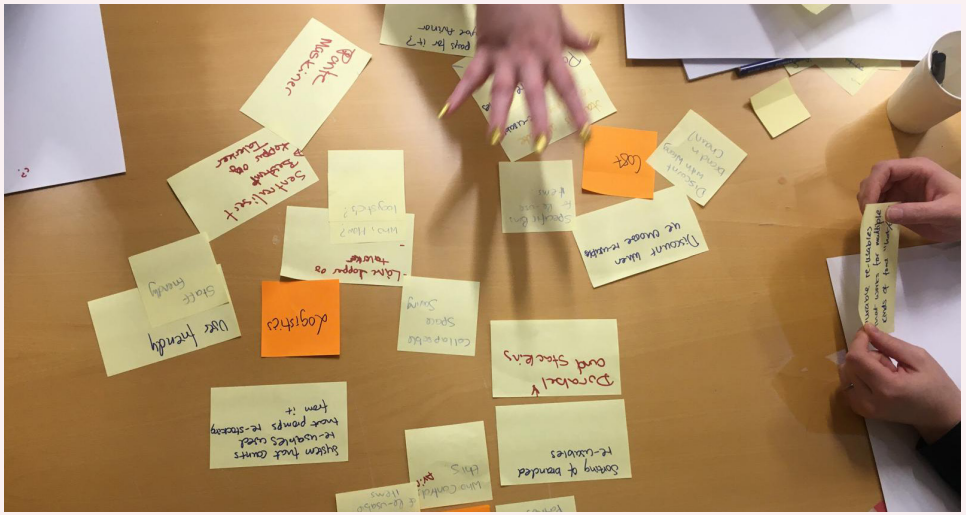


Figure 54. Co-Creation, clustering ideas

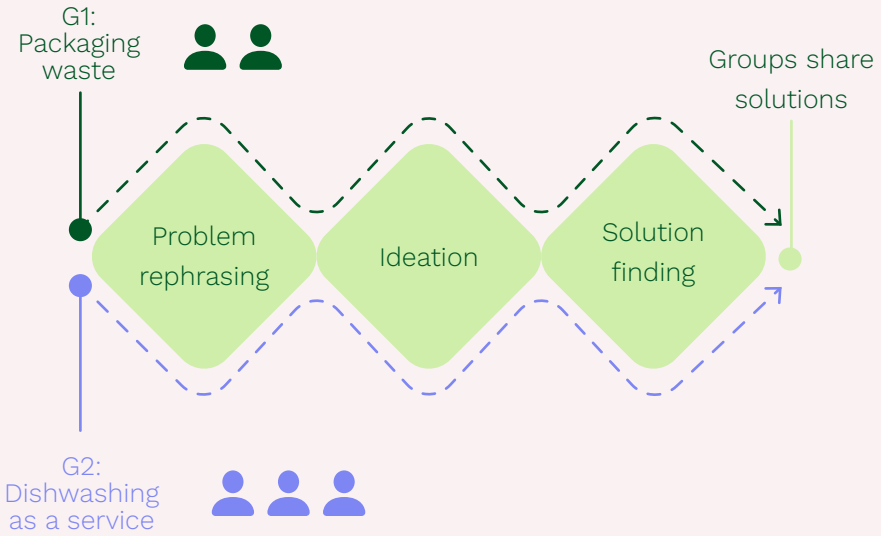


Figure 55. Co-Creation set-up

Results

In the beginning, the team worked on creating a service that makes single-use serving articles obsolete by designing a centralised dishwashing service. After the purge, the group identified various **key elements** and concerns related to the service. The group identified key elements and concerns related to the service, focusing on branding, cost considerations, spatial constraints, and the diverse backgrounds of passengers. Many of these aspects resonated with findings from the previous chapter. Subsequently, the team redefined the problem by prioritising the transition to **reusable takeaway** options (See Figure 56).

Following the round of ideation, multiple concepts emerged, which were clustered into **three groups**: logistics, control and costs, illustrating the aspects that were considered more important. Within the '**control**' cluster, concepts proposed Avinor Oslo Airport as the service owner and suggested initiatives such as placing sales points for reusable containers or drop-off points at the gates. In the '**cost**' category, ideas centred around offering discounts, opportunities for advertising external companies, and exploring who would pay the expenses for necessary equipment. Under the '**logistics**' cluster, emphasis was placed on ensuring the service's user-friendliness for both passengers and staff, with questions arising about operational logistics, collection procedures, and responsible parties.

In the final stage, the group refined their preferred ideas to develop a final concept. This concept involved **replacing single-use takeaway** food containers with reusable ones, containing a commercial space within each container for sale to non-food-related external companies to avoid competition. Upon acquiring a reusable container, passengers would be required to register, after which they could freely transport their food. The containers could be deposited at the airport's gates or even taken to the plane for return at the destination. Passengers would then register the return of the tableware. If the containers are not returned within a specified time frame, passengers will be charged.

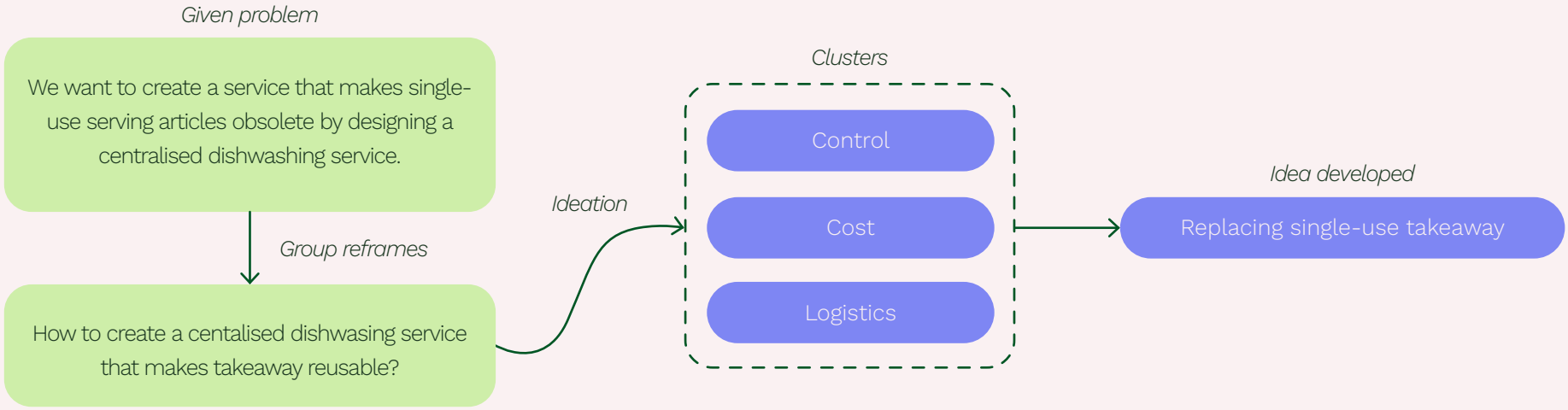


Figure 56. Co-Creation ideation overview

Conclusion

The co-creation session provided a valuable opportunity for direct engagement with key stakeholders, allowing for the **exchange of ideas** and concerns (Figure 57). However, while exploring the ideas, several important **questions** emerged: How can we effectively implement the registration system for reusable containers? What strategies will be effective in incentivising passengers to return containers? How can we coordinate the logistics of tableware collection and return to minimize disruptions to airport operations? Addressing these questions will be crucial as we move forward with the implementation of the service. Additionally, it was intriguing to learn that companies were receptive to the idea of adopting common reusable takeaway tableware designs, as they indicated that such an option would not substantially compromise their branding.

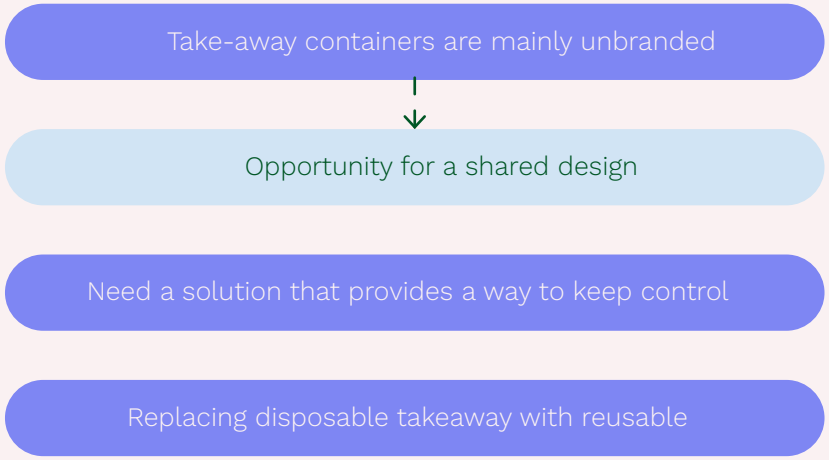


Figure 57. Co-Creation takeaways

4.1.2 Morphological chart

The Morphological chart was selected to generate concepts in a more structured way (Figure 58). Recognising the **complexity** of addressing all aspects of the service in one solution, this method enables the **deconstruction** of the service into sub-functions, facilitating idea generation for each component of the service. The results can be found in Appendix D. Figure 59 shows the sub-functions selected for the ideation.

Figure 58. Creating the morphological chart

Sub-function	Option 1	•••
Strategies to Reduce Waste from Disposable Tableware	Disposable items only available under demand	•••
Encouraging passengers to use the program	Rewards program where passengers earn points for using reusable tableware	•••
System for passengers to obtain the reusable tableware	Independent stations provided by Avinor	•••
Maintaining brand image	Standardization of the tableware but with the logos of the units	•••
System for returning used tableware	Deposit return machine (like the PANT system)	•••
System for collecting and transporting the tableware	Automatic robots	•••

Figure 59. Morphological chart set-up

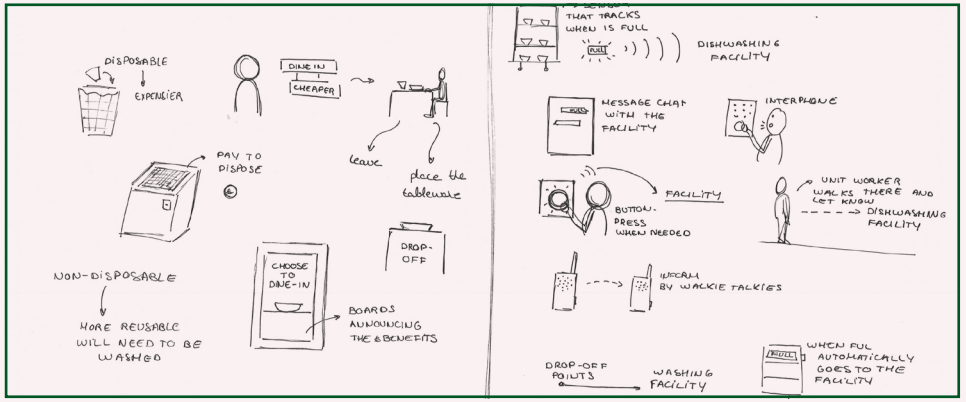


Figure 60. Braindrawing

4.1.3 Design directions: Braindrawing

From the generated ideas, **two design directions** emerged, shown in Figure 61. To develop the concept directions, the braindrawing method was used (Figure 60). This method facilitated a detailed exploration of ideas tailored to the specific context of each design direction, diving into user flow and backend flow elements. Further details on the ideas generated for each direction can be found in Appendix D.

Direction 1: Dishwashing of reusable dining-in options

This direction focuses on the service tackling the wash of **reusable dining-in** tableware. Since most units claimed to have enough dishwashing capacity, this direction englobes ideas such as a dishwashing service that acts as a **supplementary service** or using the dishwashing facility for the few units without capacity.

Direction 2: Dishwashing of reusable takeaway options

This concept consists of **replacing single-use takeaway** food containers with reusable ones. The centralised dishwashing service will be used to wash exclusively the reusable takeaway containers. With many serving units already equipped to handle reusable options, prioritising the elimination of disposable containers emerges as a strategic choice.

Figure 61. Design directions

4.2 Conceptualization

After the ideation, the main insights were translated into three different concepts (Figure 62). This section presents the three concepts and their key features in detail.

Figure 62. Concepts overview

4.2.1 Concept 1: Dishwashing on-demand

Derived from the first direction, this concept seeks to incentivise passengers to choose reusable tableware over disposable (see Figure 63). The concept involves implementing an **incentive programme** supported by prominent **signage** and banners strategically placed throughout the airport. These visuals inform passengers and highlight the programme connection to the centralised dishwashing service and its environmental benefits. By **raising awareness** through these means, the aim is to encourage a shift towards sustainable dining practices.

Staff members will inform passengers about the benefits of using reusable tableware and encourage them to dine in. Additionally, signs placed at ordering counters and dining areas will remind passengers to choose reusable options and inform them about the **rewards** they can earn. Passengers who choose to dine in or bring their own reusable containers will receive a **discount** on their meal purchases. The discount would be set at a certain percentage of the total bill. As an additional incentive, passengers will earn **points** every time they decide not to purchase a meal that involves disposable tableware. Once they accumulate a certain number of points, they can exchange them for rewards like discounts for eligible products or lounge access.

As possibly the **adoption of reusable alternatives** will increase due to the incentive programme, serving units will need to manage higher volumes of

reusable tableware. To deal with this, serving units can utilise the centralised dishwashing **service on demand**, acting as a support system. Unit staff will load soiled tableware into designated **carts**. Adjacent to the carts, trash bins will be provided for workers to dispose of any remaining food from the tableware. Once the carts are filled, workers can request assistance through a **digital platform**. Avinor Oslo Airport will then collect the carts, each displaying the logo of the serving unit and information about the service to raise awareness among passengers while transporting the cart to the facility. Within the facility, janitorial staff will clean the tableware cart by cart, ensuring that each unit's tableware remains separate, so each unit can keep its tableware design. Finally, the carts will be transported back to the units with the clean tableware.

This setup enables units to still have **control** over part of their tableware while benefiting from the service, reducing workload for staff and saving space. This service is also particularly helpful for units relying on disposable articles, as it will allow them to offer reusable alternatives, and for those lacking enough dishwashing capacity.

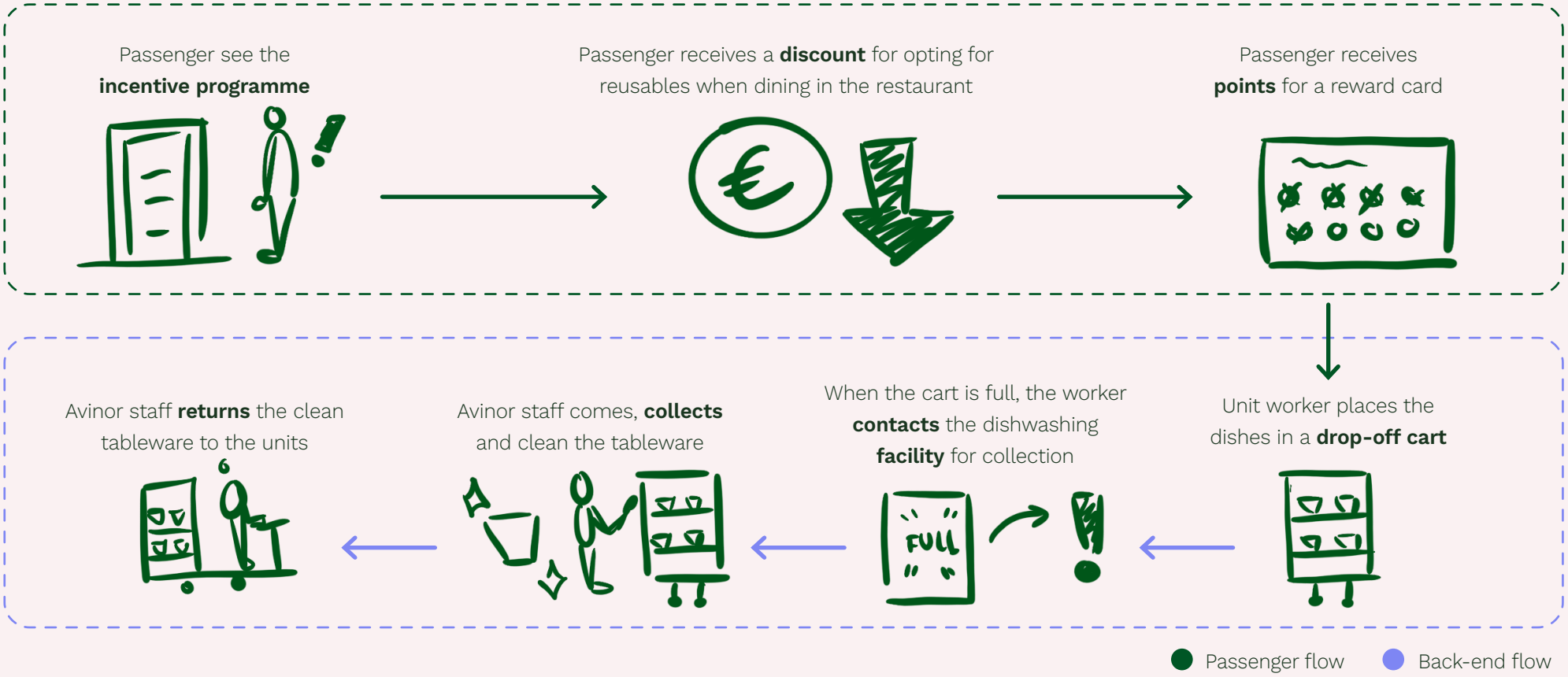


Figure 63. Concept 1: Dishwashing on demand

4.2.2 Concept 2: Reusable takeaway digital

This concept emerges from direction 2, **replacing single-use** takeaway food containers with reusable lunch boxes, as shown in Figure 64. The units will promote on their premises that an **app** needs to be downloaded to get a reusable lunchbox for takeaway, emphasizing the positive environmental impact of this choice. In the app, users need to **register** and enter their bank account details. Subsequently, when ordering takeaway at the counter, passengers need to **scan the QR** code of the reusable lunchbox through the app.

Once passengers finish with the lunchboxes, they can return them at designated s**mart drop-off points** conveniently located near **gates**. At these points, users can empty any remaining food from the container and then scan the QR code on the lunchbox to initiate the return process. Passengers will be charged if the lunchbox is not returned in a certain time.
Avinor Oslo airport janitorial staff will go through the drop-off points to get the used lunch boxes and transport them to the dishwashing facility. They will need to clean the bin with the rest of the food. In the dishwashing facility, lunchboxes will be cleaned and then transported to the serving units.
The decision to focus on food containers, as opposed to cups or cutlery, is based on the fact that, unlike paper cups, food containers typically play a less important role in conveying brand identity. This has the potential to make serving units more inclined to adopt shared designs and therefore streamline logistics. Additionally, field research indicates that single-use food containers, along with paper cups, rank among the most commonly disposed of items.

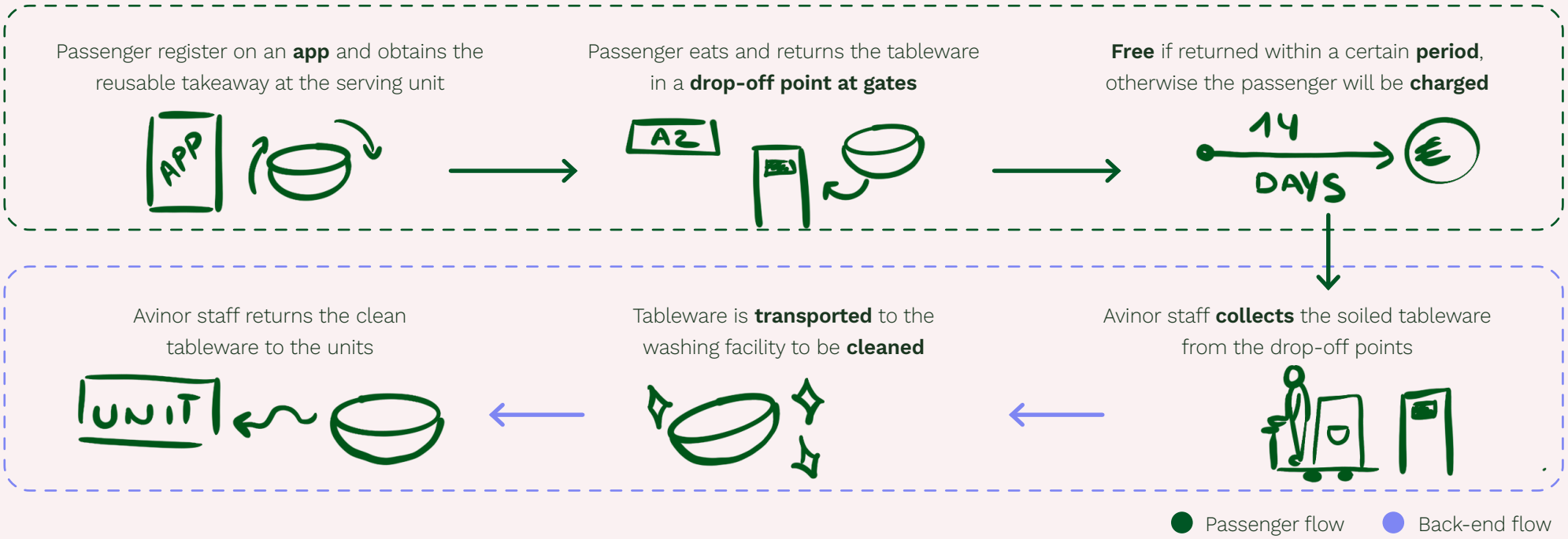


Figure 64. Concept 2: Reusable akeaway with an App

4.2.3 Concept 3: Reusable takeaway analog

In this concept (Figure 65), serving units will offer **reusable lunch boxes** for passengers ordering takeaways. When ordering, passengers will obtain reusable takeaway tableware by paying a **deposit**, that can be paid in cash or card. The tableware will show informative messaging highlighting its role in fostering an environmentally friendly airport.

Once finished, passengers can **return** the reusable tableware to any serving unit and receive the price of the **deposit back**. A unit worker will assist in the return process and provide the refund, which can occur at any convenient time, whether before catching a flight or upon returning.

Unit staff will **load the soiled** tableware into designated carts and the janitorial staff will **collect** it and transport it to the washing facility. At the washing facility, Avinor Oslo Airport staff will **clean** the tableware for later return it to the units.

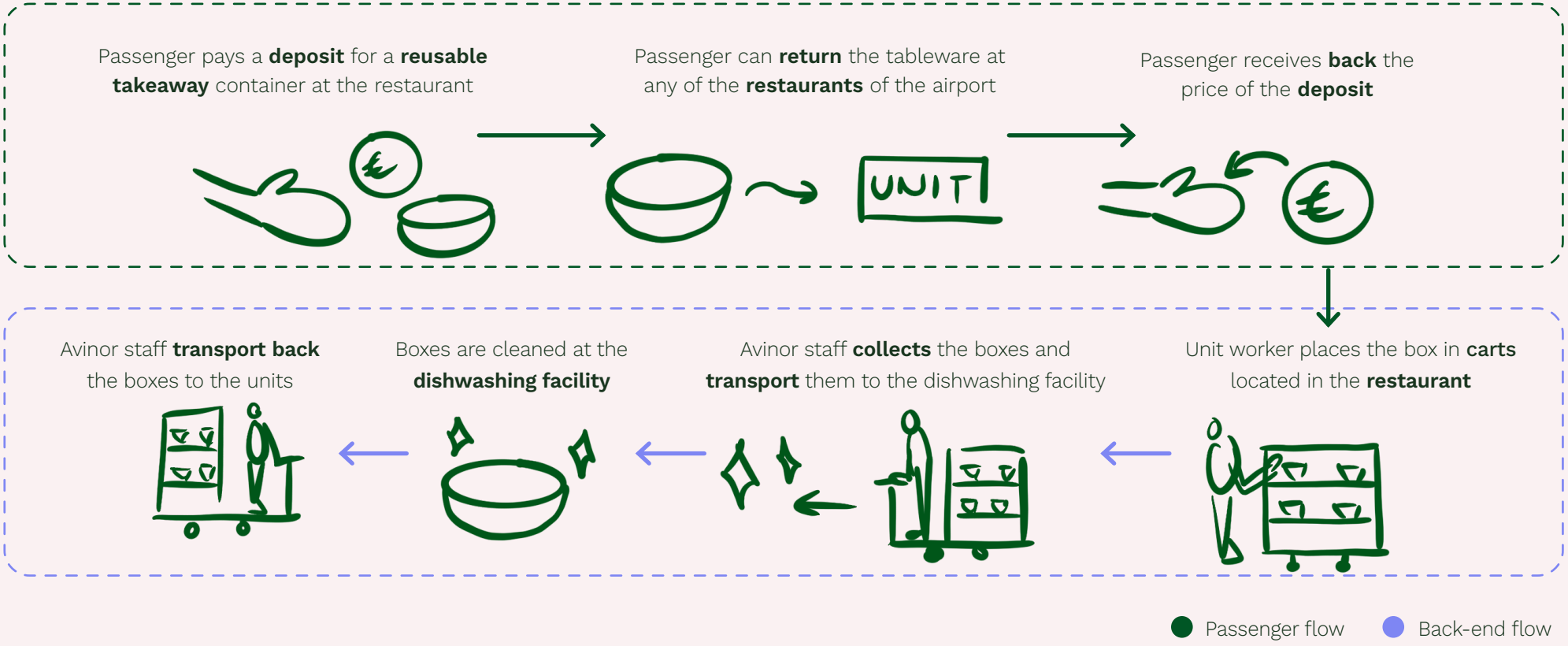


Figure 65. Concept 3: Reusable takeaway with deposit

4.3 Concepts testing

Before evaluating the three concepts, they were tested from a passenger perspective. Moreover, the three concepts were presented to the client to ensure they were on the right track and to collect feedback.

4.3.1 Passenger perspective

This concept testing aimed to assess the **acceptance** of the three concepts from the passenger's perspective. It focused on gaining insights that help later to evaluate the concepts. Therefore, the questions guiding the test were based on the design criteria (section 3.4).

RESEARCH QUESTIONS:

- Do passengers find the concept intuitive, convenient, and easy to use?
- Do the concepts offer affordable pricing options for passengers, ensuring accessibility?
- Do the concepts cause disruptions for passengers travelling in the terminal?
- Do the concepts provide passengers with alternatives that can be adapted to their ordering behaviours?

PARTICIPANT	AGE RANGE	DEMONYM
1	20-30	EU
2	20-30	EU
3	20-30	EU
4	20-30	Asian

Figure 66. Concepts testing. Passenger perspective test set-up

Set-up

A total of 4 testing sessions of **20 minutes** were conducted at the TU Delft ID Faculty. This location was chosen to enable quick feedback. Furthermore, the **four participants** (Figure 66) were selected based on their recent **visits to an airport**, having travelled within the past month.

During the testing, the participant was asked to image themselves as a passenger at Avinor Oslo Airport, ordering food from one of the serving units. For context, a **map of the airport** was provided. Subsequently, each concept was presented to the participant. The main elements of each concept were materialised into **small signs** to enhance the participant's understanding (Figure 68). This way, they could easily interact with the concept and play with the signs along the map. After testing each concept, participants were asked to respond to questions regarding convenience and ease of use and to share their thoughts. Figure 67 shows an overview of the process followed. At the end, participants were invited to combine their preferred elements to create their ideal service.

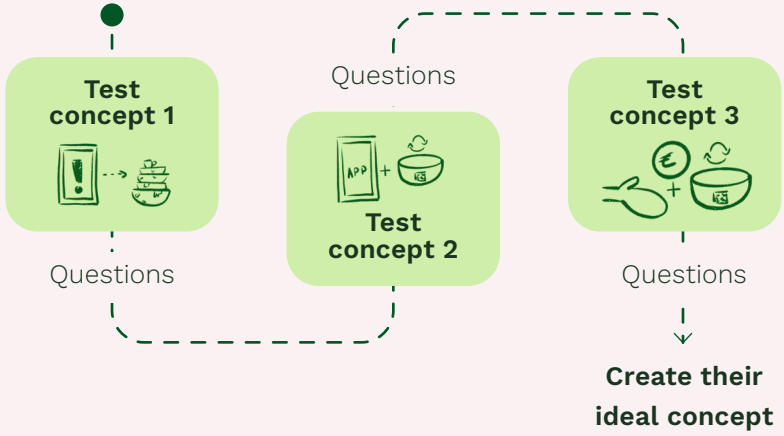


Figure 67. Concepts testing: Passenger perspective test overview

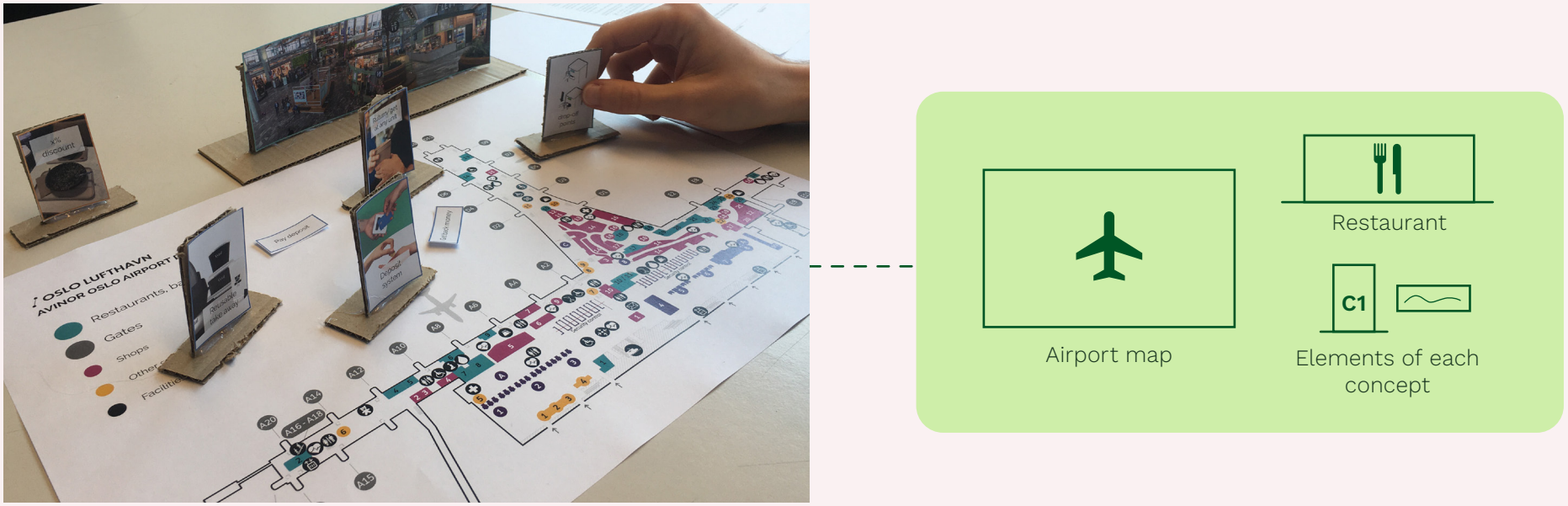


Figure 68. Concepts testing: passenger perspective test materials

Results

Figure 69 illustrates an overview of the results. Regarding **concept one**, participants reacted favourably to the discount incentives. However, it was shared that having the **discount** incentive and the **promotional card** was not necessary. This is because the card will take some time to be filled and thus does not offer an immediate, attractive incentive. Additionally, all participants expressed being concerned about the **premises** of the unit being full, which might prevent them from choosing reusable tableware. Ultimately, the four participants expressed that if the discount is not significant, they might still opt for takeaway, as they prefer this option when at the airport.

In **concept two**, all participants showed rejection of the **app**. They revealed concerns related to data privacy and not feeling comfortable sharing their bank account details. Moreover, participants highlighted concerns about the lack of data/internet availability for downloading the app, expressing distrust in using public connections to input bank details. However, they responded positively to the **reusable containers** and indicated they would likely return the containers. They also mentioned that a 14-day return period would be more than sufficient, as they typically finish their food before entering the plane. Additionally, the idea of returning the containers at drop-off points at the **gates** was accepted by everyone and described as convenient. Nevertheless, one participant highlighted that would be nice to be able to contact a person in case the returning process does not function properly.

In **concept 3**, participants showed a preference towards the **deposit system** over the app as a payment method. They claimed that a deposit system is such a used concept that they would not be bothered by needing to pay a small deposit for a reusable. Moreover, they said that they do not mind returning the containers to the serving units since, according to the map, a lot of units are located next to the gates. Nonetheless, they believed this may cause long **queues** at the units and therefore the process would take longer.

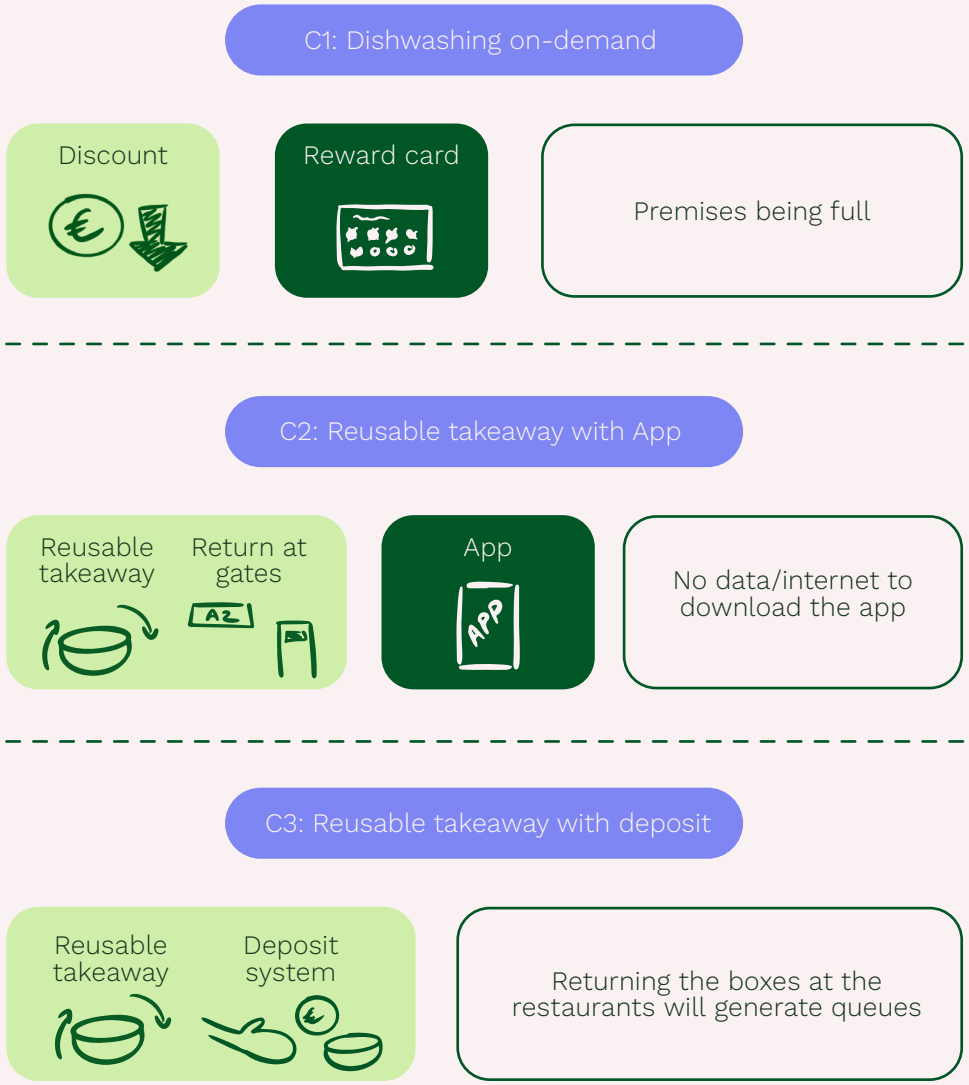
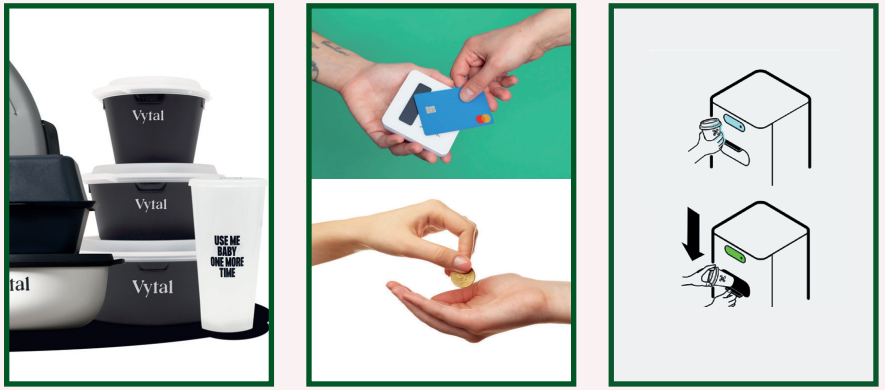


Figure 69. Concepts testing results

Conclusions

In the end, all the participants created the same **ideal concept** (Figure 70). This consisted of the reusable takeaway containers, the deposit system and the drop-off points at the unit. Overall, participants selected the **reusable takeaway** containers because of convenience and because they suited better their ordering preferences. Additionally, the drop-off points at the gates were selected for being more efficient and facilitating a fast return. Ultimately, the deposit system was chosen for their convenience and familiarity.



Reusable takeaway (C2&3) Deposit system (C3) Return at gates (C2)

Figure 70. Concepts testing conclusion

4.3.2 Client feedback

Client feedback was asked to ensure that the concepts were on the r**ight track**. For it, a document that explained each concept in detail was sent to the client. This document was received back with comments for each idea. Overall, the three concepts were accepted, and a green light was given to proceed with any of the three.

4.4 Concepts evaluation

To guide the process of deciding which concept to develop in the next phase, the **Harris Profile** (van Boeijen & Daalhuizen, 2010) was used. This method was selected since it helps to evaluate the fulfilment of the Design Criteria of the three concepts. The evaluation findings of the three concepts are depicted in Figure 71, where ++ indicates that the concept excels in fulfilling the corresponding criteria, + signifies that it meets the criteria, - indicates non-fulfilment, and -- denotes that it adversely affects the criteria. The Harris Profiles of each concept were filled taking into account the insights from the testing.

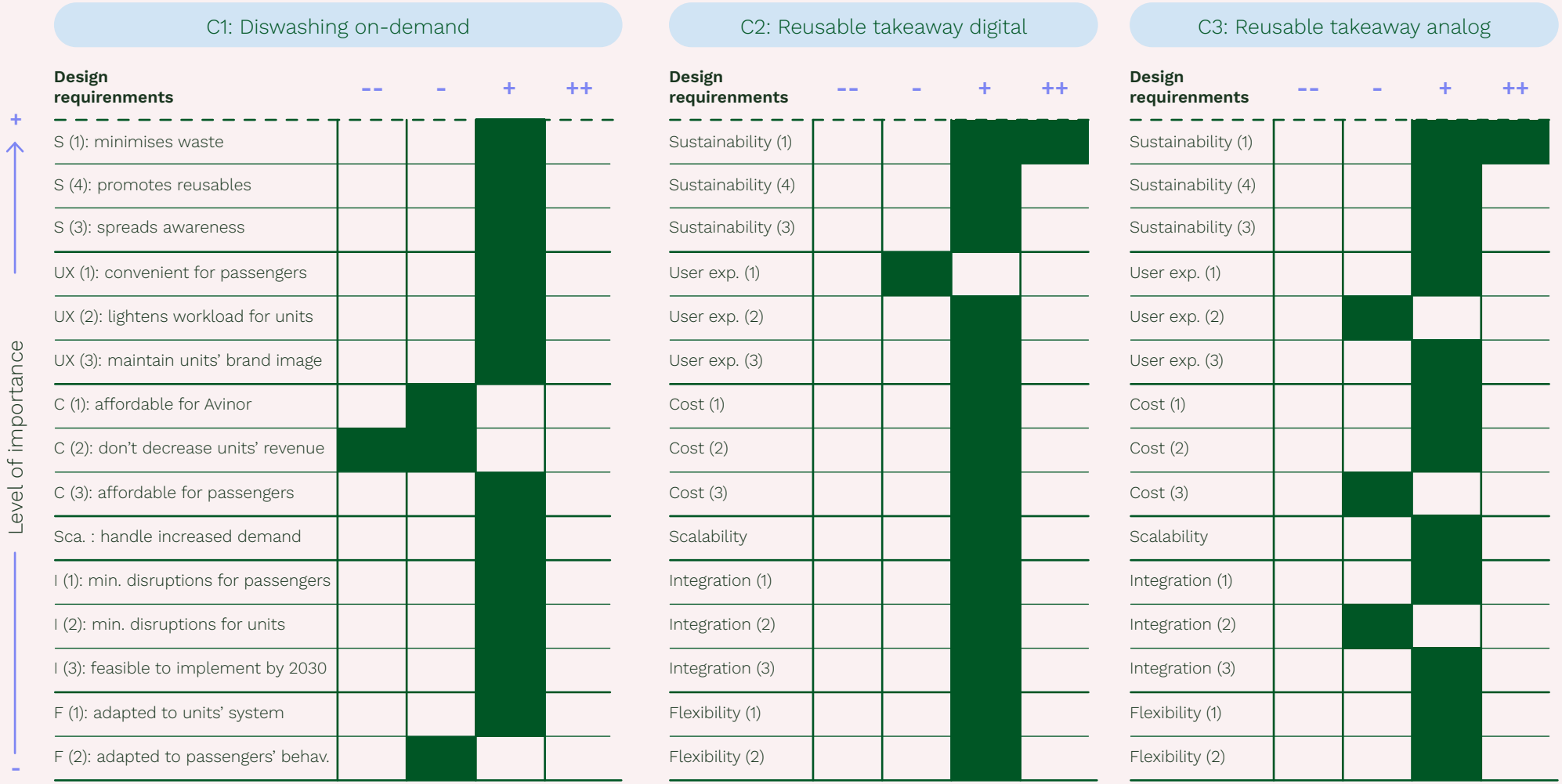


Figure 71. Concepts testing conclusion

Conclusions Harris Profile

Concept 2, the reusable takeaway with an app, performed the best in the evaluation. However, to better align the solution with the design criteria certain aspects of the other two concepts have been incorporated into the concept. Firstly, the convenience of not having to use an app will be implemented to achieve a better passenger experience. Furthermore, from Concept 1 the idea of contacting the dishwashing facility when needed will be integrated to achieve a better integration of the concept in the serving units and scalability.

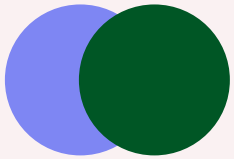
4.5 Conclusions Chapter 4

During this chapter, perspectives from tenants, unit workers and passengers have been considered. For the next phase, concept 2 will be developed in detail. Focusing in reusable containers that substitute the disposable options (Figure 72) has great potential to be accepted. This idea was widely accepted among the stakeholders during the co-creation session. Additionally, during the concept testing at the university, participants were positive about the idea of takeaway boxes, as they felt this would give them more control over their passenger experience at the airport. Moreover, several units serve **pre-packaged food** prepared in a central kitchen. Thus, reusable takeaway containers could substitute the disposable packaging used for the pre-packaged food and therefore avoid disposing of a lot of single-use packaging.

Figure 72. Scope selected idea

Chapter 5

Develop



In this phase, the final concept is refined and finalised. To guarantee the acceptance of the different stakeholders and the feasibility of the final design, different testing and validation sessions were conducted.

5.1 Final design: Green Circles

The final concept, named Green Circles, **replaces single-use** takeaway food containers with reusable takeaway food containers. This includes the disposable food containers used for serving passengers **at the units**, and the containers used for making pre-prepared food in the **central kitchen**.

How does it work?

To explain how the final concept works, the **journey of the reusable container** (Figure 73) will be followed. The **main flow** describes the jorney of the container being taken by a passenger at the serving unit and then being returned before the passenger gets into the plane. The **potential flow** illustrates the possibility of the container being taken into the plane or being transported to the central kitchen to be used to make pre-packaged food.

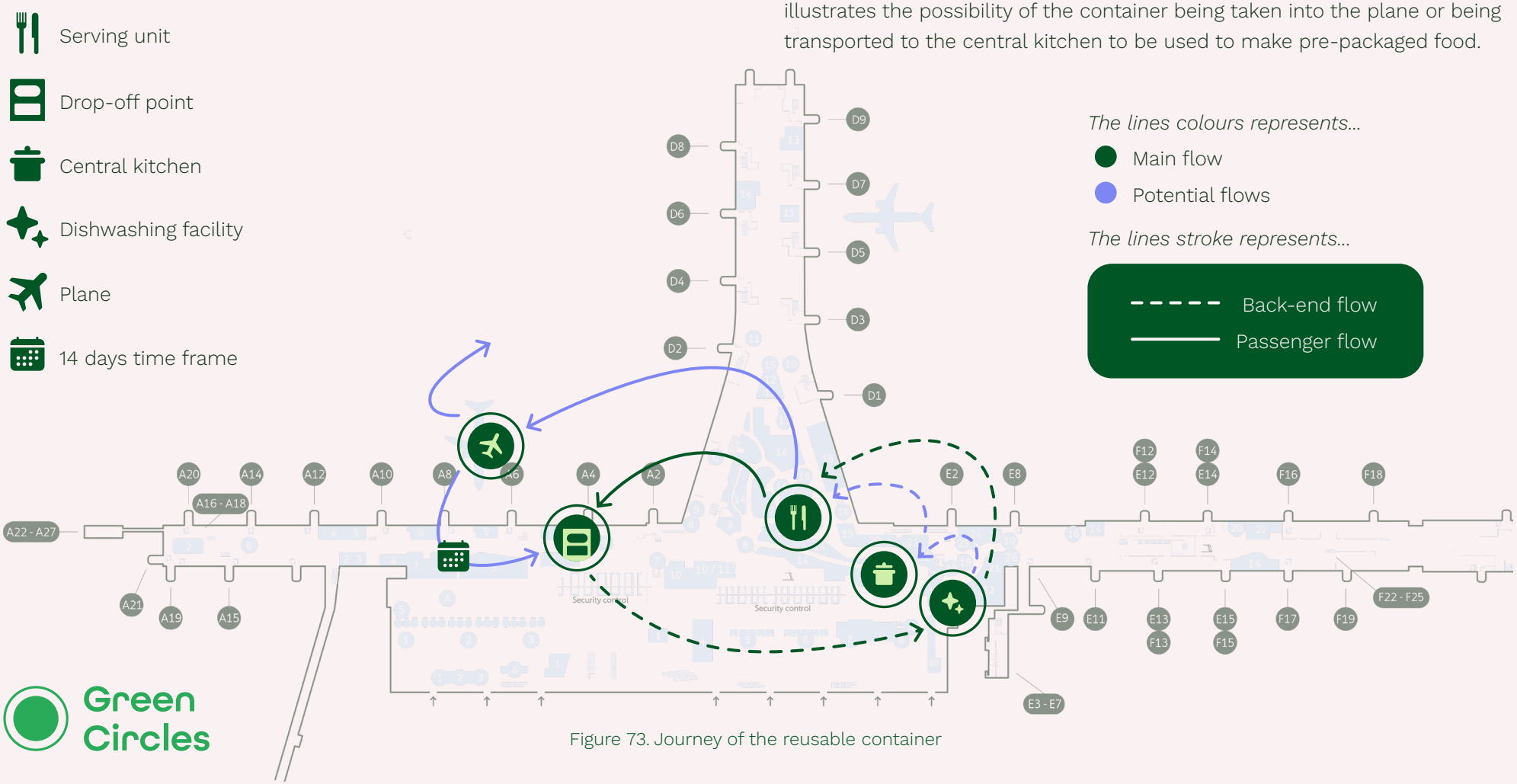


Figure 73. Journey of the reusable container

At the serving unit...

Figure 74 shows the start of the process. When passengers **order takeaway food** or buy a **pre-prepared meal**, they will borrow a reusable takeaway container (Figure75). For lending the containers, serving units will count with a device that can link the containers, equipped with an **RFID tag**, to the passenger's **bank card**. In this way, passengers only need to **pay if the container is not returned**, a concept known as '**Tap&Reuse**' (KleenHub, 2023). To inform passengers about this system, units will count with **standees** and billboards, which also highlight the connection of the system to the dishwashing service and its environmental benefits.

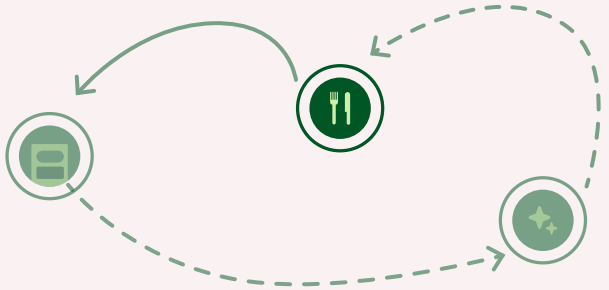


Figure 74. Journey of the reusable container step 1

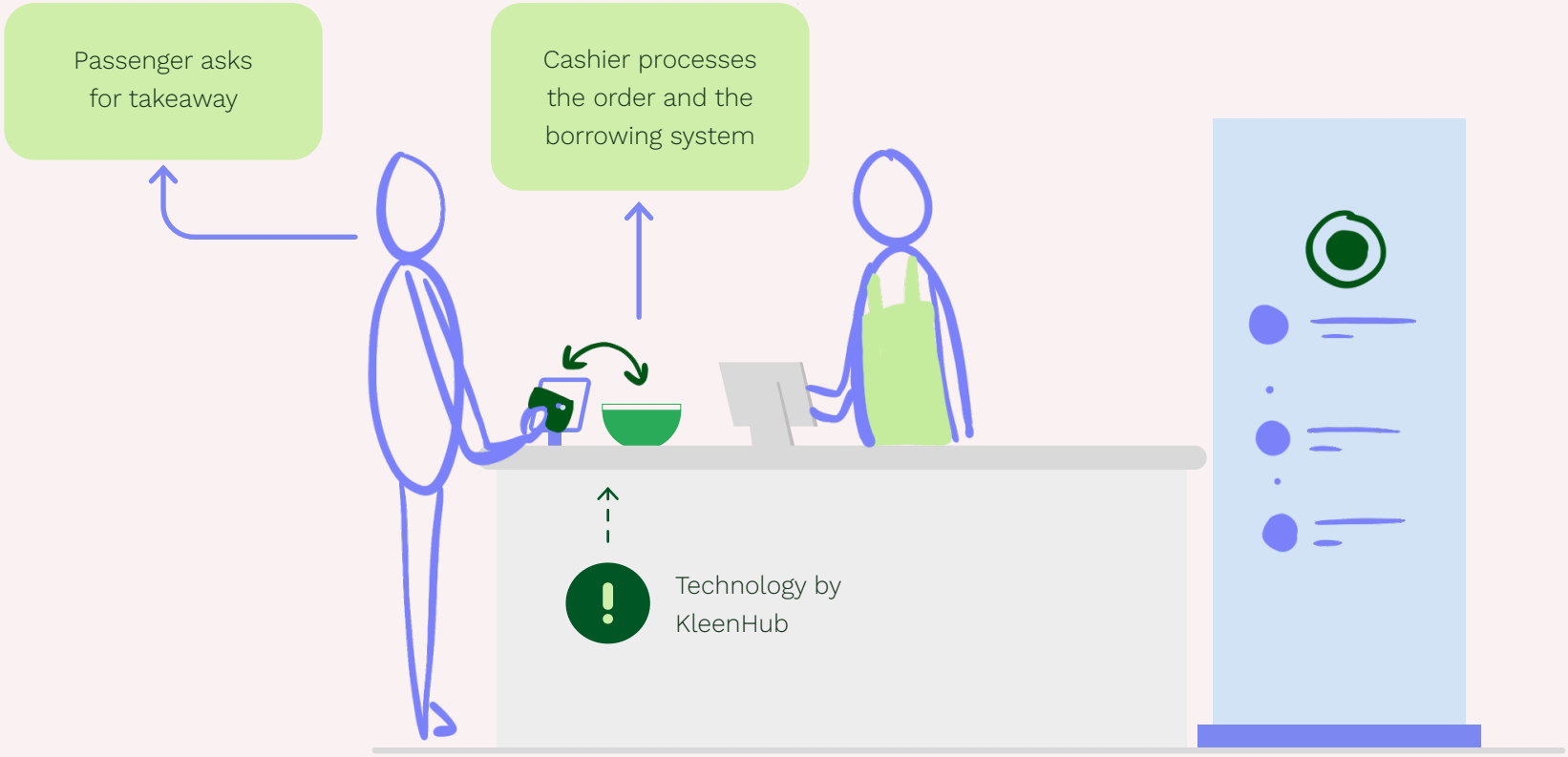


Figure 75. Obtaining the container at the serving unit

At the boarding gate...

Once passengers are done with their takeaway container, they can **return** it at any of the **smart drop-off points** located at the boarding gates or exits of the airport (Figure 76). Passengers will just need to insert the container into the machine. Then, the machine will read the **RFID tag** and accept the container, as depicted in Figure 77. Passengers have a period of **14 days** to return the containers, if not, they will be charged with **90 NOK.** This ensures a fast, convenient and deposit-free drop-off experience for passengers.

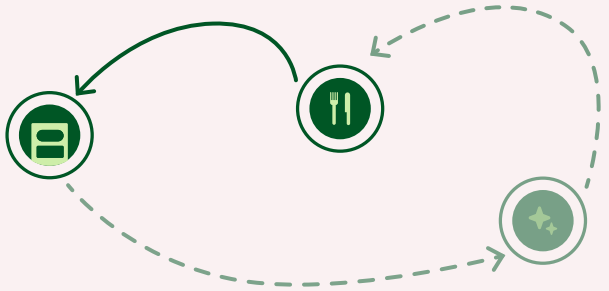


Figure 76. Journey of the reusable container step 2

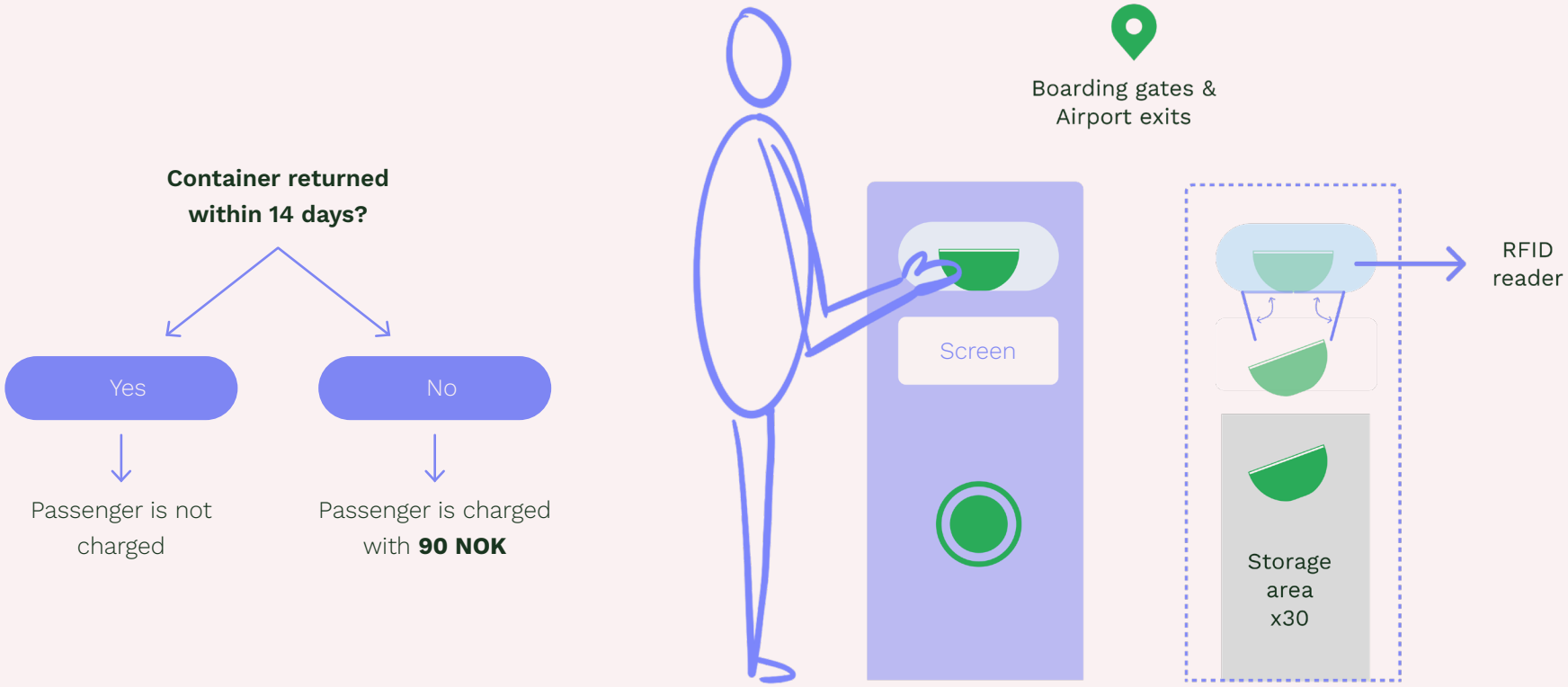


Figure 77. Returning the container at the drop-off machine

Collection and transport of containers...

The drop-off points are equipped with sensors to detect when they are full. When full, Avinor Oslo **Airport janitorial staff** will receive an alert through the Green Circles **app** (Figure 79). In this way, the janitorial staff can easily keep track of which points need to be cleaned and ensure that they are still usable for other passengers. Moreover, through this app, serving units can also request reusable containers back to the dishwashing facility when needed. The used containers will be transported from the drop-off points to the dishwashing facility (Figure 78) in **carts**, that will display information about the service to raise awareness among passengers. In the **dishwashing facility**, containers will be cleaned and then transported back to the serving units and central kitchen.

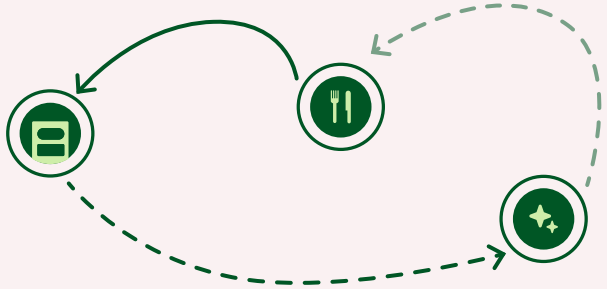


Figure 78. Journey of the reusable container step 3

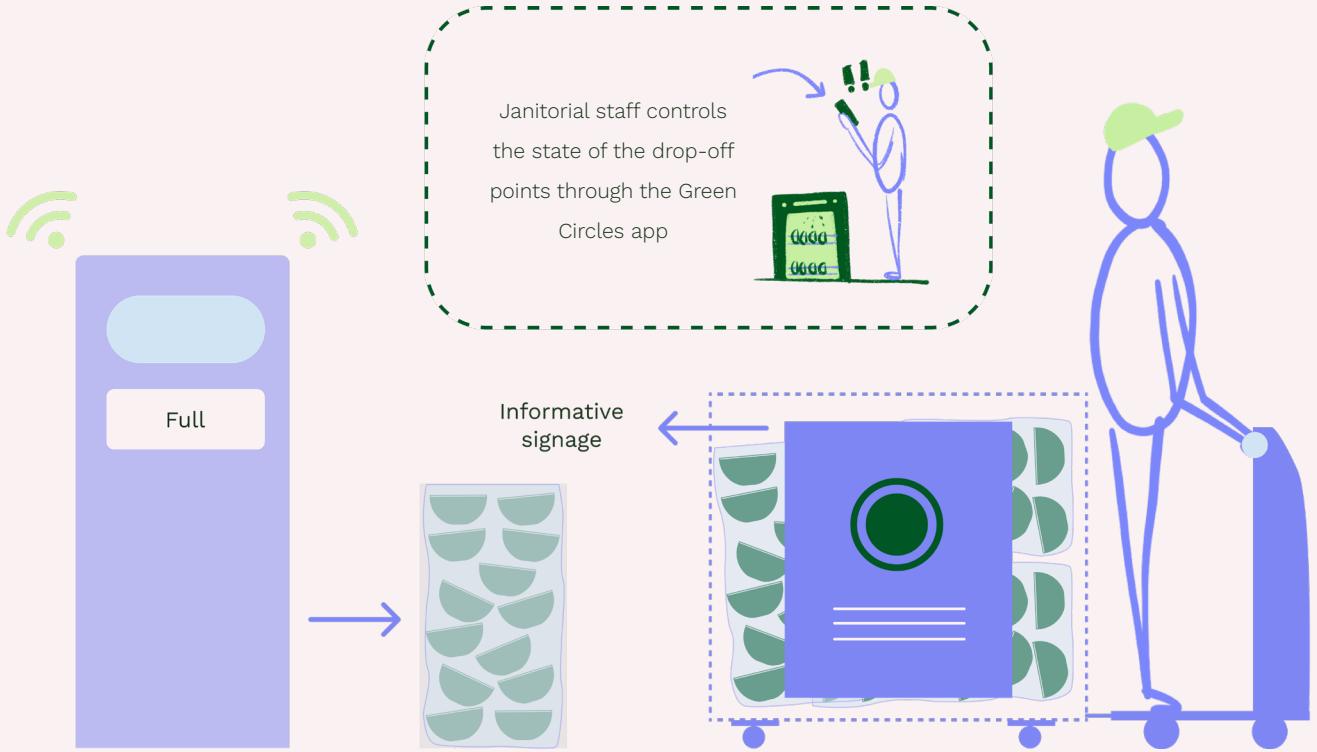


Figure 79. Returning the container at the drop-off machine

Other flows...

Apart from the main flow, the container might follow **alternative journeys** (to better understand the journeys, have a look at Figure 80). First, as shown in Figure 81, the container can be transported from the dishwashing facility to the **central kitchen** (for preparing pre-packed salads, for example) and then from the dishwashing facility to the serving unit. Additionally, if the passenger chooses to take the food onto the plane, two scenarios arise based on the passenger's travel itinerary. Figure 82 illustrates the scenario where the passenger **returns to Oslo** within 14 days, allowing them to return the container after the trip. Conversely, Figure 83 depicts the scenario where the passenger does **not return to Oslo**, resulting in the loss of the container. However, it is worth mentioning that 90% of the disposable tableware served is used at the airport (Avinor, 2022), so it is expected that this scenario would not significantly disrupt the overall flow.

Figure 80. Legend container journey

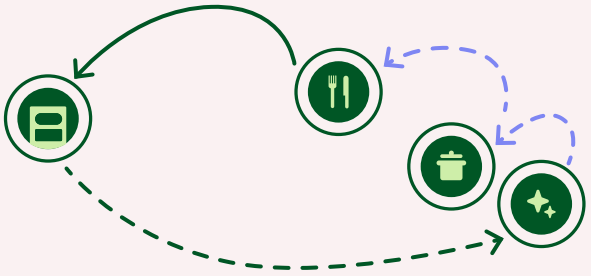


Figure 81. Journey of the reusable container alternative flow

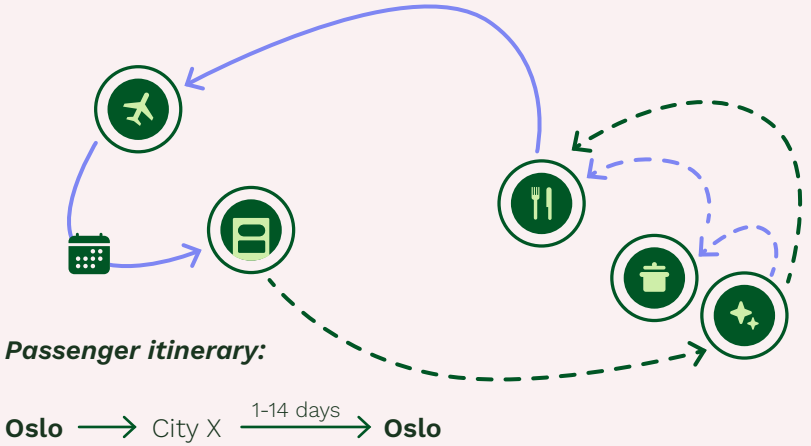


Figure 82. Journey of the reusable container alternative flow: Plane & return

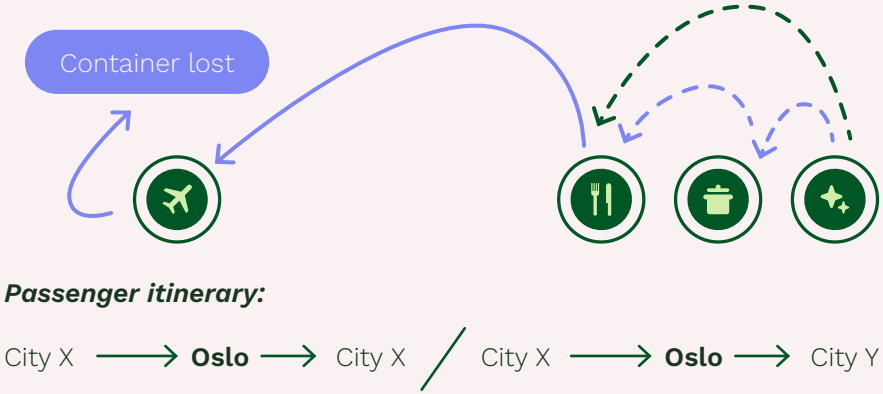


Figure 83. Journey of the reusable container alternative flow: Plane & not return

5.1.1 Service blueprint: dishwashing as a service

Green Circles consists of many steps and involves many stakeholders. To create an overview of all, a service blueprint have been created, taking as a reference the scenario in which passengers **return reusable containers** (Figures 84 & 85). The service has been divided into three stages. In the first stage, passengers acquire the reusable containers at the serving units.

Subsequently, stage two consists of passengers using and returning them at the drop-off points. Stage three focuses on the actions taken by the janitorial staff, such as collection, cleaning and redistribution. After this, the service will return to stage one and the process will start again

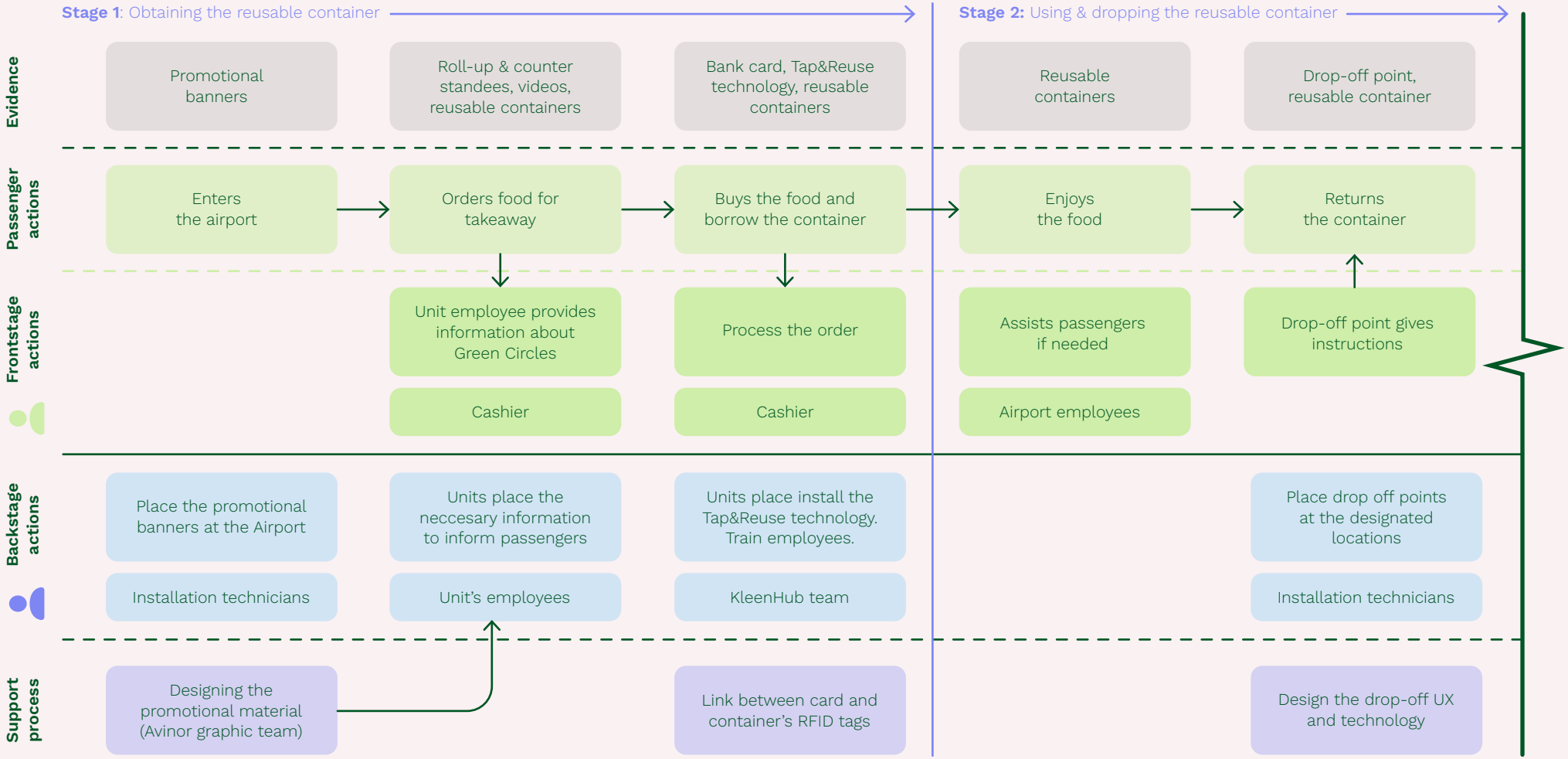


Figure 84. Service blueprint 1

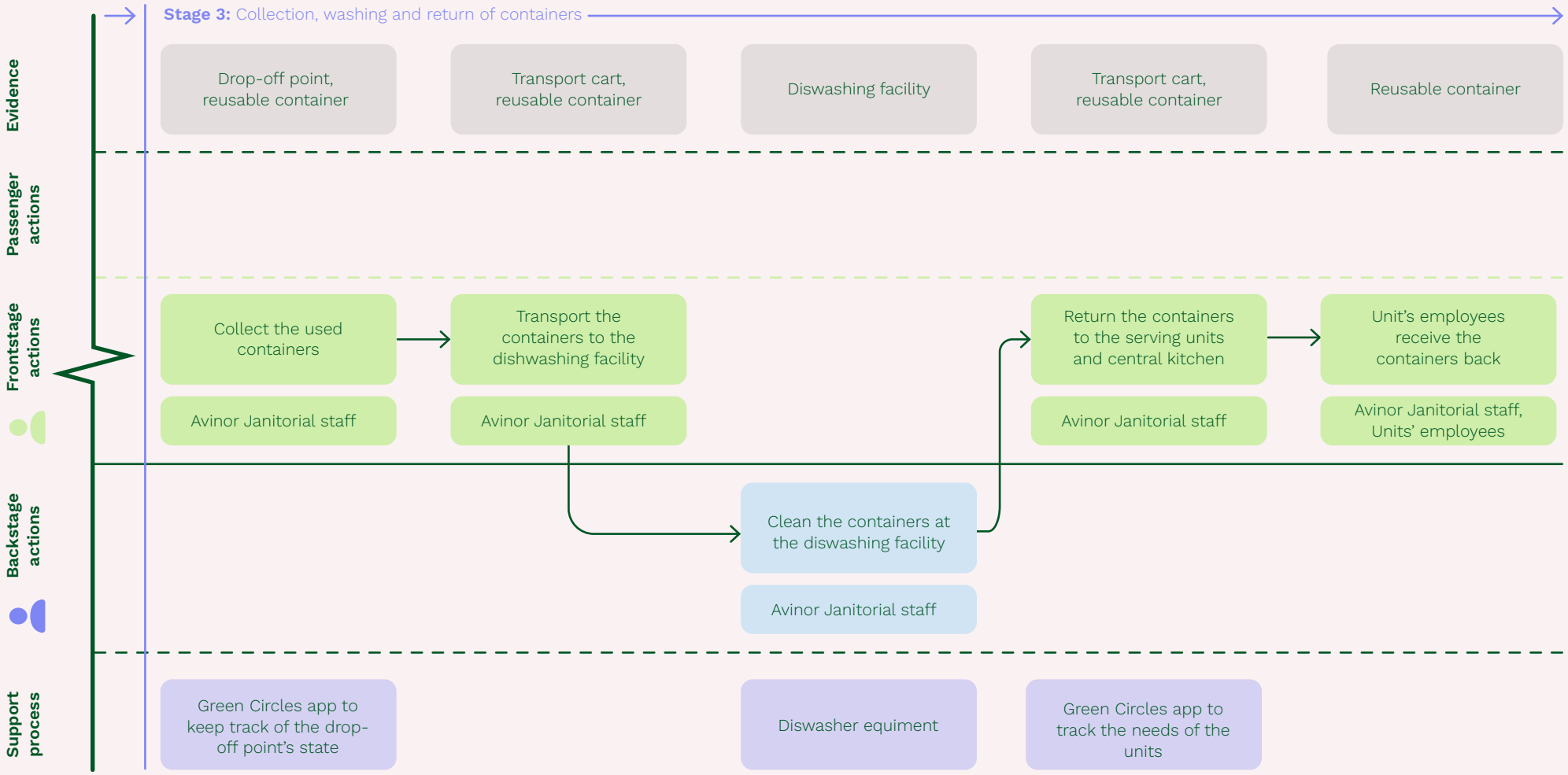


Figure 85. Service blueprint 2

5.2 Concept validation

In this section, the final concept is assessed by different stakeholders, to validate the idea and to identify potential areas of improvement.

5.2.1 Validation by a tenant and unit worker

A **one-hour** session was held to validate the final concept by the airport tenant with the most units. The participants in the session were the quality & Sustainability manager a serving unit worke. The **goal** was to understand how the service influences the workflow of the serving unit's employees, identify potential pain points and **analyse the acceptance** of the service.

Set-up

To present the idea to the participants, a storyboard was created (Figure 86). To have a better look at the storyboard see Appendix E. To support it, the system's functionality was roleplayed using various low-fidelity prototypes, as illustrated in Figure 87 & 88.

Figure 86. Storyboard & containers

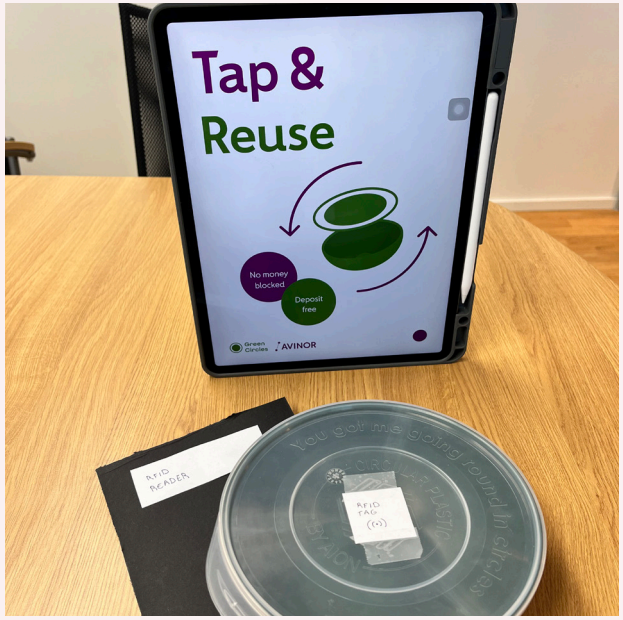


Figure 87. Tap&Reuse prototype

Figure 88. Drop-off prototype

Results

Overall, the service was evaluated as **feasible**. However, the feedback gathered was organised into the categories shown in Figure 89.

Reusable containers

- The food prepared in the kitchen should be **labelled** showing the **allergies**, as stated by law.
- The lids of the container (AION container) are not **transparent** enough, meaning that passengers cannot see clearly what is inside. This is relevant for the food prepared in the central kitchen, as they are later displayed in the serving unit's fridges.
- Using reusable containers can **expand the takeaway options** in the serving units since the existing disposable containers are not good enough for all foods, like soups.
- The **sizes** of the reusable containers need to be adapted to the existing sizes of the disposable options.

Payment method

- The payment system for borrowing the container should not take much of the unit worker, optimally it should last less than **30 seconds**.
- **Displays** showcasing information about how the service works would be really helpful to speed up the process. Suggested ideas included movies or flyers. Moreover, it was mentioned that the information should be in **different languages**, as not everyone speaks English or Norwegian.
- The **Tap&Reuse** was successfully accepted regarding safety, as it is more secure than systems that require scanning QR codes.
- Concern was raised regarding the fact that when the **internet connection** does not work, the system will stop working.

Dishwashing service

- The staff **washing** the containers should be a serious partner, as serving units work with raw fish.
- The idea of having an **app** that allows communication with the washing machine facilities was well received, as the operating company is now integrating iPads for tracking the internal logistics of the units. The app was preferred over calling directly the facility since during busy times, picking up the phone will not be that convenient.

Figure 89. Results concept validation tenants & unit worker

5.2.2 Validation by Passengers

Validation with passengers was conducted with the **goal** of assessing the **acceptance** of the service and to identify potential **pain points**. In total, seven passengers were interviewed in sessions of 5-10 minutes. More details about the interviews and participants are shown in Figure 91.

Set-up

The service was introduced to the participants through a storyboard (Figure 90), which can be found in Appendix E. After explaining the storyboard to the passengers, they were asked to share their thoughts and concerns about the service, to point out the part that could be more challenging to adapt to.

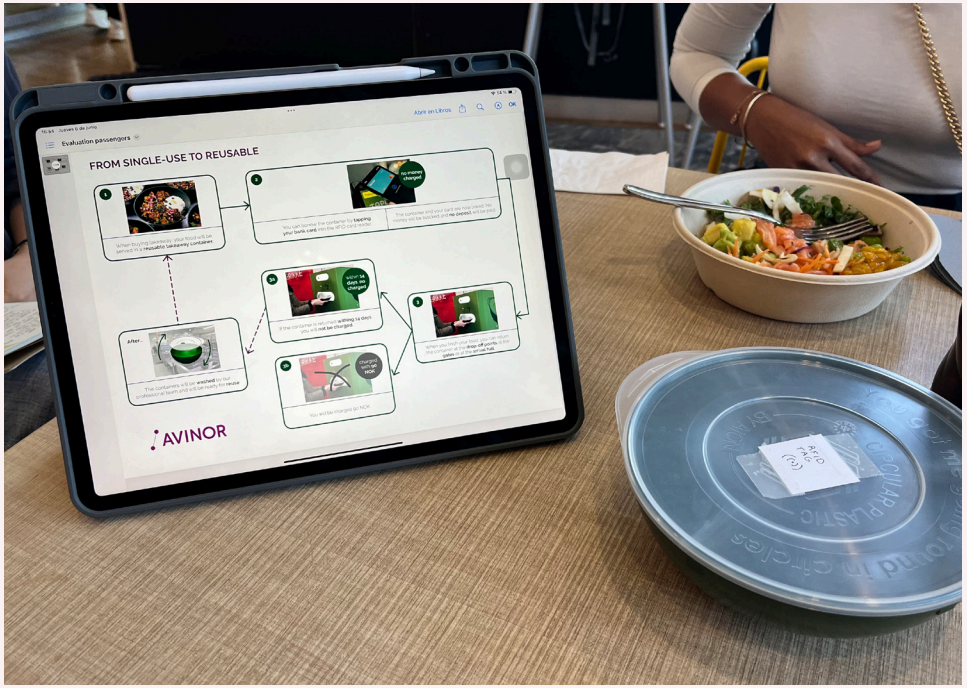


Figure 90. Results concept validation tenants & unit worker

PARTICIPANT	AGE RANGE	DEMONYM	AIRPORT AREA	LOCATION
1	18-20	Norwegian	National	Gate
2	<65	Norwegian	National	Serving unit
3	21-30	Norwegian	National	Serving unit
4	41-65	Norwegian	National	Serving unit
5	18-30	South-American	International	Gate
6	18-30	EU	International	Serving unit
7	18-30	EU	International	Serving unit

Interviewed: Individually Together

Figure 91. Results concept validation tenants & unit worker

Results

- **Familiarity**: All passengers were familiar with similar payment systems based on deposit. Therefore, the payment system was easily accepted and did not raise any concerns.
- **Returning time frame**: The time frame for returning the container was accepted by the passengers, stating that it should be enough in most of the cases.
- **Taking food for the plane**: Most of the passengers showed interest in what will happen if they want to take the food into the plane. However, all of them stated that usually they finish their food before boarding the plane.
- **Information**: Passengers pointed out that it would be useful to have some kind of information explaining how the service works, especially for older passengers who may feel less comfortable using technology.

5.2.3 Validation by central kitchen

A short validation interview with a central kitchen employee was conducted with the **goal** of assessing the acceptance of the service and to identify potential pain points. In total, the interview lasted around **15 minutes**. The service was introduced to the employee through the storyboard. After briefly explaining the concept, the employee was invited to share her thoughts and concerns about the service. The concept was **accepted**, but several concerns were raised, which are mentioned in the results bellow.

Results

- **Return**: the employee expressed concern about the containers being correctly returned. Typically, the cradles used to transport food to the serving units are not consistently returned. This is often because employees at the units might keep them for other purposes. As a consequence, there is a certain mistrust in 'returning processes'.
- **State of the container**: ontainers need to come clean, as they would not have time to clean them, and that they need to be stackable to save space.
- **App**: the idea of having an app for contacting the dishwashing facility was well-received. According to the interviewee, facilitating communication between the dishwashing facility and them would be important to ensure they have enough containers in time.

5.2.4 Conclusions validation

The final concept shows promise, with acceptance from all the stakeholders. However, there are several areas needing attention achieve an optimal implementation (Figure 92):

Efficient borrowing System

Borrowing the container should be quick and secure to accommodate passenger' needs and unit's employees' needs.

The reusable containers

Te feasibility of using reusable containers was affirmed, but practical aspects such as labelling, compatibility with existing packaging sizes and transparency needs to be consider.

Dishwashing Service

Ensuring the reliability and cleanliness of returned containers was highlighted as an important point for all stakeholders.

Figure 92. Conclusions validation

5.3 Final test

This test aims to study the impact of the design on the **passenger experience**, from getting the reusable container to returning it at the drop-off point. Design improvements can be applied to the different touchpoints from the feedback collected. The research questions are formulated to address the design criteria.

RESEARCH QUESTIONS:

- Do the participants find the concept intuitive, convenient, and easy to use?
- Is the concept perceived as affordable?
- Does the concept cause disruptions in the passenger's journey through the airport?
- Is the concept adapted to the dining needs of the passenger?

Set-up

A total of 5 testing sessions of **30 minutes** were conducted at the TU Delft Pulse building ground floor. This location was chosen because this space presents similar features with an airport (restaurants and sitting spaces for eating, working, or resting. Furthermore, the **five participants** (Figure 93) were selected based on their recent **visits to an airport**, having travelled within the past month.

During the testing, participants were asked to imagine themselves **ordering food for takeaway** at the airport. First, they needed to go to the restaurant and place their order. At the restaurant, a **banner** explaining how Green Circles works was displayed. Then, they ordered their food to the cashier (a role played by the author of this thesis). After receiving their order, participants would simulate eating it and then return the container to a **drop-off machine**. A prototype was created to replicate the passenger interaction with this machine. After testing the concept, a semi-structured interview was conducted to gather information to answer the research questions. Figure 94 provides an overview of the process followed.

PARTICIPANT	AGE RANGE	DEMONYM
1	18-30	Asian
2	18-30	EU
3	18-30	EU
4	18-30	EU
5	18-30	EU

Figure 93. Final test participants demographic

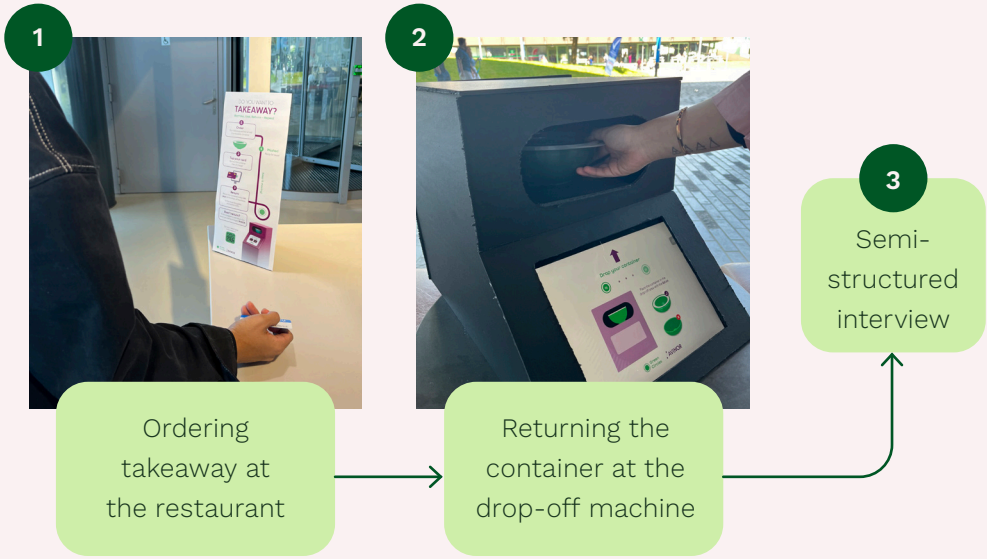


Figure 94. Final user test set-up

Results

From the interview results and the observations made during the test, several pain points related to the design of the banner and drop-off interaction were identified. Thus, changes were made to increase the understandability of both touchpoints.

Banner

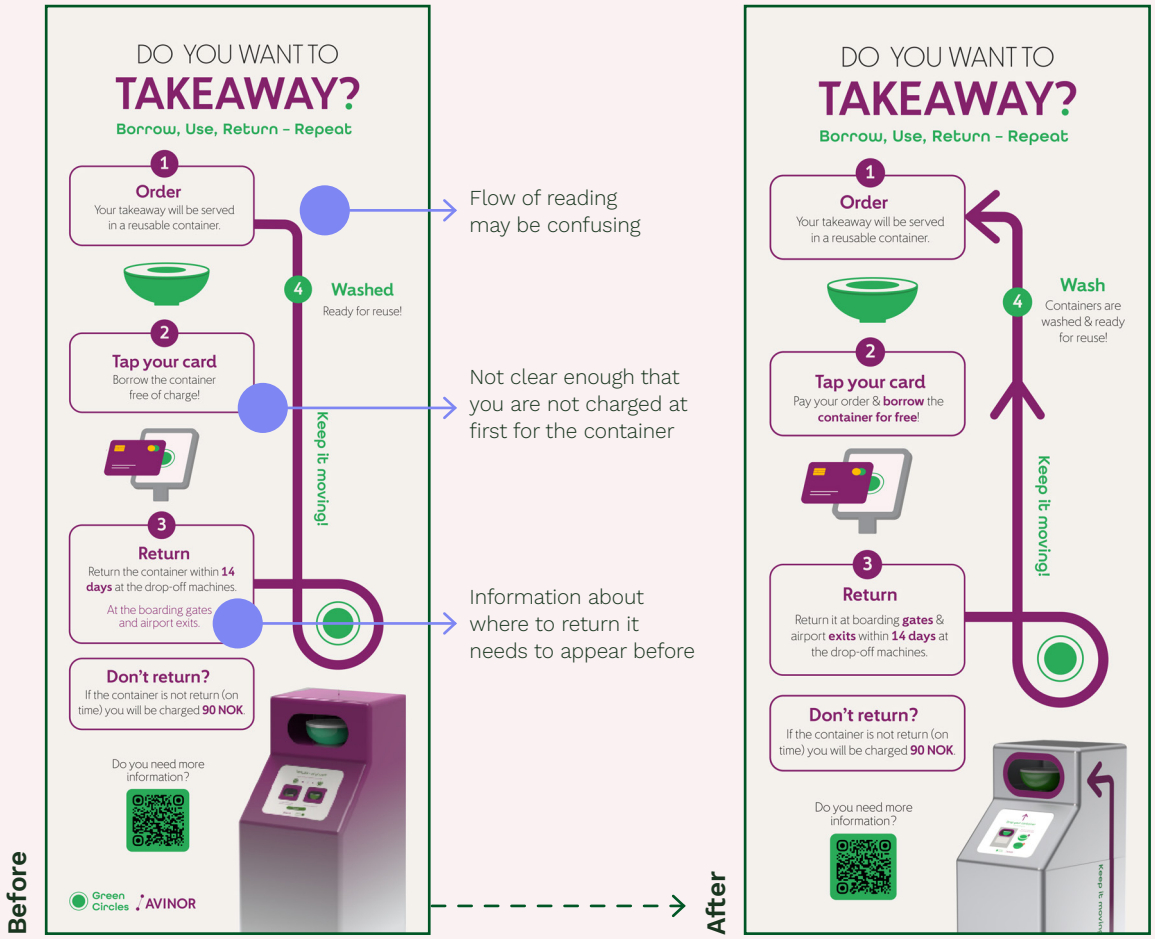


Figure 95. Banner painpoints and redesign

The painpoints that participants experienced with the banner are illustrated in Figure 95. Based on their feedback, the banner was refined. Overall, the process was described as easy to follow, with the most significant aspects being **where** to return the container and the **price** to pay if it was not returned. Additionally, participants mentioned that they did not read the banner in-depth but rather scanned it, as they felt this would reflect their behaviour at the airport or while standing in a queue. Therefore, they found the **highlighted text** particularly important.

> **"Follow the stepts 1,2,3,4 was quite easy."**
>
> Participant 2

> **"The image of the drop-off machine helped me"**
>
> Participant 3

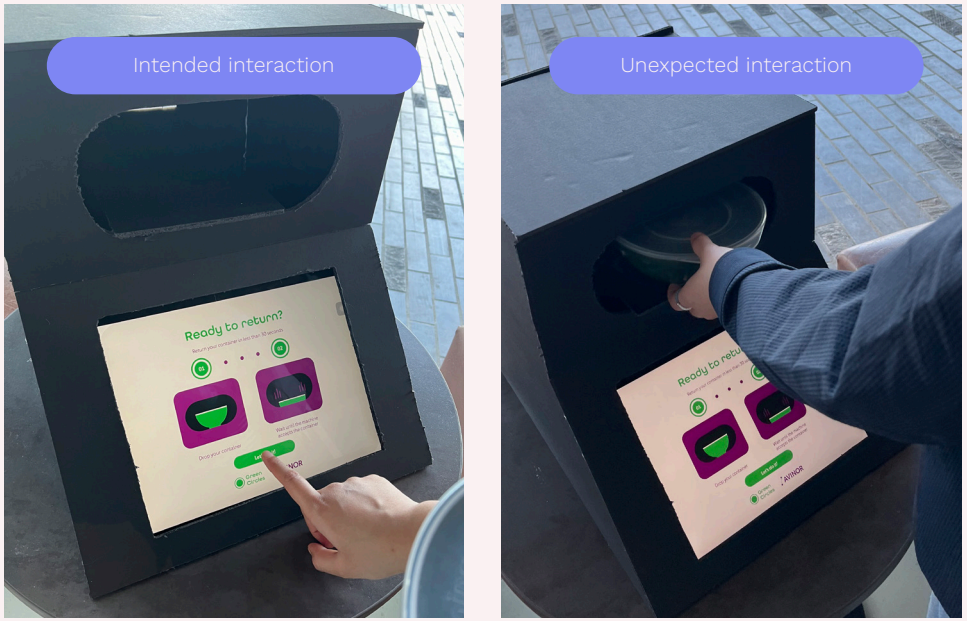
> **"At first I thought it was a pending payment."**
>
> Participant 4

Drop-off machine

The painpoints that participants experienced while interacting with the drop-off machine are illustrated in Figure 96. Based on their feedback, the **interface** was refined. Overall, the process was described as fast. However, it was observed that some participants placed the container inside the machine before starting the process on the screen, causing confusion. To address this, the '**start screen**' was removed, resulting in an even faster interaction (Figure 97). Additionally, the text displayed on the end screen was divided into two screens to make it clearer to users that the process was finished (Figure 98).

"Surprisingly fast"

Participant 3



First press 'start' then place the container

First place the container, - participant is confused for a sec.-, then press 'start'.

Figure 96. Different first interactions with the machine

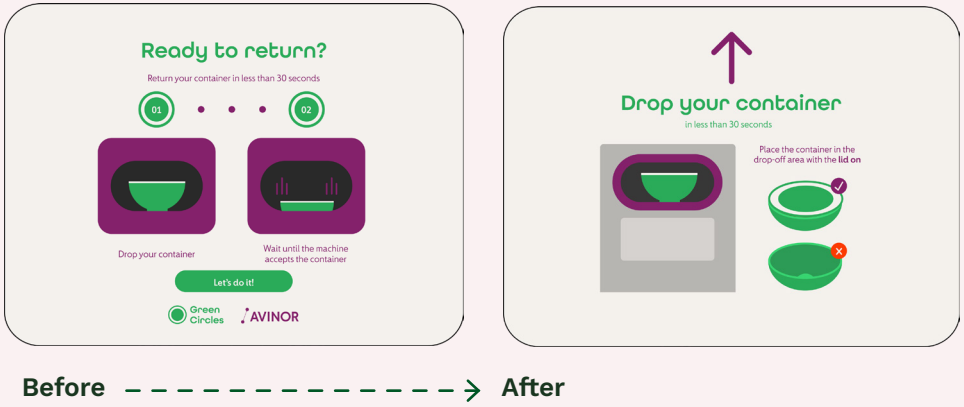


Figure 97. Change of the first screen

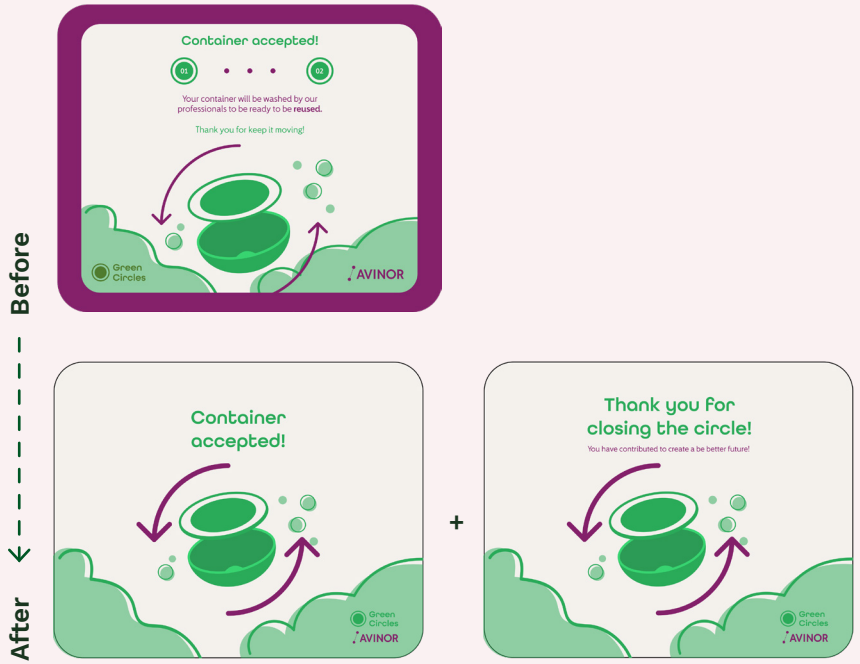


Figure 98. Change of the last screen

Conclusions

Based on the results of the test, the research questions were answered:

Do the participants find the concept intuitive, convenient, and easy to use?
Participants found the Green Circles concept to be convenient, and easy to use. The more challenging part of the process was getting familiar with the service at the very beginning. However, after reading the banner, the process was described as straightforward.

Is the concept perceived as affordable?
The concept was perceived as affordable by participants, primarily due to the fact of being charged only if the container is not returned.

Does the concept cause disruptions in the passenger's journey through the airport?
Participants reported that the process of obtaining and returning the reusable container was fast and would not interfere with their travel behaviour. The quick interaction with the drop-off machine ensured that passengers could complete the process efficiently without significant delays or interruptions.

Is the concept adapted to the dining needs of the passenger?
Participants shared that the concept is adapted to their dining needs. They appreciated the option to use able to take the container to the gate in case they wanted to finish the food there.

> **"The fact I can drop-it at the gates is really convinient"**
>
> Participant 2

> **"The concept overall was really easy"**
>
> Participant 4

5.4 Green Circles touchpoints

In this section, the different touchpoints of the design are presented (Figure 99). This includes the different elements that are part of both the user flow and the backend flow.

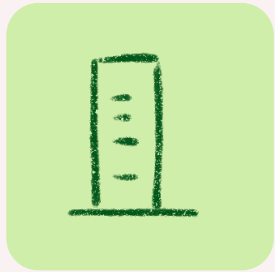
The reusable container

The borrowing system

The drop-off points

The transport carts

The app



Promotional material

Figure 99. Different first interactions with the machine

5.4.1 The containers

The reusable takeaway containers influence various stakeholder of the service, therefore **different needs** need to be considered in their design. To facilitate the acquisition of containers for Avinor Oslo airport and provide a more economical option, it was decided to look for potential suppliers in Norway. **AION** appeared as a possible candidate due to their experience in the field and commitment to sustainability, thus their containers were chosen as a starting point for the design.

Current reusable containers

Currently, **various types** of containers are available at the airport, as depicted in Figure 100. These containers come in sizes of 30ml, 520ml, 750ml, 850ml, and 1200ml. It is calculated that around 600 containers are used on an average day.

AION container features

AION containers (AION, 2024), shown in Figure 103 are available in 600ml, 800ml, 1000ml, and 1200ml **sizes**. They are made from food-grade recyclable polypropylene (PP) and come in various colours (for more details see Appendix F). They are dishwasher and microwave-safe, leak-proof, stackable and can last for approximately **400 life cycles**. Moreover, the lid of the container can be personalised with a logo or text.

Suggested implementations

Considering the sizes of both the disposable containers and the reusable AION bowls, Figure 101 has been created to suggest which reusable container can replace each disposable one.

Figure 100. Disposable food containers being used at Avinor Oslo Aiport

To be able to track the containers and link them with the passengers that borrow them, each container needs to be equipped with an RFID tag. To facilitate the recyclability of the containers, it has been decided to opt for **removable RFID tags** (Figure 102). AION coffee cups already count with this system; therefore, it is suggested to implement this in the food containers. Thus, when the container reaches the end of its lifecycle, the RFID tag can be remove, allowing the PP of the container to be easily recycled. This approach ensures the containers remain environmentally friendly and sustainable.

Furthermore, for the containers prepared in the central kitchen, it is suggested to use sustainable **water-soluble stickers** (non-toxic materials are used) to replace the stickers currently displaying the allergies (Figure 104). This method requires the same effort from the people working in the central kitchen and does not create an extra task for the staff in charge of washing the reusable containers.

	DISPOSABLE	*replaced by* →	REUSABLE
Existing options	520 ml		600 ml
	750 ml		800 ml
	850 ml		800 ml
	900 ml		800 ml
	1200 ml		1200 ml

Potential options

Create a reusable container of **30 ml**, for replacing the 30 ml disposable used for yogurts or nuts.

Create a reusable container suitable for taking away **soups**. Now it is not possible because the available disposable options are not good enough.

Figure 101. Suggested implementation of reusables

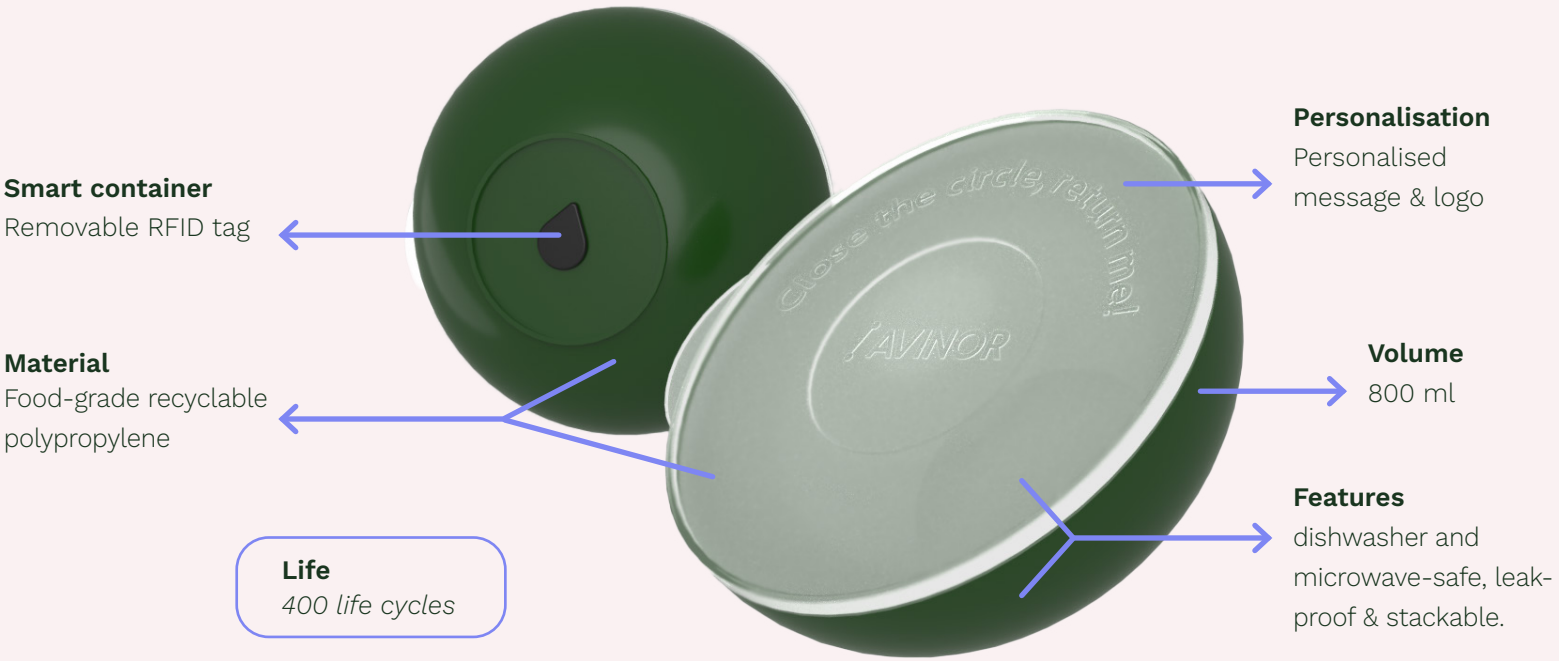


Figure 102. Render of AION bowl implementing the suggestions

The container design is been made by AION. The render (Figure 102) have been made my the author of the thesis to show its features clearly and how it would look like with the personalisation and RFID tag suggested.

Figure 103. AION bowl (Source: AION)

Figure 104. Allergy sticker

5.4.2 Borrowing system

To borrow a reusable container, a **free app** system was chosen for its convenience to passengers. Therefore, a Tap&Reuse system was selected instead, technology developed by the company **Kleenhub** (KleenHub, 2023). This system has the advantage of only charging passengers if the container is not returned within the designated time. Figure 105 illustrates how it works.

Return period

Passengers are given **14 days** to return reusable containers. No reference could be found on how long the average passenger journey takes, so the length of this period has been based on reference to other borrow/deposit systems, such as Vytal (Vytal, 2023). When interviewing passengers to evaluate the service, none expressed concerns about the return period being too short. This feedback indicates that the 14-day time frame is generally acceptable and sufficient for passengers to return the containers.

Fee for not returning & card payment

A fee of **90NOK** is suggested as a fee for passengers who do not return the containers. This amount is based on the cost of Avinor Oslo Airport purchasing the containers, standards from similar services, and setting a price that effectively motivates passengers to return the containers.

The Tap&Reuse system works exclusively with **bank cards** (any bank card and Apple and Google Pay). This **limits** the use of the service to passengers willing and able to pay by card. However, payments by card are the most popular payment method in Norway (Hague, 2023) and, according to the interviewed unit workers, most of the passengers pay by card. Additionally, this payment method is more convenient for international passengers who may not have cash in NOK.

Technology developed by KleenHub

Cashier scnans the container at the Tap&Reuse device → Cashier processes the order (food + container) → Passenger taps his bank card at the Tap&Reuse device

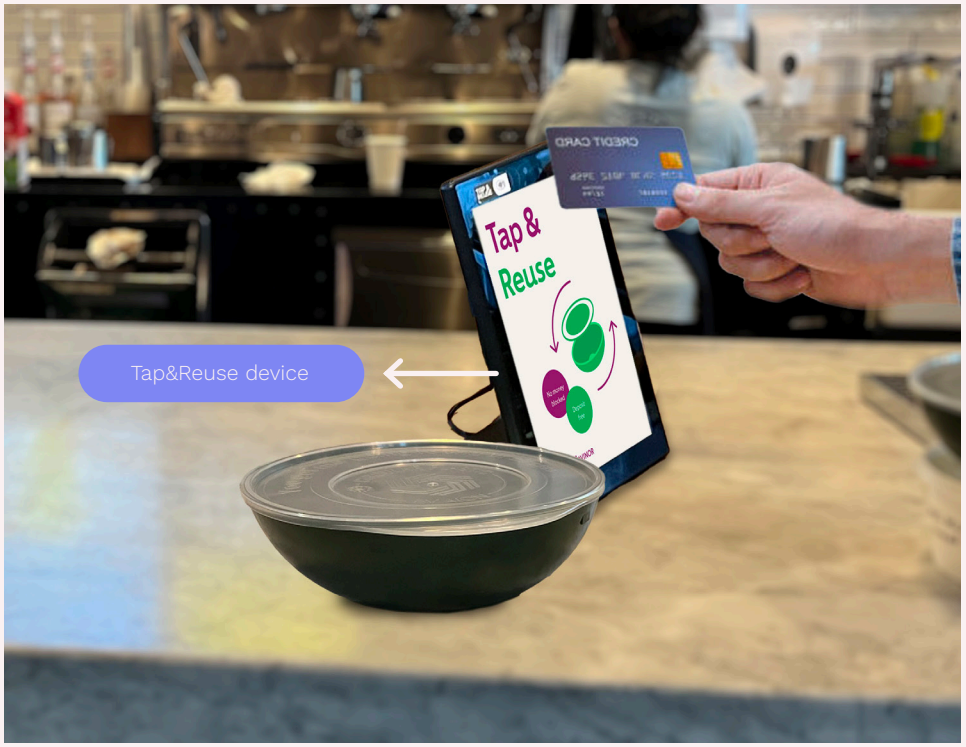


Figure 105. Borrowing system

5.4.3 The drop-off points

The drop-off points are machines that allow passengers to easily return the borrowed reusable containers. The interaction between passengers and the drop-off point has been designed to take as little **time** as possible, minimizing the time required for passengers to complete the dropping:

1. The passenger leaves the container at the drop-off area.
2. The machine reads the RFID tag and accepts the container The drop-off point consists of different element.

The drop-off point consists of the **elements** show in Figure 106.

Figure 106. Main elements drop-off machine

The screen

The screen (Figure 107) helps to guide the passenger through the **return process**. Figure 108 illustrates the screens that passengers may encounter when returning the container. It is proposed that passengers drop the containers as a unit (lid and bowl together) for several reasons. Firstly, dropping the container as a whole enables the system to easily track it when it is returned. Secondly, in case there is leftover food inside, keeping them together prevents the food from spoiling. Finally, it enables a **faster interaction** for the passenger, as cleaning the remaining food in a trash bin would take extra time, which passengers are usually not willing to spend in time-pressure situations such as before taking a flight.

Figure 107. Closer look at the screen drop-off machine

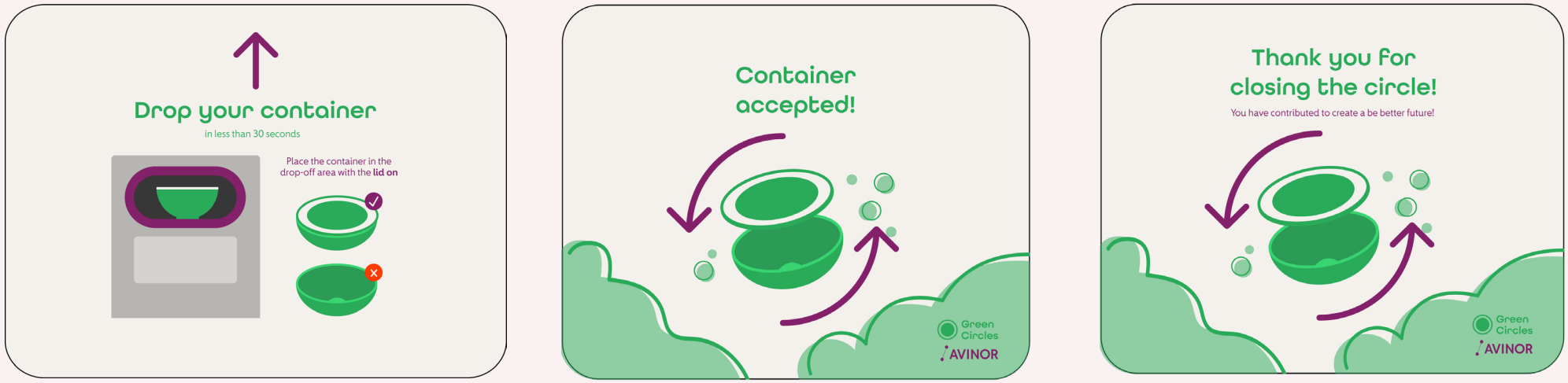


Figure 108. Drop-off machine screens

Internal structure

The returning area is equipped with an **RFID reader**. When the container is read, the gates of the returning area will open and make the container **fall** into the storage area. This ensures that passengers cannot retrieve the container once it has been returned. Additionally, the RFID reader will monitor the returned containers and provide **real-time data** on how full the drop-off points are.

The **storage area** is a compartment that stores the returned containers (see Figure 109). To facilitate easy collection by the janitorial staff and prevent the compartment from getting dirty, it is equipped with a **plastic bag**. To access this area, the drop-off point has a side opening.

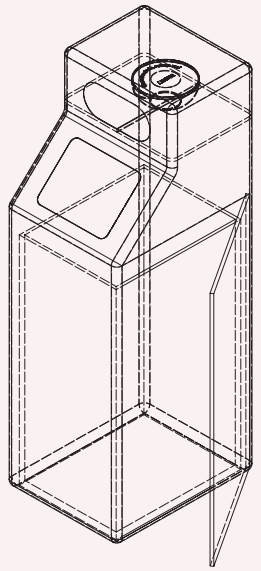


Figure 109. Drop-off machine internal structure

Measurements and capacity

The drop-off point can store around **30 containers**, taking as a reference the measurements of the 800ml AION container. Moreover, the dimension of the drop-off points is designed to be accessible to most passengers, including those in wheelchairs (Figure 110).

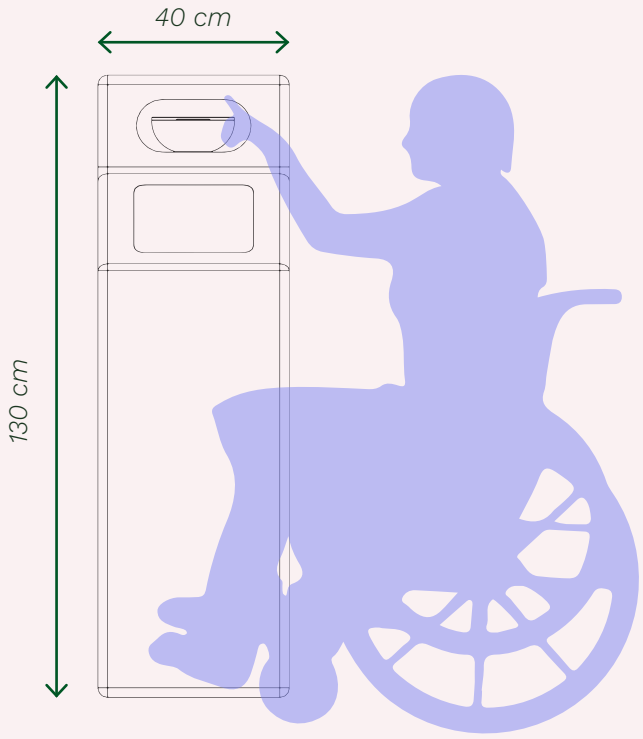


Figure 110. Drop-off machine measurements

Location

42 drop-off points will be located at the airport's **boarding gates** at the departure hall (Figure 111). Moreover, five drop-off points will be placed at the different exits of the arrival hall. In Appendix G it can be found the suggested locations for the machines.

Figure 111. Drop-off machine at the gate

5.4.4 The transport carts

To transport the collected reusable containers to the dishwashing facility, a cost-effective and practical solution involves using the carts currently used for transporting the trash from the trash bins, with some minor modifications. The modifications consist of implementing **design elements** that inform passengers about the purpose of the cart and the service (see Figure 112). In this way, the transport carts serve as a promotional point and spread awareness among passengers. The janitorial staff will collect the **plastic bags** from the drop-off points that are full and place them into the cart. This will prevent potential fluids from coming out. Moreover, the staff will need to put a new bag at the drop-off point.

Figure 112. Transport cart information

5.4.5 The app

A Green Cricles app has been developed to facilitate **communication** between the dishwashing facility and the serving units and central kitchen. The app is divided into **two main sections**: one for the dishwashing facility and one for the serving units/central kitchen. For the **dishwashing facility**, the main functions include notifying janitorial staff about which drop-off points need to be emptied and receiving information about the serving units' needs, such as the quantity and sizes of containers required (see Figure 113). For the **serving units/central kitchen**, the app's primary functions are notifying the dishwashing facility when they need containers and specifying the quantity and sizes needed. It is possible to order containers of different sizes at the same time if necessary.

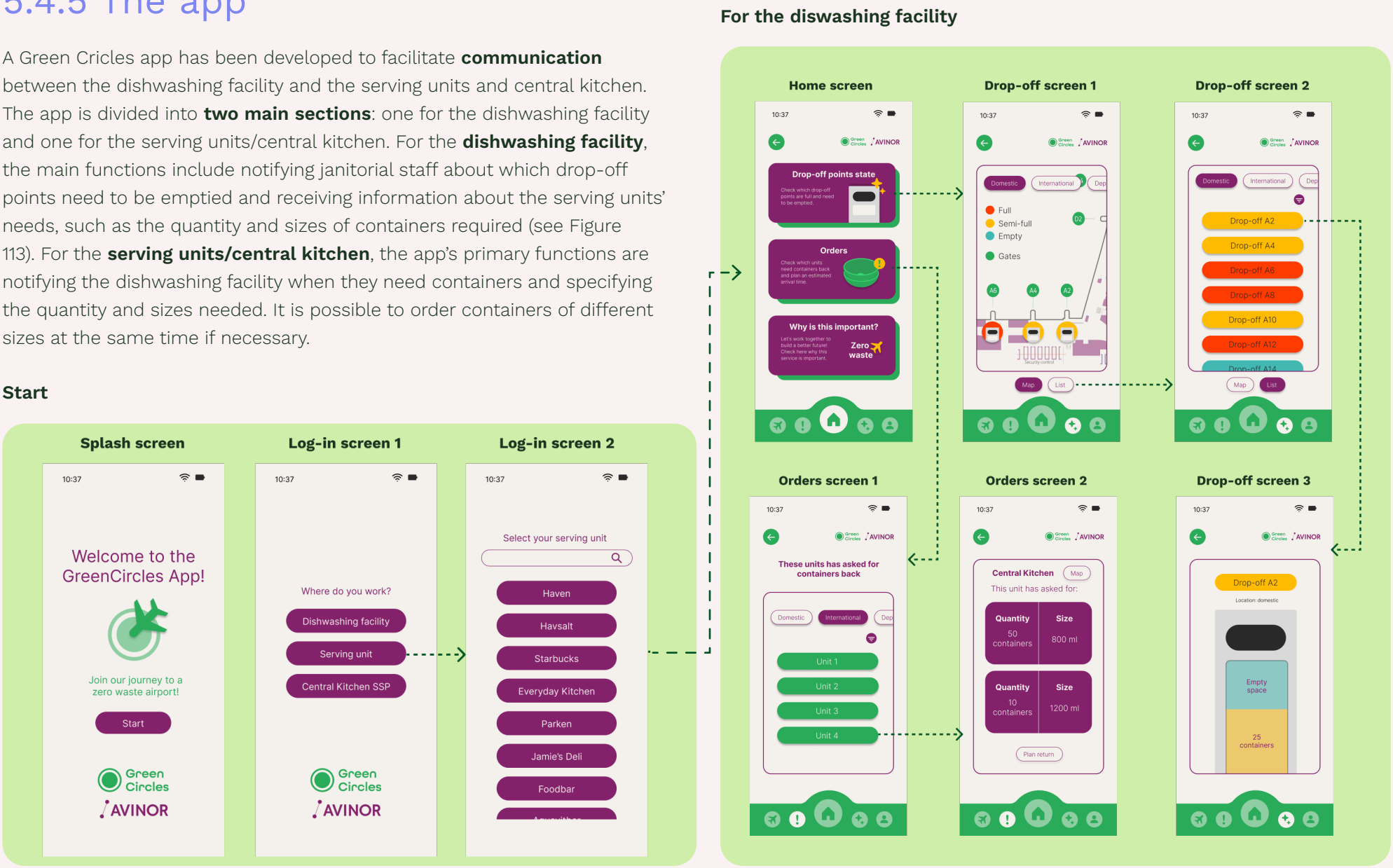


Figure 113. Greens Green Circles app diswashing facility

For the serving units

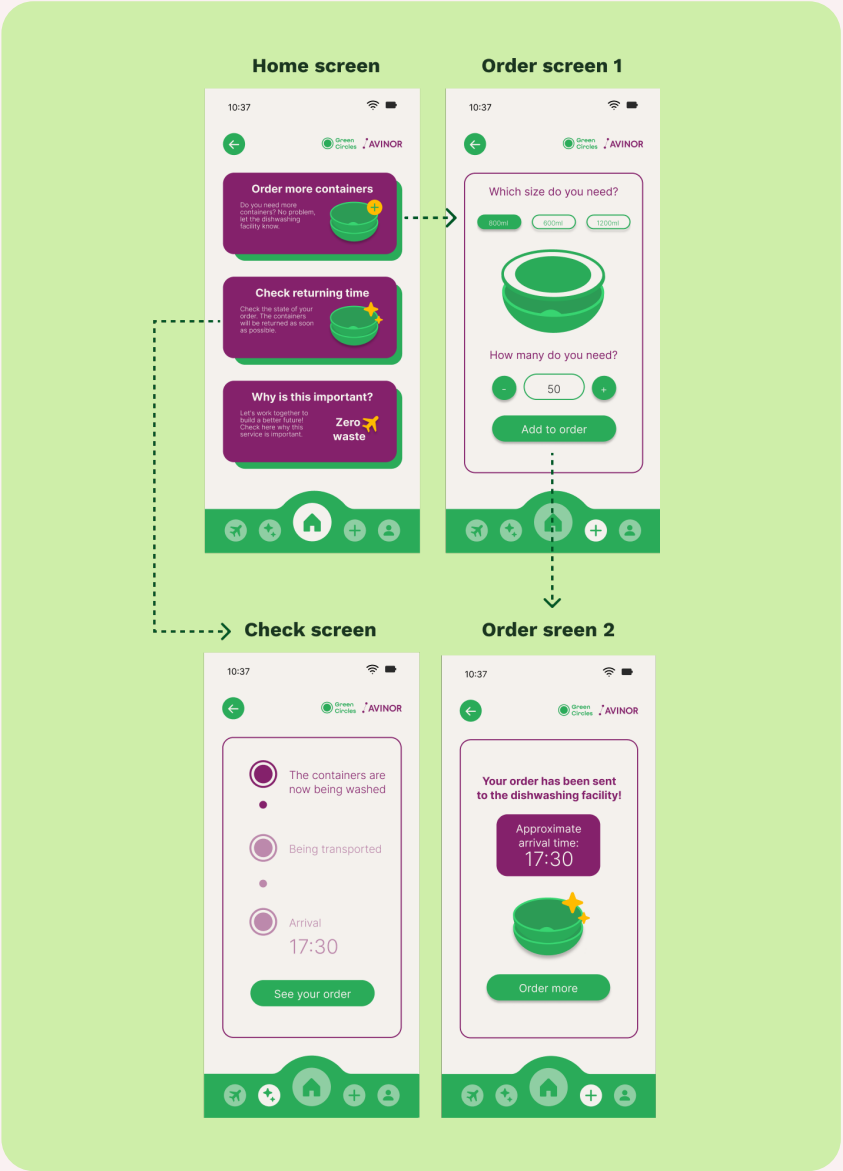


Figure 114. Greens Green Circles app start + serving units

5.4.6 Promotional Material

To assist serving units in explaining the service to passengers, various promotional means can be employed. Promotional banners could be strategically displayed at key locations such as the entrance of the airport, the post-security area, and visible spots along the terminal near the gates. To design this, the **COM-B model** (Michie et al., 2011) served as a guide Considering the target group, passengers, and the goal of encouraging the return of the reusable container, the interventions of '**education**' and '**persuasion**' were identified as the most appropriate strategies. They are illustrated in Figure 115 & 116.

Figure 115. Greens Green Promotional material 1

Additionally, roll-up and countertop standees should be placed at participating **serving units**, offering direct information to passengers waiting to order (see Figure 117). This will help cashiers explain the service to passengers if needed, saving time. Finally, for units equipped with screens, a short video can be displayed to illustrate how the service operates.

Figure 116. Promotional material 2

5.6 Horizons

Successfully implementing Green Circles requires a **progressive approach**, facilitating gradual scaling and greater impact over time. Starting with the pilot test planned for autumn this year, Green Circles is envisioned to progress through various stages (Figure 117), each building upon the achievements of the previous one. Figure 118 explains each horizon in more detail.

Additionally, Green Circles' horizons are aligned with those of **TULIPS** and **Avinor Oslo Airport**. For Avinor Oslo Airport, Green Circles supports the horizon of eliminating disposable items by 2030 and becoming a zero-waste airport with all resources in circulation by 2030 and beyond (Avinor, 2023c). This also aligns with TULIPS' objective of zero-waste airports in Europe by 2030, contributing to Package 6's goal of eliminating passenger waste (TULIPS, 2020a).

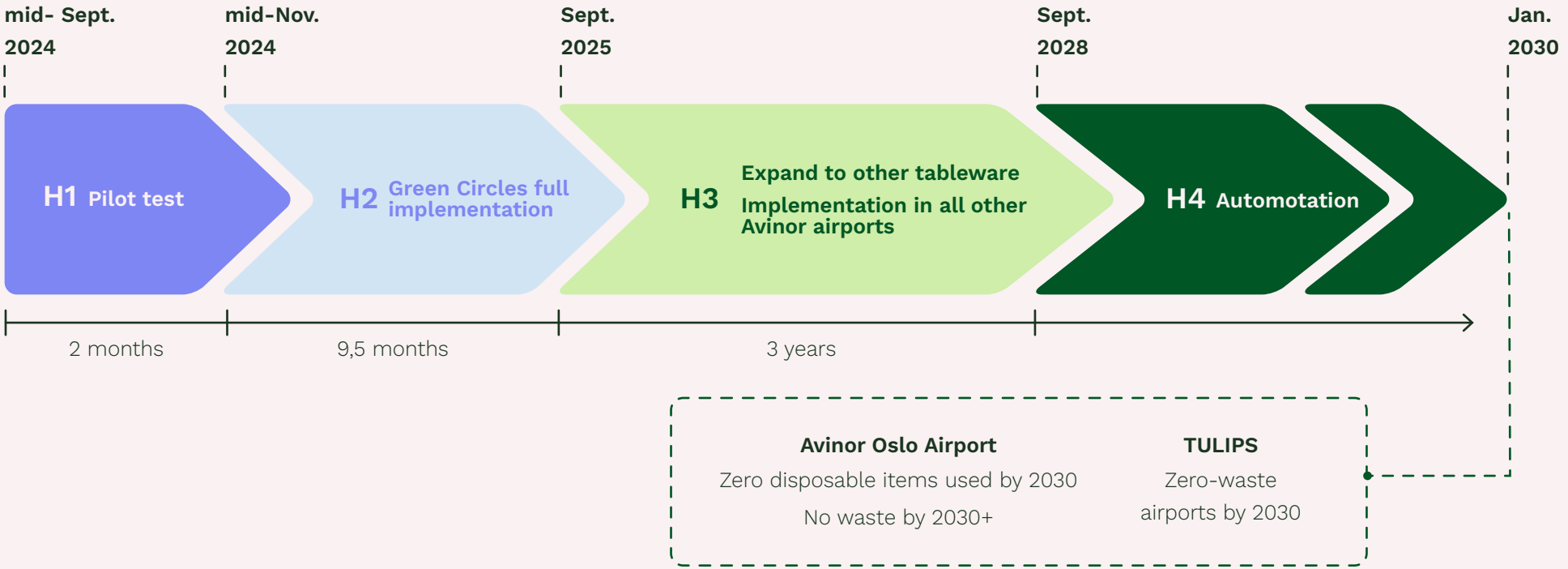


Figure 117. Green Circles Horizons

Horizon 1

Time frame: 2 months. Mid-Sept. to mid-Nov. 2024

This horizon consists of running the first **pilot** with four units. For detailed planning of the pilot (units involved, quantities, location...), refer to **Appendix H**. During this time the objective is to find potential pain points of the service and to introduce the service to passengers. Here are listed the aspects that need to be considered during this process:

- Establish a **testing area**. The International flights area is recommended due to the high number of units that use bowl containers and the proximity to the central kitchen.
- Replace of the disposable containers of 750ml, 850ml and pre-made salads with 800ml **reusable containers**. This will serve as a starting point for later expanding to different sizes of containers.
- Set up low-fidelity **drop-off points** at the participating units. For this stage, the borrowing system will not be implemented. Therefore, it is suggested to return the containers to the units to be able to implement an incentive for passengers to return the containers.
- To replace the **app** functionality, the dishwashing facility and serving units/central kitchen can communicate through text messages or calls.
- Set up the central kitchen as a **dishwashing location**.
- Hired a **third party** to do the washing, collection and returning of the reusable containers.

See Appendix H to see the detailed plan of the test.

Horizon 2

Time frame: 9,5 months. Mid-Nov 2024. to Sept. 2025

In this horizon, the service **expands** to other areas of the airport and implements the technology needed, like the Tap&Reuse, the smart drop-off points or the Green Circles app.

- Expand to other **airport areas**, apart from the international one.
- Implement the system for borrowing the containers (**Tap&Reuse**).
- Implement the smart **drop-off points**.
- Implement more **sizes** for the reusable containers.
- Implement the **Green Circles app**.
- Hire more **janitorial staff** and expand the dishwashing facility capabilities if needed.

Horizon 3

Time frame: 3 years. Sept. 2025 to Sept. 2028

On this horizon, the concept extends beyond merely replacing food containers to also include the replacement of single-use **cups**. Furthermore, during this period, there are plans to implement the service in other **Avinor airports** to achieve a greater impact.

- Expanding Green Circles to other types of tableware, such as cups.
- Expanding the concept towards other Avinor Airports.

Horizon 4

Time frame: 9,5 months. Mid-Nov 2024. to Sept. 2025

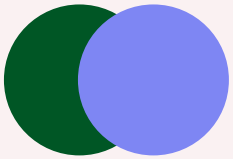
Finally, the aim is to achieve a greater level of **automation** to increase efficiency and reduce costs.

- Implementation of self-driving carts that transport the tableware from the drop-off to the dishwashing facility to the serving units/central kitchen autonomously.

Figure 118. Green Circles Horizons details

Chapter 6

Discussion



This chapter discusses the contributions and added value of this thesis. Furthermore, it includes recommendations and explores the project's limitations. Finally, it presents a personal reflection, detailing personal experiences and key learnings

6.1 Contribution

This project aimed to design a **centralised dishwashing service** at Avinor Oslo Airport. After analysing the needs of the different stakeholders, it was decided to design a centralised dishwashing service that focuses on cleaning reusable takeaway containers by implementing a reusable tableware service (Green Circles, Figure 119). Although it is recognised that this kind of service is not a new concept, the innovation of this project lies in adapting the service to the distinctive environment of an **airport**. Therefore, unique elements and interactions were designed according to this.

Unlike existing reusable tableware services that require users to return containers to a serving unit, Green Circles allows passengers to return containers at the gates. This supports the **unique flow** and behaviour of passengers within an airport setting. Moreover, this required designing the logistics of transporting containers around the airport, adding a layer of complexity that is often overlooked. Additionally, the interaction between passengers and **drop-off machines** has been designed to be as quick and efficient as possible to meet passengers' needs. Existing smart drop-off machines typically require users to perform more than one action, such as scanning a QR code or tapping a bank card, before dropping off the tableware. In contrast, Green Circles simplifies this process to a single action: passengers only need to drop off the container.

Moreover, while many similar services require users to download an app, Green Circles is an app-free service for passengers This simplifies the process and increases accessibility. Nevertheless, it was noted that an **app** could be highly beneficial for the operational side of the service, particularly for employees in serving units and the central kitchen and janitorial staff. This is a unique aspect of Green Circles that, to the best of the author's knowledge, has not been developed in existing similar services.

Overall, this service has been designed to help **Avinor Oslo Airport** achieve its 2030 Horizon of 'no disposable used' and to support efficient and sustainable use of resources within the aviation industry. While tailored to meet the specific demands of Avinor Oslo Airport, it is envisioned as a model that other airports can follow to progress towards zero-waste airports. In addition, it can serve as a model for airports that want to reduce passenger waste (**TULIPS** package 6 goal).

Green Circles

Ultimately, despite the service incorporating elements designed by third parties such as AION's containers or KleenHub's Tap&Reusse technology, the value of the service is its **holistic vision**. This means not only seamlessly integrating existing innovative solutions but also ensuring their compatibility with the overall flow of the service, thereby gaining acceptance from all stakeholders involved.

Figure 119. Green Circles service

6.2 Recommendations

Below some recommendations related to the integration of the final concept have been framed. They aim to help Avinor Oslo Airport to make a successful integration of the service.

- **Dishwashing facility**: The optimal location for the dishwashing facility would be in the international area near the central kitchen. For the pilot phase, it was suggested to place the dishwashing facility within the central kitchen; however, this presents long-term limitations due to space constraints. It is recommended to establish the dishwashing facility in an area with sufficient space for dropping off soiled containers and placing clean ones. Adequate space is crucial, as a lack of space can lead to employees placing items on the floor.
- **Employee's training:** Before implementing the service, it is important to train the unit's employees to support passengers if needed and to learn how the borrowing system works.

- **Progress meetings.** Especially at the beginning of the implementation of the service, it would be interesting to meet key stakeholders of units regularly to see if everything is working properly or if things need to be adapted.

- **Containers for pre-packaged food:** Since the reusable containers do not have clear lids, passengers are unable to see the contents of the pre-packaged food as they can with disposable containers. To address this, it is suggested to provide a 'sample bowl' covered with a transparent fill for display or to offer a photo of the food, so passengers can see what the meal looks like before purchasing.
- **Containers quantities and participating units:** Regarding bowl quantities, it is recommended to check with the units how many they need before purchasing them, but it is estimated that around 600-700 containers would be needed. A list of the suggested units for participating is shown in Appendix I.

6.3 Limitations

This section addresses the limitations of the developed concept and discusses the ones encountered during the development of the project.

- **Limitations Green Circles**: While the service has been thoughtfully designed, there are inherent limitations. There is a potential risk that passengers might not fully engage with the service, either due to lack of information or perceived potential inconvenience. Moreover, the scalability of the concept across different airports is a big challenge, as each airport probably has unique operational and logistical requirements. Finally, the concept mainly explored the possibility of replacing disposable food containers, so new challenges may arise when expanding the service to other tableware, such as cups.

- **Limited access to the context**: Another significant limitation is the restricted access to the project's context. Since the airport is in another country, there were limited opportunities for direct interaction with stakeholders and real-time testing within the actual airport environment.

- **Time constraints:** Time constraints played an important role in shaping the project. The development of the touchpoints and their testing were conducted within a limited time frame, which restricted the depth of exploration and refinement of all of the elements of service. Certain aspects, such as long-term user behaviour and operational impact, could not be thoroughly investigated due to these time limitations.

6.4 Personal reflection

As this sets the conclusion of the project, I would like to take this opportunity to share some final thoughts in a more personal tone. Firstly, I would like to convey my gratitude for being part of this impactful and engaging project. In the academic journey, we often encounter projects that may not align with our passions, but I find myself fortunate to have completed this journey with a project that motivated and inspired me.

One of the aspects of the project I enjoyed the most, despite its challenges, was dealing with the diverse needs of the stakeholders. Engaging with stakeholders from various perspectives helped me to improve my communication skills and adaptability. Furthermore, collaborating with people with a different background than mine forced me to step out of my comfort zone and explore new ways of thinking. Moreover, I found it particularly inspiring to meet people so passionate about their work, open to change and dedicated to creating a better future.

Lastly, this project boosted my confidence in service design and addressing projects with multiple touchpoints. Throughout the process, I came to understand the significance of prioritizing both project objectives and personal growth as a designer. Overall, this experience has not only expanded my practical skills but also deepened my commitment to contributing to impactful projects that drive positive change.

Chapter 7

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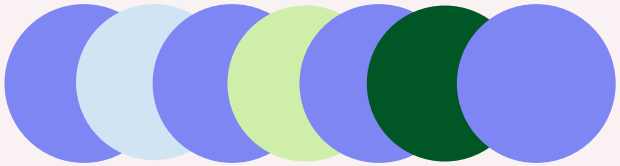

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Appendix

Appendix A: Interviews' transcripts

Appendix B: Data collection field research

Appendix C: Context mapping material

Appendix D: Ideation material

Appendix E: Evaluation storyboards

Appendix F: AION Containers

Appendix G: Location of the drop-off points

Appendix H: Pilot plan

Appendix I: Suggested units for the service

Appendix A: Interviews transcripts

Interview with Portland Airport

Interview with tenant A

Interview with tenant B

Transcripts available in the confidential Appendix

Appendix B: data collection field research

Link Airtable analysis of observations & Interviews:

Available in the confidential Appendix

Link Figjam analysis of observations:

https://www.figma.com/board/lDsQNrCqEVayMNvGYvWjuI/Field-research-analysis?node-id=0-1&t=KgXLZLdeMZVbRJTJ-1

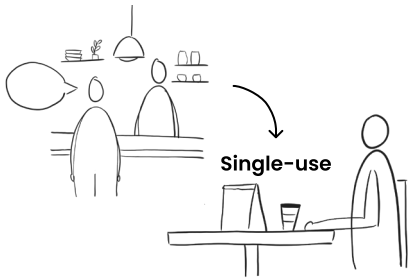
Appendix C: Contextmapping material

Which images/words do you think best describes the motivation for Noah's choices in each scenario?

Write under each scenario the number of the image(s) or the word(s) you select

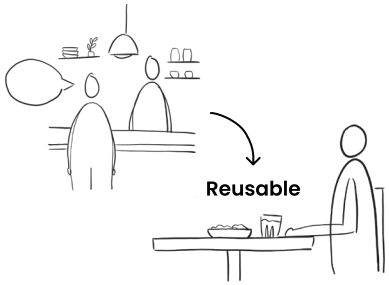
Scenario 1

Noah **asks for takeaway** but then **sits** in the restaurant to eat/drink



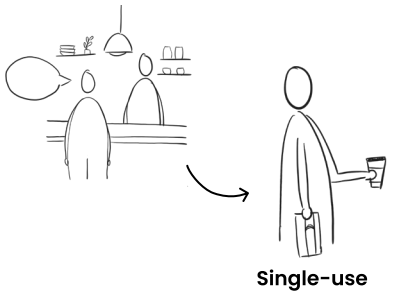
Scenario 2

Noah **orders** and then **sits** in the restaurant to eat/drink



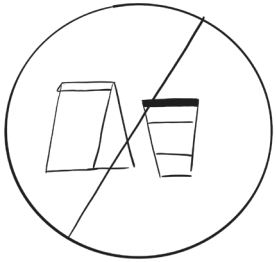
Scenario 3

Noah **asks for takeaway** and then **leaves** the restaurant



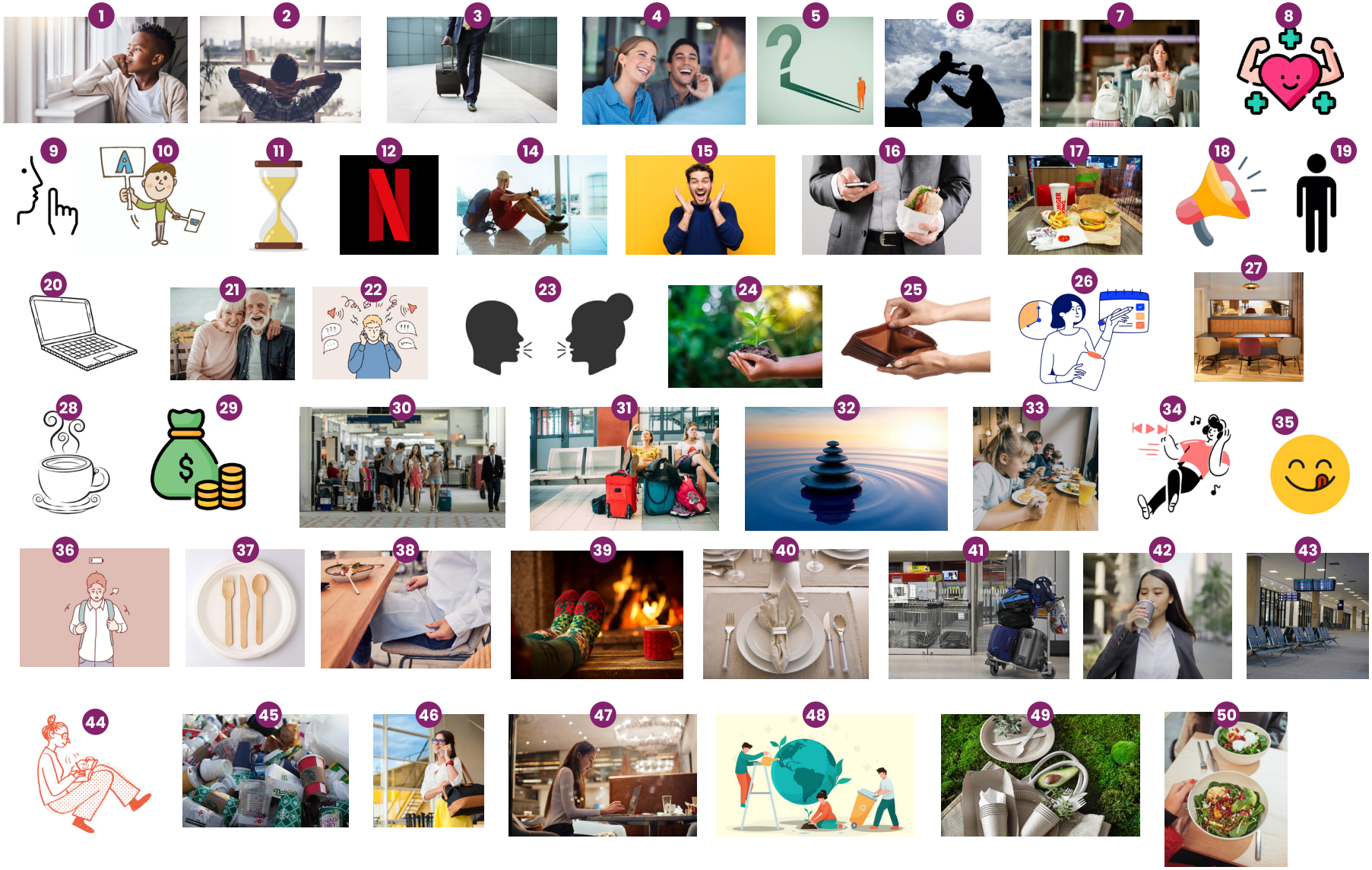
Scenario 4

In future, the use of **single-use** tableware at the airport will be completely **banned**.



What would be your concerns in this scenario?

What opportunities do you see in this scenario?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Convenience
Hygiene
Time-saving
Time pressure
Relax
Efficiency
Cost
Customization
Conservation
Comfort

Habit
Preference
Flexibility
Mobility
Work
Leisure
Energy
Control
Aesthetics
Awareness

Accessibility
Expectation
Uncertainty
Culture
Security
Necessity
Trust
Reliability
Values
Standards

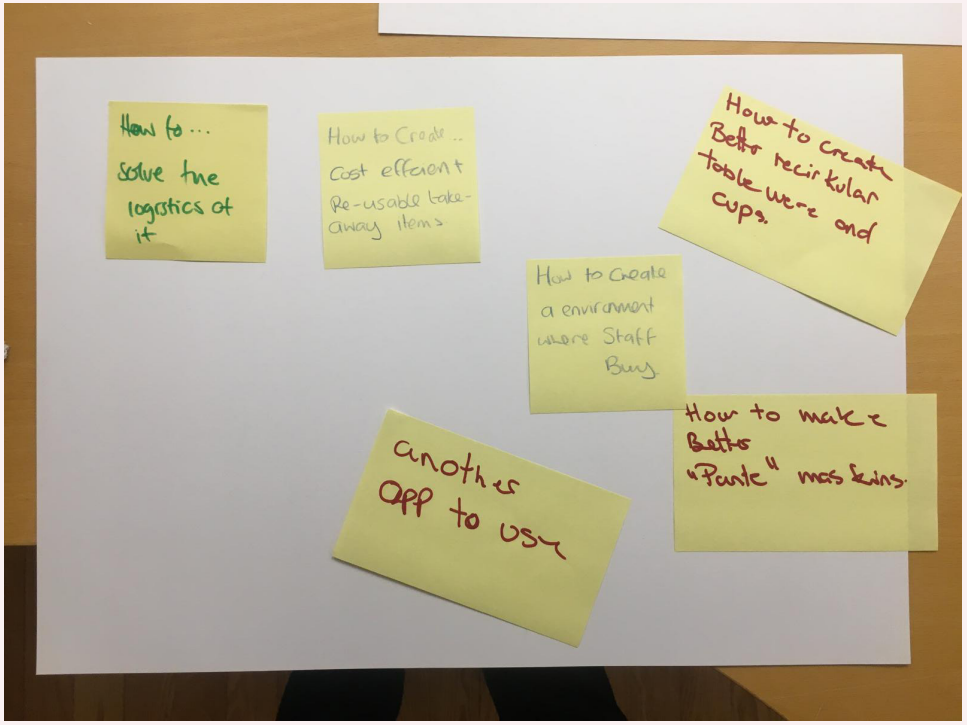
Quality
Superiority
Sophisticated
Taste
Luggage
Atmosphere
Plane
Service
Recyclability
Pollution

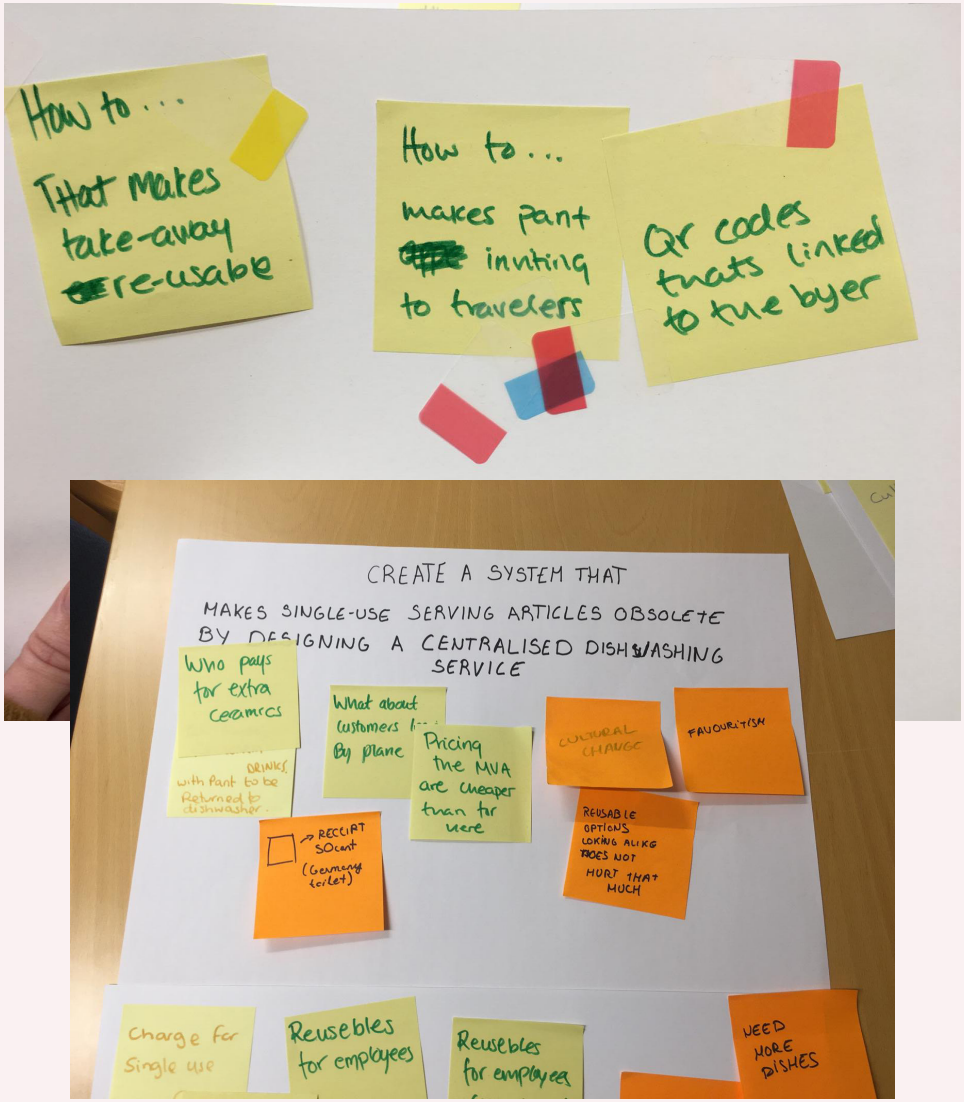
Pleasure
Satisfaction
Choice
Identity
Adaptability
Variety
Productivity
Organization
Planning
Preparation

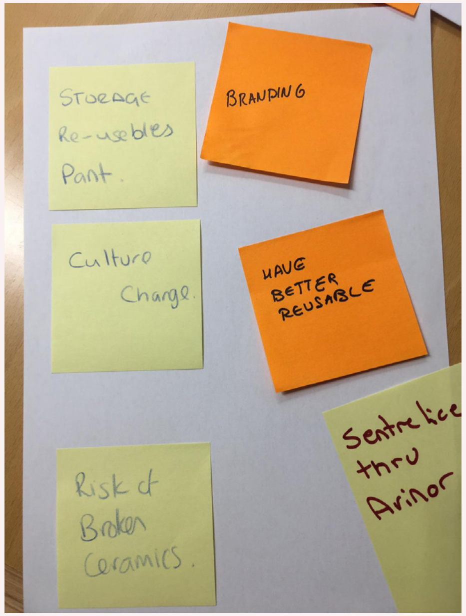
Family
Friends
Solo-travel
Partner
Age
Easy
Sustainability
Environment
Reusability
Trend

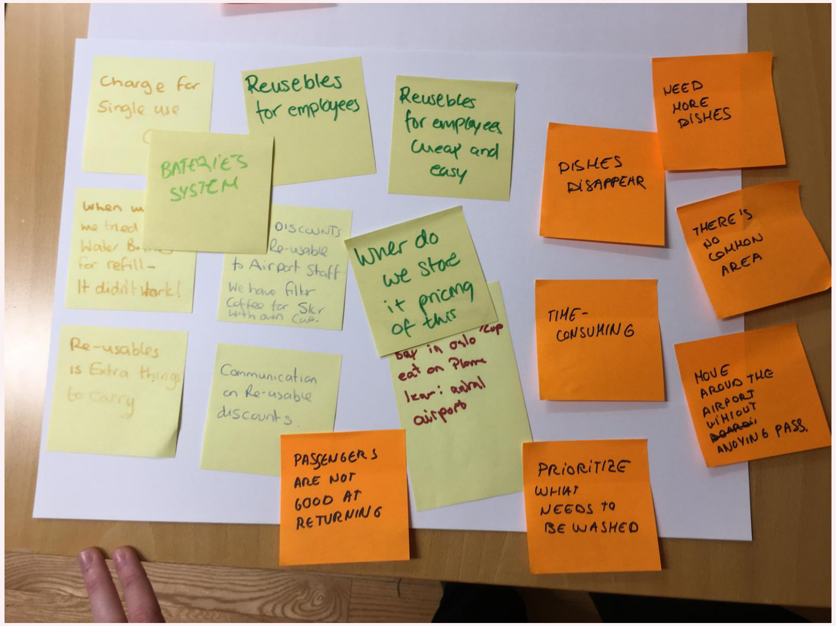
Appendix D: Ideation

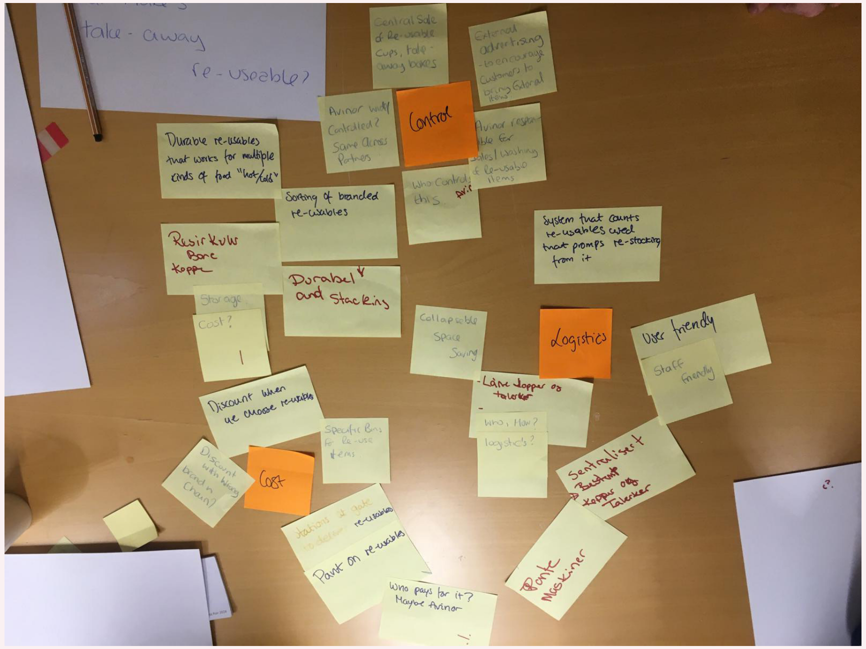
Co-creation

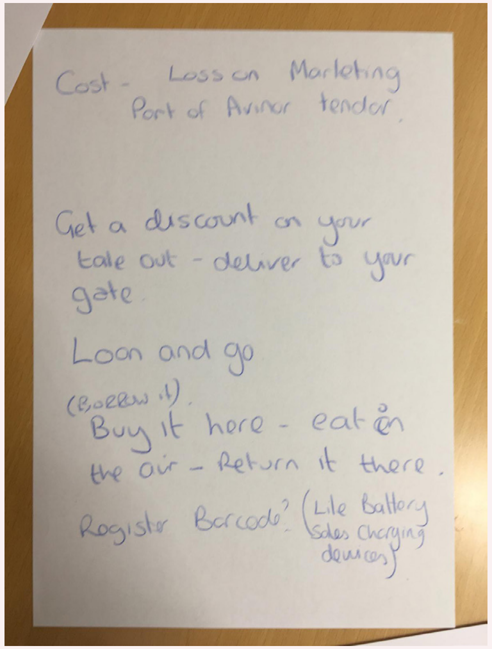




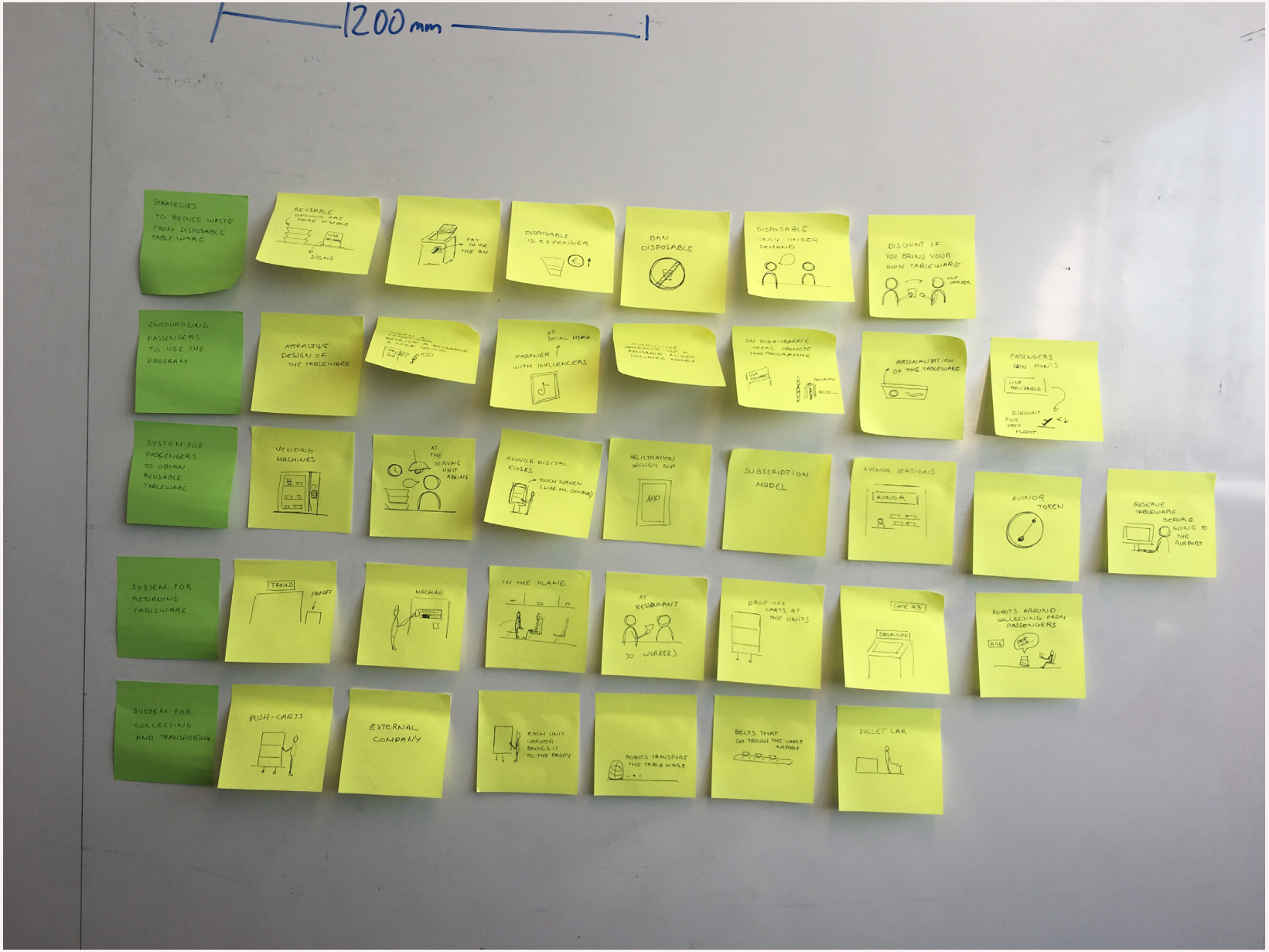

STORAGE
Re-usebles
Pant.
BRANDING
Culture
Charge.
HAVE BETTER REUSABLE
Sentraliser thru Avinor
Risk of Broken Ceramics.


Charge for Single use
Reusebles for employees
Reusebles for employees Cheap and easy
NEED MORE DISHES
BATERIE'S SYSTEM
DISHES DISAPPEAR
THERE'S NO COMMON AREA
DISCOUNTS Re-usable to Airport Staff
When do we store it pricing of this
TIME-CONSUMING
Re-usables is Extra things to carry
Communication on Re-usable discounts
MOVE AROUD THE AIRPORT WITHOUT ANOYING PASS.
PASSENGERS ARE NOT GOOD AT RETURNING
PRIORITIZE WHAT NEEDS TO BE WASHED

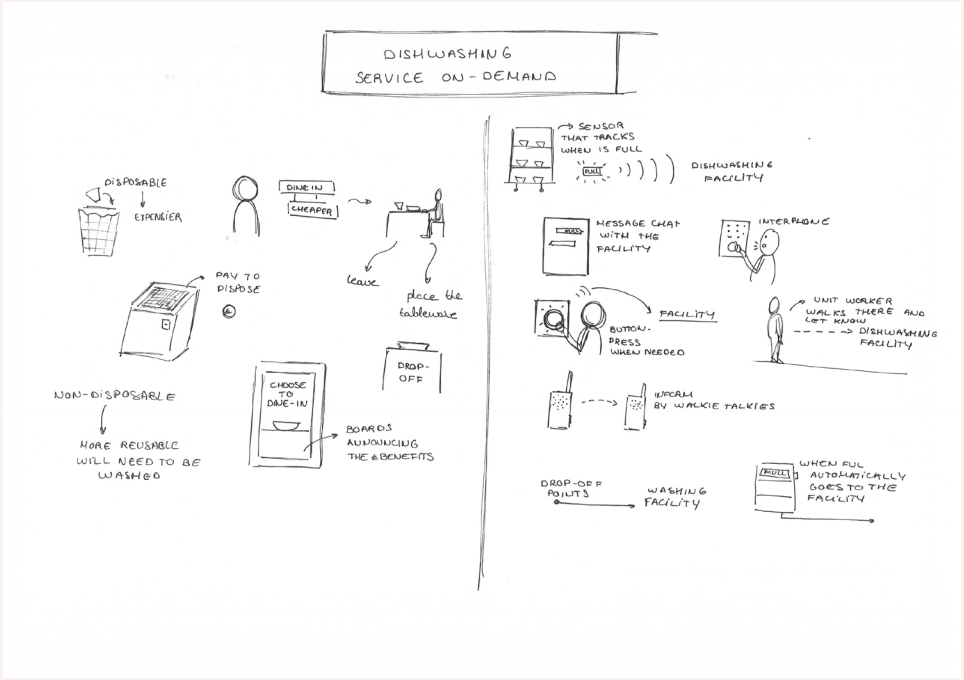

take-away
re-usable?
Control
Durable re-usables that works for multiple kinds of food
Sorting of branded re-usables
System that counts re-usables used that pomps re-stocking from it
Durabel and Stacking
Logistics
User friendly
Staff friendly
Cost
Discount when we choose re-usables
Pant on re-usables
Sentraliser

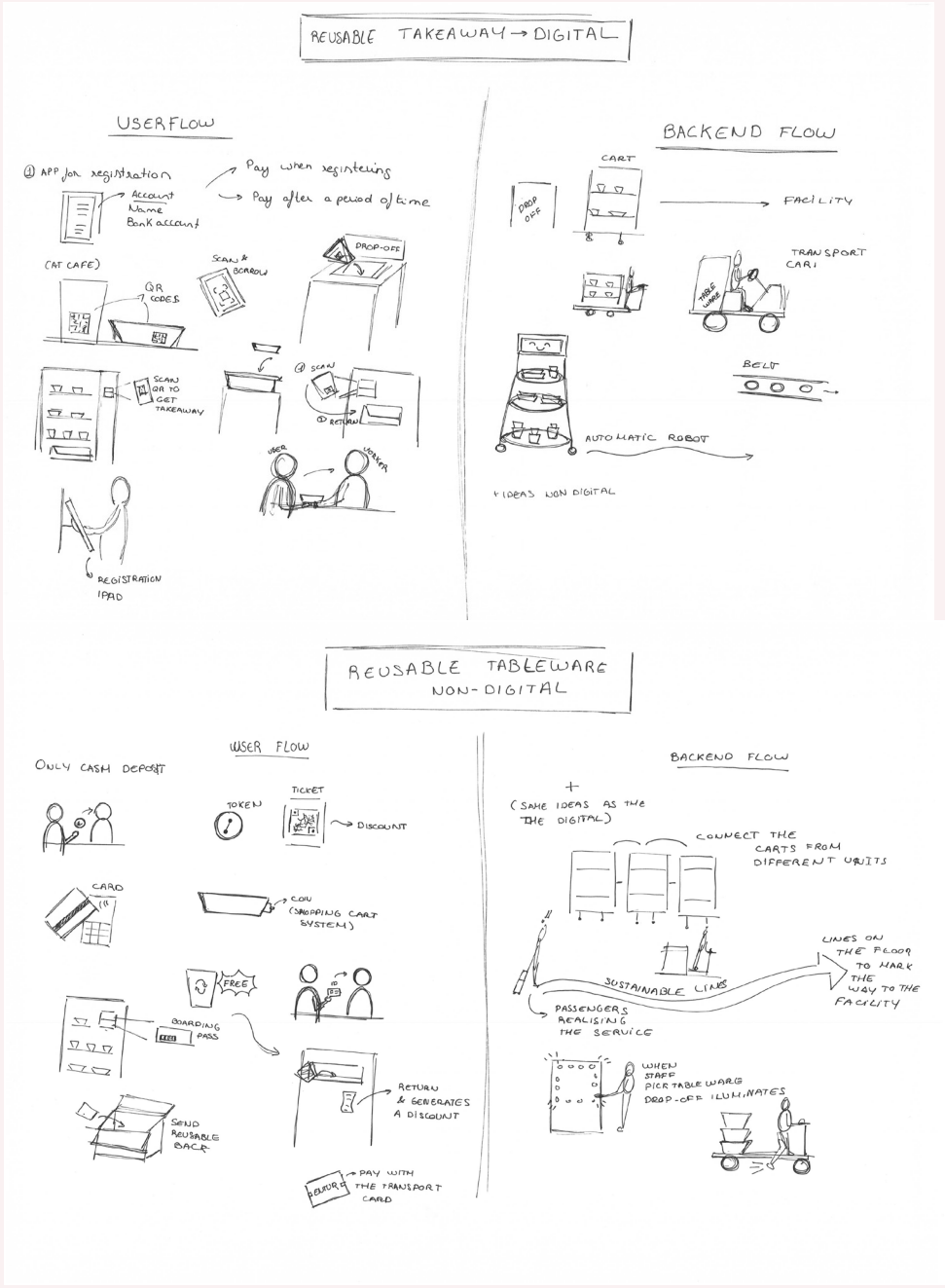

Cost - Loss on Marketing
Part of Avinor tendor.
Get a discount on your take out - deliver to your gate.
Loan and go
(BORROW it)
Buy it here - eat on the air - Return it there.
Register Barcode? (Like Battery Sales Charging devices)

Morphological chart



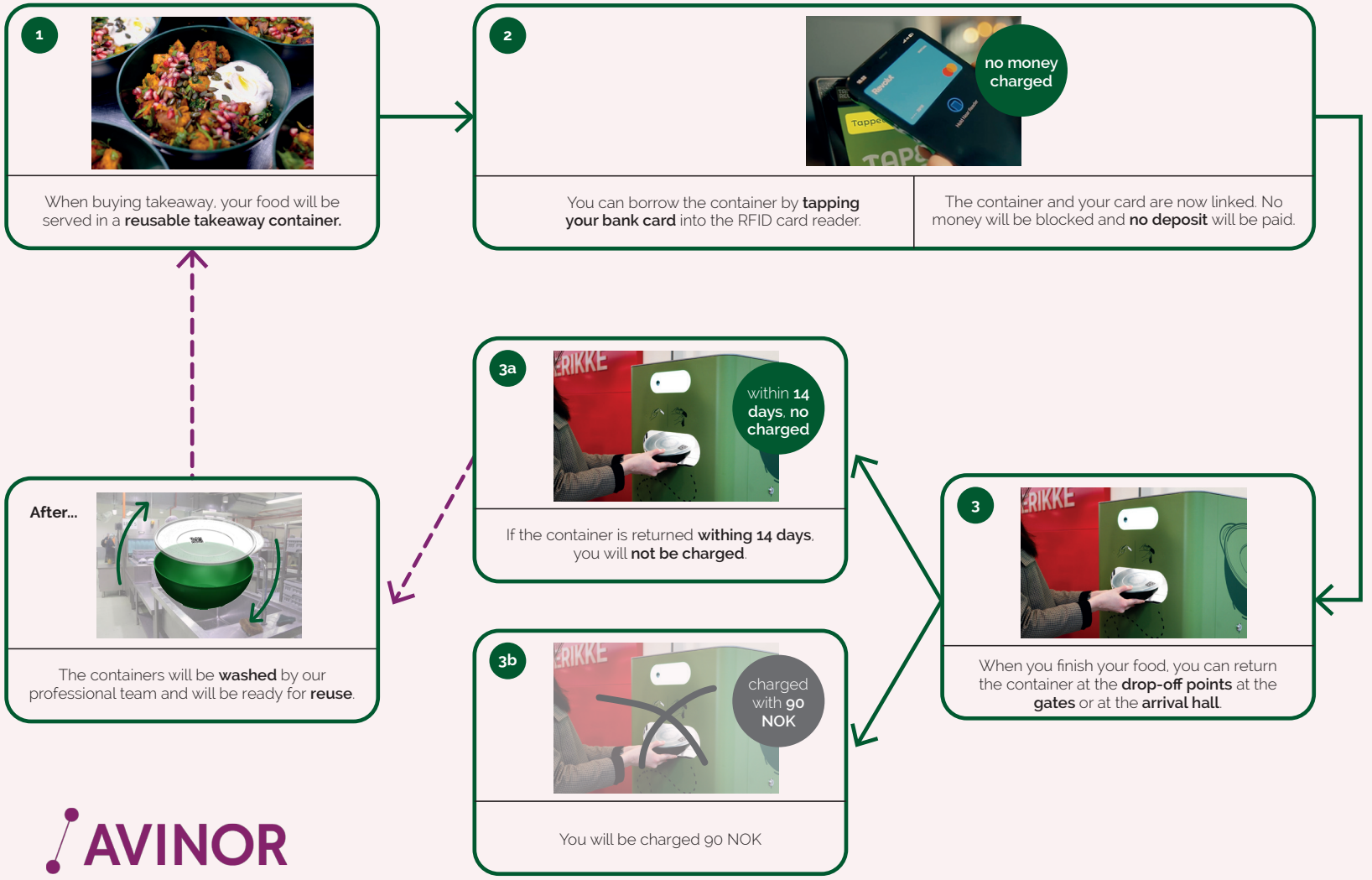
Design Directions





Appendix E: Evaluation Storyboards

FROM SINGLE-USE TO REUSABLE



0

Pre-prepared food in the **central kitchen** is made in **reusable containers**.

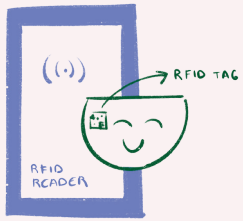
1a

At the unit, when a passenger asks for **takeaway** food, it will be served in a **reusable food container**.

1b

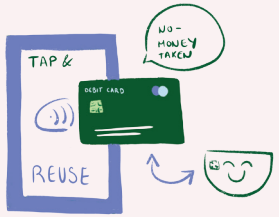
A passenger buys a **pre-packaged food** that comes in a **resuable container.**

2



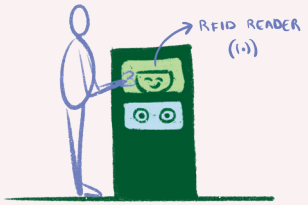
The container will be scnanned by a a device with **RFID reader.**

3



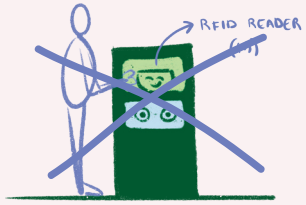
The user tap their bank card in the device. The **container and card** have been **linked**. **No deposit** is required.

4a



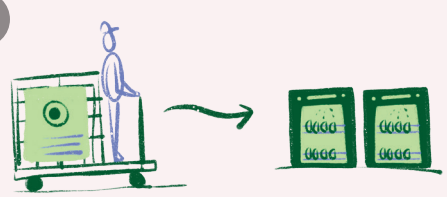
The passenger returns the container at the **drop-off point** located at the **gates.**

4b



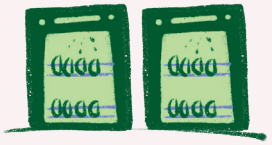
If the container is not returned within **14 days**, passengers will be charged **90 NOK**.

5



Janitorial staff **collects** the containers and transport them to the **dishwashing facility**

5



Containers are **cleaned** at the dishwashing facility.

6

Containers are **transported back** to the serving units and the central kitchen.

Serving units can **contact the diswashing facility** through an app.

Appendix F: AION containers

AION

Data Sheet
Takeaway Bowl 800ml & Lid

The AION reusable Takeaway Bowl & Lid is made from food contact grade fully circular polypropylene with documented end of life for all parts.

AIONs products are integrated with AION Loop. AION Loop is a digital platform that lies at the heart of our business model to collect and utilize data from AION's circular value chain. We ensure to know the exact material composition, follow the product throughout the full life-cycle and provide thorough ESG reporting.

Product Details

AION Product name	AION Takeaway Bowl & Lid
Material	PP Food grade
Production location	Norway
Colour	Various Options
Size (Ø x H)	Ø 173 x 64 mm
Weight, Set	~0.135 kg
Weight, Bowl	~95 g (101.3 cm3)
Weight, Lid	~40 g (42.3 cm3)
Volume, Bowl	800 mL (max 900mL)
Features	Dishwasher and microwave safe BPA free

Shipping Quantities

Bowls per Pallet	1824
Lids per pallet	3744
Pallet size	EUR Pal 80 x 120 cm
Weight, 1 pallet	-
Other Features	Microwave Safe Dishwasher Safe

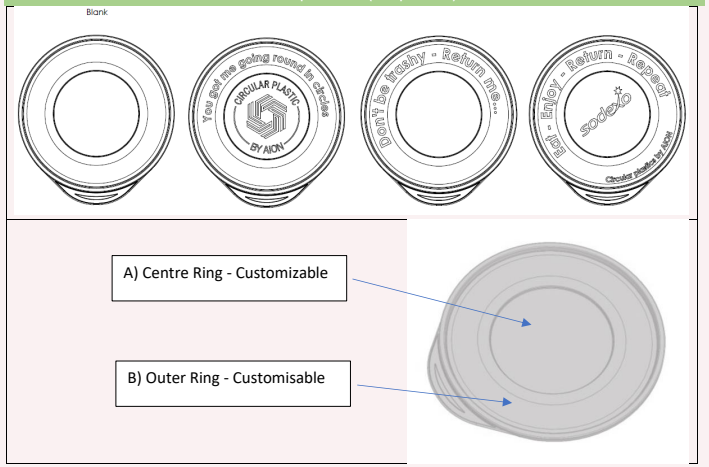
Safety & Hazards

Fire Load (set)	6.2 MJ
Stability	Stable
Incompatibility	None
Hazardous decomposition products	Oxides of carbon
Hazardous Polymerisation	Will not occur

AION

Data Sheet
Takeaway Bowl 800ml & Lid

Lid Options (Topside)



AION

Data Sheet
Takeaway Bowl 800ml & Lid

Appendix – Colour renders for visualisation Options

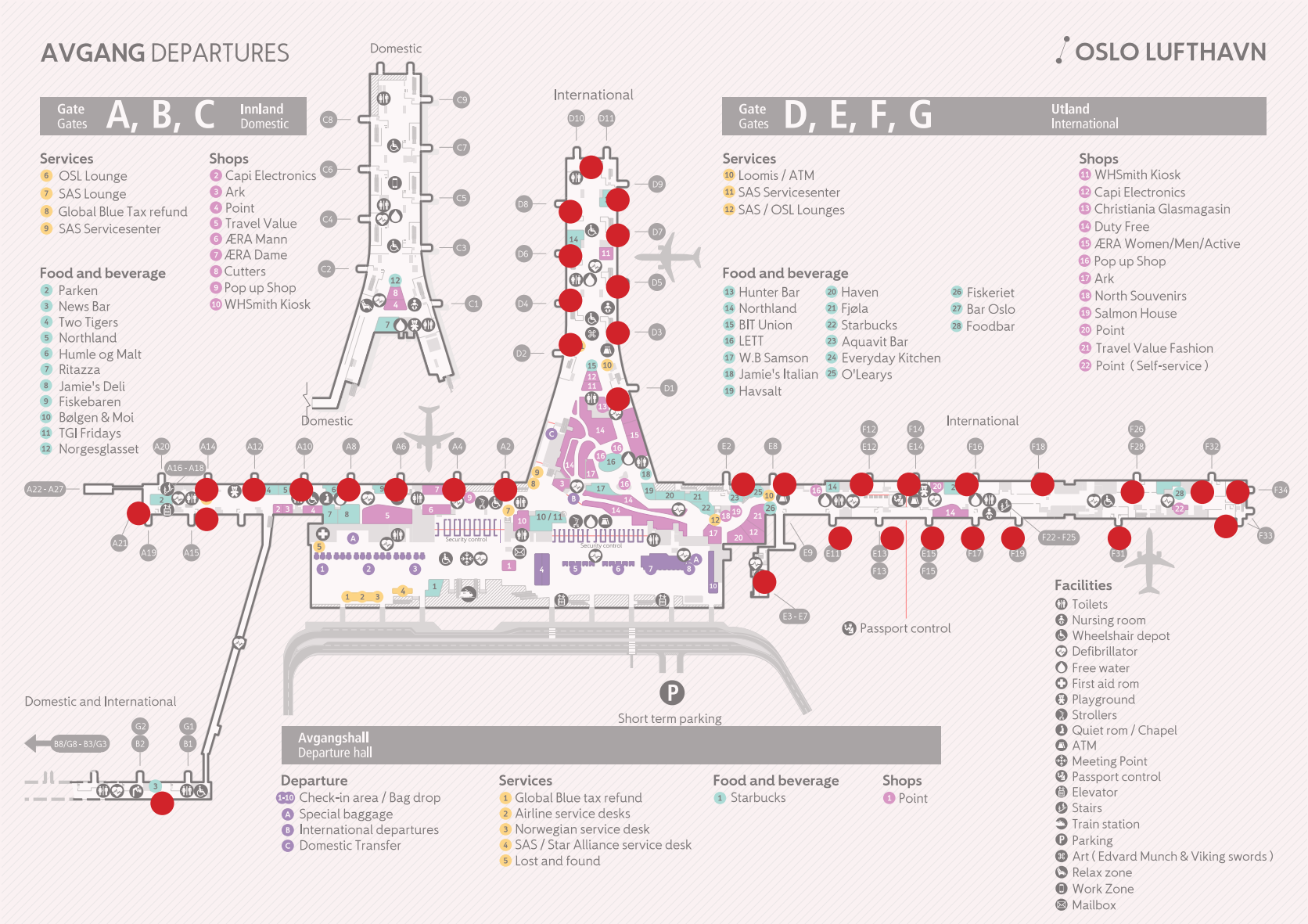
White (White – Off-white)	
Mocca Brown	
AION Green	
Black	
Clear (Translucent)	

Colors can be mixed with difference on lid/bowl

Available in the confidential Appendix

Available in the confidential Appendix

Appendix G: Location of the drop-off points

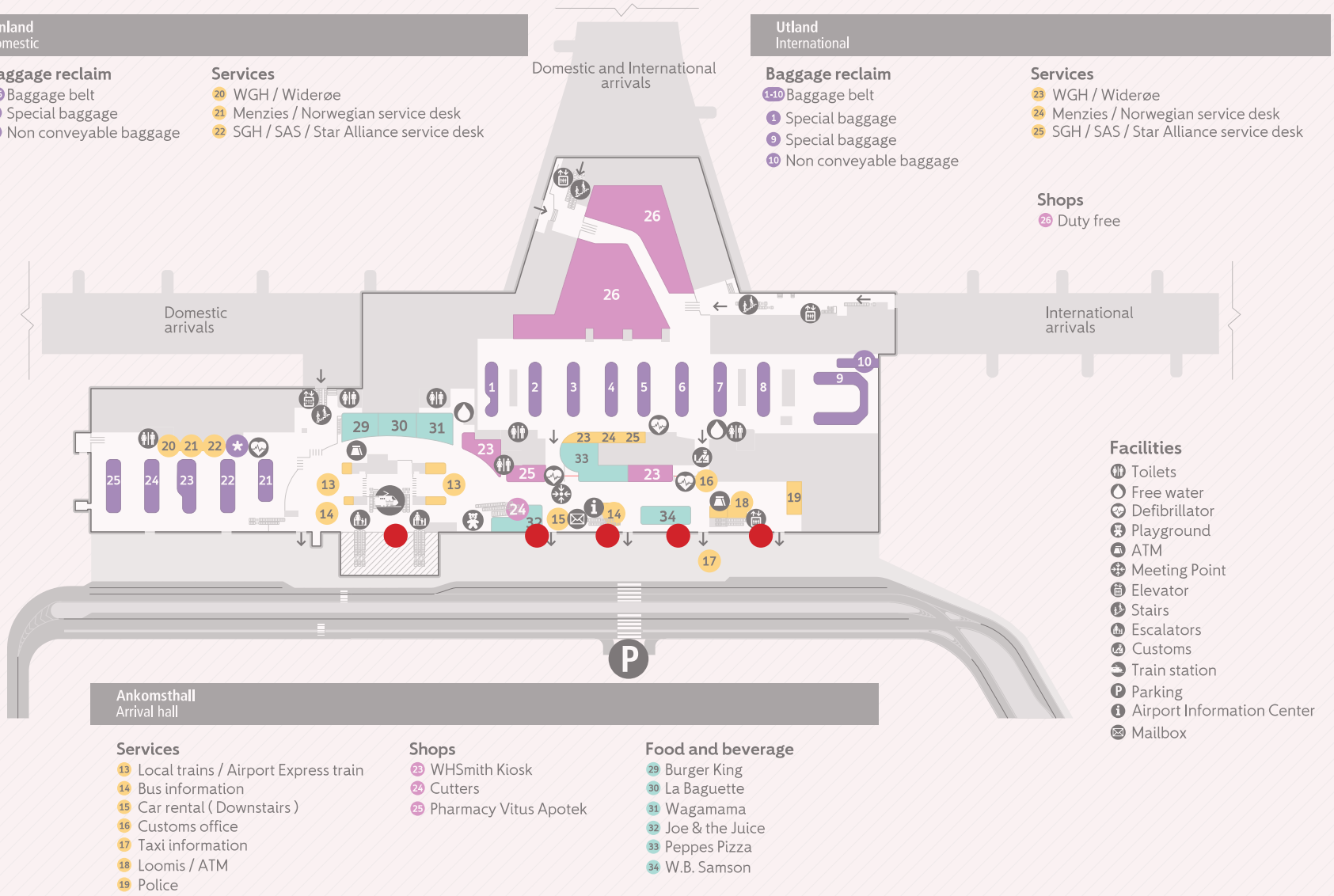


Drop-off machine

TOTAL: 42

ANKOMST ARRIVALS

OSLO LUFTHAVN



Appendix H: Pilot plan

Pilot plan available in the confidential Appendix

Appendix I: Suggested units

List available in the confidential Appendix

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

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

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

STUDENT DATA & MASTER PROGRAMME

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

Family name	Gil Falcon	7006	
Initials	M		
Given name	Maria		
Student number	5846595		

IDE master(s)	IPD		DfI	✓	SPD
2nd non-IDE master					
Individual programme *(date of approval)*					
Medisign					
HPM					

SUPERVISORY TEAM

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

Chair	Sonja Van Dam	dept./section	SDE/ CPD
mentor	Gonny Hoekstra	dept./section	HCD/ AED
2nd mentor	Rita Jonyer		
client:	Avinor Oslo Airport		
city:	Oslo	country:	Norway
optional comments			

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

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

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

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

Sign for approval (Chair)

Sonja van Dam - IO

Digitally signed by Sonja van Dam - IO
Date: 2024.02.13 16:09:00 +01'00'

Name Sonja van Dam Date 12 Feb 2024 Signature

CHECK ON STUDY PROGRESS

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

Master electives no. of EC accumulated in total _____ EC

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

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

Comments:

Sign for approval (SSC E&SA)

Robin den Braber

Digitaal ondertekend door Robin den Braber
Datum: 2024.02.15 10:22:06 +01'00'

Name Robin den Braber Date 15 feb 2024 Signature

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

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is …

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

Comments:

Sign for approval (BoEx)

Monique von Morgen

Digitally signed by Monique von Morgen
Date: 2024.02.15 10:32:58 +01'00'

Name Monique von Morgen Date 15 Feb 2024 Signature

Personal Project Brief – IDE Master Graduation Project

Name student Maria Gil Falcon **Student number** 5,846,595

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title **Designing dishwashing as a service at Oslo Airport terminal**

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

Introduction

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

The project will take place at the Oslo Airport terminal and aims to create a circular service that makes single-use serving articles obsolete. With growing awareness of sustainability concerns, there is increasing recognition of the detrimental effects of single-use items, particularly in the aviation sector (Tjahjono et al., 2023). As a response to this, and in anticipation of potential EU regulations, Oslo Airport is seeking solutions. The primary stakeholders involve Oslo Airport (the client), business units like restaurants and cafes, airport visitors, waste logistics workers, and TULIPS. The project is part of Tulips Work Package 6 - Circular Airports, which focuses on the "elimination of operational consumer/passenger waste" (TULIPS, 2020). The interests of the client encompass mitigating the environmental impact of single-use serving articles, optimizing operational efficiency for businesses, and improving the consumer experience at the airport.

The main opportunity is reducing the excess waste generated by single-use serving articles at the airport's restaurants and cafés, through a 'dishwashing as a service' as an alternative. Additional opportunities include exploring the feasibility of this circular service and enhancing consumers' dining experience while fostering a sense of environmental responsibility. Furthermore, there is an opportunity to explore strategies for behavioural change among both visitors and business units.

However, challenges include the need to understand why businesses with installed dishwashers still use single-use items or how the integration into day-to-day operations (times, routes, and redistribution) will work. The success of the designed service lies in its ability to meet the diverse needs of stakeholders and, importantly, in overcoming established habits of commercial units and consumers. Therefore, facilitating behavioural change becomes vital in encouraging the adoption of reusable items.

Tjahjono, M., Ünal, E., & Tran, T. H. (2023). The Circular Economy Transformation of Airports: An Alternative Model for Retail Waste Management. *Sustainability*, 15(4). https://doi.org/10.3390/su15043860

TULIPS. (2020). *Innovative & sustainable airports*. https://tulips-greenairports.eu/

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introduction (continued): space for images

image / figure 1

image / figure 2

Personal Project Brief – IDE Master Graduation Project

Problem Definition

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

Globally, airport terminals produce about 6 million tons of passenger waste each year, which has triggered the necessity of implementing measurements related to aviation waste management (Tjahjono et al., 2023). A large part of this waste is generated inside the terminal passing the security boundaries, especially by single-use serving articles and single-use-take-away products (Tjahjono et al., 2023). To address this environmental concern, Avinor Oslo Airport wants to explore the possibility of implementing a circular service that makes single-use serving articles obsolete. Moreover, the rest of the stakeholders face their unique problems, such as maintaining efficient systems for business units or adapting to the transition towards reusable items for passengers.

For this matter, a dishwashing-as-a-service system will be designed, including the required elements needed to meet the potential needs of the different stakeholders. By making single-use items obsolete, Avinor demonstrates its dedication to mitigating the environmental impact, aligning with the objective of TULIPS. Moreover, the project anticipates enhancing the consumer experience for passengers, as providing sustainable options to passengers is likely to increase the quality of the dining experience (Magnier et al., 2016). This value extends to commercial units, which will also benefit from eliminating the need for on-site dishwashing equipment. Furthermore, the project aims to improve the efficiency of waste logistics tasks and reflect the service's importance to the visitors.

Magnier, L., Schoormans, J., & Mugge, R. (2016). Judging a product by its cover: Packaging sustainability and perceptions of quality in food products. *Food Quality and Preference*, 53, 132 -142. https://doi.org/10.1016/j.foodqual.2016.06.006

Tjahjono, M., Ünal, E., & Tran, T. H. (2023). The Circular Economy Transformation of Airports: An Alternative Model for Retail Waste Management. *Sustainability*, 15(4). https://doi.org/10.3390/su15043860

Assignment

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

Design a dishwashing-as-a-service blueprint to reduce the waste from single-use serving articles for Avinor Oslo Airport in its restaurants and cafes and enhance their visitors' experience.

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

To develop the project, the three-diamond method will be followed (Design Council, 2024). During the first diamond, the aim will be to understand the context and formulate a clear problem statement. This involves conducting a literature review on relevant case studies and circular economy practices implemented in airports or similar contexts. Additionally, insights will be gathered from observations during field visits and interviews with the involved stakeholders together with Context Mapping sessions (van Boeijen & Daalhuizen, 2010). The second diamond will represent the ideation phase. This involves facilitating co-creative sessions (Heijne & van der Meer, 2019) with the stakeholders, brainstorming and using other methods to iterate on the ideas to develop three concepts. The conclusion of this diamond includes the evaluation of these concepts, leading to the final selection of one concept. Furthermore, the final diamond will consist of developing the selected concept. Consequently, the final concept will be defined and developed to be ultimately evaluated. For its validation, the concept will be tested in context by the stakeholders, who will provide feedback through methods that could include interviews or questionnaires.

Design Council. (2024). *Framework for Innovation*. https://www.designcouncil.org.uk/our-resources/framework-for-innovation/
Heijne, K., & van der Meer, H. (2019). *Road Map for Creative Problem Solving Techniques*.
van Boeijen, A., & Daalhuizen, J. (2010). *Delf Design Guide*. Faculteit Industrieel Ontwerpen. http://ocw.tudelft.nl

Project planning and key moments

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

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

Kick off meeting	13 feb 2024
Mid-term evaluation	17 abr 2024
Green light meeting	13 jun 2024
Graduation ceremony	9 jul 2024

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

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

Comments:

Motivation and personal ambitions

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

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

The decision to pursue this project comes from a passion for sustainable design and a commitment to making a meaningful impact. Through my studies, I have developed a deep interest in understanding how people behave and interact with the world. To this end, I have learned various methods, including interviews and context mapping techniques, to understand the context of use of products and services. Thus, I would like to prove my skills in this area, particularly given the unique characteristics of an airport environment. However, through this project I also aspire to extend my horizons by gaining experience and fluency in service design.

Moreover, I perceive this as an exciting opportunity to collaborate with a client who envisions taking a leadership role in implementing innovative and sustainable solutions. This prospect aligns with my aspirations and presents a unique chance to contribute to a transformative project. I anticipate this to be an exceptionally enriching experience, as it involves navigating the practicalities of working with an ambitious client. I am enthusiastic about exploring how I can effectively apply the knowledge and skills acquired during my master's program in the real-world context, successfully addressing the demands and expectations associated with client collaboration.

Graduation Plan

Kick-off: 13/02/2024 Week 1

Mid-Term: 17/04/2024 Week 10

Green-light: 13/06/2024 Week 17

Graduation: 09/07/2024 Week 20

Week at Oslo

First day of the week	12th Feb	19th Feb.	26th Feb.	4th Mar.	11th Mar.	18th Mar.	25th Mar.	1st Apr.	8th Apr.	15th Apr.	22nd Apr.	29th Apr.	6th May	13th May	20th May	27th May	3rd June	10th June	17th June	24th June	1st July	8th July
Total days spent	03 /100	08 /100	13 /100	18 /100	23 /100	28 /100	32 /100	36 /100	41 /100	46 /100	51/ 100	56/ 100	59 /100	64/ 100	68/ 100	73/ 100	78/ 100	83/ 100	85/ 100	93/ 100	98/ 100	100/ 100
Calendar week	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	25	26
Project week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Desk research																						
Interviews, observations																						
Analyse insights																						
Problem statement/ Design brief																						
Ideation																						
Preparation field trip																						
Co-creation sessions																						
Analysis & Conceptualisation																						
Concepts testing																						
Concept evaluation																						
Selected concept improvement																						
Preparation field trip																						
Final concept validation																						
Improvements																						
Analyse insights																						
Writing Thesis																						
Presentation																						

No working days
29/03/2024
01/04/2024
09/05/2024
10/05/2024
20/05/2024

Designing dishwashing as a service at Oslo Airport terminal

María Gil Falcón

July 2024