Course 41630 Holistic Design of Engineering Systems

Resuable Take Away-containers

in collaborating with Meyers Canteen at KPMG

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Contribution Table

Overall everybody has contributed equally to the project. The table below gives an overview of the contribution and responsibility of the individual students. It must be noted that the different tasks and/or report sections are not equal in terms of workload.

Tasks \ Team members	Jeppe	Nader	Niels	Rolf	Seina	Sofie	Tatiana
Set up scrum planner						x	x
Initial regulations research	x	x	x				
Map out existing solutions				x	x	x	x
Research EU waste and packaging directive	x	x	x				
KleenHub meeting			x				
Project partners contact			x				
Workshop - artefact level							x
Research - incentives and gamification				x			x
Worksheet template						x	
Organize fieldwork pictures						x	
Research - policies and regulations	x	x	x				
Research Fødevarestyrelsen bæredygtige FKM og Engangsplastdirektivet og genbrug af materialer	x	x	x				
Research - Meyers organisation		x			x		x
Interviews (multiple, throughout the project)	x		x	x		x	
Design initial interview questions		x	x				
Initial list of requirements		x			x		x
Prototyping - artefact - App	x			x			
Prototyping - artefact - container				x	x	x	x
Prototyping - artefact - dishwasher grid CAD					x		
Prototyping - artefact - container CAD & 3Dprint						x	
Prototyping - artefact - storage Design & physical					x	x	x
Prototyping - artefact - return station CAD & AI renders	x			x	x		x
LCA - all project stages		x					
Customer journey map	x						
Stakeholder analysis					x		x
Functional unit		x					
Milestone Presentation (I, II, III) - design & content	x	x	x	x	x	x	x
REPORT (Main responsibles per section)							
Executive summary						x	
Introduction				x			
Methodology						x	
Where we started							x
The problem space							
Discover - describing the system			x				
The current system			x				

Elements of the system			x				
Collecting data on the system	x						x
Interaction with actors			x				
System level challenges			x				
System boundary			x				
Define							
Workshop at artefact level							x
Complex system							
Evaluating with users			x				
LCA		x					
Single user plastic take-away container LCA results		x					
Requirements					x		
Problem statement			x			x	
The solution space							
Develop							
The reusable take-away container		x				x	
Material choice		x					
Meyer's Canteen app	x			x			
App features				x			
Return station				x			
Washing grid					x		
Storage					x		
Deliver							
LCA on reusable plastic containers		x					
Reusable take-away plastic container LCA results		x					
KPIs							x
Testing	x		x				
Testing the container			x			x	
Testing the app designs	x		x				
Return rate calculation		x					
Implementation plan	x	x					
Prerequisites for implementation	x	x					
Reflection and discussion		x					
Thinking principles and problem solving approach	x			x			
The system design process				x			
The use of AI tools				x			
LCA and material choice		x					
Reflection on project management						x	
Scalability						x	
Conclusion				x			
Report editing - overall	x	x	x	x	x	x	x
Finalizing report	x	x	x	x	x	x	x
Implementation manual for the client	x	x				x	
Prototype of container						x	

Executive summary

This project aims to develop a solution for reducing single-use take-away containers at Meyers Canteens. This has been done in collaboration with the Meyers Canteen at KPMG Nordhavn, which has contributed great insights throughout the project.

The current solution depends on single-use take-away containers and is problematic because those are made of plastics that cannot be recycled or reused, posing a threat to a sustainable future.

The report states methods as well as main findings that have been essential in designing a sustainable system for Meyers Canteen. The project follows the Double Diamond method. During the Discover Phase, the team did desk research, literature review, framing, brainstorming, and interviewing users and employees from Meyers Canteen at KPMG to define the system. This was followed up by an LCA analysis of the current system, a listing of requirements and the hosting of a workshop at the artefact level. To expand into the Develop phase, the team created prototypes for the app, container, storage, and return station, all of which went through several iterations. An LCA analysis was then conducted on the solution, which helped the team transition into the Deliver phase, as a basis for KPIs and material choice. Finally, the solution was validated through prototype testing and creating an implementation plan based on the gathered feedback and data.

The team concluded that by implementing the holistic take-away system that is described in this report, Meyers will become more sustainable and be able to comply with the upcoming EU regulations. Based on the group's LCA, implementing the new solution, Meyers will significantly reduce their emissions from the take-away service.

The final solution is presented in an implementation manual meant for Meyers Canteen. It communicates solution elements and implementation plan of the system in a simple manner.

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1. Introduction

Plastic; The term covers a wide range of materials, most of which are synthetic. The invention of synthetic plastics in 1907 was followed by a boom in affordable and very popular products. Since then, different kinds of plastics have been invented or discovered, and some with interesting and very useful properties. A valuable property of new plastics is heat resistance.

One of the most common thermoplastics, as they are called today, is polypropylene (PP). If one looks at the bottom of a reusable food container, it is likely to be made of PP. Plastic is in general a very good material for storing food. While being resistant to the heat from hot food, food containers made of plastic also seal the food, protecting it from bacteria and germs. This makes it safe for transportation and extends the freshness of the food. Combine this with the fact that plastic containers are dirt-cheap and extremely accessible, one can understand why they make such a good choice for take-away restaurants. However, synthetic plastic is produced from fossil fuel-based chemicals. This means they are polluting the environment during both extraction, production, and disposal. When using the plastic only once before disposal, its effect on the environment is maximized. This makes the subject of reusable containers for take-away food worth the team's time. Not a lot of restaurants, however, are willing to make the shift for a greener alternative by themselves. Luckily, others have this subject on their minds too. From 2030, restaurants will no longer be allowed to serve food in disposable packaging for in-house consumption, according to a provisional EU agreement (23). The agreement is expected to be voted through during the summer of 2024. For now, places do exist that understand their environmental responsibility and wish to do better in their green transition.

A company with quite a few of those places is Meyers. In this project the team has been working closely with kitchen personnel and daily users at the Meyers Canteen at KPMG (Copenhagen, Nordhavn), to develop a solution that minimizes the packaging waste and environmental impact linked with offering a take-away solution.

2. Methodology

In the following sections, methods for the design process and management of the project will be introduced.

2.1 The design process

For structuring the design process the Double Diamond method has been applied. See fig. 2.1.

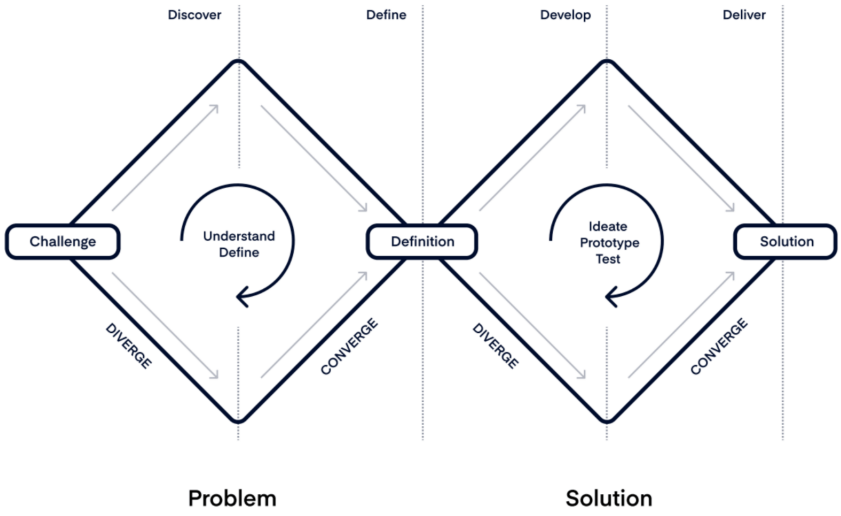


Figure 2.1: The double diamond.(25)

In the discover phase, relevant stakeholders were interviewed, and a stakeholder assessment map was constructed. Desk research was conducted to broaden the team's knowledge and fieldwork done at Meyers Canteen at KPMG to investigate and establish a partnership with the client (see appx. A.1.1).

After the discovery phase, the team moved on to the define phase where different problems and aspects were mapped out and analyzed. This was done by interviewing users and the canteen manager at KPMG while exploring regulations. Requirements were defined and by the end of the phase the following problem statement was formulated:

How might we transition Meyers Canteen from single-use take-away containers to reusable ones in response to new regulations on single-use plastics while minimizing disruption to operations and enhancing sustainability?

Having a clear direction for the work, meant the team was ready to enter the solution space.

In the develop phase the team started working on concepts and executed prototyping. A main focus during this phase was material investigation through thorough LCA work. The prototyping was carried out in close collaboration with Meyers Canteen. By the end of this phase, the team had multiple ideas and concepts.

For the final delivery phase, the concepts underwent detailing, testing, and validation. The testing and validation were done in collaboration with the end users.

Throughout the process the N-model has been applied (see fig. 2.2) and has assisted the team in breaking down the complexity of the project.

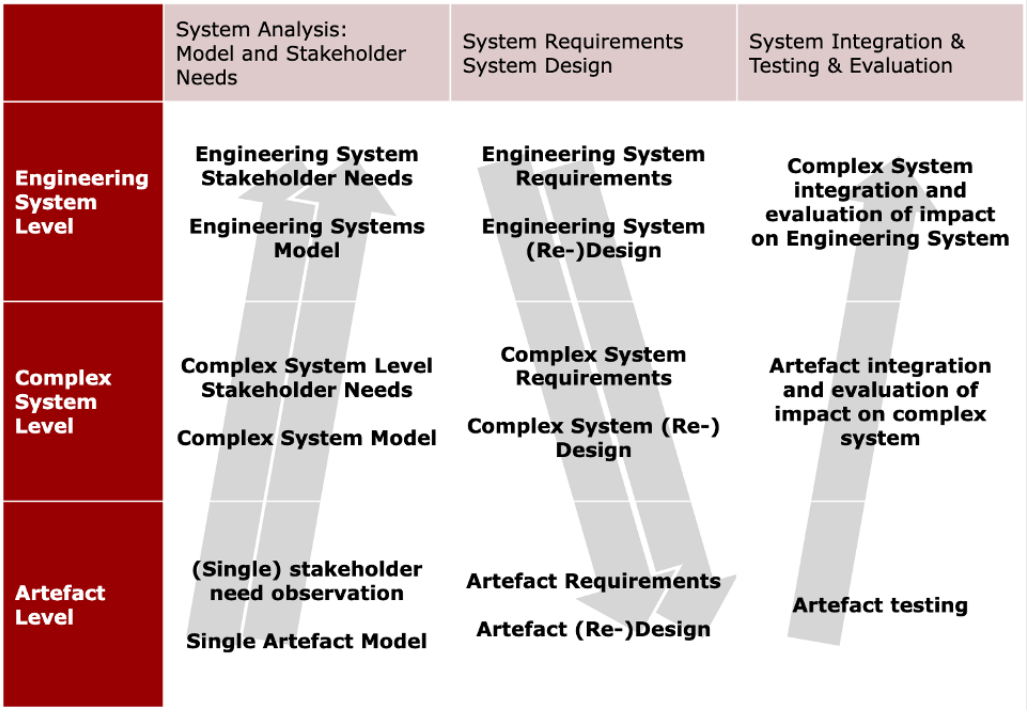


Figure 2.2: The N-model.(12)

The final solution is a holistic design taking the complex, engineering and artefact level into consideration. Physical artefacts have been produced as well as an implementation manual for Meyers Canteen at KPMG. The manual describes the first steps in moving towards a greener take-away system.

It is important to know that it has been an iterative process meaning that it has been necessary for the team, from time to time, to take a step back to come up with the best solutions.

2.2 Project management

As the project group consists of seven members, it was essential to organize group management from the beginning. This has been achieved using the Scrum method (27), where the team has conducted weekly one-minute stand-ups every Friday. The roles have rotated, allowing all group members to be scrum master and note-taker.

At the problem phase of the project, the team was divided into the different levels of the N-model, ensuring that responsibility and insight were distributed effectively.

Following the definition of the problem statement and entering the solution space, the team divided into the following subteams:

- The Engineering-level team
- The Sustainable team
- The Prototyping team

All insights and work related to the project has been documented and organized in files on Teams and on a digital work board in Miro (see appx. F.6.1).

The project management aimed to give everyone a chance at taking on different roles, gain experience in project management, and help guide the team through the complexity of the project.

3. Where we started

The team was formed based on a mutual interest in implementing a sustainable solution within the take-away food industry. To scope the project, multiple options were brainstormed upon, such as fast-food restaurants, canteens, and event venues. The team 'Reusable Take-away Containers' (RTC) was formed with the goal of finding a client within a an industry in need of a solution to end their use of single-use packaging.

Several companies were approached. The two main ones being KleenHub - specializing in reusable coffee cups and food bowls (8) - and Meyers - a Danish company running restaurants, canteens, catering, etc. (2) The selection criteria were concise: the client must provide the opportunity to work on all three levels of the N-model, should be able to communicate openly and regularly, and should provide a local venue, to give access to their facilities and end users.

KleenHub opened the door for exciting options, such as working with large venues, however, with no guarantee that the project could be locally based. Therefore, Meyers - specifically Meyers Canteen at KPMG Nordhavn - was chosen as the client. Additionally, one of the team members was an employee at KPMG at the time and the canteen staff showed keen interest in the project.

4. The problem space

This section is dedicated to the exploration of the problem space through collection of data and knowledge of the current system and an analysis to better understand the design challenge at hand.

4.1 Discover - describing the system

The Discover phase of the project focused on gathering knowledge at the artefact, complex, and engineering system levels in order to set project boundaries and help start the ideation process. The goals were to learn about the company, alternative solutions, and the related laws and regulations.

4.1.1 The current system

Meyers Canteen at KPMG offers a take-away solution, where the dish of the day will be ready for pick-up in the afternoon. The meals are ordered via the Meyers App and packed in single-use plastic containers. The single-use container is the most central artefact in this take-away system, which is illustrated below (see fig.4.1).

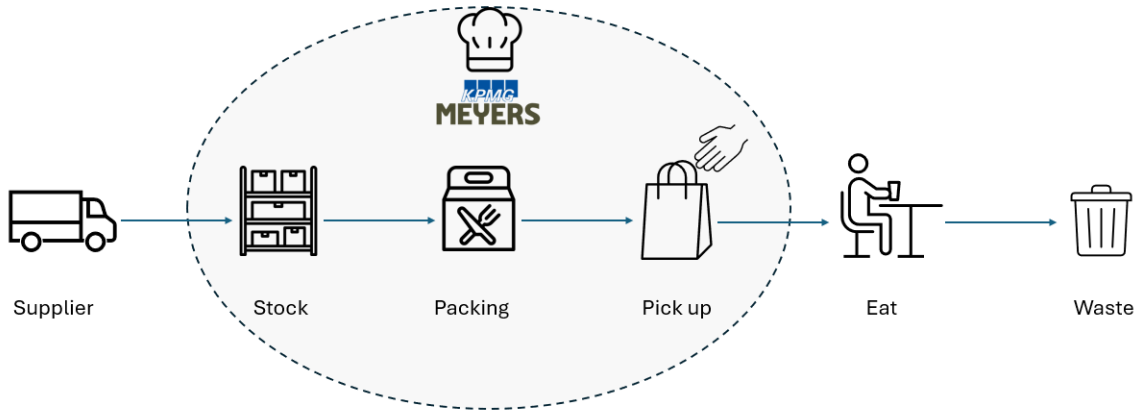


Figure 4.1: The current system

Expanding the system boundary, the system consists of a wider selection of elements (artefacts, actors, and processes), which was mapped using a stakeholder assessment (fig.4.2).

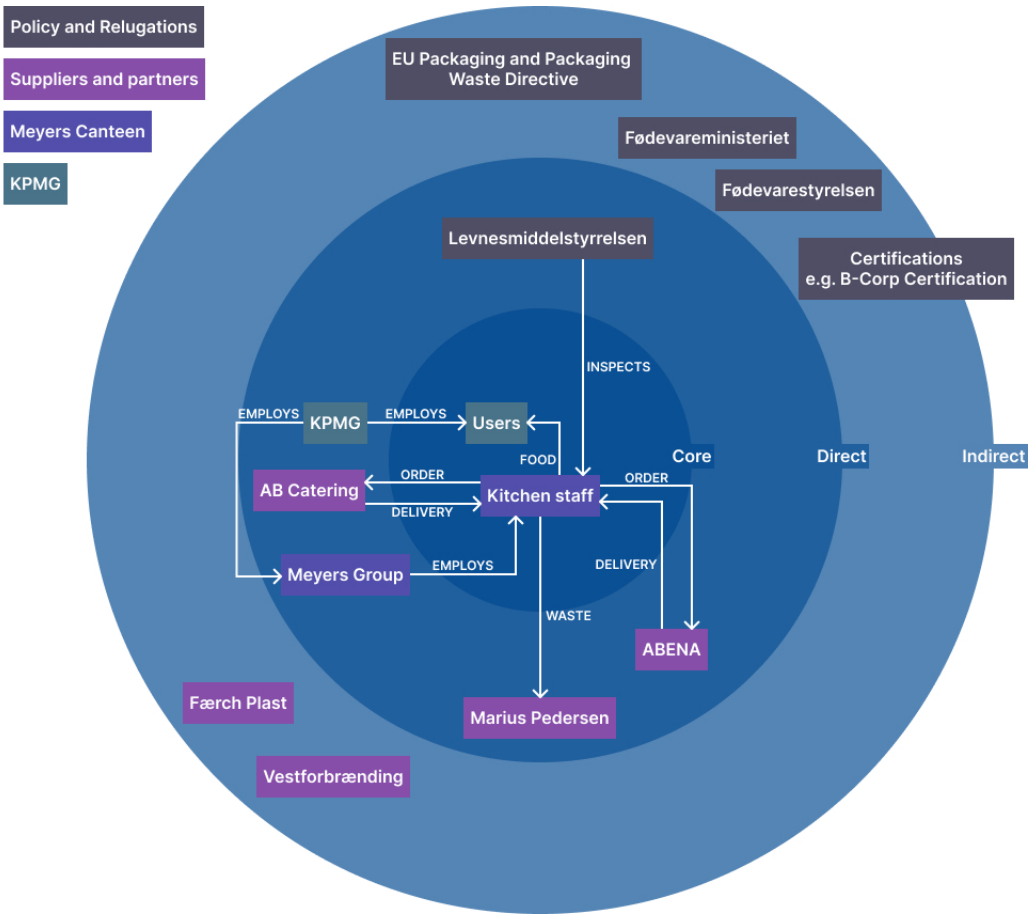


Figure 4.2: Stakeholder assessment

The mapping helped understand relations between stakeholders, but also revealed complexity in the system. The N-model was used to manage the complexity of the system, by sorting the elements into corresponding system levels, as seen below (see fig. 4.3).

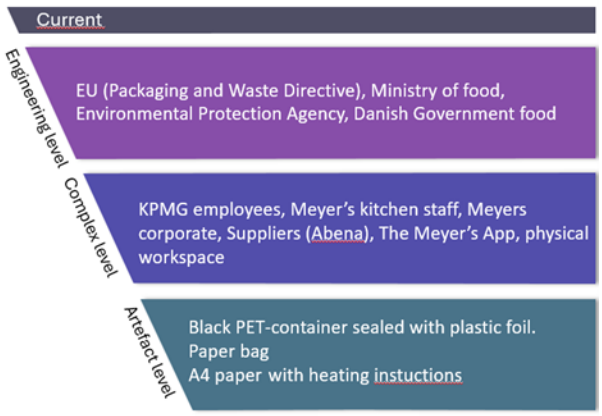


Figure 4.3: Elements in current system

4.1.2 Elements of the system

The artefact level consists of a single-use take-away container in black Polyethylene terephthalate (PET plastic). The container is sealed with glue and PP foil. The container is then packed in a paper bag and a piece of paper with heating instructions is attached.

Figure 4.4: Excisting PET container

The complex system level consists of the canteen staff, KPMG employees, suppliers, the Meyers app, the Meyers corporate department as well as the physical workspace, canteen, and kitchen provided at the KPMG office building.

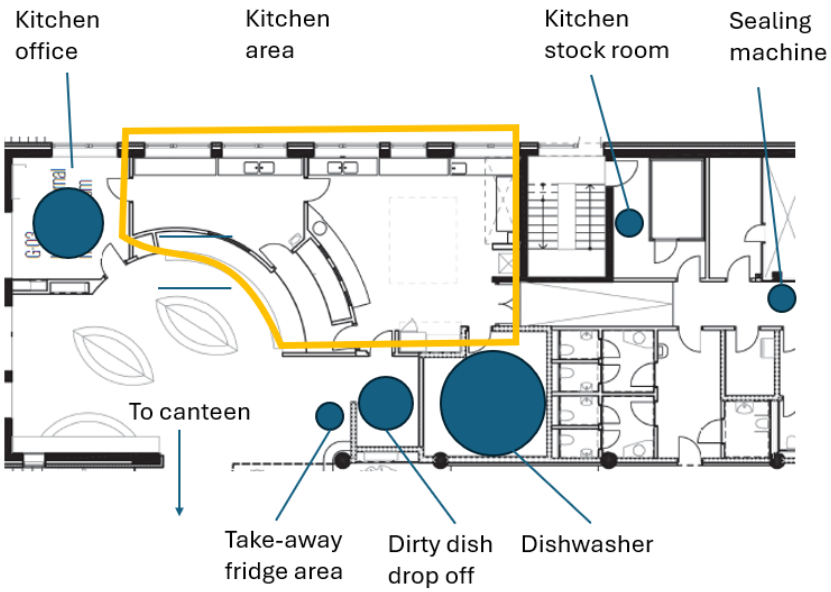


Figure 4.5: Floor plan canteen

The engineering system level consists of legislation which sets the rules and regulations on areas concerning food safety and environmental protection. Therefore, The Ministries of food, the Environmental Protection Agency, EU and the Danish government are actors at this level along with the relevant laws and regulations. See appx. H.8 for examples of EU regulations.

4.1.3 Collecting data on the system

The research was split into three groups corresponding to the levels in the N-model. The findings from the desk and field research were documented and summarized into worksheets, to help review and access the information later.

Artefact level
The artefact research consisted of an online search for examples of sustainable single-use, reusable and recyclable containers, and their benefits, rebound effects, and shortcomings.

Complex level
At the complex level, the team investigated the publicly accessible information, provided by Meyers corporation, including their sustainability reports and relevant articles. Staff members and end users were interviewed to learn about the current take-away system, the challenges it faces, feedback from users. Furthermore, the staff helped clarify questions that arose after learning about Meyers and their corporate policies and how they are handled locally.

The team learned that Meyers values sustainability and has established certain goals they intend to reach by 2030 (see fig. 4.6)(16). The individual canteens are required to follow corporate policies but have room to adjust. A clear requirement from the client was that any new system can not be too disruptive or require too many resources, such as additional workers or by bringing a heavy workload on current staff (see appx. C.3.2 for interview). This was because the take-away system is currently not a profitable part of the business model and is rather viewed as an act of service for the end user. The containers, if updated, should functionally be similar to the current ones. A major concern related to containers was contamination and maintaining a safe and sanitary work environment. Initially, the staff was against any in-house cleaning, in case a reusable container was chosen as an artefact.

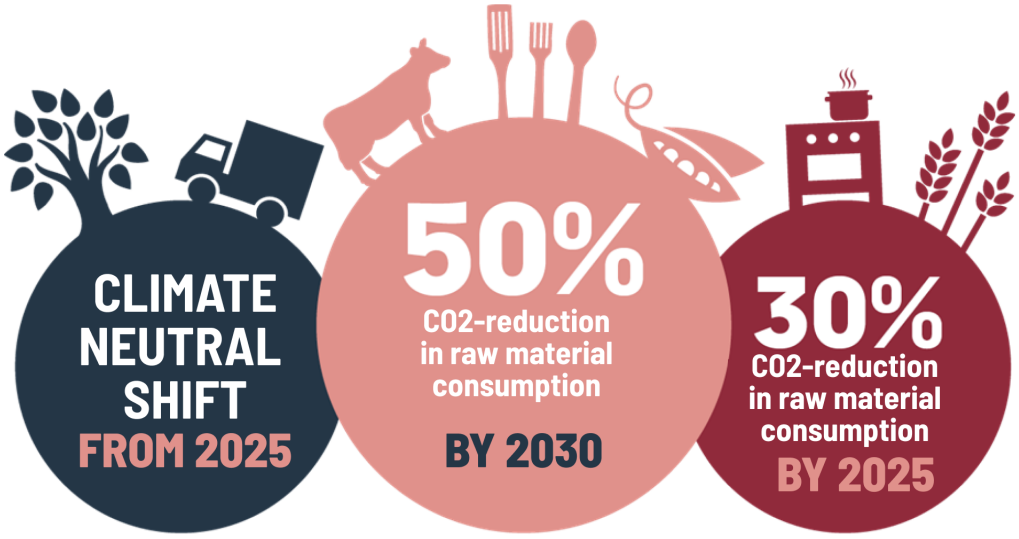


Figure 4.6: Meyers sustainability goals

Engineering level
In terms of research at the engineering level, it was carried out through desk research to better grasp the vast extent of rules and regulations on the subject of food packaging. Through websites, articles, and law texts, the team gathered a wide variety of empirical data, that was categorized to better form an overview of the valuable knowledge. Three categories were created; "Sustainability", "Labelling, marking and information", and "Hygiene" (see fig. 4.7).

Figure 4.7: Miro Screenshot

Within each category, the team organized post-it notes with a piece of information on each of them. The subject was investigated on both a national and international level, as the EU plays a huge role in the rules and regulations one has to comply with within Denmark. Most recently, an example of such has drawn much attention, as the EU council and parliament reached a provisional agreement on a proposal for regulating packaging and packaging waste. (22) Also, the mayors of Denmark's two biggest cities have publicly pushed the Danish government, to act towards a more circular economy when it comes to take-away packaging. (14) The result of desk research was a list of requirements that referred to the underlying complex and artefact level (as shown in fig. 4.8).

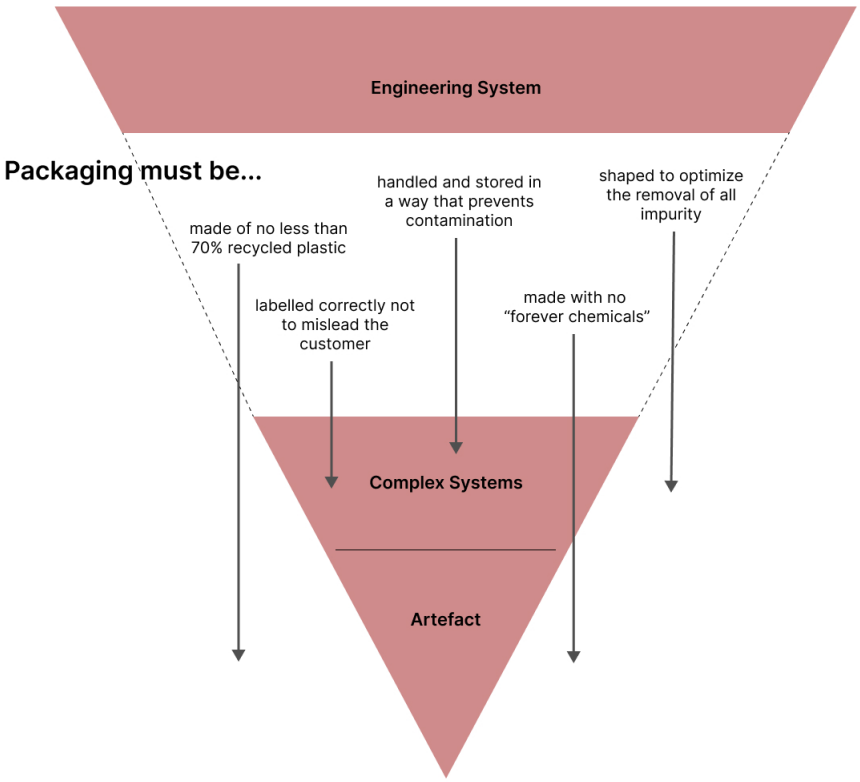


Figure 4.8: Example of engineering system findings

4.1.4 Interaction with actors

It was important to involve users and kitchen staff throughout the project to fully utilize their knowledge and experiences with the current system in addition to giving them a sense of ownership of the new system being designed. Through all phases of the design process, the team carried out interviews and interventions with actors in the system. Mostly Patrick, who is the kitchen manager in Meyers Canteen at KPMG, but also Malike, Adrian and Yifan who all are employees at KPMG (see appx. C.3 for interviews).

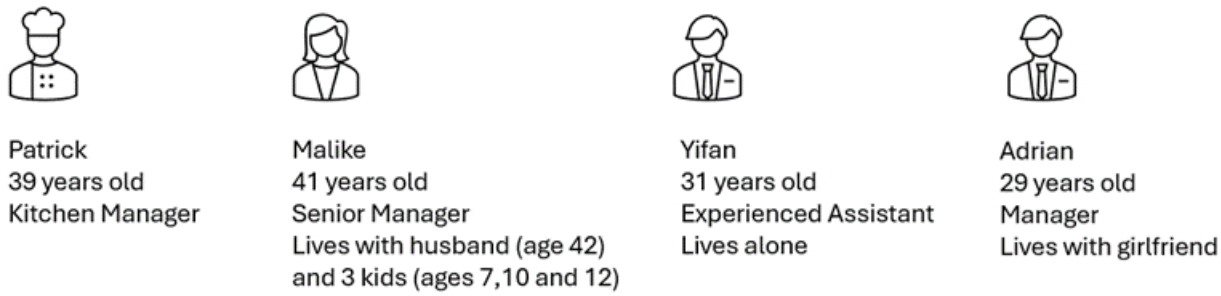


Figure 4.9: Actors involved in the project

Users were of different civil status, genders, and grade level which made them a nuanced group. All of them enjoyed the convenience of a cheap, good-quality meal, ready to take home, and all were open to the idea of a reusable container. Adrian suggested a money-incentive to bring back the container, for example, a refund or credit token in the Meyers app. Malike highlighted the importance of including an easy and discrete way of transporting the used containers back to the office canteen, as she did not like the idea of having to show her used containers on the train and in the office. (See appx. C.3.4 for further details.) It was beneficial to have different types of users represented, in order for the team to develop a design that meets the user's needs.

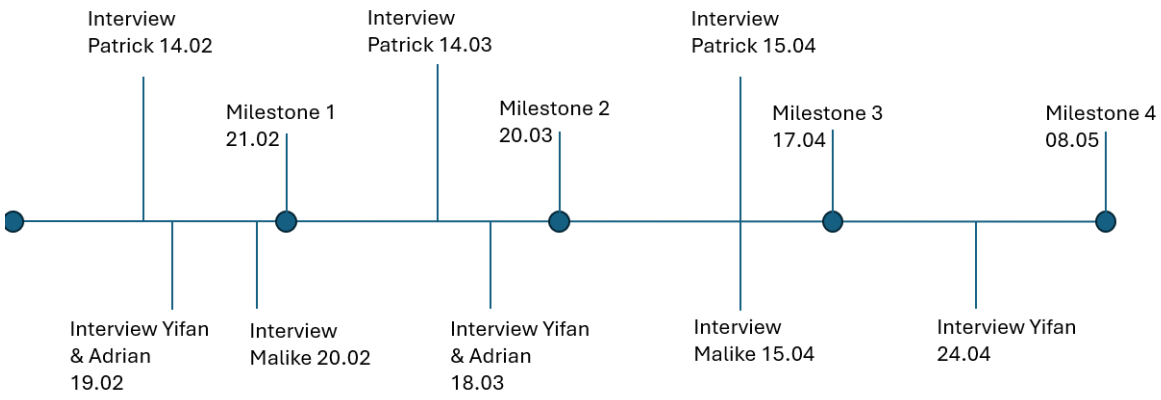


Figure 4.10: Timeline of interviews and interventions

The interventions were carried out individually for scheduling purposes, but also to ensure that actors felt comfortable sharing their honest opinions. In the first meetings, the team interviewed the users and Patrick. The questions were semi-structured by topics, but the group left space for emerging topics or questions. The team brought physical boundary objects to the meetings such as floor plan printouts, sketches of concepts/ideas for new containers, and prototypes which proved helpful in extracting knowledge from actors.

4.1.5 System level challenges

Following the collection of data on the current system, challenges and paradoxes were identified for each system level. These challenges helped set the system boundary and formulate the needs of the stakeholders on each system level.

Artefact level challenges
On the artefact level, the challenge lies in creating a more robust container, suitable for many reuses. The current will deform when subjected to high-temperature wash. The paper bag and plastic seal offer users a safe way to transport the meal home, and these artefacts must also be considered in a new design solution.

Complex level challenges
Individuals using this take-away system are motivated to do so because of the convenience. Although it is convenient to dispose of single-use containers after use, the amount of plastic waste causes inconvenience and concern for the users (see appx. C.3.4). In addition, recycling the containers is dependent on correct sorting and facilities for recycling the containers. Washing and reusing the containers seems a more sustainable alternative, and plausible for this system, since the users return to the office canteen often. The challenge here is ensuring the return of the containers.

The challenge from the canteen's perspective is that the take-away service is not profitable.

All of the above gave the team a clear idea of the design challenge: that is, ensuring the containers return to the canteen for reuse and ensuring a system which is low-cost for the canteen staff.

Engineering level challenges
Policy-, and lawmakers are concerned about the amount of plastic being consumed, and the effect it has on the environment and human health. Regulations and targets for reducing packaging waste are in place both globally and locally. The EU Directive 2019/904 forces member states to set consumption reduction targets for single-use plastic products defined as below:

Single-use plastic products covered by Article 4 on consumption reduction

(1) Cups for beverages, including their covers and lids;

(2) Food containers, i.e. receptacles such as boxes, with or without a cover, used to contain food which:

(a) is intended for immediate consumption, either on-the-spot or take-away,

(b) is typically consumed from the receptacle, and

(c) is ready to be consumed without any further preparation, such as cooking, boiling or heating,

including food containers used for fast food or other meal ready for immediate consumption, except beverage containers, plates and packets and wrappers containing food.

Figure 4.11: Definition of what products to limit from EU (24)

The Danish Government has set a goal of a 50 percent reduction in certain take-away packaging in plastic by 2026 (30). However, the infrastructure needed to reach these recycling goals is not yet present.
These targets affect the future of the current take-away system and emphasize the challenge of finding a system for reusing take-away containers.

4.1.6 System boundary

Evaluating these challenges led the project group to scope the system and set a boundary around the complex system, as shown below in fig. 4.12.

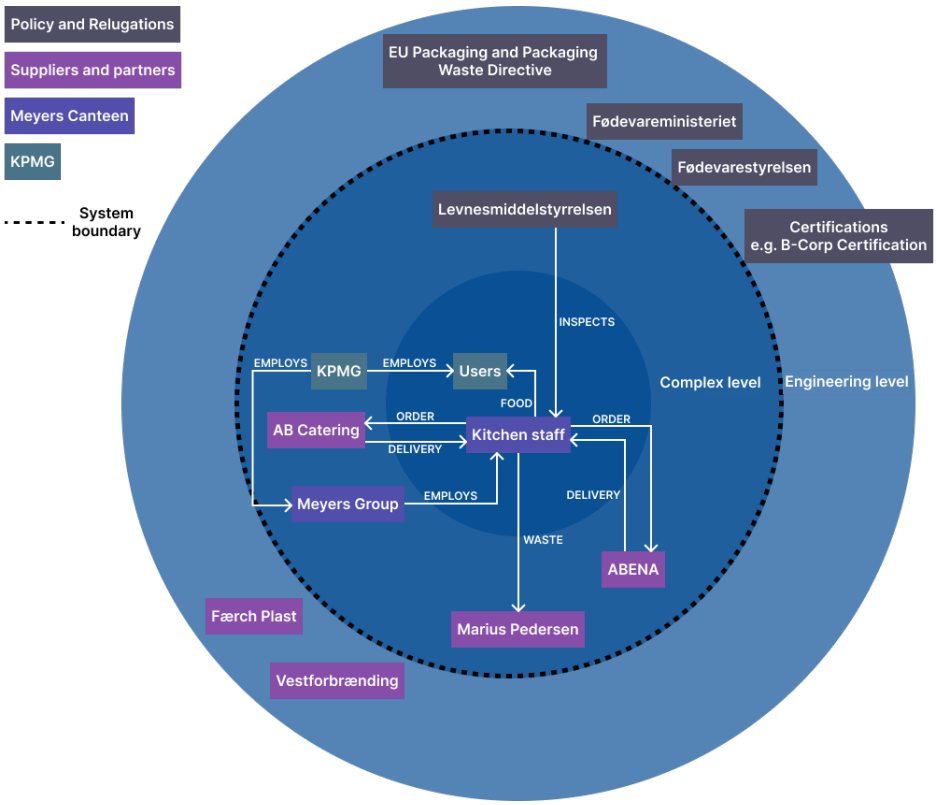


Figure 4.12: System boundary

Gathering all the findings into the N-model the team was able to formulate needs for the stakeholders on each system level (see fig. 4.13), which were used in the further work when developing requirements for the system.

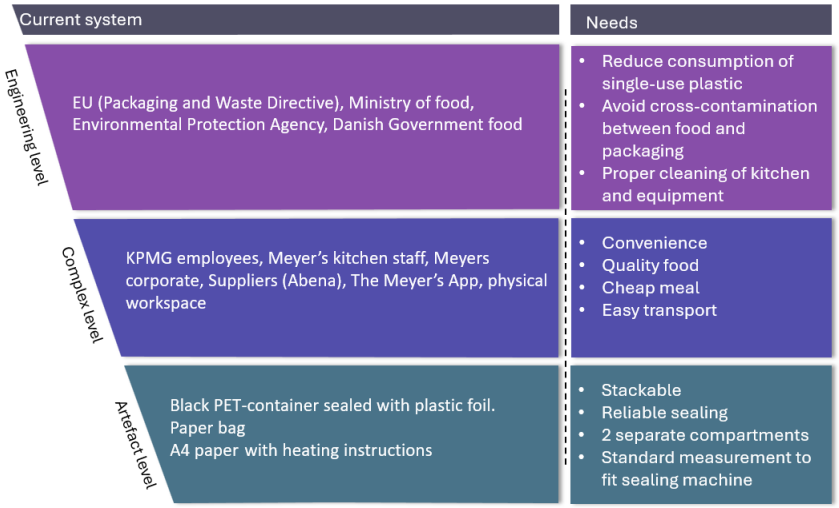


Figure 4.13: N-model including stakeholder needs

4.2 Define

The define phase is a crucial initial stage in establishing the foundation for implementing a reusable container system at Meyers Canteen. In this phase, the project's objectives were defined, and related issues were identified. The project group developed prototypes for the artefact and complex level and evaluated these with KPMG employees and canteen staff for feedback.

4.2.1 Workshop at artefact level

To define the reusable containers the team decided to plan a workshop. The goal was to investigate the potential design options, which could be used for analyzing container features as well as creating concrete ideas that could be used as boundary objects when interviewing users and Patrick. The workshop also helped visualize ideas that were being discussed during team meetings and worked as a team-building activity.
The workshop was planned in detail (see plan in appx. E.5.1), and methods were picked to help generate ideas for the container and its lid. Random objects were placed in front of the participants, while they were asked to sketch their ideas for containers and lids, on papers of the designated color - blue and pink respectively.

TEach of the two sketching sessions was concluded by reviewing the drawings in pairs and clustering them, followed by a brief group sharing and clustering similar ideas further. Each cluster was then named and ranked in the following matrix with two scales: feasibility and user satisfaction. The final ranking is visualized in the picture below (see fig. 4.14).

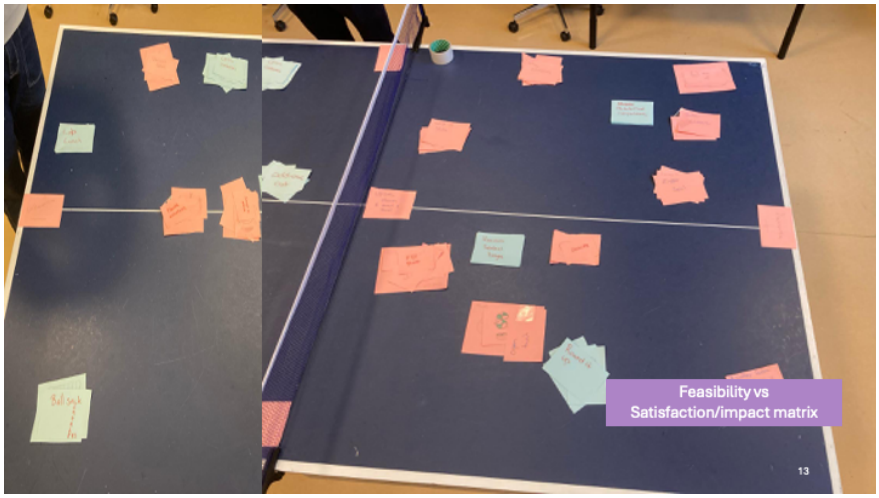
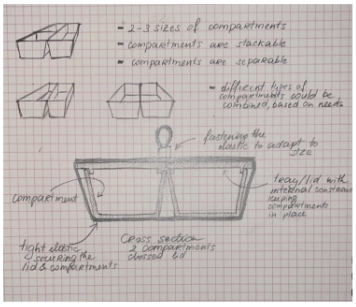


Figure 4.14: Feasibility vs satisfaction matrix used for ranking

The three clusters that ranked the highest on user satisfaction and feasibility were explored even further with desktop research (see appx. D.4.1, D.4.2, D.4.3, D.4.4) and brought into visualization to bring to Meyers Canteen for feedback (see fig. 4.15)



- Square container, space efficent
- 2-3 sizes of compartments
- Compartments are stackable, separable

- Round container for a clean wash
- Single use peelable lid / Silicon lid
- Use a machine currently used in the kitchen for a peelable lid

- Stainless steel, for weight in washing
- Round container
- Screw lid, secure

Figure 4.15: The 3 concepts with different features

After the feedback from Patrick it was obvious to the team that the container made of metal was not a good choice for the canteen and that the solution should included compartments and preferably a film lid that is adaptable to the current solution.

4.2.2 Defining the complex system

The team decided on a design constraint dictating that the containers in a new system must be washed on-site. This decision was made to keep the project simple, but also to ensure a solution with minimal amount of transportation, having the environmental impact of the system in mind. Since the layout and flow in the kitchen ensure their processes comply with food-safety regulations, the team decided to build upon this structure when developing a solution to evaluate with the users. Fig. 4.16 shows examples of ideas which were evaluated with Patrick.

Figure 4.16: Ideas for complex system design

4.2.3 Evaluating with users

When evaluating the above-mentioned ideas and concepts with users, the project group used a prioritizing game and asked users to rate solutions in relation to each other (green, yellow, and red colors, see fig. 4.17).

Figure 4.17: Prioritizing ideas

The conversation and argumentation around prioritizing solutions helped to better understand critical design requirements, arguments, and feelings behind the decisions of the users. The boundary objects in these interventions consisted of icons symbolizing the team's design considerations, and sketches from the workshop (see fig. 4.16 and 4.15). Both sketches and images helped extract knowledge from users and sparked a conversation where users engaged and built upon existing ideas. For example, when interviewing Patrick, the important aspect was brought up, that the design of existing reusable food containers makes it hard for them to dry quickly. This causes problems since removing moisture is important to prevent mold from forming when they are stacked in the storage area.

4.2.4 LCA

The team found that it was necessary to quantify the environmental burden of single-use packaging, and investigated the following:

Where in the life cycle are the climate change hotspots of one piece of single-use packaging in relation to Meyers Canteen at KPMG?

This insight guided the project's focus, pinpointing the most impactful alterations to help Meyers Canteen reach its sustainability goal. The quantification was done by conducting an LCA using the Software SimaPro.
Desk research on the life cycle of the single-use packaging was initiated and all phases are illustrated below. Further description of each phase can be found below the picture.

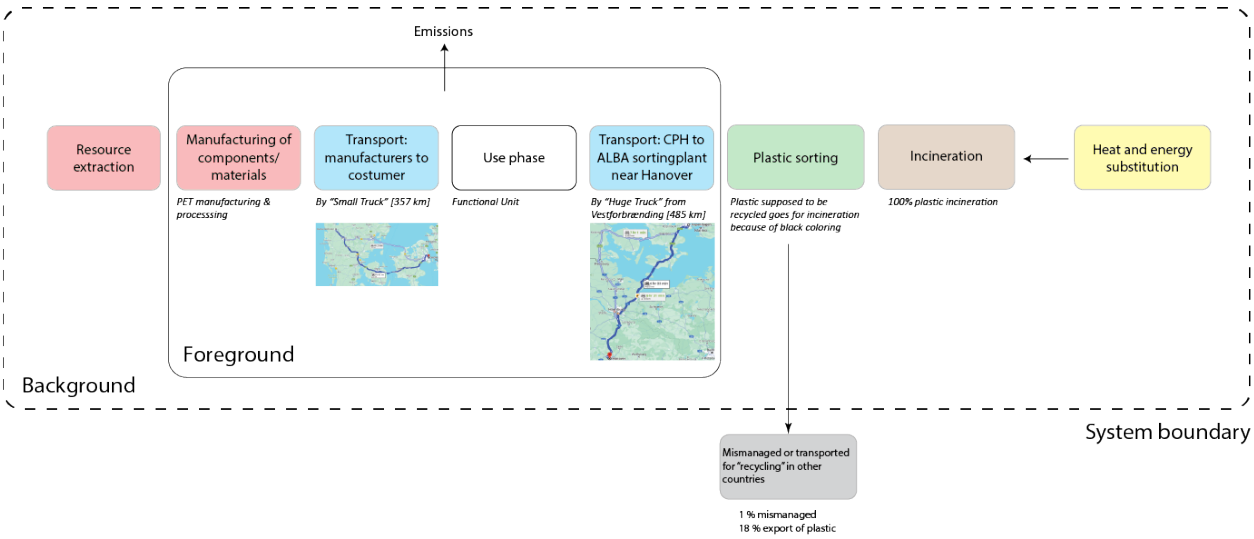


Figure 4.18: The life cycle of one single-use container

The single-use plastic packaging is made of black blow-molded PET (see appx.C.3.5). After production, it is transported by truck to Meyers Canteen in Nordhavn.
After transportation, the take-away packaging enters the consumer use phase where kitchen staff packs it with food for the users to take home, heat and finally dispose of. Assuming

the container is disposed of in Copenhagen, it is collected by a truck from Vestforbrænding (a waste handling company). Vestforbrænding transports the plastic from Copenhagen to a sorting plant in Hannover in Germany by truck for recycling (17)(32)(13).
In Hannover, the plastics are sorted into different categories. However, the technology at the sorting plant cannot detect black coloring. Hence, the single-use take-away packaging is incinerated in Germany, even though it was transported there for recycling(4).

4.2.5 Single-use plastic take-away container LCA results

Below is a graph and table from the quantified LCA, illustrating each life cycle's contribution in % to the climate change impact.

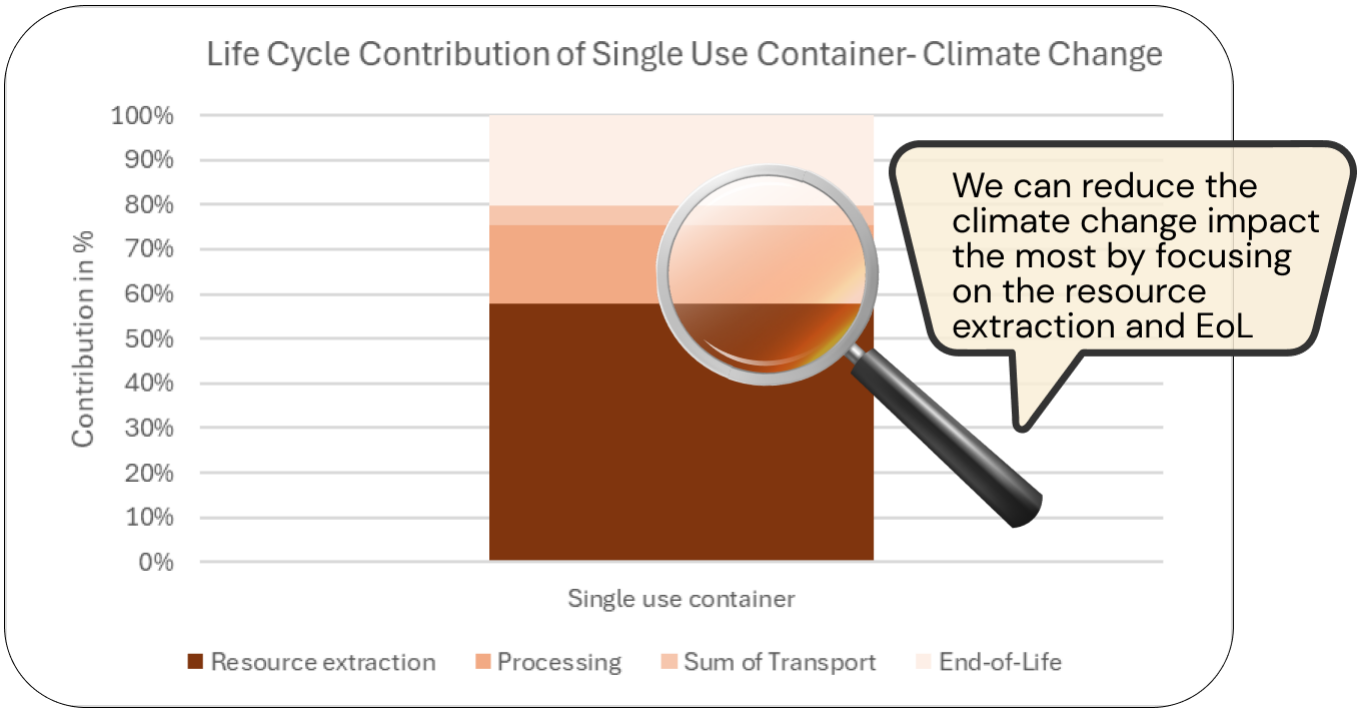


Figure 4.19: The life cycle of one single-use container

Table 4.1: The life cycle of one single-use container

	Resource extraction	Processing	Sum of Transport	End-of-Life
% Contribution	58	18	4	20

Table 4.1 shows the resource extraction and End-of-Life are the largest contribution to the climate change category. It was therefore determined that focus should be on minimizing

resource extraction and the End-of-Life phase. These findings support the team's work extending the lifetime of the take-away container, and reducing the need for additional production of new ones. Using other coloring than black to enable recycling was also agreed upon.

4.2.6 Requirements

Requirements for Containers
Based on the team's research and analysis, requirements for a new system were formulated. The reusable take-away containers must be made from materials that can withstand temperatures up to 80 degrees Celsius for compatibility with the canteen's dishwashers and adhere to food safety regulations. Due to limited space in the KPMG kitchen, the containers need to be stackable. The design of the containers must secure food contents without spillage and maintain an aesthetic quality without compromising functionality. Sustainability criteria dictate avoiding black plastic to enable recycling, using recycled rather than virgin materials, a homogeneous material to facilitate easier recycling, and ensuring durability for multiple uses to minimize environmental impact. (see appx. G.7.1 for all requirements)

Requirements for System
Cleaning must be in-house to minimize carbon dioxide emissions from transportation. The return of containers can be managed without the involvement of kitchen staff, necessitating a registration system to prevent loss and encourage returns. Storage must be managed to prevent mold growth by limiting air circulation. Additionally, concerns raised by Patrick about the potential spread of bacteria from used containers entering the kitchen must be addressed by adhering to current regulations. Furthermore, this initiative must align with Meyers' sustainability goals, including the reduction of transportation emissions.(see appx. G.7.2 for all requirements)(16)

After listing all the requirements, the team summarized them in the N-model. (see fig. 4.20)

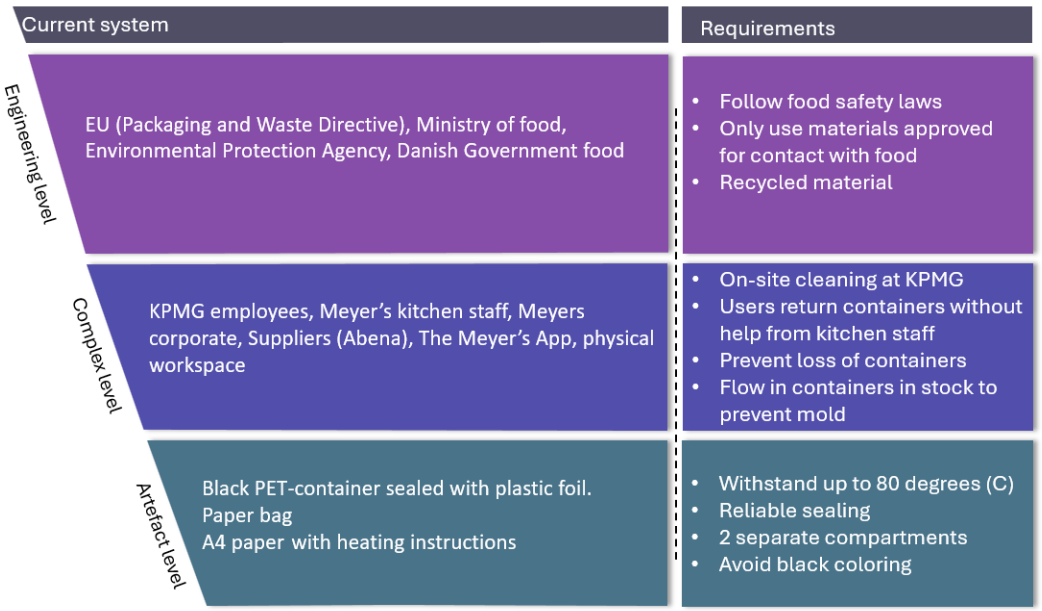


Figure 4.20: N-model corresponding to Requirements

4.2.7 Problem statement

At this point in the design process, the project group had gathered enough knowledge to formulate a problem statement to use in the following exploration of the solution space: Problem statement:

How might we transition Meyers Canteen from single-use take-away containers to reusable ones in response to new regulations on single-use plastics while minimizing disruption to operations and enhancing sustainability?

5. The solution space

The solution space covers the development of solutions which were tested with users in order to find the final solution.

5.1 Develop

After defining the problem statement it was time to develop concepts at the artefact and complex level.

5.1.1 The reusable take-away container

After iterative design development on the containers, user feedback, and prototyping, the team settled on the container design illustrated in fig. 5.1.

Figure 5.1: The reusable take-away container

The container resembles the single-use container in the number of compartments as well as being dependent on a temporary film lid. A concern regarding the container was the lack of motivation to bring it back. However, potential users have stated that the lack of a permanent lid makes them not want to keep it at home (see appx.C.3.3). By nudging the user to not keep the container at home, it is kept in the loop. The thicker material of the

reusable container enhances its durability for repeated use. The thick material also made users state that "the thickness makes me not want to throw it out." (see appx.C.3.3).

The container has round edges to ensure that food and soap do not get stuck during washing. The container is also equipped with small knobs making sure that there is airflow between the containers when stacked, preventing mold to build up.

5.1.2 Material choice

The LCA on the single-use container concluded to focus on minimizing the resource extraction and End-of-Life phase. Consequently, it became clear that the selection of material for the reusable take-away container was crucial. It was essential to select a material adhering to the following:

- Recyclable
- Sufficiently durable to prolong its reusability before undergoing significant degradation.
- Food-safe and adheres to the Danish laws.
- Capable of withstanding dishwashing at 80 °C without deformation
- Isn't heavy.
- Cheap material

The software Granta Edupack was used to look up material properties and determine what material had the lowest CO2 footprint from production. The graph below from Granta Edupack was used to explore the different material choices. All plastics that had a lower environmental impact than Polycarbonate were explored based on the requirements mentioned in the bullet points just above.

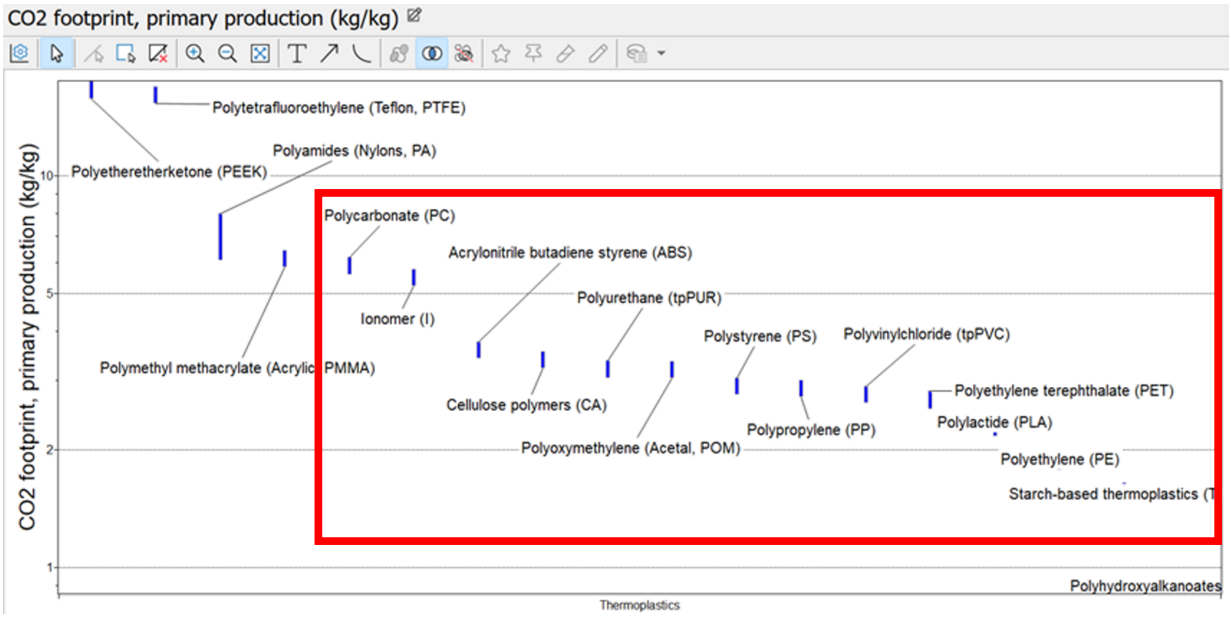


Figure 5.2: Graph of thermoplastics and their CO2 footprint when produced

Of all the materials considered, Polypropylene met the requirements most effectively. Polypropylene is commonly used for reusable food containers (3).

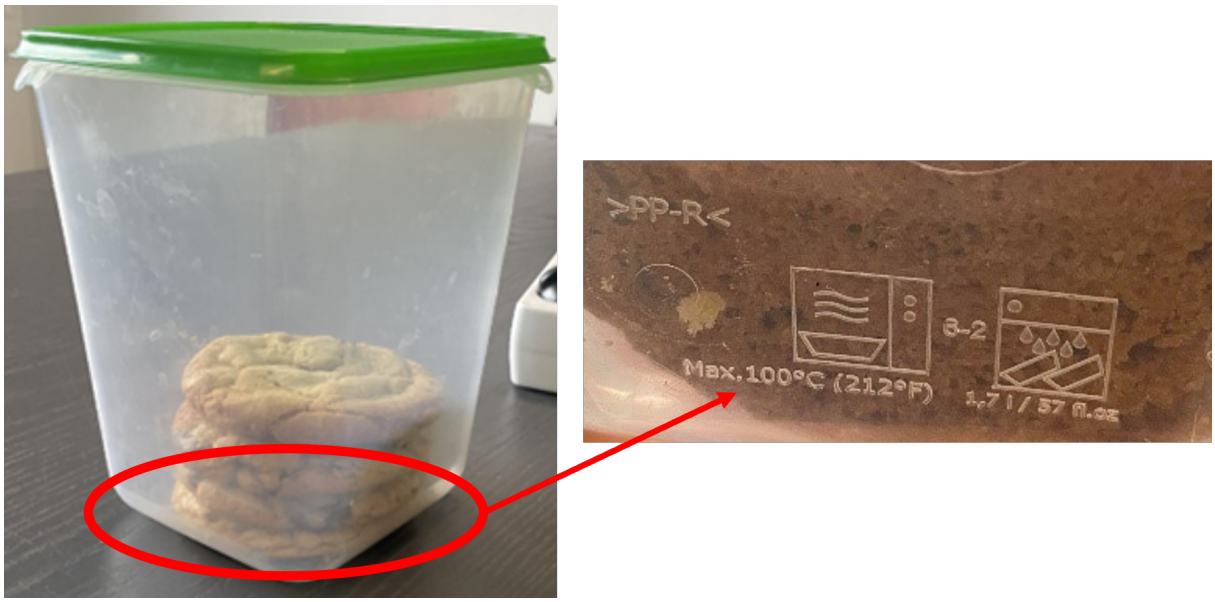


Figure 5.3: An example of a reusable food container made of PP

5.1.3 Meyers Canteen app

During the develop phase, the following question was investigated: how can the existing Meyers Canteen app be used to generate incentives to return containers?
From the beginning, the focus was on Meyers Canteen app as the medium, because user interviews showed that the users are familiar with this app and like to use it (see appx. C.3). This was leveraged to minimize the risk of losing users that would oppose downloading an additional app. Also, this would maintain the existing communication channel between kitchen staff and users, which is facilitated by the take-away ordering system, through the Meyers Canteen app. Using the app also enables the use of push notifications that can be a tool to nudge behavior, e.g. a reminder to return one's container. By utilizing the existing Meyers Canteen app, the project taps into the users' existing habits and seeks to benefit from the ubiquitous nature of smartphones.
Through the user interviews, it also became apparent, that competitiveness is a motivational factor that characterizes many of the users (see appx. C.3). This led to the idea of engaging the users more and possibly creating a sense of community around the Meyers Canteen app.
All of this sparked the concept of creating a gamified universe within the Meyers Canteen app. The specific features of the app design are elaborated in section 5.1.3.2.

5.1.3.1 Navigating a behavioral design

When touching upon user behavior and habits, you tap into the thinking principles and world views of the users. By doing so, you also enter the arena of behavioral design. Though behavioral design principles are embedded in all systems of user interaction, they carry particular importance in this project as it relies heavily on the users' will to return take-away containers. The project is dealing with user motivation, namely the intrinsic side of the spectrum (this will be elaborated further in section 5.1.3.2). (19) (15) One way this project is touching upon the users' intrinsic motivation, is through the gamification universe which intervenes in the social context of KPMG on a micro and meso level. (19)
In broad terms, the project deals with the decision-making processes and human cognition. The earlier-mentioned choices on utilizing existing communication channels and smartphone habits align with the considerations necessary for designing system 1 in dual-process cognition. (19)

With an intuitive app design through great discoverability and learnability, this project also seeks to lower the required mental resources as a strong mean of changing behavior. Though this project's ability to change behavior lies within the users' fast and automatic decisions, attention must be shown towards the interaction between system 1 and 2.
Three levels of processing must be considered when designing within the field of human cognition: visceral, behavioral, and reflective (21). By building the gamification universe within a familiar app, the project seeks to strengthen the immediate perception at the visceral level. The behavioral level comes into play as the app design tries to create an intuitive user journey that matches the expectations and goals of every action. Lastly,

the reflective level determines the emotions associated with the user experience, which the project intends to support with the CO2-info initiative.

5.1.3.2 App features

The app design is made up of a few core features and functionalities. These are listed and described below.

Figure 5.4: Frames of integration with mobile application

Notification
The dominant idea for means of motivating the users to return their containers was to use interventions through an external attraction, such as reminder notifications. These would impact the users before they act against the system, by not returning their container.

Challenge
The monthly challenges serve as both intrinsic and extrinsic motivation. The user gathers points for the community ranking list through the challenges while accomplishing goals only visible to themselves. The nature of the challenges can vary but they will all incite engagement through buying take-away food and returning containers on time. Finishing all the challenges of a month is rewarded with a trophy.

Trophy
The trophies are collectables for the user and a way of stimulating intrinsic motivation without depending on their community. If this feature succeeds, it would be the strongest engagementand that can be obtained. The literature on the subject indicates that three

traits are necessary for the existence of a collection: interrelatedness, selectivity, and sacredness (28). This needs to be applied to preserve the effect of the collection over time.

Rank
The ranking list offers a way of comparing yourself to other users, some of which might be familiar, considering that KPMG has a rather small community. Keeping the ranking list productive might be a challenge, and since the team is after continuous engagement, it is important that the gamification does not lose its appeal over time. The list would be reset once a month once a winner is named, to provide more opportunities to reach the top of the list and win a trophy. A few users expressed that collecting points would not be a positive thing to them, but rather communicate that they are lazy cooks (see appx. C.3.3). This input has resulted in the option of hiding yourself in the list.

CO2 tracking
Though the goal of the new app features is to engage through gamification, the system should account for the users that find motivation in facts and logic. This need is addressed by providing insights into the consequences of their actions, good and bad, shown on a page that tracks the CO_2 saving from their engagement in the system of reusable containers. The greater social context of contributing to environmental change works as a supplement to the gamification with a community context of KPMG.

5.1.4 Return station

When returning the container to Meyers Cateen concerns were raised regarding the containers creating chaos in the cleaning area (see fig. 5.5).

Figure 5.5: Return station

The drop-off place for the containers can be designed with different complexity. For this project, the solution shown in figure 5.6 was explored. The return station is to be placed next to the trolleys where the canteen guests drop off their plates after lunch. Its placement as well as the design is thought to be intuitive offering the users a simple drop-off place. It is also beneficial for the canteen staff as they can simply collect the containers when needed and they will not be mixed up with plates.

Figure 5.6: Return station

The return station is designed to have a platform with a spring that gets pressed down as the containers are stacked in the station. This is to reduce the risk of the containers breaking and thereby optimize the lifetime of the containers.

When emptying the return station the stacked containers can easily be accessed and retrieved by opening the front door of the station. The stack can then be taken to the kitchen for cleaning (see fig. 5.7)

Figure 5.7: Open front door of return off station

5.1.5 Washing grid

As part of the project, an efficient and safe cleaning method was needed for reusable plastic containers. However, the lightweight nature of the containers presented a risk of displacement by the dishwasher's water pressure.

To solve this the team spared with Patrick and was introduced to wash grids that hold light items in place during washing. (6)

Ultimately no grid fitted the dimensions of the container, and the team therefore developed a grid adapted to the container (see fig. 5.8).

The grid was made through rapid prototyping using the software program Creo Parametric.

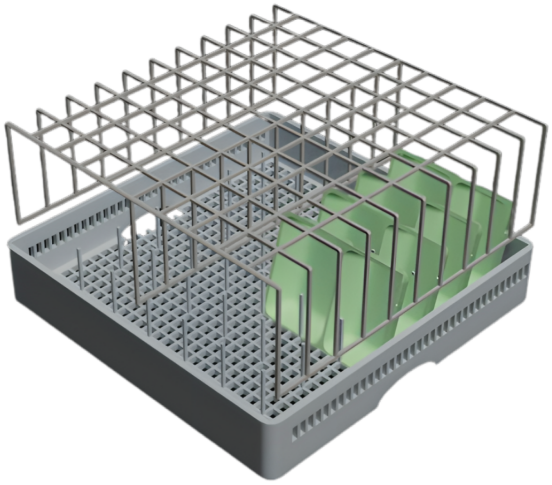


Figure 5.8: Washing grid

5.1.6 Storage

The kitchen space at Meyers Canteen is limited (see fig. 5.9). In the current solution Patrick is forced to purchase 500 plastic containers at a time, making the limited space very crowed.

The reusable container system requires less containers, leaving more room in the storage space. To accommodate the concern of mold and to distribute wear on the containers as well as provide a solution for practical storage, the team developed a storage box which can be seen in figure 5.10. Containers are being fed from the top and pulled out from the bottom.

However, feedback from Patrick indicated that such a storage system was unnecessary.

Figure 5.9: Current Storage System

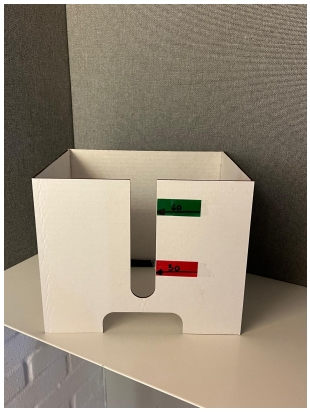


Figure 5.10: Storage Prototype

5.2 The final artefacts

An overview of the final concepts for the delivery phase is displayed below (see fig. 5.11).

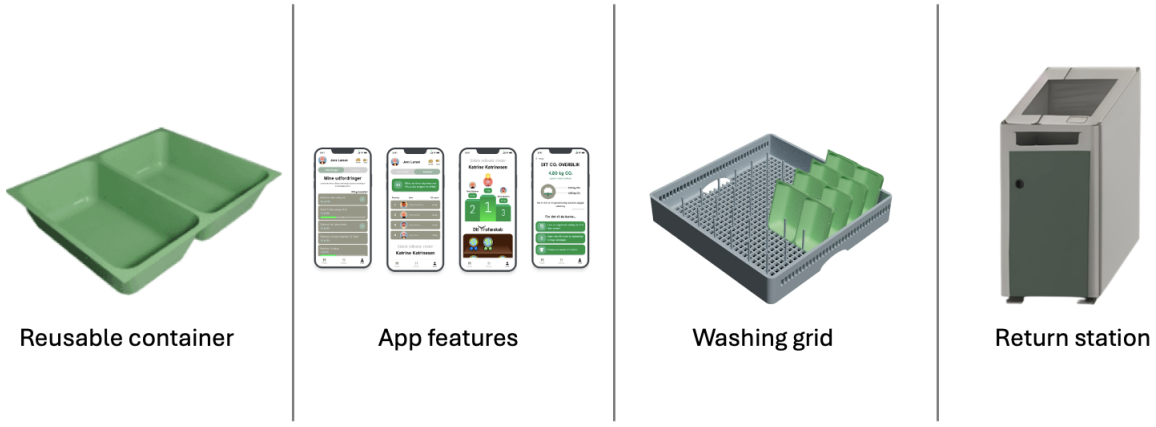


Figure 5.11: Overview of artefacts

5.3 Deliver

As the deliver phase was initiated, further sustainability considerations were taken, KPI's were formulated, multiple iterations of testing were carried out, and a structured implementation plan was made.

5.3.1 LCA on reusable plastic containers

Earlier in the report, an LCA was conducted on single-use take-away containers in conjunction with the canteen's take-away system. This was done to pinpoint where the most impactful alterations could be made to decrease the overall climate change impact for the company. In the delivery phase of the double diamond, another LCA was conducted. This was done to decide on specification for a container with the most optimal reuse rate relative to its thickness. In this case, two proposals were investigated:

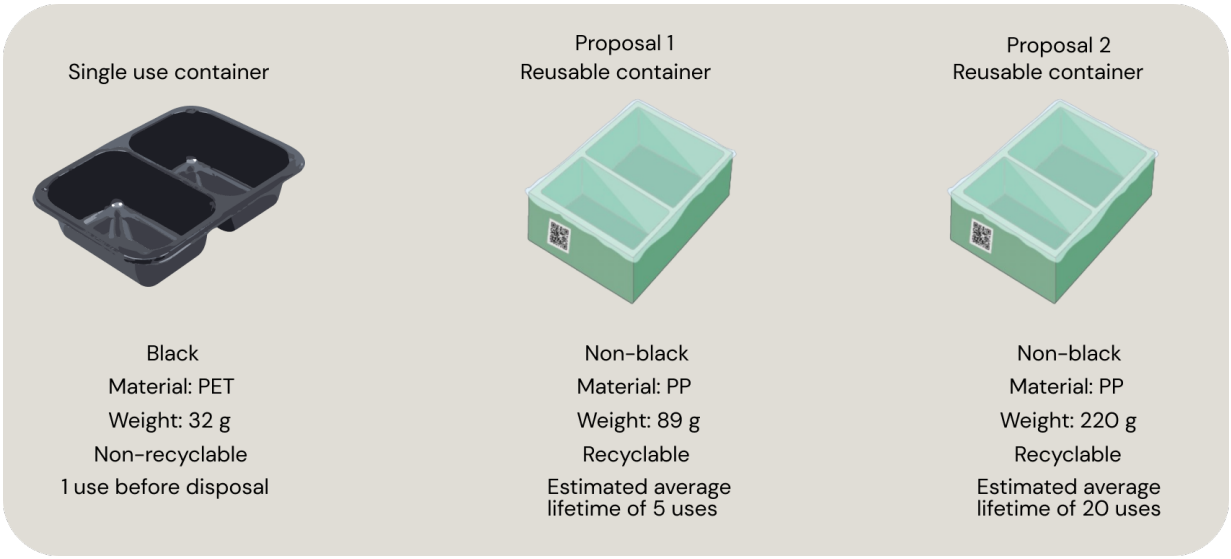


Figure 5.12: Specifications of the two proposed reusable containers compared to the baseline container

Both proposed container specifications are of non-black coloring and made of PP material, making both recyclable.
Proposal 1 has a thickness of 1.1 mm and a weight of 89 grams. Proposal 2 has a thickness of 2.7 mm and a weight of 220 grams. The two different wall thicknesses were inspired by two IKEA reusable containers, both made of PP (11)(10), with wall thicknesses of either 1.1 mm or 2.7 mm. IKEA's containers were then used as a comparative basis, for the two proposed containers' reuse rate, before being too degraded for another reuse. Proposal 1 and 2 were estimated to have a lifetime of 5 and 20 reuses, based on how sturdy IKEA's containers feel. The low reuse rates are attributed to concerns that the containers may undergo rough environments. Not only from users but also from the dishwasher, at Meyers

Canteen, operating at high temperatures, 80 ℃ (5). The two proposed containers share the same life cycle, as seen below:

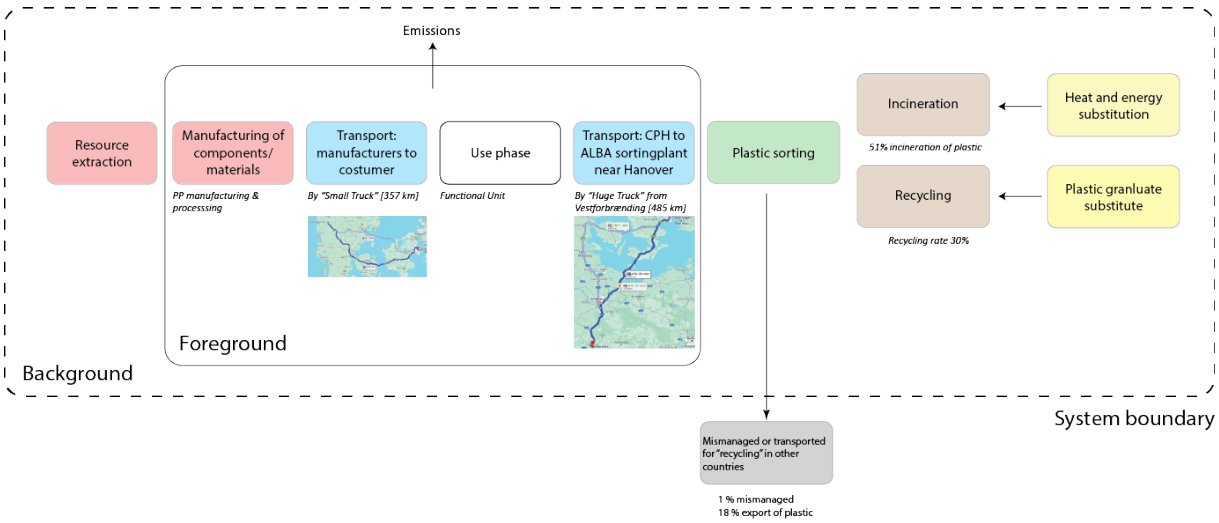


Figure 5.13: The two proposed solutions' life cycle

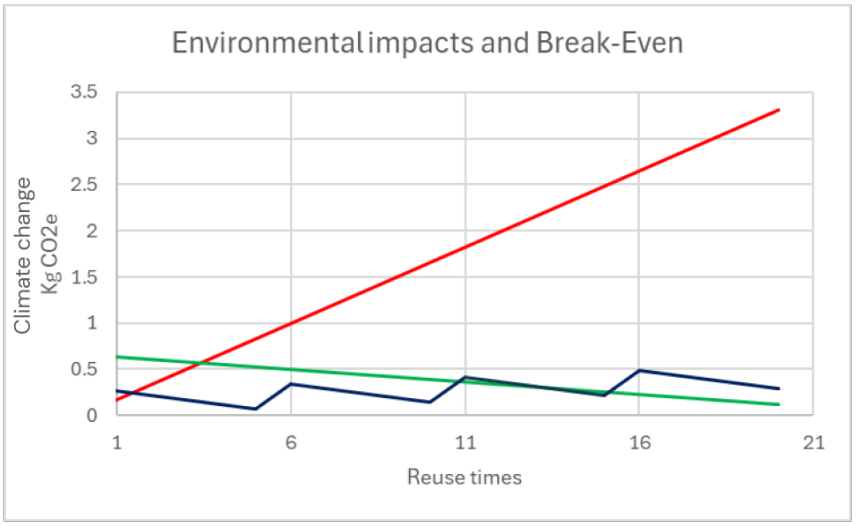
The first three phases of the reusable container's life cycle closely resemble the single-use plastic packaging. First the PP material is produced and then manufactured into a container. Then it is transported, by truck, from Faerch in Holstebro to Meyers Canteen at KPMG in Nordhavn.
From this phase, the reusable take-away container differs from the single-use container, as the container is used multiple times before being disposed of. When disposed, Vestforbrænding collects it and transports it by truck to a sorting plant in Hannover in Germany for recycling (17) (32)(13). Unlike the single-use container, the new solution is recyclable. Despite that, some of it will still be incinerated. In Germany 51% of all plastic packaging gets incinerated and 30% gets recycled, while the rest is further exported to other countries or mismanaged. (7).

5.3.1.1 Reusable take-away plastic container LCA Results

To facilitate a comparative LCA, aimed at quantifying the optimal performance among the two previously mentioned specifications for a reusable container, a functional unit was established:

To store and seal 1 portion of take-away food for 20 workdays in Meyers Canteen in KPMG (Nordhavn)

A break-even LCA analysis was conducted to quantify which of the two specifications for the reusable container was performing the best in regard to the functional unit. Below is a graph and a table showing the results.



	Unit	Single use	Proposal 1: Reusable container, 89 grams	Proposal 2: Reusable container, 219 grams
Break even with single use	Climate Change kg CO2e	X	1.6	3.5
1 time use		0.17	0.26	0.64
20 time use		3.3	0.29	0.12

Figure 5.14: graph and table of the results and their break-even points

Based on the table and graph, it is evident that the three take-away containers outperformed each other depending on the frequency of their use. Should they only be used once, the single-use container is the most environmentally friendly choice. However, after 1.6 reuses proposal 1, that is lighter in weight than proposal 2, outperforms the single-use. Proposal 2, that is sturdier and heavier, needs 3.5 reuses before being more environmentally friendly than the single-use.
On the other hand, proposal 1 is less sturdy, and has a lifetime of 5 reuses before being too degraded for another reuse. Thus, for 20 uses, Meyers Canteen needs to buy 4 containers. Meanwhile proposal 2 might have a higher initial environmental impact, because it needs more material, however, it can be reused 20 times before disposal. Hence, Meyers Canteen only needs to buy 1 container for every 20 uses. After between 10 – 11 reuses, proposal 2 outperforms the less heavy container, proposal 1. The conclusion is that with a functional unit that considers 20 reuses, proposal 2 is the most environmentally friendly decision to go further with. Moreover, the implementation of a reusable take-away container system contributes to SDG-12, responsible production and consumption (among others), by reducing the production of plastic materials(18).

5.3.2 KPIs

The objective for setting KPIs was to frame the solution and draw a benchmark line for a solution that is not only an improvement to the current system, but also could hold up to higher standards and be feasible long term, keeping in mind changes towards single-use plastic regulations.

The KPIs have been set up into categories corresponding to the three levels of the N-model. For the complexity level, the team reviewed information provided by canteen employees, and findings from the previous research and development stages. The results of the literature review scoped towards relevant legislation and LCA analysis were used for engineering and artefact level respectively.

As seen in figure 5.15, each KPI was noted down with the unit of measurement, as well as context, to ensure that the final solution will be objectively analysed based on them.

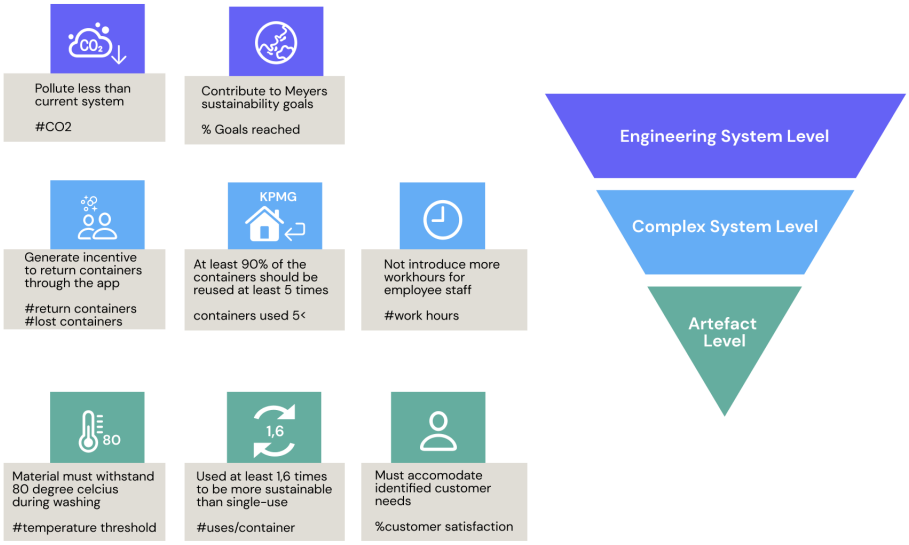


Figure 5.15: KPIs on the three N-model levels

5.3.3 Testing

In the iterative practice of designing for society, testing plays a crucial role in evaluating the solution, to get the design right as well as getting the right design, as proposed by Donald Schön (1).

5.3.3.1 Testing the container

The testing of the container can be divided into long-term and short term testing, based on design and material respectively. Further tests are needed to determine the average amount

of uses the container can withstand. Moreover the containers are designed to have airflow when stacked to avoid mold building up (fig. 4.4) which also needs to be tested further.
A concern was that food could stain the container causing it to look less presentable. However various test and real life examples (appx.D.4.5) show that even strong colored foods will not stain after a few washes. The final design of the container has been validated by Patrick.

5.3.3.2 Testing app designs

To evaluate the app design, the team tested the pretotypes with Patrick, and multiple users - Adrian, Malike, and Yifan - followed by a usability test with a functional prototype with Yifan.

Testing with Patrick
A scan feature, meant to ensure container traceability, was evaluated by Patrick. It allows him to link every container to the user borrowing it by scanning a tag on the container (ex.: a QR code). (see fig. 5.16)

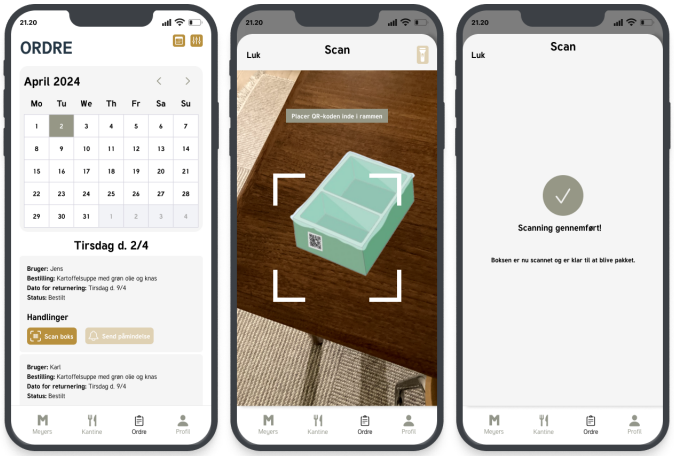


Figure 5.16: Design of the scan feature

The test took place at KPMG, and used a pretotype, as it had no functioning interactions, and merely was a high-fidelity sketch rather than an actual prototype.(**?**) The goal was to validate the relevance of the scan feature and determine whether Meyers canteen staff would use it, while with minimal resources and in a very short time.

The test answered the question: "Should we build it?" by showing that the canteen app was not the ideal medium for housing the scan function and that using the stationary computer in the office would be more convenient for this purpose and less disruptive. Additionally, using a phone while handling food raised sanitary concerns. The scan feature was disregarded, to allow for more effort to be spent towards gamification.

Testing with users

Testing of the gamification universe with users happened in two iterations. The first part was a test of the initial prototype, where participants were asked for immediate reflections on the design. The three users, Malike, Yifan, and Adrian, brought up valuable insights during the test. For example, the point that the CO2 savings on the CO2-info screen could be more visually appealing (see fig. 5.17). Also, it was mentioned that it should be voluntary whether you want to be visible on the scoreboard. Lastly, Malike made the point, that the CO2 info would motivate her a lot, but she did not see the value in the competition aspect. This was challenged by Adrian and Yifan, who found the competition aspect engaging and saw it as a conversation starter during the workday.

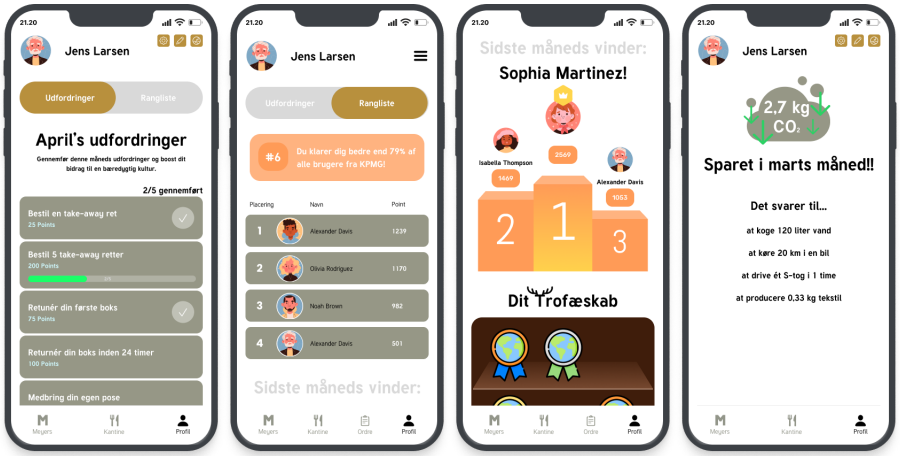


Figure 5.17: First iteration of gamification universe

As a result, the design was revisited and prepared for another iteration of testing (see fig. 5.18 for iteration two). This helped navigate the design space and made sure the team was building the right it, before building it right. (26)

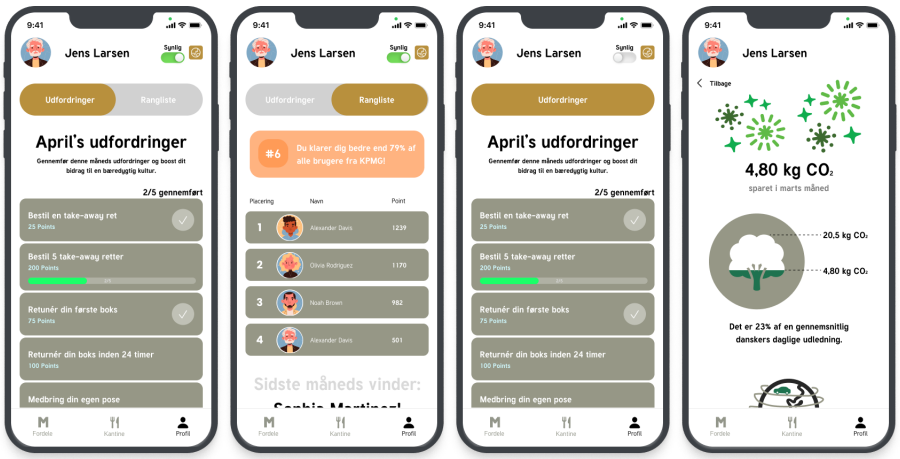


Figure 5.18: Second iteration of gamification universe

The other part of testing was carried out with Yifan, this time using a fully functional prototype and following the Thinking Aloud methodology. Yifan was asked to perform simple tasks, and express his thoughts verbally, as he navigated the prototype. (20) The prototype was run through Figma, and the screen duplicated on a bigger screen in the meeting room, to follow Yifan's journey in the app. While pretotype tests were meant to validate challenging ideas, this test was focused on usability. The purpose was to uncover the discoverability and learnability of the interface, and whether Yifan found the design intuitive to navigate.

Yifan quickly dived into the different screens of the design with no hesitation. In a very curious manner, he navigated his way through by scrolling and clicking every possible button while nodding in silence. The facilitators asked clarifying questions, to spark the conversations and reflections. For instance, Yifan was asked "If you wanted to stay hidden from the scoreboard, how would you do that?" ,to which Yifan correctly located the toggle that said 'visible' and would execute the task. The the conversation sparked numerous insights. For example, Yifan pointed out that the competition aspect he likes so much could be based on the amount of CO2 saved rather than fictitious points. "Something like you saved this much CO2 because you returned your container instead of throwing it out" Yifan explained.

The insights derived from testing both the scan feature and the gamification universe, has sparked new ideas and demanded new design moves to be made (see fig. 5.19 for revised designs).

Figure 5.19: Final design of gamification universe

5.3.4 Implementation plan

An implementation plan has been constructed to help Meyers Canteen to implement the new take-away system. It was decided to conduct a phased implementation where the system is gradually implemented. This allows Meyers Canteen to break down the implementation and review each phase before proceeding to the next one. As a result, it will assist in mitigating the risks involved in transitioning from single-use to reusable take-away containers (31). The implementation plan can be seen in fig.5.20. The dark colored stripes are new implementations for a given phase. The bright colored stripes are previous implementations carried over from earlier phases into the new one.
The implementation plan has been designed to facilitate a swift and cost-effective initiation of the reusable system. The phases transition from a high level of trust towards the users to a more regulated system, which in return, requires extra resources to implement.

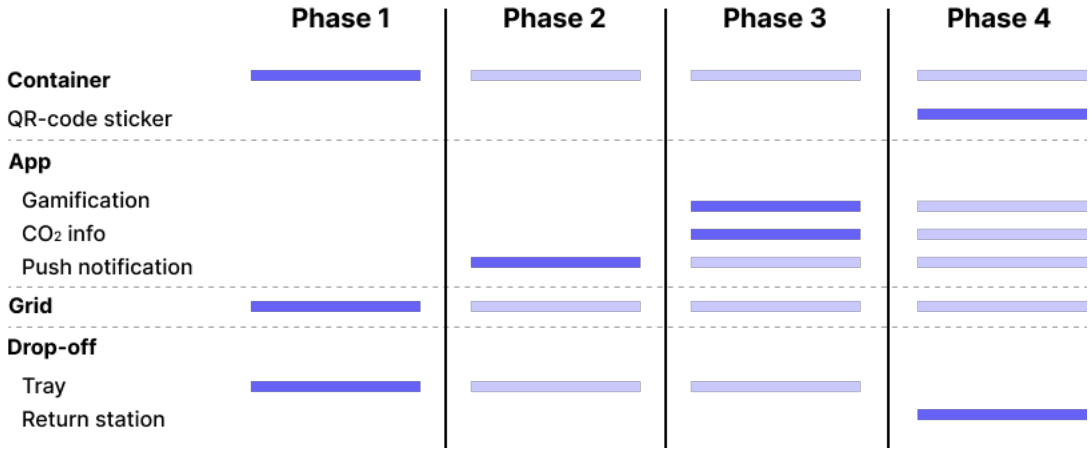


Figure 5.20: The implementation plan for reusable packaging

Success criteria
The reusable system is set to be successful once the following success criteria is met: I.9.1

95% of the reusable take-away containers have been returned within an appropriate amount of adaptation time

The criteria above is based on results from the LCA which were used to calculate the appropriate return rate. The calculations can be found in appx. I.9.1.

Achieving the success criteria does not require implementing all four phases. For instance, if the canteen reaches the return rate goal by phase 2, further implementation is not required. When Meyers Canteen concludes that enough information on the specific phase has been collected, the canteen should review whether they have achieved the return rate goal. If it has not been achieved, the next step of the implementation plan should be put into effect. Additionally, significant variations in the duration of each phase should be noted; for example, phase 1 might require only half the time for review compared to phase 2. Furthermore, when expanding the project to other canteens, the time needed for each corresponding phase may vary depending on the specific characteristics of each canteen.

Phase one
In the very first phase, it is necessary to introduce the washing grid for the reusable containers. Otherwise, it will be a hassle for the employees at Meyers Canteen to clean them. The first phase is the least comprehensive among all of the four phases. In this initial phase, Meyers Canteen has high trust towards its users to return the containers. Therefore, only the container is provided, and users are asked to return it to a designated return station, consisting of a tray, which is assumed that Meyers Canteen already has in its inventory. Meyers Canteen then collects the trays from the return station and brings them into the kitchen the following morning for washing.

Phase two
After a month, if Meyers Canteen determines that too many containers have gone missing during the pilot test, phase two begins. In this phase, the users will receive a notification on their app the following day they ordered the take-away, nudging and reminding them to return the container. However, beyond this reminder, no further action is implemented in this phase. It is believed that customers merely require a reminder to return the container. Thus, the only difference between the first and second phase is the introduction of the app notification reminder.

Phase three
If Meyers Canteen has not achieved the 95% return rate for the containers, phase three begins. The main objective of this phase is to create both a community and individual driven incentive for the return of the container. This is done via app development. Instead of only receiving an app reminder to return the reusable container, the user will be asked if they returned it. If they select "yes," they can view their saved CO2 footprint for returning the container. Additionally the "Gamification" part is introduced among the users where

they can view their colleagues' total saved CO2 footprint. This is aimed towards providing another incentive in returning the container, the chance to be the top CO2 saver. However, customers will have the opportunity to participate in the gamification aspect or opt out. By informing users about their contribution to the environmental savings and creating a competition, it is hoped that they will be more motivated to return the containers.

Phase four

The final phase of the implementation plan further builds upon the previous phases and is the most comprehensive phase. The main part is the introduction of tracking the containers. Tracking is enabled by the introduction of a QR-code sticker on the container itself that is assigned to the corresponding user when the employee at Meyers Canteen is packing the take-away dish. This function allows Meyers Canteen to assign every container to the user who ordered the given take-away dish. The user will return the container via the new return station designed within this project. As the user scans the container at the return station, its state changes to "returned". The system will therefore have an overview of containers: in storage, assigned to user, returned or broken. Additionally, the users' CO2 saving score will only be updated after the return-scanning, removing the risk of users incorrectly indicating returns that have not happened.

6. Prerequisites for implementation

Given the time frame of the project, further work needed to be done before the solution can be implemented. The next phase of the project would be to realize the container, return station, and app beyond the prototyping level.

The container
The container needs to be produced, and in order for that to be realized a mould must be designed. The time frame for this is estimated to be around 2 months and the price around 500,000 dkk based on expert knowledge from Michael Lindholt from Faerch (see appx. C.3.5).

The return station
The design of the return station needs work to be put into production. This work includes an assessment of whether or not it is even worth it, to develop a customized solution for this system. The spring-loaded mechanism carries some complexity, but is not a novel technology and is rather common in big canteens for traditional plates. Depending on the cost of development, this might make it favorable to go with an off-the-shelf solution, to keep the price from becoming a barrier when the system is pitched to companies like Meyers Canteen.

The app
For further work on the app design, additional usability would have been beneficial. This could strengthen or challenge the preliminary results, and open up for yet another iteration. Also, the app design requires dedicated time for development into the existing infrastructure.

7. Reflection and discussion

7.1 Thinking principles and problem solving approach

The team approached this project with a strong commitment to sustainability. Knowing and understanding the coming change in legislation, companies need a system to help them live up to those laws. Because of this, market validation and general business work, have taken little to no focus during development. While the system is designed to obey a set of laws, sustainability itself has been a goal throughout to avoid any greenwashing.

The Double Diamond guided the team navigating the complexities of an iterative design process. This entails the model's ability to foster the principles of divergent and convergent thinking. The project has been user-centric from the very beginning and the group conducted numerous interviews throughout the project. By placing the user at the center of the process, the team has gained a deeper understanding of the users' needs, preferences, and pain points. With empathy at the core of the process, the final solution not only addresses the practical requirements of the system but also considers the human elements of convenience, motivation, and behavior.

In retrospect, the user-centric approach might have caused the team to deviate from paying attention to the corporate aspect of Meyers Canteen. Meyers is a big company with a natural interest for profit maximization and maintaining a sustainable image. With a bigger focus on these interests, the system could have catered more to corporate Meyers interests. One possible explanation for this could be the system boundary excluding the general market and competitors. While this is an unexploited opportunity, the scope has kept the project on track given the time frame and resources.

Design Thinking principles have served as a toolkit to balance and stay attentive toward desirability, feasibility, and viability.(9) The attention towards this balance has been relevant as the implementation plan considers financial costs and seeks to prevent unnecessary investments for Meyers Canteen, while the design decision on leveraging existing technology has been made to accommodate feasibility.

7.2 The use of AI tools

Rendering with AI (Vizcom) has been useful in generating rough renders of artefacts early in the design process, based on sketches. This made it easier to compare and communicate concepts, without the need for details that an actual 3D model and render would take.

Generative AI (chatGPT) has been used to generate text material for app visualization used in testing and comparisons. Though the tool itself had little impact on the final results, it enabled a swift process when updating and changing designs and content of the app.

7.3 LCA and material choice

Despite conducting a thorough LCA of the reusable containers, the precision of the analysis can still be questioned. Particularly regarding the estimation of the number of reuses for the two proposed specifications of the take-away containers. These approximations were rough estimates, due to the lack of available literature on how much the wall thickness influences the number of reuses.

Furthermore, recycled PET plastic is the only plastic that is food grade certified (29). As PET did not meet all the requirements for the take-away container, using recycled plastic was not an option. This made it clear, that it was necessary to produce the container with the chosen virgin PP. However, should recycled PP one day become foodgrade certified, it would significantly decrease the Take-away container's overall climate change impact.

7.4 Reflection on the design process and the project management

It worked well for the team to apply the Double Diamond in combination with the N-model. The different levels of the N-model helped break down the different design phases making it easier to navigate the the high complexity of the project. The team worked well at applying different skills when needed, from rapid prototyping to hardcore desktop research.

Overall the agile management approach worked well for the team and helped fuel the project forward. However few things could still have been improved. Towards the end of the project the scrum plan was forgotten a few times leading the team to spend longer time aligning which created long discussions. The importance of structure when working in large teams became apparent.

7.5 Reflection on scalability

The current solution is tailored to Meyers Canteen in Nordhavn which has approximately 10 take-away servings a day. Other companies like Rambøll have around 100 take-away services a day. Therefore it is noted that if scaling the solution to other canteens, unforeseen challenges may arise.

8. Conclusion

This paper concludes the development and implementation plan for a sustainable take-away system in Meyers Canteen at KPMG Nordhavn. Guided by the Double Diamond, N-model and designed with a user-centric approach, the system is more sustainable than the existing solution while meeting regulatory requirements and user needs. Sustainability has remained a core focus from start to finish, ensuring that the solution contributes positively to environmental goals, fostered by legislation or not. By having designed a container suitable for reuse, material consumption is optimized, and the solution contributes to the SDG 12-responsible production and consumption (among other SDGs).

The solution displays the versatile nature of plastic, showcasing the fact that the use of it can coexist with a sustainable future. With consideration of scalability and through ongoing collaboration with users, the team believes the new system has the potential to be a sustainable take-away solution in various contexts with a need or wish to transition from single-use to reusable take-away packaging.

The project as well as the Manual for Meyers Canteen, demonstrates that it is possible to transition from a single-use take-away containers to reusable ones in response to new regulations on single-use plastics while minimizing disruption to operations and enhancing sustainability.

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8.1 Appendix

A.1 Fieldwork

A.1.1 The take-away containers in the Meyers KPMG kitchen

The take-away containers in the kitchen

The containers are stored in a storage room. The kitchen has to order 500 containers at a time which puts stress in the storage room

Sealing machine of the takeaway containers. Sealing machine requir es little maintenance.

The hallways inside the kitchen where sealing machine and poke containers are stored. Flexible room with rolling tray tabels

Containers for more "fancy" events, and when poke bowls are being served

DTU	Course: 41639 Holistic Design of Engineering System		Group: RTC
	Title: The take-away container in the kitchen		
	Category: Fieldwork	ID:	
Author: Sofie	Date:	Page no.: 1/1	

B.2 Desk research

B.2.1 Return stations from Genkrus and Tivoli

Genkrus

Tivoli

DTU	Course: 41639 Holistic Design of Engineering System		Group: RTC
	Title:		
	Category:	ID:	
Author:	Date:	Page no.:	

C.3 Interview

C.3.1 User interview, container and app prototyping

C.3.2 User interview, Patrick

The take away system

Generel:
Meyers canteens are required to have the take-away option from Meyers group.

To options when ordering:
- Meal of the day
- Frozen takewaya

10 take away portions a day of the "Meal of the day".
The take-away food is ordered and paid through Meyers app

Meal of the day:
The limit of mac 10 take-away portions a day is due to planning of what ingredients to buy and that Patrick doesn't want a take-away joing.

The food is taken from the buffet before it opens for the guests to make sure there is enough

The Meyers App and Screens
You can order until 10:00 am for the same day.
The app also offers other Meyer's products (eg. jam, flour, vinegar etc.).
The app is a great tool. Used a lot.

The canteen uses a screen to communicate (eg. Menu of the day, which works well.

Patrick 39 years old, Kicthen manager for Meyers Canteen (11 years) in KMPG (8 years)

Package process:
- 11:00 : orders are printed out and packed before the lunch buffet opens.
- The take-away is sealed in the sealing machine.
- They don't weigh the portions, it's on gefühl.
- The person doing the hot dich packs the hot. The person doing the saladbar packs the salads.
- They comminicate on how to pak it (big salat for 2 people, small for 1 person) to save packaging.
- The portions are packed in a bag with heating and instructions and placed in the fridge.

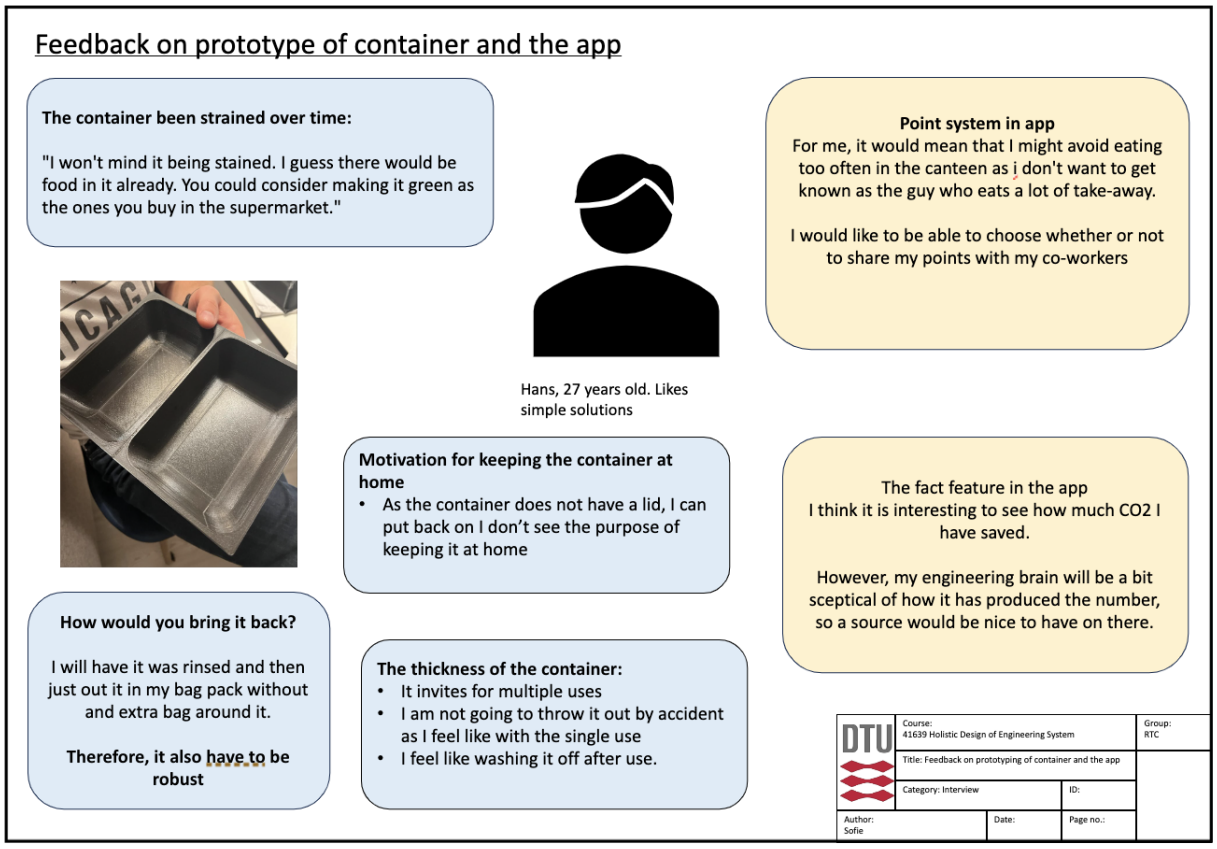
No recources availble to expand staff for take-away offer

The freeze food
Often made from left overs. Are a bit cheaper than the other takeaway option.

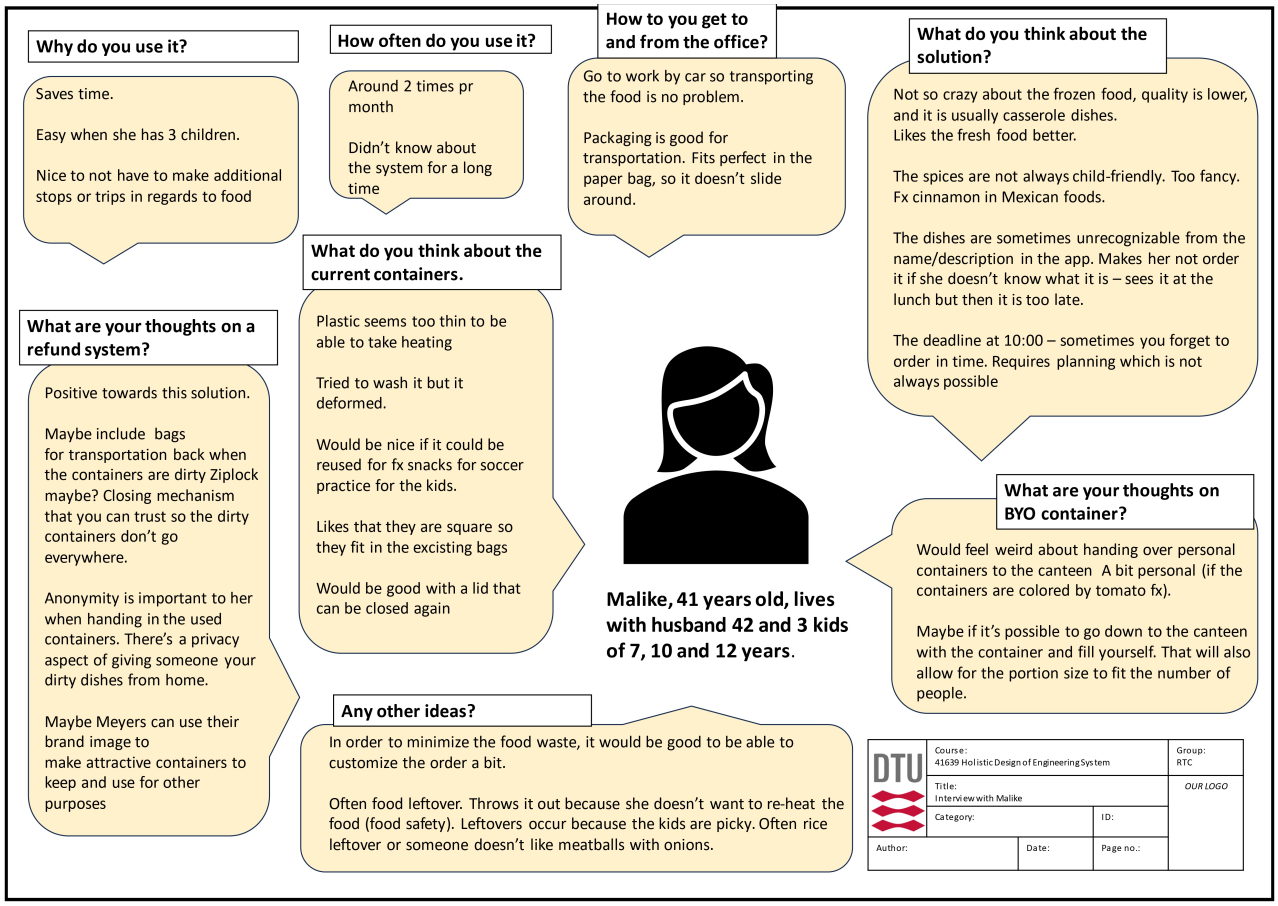
Good for students and people with kids.
It's also possible to take home left over buns from the Friday breakfast (buy 6 frozen)

DTU	Course: 41639 Holistic Design of Engineering System		Group: RTC
	Title: Interview with Yifan		*OUR LOGO*
	Category:	ID:	
Author: Sofie	Date:	Page no.: 2/3	

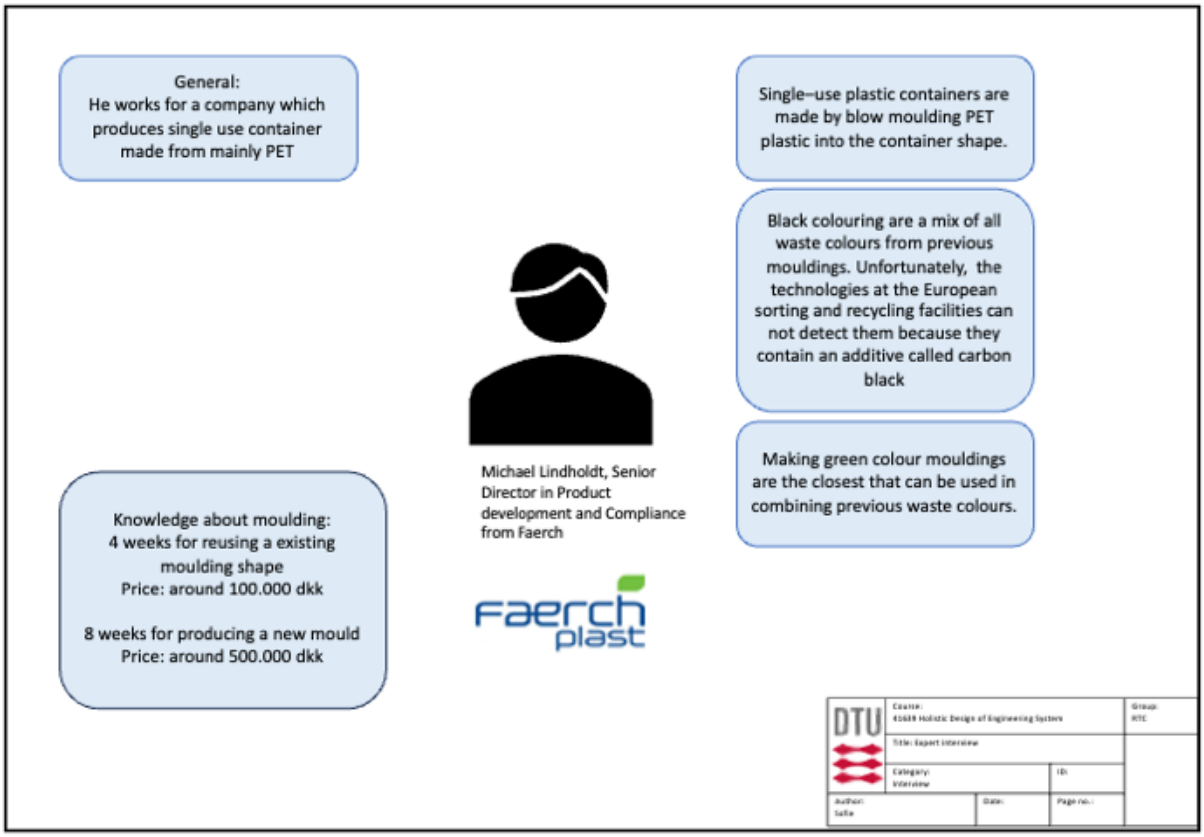
C.3.3 User interview, Hans



C.3.4 User interview, Malike



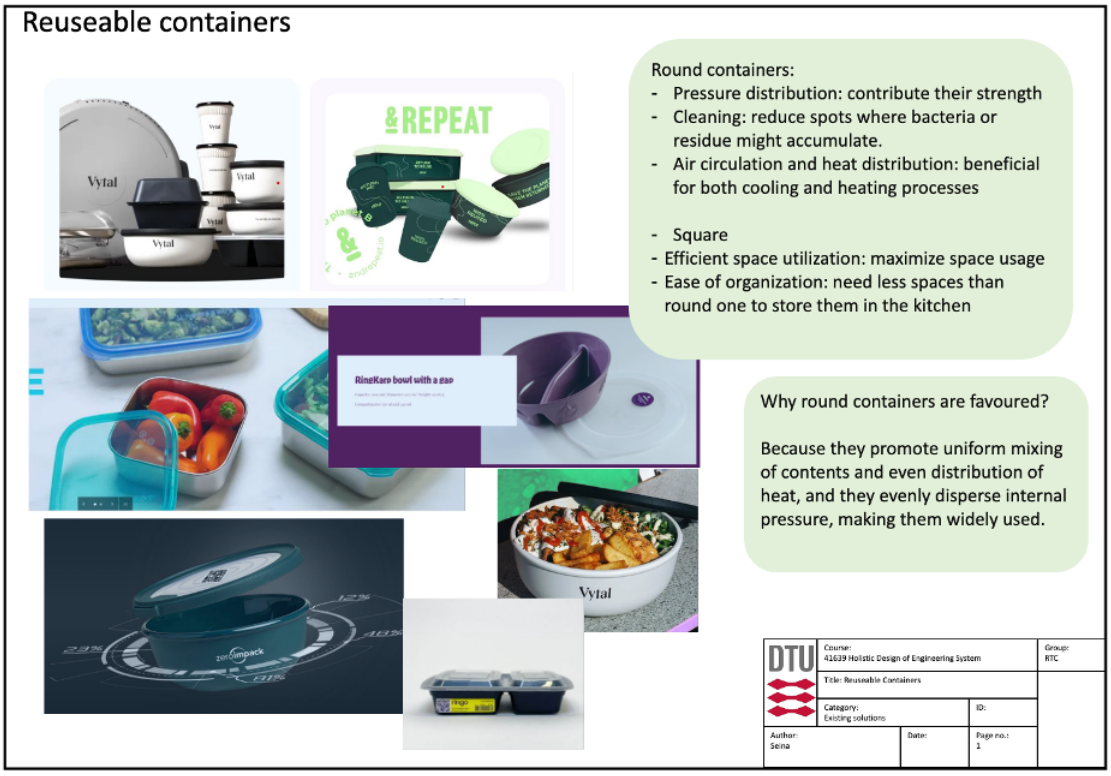
C.3.5 Expert interview, Michael



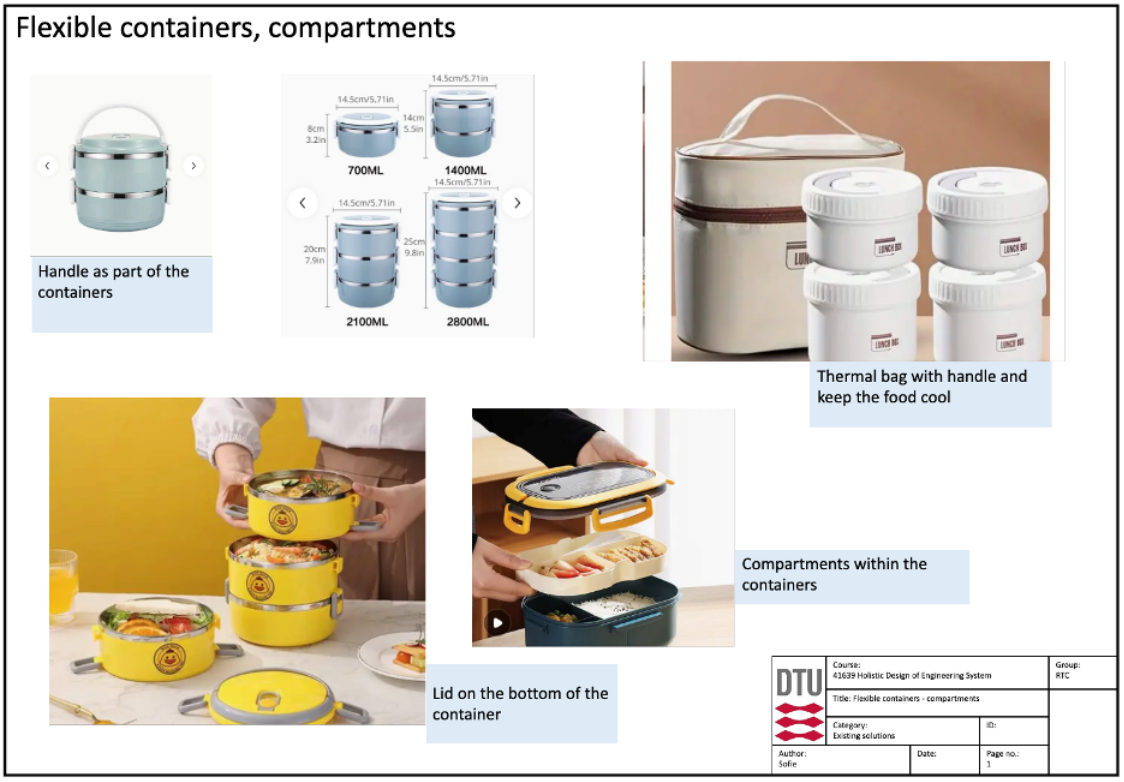
D.4 Existing solutions

D.4.1 Reusable containers 1

D.4.2 Reusable containers 2

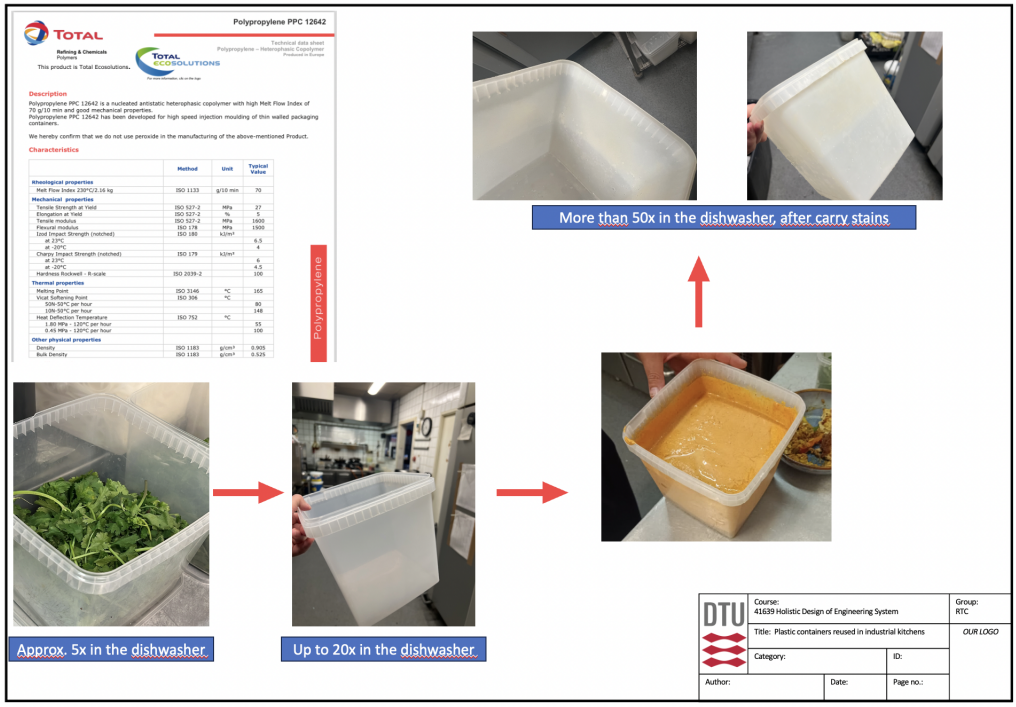


D.4.3 Reusable containers 3



D.4.4 Reusable containers 4

D.4.5 Reusable containers - real example



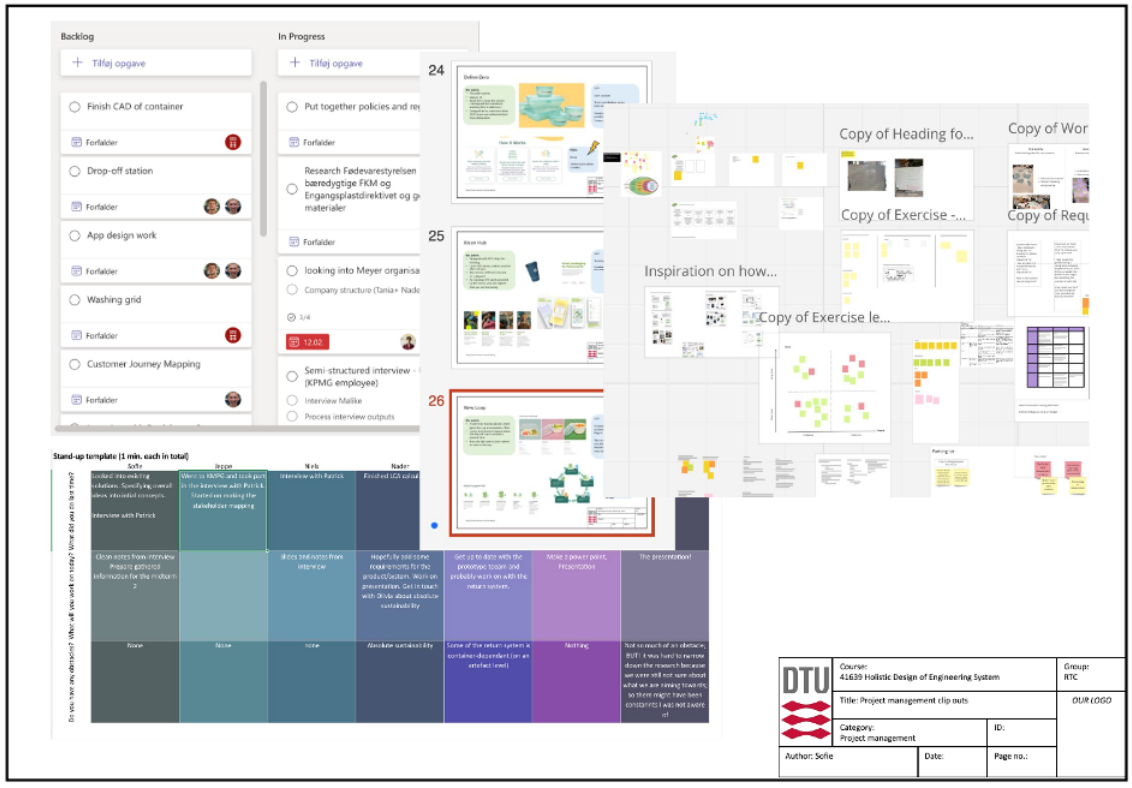
E.5 Discover

E.5.1 Workshop schedule

	Duration (5 min)	Activity	Purpose	Materials	Notes
Intro	5	30 sec/pers. Share how is your energy level - show the agenda	Just to get started and figure out if everyone is ready to begin		
	3	Present the problem (we settled on it the last time) and the possible requirements for the take-away containers			
	10	30 circles: - Take the Thirty Circles sheet and a pen. - Draw recognisable objects in as many circles as possible. That could be a pizza, clock, apple, etc. Set the timer for 3 minutes. - Once the time has ended, discuss the outcome with the participants (we broke them in pairs). -How many circles did you fill up? Are there any recognisable patterns or are any of the ideas related, fx. several planets or different sport balls. - Was the task challenging? Did you or someone "break the rules" by combining circles or using them in an unexpected way?	The goal is to push the limits of your creativity and fill up the sheet of 30 empty circles with as many recognisable objects as possible in the given time.	1 x A4 template with 30 empty circles	
Sketching	5	- "unveil" the crazy objects - take a quick turn around the table to talk about them; what is the most "out of the box" object; participants can then choose 1-3 objects; these will be inspiration for participants' sketches;	the objects are meant to further inspire the participants and challenge them to use less traditional shapes and think outside the box;	multiple unusual objects, not related to the topic of the workshop	Ask Sofie for corrections for the method here :D
	20	- Sketches for boxes: as many shapes as possible, at least 5 (each participant) - in pairs, discuss them and cluster them if applicable (based on similarity) - briefly share the clusters with everyone, and show / explain the designs; place the clusters on the white board/wall; the next groups share their ideas, if anything overlaps, add to the cluster, otherwise create a new group;		- ideally: the 2 sketching blocks would be done on colored paper to color code; - markers, pens, pencils; etc. - 2 colors of papers; 5 x A5/ per person; - tape for clustering; - Wall;	
	10	Break			
	20	- Sketches for lids: as many shapes as possible, at least 5 (each participant) - in pairs, discuss them and cluster them if applicable (based on similarity) - briefly share the clusters with everyone, and show / explain the designs; place the clusters on the white board/wall; the next groups share their ideas, if anything overlaps, add to the cluster, otherwise create a new group;			
	15	- in pairs create discuss and note down different possible connections that could work between lids and boxes; - share ideas with everyone and cluster again;		- pencils, - paper	
Selection process	5	Break / set up for next stage	create a matrix: lids x boxes; at each intersection mark the connection types possible;		
	25	- decide on 2 scales that will be used for further scoring; - each variation is asigned a code/color/number/IDK - in pairs, evaluate the different variations and place them on the scale matrix on the template provided		- Template with an empty scale matrix for each pair	
	15	pairs bring up their rankings/ discuss and a final score is noted on a big matrix		- Final scale matrix on the white board -White board markers	
	5	Closing: the outcome is the top 3 variations, based on the final rankings; - take a a few minutes to let the participants share their feelings and impressions related to the results of the session; - agree on the next steps;			

F.6 Project management

F.6.1 The teams project management



G.7 Requirements

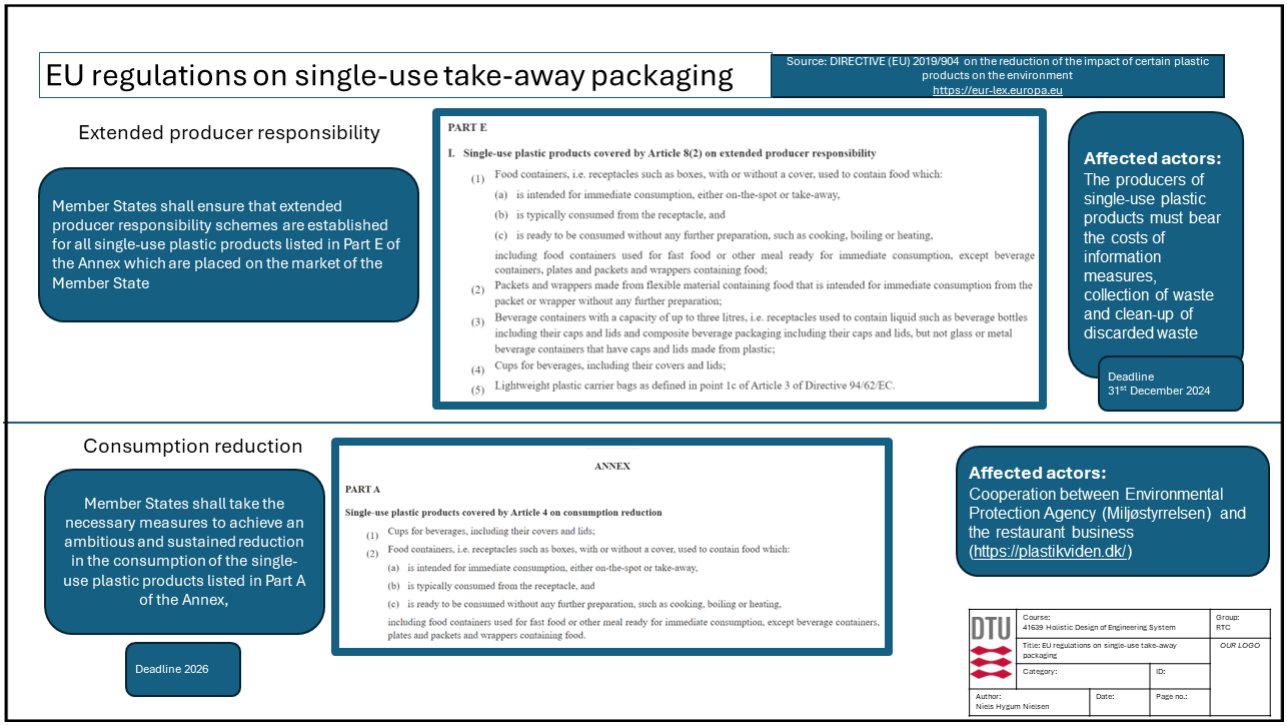
G.7.1 Requirements for container

Area/ Theme	Requirement	Criteria	Notes
Material properties	Withstand temperature up to 80 degrees Safe for food use	Should be withstand temperatures from -18°C (suitable for freezer storage) to 160°C (suitable for oven use). Should provide thermal insulation Longevity: must enable the container to be reused X amount of times (so that it is more sustainable than the current solution)	
Cleaning	Suitable for dishwasher	Nonstick surface	
Storage	Must stackable		An appropriate depth, stackable
Shape/design	Seal food so nothing is spilled The aesthetics should not comprise the function	Food is kept separate Can be closed and safely sealed contents Compact design, and lightweight Stackability No slim edges or crevices that could compromise the cleanliness	
Sustainbility	No black coloring No virgin materials No glue to attach the product together Utilize recyclable materials Not use materials mixed with different materials within a component (Makes it impossible to recycle) Materials that are steady enough to be reused	The brighter materials used the better The less use of different materials the better The higher the recyclability content the better Needs to be reused as many times as possible before leaving for the recycle-stream	

G.7.2 Requirements for system

Area/ Theme	Requirement	Criteria	Notes
Cleaning process	Has to be in-house cleaning Has to be cleaned to the same standard as today Stable inside the dishwasher (Temperatures, placement, doesn't go flying around, water pressure).	Minimum disruption to the current system Minimum effort in moving the dirty containers to the dishwasher	
Returning container	Possible without the involvement of kitchen staff Register the return of containers Incentive to return containers	Track the containers Keeping the users engaged in using the system	
Storage	No risk of contamination Stored according to legislation	Utilize current storage space Efficient storage system (The containers in themselves, and the containers as a whole)	
Legislation	Needs to fulfill current legislation on the area (Handling dirty dishes in the kitchen)		Danish Health Authority
Sustainbility	Should comply with Meyers goals Reduces transportation costs	Should not be less sustainable than the current system Should track impact (how many times containers are reused) The entire system must utilize less energy and CO2 footprint than the current one	Data could be used as incentive towards staying in the loop for the customer

H.8 EU regulations



I.9 Return rate

I.9.1 Calculations for the return rate

From the LCA calculation, it was seen that the container with specification proposal 2 was better than proposal 1 after 15 times of reuses.
If a container has a reuse time of 20 times before disposal, and one container is lost after every 16 reuses, we can calculate the loss rate as follows:

The total number of containers lost over all reuses:
- Since one container is lost after every 16 reuses, the total number of containers lost over 20 reuse cycles can be calculated by the following:

Total number of containers lost $evalf\left(\frac{20}{16}\right) = 1.250000000$

The loss rate can now be calculated:

$$\text{Loss rate} = \frac{1.25}{20} \cdot 100 = 6.250000000$$

So, the loss rate per container would be 6.25%. This means the return rate is 93.75.
It was decided to round the number up to 95 % to simplify the loss rate value.