**Challenge SDG12 Responsible Consumption and Production**

**Final report**

Juliana Tikhomirova
Salli Tuominen
Tiia Katajamäki
Elina Korventausta
Tarja Koski
Mireia Pagès Guitart

CERN Bootcamp 2023

June 2023

Abstract

We are consuming single-use packages at an exhausting rate, adding to the global plastic waste problem. Annually, we use about 1 billion single-use take-way packages, and the home delivery sector is expected to triple by 2030.

This report presents an easy access solution for the return and washing of food take-away packages, utilizing existing infrastructure and services. The solution presents a system with re-usable take-away food packages with a deposit. Using VISIR2 technology and AI for quality checking, and combining this with optimized logistics and centralized washing, the potential positive environmental impact of re-use packages can be captured and scaled.

*This is part of ATTRACT that has received funding from the European Union's Horizon 2020 Research and Innovation Programme.*

Keywords: multiple-use package, take-away food industry, package as a service, VISIR2

# 1 Introduction

In this report our group will introduce the United Nations (UN) sustainable development goal (SDG) 12 and our teams chosen approach to tackle the challenge. We chose “We aim to avoid and reduce single-use plastics” as our intent statement based on our preliminary research on the best way to take on this goal with a large impact and a big enough magnitude.

In our preliminary research, we investigated this topic from the point of view of circular economy, consumer behavior, production patterns and politics. During our development process, we chose to look further into the plastics that are used in single-use take away packages, as we recognized this to be a growing issue of both sustainability and food safety issues. Our How might we -question developed into “How might we reduce the need for single use plastic products in the take-away industry”.

In this report, we start by introducing the sustainable development goal 12, as well as the issues with single-use products and the take-away industry to elaborate on the motivation of our project. Then, we move on to discuss our developmental approach and the design process of our solution. Lastly, we finish by presenting our solution on how to reduce single use plastic items by introducing a concept of reusable plastic take-away packaging together with a sustainably built returning, washing and quality checking scheme.

## 1.1 Sustainable development goal 12: Responsible consumption and production

The sustainable development goal 12 Responsible consumption and production (SDG12) aims to promote sustainable consumption and production patterns to strongly preserve the subsistence and livelihoods of present and future generations. Unsustainable patterns of consumption and production have major consequences on climate change, biodiversity loss and pollution, which is also known as the triple planetary crises. Tackling the consumption and production patterns issues and its drawbacks is a major interest to prevent environmental degradation and sustain human wellbeing. Relevant targets for achieving SDG12 would be to both improve resource efficiency and reduce waste and pollution, as well as to consider the entire life cycle of economic activities and shape a new circular economy. Governments and citizens should have an active engagement in multilateral environmental agreements to further support the SDG12 (UN, 2020).

There are many ways of changing consumption habits which will lead to a bigger impact on the whole society. For instance, there is a 13.8 % food loss after or during harvesting, transport, storage, and processing alone, and an additional 17 % at the consumer level, consequently accounting for an enormous waste of economic funds and for 8 to 10 % of the global greenhouse

gas emissions. Thus, reducing food loss and waste can potentially benefit environmental sustainability. Another example would be that the unfeasible production and consumption has a huge impact on water pollution, and how recycling or reusing could improve the situation (UN, 2020).

It is in businesses' interest to identify "hot spots" within the value production and consumption chain, in which we could develop and apply innovative interventions to improve the environmental and social impact of the system, and to inspire individuals to acquire a more sustainable lifestyle. On a consumer level, the optimal action points would include reducing everyone's waste and plastic consumption and making informed purchases (UN, 2020).

Inside the SDG 12 goal, the United Nations (UN) set eleven different goals for building more sustainable consumption and production patterns. The ultimate goal is to implement green programs to the manufacturing and the usage of resources which enhance international cooperation, forcing all countries take action and ultimately benefit from the outcome. This framework of initiatives should cover the reduction of food loss and waste, as well as of the chemicals that can reach air, water, and soil. They should also suggest technological strategies to monitor and minimize the adverse impacts of these chemicals on human health and the environment. Finally, it should be possible to rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption, and to promote awareness for sustainable development and lifestyles in harmony with nature (UN, 2022).

### 1.2 The Challenge: Single-use products

After several discussion around topics such as not wasting resources, minimalism and how to prevent waste that ends up in the nature or landfills our group focusing on the SDG 12 goal has narrowed down our challenge to: "How might we reduce the need for single use plastic products".

A single-use item, also known as a disposable item, is designed to be used only one single time before being thrown away, and it is not intended to be reprocessed in any way, such as by being cleaned, sterilized, repackaged, or relabeled (FDA, 2001). Single use plastic (SUP) products are defined as "An SUP product is a product that is made wholly or partly from plastic and that is not conceived, designed or placed on the market to accomplish, within its life span, multiple trips or rotations by being returned to a producer for refill or re-used for the same purpose for which it was conceived." by Tukes (2023). The key characteristic of a single use product therefore is that it is not intended to be used for the same purpose several times. Single use products can however be recycled, both upcycled creating higher value products or downcycled creating lower value products of the single use materials.

SUPs are perhaps the most harmful kind of single use products due to many factors. One of the most alarming reasons is the quantities of plastic produced; over 300 million tons annually, half of which is meant for single use purpose (Lindwall, 2020.) Plastic production is growing much faster than other common materials for single use products such as cardboard and paper. From the year 2000 plastic production doubled in less than 20 years (Our World in data, 2023.) while paper and cardboard production grew at a moderate pace of 7% from 2005 to 2015 (Researchgate, 2023.)

Recycling SUPs has been identified to mitigate the impacts of plastic waste, but results have been poor. According to Our World in Data (2023) only 20% of world´s plastic was recycled in 2015. Around 25% was incinerated and 55% ended up in landfills or in the environment. Plastic is also the most common marine debris and in recent studied 90% of marine birds have had plastic in their stomach. Experts are also estimating that in 2050 there will be more plastic than fish in the oceans (Lindwall, 2020.)

In addition to the plastic waste harming ecosystems, plastic production and incineration are major causes for carbon dioxide (CO2) emissions. 2019 the emission totaled around 0,85 Gt of CO2 which is roughly the same as all aviation emissions. If plastic production continues to grow as projected, these emissions will triple by the year 2050 (CIEL 2019.)

Simply replacing SUPs with other materials is not the optimal solution either. There are studies showing that the environmental footprint of a paper bag can be 2,5 times higher than that of a plastic bag (Sevitz et al. 2012.) Therefore, there seems to be a need to simply reduce the usage of single use products altogether by reusing materials more efficiently.

### 1.3 Take-away food industry

Team Less is more had the vision to reduce material usage and waste by reducing the need for single use products. When researching the topic and observing the world around us we came up with a specific industry we wanted to target: the fast-growing take-away food industry.

Take-away food industry has rapidly evolved from the traditional restaurant specific pizza delivery to an industry where any restaurant can provide delivery service without any resources invested or hiring delivery personnel. Easy to use apps and completely new logistics schemes powered by big platforms have made this possible. The industry´s turnover in 2020 was over 150 billion and it is expected to more than triple by 2030 (Ajuha et al, 2021). Biggest volumes, over 40 %, come from Asia and Pacific region, especially from China, India and Japan. Followed by Europe and the US each with approximately 20 % share of the global market (Grand View Research, 2023).

Most, if not all, deliveries are made in packages that are single use creating approximately 1 billion single use packages that mostly end up in waste, not recycled.

# 2 Developmental approach

## 2.1 Design thinking and Service design

Both service and design thinking methodologies are focused on human-center design, and they are viewed as an approach and a mindset to problem solving and innovation. Design thinking is solutions centered methodology where the purpose is to empathies with the user or customer and try to figure out their actions and mind set and create a solution based on that (Rebelo, 2015; Han, 2022.)

Design thinking is based on four steps clarify: narrowing down the focus, ideating (how could the problem be solved), developing (what could the solution be) and implementing where the solution is brought to life. Very much like the sprint methodology, design thinking is focused on finding a user centric solution to improve their experience when dealing with a product or a service. Whereas design thinking is the innovation of solutions for problems, service design is focused on improving services to be more user-friendly and thus improving the user experience (Rebelo, 2015; Han, 2022.)

Both the design thinking and service design are applied in the book Sprint: how to solve big problems and test new ideas in just five days in a concrete easy to understand way (Knapp, Zeratsky & Kowitz, 2016).

## 2.2 Sprint methodology

The book Sprint: how to solve big problems and test new ideas in just five days is a detailed description of a design sprint that utilizes service design. A sprint is a five-day intense work that is meant to produce insights to support decision making. A sprint can be conducted to support an organization or a group when a project has high stakes which will require a lot of time and/or money, when a project can't meet their deadline and they need to figure out what is the most important part to concentrate on, the project or work needs fast deliverables or the project is just plain stuck to help kick start the work (Knapp, Zeratsky & Kowitz, 2016)

A sprint team is the collection of the people participating in the sprint. The sprint team can be built of different key members across an organization who bring value in expertise, experience, and ideas and who understands the problem the sprint is confronting. The sprint team has two significant roles within the team the decider and the facilitator. The decider is the official decision maker of the team and generally has the most in-depth knowledge of the project. The

facilitator is responsible of the overall process, managing time and whose role is to lead the conversations. The ideal size of a sprint is seven people or fewer (Knapp, Zeratsky & Kowitz, 2016)

### 2.2.1 Goals and target of the sprint

In a sprint everyday has a specific schedule, purpose, and goal. Monday's purpose is to define the goal of the sprint and collect as much information as possible about the problem by interviewing experts. The day starts by determining the long-term goal of the project and what are the biggest obstacles for reaching it. Using How might we -questions the sprint team tries to answer them during the week. (Knapp, Zeratsky & Kowitz, 2016)

During the day the sprint team will draw a map of the customer journey for the product or service that is the topic of the sprint. The map is simple illustration of the actors or "characters" journey through different phases of their interactions with the product or service and what is the result of their journey. (Knapp, Zeratsky & Kowitz, 2016)

At the end of Monday, the sprint team will choose a target for their sprint. Based on the customer journey map, data gathering and How might we -questions, the decider will choose the target customer and what is the step of the customer's journey that the sprint will focus on – this is what the sprint team will be focusing on for the rest of the week. (Knapp, Zeratsky & Kowitz, 2016)

### 2.2.2 Data analysis

The second day, Tuesday, starts with reviewing the existing ideas within the team, before moving on to sketching out those ideas in more detail. When reviewing already existing ideas, Knapp and colleagues (2016) suggests turning into already existing solutions from other fields or other types of businesses, rather than focusing on what has already been done in the field of the problem at hand. These ideas will be gathered together and used in the afternoon. In our own sprint schedule, we spent time on Tuesday to do some further data gathering by conducting additional interviews with experts.

### 2.2.3 Ideation

Once the team has gathered ideas, it is time to start individually sketching out those ideas (Knapp, Zeratsky & Kowitz, 2016) By sketching, Knapp and colleagues refer to creating some kind of visual representation of the idea with a piece of paper and a marker. This visual representation serves as a boundary object for the team to gain mutual understanding of what is actually meant by the idea. This reduces the risk of great ideas being dismissed due to unclear or confusing wordings or explanations not fully understood (Knapp, Zeratsky & Kowitz, 2016).

An important part of the sprint happens on Friday when the prototype of the solution is presented and tested on possible customers. According to Knapp and colleagues (2016) it's the facilitators job to find the test customers on Tuesday. It is important to find real or realistic customers to test the product and get their authentic reactions and feedback on it.

### 2.2.4 Deciding on a solution

Wednesday starts by assessing the individually generated sketches from Tuesday. The solutions are displayed, discussed, and voted on within the team. In the end the decider will cast their vote and make the final decision what solution the rest of the sprint will be focused on. (Knapp, Zeratsky & Kowitz, 2016)

At a later point on Wednesday afternoon, it is time to move on with the chosen idea. The point is to create a storyboard of the solution that has been chosen. A storyboard refers to a visual representation of a step-by-step plan for the prototype to be created on Thursday. Knapp, Zeratsky and Kowitz argue on creating the storyboard first, rather than jumping straight into creating a prototype. The reasoning lies within the small issues to be solved, that only become visible once the idea is brought into a more concrete and detailed form. Creating a storyboard of the interaction or the process allows the team to see these questions to be solved, before they are too invested in creating the actual prototype. This also streamlines the process of building the prototype, and consequentially saves time later on in the process. A storyboard is a collection of images describing the process that happens. It is reminiscent of a comic strip, often combining drawings with text. (Knapp, Zeratsky & Kowitz, 2016)

At the end of Wednesday, the sprint team should have a clear vision of the prototype they are going to create on Thursday and how it's going to be tested on Friday. Getting to this point is the hardest part of the sprint (Knapp, Zeratsky & Kowitz, 2016).

### 2.2.5 Prototyping

The next phase of the design sprint is dedicated to creating a realistic prototype pf the chosen solution. Knapp, Zeratsky and Kowitz claim that one day of work will be enough for prototyping, given the work done in the previous three days. This is made possible since the prototype is essentially a façade or a "looks real enough as long as no one looks too closely" -version of the product or idea in preparation (Knapp, Zeratsky & Kowitz, 2016).

A prototype is used to convey the general idea of the solution to the possible customers on Friday and gather their feedback and reactions to it. The challenge with prototyping is working efficiently enough to be able to complete everything in one workday, and still have enough time to make final changes and test the product out in the afternoon. Knapp, Zeratsky and

Kowitz (2016) addressthis issue by dividing up the work between the team members, so that everyone will have their assigned task to take care of in bringing the solution to life.

#### 2.2.6 Testing the solution

On Friday it's time to test the prototype. The testing is done with the potential customers gathered on Tuesday. In the testing the potential customers are shown a façade of the solution and their reactions and feedback is recorded and later analyzed within the sprint team (Knapp, Zeratsky & Kowitz, 2016).

At the end of the sprint process on Friday afternoon, it's time to gather all the evidence and take a look at the created concept. Knapp, Zeratsky and Kowitz (2016) remind to circle back to Monday and look was the long-term goal and the HMW-questions answered. Based on the results the team can continue to work with the project, adjust and conduct another sprint in the future or discard the idea and move on to something else. (Knapp, Zeratsky & Kowitz, 2016).

## 3 Evolution of the design

Next, we will discuss in detail our progress during the design sprint and the evolution of our design from an initial idea to a final solution. The CERN Bootcamp started with an introduction on the importance of open science and giving feedback on each other's projects. We also went through all the assignments that needed to be completed by the end of the course. Afterwards, we continued working with our groups to further develop our projects.

### 3.1 Identify the challenges of our target

Our group digged into our project by writing challenges around the use of single-use materials on food take away industry. This helped us to group the challenges in broader topics. We then transformed these broader challenges to How might we -questions (HMW), which can be seen in Figure 1. This step allowed us to turn the identified challenges into opportunities as well as identify action points. As a group, we realized that most of the HMW questions were included in and defined by the consumer behavior and the restaurant management on food take away services. For this reason, we decided to build on top of those two narrower challenges.

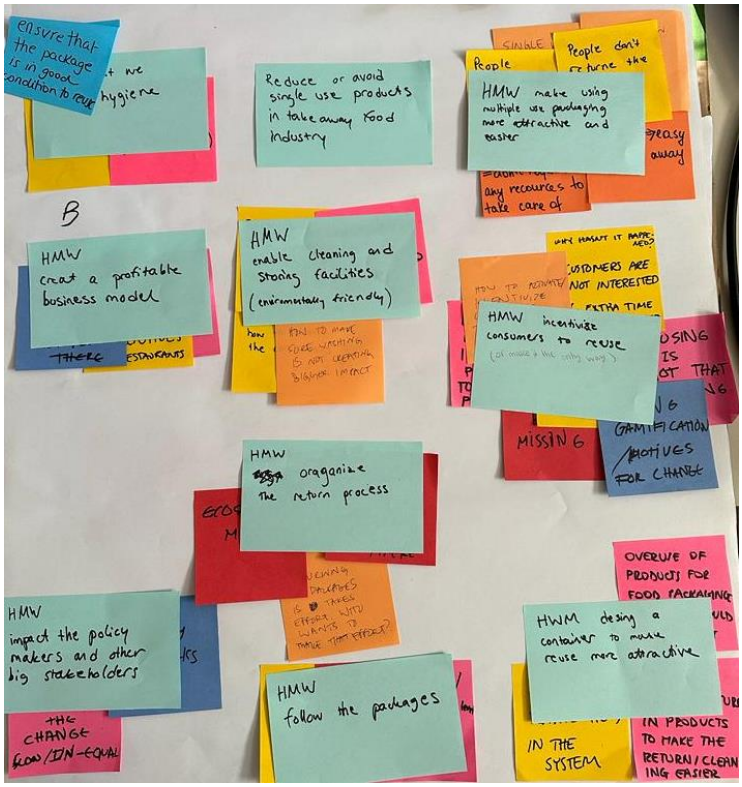



Figure 1: HMW questions resulted from the existing challenges around the use of single-use materials on food take away services.

## 3.2 Building the journey map

Our group moved on to build the journey maps from the consumer behavior and restaurant perspectives. As a summary, a journey map is a story of a person's experiences over time (Stickdorn, 2018). Journey maps typically describe a customer's or user's reactions while using a service or a product. However, they can also assess any stakeholders' experiences. Journey maps aim to visualize the different parts of the customer journey when interacting with the service or product. Figure 2 and Figure 3 display the consumer behavior and restaurant journey maps.

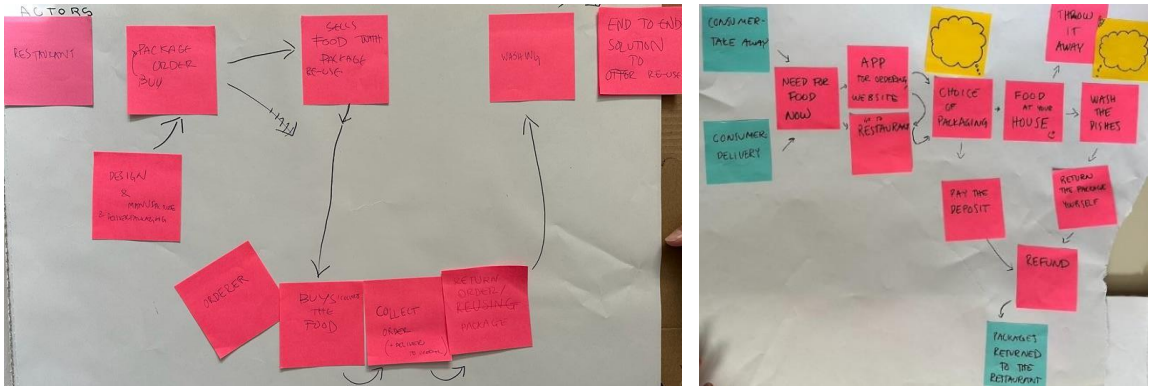



Figure 2 and 3. Journey maps on the consumer behavior (right) and restaurant's (left) point of view.

After building the journey maps, we discussed them with the group, added what was missing and pinned point the challenges that we could identify. As expected, some of the challenges matched a few of the HMW questions formulated before. Following that, each one of us was granted three votes to decide which challenge would be best to tackle. Figure 4 and Figure 5 display the voting on the journey maps. As the figures show, there was a tie between two challenges: the action of returning the food box to the pick-up point and the washing of the food containers. We agreed to continue focusing on both challenges, as they were narrow enough to tackle both.

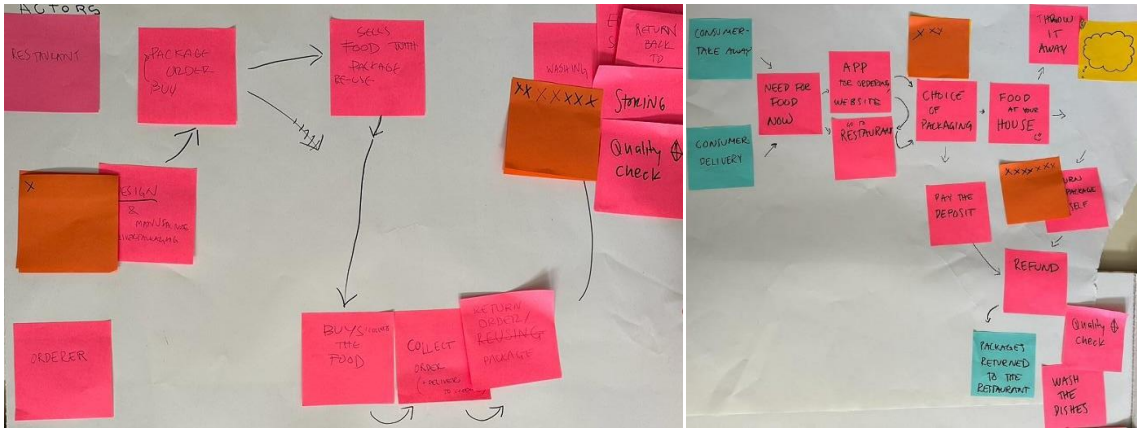


Figure 4 and 5: Voting outcome of the journey maps.

## 3.3 Data gathering

The next step was to gather all known data from the previous assignment and new research regarding both the selected challenges. As Figure 6 and Figure 7 show, we wrote the data on post its and grouped them into different sub-challenges. Afterwards, we agreed on which of those issues we should focus on. There were two popular points, each one belonging to a different journey map. Those issues were, on one hand, how to make the return easier and, on the other hand, how to wash and quality check the food boxes. Since those challenges were specific enough, we decided to tackle both of them.

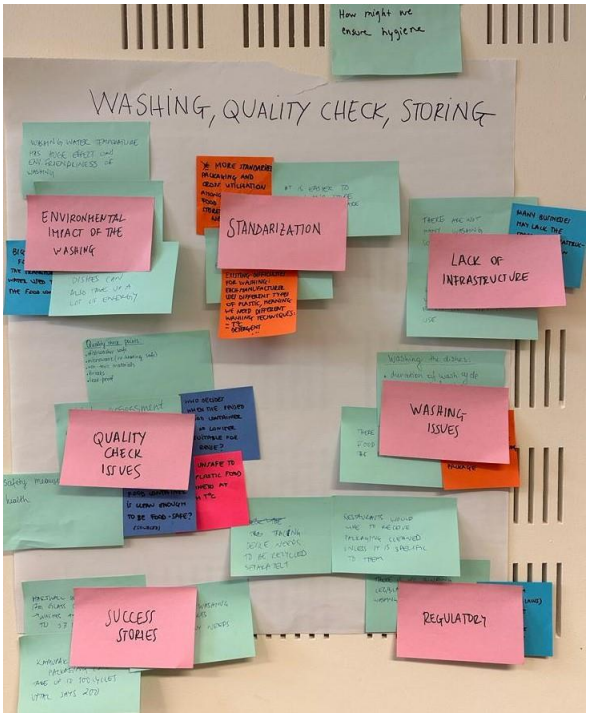




Figure 6 and 7. Data gathering of the selected journey maps challenges and grouping it on sub-issues.

### 3.4 Interviews at CERN

To further complement the interviews we had done at the data gathering phase before the bootcamp, we conducted three more interviews during the bootcamp.

#### 3.4.1 Interview with Andrea Ballabio, VISIR2 technology

The interview with Andrea Ballabio, the VISIR2 coordinator was executed in Teams. We asked for the possible applications of this technology. He first explained to us, in simple words, how VISIR2 works. We understood that it is based on a normal camera that uses infrared to see what the naked eye cannot spot. VISIR2 can show bigger or smaller things depending on the objective given for the camera, e.g. microscope or telescope objectives. Also, the infrared light enables it to see through transparent objects even though they are colored, e.g. leaves and candy packaging, but not through opaque materials such as iron and copper. He ended up telling us how VISIR2 can be useful for night vision, industrial inspections, quality controls, drug sorting and much more. We then asked if VISIR2 could see if a food box is broken or clean, and he told us that it could potentially show us cracks if the box is transparent. However, VISIR2 probably can't detect food scraps, bacteria or microplastics. In addition, he explained that VISIR2 could detect superficial damages while rotating and imaging around opaque food boxes. After the interview, we were convinced that VISIR2 could likely be the technology for our solution.

### 3.4.2 Interview with production coordinator Roosa Tikanoja

We had an informal lunch interview with another course participant Roosa Tikanoja, form the SDG 3 group. Roosa works as a producer in the film and television industry, and she was able to give us insights on how single use items are used on film sets. Roosa told us that whenever possible the production uses real cutlery in their catering if the set is in an easily accessible place. However, more often than not the set is in a hard-to-reach location and the production has to make the choice which is easiest to carry out.

Roosa emphasized that it comes down what is easiest for the production team to set up. If having multiple-use cutlery and other no single-use items causes extra work, the production will choose the easier option. The choice can also depend on the vendors who produce the food to the location. If the vendor doesn't have the proper facilities to wash and store multiuse items, will they automatically provide only the single use option.

The interview with Roosa supported our assumptions that using multiuse items needs to be an easy option. When a person or a whole team would have to put extra effort into using multiuse items, will they choose the easier option.

### 3.4.3 Interview with Chrysoula Manoli, AHEAD technology

The interview with AHEAD was conducted on Tuesday. Chrysoula Manoli, the pointed AHEAD contact person, described the AHEAD technology to us and explained how it is currently possible to use and what are the next steps in their ATTRACT project. AHEAD is a small 3D printed measuring device that has sensors which can be used to measure different liquid properties. Currently AHEAD can be used to measure the temperature of liquid. The next steps are to get it to measure pressure and flow rate of liquid. In the future AHEAD is hoping to expand the measuring capabilities to other properties too such as the acidity and PH level of liquid and other liquids besides water, which is currently the only possibility.

After all the interviews at CERN, our team discussed which technology had more potential to be used in our solution. ULTRARAM was a promising tool to record data regarding returning and reusing food packages. However, the technology purpose felt too generic for us. VISIR2 was very appealing to us, as it could be introduced in the quality control of food boxes, which we considered could be a crucial step on our solution. Also, this technology was able to do what we expected to in order to employ it on the quality control. AHEAD was a very interesting technology, mostly because of its ability to detect water properties. We thought this could be used to assess if the food box washing was ecofriendly, but it turned out this technology is not capable of sensing or measuring chemicals. To sum up, our group decided to select the VISIR2 technology to complete our prototype.

## 3.5 Ideation

The dance workshop was the first session that we had in Idea Square. The aim of the seminar was to open our senses, feel comfortable in the working place and get ready to ideate solutions for our challenges. We started by imagining whatever came to our minds and followed to think a character based on a mix between ourselves and a skilled animal. We believe this exercise was useful for us to characterize and get to know ourselves better. Afterwards, we walked around the room impersonating this creature, which we think enhanced our feeling of ease. We finished the workshop by finding a partner and mirroring each other. This activity allowed us to identify the leader or follower in us, and to know how to alleviate it to fit in the group dynamics. After the session, we came to the conclusion that the seminar did somehow benefit and prepare us to start ideating.

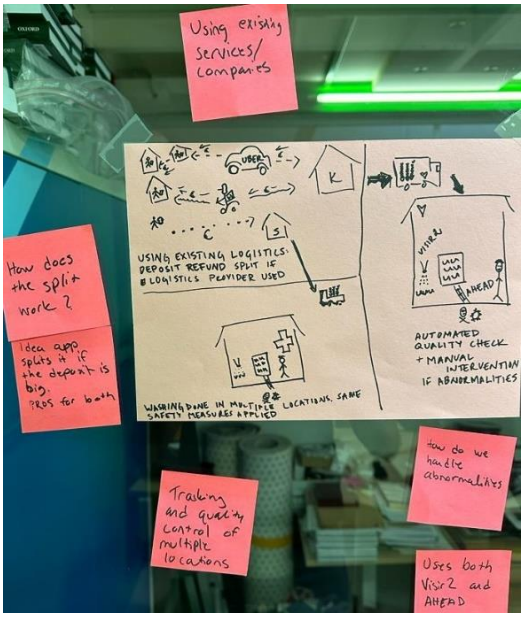
Our group also participated in the ideation seminar in order to get ready to turn our insights into ideas. Lots of ideation methods were explained to us. One strategy was the six thinking hats, which aims us to think from six different perspectives while ideating a solution. For instance, the white hat limits us to think from the facts and information perspective, while the green hat enhances our creativity and novel ideas. The workshop also went through how to create a storyboard of our solution. Our takeaway message from the session was to encourage all the group participants to generate lots of wild and poorly developed ideas, and to remind ourselves that everyone's insights are equally important.

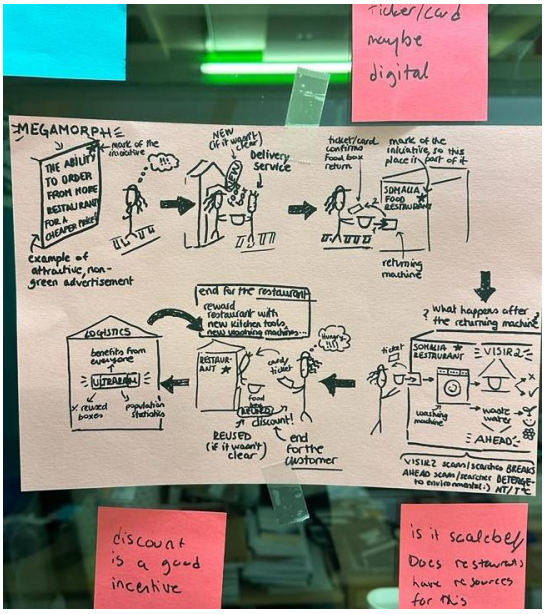
Since our group had already selected the topic, we got together to discuss which strategies we would apply to ideate and find our solution. We applied the Crazy 8 strategy to effectively brainstorm. The Crazy 8 is an ideation method used in service design to quickly and messily create eight different solutions in eight minutes (60 seconds per solution) (Knapp, 2016). You start by dividing a sheet of paper into eight parts and either create eight different solutions to an idea or eight different variations of the same idea. As a result, you are left with some new and fresh ideas that might help continue your process. After the Craxy 8 strategy, everyone explained what they came up with. Some of the solutions that we discussed were:

- Pizza truck with its own oven to serve directly on the customer's plate.
- Using VISIR2 to scan cracks on food boxes and getting them out the circular system.
- Install automated monitoring of dishes to detect defects before they break.
- Adding fixed lids to the food containers so it's easier to clean.
- Return and wash at the same station.
- Use existing washing facilities, like school cafeterias.
- Returning points at local grocery stores.
- Possibility to order the pickup through an app.
- UBER divers can collect dirty food boxes and receive part of the deposit.

- QR code for tracking the food boxes.
- Special trash cans so anyone can return them and get the deposit.
- Replace the deposit with discounts on the next order.
- Non-green message: “the pickup service takes out the trash for you”

To continue with ideation, we decided to individually sketch for thirty minutes one solution based on the best ideas shared during the Crazy 8. Once finished, we displayed the drafts on the wall in an anonymous way, so that no one knew who sketched which. Afterwards, the Facilitator went through each one of the sketches, trying to describe by herself what she understood from the drawings. With the help of the group, the Facilitator also wrote advantages and drawbacks of each solution on post its. Figure 8 shows six different sketches done by our team. As the images show, all of the sketches portrayed customers returning their food containers to be washed and quality checked by VISIR2. On one hand, the returning was described either as customers going to the pickup point by themselves or as customers ordering a pickup service. On the other hand, the washing was portrayed either as a single, big facility or as different, small, already existing facilities, such as restaurants, hospitals and cafeterias. Nonetheless, the sketches were similar to each other on the general terms.



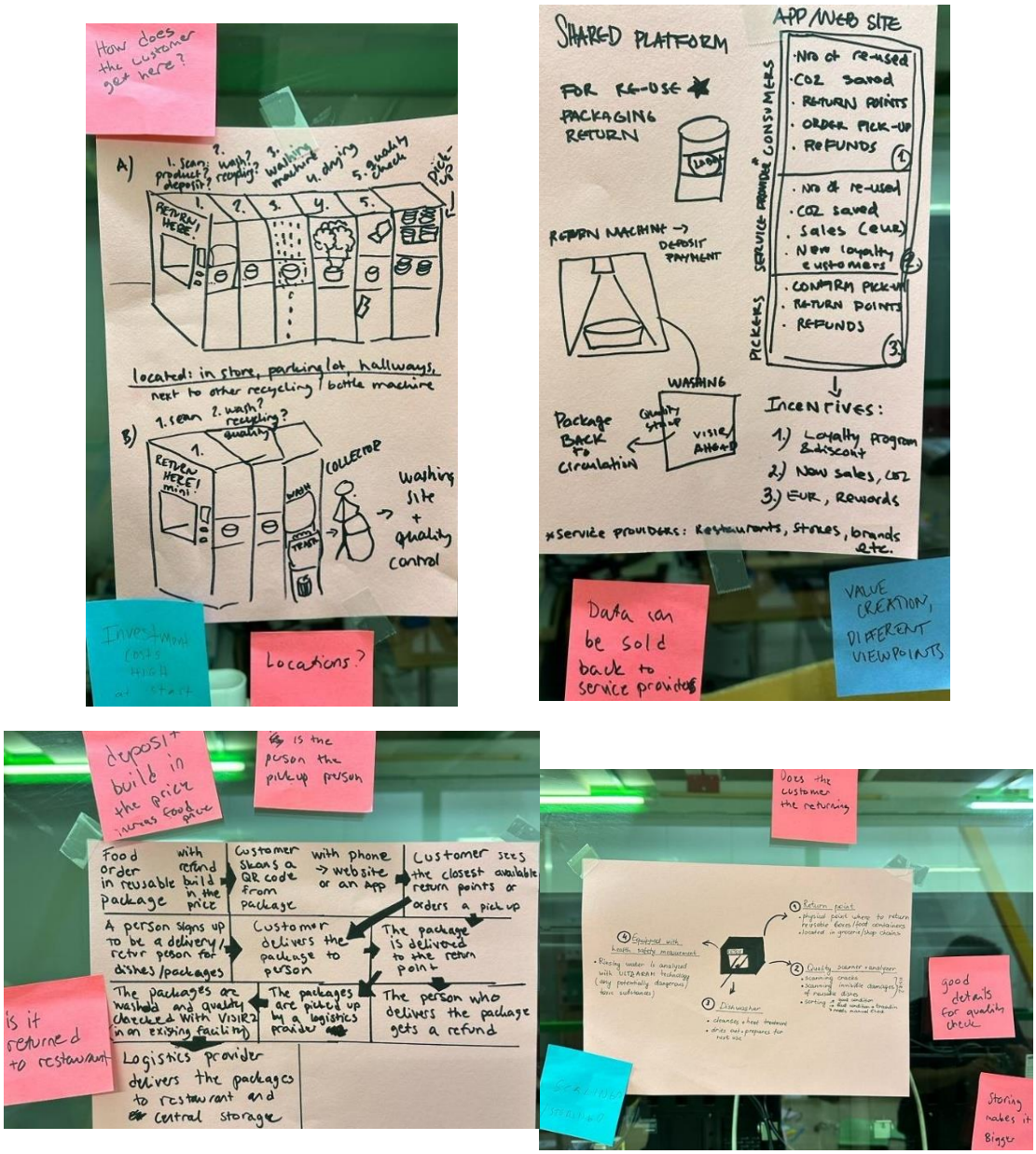



Figure 8: Sketches for the solution

After discussing all the solutions, the author of each draft took one minute to explain what she intended to represent, and to answer any questions that the group had. Following that, we discussed which sketch we liked the most and we ended up mixing parts of each draft to build the optimal solution. Nonetheless, there were still little aspects that needed to be voted, such as if the user pays a deposit or not, who collects the empty food boxes or how the washing and quality control happens.

We agreed that the final solution would be a customer that chooses to order food in a “less is more” reusable package, therefore they pay a certain deposit for the food container. Once the customer finishes the meal, they can return the food box themselves or order a pickup service on the food delivery app used before. Either way, the food package is returned in a pickup point, e.g., a supermarket or a restaurant. The person who returns the food container will receive the deposit back. Later, the logistics from this SDG12 start-up bring the boxes to the washing facility, where they are washed, and quality checked by VISIR2. The food packages that are (about to be) cracked are sent to recycling, while those in good condition are returned to the restaurants. Thus, the food container enters the circular economy where it is reused. For the whole package journey we had “less is more” as our design principal.

## 3.6 Prototyping

Before prototyping our idea, our group participated in the prototyping session. We understood that a prototype is a simple representation of a product or a service. Prototyping is helpful because we receive enough feedback to know if our solution is on the right path. Testing a primitive version of our idea allows us to learn about its strengths and weaknesses, and it takes us to the future to check if our solution could be successful in the society. Our key takeaway from the session was that a prototype doesn’t have to be a finalized product and that we can prototype with role-plays as well. We believe this last point helped our team a lot, since our solution was a service.

It was essential for our group to first define our solution before prototyping it. This ensured that all the team members were on the same page with our idea and saved us from any future misunderstandings. The service that we wanted to prototype is showed in the Figure 9.

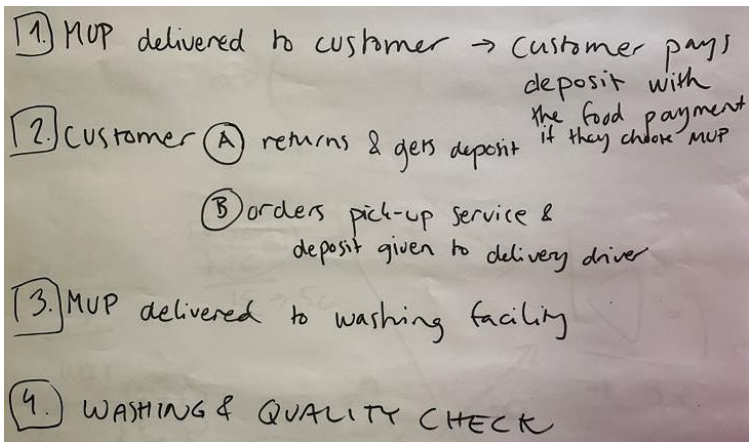



Figure 9: Definition of our final solution.

The second step was to create the storyboard of our prototype, which is displayed in Figure 10. A storyboard is a step by step, graphic representation of how the product is used or the service

is experienced. This exercise helped us to decide doing a role-play prototype and to choose which part of the prototype we would build in a physical form. Our team thought that it would be beneficial for the audience to understand our prototype if we created the pickup return point and the washing machine with the VISIR2.


Figure 10. Storyboard of our final solution.

To start prototyping, we divided the tasks between ourselves by creating three groups: the handicraft, presentation, and script teams. The first team was in charge of prototyping the pickup return point and the washing machine with the VISIR2. Figure 11 shows a draft on how the prototype of the washing machine should look like. The pickup return point was easy to craft, as we only covered a carboard box with black tape. To build the washing machine, we made holes in a carboard box and covered with silver paper, and we added a plastic tube outside the machine with a screen attached to the tip to show how VISIR2 worked. We also designed two food boxes to complement the whole prototype. Later on in this report, we present the finalized version of the prototype as a part of our solution.

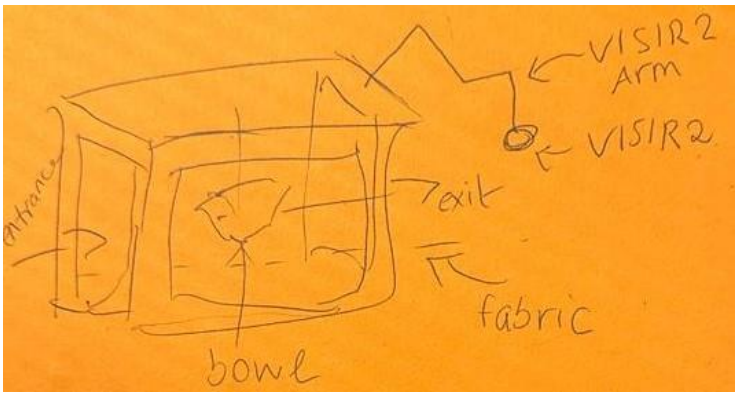



Figure 11. Draft of our washing and quality check prototype.

### 3.7 Presentation and the Shark tank

While prototyping, we also attended the final presentation and value proposition sessions. The first seminar guided us on how to prepare ourselves and our supporting material for the shark tank. The second seminar focused on how to identify the value our solution would offer to the different stakeholders and the surrounding society.The evolution of our prototype ended with the shark tank, where we presented our idea and prototype to the teachers, and they gave feedback on how to upgrade the presentation and performance for the real demonstration. Our group received lots of constructive criticism, so we spent the hours before the final presentation improving our slides and prototype. For instance, the teachers suggested we write more numbers on how our solution was better than the existing SUP packaging. They also recommended designing our reusable food box to have a more complete prototype.

## 4 Final solution

Our solution for the issue introduced in the introduction is a service concept and business model of a multiple-use takeaway container offered as a service. This concept solves the need for excessive plastic use for single-use take-away food containers and contributes to the reusing of plastic in an efficient and environmentally friendly way.

### 4.1 The product design

In the center of the solution is a multiple-use plastic container used to transport and serve take-away food in. We identified several design properties for such a food package. To enable efficient serving, washing, and storing, the multiple-use take-away food containers need to be standardized in size and shape, allowing of course for a few different models such as a pizza box solution and a bowl-like container for several different dishes. The packages need to be produced of a lightweight, but durable plastic that stays safe for food consumption even after up to several hundred reuse cycles. The container must also be easy to wash industrially and cannot contain any small nooks where food remains could get stuck. For the purpose of an easy return, the lids of the containers should be attached, so that the entire container will be returned as one unit (rather than a separate bowl and lid). The lid needs to close tightly to the bowl to ensure both convenience of transporting the food, as well as a hygienic return of the used container. In addition, the feel and look of the bowl need to be attractive for the customer, ideally providing a feeling of a good-quality eating experience when using the package. The attractiveness of the package could further be accentuated by using design features of Scandinavian design, or even including a well-recognized designer in the designing process.


Figure 12: Properties of the multiple-use take-away container

## 4.2 The package journey

Our solution started with the identification of the journey the multiple-use take-away food package would need to travel in order to complete an entire circle back to reuse. We identified several essential stakeholders playing a role as part of our solution. These stakeholders also form the partnerships needed in the realization of the multiple-use package journey. Next, we will discuss the different phases of the package journey, as presented by Figure 13.

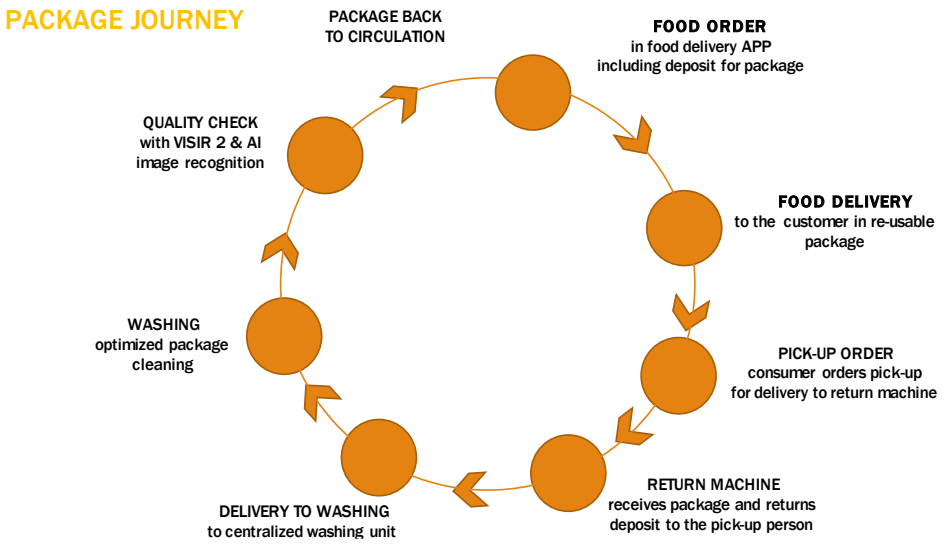



Figure 13: The package journey

The journey of the multi-use take-away food package starts from the restaurant or café using the package to deliver their food to the customers. In our suggested business model, the packages are offered to the restaurants as a service where the restaurant pays per use of package after the food portion has been sold to the customer.

Next, the multi-use take-away food container will continue its journey to the customer, either by a delivery service or directly. Here, we need to create a partnership with a food delivery provider, such as Wolt or Doordash. The food delivery provider is also in a crucial role in managing the ordering process between the customer and the restaurant, where the customer encounters the option to order their food using our multiple-use packages.

After the consumer has received their food order and eaten it, the package becomes a used dish, that needs to be delivered further to be washed. Here, our solution provides several options for the customer to return the dish. We recognized as an essential part missing in the current system to be an easy return system for the used dishes, as the sparsely located collection sites in the current system create a need for the packages to be pre-washed at the customer's home and stored until the next purchase at the same restaurant.

Our solution is built upon the idea to make use of the existing facilities for collecting recyclable items such as bottles or clothes. In Finland, we have an extensive network of bottle return machines belonging to Palpa, the bottle recycling service owned by various alimentary and drinks companies. This existing network could also potentially be used to scan and collect the multi-use take-away food packages. Alternatively, a separate but similar system could be built for in collaboration with other reusable item providers. Essential for the functioning of such system would be that the collection sites would be located within an easy reach for the customers.

In addition to returning the reusable packages by themselves, we also created a concept for package return as a service the customers could order via the food delivery service providers' app. Platform economy provides a new market for workforce looking to complete several service tasks combined, and this kind of service could be an interesting earning possibility for e.g., food delivery drivers or taxi service offerors. In return, the deposit system created for the multiple-use take-away food packages would offer an easy way of handling the transaction of payment from the customer to the package returner, as the deposit will be returned to the person completing the return to the package return sites.

From the package return sites the used packages will need to be taken to the washing sites for the industrial level wash and quality check. This part of the logistics (bringing the dishes from the collection sites to the washing facilities), as well as taking the cleaned and checked dishes from the washing facility back to restaurants for reuse are the only part of logistics that the

service provider would need to organize themselves. For all other parts of the package's journey would be handled by other partners.

### 4.3 Returning multiple use packages

After consuming the meal from a reusable packaging there are two ways of returning the package back to the service provider Less is more. The customer can look up from the application the nearest drop of locations for the reusable package. The application displays the locations on a map and the customer can choose where they want to return the package themselves. The locations are in frequently visited places for example grocery stores, shopping centrums and the restaurants that are utilizing the service of reusable packages.

In addition of the customer returning the package themselves, they can order a pick-up for it. Delivery service providers who already work as a food deliver can register in the application for a provider of the return service. In this case the customer can look up the closest delivery service providers and order them to pick up the reusable package from them.

When the reusable package is returned to the return machine the person doing the return is paid the deposit. This means that if the customer who paid the deposit returns the package themselves, they get the deposit paid to them, but if they have ordered the return of the reusable package as a service the person doing the return will get the deposit paid to their account.

The concept is to use as much as possible existing infrastructure whenever possible this includes the return machines. An example of this is using the Finnish bottle return (Palpa) machines. The bottle return machines could be programmed to recognize the reusable packages and sort them for collection and washing. In addition of utilizing the existing infrastructure, new return machines could be installed in convenient drop of locations.

### 4.4 Washing multiple-use packages and using VISIR2 tool as a quality control

Washing is the next step of our solution. The service provider would be responsible for organizing logistics and delivering the multiple use dishes to the centralized washing unit, which would wash the dishes on the industrial level. Our team established some principles, which would be strictly followed by the washing facility, to provide a high-quality service and to ensure hygienic and quality aspects of the dishes. A prototype of the washing machine technology is presented in Figure 14.

As the packaging is standardized, the washing process would be the same for all dishes. The process would start with choosing the right water temperature as well as washing liquid: with a certain chemical formula and amount of it. Those measures would be essential to follow due

the fact, that wrong temperatures can impact the quality of plastic causing thermal degradation and therefore cracks, chipping and weakening of material.

Afterwards, all dishes would be immediately checked by VISIR 2 technology, which could provide us with the quality control. There are several purposes of the quality control : to provide food safety as well as predict the duration of the lifecycle of the dishes and help to understand if the service provider can reuse the dish. VISIR2 technology has non-invasive SWIR detectors which detect, for example, electromagnetic spectrums, temperature, foreign contaminants, early bruising, defects of the products and their packaging. VISIR2 is able to see through materials and identify various types of polymers. Therefore, this technology would allow us to detect the defects of the containers, even the minor ones which humans eye can not see.

The defects of the containers would be crucial to identify, because toxic chemicals are leaking from the cracked plastic and potentially poisonous to the health. Our team agreed on combining the VISIR2 technology with any suitable analyzer (artificial intelligence) or any other device which could potentially differ and then sort the dishes with defects from the holistic ones. In case detector defines the crack or any other deterearation of the material, the dish is automatically sorted to recycling or utizilation. The technology would be attached to the washing mashine neccesserily, which would be convenient to install and use.


Figure 14: The prototype of the dish washing technology

## 4.5 The value proposition canvas

To depict the value our solution will create to the customers, we formed a Value proposition canvas (Osterwalder, Pigneur, Bernarda & Smith, 2015) to describe the service offered. Here,

it is important to note that the customers of our service are both the consumers, the delivery services and the restaurants. The Gain Creators list how our service will create customer gains, while Customer Gains are the outcomes and benefits expected by the customer. Customer Jobs explain what tasks the customers try to get done in the service. Finally, the Customer Pains and Pain relievers describe how the solution will need the needs of the customers.

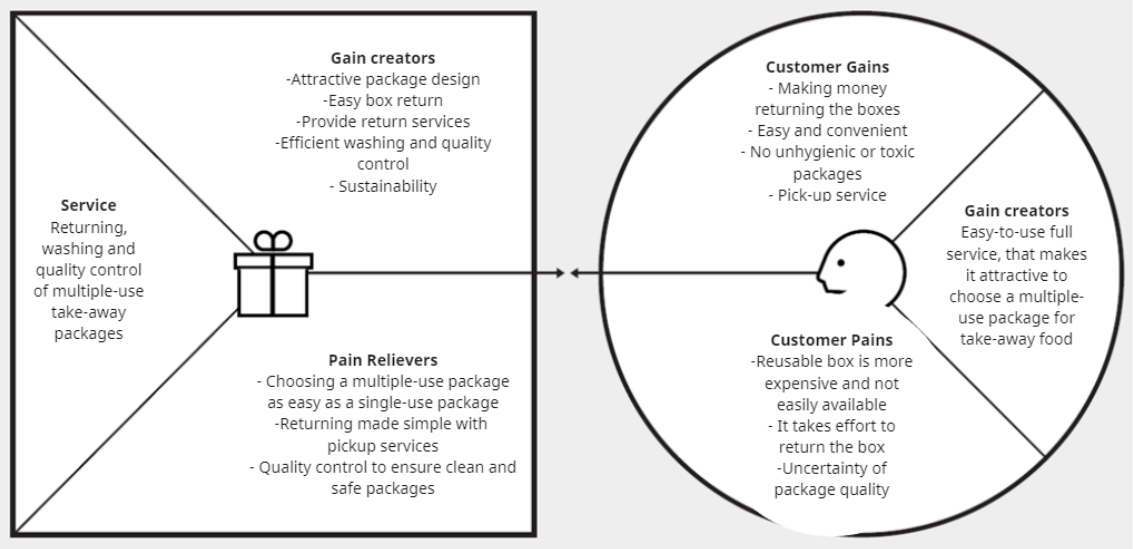



Figure 15: The value proposition canvas

## 4.6 Business model

The business model designed for the solution would be twofold, package as a service and the deposit scheme. Here, the idea would be that the company proving this would offer the re-usable packaging as a service to restaurants that pay per use. Service offered to the restaurants by the company here would include transportation, the use of packaging, return logistics, washing and quality check. This means the restaurant does not need to put in any extra effort compared to using single use packaging.

In a brief business case calculation we concluded that with large volumes, we would be able to offer the service at roughly similar prices as the restaurants pay for single use packaging, at approximately 35c per use. The variable costs calculated included washing, logistics and platform fees resulting in an estimation of 20c per cycle. We estimated the price of the containers to be 4€ resulting in 4c per cycle cost if 100 cycles are achieved. Following this, the profit for each container cycle would be 11c, approximately 30%. This would be partly covering any unassumed costs and administration and salary costs for the company offering this service. This assumes all packages would reach 100 cycles but break-even results could be achieved if each package circulates as little as 24 times.

Calculations show that an active customer base of less than 200 000 people ordering once a week would result in a profit of 1m€, which would be allocated as described above. This calculation demonstrates that logistics and washing could be organized for a compact area therefore making the solution scalable for moderate size cities in addition to bigger cities.

The deposit collected from the consumer will ensure package returns by financing the reverse logistics and compensate for any lost packaging but it will not be a profit item. The deposit system is explained in more detail in the Package journey part in 4.2.

## 4.7 Impact of the solution

As described in paragraph 1.3, our goal is to impact two key areas: waste prevention and minimizing material usage. The global take away industry uses roughly 1 bn single use containers yearly and the industry volumes are expected to triple by 2030. By shifting to multi use containers that are each used 100 times we would reduce the waste by 990 000 000 containers or 48 000 tn. This equals to four Eiffel tours. It would of course not be possible to turn all single-use take away packages to multi-use, but just 25% would save us the weight of the Eiffel tour in waste. United Nations Environmental Programme (UNEP) has also made ending plastic pollution one of their key topics to tackle. And as Inger Andersen, the Under-Secretary General to the UNEP has stated: *"We simply can not recycle our way out of this mess. Only a determined elimination of unnecessary plastic, a full redesign of the products that we envelop in plastic and a full market transformation that drastically reduces the flow of virgin plastics can do that."* (Andersen, 2023).

As for the material usage, our solution could reduce the need to produce new plastic by 97%. One single-use container weights an average of 50g and multi-use container weights an average of 150g. If a multi-use package is used 100 times, we would reduce the need for plastic by almost 5kg. Oil is used as material for plastic production and the drilling and wrecking cause air and water pollution.

As global warming due to greenhouse gas emissions is a burning problem, we also researched on the impact of our solution to this. In a recent study Hitt et al (2023) concluded that using multi-use containers for take away food reduces the global warming potential by 70% if the container is used at least 20 times. This however can turn upside down if containers are completely washed at home and driven to drop off locations separately from other logistics. Therefore, it would be important to educate customers about washing and ensure drop off points are at frequently visited locations. Hitt et al (2023) also came to similar conclusion than us on the waste reduction potential. According to their study, solid waste would be reduced by 81%.

# 5 Conclusion and reflection

## 5.1 Conclusion on the solution

In conclusion, our proposed solution to the take-away food package single-use plastics challenge would be offering a multiple-use take-away food package as a service. This solution reduces the build-up of plastic waste, and consequently reduces the material need for producing new plastic for making single-use take-away packages. Our solution makes use of existing infrastructure in terms of both existing return points and underused washing capacity, reducing the need to build new facilities and therefore saving resources.

The service model we created results in an easy-to-use solution to make using reusable food containers both more attractive to the customers and more affordable to restaurants and other businesses. In addition, with using the VISIR2 technology we can further advance food safety and the safe use of plastic in food industry in a responsible and resource-efficient way.

Building on top of previous existing solutions, we specifically looked into the motivational factors affecting the attractiveness of the multiple-use packages from the viewpoints of the customer and the restaurant. In our model, we increased the attractiveness of the solution by combining it with services and service providers already familiar to the customers. This in turn enhances our business case, as existing infrastructure can be used for the benefit of our proposed solution to minimize the environmental impact of building new facilities, while also reducing the initial investment costs needed.

## 5.2 Reflection on the sprint process

The design sprint process was an interesting experience for our group, from which we all learned new things about both the substance matter itself, as well as the process needed to go through to reach the solution. In the beginning of the process, our team struggled a lot with the uncertainty of what was expected of us, and at what rate we should be for example narrowing down our focus for the project. Leaning on Knapp, Zeratsky and Kowitz (2015) advice, our team did our best to trust the detailed process the Sprint book has presented. After all, this design sprint felt like a project that requires a substantial time and resource to be allocated to it, but with some doubts of whether something tangible coming out of the process at the end. Familiarizing oneself with the theoretical background of the sprint process was one way of coping with the anxiety of not knowing for sure where the process was headed. However, we did note that trusting something that’s unfamiliar is difficult to us humans, in all situations, as we don’t cope well with the unknown.

The unknown became slowly something known to us as the process went on. The extensive research done in the two months before the bootcamp helped us to gain confidence in our

understanding of the problem. A week before the bootcamp, we started slowly drifting towards the idea of take-away food industry as our main focus and narrowed down the topic to single-use plastic take-away food containers.

In terms of group dynamics, our group functioned well from the very beginning. We evolved to a team with a great team spirit during our time in Switzerland. During the way, we struggled the most with finding a uniform opinion of the way we should proceed with the topic. In both parts, pre-bootcamp and the bootcamp, we had a clear beginning phase, a mid-phase with more struggles, and a finishing phase with finding solutions and inspiration to proceed again efficiently.

Kaner (2014) talks about the pains the developing group goes through, using the term “groan zone” to describe the less-pleasant middle part of a process where the team loses confidence in their ability to solve the issue, and the process seems impossible to finish. Our team clearly recognized this phase also during the research. However, this clearly served a purpose for us, as Kaner argues that it is necessary to take time for the groan zone in order to get that phase out of the way before moving on to the creative phase. According to Kaner, it takes up the middle part of the process, thus landing on approximately Wednesday, or the Decide phase of the process. This seems to hold true in our case as well since most team members stated that Wednesday was the hardest day. Thursday on the other hand was triumphant as we were building the prototype and things seemed to advance really well.

After discussing and pondering so much on possible aspects of the solution, it was a flow-like experience to put the final presentation and all the deliverables together. Without the time spent on discussing different details of the solution, we wouldn’t have been able to take all of these into consideration when designing the final solution. All in all, we were very satisfied and happy with the result of our development process and the solution we created.

References

Printed

Bland, J.D. & Osterwalder, A. 2020. *Testing business ideas*. New Jersey: Wiley.

Hitt, C., Douglas, J. & Keoleian, G. 2023. Parametric life cycle assessment modeling of reusable and single-use restaurant food container systems. *Resources, conservation and recycling*, 190, p. 106862. doi:10.1016/j.resconrec.2022.106862.

Kaner, S. (2014). *Facilitator's guide to participatory decision-making*. John Wiley & Sons.

Knapp, J., Zeratsky, J. & Kowitz, B. 2016. *Sprint: how to solve big problems and test new ideas in just five days*. Bantam Press. E-book.

Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2015). *Value proposition design: How to create products and services customers want*. John Wiley & Sons.

Sevitz, J., Brent, A. C., & Fourie, A. B. (2003). An environmental comparison of plastic and paper consumer carrier bags in South Africa: Implications for the local manufacturing industry. *South African Journal of Industrial Engineering*, *14*(1), 67-82. doi:10.7166/14-1-299

Stickdorn, M., Hormess, M. E., Lawrence, A., & Schneider, J. (2018). *This is service design doing: applying service design thinking in the real world*. O'Reilly Media, Inc.

Electronic

Andersen, I. (2023): A big step towards ending plastic pollution. Speech delivered to the Opening plenary of the second meeting of the intergovernmental negotiating committee (INC-2). Available at https://tinyurl.com/4zy388tp. Referenced 14.6.2023.

Ajuha, K., Chandra, V., Lord, V., Peens, C. (2021): Succeeding in the fast-growing food-delivery ecosystem will require understanding how overlapping economic forces affect a complex web of stakeholders. https://tinyurl.com/2rddky8m. Referenced 12.6.2023.

CIEL (2019): Plastic & climate. The hidden costs of plastic planet. https://tinyurl.com/musm7ss6 . Referenced 11.5.2023

Food and Drug Administration (FDA) (2021): Labeling Recommendations for Single-Use Devices Reprocessed by Third Parties and Hospitals; *Final Guidance for Industry and FDA*. https://tinyurl.com/2p9ade45 Referenced 13.4.2023

Grand View Research (2021): Online Food Delivery Market Size, Share & Trends Analysis Report By Type (Platform to Consumer, Restaurant to Consumer), By Region (North America, Europe), And Segment Forecasts, 2023 – 2030. https://tinyurl.com/3vwat5s5. Referenced 12.6.2023.

Han, E. (18.1.2022) What is design thinking and why is it important? Harward Business School Online. https://tinyurl.com/25fsjwzu Referenced 12.6.2023

Lindwall, C. (2020). Single-Use Plastics 101. NRDC. https://tinyurl.com/ybnu25zf Referenced 13.4.2023

Our World in data: Global plastics production. https://tinyurl.com/5n7fzxuw Referenced 11.5.2023

Rebelo, D. (2015). Difference between Design thinking and Service Design. https://tinyurl.com/hnaaee3h. Referenced 12.6.2023

ResearchGate: Global consumption of paper and cardboard from 2006 to 2015 (in million metric tons) (2015). https://tinyurl.com/3526anec Referenced 11.5.2023

TUKES: Single Use Plastics (SUP). https://tinyurl.com/mwzv4p4h Referenced 11.5.2023