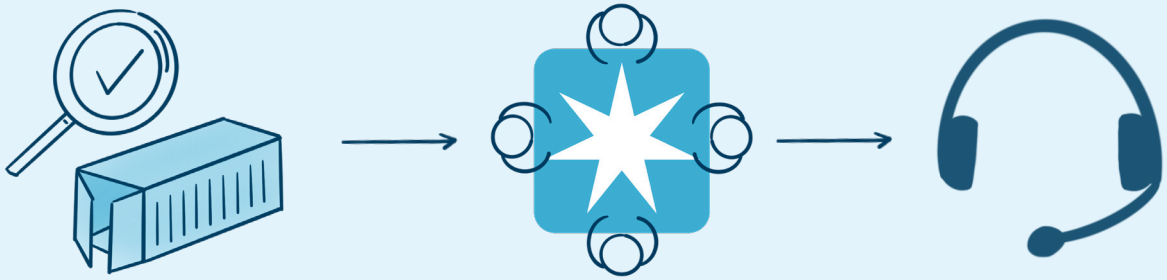
Enhancing the efficiency of the foodgrade container supply chain

Graduation report



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Preface

Dear reader,

During summer 2025, I started thinking about the graduation project I wanted to execute. The most important criterion for this project was that it should be at a large company with complex problems to learn how strategic design fits in these larger organisations. Maersk was the perfect fit for this, since it is a large company that is not that familiar with strategic design.

While I was studying in Finland for a semester, I prepared the project proposal and approached my coaches. I immediately felt enthusiastic about learning more about supply chains and designing for this topic, even with only online discussions. Supply chain design was something I did not learn much about during my studies, but I felt I could do this.

During my seven years of studying at TU Delft, I learned so much about designing, a bit about architecture, and mostly a lot about myself as a designer. The years of studying showed me that I enjoy complicated problems that ask for a holistic approach, because this pushes me to work harder. Besides, I enjoy combining strong analysis with design, which made SPD the perfect fit.

Luckily, this graduation project gave me the opportunity to work on a very complicated and extensive problem. Maersk's extensive supply chains kept surprising me during my thesis. When you think you know everything, there is always more. This created a fun and educational project. I am very proud of the result of overcoming all challenges, and of bringing it together in this report and the workshops design.

During the entire period, I received a lot of support from my coaches. First and foremost, I want to thank Joost van Wilsum, my supervisor at Maersk. Joost, thank you for your open approach and support throughout my entire thesis. I value your question, "How can I coach you?", at the start of the thesis, which created such an open atmosphere and immediately made me feel at ease. This gave the thesis a good start, and I felt your support throughout all twenty weeks of the thesis, which helped bring my thesis to an amazing result. And of course, thank you for the countless ping-pong games (still practicing), stairs after lunch, fun facts of the day and opening up an entire culinary world.

I also want to thank Shahrokh Nikou, my chair. Shahrokh, thank you for pushing me to dive deeper into the literature to ground my thesis even more. I enjoyed (and was sometimes frustrated by) your critical questions, which made me explore the supply chain and design even further. I could feel your joy in this project, which made me even more enthusiastic about the direction of process improvement as well.
Lastly, I want to thank Bart Bluemink, my supervisor. Bart, your joy for designing is contagious, which made me push myself to design even better. This also challenged me to discover different directions and put the project into a long-term perspective.
Shahrokh and Bart, I enjoyed all meetings we had, since they always brought new insights, even if we were just sparring. Of course, this all started with our shared Finland experiences. Thank you both for all the time and guidance during this thesis. I felt supported by both of you throughout all decisions, even when I was a bit doubtful.

This thesis is the final project at IDE, marking the end of my studies. For the past seven years, the TU Delft has been a place where many fun experiences, friendships, lessons arose. I will take this with me and cherish it, even now that my time in Delft has come to an end. I look forward to the time ahead and am curious about where the experiences of the past years and this thesis will bring me.

I hope you enjoy reading my thesis!

Tesse Wolthaus
Delft, May 2026

Executive summary

Problem
FrieslandCampina ships their infant formula milk in foodgrade containers of Maersk. The regulations for shipping this milk powder are very strict. Many containers prepared for FrieslandCampina are rejected before shipment because they do not meet the required standards. Maersk has to bear these costs and deal with decreased customer satisfaction. These two factors directly and negatively influence Maersk's operational efficiency, which should be addressed.

Approach
The approach for the research of the problem was two-sided: a literature review combined with a case study analysis of the foodgrade container supply chain for FrieslandCampina. The literature review provided insight into supply chain management and the approach of lean supply chain management. The case study analysis showed the different challenges, identified as waste, across the supply chain that lead to rejections, thus lowering operational efficiency. These insights are concluded in a framework.

To validate the framework, nine interviews were conducted. These gave insight into the five flows proposed in the framework: misaligned goals across the supply chain, health and safety standards, fragmented customer service, silos across the supply chain, and (volatile) empty flow.

Key findings
The key insight was that the FrieslandCampina experienced many frustrations because of Maersk's fragmented customer service and rejections. They placed themselves between the different departments to ensure all departments are notified when rejections occur. However, within Maersk, this made the customer service very reactive and misaligned. To create an integrated customer service, FrieslandCampina must be placed outside the organisation, and the internal departments have to be aligned.

Design
To create this alignment, the integrated customer service workshop guide has been designed. This workshop guide supports the Equipment Manager in hosting workshops independently. In the workshops, the involved departments work together on the deliverable of the workshops: a RACI-matrix that shows responsibilities, information exchanges, and customer contact points. Through this matrix, all internal departments become aligned, which enables integrated customer service.

Conclusion
To increase the operational efficiency of the foodgrade container supply chain, Maersk has to build on integrated customer service. This can be achieved through internal alignment. Through a series of workshops, internal departments jointly build on a shared agreement, creating internal alignment and external customer satisfaction.

Contribution
This thesis created a workshop guide for Maersk to enhance operational efficiency, and a complete RACI-matrix for the FrieslandCampina foodgrade container supply chain.

Glossary

List of abbreviations

CX	Customer experience/service
CY	Container yard
EMR	Equipment, maintenance, and repair
FMCG	Fast moving consumer goods
HACCP	Hazard analysis and critical control points
IFM	Infant formula milk
LSCM	Lean supply chain management
MCIC	Maersk Container Inspection Criteria
SCM	Supply chain management
SD	Store door

List of terms

20DRY	20ft intermodal shipping container. This container is mainly used for very heavy cargo.
40HC	40ft intermodal shipping container. This container is mainly used container for shipping cargo with high volumes.
Barge	A ship used for inland waterway transport of containers. It moves between the terminals and inland depots.
(Container) handling	All movements of the container at terminals or depots. These movements can be for loading or stacking.
Depot	A container storage location where empty containers are inspected, cleaned, repaired and prepared for usage.
Foodgrade	An intermodal shipping container specially prepared for food. This container meets hygiene requirements for this cargo.
Gemba	Japanese for 'the real location'. With gembas, one goes to the workplace to see what happens and what are challenges within the process
Reefer	40ft isolated intermodal shipping container with cooling system. This container is mainly used for cargo that must be cooled during the entire transport period.
Terminal	A logistic facility where containers can be moved from one transport mode to another. Often, these are located at the seaside.
Vessel	A ship for sea transport of containers. All movements of the container at terminals or depots. These movements can be for loading or stacking.

Table of contents

Preface 2

Executive summary 3

Glossary 4

Table of contents 5

1. Introduction 7
- 1.1 Problem defintion 8
- 1.2 Research question 8
- 1.3 Scope and delimitations 8
- 1.4 Research methodology 8
  - 1.4.1 Use of AI 9
- 1.5 Broader relevance 9
- 1.6 Expected results 9
- 1.7 Structure of thesis 10

2. Maersk and the shipping industry 11
- 2.1 Maersk's background 12
- 2.2 Maersk's way of working 12
  - 2.2.1 Core values 12
  - 2.2.2 Organisational structure 13
- 2.3 Container shipment 13
  - 2.3.1 Regulations for container shipment 13
  - 2.3.2 The container shipment supply chain 14
  - 2.3.3 STAR 15
  - 2.3.4 Container grades and foodgrade 15
  - 2.3.5 Container cleaning procedure 16
- 2.4 Competitive landscape 16
  - 2.4.1 The container shipping industry 17
  - 2.4.2 Competitive field 17

3. Case study analysis 19
- 3.1 The foodgrade case study 20
- 3.2 Efficiency at Maersk 20
- 3.3 Customers at Maersk 20
- 3.4 Understanding FrieslandCampina 22
- 3.5 Deep dive into the foodgrade supply chain 22
  - 3.5.1 Container forecast 24
  - 3.5.2 Checkpoints and measurements 24
  - 3.5.3 Collaboration across the supply chain 25
  - 3.5.4 Compliance to foodgrade specifications 25
- 3.6 Foodgrade container rejections 28
  - 36.1 Rejections by FrieslandCampina 29
- 3.7 Efficiency across the foodgrade container supply chain 30

4. Literature review 32
- 4.1 Supply chains 33
  - 4.1.1 Supply chains as service ecosystem 33
  - 4.1.2 Risks in supply chains 33
  - 4.1.3 Supply chain performance 34
- 4.2 Supply chain management 34
  - 4.2.1 Alignment across supply chains 35
  - 4.2.2 Supply chain relationships 35
  - 4.2.3 Service level agreement 37
  - 4.2.4 Collaboration through information 37
  - 4.2.5 Redesigning supply chains 38
- 4.3 Lean supply chain management 39
- 4.4 Conceptual framework development 40

5. Research methodology 43
- 5.1 Qualitative interviews 44
- 5.2 Pilot interview 44
- 5.3 Data collection 44
- 5.4 Data analysis 45
- 5.5 Validity and reliability 45

6. Framework validation 46
- 6.1 Thematic analysis 47
- 6.2 Framework flows validation 47
  - 6.2.1 Compliance with standards 48

6.2.2 Integrated customer service 49
6.2.3 Aligned supply chain standards 50
6.2.4 Cross-collaboration across supply chain 51
6.2.5 Predictable empty flow 52
6.2.6 Reducing costs 53
6.3 Flow order 53
6.4 Limitations 53
6.5 Conclusion 55

7. Design process 57
7.1 Desirability sprint 59
7.2 Feasibility sprint 60
7.3 Viability sprint 62

8. Final design 64
8.1 The workshop guide: Integrated Customer Service 65
8.2 The RACI-matrix for the FrieslandCampina supply chain 67

9. Conclusion 69
9.1 Main research question 70
9.2 Sub research questions 70
9.3 Contribution 71
9.4 Limitations 72
9.5 Recommendations 72

10. Personal reflection 73
10.1 Personal learning ambitions 74
10.2 Project results 74

References 75

Appendix 79
A. Project proposal 80
B. MCIC specifications 83
C. Rejection codes 84
D. Draft frameworks 85
E. Search terms literature review 87
F. Definitions supply chain management 88
G. Interview protocol 89
H. HREC application 91
I. Informed consent form 95
J. Interview results per stakeholder group 96
K. Interview codes 98
L. Brainstorming methods 99
M. First workshop design 101
N. Set-up workshop session 1 102
O. Designing Workshop 1 and 3 105
P. Set-up workshop session 2 107

Introduction

The global shipping industry forms the backbone of international trade, with over 80% of all goods transported by sea each year (United Nations Trade and Development (UNCTAD), 2025). In 2024 alone, approximately 12.7 billion tons of goods were shipped.

Maersk is one of the world's largest and leading shipping companies (AXS Marine, n.d.; Nikolakis, 2025). To maintain this position in the competitive maritime landscape, efficiency in cost, time, and logistics is crucial. Beyond logistics and storage, Maersk manages the transportation of a wide variety of products (Maersk, n.d.-d). This ranges from bulk goods to vulnerable goods, with Fast Moving Consumer Goods (FMCG) representing one of the largest segments, projected to grow by 5.4% by 2030 (Allied Market Research, n.d.; Maersk, n.d.-b).

Among others, FrieslandCampina is a major customer of Maersk. They ship infant formula milk (IFM), an extremely vulnerable good within FMCG. FrieslandCampina ships IFM worldwide, with China as a key market. This requires meeting strict safety and health standards which are set by FrieslandCampina and HACCP (Hazard Analysis and Critical Control Points) regulations set by the EU (European Parliament, 2004). The importance is emphasized when some babies in France got sick from drinking infected IFM (Le Monde, 2026; NOS Nieuws, 2026). IFM pollution can happen anywhere, including during shipment in containers. This makes FrieslandCampina even more cautious.

There are different container grades within Maersk, each dedicated to specific types of cargo (Maersk, 2021b). FrieslandCampina consistently requires the highest grade (S+) or foodgrade containers, which asks for a high level of container quality from Maersk. These foodgrade containers must meet more than twelve different requirements. For example: "Floor and interior panels shall be free from holes, burrs, splinters, stains and sharp edges" (A.P. Moller-Maersk, 2021, p. 2), which often asks for multiple repairs. Other requirements include, among others, that no added patches are allowed, painted surfaces must not have transferable rust stains, and the container must be odour-free.

1.1 Problem definition

With all specifications set by FrieslandCampina for containers, the process of container preparement takes a long time and many steps. Before IFM is shipped, the container must undergo extensive cleaning, repairs, and pass multiple checkpoints to ensure compliance with the required health standards of foodgrade. While the entire process is necessary, it results in reduced efficiency in time, cost and value across the supply chain. Due to its relevance to this process, FrieslandCampina will be used as a case study.

Several studies have proposed methods to optimise this process. Kokvin et al. (2013) and Mughal and Sziebig (2014) designed robots to clean containers autonomously. Furthermore, Kuo et al. (2025) developed a CAD-transformer capable of identifying defects to classify the container's grade. Despite these developments, such solutions have not resolved the lower efficiency level in the foodgrade container process. To address this gap, this thesis researches the current supply chain and assess waste across the empty container supply chain.

To enhance efficiency within the foodgrade container supply chain, this thesis aims to identify the most influential challenges of waste that reduce operational efficiency and gain understanding of Maersk's goals for the foodgrade container supply chain. To identify opportunities for enhancing efficiency within the supply chain, barriers can be identified to support the redesign of the foodgrade container supply chain.

1.2 Research question

From the problem definition, I can formulate the research question and the perceived outcome. The aim is to enhance the efficiency in the foodgrade container supply chain. To understand and achieve this goal, I formulated the following research question:

'How can Maersk enhance the operational efficiency of the foodgrade container supply chain?'

To gain a deeper understanding and explore the research question, I formulated the following sub-questions:

- What challenges in the foodgrade container supply chain lead to rejections?
- How can Maersk improve the value they deliver to FrieslandCampina?
- How can Maersk eliminate waste across the foodgrade container supply chain?

1.3 Scope and delimitations

To ensure clarity and focus for this thesis, the scope and delimitations for the research question and sub-questions are also stated. These are addressed in this section.

Foodgrade containers are mainly booked by customers shipping extremely vulnerable cargo. FrieslandCampina is one of these customers and used for this thesis as a case study. Their specifications are very strict, making this customer relevant to research.

Besides, FrieslandCampina almost exclusively uses foodgrade containers, which limits in this research to this container type. Within the category of foodgrade containers, FrieslandCampina primarily uses the size 40HC containers. The number of 20DRYs is too small to be significant. Therefore, this research focuses exclusively on 40HC foodgrade containers.

Since FrieslandCampina ships from the Netherlands to other parts of the world, the shipment procedure of shipping containers from the Netherlands is used. The main difference between the Netherlands and other countries is that the Netherlands use barges for inland transport, while most other countries use trains. This thesis will focus on the barge as inland transport method.

The standards for shipping foodgrade containers are based on the regulations of the Institute of International Container Lessors (IICL, 2025) and Maersk's internal standards, MCIC (Maersk, 2021a), which build upon the IICL standards. Therefore, both IICL regulations and Maersk's standards are used as the foundation for improving the foodgrade container supply chain. In addition, FrieslandCampina stated required specifications containers must meet. Therefore, FrieslandCampina's specifications are also used as a frame of reference for defining foodgrade container standards.

1.4 Research methodology

To answer the research question of this thesis, a complex system design approach will be applied. Within this approach, the double diamond

framework is used as a structuring framework to guide the research process, particularly in organising phases of exploration (divergent), and synthesis (convergent), rather than as a formal research methodology (Figure 1). However, I redefined the discover, define, develop and deliver phases to better fit a complex systems context, such as a supply chain.

The first phase focuses on system framing, followed by designing rules. In the second diamond, development and experimentation are the core activities, ending with implementation. Multiple research methods are applied during these phases in the double diamond. The following methods are used to answer the research question:

- Company analysis: This analysis aims to diverge by understanding Maersk's values, organisational structure and operations. It provides insights into the broader context of the foodgrade container supply chain and Maersk's underlying goals for improving it. Competitor analysis is used to gain deeper understanding in Maersk's competitive landscape. In addition, qualitative interviews are conducted to understand Maersk's operational network.

- Case study analysis: I conducted an analysis of the case study to fully understand the flow of foodgrade containers. For this analysis the research methods applied are value identification, supply chain mapping and gemba walks at depots, terminals and at FrieslandCampina's warehouse.

- Literature review: The review provides theoretical insight to supply chain management, risks for supply chains and lean supply chain management. I used insights gained from the literature and the case study analysis to conclude the first diamond in the converging phase by proposing a framework.

- Qualitative interviews: Semi-structured qualitative interviews were conducted to validate the developed framework and establish design requirements. All interviews were conducted with stakeholders in the foodgrade supply chain. After the interviews, results were analysed using thematic coding.

- Design sprints: To enable rapid iterations, the diverging development phase consists of three design sprints of approximately two weeks. These sprints focus on desirability, viability and feasibility. Brainstorming and experimentation methods are used to develop and test ideas during this phase. Among others, these methods are WWWWWH, how-to's, C-box and co-creation.

- Workshop booklet: A workshop handbook is developed to support the implementation of the design. In this phase, the design is fully developed to ensure its implementation and alignment with Maersk's long-term plans.

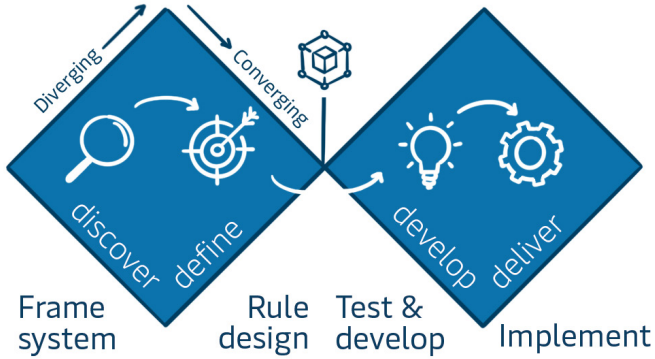


Figure 1: The double diamond framework

1.4.1 Use of AI

Besides all applied methods, I also used tools to support my design process. In this thesis, artificial intelligence (AI) is used as a supportive tool. The role of AI is primarily to act as a sparring partner during brainstorming and to assist in rewriting text into academic English. For this purpose, input is given by me and output is critically assessed. AI was not used to generate any data or drew any conclusions for this thesis. I, as the author, remain responsible for all outcomes.

1.5 Broader relevance

As stated in the problem definition and research question, this thesis aims to enhance efficiency in the foodgrade container supply chain. When the supply chain is effectively redesigned, the insights can also be applied to other container supply chains within Maersk and to other customers. This case is relevant for Maersk, because it can strengthen its position in the competitive landscape.

1.6 Expected results

Given the research question, I also formulated the design assignment for this thesis. This assignment ensures that design is used to answer the research question. The assignment is:

'Design an intervention to enhance the operational efficiency of Maersk's foodgrade container supply chain.'

At the end of this thesis, I expect to have a developed intervention, that enhances the efficiency across the supply chain, together with a tactical and strategic roadmap. The findings derived from the literature review and case study analysis provide the foundation for creating a framework and designing an efficient supply chain for foodgrade containers. Throughout the research, deeper understanding will contribute to the identification of the main waste sources within the supply chain.

Before developing the intervention, a framework will be built with the identified sources of waste. The supply chain framework will identify and structure the necessary interventions to improve the efficiency of food-grade containers. Based on this, a targeted intervention will be designed, proposing a specific approach to the redesign of the supply chain.

Due to the long existence of the supply chains, the supply chains are rigid. Therefore, tactical and strategic roadmaps will be developed to ensure implementation of the supply chain intervention.

1.7 Structure of thesis

This thesis begins with Chapter 2, which contains a company analysis, focusing on the core values, its way of working and container shipment operations. Chapter 3 presents the case study analysis of the foodgrade container supply chain. This is followed by a literature study focused on supply chains, supply chain management and lean supply chain management, in Chapter 4. This chapter ends with a proposed efficiency framework for the foodgrade container supply chain.

Chapter 5 discusses the research design for validating the framework. This is followed by the interview analysis and the proposal of a validated framework in Chapter 6. Chapter 7 covers the design process, followed by Chapter 8, which discusses the design validation. Chapter 9 presents the final design and Chapter 10 concludes the thesis by answering the research question and the subquestions.

2

Maersk and the shipping industry

This chapter provides an overview of Maersk and the bigger picture of the shipping industry. First, Maersk's background will be presented, followed by their core values. Next, Maersk's way of working will be explained. Then, the container shipment operations are covered, including an overview of Maersk's own depot, STAR. The chapter ends with describing the competitive landscape and trends in this field.

2.1 Maersk's background

Maersk was founded in 1904. It started as, and still is, a family business in Denmark. Over the last decade, the company has grown significantly from a traditional shipping line into a company that continues to expand its activities across global supply chains (Maersk, n.d.-f).

Maersk's slogan is "all the way" (Maersk, n.d.-f), which can be seen in different parts of the company. "All the way" primarily refers to the role Maersk plays within the supply chain (Maersk, n.d.-a). The company can handle the entire transport process, from the customer shipping the cargo to the final destination of the cargo. However, this is not the only interpretation of "all the way". Maersk also focuses on all the way to net-zero in its emissions, with 2030 as their net-zero target.

The slogan logically leads to Maersk's vision: "We believe in an integrated world. One planet. Connected all the way." (Maersk, n.d.-e). With this ambition, Maersk aims to become a global integrator, connecting sea and land through its supply chain. This strategic direction has shifted Maersk from a traditional shipping line into a company that plays a crucial role in global trade and maritime transport. To pursue this strategic direction, Maersk has created a way of working that strengthens their position in this global network.

2.2 Maersk's way of working

With Maersk existing for over 100 years, the company has had time to build their own way of working. These ingrained habits make Maersk the company it is today. This section explains Maersk's core values and organisational structure that influences their way of working.

2.2.1 Core values

Maersk has five core values, which all influence the way Maersk works (Maersk, n.d.-e). These core values are: constant care, humbleness, our employees, uprightness, and our name (Figure 2). All of the values are always present within the company, steering the way it handles worldwide logistics.

These five core values enable Maersk to focus on strong collaboration with partners and employees, striving to develop and maintain robust and reliable logistic supply chains. By being open-minded, continuously improving and acting transparently, the company protects and strengthens its brand excellence.

Thus, these core values create the culture and mindset of Maersk, shaping the way decisions are made. In addition, they define how the company and its employees behave. The core values also influence this thesis. In particular, humbleness shapes my design, because the analysis relies on employees sharing their problems and the design relies on the open-minded attitude of those affected by the final design.

Maersk's core values

Constant care	'Constant care' stands for taking care of today, while being prepared for tomorrow. This means always striving for innovation and improvement, for example through the development of new vessels aimed at net zero transport.
Humbleness	'Humbleness' encourages Maersk to listen, learn and share. Staying open-minded makes it possible to learn from their colleagues, customers and the evolving world.
Our employees	'Our employees' is fully focused on giving employees a safe working environment that enables growth and development. The workplace is diverse and global.
Uprightness	With "uprightness", Maersk aims to create strong connections with its customers and partners. The company seeks to earn their trust and ensure that they believe in Maersk's promises.
Our name	Maersk stands for excellence, which makes "our name" a core value. The Maersk name has a strong reputation, which must be maintained. All employees act in a way that preserves the integrity and upholds the company's promises.

Figure 2: Maersk's core values (Maersk, n.d.-e)

2.2.2 Company structure

Next to the culture within the company created by the core values, Maersk also has an organisational structure that defines how tasks and responsibilities are organised. With Maersk being a worldwide company, they must operate within a strong organisational structure. There are two organisational structures that are used within the company.

Primarily, Maersk has a strong matrix structure (Table 1). Each Maersk office has several departments, such as sales, customer experience (CX), equipment, and EMR (equipment, maintenance and repairs). The offices are located mainly close to ports. With every office having similar teams, these teams collaborate across offices. This enables both functional and office-based teams, making it possible to share and build expertise, thereby fostering innovation. However, the matrix structure can also create confusion for both employees and managers. This is caused by dual reporting lines, creating a complex organisational structure.

With the matrix structure, high innovation is expected. However, the bond between similar functional teams is currently stronger than the bond within offices. This leads to silos between teams within offices. To illustrate this: all equipment teams interact well across offices, but within the office, sales, customer service, and equipment do not interact that often. This almost creates a traditional functional structure. This lack of collaboration reduces Maersk's current ability to innovate.

Table 1: Matrix structure of Maersk

Offices	Rotterdam	Antwerp	Hamburg
Departments	Sales	Sales	Sales
	CX	CX	CX
	Equipment	Equipment	Equipment
	EMR	EMR	EMR

Secondarily, Maersk also has a network structure (Figure 3). Maersk collaborates with, and is dependent on many partners, such as truckers, terminals, depots, and inland depots. Each of them is needed to support the entire supply chain, making them part of the ecosystem (Section 4.1.1). Maersk informs all its partners when containers are booked. Through this network structure, Maersk can focus on its core tasks. This enables Maersk to focus on innovation. However, it is also a challenge to work with many partners. There can be misalignment in expectations and communication, leading to less efficient supply chains.

Looking at the matrix structure and the network structure, Maersk could be highly innovative. The silos created within the offices and the outsourcing pose some challenges, but there also is a clear opening to innovate. With the cross-collaboration across offices and across the supply chain, Maersk has quick reporting lines. This enables problem detection in the supply chain and makes it easier to address issues. Maersk especially needs this opening for innovation, since they have many extensive supply chains that must be monitored and managed. Most supply chains are standardised over time, but innovation is essential since the shipping industry is constantly evolving.

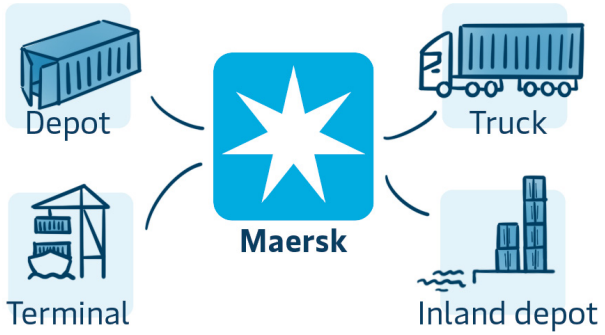


Figure 3: Network structure of Maersk

2.3 Container shipment

The shipping industry relies on extensive supply chains for containers. This section first gives an overview of the different regulations for container shipment. Subsequently, the standard container shipment supply chain is explained. This is followed by zooming in on a specific part of the shipping procedure, the depot, after which the cleaning and preparing processes at these depots are explained.

2.3.1 Regulations for container shipment

To ship cargo overseas on a vessel, cargo is packed in a container. Looking back, the first container standards were introduced in 1968 (Leivestad, 2022). ISO standard containers have been the industry standard since that point. These standards describe standardized container sizes. Since the introduction of ISO standards, 20ft and 40ft containers became standard industry sizes for containers. However, these are not the only standards that emerged.

ISO containers have to meet many specifications, which are set out by the Institute of International Container Lessors (IICL) and describe the specifications for containers and repairs (IICL, 2025). These regulations are industry-wide standards that are followed by all shipping lines. There are many pressing regulations that influence the IICL standards. These include international treaties, laws, and safety standards. Therefore, the IICL revises their standards yearly.

For shipping food in particular, there are many requirements that containers must meet to ensure safety. These requirements come on top of the IICL specifications. In 2004, the European Union adopted legislation stating that all containers used to ship food must comply with HACCP (hazard analysis and critical control points) regulations, focusing on hygiene (European Parliament, 2004). The HACCP regulations also oblige companies to maintain a traceable cleaning history for containers. This means that the cleaning history must be registered for each container separately. Furthermore, the European Union has laws to promote sustainability in the shipping industry. These regulations are established under the European Union Emissions Trading System (EU ETS) (European Parliament, 2024). These regulations were initiated because of the high emissions in the shipping industry (European Environment Agency (EEA), 2025). Through these regulations, shorter turnaround times are encouraged for fleet optimisation. This means that the cleaning process of containers must speed up to enable quicker container reuse.

All these regulations influence the way the shipping industry handles containers. The IICL and HACCP regulations are used daily at the depots and terminals. Each container must meet mandatory requirements and is fully integrated into the container supply chain.

2.3.2 The container shipment supply chain

The supply chain for containers in this thesis is based on cargo shipment from the Netherlands. Supply chains are standardised across all shipping lines (Port of Rotterdam, 2023). Details might differ, but the outline is similar for each company.

The standard container shipment process starts with an empty container, located at a depot or terminal (Figure 4). By barge (or by truck or rail; in the Netherlands, barge transport is common), the container is brought to an inland depot. From this inland depot, the empty container is transported to the customer by truck. At the customer's warehouse, the container is filled with their cargo. After filling, a truck transports the full container back to an inland depot. A barge then transports the container from the inland depot to a terminal. Once it arrives at the terminal, the container is loaded onto a vessel. The vessel transports the cargo overseas.

When the vessel arrives at the overseas location, the container undergoes the reverse process. It is transported from the terminal to a warehouse for unloading. After unloading, the empty container is transported back to a depot where it is cleaned for reuse by other customers.
As mentioned above, Figure 4 shows a general overview of the container shipment supply chain. However, there are more specific processes connected to this supply chain. These underlying processes take place at the depots to clean the container for the next customer.

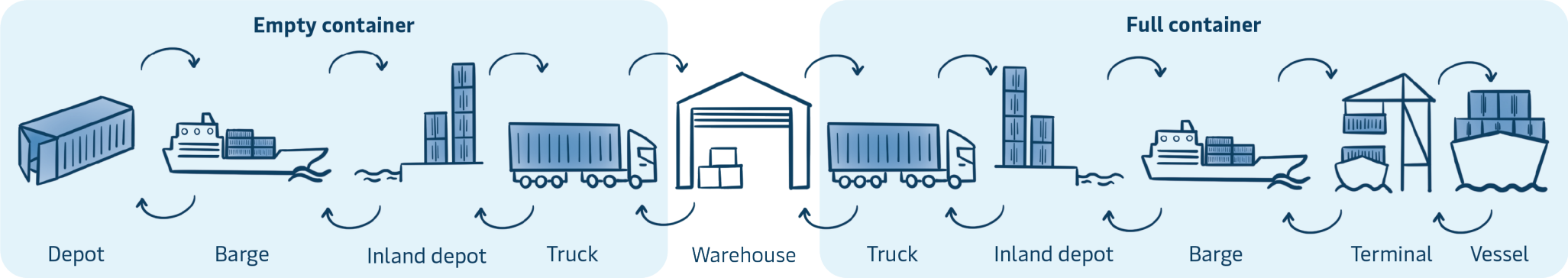


Figure 4: Standard cargo shipment procedure



Figure 5: Location of STAR at the Maasvlakte



Figure 6: Road accessibility STAR

2.3.3 STAR

To ship cargo, the depot where the empty containers are stored is crucial in the supply chain. As shown in Figure 4, this is where every booking begins. At these depots, empty containers are stored, repaired, and washed. After preparing the empties, the container can be transported to an inland depot. Maersk has its own container depot at the Maasvlakte in Rotterdam: STAR (Figure 5) (STAR Container Services, n.d.). STAR is located close to APM, Maersk's own terminal, and other terminals located at the Maasvlakte. As shown in Figure 6, STAR only has a road connection, which means that containers can only be moved to a terminal by truck. The empty containers are often brought to the APM terminal to be loaded onto a barge destined for an inland depot.

STAR handles only empty containers and prepares both dry and reefer containers for Maersk. Because it is Maersk's own depot, it is often the preferred depot for bookings, depending on stock levels and booking specifics. Maersk can also book empties at other depots, such as Kramer, when STAR cannot supply the required containers.

This thesis focuses on empties prepared at STAR, since it is often Maersk's preferred depot for bookings in the Netherlands. However, other depots have similar processes, making STAR a good example for this thesis.

2.3.4 Container grades and foodgrade

There are many regulations governing the shipment of cargo in containers. To establish common standards for shipping cargo, the IICL created industry-wide norms for the entire container sector (IICL, 2025). Based on this IICL baseline, Maersk developed its own additional standards: Maersk Container Inspection Criteria (MCIC) (Maersk, 2021a). The MCIC is Maersk's internal baseline for container quality. Each component's specifications are documented in these standards. To ensure that all standards are met, STAR uses the MCIC as a baseline for their cleaning procedures.

In the MCIC, Maersk states container grades to indicate the quality of containers. There are five different grades (S, M, K, E, and Q), all serving different cargo shipments. The letters are random and do not have a meaning.

After shipping cargo, every container is regraded, because damage might occur during shipment. Grading takes place at STAR upon arrival of the empty container. During grading, possible upgrades or necessary downgrades are also assessed. Like shown in Figure 7, not all upgrades are possible. Only smaller ones are permitted, as this reduces costs. The larger the upgrade, the higher the costs. To minimise expenses, Maersk only carries out smaller upgrades in the Netherlands, whereas bigger upgrades are executed in Asia. There, the costs are around one third of the costs in the Netherlands.

Since the beginning of 2025, Maersk has built 50,000 new 40HC containers. These containers enter the industry as grade S containers, which reduces the number of required container upgrades. With the new containers, the overall age of the fleet decreases. Older containers need more repairs, so the renewed fleet requires fewer repairs (Shah et al., 2024). Besides, due to the

unused quality of the new containers, Maersk aims to keep them within the grades S and M. Therefore, downgrades are prevented as much as possible.

Foodgrade containers
The five grades Maersk uses, cover most containers. However, the category of containers for FrieslandCampina is referred to as a different grade: foodgrade. These foodgrade containers are a part of grade S. As shown in Figure 7, the foodgrade containers can only be prepared from an S or M grade. When referring to foodgrade containers, they are often described as S+ grade or Campina grade. The '+' is added because the foodgrade containers have additional specifications.

In general, every container must be clean, dry, and odourless. However, for foodgrades this is insufficient. Foodgrade containers are mostly used for shipping food, which requires high standards because of food safety. Examples of additional requirements are that they must be fully rust-free and cannot have any repairs such as patches. Detailed specifications can be found in Appendix B.

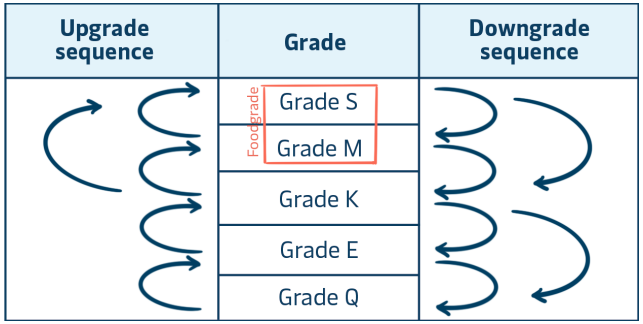


Figure 7: Upgrade and downgrade sequence (Maersk, 2021a)

Due to these rigid specifications, STAR only uses containers that are a maximum of five years old for foodgrade containers. However, other depots, such as Van Berkel, use different standards. There, a foodgrade container can be up to fourteen years old, which is a significant difference compared to STAR.

Thus, at STAR, all foodgrade containers can be at most five years old. This means that the container must have been manufactured in 2021 or later (for this thesis). Furthermore, foodgrade containers can only be prepared from an S or M graded container and must meet additional requirements.

2.3.5 Container cleaning procedure

To clean containers at depots, three procedures are possible (Table 2). The condition of the container determines which procedure is required: brooming, high-pressure water cleaning and steaming (Maersk, n.d.-c).
If a container is only lightly contaminated, meaning no transferable stains but only loose dirt, brooming is sufficient. This method is often included in standard handling of depots and is therefore the most cost-effective option. However, when stains are present, a high-pressure water hose is required. After this method is applied, the container must dry completely, as containers cannot be used when they are wet.

Table 2: Cleaning procedures at depots

	Brooming	Water hose	Steam
When	Light contamination	Stains	Persistant stains
Airblow to dry inside	×	✓	✓
Foodgrade suitable	✓	×	×

Lastly, containers can be cleaned using steam with hot water. This method is only applied when stains are persistent. It is the most expensive cleaning method and is therefore only used when the other methods are insufficient.

For foodgrade containers, only dry cleaning, brooming, is allowed. When the container is cleaned with water, moisture can get into the floorboards. This can cause mould to grow when IFM is shipped and remains at sea for more than three months. During this period, there is sufficient water, nutrients and oxygen, which creates the perfect environment for mould growth.

2.4 Competitive landscape

Besides designing, managing and monitoring entire supply chains, Maersk also has to monitor trends and developments in the field to keep up with its competitors and stay relevant in the shipping industry. This chapter examines the competitive field of the shipping industry and how this has evolved over the last few years. Subsequently, the chapter discusses trends and developments in the shipping industry.

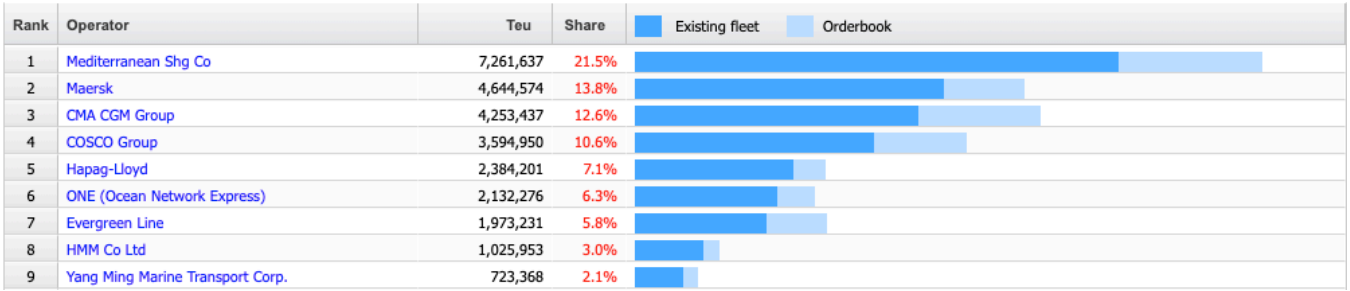
2.4.1 The container shipping industry

The shipping industry is perceived as a very large industry. However, there are only a few companies that dominate the market. In 2015 there were still seventeen large shipping companies, in 2026 there are only nine: MSC, Maersk, CMA CGM, COSCO, Hapag-Lloyd, ONE, Evergreen, HMM, and Yang Ming (Vermeulen & Goslinga, 2022). These nine shipping companies account for 82.8% of the market share (Figure 8), making the field a good example of an oligopoly (AXS Marine, 2026). An oligopoly market is a market where there are only a small number of suppliers, but many consumers. These suppliers are often interdependent, since they all hold large market shares. With these large market shares, there are high barriers to entry for new firms. This competitive field is not only based on price, but also on factors as reliability and quality. For Maersk this means that they have to compete with the other major shipping lines not only on price, but also on container quality and shipping-time reliability.

The industry of today is largely shaped by innovations introduced in 2013 (Vermeulen & Goslinga, 2022). In 2013, Maersk built the first triple-E ship, a vessel which could carry over 18.000 containers, which means 2500 extra containers. This significantly changed the container industry, as these larger vessels carry far more containers, increasing the margins per container. These margins increased the profit of shipping lines.

For Maersk it initially appeared that this innovation would allow the company to dominate the market, because other shipping lines could not bear the costs of building these large vessels. However, it prompted other shipping companies to form alliances and also invest in building these triple-E ships, initiating a container race. As Maersk forecasted, individual shipping companies could not bear the costs of building sufficient vessels independently. Nevertheless, ships were built and shared across shipping lines to compete with Maersk.

With the introduction of larger vessels, ports and terminals also had to adapt (Vermeulen & Goslinga, 2022). Triple-E ships could not dock at all terminals, because of the enormous sizes of the vessels. This means that terminals capable of docking these ships experienced significant business growth. Consequently, other terminals also had to upgrade to capture a share of the expanding container market.



Rank	Operator	Teu	Share
1	Mediterranean Shg Co	7,261,637	21.5%
2	Maersk	4,644,574	13.8%
3	CMA CGM Group	4,253,437	12.6%
4	COSCO Group	3,594,950	10.6%
5	Hapag-Lloyd	2,384,201	7.1%
6	ONE (Ocean Network Express)	2,132,276	6.3%
7	Evergreen Line	1,973,231	5.8%
8	HMM Co Ltd	1,025,953	3.0%
9	Yang Ming Marine Transport Corp.	723,368	2.1%

Figure 8: Market share of each shipping line (AXS Marine, 2026).

With the triple-E ships entering the shipping industry, the market has changed significantly. More containers could be carried each time a vessel departed. This led to expansion of terminals and reshaped the industry permanently by forcing the shipping lines to form alliances and share vessels.

2.4.2 Competitive field

Until now, shipping companies still operate within alliances. These alliances have agreements in place to share their vessels for container shipment. When establishing such agreements, companies determine the percentage of containers on vessels allocated to each partner. Through these alliances, shipping companies can maximise vessel utilisation and the transport of loaded containers, while minimising empty container movement (Mangan & Lalwani, 2016; Vermeulen & Goslinga, 2022).

There are three major alliances, involving eight of the nine major shipping companies (Figure 9) (Deiss, 2025; Evofenedex, 2024). After a ten-year alliance with MSC, Maersk formed a new alliance with Hapag-Lloyd: Gemini (Maersk, n.d.-g). MSC decided to operate independently and is therefore not included in any alliance. Furthermore, there is the Ocean Alliance, consisting of CMA CGM, Cosco, and Evergreen. Lastly, there is the Premier Alliance, including ONE, HMM, and Yang Ming.

The alliances have different goals to distinguish themselves. However, all alliances and MSC mention reliability as a core value. This is an important characteristic, because customers

rely on the shipping lines. Therefore, reliability is essential to serve customers and can strengthen a company's market position.

Gemini has the strongest focus on reliability of all alliances, claiming that they have reached a 91.2% reliability (Hapag-Lloyd, n.d.; Maersk, n.d.-g). This alliance has achieved this by their hub-and-spoke network, which has a reduced number of ports where vessels stop. At these hubs, cargo is transferred onto a feeder for shorter shuttle services. For example, if a vessel from Asia arrives in Rotterdam, containers are transferred on feeders to be transported to Gotenburg.

The Ocean Alliance also focuses on reliability, followed by efficiency. They have the biggest market share with 29.1% and a large network of ports (AXS Marine, 2026). On the Asia-Europe route they have 162 ports, making their network extensive compared to Gemini who only uses 53 ports (CMA CGM, 2019; COSCO Shipping lines, 2022; Evergreen Marine Corp., 2024; Evofenedex, 2024).

The Premier Alliance focuses on reliable and flexible services (HMM, 2024; Ocean Network Express, 2026; Yang Ming, n.d.). By sharing their vessels, they achieve higher flexibility, because these companies are the smaller ones of the industry. The alliance accounts for 11.3% of the market (AXS Marine, 2026). However, although all alliances have this benefit of flexibility, it remains unclear how the Premier alliance achieves this extra flexibility.

While all alliances focus on reliability by joint forces of the shipping lines, MSC focusses on reliability by being independent (MSC, n.d.). They have a broad network of ports and many vessels, which makes it possible to work independently. They also promote flexibility that comes with being independent.

Looking at all shipping lines, it is difficult to find information about most alliances on their websites. Maersk and Hapag-Lloyd are the most outspoken shipping lines regarding their alliance, but the Ocean and Premier Alliances are less open. This might also come from the fact that the shipping lines do not have a choice to form an alliance. They must keep up with the competitive field, making it essential to ally. At the same time, MSC promotes the benefits of working independently, but not all shipping lines can afford this, since this requires huge investments. In the shipping industry, the focus lies mostly on reliability within both companies and alliances.



Figure 9: Alliances between shipping companies and MSC working independently

3

Case study analysis

This chapter explains the case study that is used to redesign a more efficient supply chain for foodgrade containers. This chapter explains the perspectives of Maersk and the customer in this case study, FrieslandCampina. Subsequently, I analyse the entire supply chain of foodgrade containers, the information flow and causes of the rejections of these containers. The chapter concludes by identifying the main factors that influence the overall operational efficiency in the foodgrade container supply chain.

3.1 The foodgrade case study

To gain a good insight into the foodgrade container process, I used a case study. In this thesis, the foodgrade containers that FrieslandCampina orders and uses are analysed to answer the research question stated in Section 1.2. This case study is applicable to the efficiency of the research question, because FrieslandCampina orders a high number of foodgrade containers per year combined with a relatively high rejection rate compared to other customers. These rejections lead to customer dissatisfaction and increasing costs for Maersk, resulting in a weaker relationship between Maersk and FrieslandCampina.

Within this specific case, FrieslandCampina orders foodgrade containers (bi)weekly from Maersk. These containers are prepared at STAR and then shunted to APM terminals. There, the containers are transported to an inland depot by barge[1]. At the inland depot, a truck driver picks up the container and transports it to FrieslandCampina's warehouse. There, the IFM is loaded into the container. The supply chain of the foodgrade containers, from empty until overseas transport, is analysed for this thesis (Figure 5).

[1] *Specific location of inland depot cannot be given due to business confidentiality*

3.2 Efficiency at Maersk

To analyse the case study, the efficiency of the supply chain is evaluated. This is done to answer the research question, which focuses on how the efficiency in the foodgrade container supply chain can be enhanced. However, efficiency is a broad concept. Therefore, one definition must be clearly established to align the research results and the proposed design to enhance efficiency.

At Maersk, efficiency can be defined in terms of cost, time, and value. All activities must deliver as much value as possible to customers at the lowest cost within the shortest possible time. However, time is the least pressing factor among these three factors. Therefore, the focus of the case study analysis is on cost and value streams within the supply chain of foodgrade containers. This definition of efficiency will be applied throughout this report.

3.3 Customers at Maersk

To start with the analysis, the value that Maersk brings to customers is analysed. Maersk's way of working is extensively discussed in Chapter 2. However, the perspective of the customer is also essential. The customer experience can add or diminish value for customers, making this process essential for an efficient foodgrade container supply chain.

Maersk works together with many customers. Some customers make spot bookings, but in this case study, yearly contracts are used. These contracts are drawn up during an annual tender process. Most large companies use these tenders to distribute the share of cargo among different shipping lines and settle fixed prices. Each year, the percentages are redistributed among the competitors, which makes the tender process important for Maersk's profit.

During this tender process, the sales department of Maersk responds to the open tender of a customer. Sales proposes a contract for the upcoming year, including specifications regarding cost, responsibilities, and procedures when a 'black swan' event, like the closing of the Street of Hormuz (Poort, 2026), occurs.

In addition to the contractual specifications, requirements regarding container quality are also included in the contract. Sales adjusts the specifications to the level requested by the customer. However, Maersk's own container grade specifications (Section 2.3.4) are rarely used during the drafting phase. Sales primarily advocates for the customer, however also EMR is consulted to provide input on the specifications. As a result, there may be a difference between Maersk's internal grades and the grades agreed upon with customers. This particularly happens because sales does not always fully use the internally used grades. In this case, sales commits Maersk to meeting customer requirements that cannot be met from an operational perspective.

According to sales, signing the contract establishes mutual trust between Maersk and FrieslandCampina by formalising agreements. The contract is not used as a control mechanism in the event of disruptions, but it serves to alignment expectations between both parties. After signing the contract, the sales department becomes minimally involved in the customer relationship. Sales transfers responsibility to CX and operational departments, which are expected to execute in accordance with the contract. CX handles the bookings of the customer, but is also the first point of contact when disruptions or complaints occur.

Equipment ensures that the containers for the bookings are prepared, but is not directly in contact with the customer. When disruptions occur, such as rejections or operational issues, customers can contact CX. If required, CX escalates the issue to EMR (and equipment) for further investigation.

These fragmented responsibilities result in customers interacting with multiple departments within the company. This may lead to inconsistent information and complicates points of contact for customers (Figure 10). Simultaneously, the fragmentation of responsibilities across departments creates a lack of ownership within Maersk. As several departments are responsible for specific parts of the booking process and customer contact, it is unclear who holds final responsibility. For customers, this results in delayed and inconsistent responses from Maersk. Altogether, these factors lead to lower customer satisfaction.

To assess efficiency in the customer journey, different influences are listed in Table 3. All steps in the customer journey also have either a positive or negative influence on the efficiency within Maersk. In particular, the fragmented customer service has a negative influence on efficiency, since misalignment arises between different departments.

In conclusion, the fragmented customer service leads to a reduced level of added value for the customer. The fragmented responsibilities make it hard for customers to understand the points of contact, while Maersk shares inconsistent information. Thus, this fragmentation lowers the operational efficiency of the supply chain.

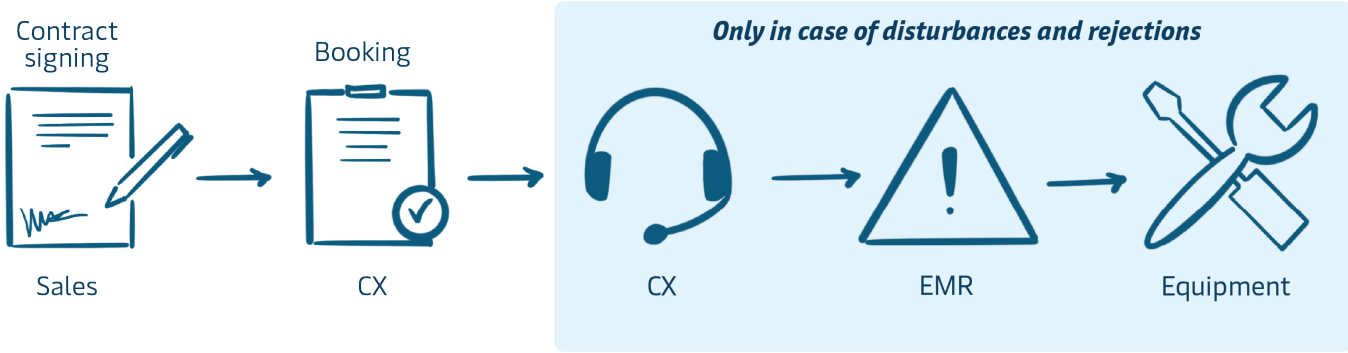


Figure 10: Points of contact for customer

Table 3: Influences of the customer journey on efficiency

Customer journey	Positive influences on efficiency	Negative influences on efficiency
1. Customer shares tender with their needed specification	• Standard specifications since 2013	• The customer asks for personalisation • The customer wants everything as cheap as possible
2. Contract for 1 year will be proposed by the sales department of Maersk (EMR gives input)	• Contact between sales and operations	• Maersk cannot deliver the personalisation • Misalignment between operations and sales creates fragmented customer service
3. Sales and customer sign contract	• Signing the contract creates mutual trust and alignment • A year of profit is ensured by the customer	• Misalignment of values of Maersk and customer • Contract not used as control mechanism
4. Customer books container with Maersk	• Maersk earns money with bookings	• More pressing specifications by customers
5. Booking goes to CX	• Seperated responsibilities within Maersk	• Another different stakeholder in the customer journey, which creates confusion for customer
6. Equipment checks stock at depot		• Takes time to ask for stock through email
7. Booking goes to STAR	• Confirmation of booking makes money	• Too little stock leads to decreased customer satisfaction • Too little stock leads to less booking confirmations • Seperate booking confirmation depot and customer

3.4 Understanding FrieslandCampina

By understanding the customer's perspective, possible misalignment in expectations or goals can be assessed, which also influences operational efficiency. In this case study, FrieslandCampina is the customer that books the containers. FrieslandCampina is considered highly demanding, as they reject many containers from Maersk and have strict requirements that the containers must meet. However, these rejections have a history. FrieslandCampina is one of the few companies that can still ship diary products to China, which is a major market for the company. To operate in China, the company requires a license to operate. This strict operating field emerged in the period from 2008 to 2011 (NOS, 2015). During this time, the Chinese IFM was polluted with melamine, leading to nine deaths and over 300.000 ill people. This made the Chinese IFM market collapse, leading to FrieslandCampina responding to the demand for non-Chinese diary products and IFM shipped to China.

Besides, FrieslandCampina responding to the demand, China also set stricter regulations to check these imported dairy products. When the dairy products arrive in China, the Chinese authorities encourage terminal employees to identify as many defects as possible. If defects are found, the sending company, FrieslandCampina in this case, must return the cargo at their own costs, as it no longer complies with Chinese regulations. If too many incidents occur, dairy companies risk losing their license to operate, which pushes these companies to be extremely cautious.

These regulatory pressures in China have made FrieslandCampina increasingly strict towards containers in the Netherlands. Although the Chinese regulations are outside FrieslandCampina's circle of influence, the company must ensure that their cargo meets the required standards in order to maintain their license.. Therefore, each container is thoroughly inspected before cargo loading and rejected if it does not comply with their specifications.

FrieslandCampina works with their specifications, which they also communicate to Maersk and the inland depot. They expect Maersk to also work with these specifications, but Maersk works with their MCIC standards. FrieslandCampina's specifications have not changed since 2013 (FrieslandCampina, 2013). However, within Maersk, employees have noticed an increase in strictness. Maersk's employees report that FrieslandCampina rejects more containers, often without valid reason, according to MCIC, and raises more complaints. This development makes it more challenging for Maersk to maintain high customer satisfaction.

Thus, with FrieslandCampina's stricter regulations, it is harder for Maersk to deliver containers that meet their requirements. Besides, both parties working with different standards, also makes it difficult to agree on suitable containers. This affects both the value and costs, making operational efficiency lower.

3.5 Deep dive into the foodgrade supply chain

After analysing the way of working within Maersk and FrieslandCampina, I analysed the entire foodgrade container supply chain and its efficiency. The supply chain that is used in this thesis is based on containers shipped from the Netherlands. Foodgrade containers go through an extensive process when they are ordered by customers. The entire supply chain is shown in Figure 11. The supply chain already starts when the empty container arrives at STAR. There, the container undergoes an external scan. At this checkpoint, the age of the container is assessed, which serves as the first quality control point.

When the container is built in 2021 or later, it is brought to a designated area for grades S and M within STAR. There, an inspection is carried out. This check verifies whether the container is indeed suitable for an S or M grade and what actions have to be taken to obtain the suitable grade. If the container does not need any repairs, the container only requires the cleaning procedure. However, if needed, the container undergoes either a downgrade (S to M, or M to K) or an upgrade (M to S), which increases processing costs and time.

Once the container is clean and has the correct grade, it is placed in a temporary stack until transport is arranged. A truck transports the container from STAR to the APM terminal, this is referred to as a shunt. At the terminal, the container is loaded onto a barge and transported to an inland depot.
At the inland depot, an inspector checks again whether the container meets the foodgrade specifications. This forms another quality check in the supply chain. However, the inland depot does not use MCIC like STAR. They use FrieslandCampina's specifications instead, which they received from FrieslandCampina.

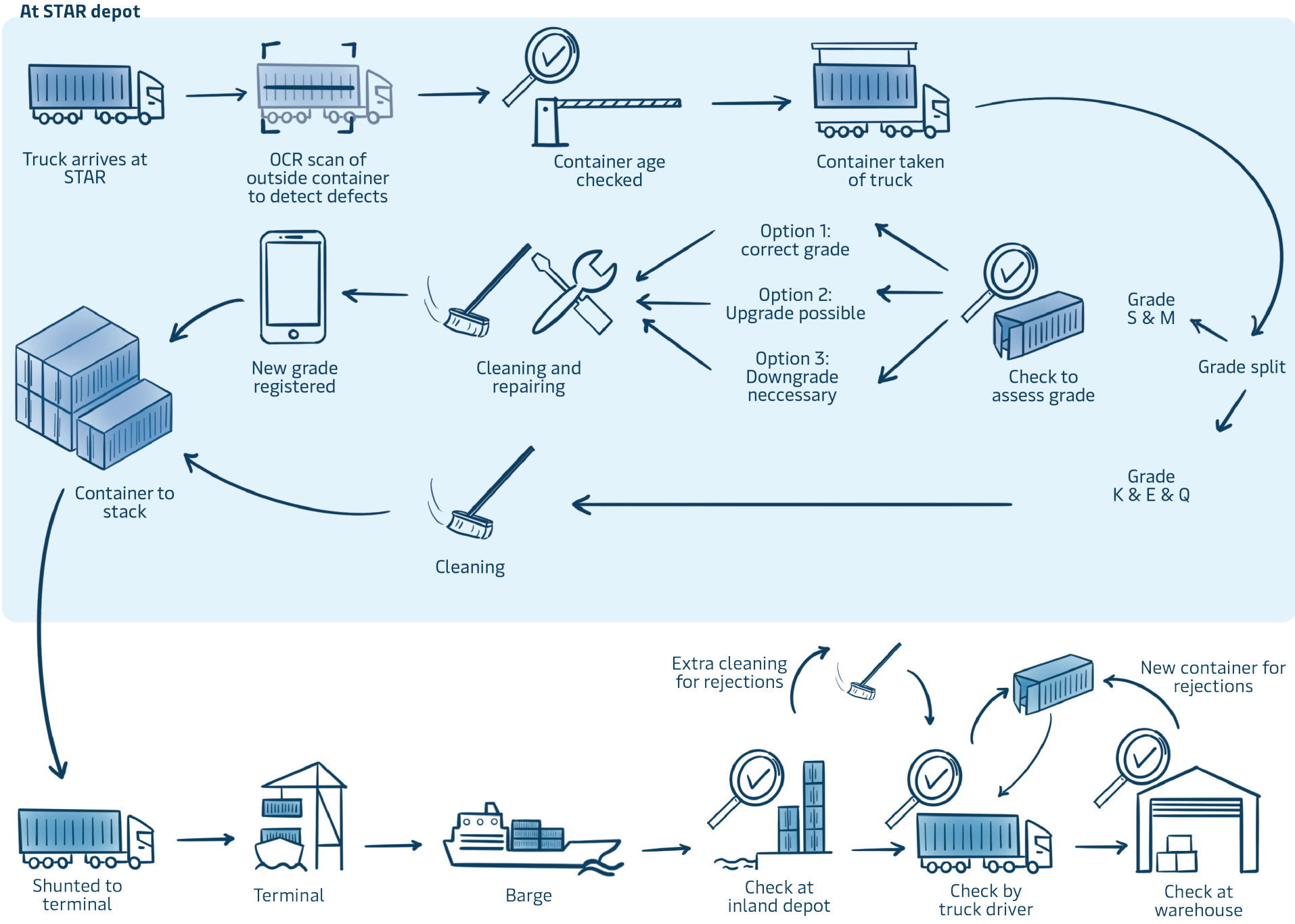


Figure 11: The foodgrade container supply chain

If the requirements are met, the container is transported to the customer, after being inspected by the truck driver. This additional check is added to ensure its quality, as the container undergoes a final check to see whether it meets the specific customer demands.
Once the container arrives at the customer's warehouse, it is inspected again by the customer's employees. If accepted, the container is loaded with cargo. If rejected, the truck must return to the depot to switch containers, creating delays, and additional costs.

3.5.1 Container forecast

To ensure good quality foodgrade containers, STAR always has to have enough young containers. Normally, STAR is a dry surplus location, meaning they have more containers arriving than leaving. This means that STAR generally has enough containers that can be used as foodgrade containers.

However, if STAR does not have enough of these younger containers, STAR has to prepare foodgrade containers from older containers. These upgrades are possible, but not desirable since this entails higher costs. Younger containers need less repairs to meet foodgrade standards, making older containers automatically more expensive to prepare for the foodgrade specifications (Shah et al., 2024).

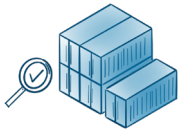
To ensure efficiency in preparing foodgrade containers, Maersk has to forecast the incoming containers well. Even with a dry surplus location in Rotterdam, the incoming containers have to be monitored to reduce repair costs, enhancing efficiency from the cost perspective.

3.5.2 Checkpoints and measurements

With the high requirements of FrieslandCampina, containers get rejected, even with enough available young containers. Across the supply chain, there are five different moments where the container can get rejected as shown in Figure 11 with a loop pictogram. The checkpoints have different functions, locations or use different standards. The differences between the checkpoints can be found in Table 4.
What is interesting about these checkpoints, is that there is overlap between the checkpoints. Looking at Table 4, check 3, 4, and 5 all assess the same: whether the upgrade after check 2 has been carried out correctly. Previously, check 2 also verified whether check 1 was executed correctly, but STAR adjusted this to make the process more efficient. Now, check 1 is only based on the container age, making the first check objective rather than subjective.

Another interesting aspect is that the different checkpoints have different standards to evaluate the specifications of the container. STAR uses Maersk's MCIC, but at the other checkpoints FrieslandCampina's specifications are used. The different use of standards between locations makes it hard to comply with the specifications.

Table 4: Checkpoints in the foodgrade container supply chain

					
Where is the check	STAR Gate	STAR S & M checkpoint	Inland depot	Truck loading inland depot	Customer warehouse
What is checked	What is the container's age?	What is the container grade?	Is the container foodgrade level?	Is the container foodgrade level?	Is the container foodgrade level?
Used measurement specifications	Year built	Maersk MCIC	FrieslandCampina	FrieslandCampina	FrieslandCampina
Who executes check	Gate keeper	Boxmechanic	Depot inspector	Truck driver	Customer warehouse

Currently, the efficiency of the foodgrade container supply chain is reduced by the misalignment of standards between different parties. With different standards, it is difficult for all stakeholders to accept the same container. This has a negative influence on the value Maersk brings for customers, since the containers do not always meet their standards.

3.5.3 Collaboration across the supply chain

The container passes different locations to move from checkpoint to checkpoint. All checkpoints are always passed by a foodgrade container for FrieslandCampina, it is not possible to skip a checkpoint. Since these checkpoints are at different depots, it is reasonable to expect collaboration between these parties. However, between the different locations in the supply chain, there is only limited information sharing. The different parties collaborate when necessary, but can mostly work independently. This can cause silos in the supply chain.

With these silos, it is harder to quickly detect problems. This slows the supply chain down and decreases the value for the customer. In this case, this means it is difficult to quickly detect rejected containers, leading to decreased customer satisfaction. Furthermore, silos also increase the costs, since miscommunications might lead to mistakes that could have been prevented. Thus, these silos lower the overall efficiency by decreasing the value for the customer and increasing costs for Maersk.

3.5.4 Compliance with foodgrade specifications

To evaluate the efficiency within the supply chain, each activity in the supply chain was examined for positive and negative influences on efficiency. Table 5 shows these positive and negative influences.

It is interesting that besides the forecast, misalignment of the specifications and silos across the supply chain, it also becomes clear that it is hard to comply with the standards. This is mainly caused by the subjective interpretations and unclear specifications. As FrieslandCampina becomes stricter, it is harder to follow their specifications for the different stakeholders across the supply chain, since not all specifications are always documented and communicated to Maersk.

Compliance with standards is essential to provide foodgrade containers with the correct specifications to the customer. If this compliance is not met, the value that Maersk brings to the customer decreases. This leads to an overall decreased operational efficiency.

Table 5: Influences of supply chain on efficiency (part 1)

Supply chain	Positive influences on efficiency	Negative influences on efficiency
1. Container arrives at STAR	• Own depot enables flexibility	
2. OCR scan of outside of container to check and detect defects	• Photos make sure that container states can easily be found in the system • Automised, so less man hours	• Machine can miss defects • Some defects cannot be assessed automatically
3. Built year of container is assessed	• Quick and objective check	
4. Container taken off the truck	• Quick handling	
5. Grade S & M	• New container fleet has better container states	
6. Grade K & E & Q		• Old containers are hard to repair
7. Second check: is the given grade correct?	• Extra check ensures containers get the correct grade	• Many checks for foodgrade containers • Unclear specifications of foodgrade containers
8. Possible outcomes check Option 1: correct grade Option 2: upgrade possible Option 3: downgrade necessary	• Re-evaluating whether the correct upgrade is prescribed to save money • Seperate location to speed up the process	• Winter season makes preparing foodgrade containers harder • Reparations cost money • Hard to determine when an upgrade is needed (unclear specifications)
9. Container goes to cleaning area	• Little empty handling • Different methods (air blow, high-pressure water hose and steam)	• Employee's decision which method is required, making it subjective
10. Mechanic registers new grade in app	• Digital registration to meet HACCP and EU ETS regulations	• Many different platforms
11. Container goes to stack	• Empty container that is ready to use enables new bookings	
12. Container shunted to APM by truck		• Only possible to move containers by truck to terminal for barge
13. Barge towards inland depot	• Repositioning the container closer to the customer to reduce truck costs	
14. Acceptance container at inland depot	• Costs of container transport by truck are lower by repositioning	

Table 5: Influences of supply chain on efficiency (part 2)

Supply chain	Positive influences on efficiency	Negative influences on efficiency
15. Rejection container at inland depot	• The depot often has a back-up to replace the container quickly for the customer	• Additional cleaning costs time and money • Extra checks takes time • Unclear specifications lead to depot creating their own checklist • Last minute, the container can still be rejected
16. Acceptance container by truck driver	• Container is transported to the custumer	
17. Rejection container by truck driver		• Extra check takes time • Unclear specifications of foodgrade containers • Last minute, the container can still be rejected
18. Acceptance container at customer's warehouse	• Acceptance makes money	
19. Rejection container at customer's warehouse		• Extra checks take time • Unclear specifications of foodgrade containers • Last minute, the container can still be rejected • Rejection costs Maersk money for extra handling and transportantion costs

3.6 Foodgrade container rejections

When the checks within the foodgrade supply chain are negative, the container gets rejected. However, when the container is rejected, it follows a different procedure than the supply chain that is described in the previous section. When a container is accepted by the customer, it is loaded with cargo and transported to the terminal to prepare it for overseas shipment. In this case, Maersk is not notified, as the process continues as planned.

However, when a container is rejected, the situation changes. Maersk is notified of each rejection, usually by the inland depot. However, when rejections occur frequently, FrieslandCampina also directly contacts Maersk. In such cases, FrieslandCampina escalates the issue to ensure that the problem is addressed. They contact all employees whose email addresses they have.

Within Maersk's departments, there is overlap in certain tasks and communication links with customers, which sometimes makes responsibilities unclear (Section 3.3). As a result, responses from Maersk are often delayed, since it is not always clear who should take ownership. This creates frustration for the customer and decreases trust in Maersk. As mentioned earlier, this fragmentation of responsibilities leads to decreased efficiency since the customer satisfaction decreases.

After Maersk is notified about the rejection, several actions take place simultaneously (Figure 12). The rejected container must be transported back to Rotterdam, while a replacement container is sent from the depot to the customer's warehouse. Maersk bears the costs of returning the rejected container and delivering a new one. In total, this costs over €500 per rejection[1]. Since nobody wants to bear these costs, other stakeholders check Maersk's container thoroughly. If an inland depot accepts the container, but the customer rejects it, the inland depot bears the costs for the truck drive. This makes all stakeholders critical on the containers during a check.

In addition to the container movements, EMR is notified of the rejection and starts an investigation into the cause of the rejection. This investigation is conducted to identify the source of the rejection. When the source is identified, it is used as a learning opportunity.

All influences of the rejection procedure on operational efficiency are summarised in Table 6. This table shows that rejections have a significant influence on the operational efficiency of Maersk. With every rejection, Maersk has to pay for transporting the container back to Rotterdam and transporting a new container to the customer. Furthermore, the customer satisfaction decreases since Maersk has a slow response time on rejections. Thus, rejections place pressure on both costs and value, decreasing the overall efficiency.

[1] *Specific amount cannot be given due to business confidentiality*

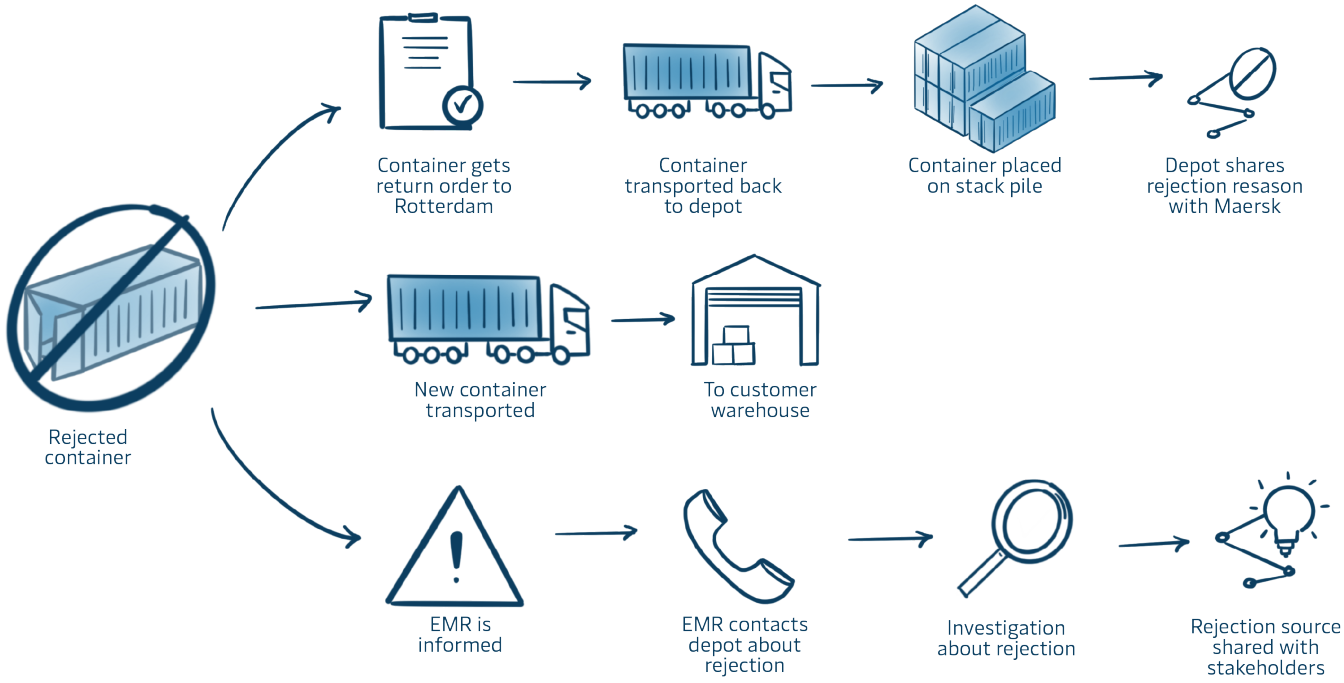


Figure 12: Flow of rejected container

Table 6: Influences of container rejection on efficiency

Rejection chain	Positive influences on efficiency	Negative influences on efficiency
1. Acceptance of container at customer warehouse	• Acceptance makes money • No positive feedback loop saves time	
2. Maersk receives rejection		• Many costs and man hours • General state of containers is bad/dirty/ rusty
3. Rejected container gets order for transportation back to Rotterdam	• Quick handling enables more usable containers	• Takes time to order
4. EMR is informed about rejection	• Slow reaction of Maersk on rejections	
5. Customer gets new container from depot	• Quick solving of disruption	• Lower trust in Maersk from customer • Maersk has to bear the costs
6. Container is brought back to depot		• Old containers are hard to repair • Handling costs Maersk time
7. Rejection reason is shared with Maersk by the depot		• Rejection reasons are communicated way after rejection
8. EMR does investigation to find the root problem of rejection	• Learning outcomes from insights investigation	• Takes up time to prepare and conduct the research

3.6.1 Rejections by FrieslandCampina

With an understanding of the rejection procedure, I started analysing the causes of the rejections by FrieslandCampina. This analysis also highlights the urgency of the problem. For this purpose, all rejections at the inland depot and customer's warehouse in 2025 have been analysed. In total, there were over 150 rejections for FrieslandCampina, representing 2% of all containers ordered by them. Although this may not seem extreme, it has a structural impact on the supply chain. Rejections interrupt the planned flow, require additional movements and lead to decreased customer satisfaction. Furthermore, Maersk has to bear the costs of all rejection handling, roughly estimated at €85.000 for 2025 alone.

Furthermore, the figures for 2025 are not fully representative, due to Maersk's new container fleet entering the industry. This currently reduces the number of rejections, but the problem is likely to reoccur in a few years. By that time, the new container fleet will likely have lost part of its quality due to the intensive usage of the containers.
Looking at the numbers for 2025, most rejections occurred during the winter months (Figure 13). Cold weather makes upgrading more difficult, as upgrading takes place outdoors. Activities such as paint drying take longer and moisture can develop more easily, leading to higher likelihood of rejection. The reasons for rejection are all related to the interior of the container. Through coding, the rejections were categorised by rejection reason (Appendix C). Figure 14 shows the distribution of rejection causes in 2025. The most common reason is the general state of the container, followed by dirt and rust. The cumulative pareto line shows that these three reasons account for 50% of all rejection reasons. After this quick acceleration, the line flattens. These findings show that there are no specific issues in the cleaning procedure, but the general flow does not work well. The general state, dirt, and rust are a basic rejection reasons that are easy to interpret subjectively.

From the analysis of rejections by FrieslandCampina in 2025, it is difficult to identify a single root cause. However, the number of rejections must be reduced, since this costs Maersk around €85.000 per year. The rejections are caused by deficiencies in the foodgrade container supply chain, making it essential to redesign this.

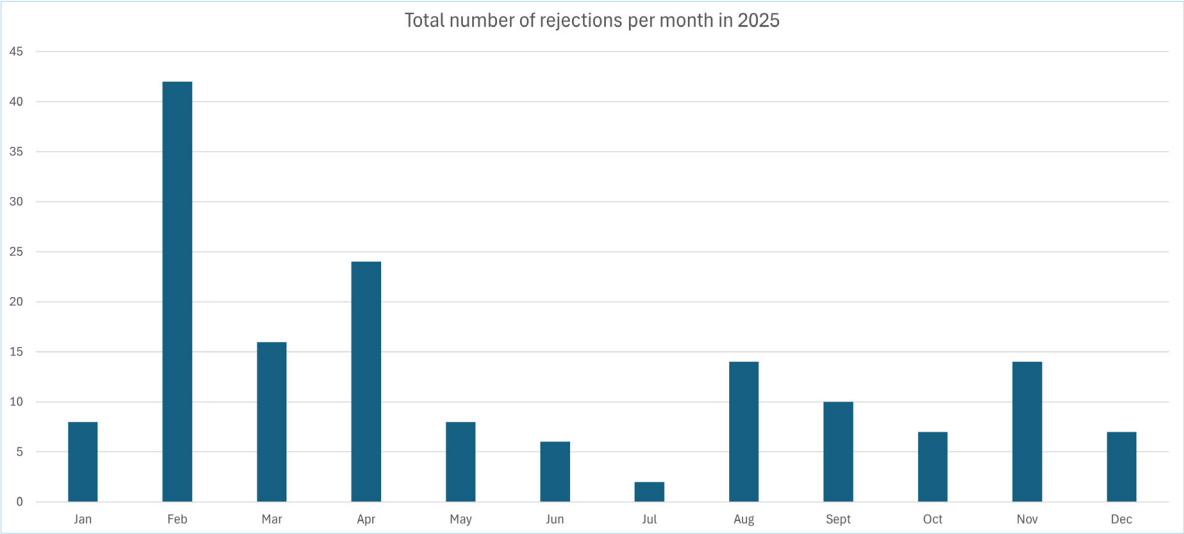


Figure 13: Rejections by FrieslandCampina per month in 2025

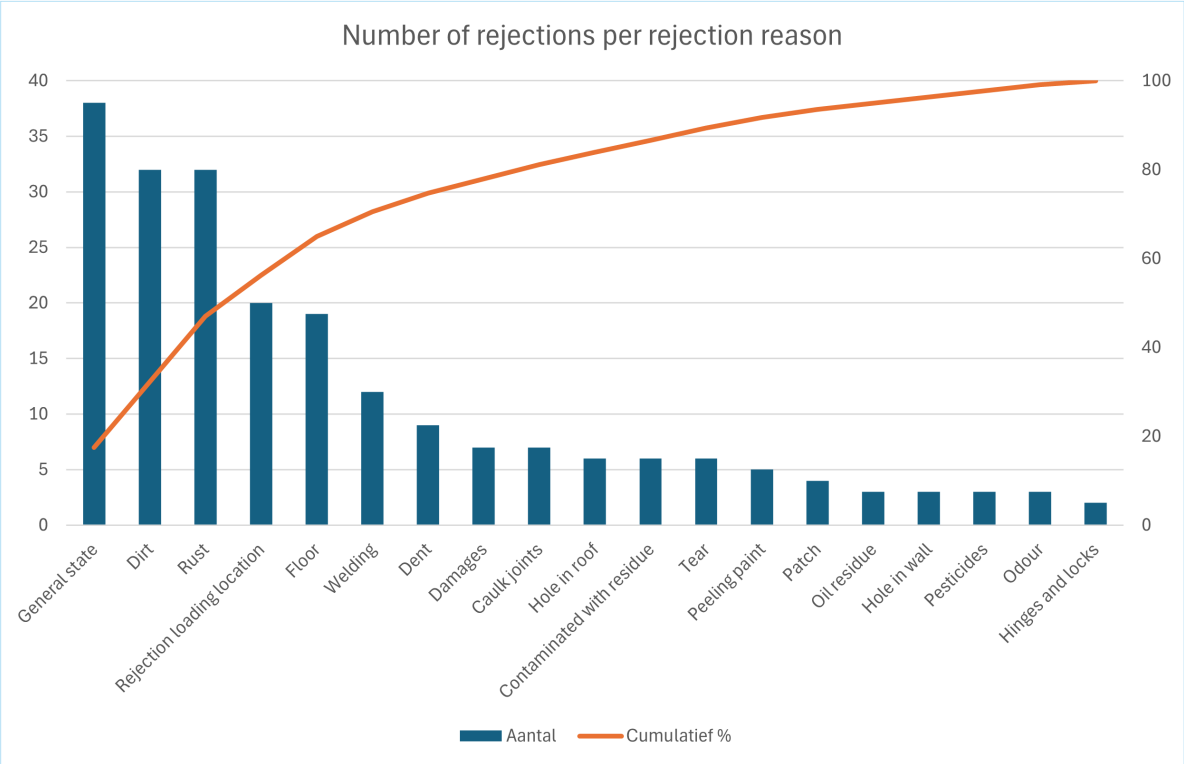


Figure 14: Rejections by FrieslandCampina per rejection reason

3.7 Efficiency across the foodgrade container supply chain

In this chapter, I analysed the case study of FrieslandCampina ordering foodgrade containers at Maersk. The supply chain until overseas transport is mapped, focusing on the first part of this supply chain where the container is transported to the customer warehouse to load with cargo. However, this flow does not always work efficiently, which leads to rejections. The rejection handling and the underlying source of rejections by FrieslandCampina were also analysed.

During the analysis, I observed that rejections lead to high costs for Maersk and lower customer satisfaction. Together, these factors reduce operational efficiency. Therefore, the rejections must be prevented to enhance the operational efficiency. Currently, multiple checkpoints are in place to prevent these rejections. However, these do not function optimally, as different checkpoints apply different specifications to measure the quality of the container.

Before the container gets rejected, there are many factors that influence the efficiency across the supply chain of foodgrade containers. All these factors were captured in Table 3, 5, and 6. To create a broader picture of the overall efficiency, the factors were clustered (Figure 15). In total, eight different clusters were identified, all of which were interrelated.

As mentioned earlier, this case study analysis is focused on operational efficiency, which consists of value for the customer and costs for Maersk.

Therefore, it is logical that the factors in figure 19 formed clusters with these themes. Value took the form of 'ensuring container quality', since most value for the customer is added by containers with the correct quality. Costs, on the other hand, formed a 'reducing costs' cluster, since Maersk focuses on lowering costs to enhance their operational efficiency.

These clusters were the starting point of the overall conclusion of the case study analysis; several iterations built on this later in the thesis. Eventually the most important five clusters became: health & safety standards, fragmented customer service, misaligned goals across supply chain, silos across supply chain, and (volatile) empty flow. These clusters represent the main challenges in the foodgrade container supply chain, all emerging from the case study analysis in this chapter. The challenges became a starting point for the framework presented in Section 4.4. The clusters are interrelated, which is investigated in the different sketches for frameworks (Appendix D). Furthermore, the cluster relationships are also further researched with the literature review in Chapter 4. Here, I also elaborate on the challenges and how these are related to the operational efficiency.

Thus, the efficiency in the foodgrade container supply chain is influenced by the five main challenges, because these challenges influence the efficiency in cost and value.



Figure 15: Clustered positive and negative factors of efficiency in the foodgrade container supply chain

4

Literature review

This chapter elaborates on the literature review conducted for this thesis. The review primarily focuses on supply chain management and, more specifically, lean supply chain management as an approach within this field. These subjects are highly important for this thesis, as they provide deeper insight into supply chains and contribute to achieving higher operational efficiency. Therefore, this review provides input for designing a foodgrade container supply chain with enhanced efficiency.

The search for relevant articles was conducted using Google Scholar and Scopus. Keywords were used and combined to optimise the search results. Appendix E shows all keywords used to conduct this literature review. The main keywords included supply chain management, supply chain efficiency, lean management, business relationship management, and service level agreements. These keywords were derived from the research question stated in Section 1.2.

This literature review first explains the fundamentals of supply chains, followed by an explanation of supply chain management. These sections are then followed by a section on a specific approach to supply chain management, lean supply chain management. At the end of the review, I propose a framework based on the literature review and the previously conducted case study analysis. This framework is used to redesign the foodgrade container supply chain to enhance operational efficiency.

4.1 Supply chains

A supply chain can be defined as the network of organisations and activities involved in the entire process of creating value in the form of a product or service, including upstream and downstream processes (Ballou, 2007; Cooper et al., 1997; Lambert & Cooper, 2000; Mangan & Lalwani, 2016; Mentzer et al., 2001). In these supply chains, there are flows of products and information from a source to a customer (Mentzer et al., 2001).

4.1.1 Supply chains as service ecosystems

In the 1960s and 1970s, there was research that investigated the characteristics of logistics and supply chains and how they operate, stating that supply chains aim to create value through delivering a product or service (Ballou, 2007). However, over the last two decades, multiple publications have addressed supply chains as complex systems that creates value.

Vargo & Lusch (2004, 2008, 2016) argue that the modern economy increasingly depends on service-dominant logic. In this theory, value is exchanged through services instead of products, and is realised through how products are used to serve the customer. Companies can never directly create value for the customer, but only make a value proposition. Maersk's value proposition is to transport cargo safely overseas. The containers owned by Maersk are their goods, but the safe transport of cargo using these containers creates value. The goods (the containers) serve as mechanisms for service provision (Vargo & Lusch, 2004).

Within the service-dominant economy, value is created through networks, called service ecosystems (Adner, 2017; Vargo & Lusch, 2016). Adner (2017) states that ecosystems can be defined by the value proposition. This ecosystem-as-structure consists of four elements: activities, actors, positions, and links. Activities refer to all actions that contribute to value creation, which are executed by the actors that hold different positions in the ecosystem. The links specify what is transferred between these actors. Vargo & Lusch (2008, 2016) conceptualise the links as resource integration and service exchange, where all actors contribute to value creation with knowledge and skills.

An important aspect of the ecosystem theory is that value cannot be achieved without the involvement of other actors, creating actor interdependence (Adner, 2017; Vargo & Lusch, 2016). To achieve value creation, all actors have to contribute, including the customer (Vargo & Lusch, 2004, 2008, 2016). The customer is always a co-creator of value, because they assign value to the service through the way they use, maintain, and adapt the service to their own situation. The process of value cocreation in service-dominant logic is shown in Figure 16 (Vargo & Lusch, 2016). Value exchange is both limited and enabled by institutions, which are rules, norms, meanings, and practices that shape the ecosystem. This cycle continues to iterate within the ecosystem.

Looking at the case study of this thesis, FrieslandCampina co-creates the value of Maersk's ecosystem. Maersk's service is applied to the transport of the IFM to China. All the actors, such as sales, equipment, CX, EMR, STAR, barges, inland depots, terminals, trucks, and vessels contribute to Maersk's service, but value only arises when FrieslandCampina also contributes to the ecosystem. FrieslandCampina specifies the standards for the foodgrade containers, which equipment uses to instruct STAR to prepare the right containers, enabling IFM shipment. Moreover, all actors are needed to create the value of safe cargo transport, creating actor interdependence. Thus, the foodgrade container supply chain is an ecosystem that creates value for FrieslandCampina.

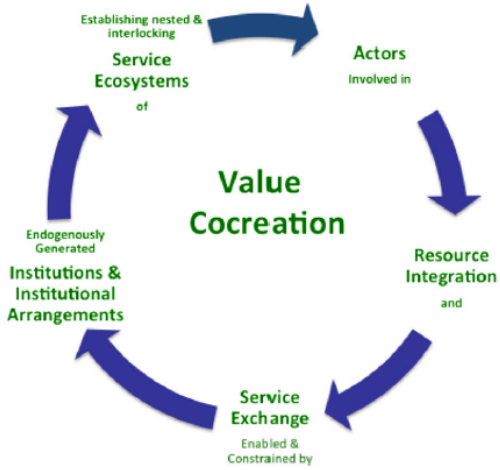


Figure 16: The narrative and process of S-D logic (Vargo & Lusch, 2016).

4.1.2 Risks in supply chains

Supply chains and ecosystems inherently involve risk. With multiple activities, actors, positions, and links, disturbances can occur. This creates challenges for organisations and the actors that contribute to the value proposition, and therefore for the entire ecosystem. Companies

that can adapt quickly to these disturbances have a competitive advantage, which makes it crucial to address this topic (Bluemink, 2025). Disturbances are not random adverse events, but arise from the structural characteristics of the supply chain (Jüttner et al., 2003). In supply chains, three main sources of risk can be identified: internal, external, and environmental risks (Christopher & Peck, 2004; Kochan & Nowicki, 2018).

Every supply chain is vulnerable from within; internal risks, mainly caused by the processes themselves. Processes can be affected by internal disturbances or by a lack of control. This slows down planning and decision-making, leading to an ineffective supply chain (Christopher & Peck, 2004). Furthermore, supply chains as ecosystems involve co-creation risk and adoption chain risk (Adner, 2017). Co-creation risk refers to the risk that all actors must innovate to ensure that innovations function, which resonates with the actor interdependence that arises in ecosystems. The adoption chain risk refers to the number of actors that must collaborate and adapt for an innovation to function.

At Maersk, many actors, such as STAR, inland depots, and the equipment department, must collaborate to ensure innovations are successfully implemented. When innovations are proposed and implemented, all actors must collaborate, or the ecosystem risks losing value. To ensure smooth processes within the supply chain, the control and planning for these innovations must be strong.

In addition to internal risks, external risks relate to customer demand and supply conditions. When these are unbalanced, the supply chain may either experience overstocking or face shortages. However, these risks cannot be directly controlled by organisations, making it essential to forecast and adjust to fluctuations in demand and supply. Forecasting is done through collaboration and information flows, which means that companies rely heavily on these flows (Mentzer et al., 2001; Truong et al., 2017). Therefore, the demand for foodgrade containers by FrieslandCampina and the supply of empty containers should be balanced and forecast by Maersk.

Finally, there are environmental risks, including natural disasters, political instability, and regulatory changes. Compared to external risks, environmental risks are harder to forecast, as they often occur as sudden shocks, which increases the importance of adaptability within organisations. A relevant example is the sudden closing of the Strait of Hormuz, which could not have been predicted (Poort, 2026). Maersk must respond quickly in such situations, since their vessels also transit this waterway.

Given the different risks in supply chain ecosystems, Maersk should mitigate disturbances by ensuring well-organised planning and control. In addition, Maersk should forecast the supply of containers and customer demand, while being able to quickly adapt to environmental disturbances such as the closing of the Strait of Hormuz.

4.1.3 Supply chain performance

Adner (2017) states that it is important to align partners within the ecosystem, referred to as ecosystem strategy, to prevent disturbances. Without alignment, actors work towards different goals within the supply chain, which reduces the effectiveness of the value proposition.

Through the management of risks and the alignment of actors, ecosystem performance can be enhanced (Vargo & Lusch, 2008). However, this alignment and risk mitigation, are not automatically embedded in supply chains, which has led to the emergence of supply chain management (SCM). The next section elaborates on SCM theory and how this can be applied to the case study.

4.2 Supply chain management

Ecosystems, and in this thesis supply chains, do not exist as a rigid system. They are organic and dynamic networks in which activities and actors influence each other (Wieland, 2020). Within supply chains, the most important exchanges are flows of information, materials, and financial resources (Mangan & Lalwani, 2016; Mentzer et al., 2001). These flows are interrelated and must be managed together with all other relationships within the supply chain. Hence, supply chain management (SCM) emerged.

There are many different definitions of SCM (Appendix F). This thesis uses the following definition: SCM creates value, enhances efficiency, optimises performance, and achieves customer satisfaction across organisational boundaries (Cooper et al., 1997; Li et al., 2005; Mangan & Lalwani, 2016; Mentzer et al., 2001; Wieland, 2020). This is achieved through the

management of processes and activities throughout the entire supply chain, including those outside one's own organisation (Cooper et al., 1997; Wieland, 2020). This means that the different flows are managed across the supply chain. As a result of SCM, there is a shift from organisation-centric management towards network-centric management, because organisations depend on many different actors in the supply chain (Akyuz & Gursoy, 2019). In this thesis, this means that the part of the supply chain outside Maersk, such as STAR and inland depots, should also be included in Maersk's decision-making process.

In the competitive field, businesses are no longer competing as isolated firms. Instead, their supply chains compete, meaning that the most efficient and strategically aligned supply chain succeeds (Akyuz & Gursoy, 2019; Lambert & Cooper, 2000; Li et al., 2005). These supply chains must deliver value to customers, otherwise the organisation's reputation among customers can get harmed (Kain & Verma, 2018; Vargo & Lusch, 2004). This means that to gain competitive advantage and enhance efficiency, supply chains must respond to customers' demands to achieve customer satisfaction (Mentzer et al., 2001). In addition, the supply chain ecosystem requires continuous improvement, because a firm can always improve how it serves value to the customer and financial performance (Vargo & Lusch, 2004).

Since multiple stakeholders contribute to operational efficiency and customer satisfaction, all stakeholders must be aligned to succeed in the competitive field (Adner, 2017; Li et al., 2005; Mentzer et al., 2001). Therefore, a company's performance depends on strong interorganisational relationships and alignment. For Maersk, this means that they should manage relationships with both FrieslandCampina and all actors in the supply chain, such as STAR and the inland depot.

In conclusion, to ensure supply chains work efficiently, SCM should be applied to the supply chain flows. Implementing SCM creates competitive advantage, as it helps companies and their supply chains deliver value to their customers. To achieve this competitive advantage, companies rely on strong relationships and alignment across the ecosystem.

4.2.1 Alignment across supply chains

Effective supply chains require strategic alignment, because a shared goal creates a common understanding of the desired outcome across the entire supply chain (Adner, 2017; Cooper et al., 1997; Porter & Millar, 1999). With this shared goal, better organisational conditions can be achieved, leading to higher performance and competitive advantage (Mentzer et al., 2001).

To achieve efficiency across the supply chain, organisations must first align their goals internally to ensure they target the appropriate customers to deliver value to, and regularly revise these goals (Lambert, 2009). Without internal alignment, it is impossible to have alignment across the supply chain. Once this is established, alignment with partners in the supply chain should be addressed. The goal of the supply chain should be clearly defined at the start of the collaboration and revised regularly, so this process must be actively managed.

Furthermore, the co-creation risk proposed by Adner (2017) refers to the requirement that all actors must innovate simultaneously to ensure the successful implementation of innovations. When the ecosystem is aligned, the co-creation risk decreases, because actors are coordinated in implementing the innovations.

Thus, to achieve high customer satisfaction and gain competitive advantage, actors in supply chains must be aligned. This process starts with internal alignment within the leading company, followed by alignment across the entire supply chain. Through strong SCM, relationships within the supply chain are managed and kept goal-oriented, while reducing co-creation risk.

4.2.2 Supply chain relationships

By building strong and aligned relationships, the performance of the supply chain improves and customer satisfaction increases (Mentzer et al., 2001; Truong et al., 2017). Ecosystems consist of multiple collaborations and value exchanges. Bluemink (2025) proposed the roles and relationship framework to map and assess the different value proposition flows and relationships within an ecosystem by showing the roles of all actors (Figure 17).

As shown in Figure 17, suppliers (partners) and customers influence the supply chain differently, since they have different value exchanges. Suppliers indirectly influence product outcomes for customers, making them essential in supply chain management (Cooper et al., 1997). Therefore, these relationships should be addressed separately and subsequently aligned.

Figure 18 shows the value propositions that the different actors exchange. In this thesis, Maersk is the orchestrator of the ecosystem, while FrieslandCampina is the direct customer. However, the end-users are Chinese citizens, who use the IFM. The partners are the different actors in the supply chain, such as STAR and the inland depot.

Customer relationships
Customer focus is positively related to process control and operational performance (Li et al., 2005; Mentzer et al., 2001; Truong et al., 2017). Moreover, the customer ultimately determines the value of the service, making customers indispensable (Vargo & Lusch, 2004, 2008, 2016). By focusing on customer needs to define value, organisations can align supply and demand, leading to improved operational performance. In addition, actively managing customer relationships contributes to competitive advantage (Li et al., 2005; Mentzer et al., 2001).

Actively managing these customer relationships means focusing on customer satisfaction and complaint handling (Majka, 2024). Both factors influence how customers perceive the added value of the service. Managing these aspects also supports trust development, and thereby strengthens the relationship (Greenhalgh, 2001).

Given the importance of delivering value to customers to enhance customer satisfaction, companies should understand their customers. Only by understanding and aligning with customer needs, companies can add value that is satisfactory to the customer (Majka, 2024). Despite the importance of addressing customer value, many organisations fail to identify

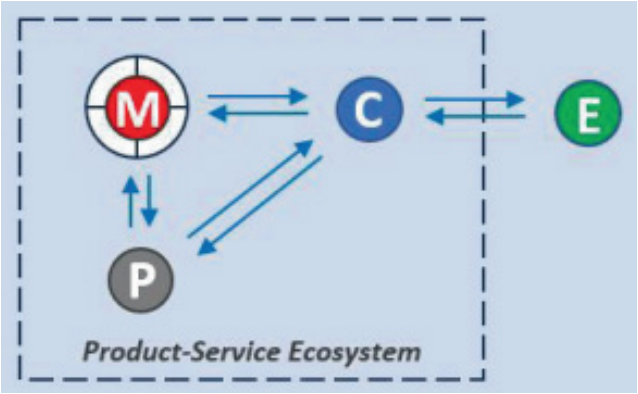


Figure 17: The roles and relationship framework (Bluemink, 2025)

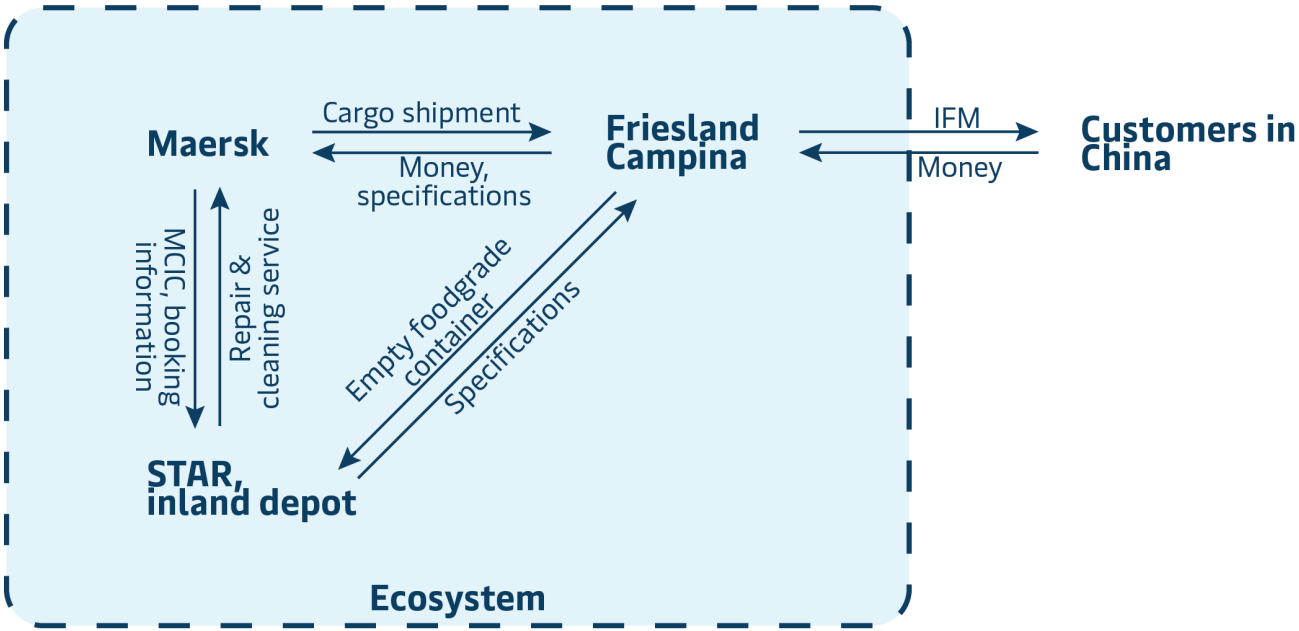


Figure 18: The roles and relationship framework of Bluemink (2025)

customer dissatisfaction in time, which makes defining expectations and early identification of dissatisfaction essential. (Holmlund-Rytkönen & Strandvik, 2005). This can be achieved through service level agreements, which the next section will elaborate on (Jin et al., 2002; Majka, 2024; Marilly et al., 2003).

In conclusion, customer relationships and serving customers are highly important for companies, as they enhance operational performance and competitive advantage. To achieve this, companies must understand their customers to develop a suitable value proposition and enhance customer satisfaction. Customer relationships are therefore an essential part of SCM.

Supplier relationships
On the other hand, supplier management also positively influences operational performance (Truong et al., 2017). SCM depends on trust and commitment both within the company and between the company and its suppliers, as this leads to goodwill on both sides (Mentzer et al., 2001). Furthermore, by aligning suppliers through relationships, value is exchanged more effectively across the supply chain ecosystem (Vargo & Lusch, 2016).

There are several key elements that support the development of long-lasting relationships with suppliers. As mentioned earlier, creating and maintaining a shared vision leads to better organisational conditions and higher performance. This also applies to supplier relationships, which benefit from such shared visions, and should be supported and understood by all actors (Lambert & Cooper, 2000). To achieve this alignment among actors across the supply chain, cross-collaboration and regular information flows are required (Jasti & Kodali, 2015). For Maersk, this means collaborating with different actors, such as STAR and inland depots. Furthermore, service level agreements can help align suppliers, since they formalise agreements and expectations for the stakeholders.

4.2.3 Service level agreement

A service level agreement (SLA) is an agreement between two or more organisations, or between a company and a customer, regarding the services provided. This contract defines the roles and responsibilities of both parties, including measurable specifications to ensure that the agreement can be monitored (Jin et al., 2002; Marilly et al., 2003). The SLA ensures reliability and clarity between both parties, because it creates clear expectations and enables performance monitoring, thereby improving satisfaction for both parties.

Within an SLA, it should be clearly stated which party is responsible for each part. This makes a lack of ownership, which can harm businesses, less likely (Jüttner et al., 2003). For long-term relationships, SLAs should be revised regularly to ensure they remain up to date (Trienekens et al., 2004). Maersk and FrieslandCampina do this through yearly tenders, during which new contracts are proposed.

In conclusion, relationships across the supply chain are essential for effective supply chain performance. These relationships improve the exchange of value by aligning actors across the supply chain, thereby enhancing operational efficiency. Such relationships must be managed at both the customer and supplier level. SLAs can be used to clearly define the roles and responsibilities of each actor.

4.2.4 Collaboration through information

Besides initial alignment through the SLAs, continuous information flows should be maintained to support and sustain supply chain relationships and to preserve aligned (Li et al., 2005). This means that the flow of information should be managed continuously, with both customers and suppliers.

Information flow is essential for collaboration within companies and across the supply chain. Effective information sharing helps prevent silos from occurring, which can lead to misalignment across the supply chain in the long term, while in the short term it can also slow decision-making and problem detection. Furthermore, an effective information flow enables closer monitoring of cost savings, allows fine-tuning of processes, and increases responsiveness (Kain & Verma, 2018). In addition, the information flow should be bi-directional to reduce information distortions.

From an internal perspective, supply chain management is crucial for preventing fragmentation within organisations (Ballou, 2007). Without coordination, silos emerge, creating misunderstandings and misalignment between departments. Through structured information sharing, links are formed that connect these silos, reducing misalignment and enabling faster decision-making (Lambert &

Cooper, 2000). When fragmentation is prevented, cost savings can be achieved and efficiency increases due to collaboration between teams (Mentzer et al., 2001).

In addition to the internal perspective, information flow throughout the entire supply chain is essential, as all stakeholders are dependent on information (Figure 19) (Cooper et al., 1997). Stakeholders outside the company must be informed to ensure alignment between supply and demand. Figure 19 shows that information flow overarches the supply chain, connecting all actors, which makes information essential for efficient supply chains.

The information that is shared with both customers and supply chain actors, should be qualitative (Li et al., 2005). This means that the shared information should be reliable and accurate, and it should be embedded in regular information flows. To ensure that the correct information is shared, companies must determine who receives which information and establish the appropriate information channels (Mason-Jones & Towill, 1997). Taken together, these elements require a holistic approach to information flow management.

Thus, information flow is essential for keeping all actors, both internal and across the supply chain, aligned. Furthermore, information sharing enables fast decision-making and enhances efficiency. The information should be able to flow throughout the entire supply chain, ensuring that all actors are informed.

4.2.5 Redesigning supply chains

To ensure that a supply chain operates at the highest level of efficiency, it must be continuously improved and redesigned (Anaba et al., 2024; Lambert & Cooper, 2000). Before beginning the redesign process, it is important to define the perceived outcome (Mentzer et al., 2001). A defined goal for redesigning creates alignment among supply chain stakeholders and ensures that customer needs are incorporated (Stevens, 1990). Customer needs must be researched and validated beforehand, as the supply chain ultimately delivers value to the customer. For this purpose, strong relationships with suppliers, customers, and third parties are required (Kain & Verma, 2018).

Redesigning supply chains for higher operational efficiency, requires a structured approach. Efficiency is achieved when the entire supply chain is reviewed. Therefore, a holistic approach is essential. The difference between supply chain management and supply chain redesign is that supply chain management ensures flow regulation. Through SCM, the information flow reaches all actors and operates continuously. On the other hand, supply chain redesign focuses on redesigning the different flows to make them function more efficiently. Thus, supply chain redesign is needed for flow optimisation, while supply chain management focuses on flow regulation.

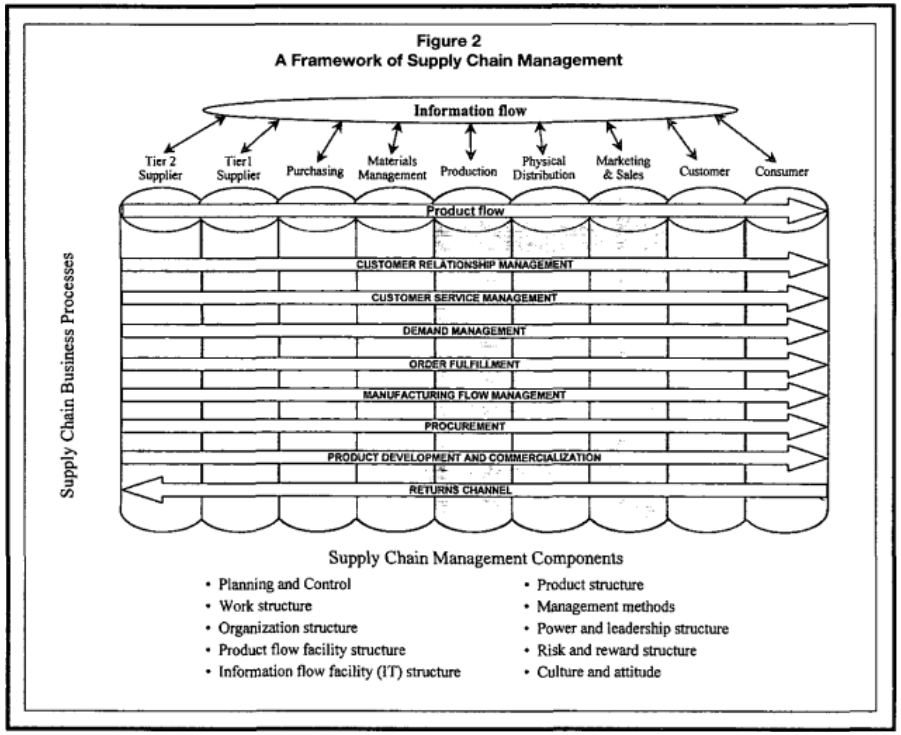


Figure 19: A framework of supply chain management (Cooper et al., 1997)

4.3 Lean supply chain management

There are many different approaches to supply chain redesign. In recent years, lean supply chain management (LSCM), an approach within SCM, has become a popular approach within industries that operate supply chains. LSCM is particularly relevant for this thesis because this approach focuses on elements that significantly influence supply chain efficiency.

Lean management focuses on eliminating waste (Anaba et al., 2024; Li et al., 2005; Womack et al., 2007). This waste often relates primarily to cost and time across the entire supply chain, but it can also concern other elements, such as materials or transportation (Ionel, 2024). Waste refers to anything that does not add value to the service for the customer. To eliminate this waste, it is important to adopt a holistic perspective and work without silos, meaning that the entire supply chain must be reviewed (Mason-Jones & Towill, 1997). For the foodgrade container supply chain, this implies that the entire supply chain must be analysed to identify the activities that add and diminish value.

When lean management principles are implemented in supply chains, higher operational performance can be achieved (Ahamed & Yamuna, 2025; Maldonado-Guzmán, 2025). Applying this approach leads to improved business relationships and higher customer satisfaction, alongside enhanced operational performance, which is driven by the improved value delivered to the customer through LSCM (Ionel, 2024).

Core principles of lean management include the just-in-time (JIT) principle, cross-collaboration, and the Kaizen methodology (Anaba et al., 2024). JIT ensures that products in a supply chain arrive exactly when needed, enabling the supply chain to respond to customer demand. Through JIT production, pull production arises, meaning that the supply chain only produces when customers place orders.

The second principle, Kaizen, focuses on continuously making incremental improvements to enhance the overall process. Continuous improvement resonates with the service-dominant logic of Vargo and Lusch (2004), who state that firms can always improve how they serve customers and enhance financial performance, which makes LSCM suitable for the foodgrade container supply chain.
To implement lean management in a supply chain to enhance efficiency, different steps are required. This implementation of LSCM consists of five steps, shown in Figure 20 (Anaba et al., 2024; Lean Enterprise Institute, 2024; Li et al., 2005; Womack & Jones, 1996):

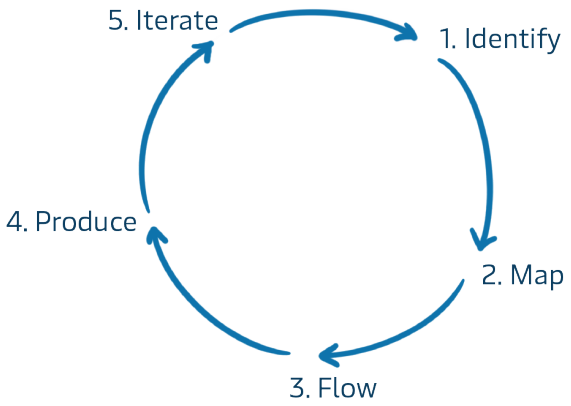


Figure 20: Lean supply chain management circle (Lean Enterprise Institute, 2024)

1. *Identify the value:* Investigate the proposed value that the supply chain can deliver to the customer, as only the customer can determine real value.

2. *Map the supply chain:* Identify crucial steps in the supply chain throuIdentify crucial steps in the supply chain through mapping. Each step must be documented to create a complete overview. Gemba walks (observing at the location where the activities happen) should be used to ensure accurate understanding of the process. Mapping helps identify key stakeholders and their links within the supply chain and helps uncover the core processes in the supply chain that support achieving the proposed value.

3. *Enable flow:* Design a supply chain where the crucial activities flow without interruptions by adjusting processes where necessary. Supplier relationship management, customer relationship management, and information flow are essential for effective supply chains (Jasti & Kodali, 2015).

4. *Produce:* Apply JIT pull production by producing only what is requested by the customer and delivering it just in time. This requires waiting for customer orders before production begins to prevent waste in the supply chain.

5. *Iterate:* Continuously improve processes over time. LSCM builds on the Kaizen principle, meaning continuous improvement, through ongoing incremental improvements to enhance the overall process.

In conclusion, implementing LSCM leads to a more efficient supply chain. It is an approach within SCM, ensuring that waste within the entire supply chain is eliminated, while enabling the essential value-adding processes to flow. In addition to reduced waste, stronger relationships and improved information flows result from LSCM. The efficiency is maintained through continuous improvement of the supply chain by applying the Kaizen principle.

4.4 Conceptual framework development

Taking the case study analysis and the literature review together, I propose a conceptual framework to enhance efficiency in the foodgrade container supply chain (Figure 21). This framework is created through a thorough analysis of the value that Maersk proposes (Chapter 2), combined with the most important flows required to achieve the proposed value in the foodgrade container supply chain (Chapter 3). The insights derived from the literature review in this chapter were used to provide a scientific foundation for the framework.

Within the framework, the overall goal is stated as operational efficiency. This means that Maersk aims to be as efficient as possible. Operational efficiency can be defined as creating the most value for the customer (external value) at the lowest possible cost (internal value). These two values both directly influence the operational efficiency.

The external value in this thesis is ensuring container quality for FrieslandCampina, since they rely on high-quality containers to ship their IFM to China. This represents Maersk's value proposition to FrieslandCampina. If this is not delivered, rejections occur, leading to reduced value for FrieslandCampina and therefore a decrease in operational efficiency.
The internal value, on the other hand, focuses on financial performance. Maersk aims to optimise this flow by reducing costs and increasing profit margins. When rejections occur, costs for Maersk increase significantly, because Maersk must transport the rejected container back to Rotterdam and deliver a replacement container to FrieslandCampina at Maersk's expense. Consequently, rejections reduce operational efficiency from the internal value perspective.

Both ensuring quality and reducing costs require effort. I identified five essential flows that enable these internal and external value streams. These flows are structured as challenges, processes, and outcomes. When all outcomes are achieved, both value streams positively contribute to operational efficiency. However, each outcome can be obstructed by challenges. The challenges negatively influence operational efficiency and can be regarded as waste within the supply chain that must be eliminated (Anaba et al., 2024; Li et al., 2005; Womack et al., 2007). Therefore, processes are implemented to prevent these challenges from influencing supply chain performance. When the processes function effectively, the desired outcome is achieved, resulting in enhanced efficiency in the foodgrade container supply chain. The identified challenges, processes, and outcomes are as follows:

1. Health and safety standards
FrieslandCampina has strict requirements. This is the result of the combination of HACCP regulations and regulations set by the Chinese government. The specifications set by FrieslandCampina are all linked to the condition of the container when it arrives at their warehouse. Thus, to create the proposed value for the customer, Maersk must comply with these strict requirements to serve the customer and meet the SLA (Adner, 2017; Jin et al., 2002).

To overcome this challenge, Maersk has implemented inspection and cleaning procedures to comply with the standards of FrieslandCampina, which ensure that containers of the correct grade are used and thoroughly cleaned. When these procedures are followed, Maersk should achieve the desired outcome of compliance with standards. However, undocumented and subjective standards from FrieslandCampina hinder compliance.

2. Fragmented customer service
The second challenge is the fragmented customer service. Within Maersk different departments (Sales, CX, EMR and equipment) are responsible for handling bookings and customer contact. As these responsibilities are spread across departments, fragmentation and lack of ownership arise. All involved employees handle part of the customer interaction, but are often not aware of the activities carried out by other departments for the same customer. This results in an unclear customer service structure internally and for FrieslandCampina. In addition, FrieslandCampina contacts multiple employees within Maersk when rejections occur, whereas CX should be the point of contact. This further complicates internal communication at Maersk.

Maersk should take good care of customer contact and prevent frustrations, because this lowers operational performance (Li et al., 2005; Mentzer et al., 2001; Truong et al., 2017). To overcome this fragmented customer service, a process of cross-functional customer service handling is implemented. This means that different departments are represented in meetings with FrieslandCampina. The expected outcome of this process is an integrated customer service, which should create internal clarity and increased value for FrieslandCampina.

3. Misaligned goals across supply chain
Misaligned goals across the supply chain form another challenge. This misalignment emerges from the different ways of working of the actors involved. Maersk operates based on its own internal criteria, the MCIC, while FrieslandCampina uses their own specification document. Although the MCIC applies within Maersk, the sales department does not fully implement these standards, as they primarily advocate for the customer.

Furthermore, standards differ across the supply chain: STAR applies MCIC, while MCS applies FrieslandCampina's standards. As a result, checkpoints across the supply chain are misaligned, since actors inspect the container on different criteria. This can lead to wrongful rejections, where containers that comply with MCIC are still rejected, and misaligned expectations, which must be prevented to deliver value to FrieslandCampina.

To achieve aligned supply chain standards as the desired outcome, actors across the supply chain must align their goals (Adner, 2017; Cooper et al., 1997; Porter & Millar, 1999). The implemented process is therefore alignment, in which all actors agree on a single set of standards that is applied consistently throughout the supply chain.

4. Silos across supply chain
Silos have emerged across the supply chain because different actors do not consistently collaborate. Each actor operates within their own silo, sharing information only when required by others. Maersk, STAR, the inland depot and FrieslandCampina all operate within silos, which makes it difficult to detect disruptions quickly and slows decision-making. However, all actors need information from each other to work effectively in the supply chain (Li et al., 2005).

To break these silos, a process of sharing operational information is implemented. This enables cross-collaboration across the supply chain. Through cross-collaboration, disruptions are detected more quickly and decision-making is strengthened. This positively influences both the internal and external value streams.

5. (Volatile) empty flow
Empty containers are essential for shipping cargo. Due to the different container grades, Maersk is highly dependent on the young empty container flow. When mainly lower grades enter STAR, Maersk must spend money on doing more expensive and time-consuming cleanings and repairs. Otherwise, Maersk cannot meet the customer's expectations. Additionally, Maersk can work according to the JIT-principle by forecasting effectively, creating the opportunity to prepare containers only when they are booked by the customer (Anaba et al., 2024).

To prevent these expensive repairs, forecasting and planning of container demand and supply is essential. By forecasting the empty flow, Maersk can ensure that grade S and M containers are available for FrieslandCampina, which reduces the costs on cleaning and repairs. Thereby, operational efficiency is enhanced.

Conclusion
The foodgrade supply chain efficiency framework is the conclusion of both the literature review and the case study analysis. The identified flows should function effectively, meaning that the supply chain should be redesigned to ensure that all desired outcomes are achieved and challenges do not obstruct supply chain activities. The challenges identified can be considered as waste within the supply chain and must therefore be eliminated to enhance the operational efficiency of the foodgrade container supply chain.

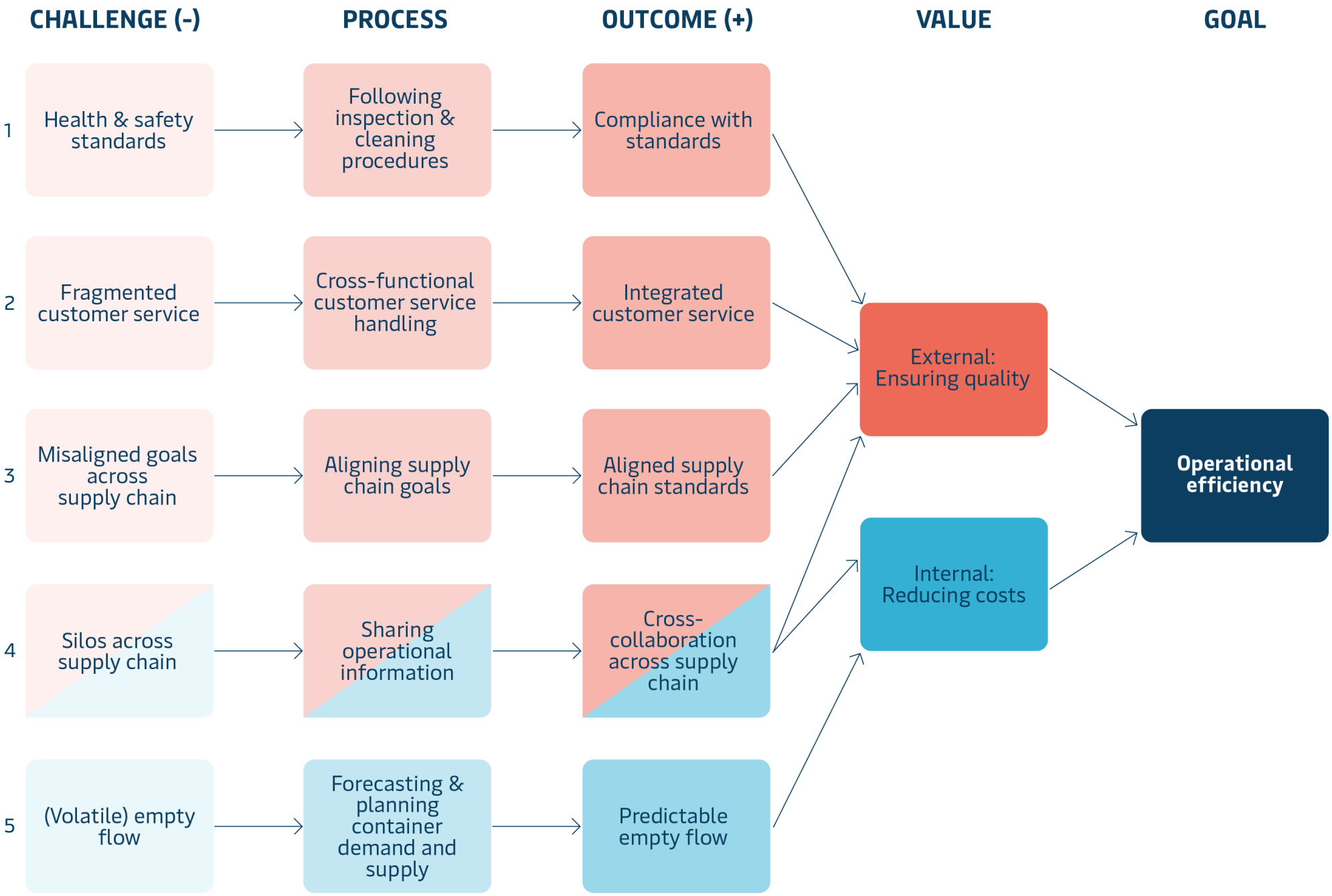


Figure 21: The foodgrade container supply chain efficiency framework

5

Research methodology

As mentioned in Section 1.2, the research question to be answered is as follows:

'How can Maersk enhance the operational efficiency of the foodgrade container supply chain?'

To answer this question, I conducted the literature review and case study analysis. The framework developed from this study has to be validated to ensure that the research question is addressed accurately. Therefore, qualitive research is conducted through interviews.

The interviews enable me to validate the proposed framework in Section 4.4 and identify opportunities for suitable design interventions. This chapter further elaborates on the qualitative research method used to answer the research question and validate the framework. First, the interview design is explained. Subsequently, the participant selection and data analysis are described. Lastly, the validity and reliability of the research are discussed.

5.1 Qualitative interview protocol

To validate the framework, I used insights from the literature review to build the interview protocol. Through this approach, theoretical validation is conducted. Especially LSCM was relevant for this interview protocol, since the proposed framework identified waste that can be eliminated through the application of LSCM.

The first two steps of LSCM, shown in Figure 23, are especially important for this validation, because these identify the value and map the supply chain (Anaba et al., 2024; Li et al., 2005; Womack & Jones, 1996). Through these two steps, the crucial flows can be validated and suitable design directions can be explored.

To identify the value, the proposed value of the supply chain is discussed with the different participants. This validates whether the different actors are aligned on the proposed value, which is necessary to enhance overall efficiency (Mentzer et al., 2001; Truong et al., 2017). In addition, by identifying the proposed value, the different value exchanges within the supply chain can be validated, which marks the start of the mapping phase (Bluemink, 2025; Vargo & Lusch, 2004, 2008, 2016). Furthermore, analysing this value exchange helps to uncover the actor interdependence within the supply chain, which demonstrates how all actors are interdependent to achieve the value proposition (Adner, 2017).

Besides mapping value exchanges and alignment, supply chain mapping uncovers the activities across the supply chain, which enhances operational efficiency (Mentzer et al., 2001). Furthermore, cross-collaboration can be assessed. This is essential, because cross-collaboration enables information flow that must be consistent over the entire supply chain to ensure quick decision-making and fast problem detection (Cooper et al., 1997).

Based on the insights derived from the literature review, the interview protocol is developed (Appendix G). The interview questions focus on validating the framework, which is achieved by interviewing all participants. However, some questions are not applicable to all participants and are therefore only asked to a subset of the participants.

The interviews will be conducted using semi-structured approach, which enables me to validate the framework while maintaining openness to additional relevant insights. This ensures that the framework aligns with both theory and practice. Before the first interview, the interview is conducted internally as a pilot. After this pilot, the questions are reviewed. This improves clarity and consistency for the participants. All interviews will be conducted in accordance with the procedures outlined in the HREC forms and the informed consent forms (Appendix H, I).

5.2 Pilot interview

To ensure that the interview is clearly understood by all participants, the interview is tested with an employee of Maersk. This employee is closely involved with all stakeholders and has extensive knowledge of the case study.

By conducting a pilot interview, I was able to test the interview protocol for clarity and whether it covers all relevant aspects. After the pilot test, I adjusted some details to improve the interview protocol.

5.3 Data collection

After the pilot test, the interviews are conducted. To gain deeper insights, different stakeholders within the foodgrade supply chain are interviewed. For this purpose, both employees of Maersk and stakeholders outside Maersk are included in the research.

People in the right positions have to be selected to ensure that the framework was validated from a holistic perspective on the entire supply chain of the case study. For this reason, I will involve people that are closely involved in the case study but are also hold decision-making roles within the supply chain. By selecting decision makers, the validation is conducted with stakeholders who understand why certain decisions are made within the supply chain and which barriers they experience. In addition, their insights provide an indication of adjustments are feasible given their decision-making authority.

Besides the decision-making authority, the interviewees are also selected based on the checkpoints identified in the case study analysis. These checkpoints all contribute to the quality of foodgrade containers, which makes the perspectives of these stakeholders relevant. The participant selection consists of seven stakeholder groups, including ten participants.

The following external participants are interviewed:

- Rotterdam depot employee (N=2): These depot employees of STAR and depot in Rotterdam are responsible for inspecting and cleaning the container when containers are booked by FrieslandCampina. They provide insight into the initial stages of the supply chain, from the arrival of the empty container to barge transport.
- Inland depot inspector (N=2): These inspectors have knowledge of the process undertaken once a prepared container arrives from Rotterdam. Their perspective provides insight into the checkpoint conducted at the inland depot.
- Employee of FrieslandCampina's warehouse (N=2): these employees of FrieslandCampina represent the customer perspective of the supply chain and Maersk's value proposition.

There are also interview participants from Maersk internally. These participants are all involved in the customer contact and container bookings for FrieslandCampina. In addition, these employees can share insights into the internal customer handling wihtin Maersk. The following participants are selected:

- Employee of the EMR department at Maersk (N=1): This employee provides deeper insight into the FrieslandCampina case with a primary focus on rejections and the way both Maersk and FrieslandCampina applies their standards.
- Employee of the equipment department at Maersk (N=1): By interviewing this employee, insights are obtained into the execution of container bookings. In addition, this participant can elaborate on rejections from the perspective of the equipment department.
- Employee of the CX department at Maersk (N=1): This employee can share insights into customer bookings and complaints.
- Employee of the sales department at Maersk (N=1): The sales employee can elaborate on the tendering process and how FrieslandCampina's requirements are handled by Maersk.

5.4 Data analysis

All semi-structured interviews are conducted face-to-face or via Microsoft Teams when meeting face-to-face is not possible. During the interviews, data is recorded in written notes and audio recordings. After each interview, the notes are processed immediately and complemented where needed. In addition, the audio recordings are transcribed using the Microsoft Word transcription tool.

First, the interviews will be analysed per participant group, followed by thematic coding. The function of the coding is to identify recurring themes and ensure validation of the framework. After coding, the reoccurring themes will be clustered with the framework and mapped to identify the most pressing problems.

5.5 Validity and reliability

To ensure validity, multiple stakeholders within the supply chain are interviewed. This helps to reduce interviewer bias. By including multiple perspectives, different angles are represented and incorporated into the research to validate the framework.

In addition to interviewer bias, sampling bias may also occur. This is mainly due to Maersk acting as the connection between the researcher and external stakeholders, while Maersk itself is also part of the supply chain. This may influence both the selection of participants, and the information external participants are willing to share. Participants may not answer the question as openly as they otherwise would, as their answers could potentially be visible to Maersk. To mitigate this risk, confidentiality is ensured both verbally and through the informed consent form (appendix I) prior to the interviews.

Furthermore, this research is conducted within a limited timeframe, which restricts the outcomes. Given the time constraints, it is possible that the researcher focuses more strongly on specific directions to ensure that the research question is answered within the allocated time. This limits the breadth of the research. Therefore, the intended outcome will be revised multiple times throughout the research process. This outcome must align with both the research question and the available timeframe.

6

Framework validation

After conducting nine interviews, I analysed the results. The interviews provided deeper insight by addressing the following topics: the foodgrade container supply chain, foodgrade standards, the rejections, communication, sharing information, customer service, and forecasting. Through these insights, the framework proposed in Section 4.4 could be validated to see whether it correctly fits the context of Maersk and the FrieslandCampina case study.

Both open and axial coding were used to analyse the interviews. Through open coding, I analysed the interviews on what was stated by each participant and across stakeholder groups (Appendix J). Subsequently, an axial coding approach was used to generate overarching themes that recurred across multiple interviews. By applying both coding techniques, the interview data could be used to validate the framework.

This chapter presents the interview results. It starts with the outcomes of the coding, discussed per essential flow in the framework. For each flow, a schematic overview of the current state is provided. The chapter concludes with the refined framework and a design direction for this thesis.

6.1 Thematic analysis

Through open and axial coding, nineteen different themes were derived from the interviews (Appendix K, Figure 22). To be identified as a theme, at least two participants had to report similar topics that could be clustered under an overarching theme. These topics were identified through a critical analysis of the interview transcriptions, after which they were compiled in an Excel file to compare overlapping responses across participants. To validate whether these themes also support the framework, they were clustered within the framework (Figure 22). All topics could be matched to a component of the framework, which confirmed their relevance for the validation process.

6.2 Framework flows validation

With the clustered themes, the different framework streams were reassessed. This section elaborates on the insights provided per flow in the framework. The different themes are addressed, and a schematic overview of the current state of each flow is presented.

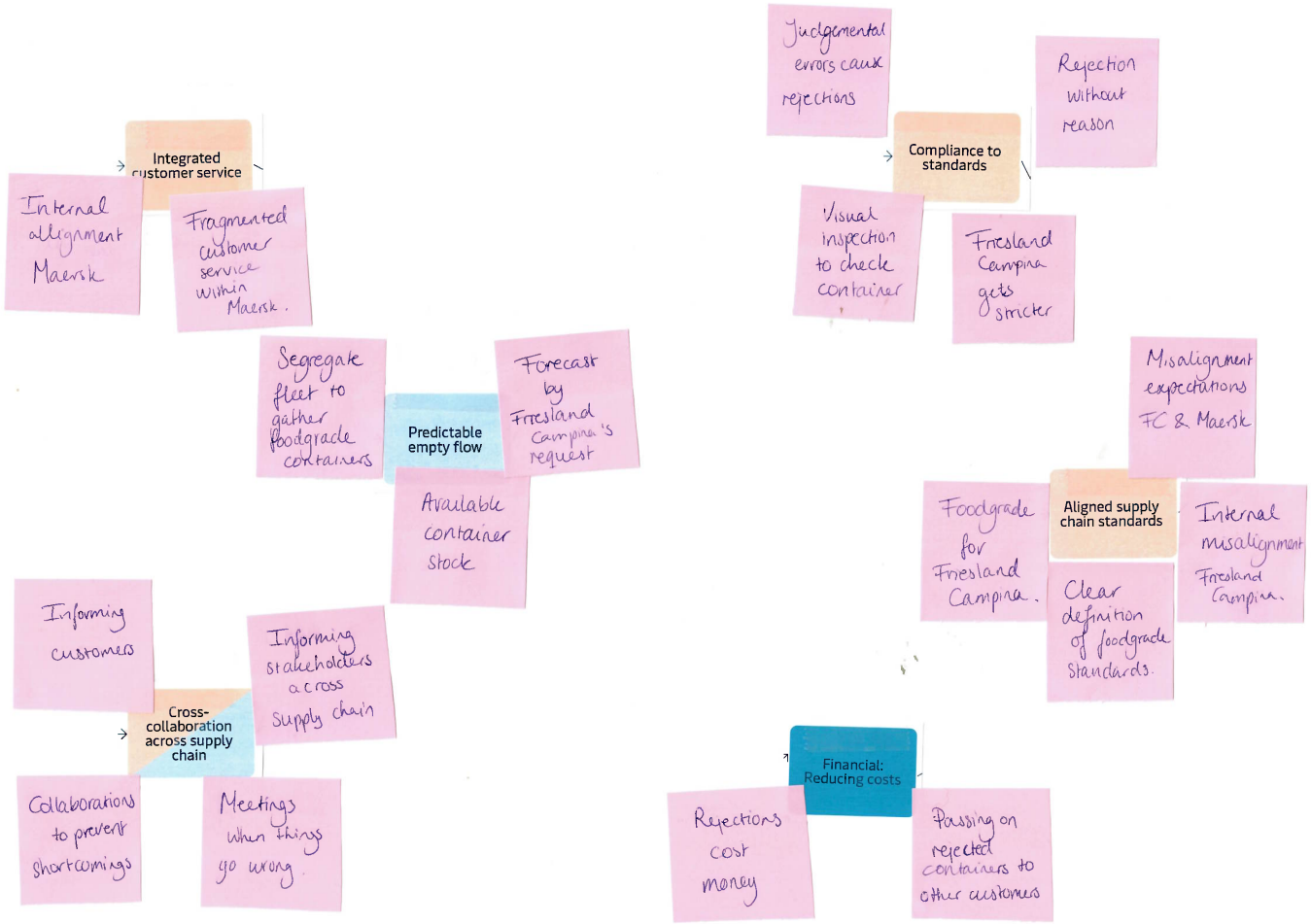


Figure 22: The derived themes from interviews clustered onto the framework flows

6.2.1 Compliance with standards

The first flow of the framework has the perceived outcome of compliance with standards. There were four themes that matched this flow: *visual inspection to check container, judgemental errors cause rejections, rejections without reason,* and *FrieslandCampina gets stricter.*

Currently, the supply chain uses different standards, the MCIC and FrieslandCampina's specifications (Figure 23). Seven interview participants stated that visual inspections are conducted to check whether the container meets the requirements. These inspections take place at different locations across the supply chain, with each location having its own employees executing the visual checks.

However, these checks are often not thorough. EMR, STAR, and the inland depots all stated that judgemental errors frequently occur. Not all employees inspect containers in exactly the same way, as this process relies on human interpretation. Differences in how the standards are perceived lead to rejections.

At the same time, compliance with the standards is increasingly difficult due to FrieslandCampina has started rejecting containers without providing clear and correct justifications. This means that containers comply with the MCIC requirements, but are still rejected. Maersk has not changed the containers they deliver. However, these containers are now rejected, which was not the case previously. FrieslandCampina is becoming stricter in their requirements, but these changes are not communicated to Maersk.

Without informing Maersk about the additional or revised reasons for rejection, the specifications become subjective, which increases the likelihood of human error. As a result, the current flow in the framework ends at 'following inspection & cleaning procedures', as this process is not fully applied in a way that all parties agree. Therefore, there is no compliance with standards yet (Figure 24).

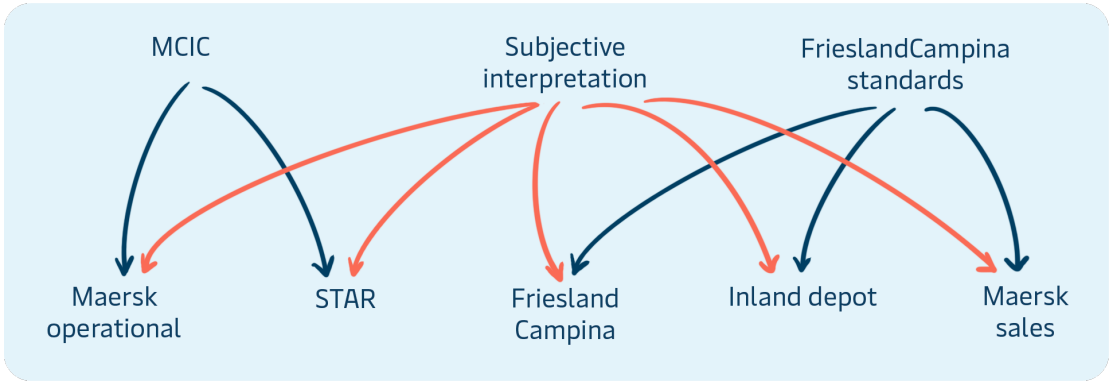


Figure 23: Current process of flow



Figure 24: Current compliance to standards flow

6.2.2 Integrated customer service

For the integrated customer service, two themes were identified that match the flow: internal alignment within Maersk and fragmented customer service within Maersk. Both themes focus on Maersk internally, which aligns with this flow, as it is aimed at the internal customer service of Maersk.

Internally, the different departments need trust each other and collaborate. However, within Maersk, the departments all state that they only inform each other when necessary, which leads to limited to no awareness of problems, processes or projects other departments are working on. The CX, equipment and EMR departments specifically report experiencing difficulties due to this structure that makes silos emerge, as expectations and agreements are unclear. This is occasionally addressed through meetings between two departments. However, there are often not more then two departments present, which makes broader alignment across departments impossible.

Figure 25 shows how the departments collaborate and inform each other, according to the participants from the different departments. In addition, this overview shows how the departments communicate with FrieslandCampina. Normally, CX is the designated point of contact for customers. However, FrieslandCampina keep their end of the bargain.

FrieslandCampina states that they contact everyone when rejections occur, as Maersk's response is perceived as slow in these situations. According to the inland depots, it takes time before employees from different departments become aware of the problem, which increases the response time. With this way of working, FrieslandCampina places itself between internal departments of Maersk, rather than the preferred situation in which Maersk is internally aligned and provides a single, and proactive point of contact for customers (Figure 26).

Together, these two themes indicate that the flow is still at an early stage of cross-functional customer service handling (Figure 27). The limited collaboration results in fragmented customer service. In addition, FrieslandCampina's behaviour challenges achieving internal alignment at Maersk, also resulting in the fragmented customer service.

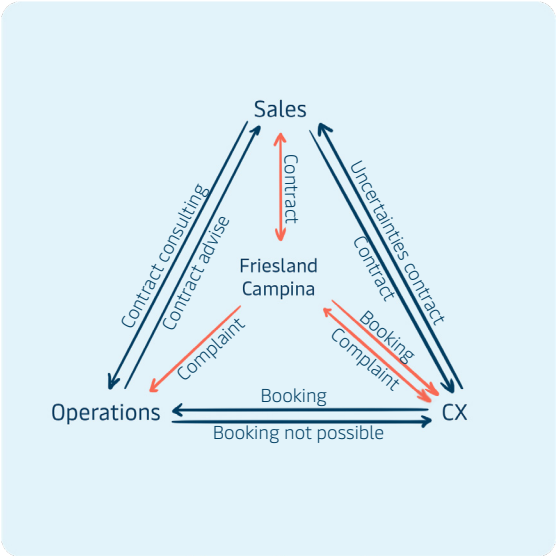


Figure 25: Current process of flow

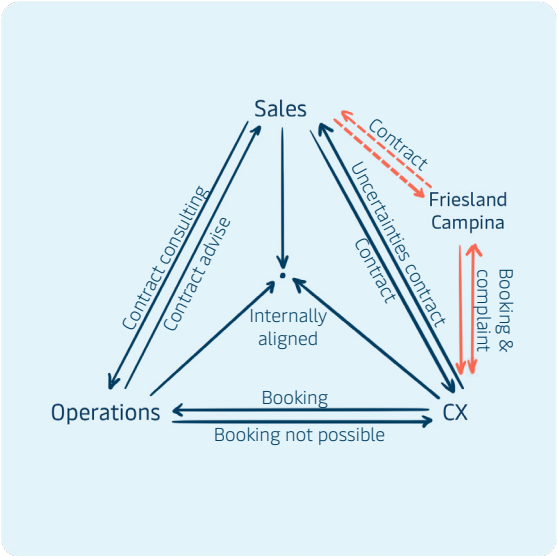


Figure 26: Preferred process of flow



Figure 27: Current compliance to standards flow

6.2.3 Aligned supply chain standards

From the interviews, the themes foodgrade for FrieslandCampina, clear definition of foodgrade standards, internal misalignment FrieslandCampina, and misalignment expectations FrieslandCampina and Maersk were derived. All of these themes correspond to the flow of aligned supply chain standards.

During the interviews, it was noticeable that most participants used the specific term foodgrade for FrieslandCampina, which aligns with MCIC. Even FrieslandCampina uses the term of foodgrade containers. However, when participants were asked what these foodgrade specifications entail, stakeholders referred either to the MCIC or FrieslandCampina's standards, indicating misaligned goals.
Even within FrieslandCampina, different perceptions of the intended goal exist. EMR, STAR and even FrieslandCampina all mentioned this during the interviews and reported difficulties in managing this misalignment. Some FrieslandCampina employees apply undocumented standards, while others work strictly according to the official FrieslandCampina specifications. This misalignment also effects the compliance-with-standards flow (Section 6.2.1).

Overall, the misaligned lead to a division between stakeholders that operate based on the MCIC and documented FrieslandCampina specifications (Figure 28). Furhtermore, the undocumented standards influence FrieslandCampina's alignment internally. Aligning activities barely take place, keeping the goals misaligned across the supply chain (Figure 29).

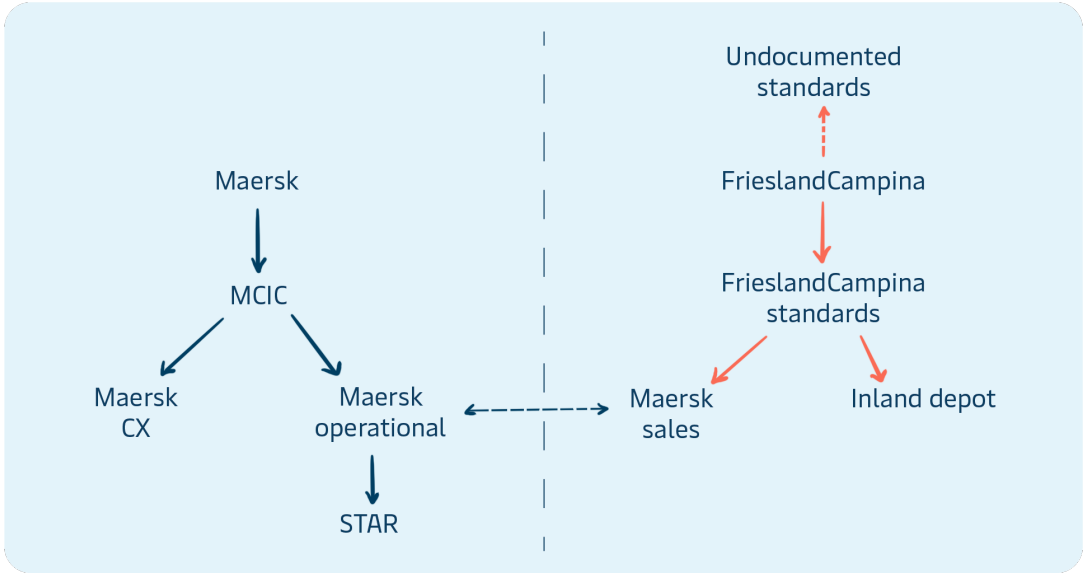


Figure 28: Current process of flow



Figure 29: Current compliance to standards flow

6.2.4 Cross-collaboration across the supply chain

For the cross-collaboration flow, four themes are derived from the interviews: informing stakeholders across supply chain, informing customers, collaboration to prevent shortcomings, and meetings when things go wrong.

During the interviews, all stakeholders referred to informing the next stakeholder rather than collaborating. The information that is shared mainly concerns the container bookings, which results in short, one-way information streams. CX and the inland depots also inform the customer when needed.

Figure 30 presents the information streams in the supply chain. The arrows clearly show that many information streams are one-way, indicating a lack of two-way collaboration. The only form of collaboration mentioned is that STAR and the equipment department hold meetings twice a week to forecast bookings and ensure the availability of containers with suitable grades for customers.

Instead of regular collaboration, this supply chain operates in a reactive manner. According to seven participants, meetings typically take place when problems arise, but not on a regular basis. This means that stakeholders have almost no opportunities to build stronger relationships, which allows silos to persist, as they mainly interact when the situation has already escalated.

These themes together show that the current flow mainly focuses on sharing operational information, but there is no cross-collaboration yet (Figure 31). This keeps silos between stakeholders across the supply chain, decreasing efficiency.

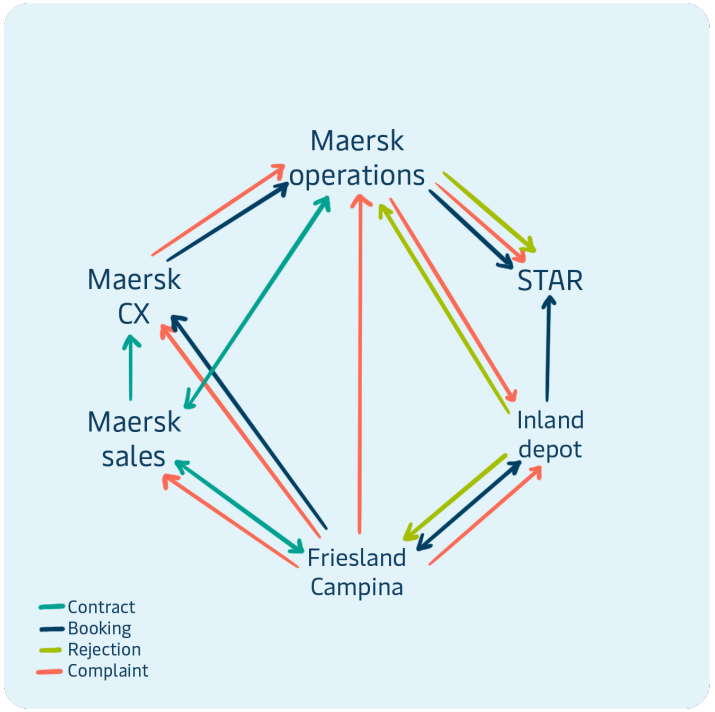


Figure 30: Current process of flow

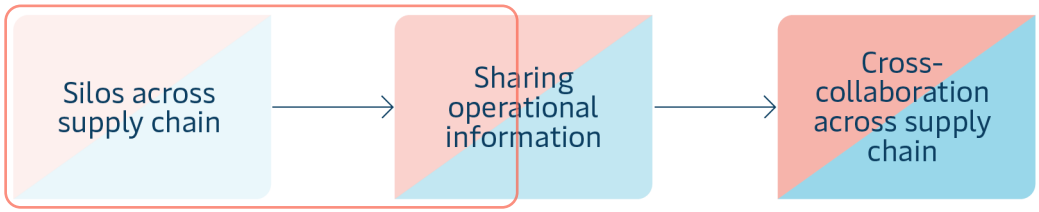


Figure 31: Current compliance to standards flow

6.2.5 Predictable empty flow

For the final flow, three relevant themes were derived from the interviews: segregate fleet to gather foodgrade container, available container stock and forecast by FrieslandCampina's request.

STAR and EMR stated that a fleet segregation is applied for containers with grades S and M. This segregation ensures the availability of high-quality containers for FrieslandCampina. All these containers are built in 2021 or later, making them suitable for foodgrade.

FrieslandCampina, on the other hand, stated that there are not enough available containers, resulting in a shortage. However, all other stakeholders contested this statement. Maersk's employees, STAR and the inland depot do not experience the same issue and even mentioned the possibility of 'cherry picking' to ensure that the best containers are allocated to FrieslandCampina. However, the reason FrieslandCampina experiences shortages, is caused by their high rejection rate, leading to container shortages.

Due to these rejections, it becomes challenging to forecast sufficient containers for FrieslandCampina, as current planning assumes that containers will be accepted. Furthermore, FrieslandCampina does not share a forecast of required containers volumes, which Maersk's employees need to maintain stock levels for the customer.

Together, these themes indicate that the empty flow is currently well predicted (Figure 32, 33). FrieslandCampina does not always experience this. However, less rejections combined with improved forecasting would likely result in less container shortages for FrieslandCampina.

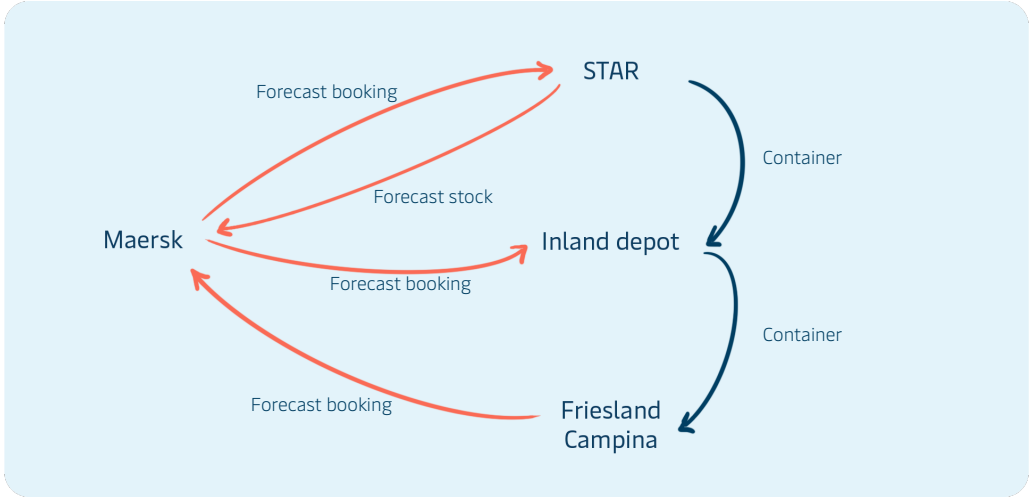


Figure 32: Current process of flow



Figure 33: Current compliance to standards flow

6.2.6 Reducing costs

The last two themes, rejections cost money and passing on rejected containers to other customers, are both directly related to reducing costs rather than to one of the framework flows. The theme rejections cost money states the obvious and therefore not elaborated on further.

During the interviews, EMR and an inland depot mentioned the possibility of passing on rejected containers to other customers to save costs. In this situation, rejected containers from FrieslandCampina would be allocated to another customer with less strict requirements, without first transporting the container back to Rotterdam. This action would save both time and costs. However, this part falls outside the scope of this thesis and therefore not examined further.

6.3 Flow order

In addition, to the analysis on the current state of the flows, the order of the flows was validated. To assess the relative importance of the themes, these were mapped on a C-box of costs and value, consistent with the value streams of the framework (Figure 34). In this way, the themes, representing the current state of the flows, were used to identify the most pressing themes affecting the operational efficiency of Maersk's foodgrade container supply chain.

Based on this mapping, the most critical themes were primarily related to misaligned standards across the supply chain. Therefore, this flow was positioned as the first flow in the refined framework presented in Section 6.5, highlighting its importance. The current misalignment across the supply chain leads to financial losses and reduces the value for the customer. Furthermore, this flow is closely linked to the flow compliance with standards, as these flows influence each other. Once clear alignment is orchestrated, compliance with standards becomes easier for Maersk. Therefore, these flows are linked to each other in the refined framework.

The other flow identified as highly important is integrated customer service. This flow has the potential to add value to the customer, but currently does not, due to the internal fragmentation. Internal misalignment and lack of collaboration also negatively affect collaboration across the supply chain. Therefore, the flow cross-collaboration across supply chain is positioned under the integrated customer service flow.

The current empty flow of containers is predictable, which indicates that the flow is already developed towards its intended outcome. The forecasting process is adopted by the employees, which reduces costs and enhances efficiency. Therefore, this flow is placed lowest in the framework.

These insights are used to present the refined flow in Section 6.5, in which the order of the flows is adjusted based on their identified relevance.

6.4 Limitations

To validate the framework, I aimed to interview at least two representatives from external parties and one person per internal department. This limits the outcome, as the number of internal interviewees is relatively small. However, the employees interviewed, were the key decision-makers involved in the FrieslandCampina case study and therefore relevant participants. Externally, I was only able to interview one person from the depots in Rotterdam. As a result, a total of nine interviews were conducted instead of planned ten. Nevertheless, I interviewed an employee from STAR, which was the most relevant depot for this thesis.

In addition to the interviews conducted, two interviews were carried out over email, because the participants were unavailable for online meetings. As it was not possible to do the interviews in person, the interview questions from the protocol were sent to the participants, who responded over email. These responses are used as input for the interview results, as they still contain the participant's own words.

During the interview period, I also attended four meetings involving different stakeholders. However, the meetings could not be used as input for the framework validation, as no accurate transcriptions or notes were available. While some useful insights were derived from these meetings, these are used as contextual background, but not directly in this validation.

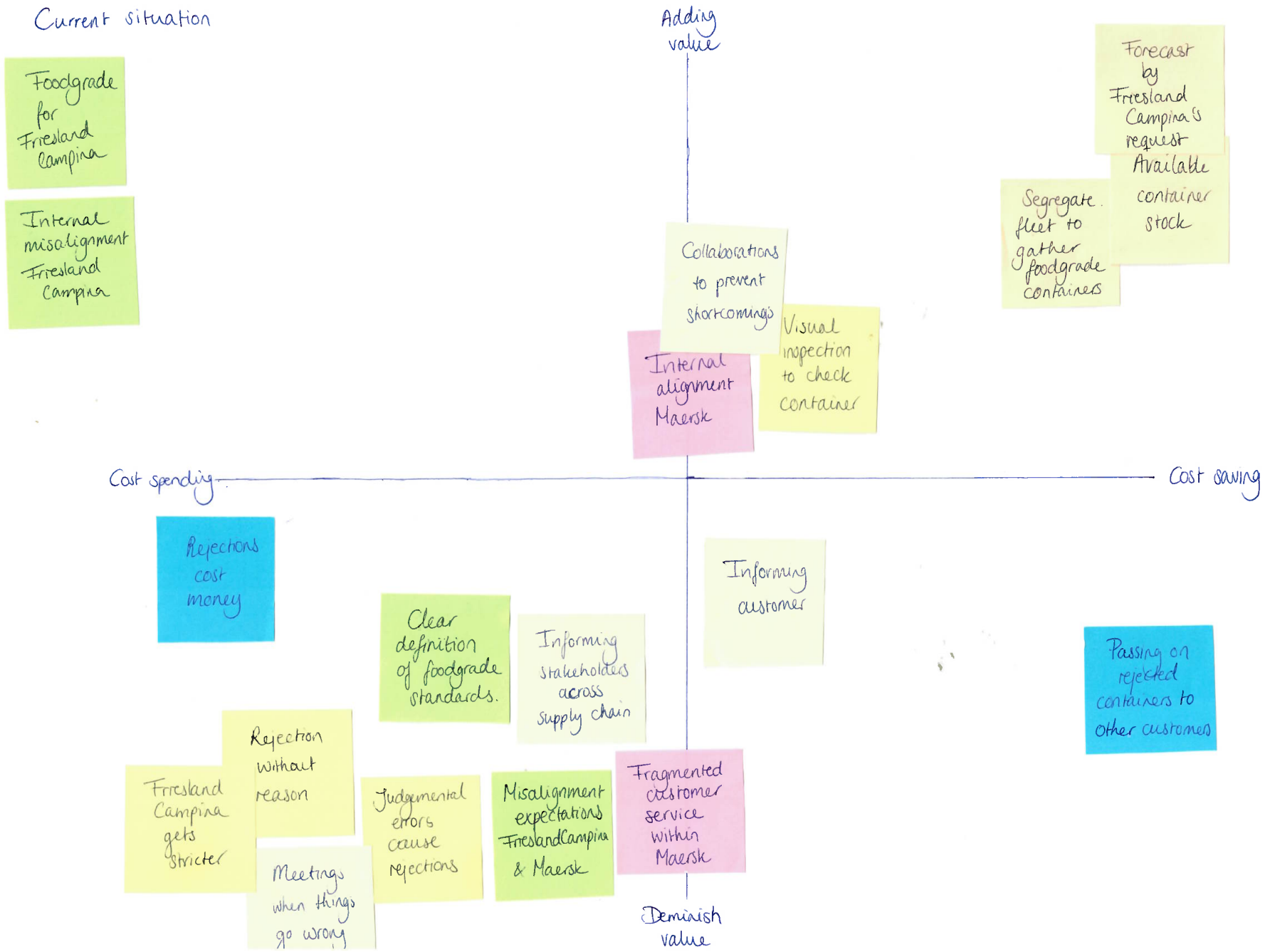


Figure 34: The derived themes from interviews mapped onto a C-box, the x-axis representing cost, the y-axis representing customer value.

6.5 Conclusion

With the interview insights, the framework is validated. By clustering the coded themes within the different flow of the framework, the relevance of the themes was established. Most themes matched the flows, and two themes matched the value stream of reducing costs. However, one of these themes fell outside the scope and the other theme did not add additional information. Therefore, these themes were left out of the conclusion.

With the derived themes, all flows were validated, which revealed their current state. Four of the five flows do not reach the desired outcome and therefore still experience the waste caused by the challenges. The depth of implementation (process) and adoption (outcome) of these flows is therefore presented in the refined framework (Figure 35). The boxes over the flows represent progress in the implementation and adoption. The further the box extends to the right, the higher the level of implementation and adoption is.
Most flows show initial process implementation. However, these processes are not fully adopted by all employees and stakeholders. As a result, the flows do not yet achieve full operational efficiency. However, the last flow, the (volatile) empty flow, is fully adopted and implemented.

Furthermore, the order of the flows was validated. By mapping the themes derived from the interviews onto a C-box, their importance was identified. This determined the order of the flows in the refined framework. In addition, some flows are interconnected, as they influence each other.

In conclusion, this framework highlights the most pressing flows that requires attention, misaligned supply chain standards. This flow must be redesigned to achieve enhanced operational efficiency (Mentzer et al., 2001). This direction is therefore selected as the design direction in the upcoming chapters of this thesis. The other flow that requires attention is the fragmented customer service flow. Since there is a lack of time, this flow will not be addressed at this stage of the thesis.

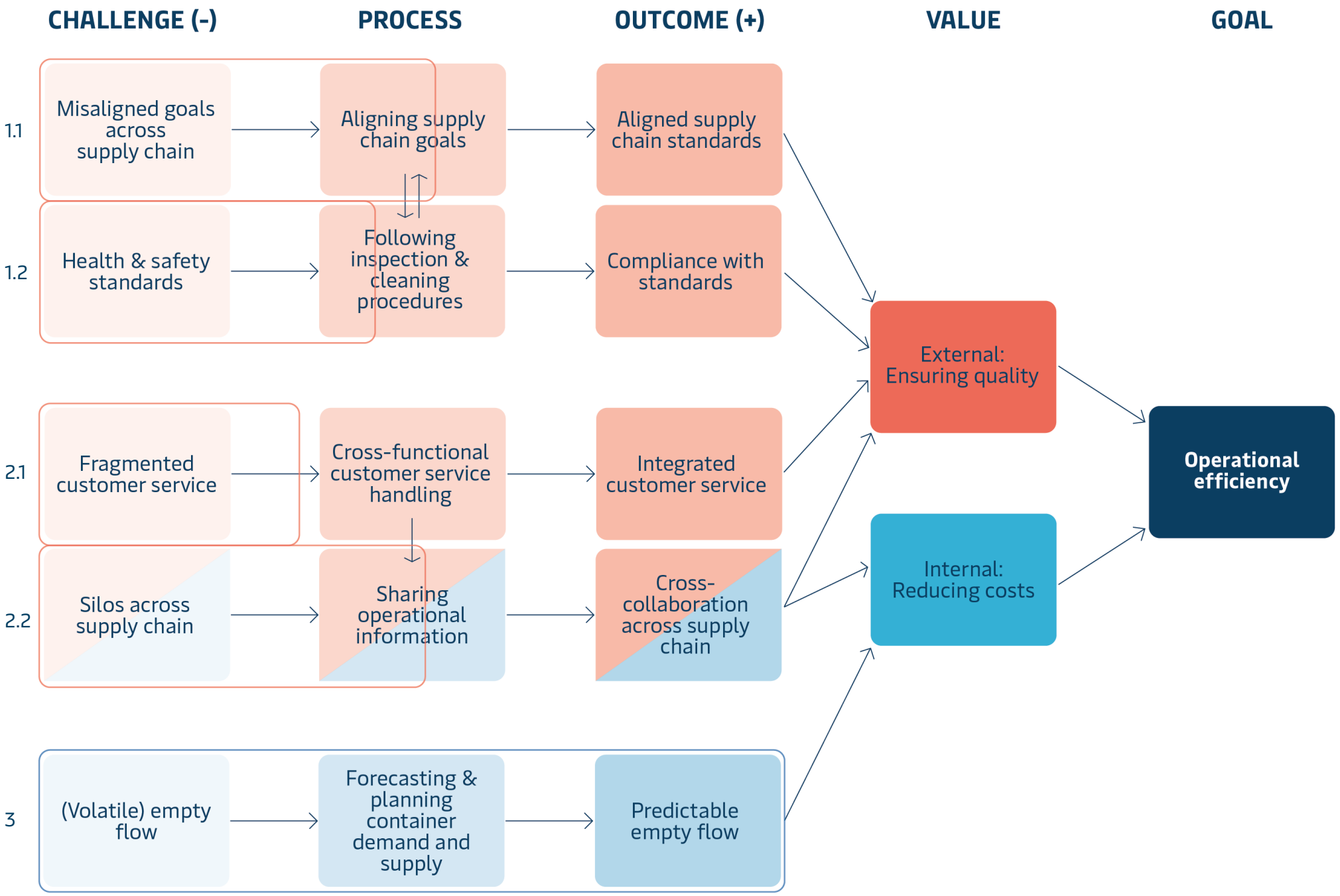


Figure 35: The refined foodgrade container supply chain efficiency framework

7

Design process

As introduced in Section 1.4, this thesis uses the approach of the double diamond framework. The first diamond has been completed, with the refined framework proposed in Chapter 6 serving as the conclusion of the design direction. Within this design direction, the misaligned goals across the supply chain must be addressed through a design intervention.

To design this intervention, an agile approach is applied, meaning that three design sprints are executed (Figure 36). By working in sprints, rapid design outputs are generated, which creates room for iteration. The first sprint focuses on the desirability of the design. This means that the design should solve the actual problem of misaligned goals and validate whether it meets the needs of Maersk. After the desirability sprint, the feasibility sprint follows. This sprint aims to assess whether the design works and can be implemented in the current ecosystem. Lastly, the viability sprint focuses on whether the design has a positive impact in the long term. This sprint examines the value the design delivers over time to assess whether the concept can be implemented with sustainable impact.

In this chapter, the activities executed in each sprint are discussed. The chapter starts with the desirability sprint, followed by the feasibility sprint, ending the chapter with the viability sprint.

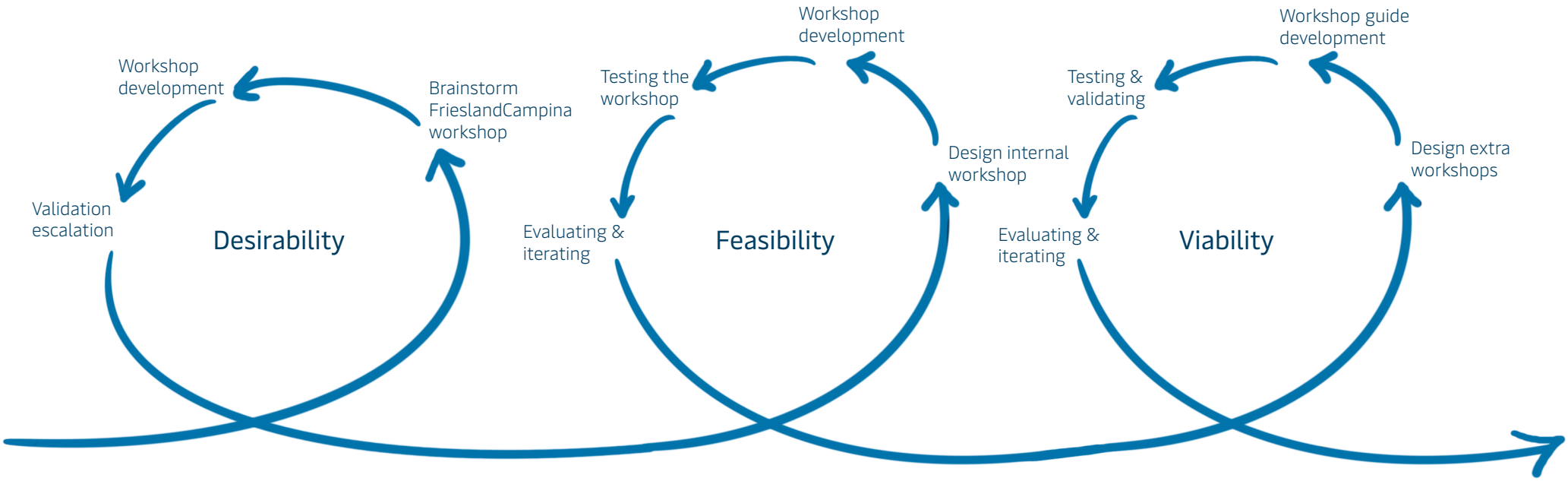


Figure 36: The design sprints conducted in the design process

7.1 Desirability sprint

At the start of the desirability sprint, the design direction was already determined. Based on the interview insights, it was concluded that the design should create aligned goals across the supply chain to enhance overall efficiency. From there, I started with the 5W1H method to verify whether all information was complete and to initiate idea generating (Appendix L). At this point, it was clear that a design was required to create alignment among stakeholders.

Brainstorm & design
To create the design, I continued brainstorming based on the initial insights from 5W1H. Through how-tos and brainstorming techniques (Appendix L, Figure 37), I identified that developing a workshop to align participants would be a suitable apporach, as this would facilitate clear communication of ideas and perspectives among stakeholders. Consequently, this approach became the direction of the design.

Develop
With the workshop direction, I started designing a suitable workshop aimed at bringing FrieslandCampina and Maersk closer together. These stakeholders currently operate based on different standards, which requires alignment (Section 6.2.3). The workshop needed to be interactive and foster an open atmosphere to ensure that the stakeholders would work towards agreement during the workshop. Appendix M presents the partially developed design for this workshop.

Validation
During the development of the workshop, the situation between Maersk and FrieslandCampina unfortunately escalated. This made it impossible to organise and execute the designed workshop within the time-bound scope of this thesis, partly due to uncertainty regarding the upcoming period of collaboration between both parties.

Although this situation was unforeseen, it immediately highlighted the desirability of the design, which created an acceleration towards the validation phase of the first sprint. A joint workshop involving both Maersk and FrieslandCampina was no longer desirable in the current context. Based on this insight, the design direction was redirected towards the other critical flow for Maersk, the fragmented customer service (Section 6.2.2). During and after the interviews, it became clear that the employees of Maersk require internal alignment to move towards an integrated customer service. Achieving this would lead to delivering higher value to customers and enhancing operational efficiency. In addition, the internal collaboration will strengthen, which is also useful in situations such as the escalation with FrieslandCampina. Thus, this will be the design direction in the feasibility sprint.

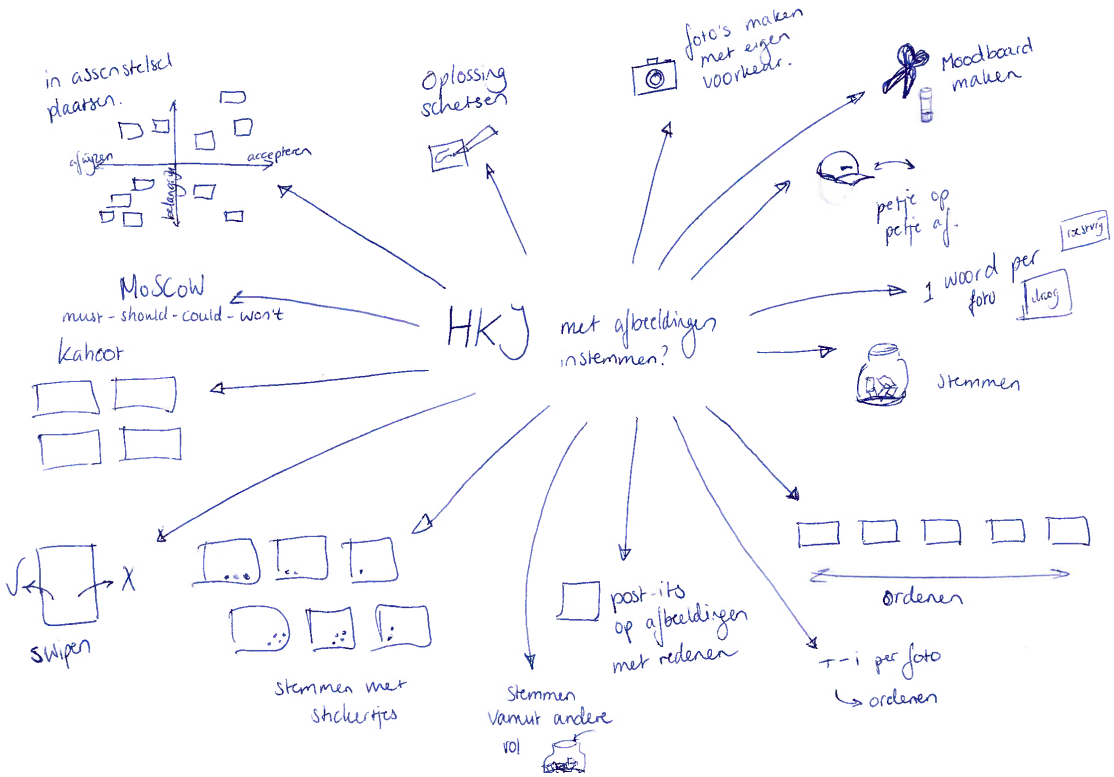


Figure 37: Brainstorming with How-to method

7.2 Feasibility sprint

From the insight gained in the desirability sprint, where a joint workshop with FrieslandCampina was not possible, I shifted towards the approach of designing an intervention to create cross-functional customer service handling and, ultimately, an integrated customer service. In addition, I considered it important that the design could be used as an escalation tool. During escalations, internal alignment is essential, because the customer service is in the spotlight. Therefore, the aim is to design an intervention that establishes an integrated customer service and is suitable for use during escalations.

Brainstorm & design
To design for this alternative flow, I used the ideas gained during brainstorming activities in the desirability sprint. This enabled me quickly start sketching workshop concepts (Figure 38). Initially, the aim was to develop a design that could also be applied online. However, the goal of these workshops is to create an integrated customer service, which requires collaboration, communication and alignment, elements that can be achieved more effectively when employees sit physically in the same room. Therefore, I decided to develop a workshop in which no laptops are required.

Develop
The idea of the workshops evolved into a workshop that Maersk's employees can use without my presence. Additionally, the workshop must address a specific problem to ensure that the workshop has a tangible impact and leads to actual process improvement. Therefore, the developed workshop consists of six steps, each focused on fostering communication around the issue in the supply chain, ultimately contributing to an integrated customer service. Several creative techniques are incorporated, such as problem generating, clustering and mapping. I found these techniques through researching workshop facilitation methods and applied these to the context of my workshop design.

Validate
To validate the workshop, I organised a session with the internal stakeholders involved in the FrieslandCampina case. During this workshop, the unclear communication channels of this process were addressed to assess whether this workshop could be applied to different processes beyond the case study of this thesis. I created a complete step-by-step set-up to test the workshop, including templates (Appendix N).

Prior to the workshop, I also discussed it with my supervisor at Maersk to ensure its relevance and usefulness within the applied case study. After this pilot, several details were adjusted.
Five participants attended the workshop, which was completed within an hour. This was unexpected, since the planning was tight.

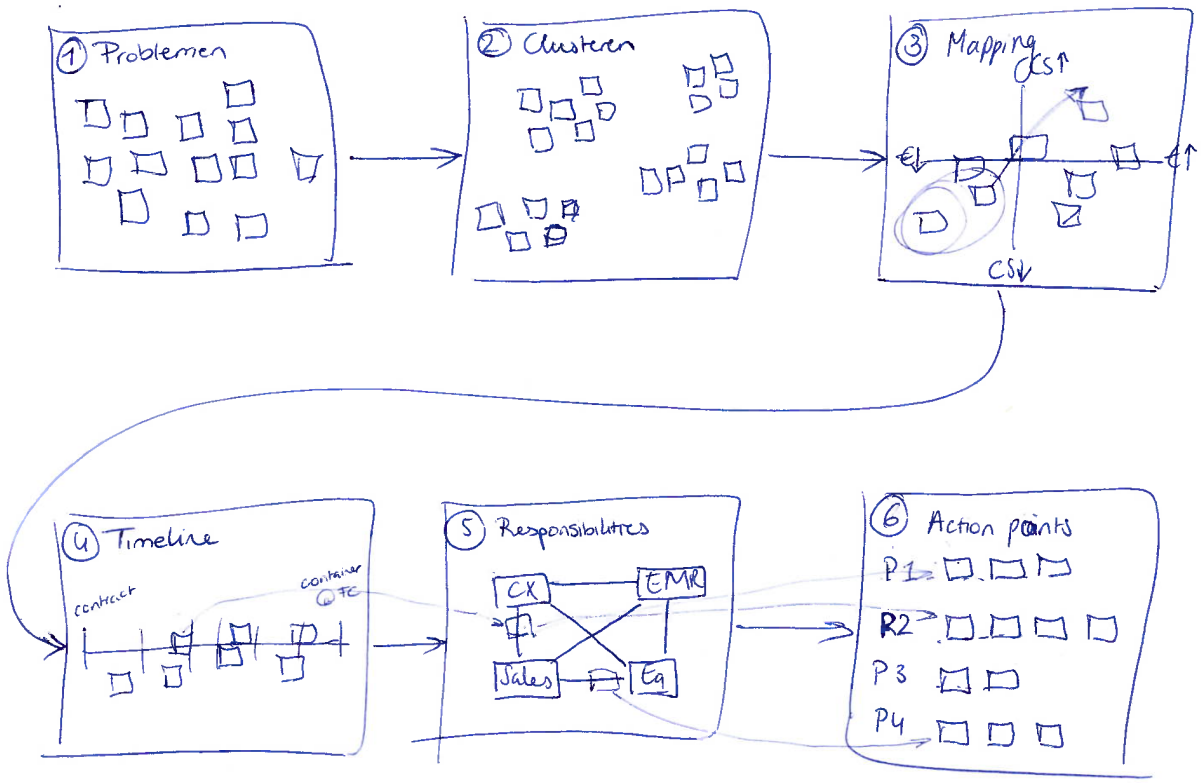


Figure 38: Sketching set-up workshop steps

However, with strict facilitation management, this was feasible. For a less experienced, additional time would be recommended.
The workshop proceeded as intended, with active participation from all attendees. They generated problems, mapped and created tasks (Figure 39, 40, 41). The steps in the workshops were clearly understood, which validated the components of the workshop design.

A significant insight that emerged from this workshop, was that it raised many questions. I assumed that the participants had adequate insight into the tasks and responsibilities of other departments, but this was not the case. Participants asked many questions during each step, which made slowed the progress down. The participants wanted an immediate answer to their questions, which made the workshop shift towards detailed process issues. This observation highlighted the necessity of an extra workshop prior to this one that clarifies the goal and process of the supply chain.

In addition to the need for an additional workshop, participants also expressed concerns about the implementation of the defined tasks. While a follow-up meeting was already considered, this feedback highlighted the urge of this follow-up. Here, a responsibility matrix can be used to support implementation.

In conclusion, the currently designed workshop is feasible within the context of Maersk. However, additional workshops before and after are required to provide clarity. The first workshop should focus on establishing a shared goal and process, as the customer service is currently fragmented. This makes the participants unaware of the full process at other departments. The third workshop should create a clear result that can be implemented across the process. These insights marked the conclusion of the feasibility phase.

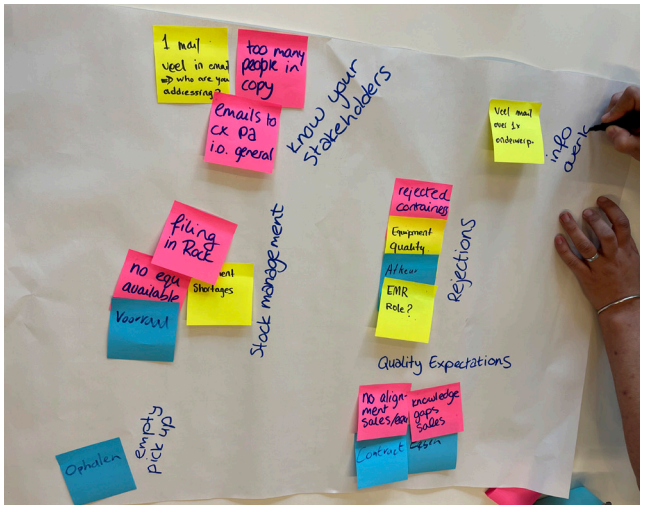


Figure 39: Problem clustering

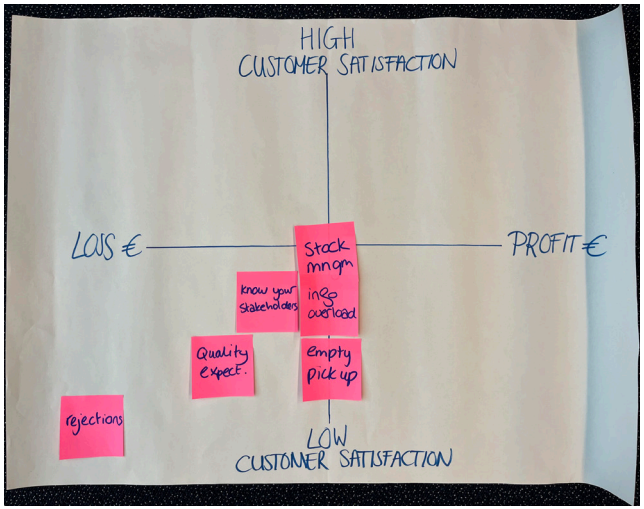


Figure 40: Mapping the clusters

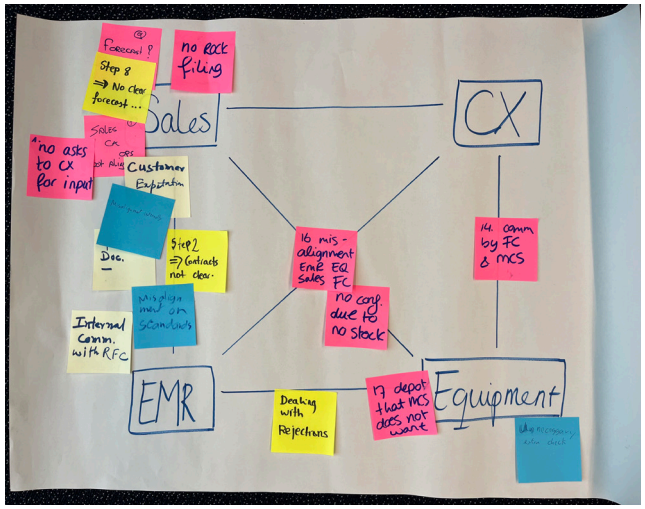


Figure 41: Identifying responsibilities

7.3 Viability sprint

During the viability sprint, I started with the idea of designing three workshops to create a more integrated customer service during escalations. For this, it is important that employees of Maersk are able to execute these workshops independently after I finish this thesis. Therefore, I decided to develop a workshop guide in which all workshops and their context are explained. This guide is intended to support the workshop host.

Brainstorm & design
With the concept of the workshop guide, I started sketching ideas for these workshops that would meet the goal of creating an overview of the process for Workshop 1 and a clear implementation tool in Workshop 3 (Appendix O). During the sketching phase, I also linked my workshops towards the lean supply chain management approach. The five steps can be applied across the workshops: identify and map in Workshop 1, flow and produce in Workshop 2, and iterate in Workshop 3 (Figure 42). Using this structure, the complete series was designed.

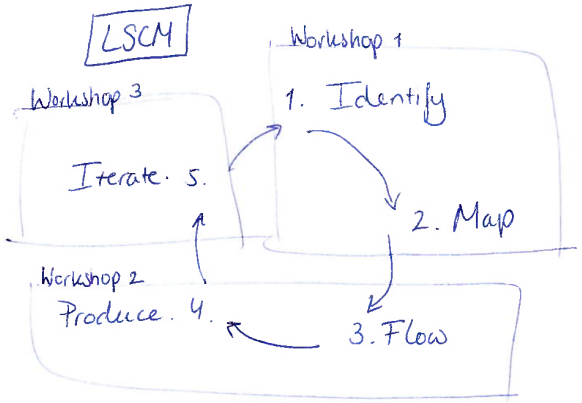


Figure 42: LSCM steps with workshops

Develop
It is important to develop a tool that ensures implementation after the workshop series. Maersk currently works with RACI-matrices, which stands for Responsible, Accountable, Consulted and Informed. Within this matrix, the different tasks for each department are assigned per process activity. This approach prevents overlapping responsibilities and creates an internal SLA. However, the information exchanges are not included in this matrix. Therefore, I decided to integrate the information streams into the RACI-matrix to create broader understanding and clear agreement among the stakeholders. When this RACI-matrix is implemented, Maersk can achieve a more integrated customer service, leading to enhanced operational efficiency.

Validate
During the second validation session, I followed up on the workshop conducted in the feasibility sprint. Through this follow-up, I aimed to validate both the impact of the workshops and the RACI-matrix with integrated information exchanges. Besides, I also wanted to validate who would have to take up the role as workshop host. By assessing the impact, the viability of the workshop can be evaluated.

Unlike the first workshop, this workshop was held online. While this was unplanned, it was useful to test whether this format would also be suitable for the workshop. However, online engagement with and between participants was lower than during the in-person workshop. Additionally, since Maersk is an operational company, the work continues even during meetings. This made the participants tempted to send emails or carry out other daily tasks. Therefore, I would recommend hosting the workshops in person without laptops present.

Even online, the workshop was useful. We started by evaluating the tasks, and all participants were open about their experiences, which created an open atmosphere and strong participant engagement.

After evaluation, the participants (Sales, CX, Equipment, and EMR) all contributed to creating a shared RACI-matrix that they could use (Figure 43). In FigJam, the participants used post-its to evaluate tasks, build on the RACI-matrix, and create alignment. During this workshop, it became clear that it was a wise decision to prepare the RACI beforehand, since creating it with the entire group takes a lot of time. It is more useful to go over it together than to create it fully during the workshop.

In addition to validating viability, I also aimed to validate several recommendations. As stated in Section 6.2.2, the current customer service is not only fragmented, but also reactive rather than proactive. Proactivity cannot be achieved in a workshop series, as it requires time. Therefore, my proposal is that these workshop sessions are used at the start of new processes or with new customers. This would increase the impact of the workshops and enhance Maersk's operational efficiency, not only within the foodgrade container supply chain, but across multiple processes.
After the workshops, I still recommend this alignment workshop(s) with customers. During the workshops, it became clear that it is highly useful to bring people together to discuss their needs and problems and create alignment. This should also be done with customers.

Besides applying the workshops to new processes or customers, I also recommend implementing Workshop 1 as part of the onboarding programme. This would help new employees gain an early understanding of tasks and responsibilities across departments and supply chains. Therefore, this recommendation was validated during the workshop. The participants also saw the need for this. The departments with new employees should show and explain the RACI-matrix to them to ensure the supply chain keeps performing.

In conclusion, the second workshop was successful, as it resulted in a clear RACI-matrix for all departments. I created a neat document after the workshop and shared it with all internal stakeholders involved in the FrieslandCampina supply chain.
However, I decided to change parts of the workshop. Instead of drawing the information streams, I decided to group the activities across the supply chain. Additionally, the host has to prepare the RACI-matrix beforehand. These adjustments are implemented in the final design.



Figure 43: The RACI-matrix results in Figjam

8

Final design

Through the three sprints in Chapter 7, the final design was created. This final design takes the form of a workshop guide and a RACI-matrix for the foodgrade container supply chain of FrieslandCampina. These are explained in more detail in this chapter. The chapter starts by elaborating on what the workshop guide is and how it can be used.

8.1 The workshop guide: Integrated Customer Service

The workshop guide is developed to enable employees of Maersk to execute the workshop series independently. The workshops can be used as an escalation tool when problems with customers occur and help to create insight among employees involved in the processes. Furthermore, they are encouraged to improve the communication channels in this process. By applying the workshops, Maersk can achieve internal alignment and establish stronger communication channels, ultimately leading to an integrated customer service. This increases the value delivered to the customer, thereby enhancing overall operational efficiency.

Through the use of several creative techniques, the employees apply the lean supply chain management approach. By applying this approach, the workshops follow a clear structure of value identification and supply chain mapping, followed by enabling communication flows to work and implementation in their daily operations. To address all steps of LSCM, the workshops are a series of three:

- *Explore - Workshop 1*
  The first workshop aims to align the participants by identifying the value of the supply chain and mapping the entire process of the addressed problem. Through this mapping, knowledge gaps among the employees, caused by silos, are addressed. This ensures shared understanding of the supply chain, which enables the redesign of the communication channels for integrated customer service.

- *Define - Workshop 2*
  The second workshop has its focus on improving communication channels by addressing the problems that lead to unclear communication channels across the supply chain. In addition, the participants develop with concrete process tasks aimed at improving the supply chain's integrated customer service.

- *Refine - Workshop 3*
  The third workshop enables the participants to iterate on the process tasks developed during the Define Workshop. During this workshop, the effectiveness of these tasks is evaluated, after which refined tasks are implemented in the supply chain. The workshop concludes with a full overview of all tasks, responsibilities and the information exchanges, developed by the participants in the form of a RACI-matrix. This serves as a SLA for executing the different process activities. To keep this RACI-matrix working over time, the participants also discuss how they will use the matrix and who is responsible and accountable for updating it.

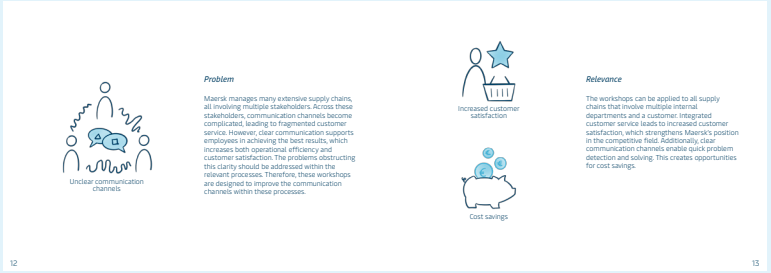
Figure 44 shows pages of the workshop guides. There are four booklets, together creating a strong basis to host the three workshops. The first booklet is the overview booklet, followed by three booklets addressing the workshops. Since the guides are extensive, only a selection of pages is included to provide insight into the final design. However, for a complete understanding, it is recommended to consult the full guide.

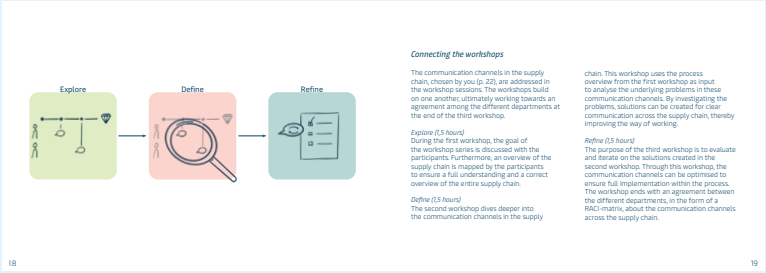
The guides are written in detail, as employees are expected to host the workshop independently. Therefore, the guide begins by explaining its purpose and scope. This is followed by an explanation of the context and an overview of the workshops, which clarifies what the reader can expect and what impact it may have. Subsequently, the deliverable of the RACI-matrix is explained to help the host understand what results have to be achieved at the end of the three workshops. Furthermore, an example of the FrieslandCampina workshops and RACI-matrix is provided, to give the host realistic insight into the workshops and their result.

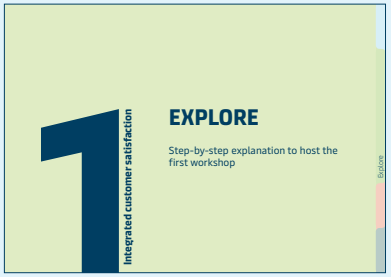
Additionally, some workshop preparation guidelines are provided. These guidelines help the host select the problem addressed during the workshops and inform what needs to be organised beforehand. The host can select any process that involves multiple internal stakeholders from different departments, particularly processes that also involve customers and external stakeholder. Furthermore, workshop variances are provided to allow the host to adapt the workshops to the specific problem and participants.
In addition, recommendations for next steps are presented, which provides insight into how the workshops can have a broader impact in the long term.

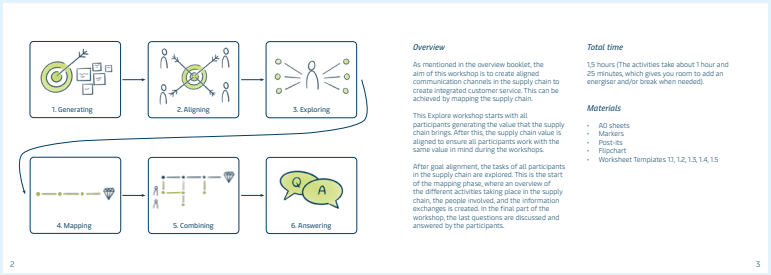
After the workshop overview booklet, each workshop is explained in detail in a seperate booklet. Following these steps allows the host to facilitate the workshop. Each intro, part, and outro explains what the output goal is, what materials are needed, and how much time it takes to carry out the tasks. Furthermore, the purpose of the part is explained to give the host insight into why they carry it out. A step-by-step plan fully explains each step the host has to take with the participants.



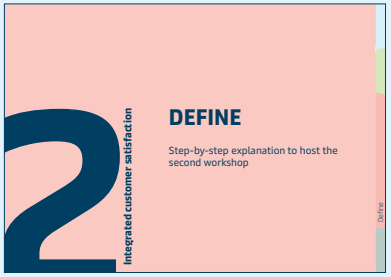


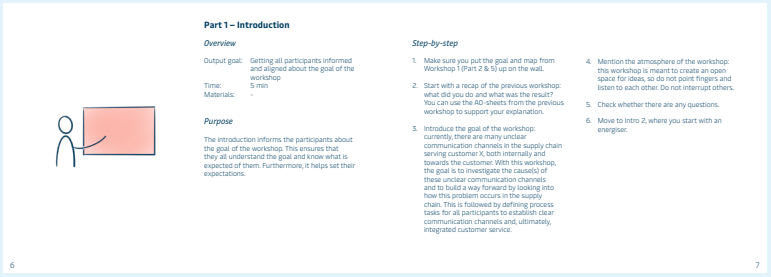


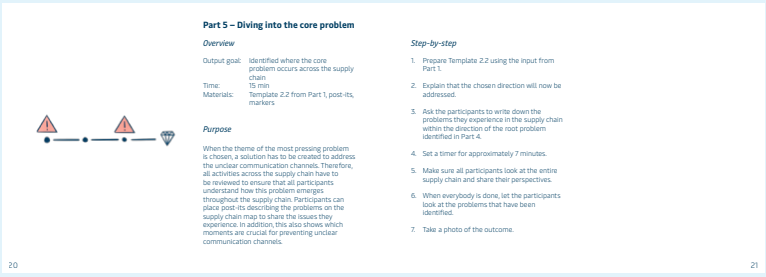
















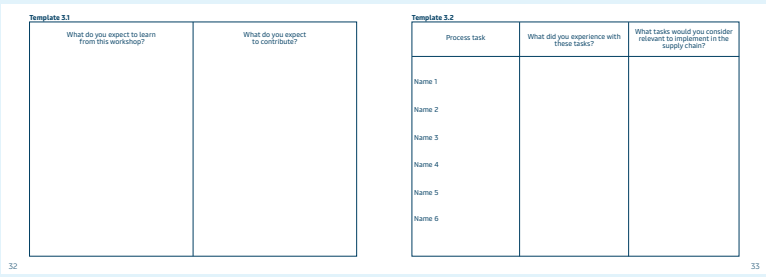


Figure 44: The workshop guide - Integrated customer service

In addition, all required templates are included in the final chapter of the guide. These templates visualise insights for the participants, which supports understanding, and supports the host through the activities.

After the workshops, the host can send a neat version of the RACI-matrix to the participants. To support the host, an Excel sheet is created (Figure 45). Excel is often used within Maersk and is therefore a suitable and sustainable tool for creating this overview.

In conclusion, the workshop guide enables employees of Maersk to build integrated customer service within supply chains that serve customers. By applying these workshops, internal information exchanges and communication channels are aligned, which improves the value delivered to customers. Creating integrated customer service ultimately enhances Maersk's operational efficiency.

	A	B	C	D	E	F	G
1		**Activity**	**Information exchanged**	**Dep1**	**Dep2**	**Dep3**	**Dep4**
2	1						
3	2						
4	3						
5	4						
6	5						
7	6						
8	7						
9	8						
10	9						
11	10						
12	11						
13	12						
14	13						
15	14						
16	15						
17	16						
18	17						
19	18						
20	19						
21	20						
22							

Figure 45: The RACI-matrix Excel sheet

8.2 The RACI-matrix for the FrieslandCampina supply chain

In this thesis, the foodgrade container supply chain for FrieslandCampina was addressed, since it had many problems, with fragmented customer service standing out. The sessions held to validate the workshops designed for this thesis, created a RACI-matrix (Figure 46). All departments (Sales, CX, Equipment, and EMR) were present during these sessions, or gave input afterwards. Together, the input created a complete RACI-matrix, covering all activities, information exchanges, and customer contact points.

The departments currently use the FrieslandCampina RACI-matrix. It already supports them in reaching out to the other departments more easily and helps them understand the responsibilities and activities for each department. Thus, the RACI-matrix is improving the integrated customer service at the office.

During the Refine workshop, the participants also discussed that the RACI-matrix will be updated if they experience that adjustments are needed. All participants can suggest these adjustments. Besides, the Equipment Manager will be responsible for the workshops internally, since he is closely involved in the process and has a good overview of the process from his position in the company. This keeps the RACI and the workshops alive over time.

		Activity	Information exchanged	Sales	CX	Equip-ment	EMR
Contract	1	Alignment call with E&E and sales prior to new tender release		R,A		C	C
	2	Sales proposes contract for tender to FC	• Quality container documents. Nominations 8 weeks prior effective tender date. • Volumes per pick-up location, per equipment type, per quality type needs to be received. • Make FC aware of the importance of having a forecast.	R,A			
	3	EMR & equipment provide input for contract to sales	• E&E gives feedback on what can/ cannot be delivered per equipment type and quality.	I	I	R,A	R
	4	Sales & FC sign contract	• Contract will be signed only on certain stipulation which need to rewritten for the contract. Not EMR related but very much interesting for next year.	R,A			
	5	Sales informs CX and E&E about nominations per origin and equipment type	• E&E needs to discuss supply plan, safety stocks, customer allocation (or not) and inform suppliers (depots) on what is expected from them.	R,A	I	I	I
	6	Sales files contract to enable bookings at CX	• Sales files allocation in CAT and requests customer allocations in ROCK from Equipment.	R,A	I	I	
Booking	7	FC books with CX through intermediary			I		
	8	Equipments receives booking from inland depot	• Number of equipment needed			I	
	9	Equipment handles stock management for booking	• Ensure forecast is up to date and target stock levels are set corrrectly			R,A	I
	10	Container cleaning and repairing					A
	11	Container transport to inland depot	• Number of containers needed for repositioning			A	
	12	Informing FC of container release			R,A		
	13	Inland depot checks container and transports it to FC					
	14	FC accepts or rejects container					
	15	Rejection: FC contacts CX	• Details about rejection: reason and pictures from inland depot		I		
	16	CX takes the discussion with FC and brings the case to Equipment & EMR			R,A	I	I
Rejection	17	Equipment gives return order for the rejected container	• Number of containers rejected and where they were released so EMR can pick them up with the right depot			R,A	
	18	EMR investigates rejection cause					R,A
	19	Inland depot transports new container to FC					
	20	Equipment files a Manual PO for inland depot for extra transports				R,A	

◯ = contact point with FrieslandCampina, R = Responsible, A = Accountable, C = Consulted, I = Informed

Figure 46: The RACI-matrix for the FrieslandCampina supply chain

9 Conclusion

This thesis contributes to enhancing efficiency at Maersk, specifically for the foodgrade container supply chain for FrieslandCampina. Through the case study analysis, literature review, semi-structured interviews and design process, the research questions and the sub questions have been addressed.

In this chapter, the main research question, followed by sub research questions are addressed. Subsequently, the chapter elaborates on the contribution of this thesis for Maersk, as well as on social, economic, and environmental levels. The final sections discuss the limitations and provide recommendations for future research.

9.1 Main research question

As stated Section 1.2, the research question addressed in this thesis is:

'How can Maersk enhance the operational efficiency of the foodgrade container supply chain?'

As stated in this thesis, efficiency can be validated by value delivered to the customer at the lowest possible cost for Maersk. Therefore, these aspects are used to assess the efficiency of the foodgrade container supply chain.

To answer the main research question, the sub questions were used, as together they lead to answering the main research question (Section 9.2). Maersk can enhance the operational efficiency of the supply chain by eliminating the challenges within, which results in positive outcomes that contribute to both increased value delivery to the customer and cost reduction within Maersk.

By focusing on the flow of [2.1] fragmented customer service, Maersk can achieve enhanced operational efficiency by establishing integrated customer service. This has to be both implemented and adopted by employees to achieve integrated customer service. By applying lean supply chain management, the communication channels within the process can be clarified. This creates an integrated customer service, since the internal departments know where to find each other, when to connect, and what responsibilities all departments have. This ultimately leads to higher value delivered to the customer of the foodgrade container supply chain.

However, Maersk would also benefit strongly from creating a design to [1.1] align the customer's expectations with Maersk's standards. Due to time constraints, this could not be executed and is therefore a recommendation addressed in Section 9.5.

In conclusion, by eliminating fragmented customer service through cross-functional customer service handling, Maersk can create integrated customer service, which increases the value delivered to customers, thereby, enhancing operational efficiency.

9.2 Sub research questions

This section answers all three sub questions of this thesis.

What challenges in the foodgrade container supply chain lead to rejections?
The foodgrade container supply chain is an extensive process that inherently involves multiple challenges. However, this thesis gathered the five main challenges within the proposed framework in Chapter 6 (Figure 38).

[1.1] Misaligned goals across the supply chain lead to rejections, as they result in misunderstanding between stakeholders (Adner, 2017; Cooper et al., 1997; Porter & Millar, 1999). This poses the first challenge, as Maersk and FrieslandCampina operate based on different standards. This difference leads to container assessment according to different criteria, which contributes to rejections.
[1.2] The second challenge concers health & safety standards, which refers to the subjectivity and lack of clarity of the standards applied by both Maersk and FrieslandCampina. This subjectivity creates the opportunity for human errors to occur, leading to rejections, which lowers the value for FrieslandCampina and causes Maersk to not comply to the agreements (Adner, 2017; Jin et al., 2002). This challenge is also influenced by the misaligned goals across the supply chain.

[2.1, 2.2] The third and fourth challenge contributing to rejections are fragmented customer service and silos across the supply chain. Both, internal and external fragmentation creates silos, which reduces the efficiency across the supply chain. Internally, fragmented customer service leads to reduced value delivered to the customer, while externally, silos result in decreased responsiveness and slower problem-solving (Li et al., 2005; Mentzer et al., 2001; Vargo & Lusch, 2016). Internal fragmentation leads to external fragmentation, making the challenges intertwined.

[3] Lastly, the (volatile) empty flow can also lead to rejections, as this determines the availability of high-quality foodgrade containers. When only lower-quality containers are available, it is more likely for rejections to occur, leading to increased costs for Maersk.

The challenges in the foodgrade supply chain can each lead to rejections independently, as they influence the stakeholder's and the customer's operational standards, inspections, internal and external collaboration, and container availability. However, these challenges can also reinforce one another, which further increases the chance of rejections.

How can Maersk eliminate waste across the foodgrade container supply chain?
To eliminate waste across the foodgrade container supply chain, the challenges have to be prevented (Ionel, 2024; Li et al., 2005). For this, implemented processes can transform the challenge into positive outcomes. However, to achieve the outcomes, adoption by Maersk is essential.

[1.1] The first processes supporting waste elimination is aligning the supply chain goals to address misaligned goals across the supply chain. This alignment increases the value for customers. [1.2] Furthermore, following cleaning and inspection procedures leads to compliance with the health and safety standards.

[2.1] Internally, cross-functional customer service handling can lead to an integrated customer service. [2.2] At the same time, sharing operational information enables cross-collaboration across the supply chain, which prevents silos. [3] Lastly, forecasting and planning container demand and supply contributes to a predictable empty flow.

Currently these processes are implemented but not fully adopted. Therefore, full adoption of these processes within Maersk is required to ensure that the waste is eliminated.

How can Maersk improve the value they deliver to customers?
To improve the value delivered to customers, rejections must be prevented at Maersk. Rejections lead to decreased customer satisfaction, which Maersk needs as a profit-driven company. They have to take good care of the customer relationships to enhance the value for the customer (Adner, 2017; Li et al., 2005; Mentzer et al., 2001; Truong et al., 2017). Therefore, the identified challenges have to be transformed into positive outcomes.

In the foodgrade container supply chain, the five challenges discussed above all contribute to rejections. In particular, [1.1] misaligned goals across supply chain and [2.1] fragmented customer service affect the customer satisfaction. To deliver increased value to customers, alignment across the supply chain and an integrated customer service are essential.

Through alignment, Maersk, FrieslandCampina, and other stakeholders align on the requirements that foodgrade containers must meet. This makes the expectations align, leading to fewer rejections and improved value delivered to the customer.

Creating an integrated customer service also improves the delivered customer value. When Maersk is internally aligned, the communication and information towards the customer become clear. This leads to improved problem detection and problem-solving, thereby delivering increased value to the customer.

In conclusion, Maersk can improve the value delivered to customers by aligning goals across supply chains and creating integrated customer service.

9.3 Contribution

This thesis contributes to different aspects of Maersk and provides a social, economic and environmental contribution through the design intervention of the workshop guide. Therefore, this section elaborates on the contributions delivered by this thesis.

Theoretical contributions
The developed foodgrade container supply chain efficiency framework provides a theoretical contribution to Maersk. This framework identifies the different challenges, processes, and outcomes that influence the operational efficiency of Maersk's the foodgrade container supply chain. Additionally, the framework defines the operational efficiency at Maersk as the highest value delivered to the customer at the lowest possible cost. Maersk can use this framework in the future as a reference to enhance efficiency across multiple supply chains.

Practical implications
For this thesis, a workshop guide for Integrated Customer Service is designed and developed. Maersk can use this for multiple customers. The booklets are a physical contribution to the company.

Additionally, the complete RACI-matrix for the supply chain of FrieslandCampina is a contribution to the Sales, CX, Equipment, and EMR departments.

Contribution to Maersk's competitive position
For Maersk, the main outcome of this thesis, the workshop guide, contributes to enhanced operational efficiency. Applying the workshop

series leads to increased value delivery to the customer, as clear communication channels enable an integrated customer service.
Since Maersk is a profit-driven company, this is beneficial, as increased customer value also strengthens their position in the competitive field. Through the adoption of the workshops, an integrated customer service can support this strengthened competitive position.

Social contribution
The workshop guide improves internal collaboration. By discussing the problems and creating clear responsibilities, the collaboration between departments strengthens. In addition, an integrated customer service contributes to building stronger relationships with the customers and other stakeholders. Clear communication streams lead to enhanced customer satisfaction, which helps strengthens relationships over time.

Economic contribution
Within in this thesis, the container rejections have been analysed. Through the application of the workshop guide, the rejection rate can be decreased, as the internal departments become aligned. By reducing the rejection rate, Maersk's profitability increases. With rejections costing about €500 per container, there is a lot of potential impact. For 2026 alone, this could result in a reduction of approximately €75.000.

Environmental contribution
Beyond the economic benefits of less rejections, the workshop guide also contributes to environmental sustainability. Less rejections lead to less additional container transports from Rotterdam to inland depots to Rotterdam. This reduces transport emissions.

9.4 Limitations

In this thesis, I am the only responsible researcher. This creates the risk of a biased view. In addition, there I had to deliver results within the scope of this thesis, which can have steered the direction of this thesis. To mitigate this bias, multiple validation rounds were conducted throughout this thesis, including interviews, and the workshop sessions.
However, despite the validations, bias may still occur. The thesis would have been less not have these limitations if it had been conducted within a multidisciplinary team and without strict time constraints.

Currently, the workshop guide is ready to use for employees of Maersk. However, employees also must be aware of the existence of the guide and the potential impact. After this thesis, a limited number of employees know about this, which can limit the use of the guide.

9.5 Recommendations

The design direction of this thesis was to develop a design that creates an integrated customer service within Maersk. However, during the research multiple flows were identified that could also serve as design directions, which is a recommendation for further research. This section therefore elaborates on specific recommendations related to these flows, as well as recommendations aimed at expanding the impact of the workshop guide.

A workshop for customers
To enlarge the impact of the workshops, I recommend developing a workshop (series) that also aligns the expectations of Maersk and their customers. This also connects with the [1.1] aligned goals across supply chain from the framework. For this, the workshop in Appendix M can be further developed. By organising a workshop with customers, the misalignment flow can be addressed, which enhances the operational efficiency.

A workshop for external stakeholders
In addition to workshops for customers, a workshop with external stakeholders would improve collaboration across the supply chain, as this would break silos. Therefore, I recommend adapting the workshop series towards a workshop for external customers as well. As an initial step, stakeholders could be invited to participate in the second workshop, after the first workshop is conducted internally.

From reactive to proactive
The customer service of Maersk is reactive. While implementing the workshops leads to collaboration and communication for an integrated customer service, it does not make the customer service proactive. Therefore, I recommend using these workshops at the start of new processes and with new customers. This could enable Maersk to be proactive from the start.

Onboarding new employees
At Maersk, not all employees are fully aware of the stakeholders involved in the extensive processes. Therefore, it can be beneficial to implement a version of Workshop 1 within the onboarding programme for new employees. By doing so, the employees develop an early understanding of the supply chains.

10

Personal reflection

Before this thesis, I wrote down personal learning ambitions. These were discussed during the kick-off and in the project proposal. In this final chapter, I reflect on these learning ambitions.

10.1 Personal learning ambitions

In the project proposal I wrote down the following three learning ambitions:

1. Learn and gain experience about the corporate structure within larger companies.
2. Learn about how design thinking and strategic design fit in these larger organisations.
3. Learn more about supply chains and how to design within and for them.

During previous internships, I had worked in smaller companies. However, before graduating, I also wanted to explore what it would be like to work in a larger company and how strategic design would fit there. During my time at Maersk, I enjoyed the large company, because this also brought room for specialists in specific topics. Each department had their own specialists, which was very interesting to learn from.

Furthermore, I also learned a lot about strategic design within the company. Throughout my graduation project, I experienced that Maersk had almost no experience with strategic design. Therefore, it was sometimes hard to explain what I was doing and why I was doing it. From this lack of designers, I learned a lot about how to approach stakeholders, how to engage employees in workshops, and especially how to translate my design insights to the employees. At the start, I found it hard to share some insights, because it also pointed out sensitive issues, because there were many frustrations. During the interviews and when presenting the results I found out how to communicate this carefully without insulting employees. Besides, many of the employees were actually curious about the outcome, which made it easier to speak openly about the insights.

I also wanted to learn more about supply chains. During my thesis, I gained a deeper understanding of how to design supply chain optimisations. Through a literature study on different supply chain management approaches, I started to see ways to create overviews of the supply chains, and to also define the root problems. In this project, the skills learned at IDE and previous internships, led to having a large toolkit to tackle supply chain design, which supported me throughout the project. I transformed many of these skills to fit in the supply chain design to bring in creative and strategic design, while keeping the corporate approach of Maersk. I think this merged well together throughout this thesis. In future projects, I would know better where to start and also could better link the theory to design.

10.2 Project results

The project was quite tough to start with, because of the industry I had to understand, the many stakeholders involved, and the demanding customer, while also learning about supply chain management and finding literature to ground the project. However, throughout the project, I gained a grip on the project and worked towards a great outcome.

It is unfortunate that the escalation between FrieslandCampina and Maersk developed during my thesis, but the integrated customer service was also a highly desired direction. I would have enjoyed also designing a workshop for FrieslandCampina and Maersk, but in hindsight, I think the integrated customer service actually was a good way to improve the efficiency. By aligning internally first, it will be easier to align the customer and Maersk.

Furthermore, throughout the design sprints, I tested desirability, feasibility, and viability by hosting the workshops I designed. This was very insightful, even though not all participants could always be present. In future projects, I would be even clearer to the participants that their in-person presence is expected and needed. I found it sometimes hard to speak up like that from the role of an intern, but I developed myself in that area as well throughout the project.

At the end of this thesis, I am very proud of the results achieved and would say that I am positive about the impact and the fit for Maersk.

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Appendix

A. Project proposal
B. MCIC specifications
C. Rejection codes
D. Draft frameworks
E. Search terms literature review
F. Definitions supply chain management
G. Interview protocol
H. HREC application
I. Informed consent form
J. Interview results per stakeholder group
K. Interview codes
L. Brainstrorming activities
M. First workshop design
N. Set-up workshop session 1
O. Designing Workshop 1 and 3
P. Set-up workshop session 2

Appendix A: Project proposal

Project Proposal form

IDE Master Graduation Project

In this proposal the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document needs to be prepared for the Kick-off meeting and should be submitted in MyCase.

Name student Tesse Wolthaus **Student number** 4992849

Project title Increasing the efficiency of the food grade container cleaning process

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

MSc programme ☐ Design for Interaction ☐ Integrated Product Design ■ Strategic Product Design

☐ Other *(in case of a double degree outside IDE):*

Introduction

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

The global shipping industry forms the backbone of international trade, with over 80% of all goods transported by sea each year (United Nations Trade and Development (UNCTAD), 2025). In 2023 alone, approximately 12.3 billion tons of goods were shipped.

Maersk is one of the world's largest and leading shipping companies (A.P. Moller-Maersk, n.d.-a). To maintain this position in the competitive maritime landscape, efficiency in cost, time, and logistics is crucial. Beyond logistics and storage, Maersk manages the transportation of a wide variety of products (A.P. Moller-Maersk, n.d.-c). This ranges from bulk goods to vulnerable goods, with Fast Moving Consumer Goods (FMCG) representing one of the largest segments, projected to grow by 5.4% by 2030 (Allied Market Research, n.d.; A.P. Moller-Maersk, n.d.-b).

Among others, infant formula milk (IFM) is a vulnerable good withing FMCG. Shipping IFM worldwide, with China as a key market, requires meeting strict safety and health standards which are set by FrieslandCampina (J. van Wilsum, personal communication, 18 September 2025). There are five container grades, each dedicated to different types of cargo. To ensure safety, container grade S is used, which is the highest classification (Figure 1). Grade S has at least twelve different requirements, depending on the container's origin (A.P. Moller-Maersk, 2021). For example, "Floor and interior panels shall be free from holes, burrs, splinters, stains and sharp edges" (A.P. Moller-Maersk, 2021, p. 2), which asks for multiple repairs, leading to a high workload. Other requirements specify that no added patches are allowed, painted surfaces cannot have transferable rust stains and the container should be odor-free.

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Introduction (continued): space for images

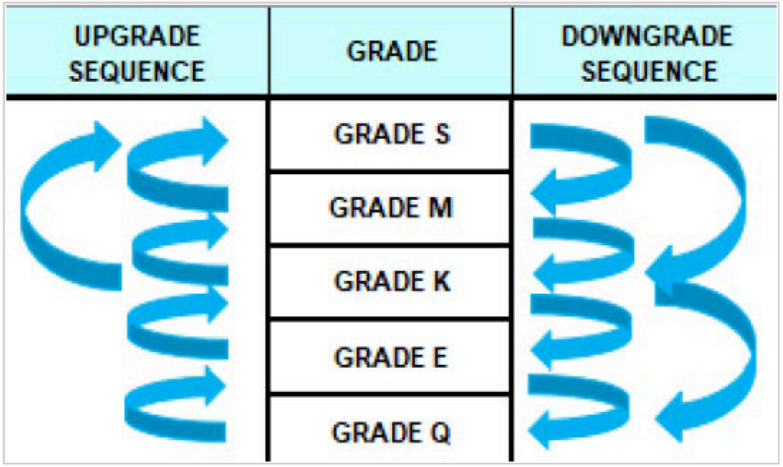


Figure 1: Available container grades and their upgrade possibilities at Maersk (A.P. Moller-Maersk, 2021)

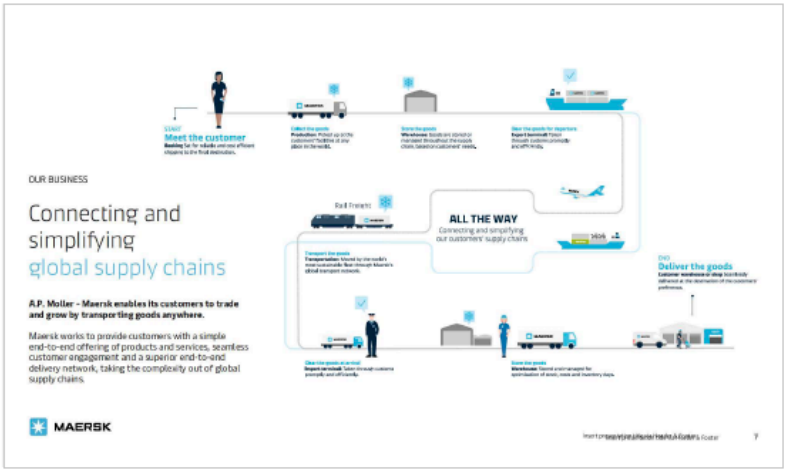


Figure 2: Cargo-handling supply chain at Maersk (A.P. Moller-Maersk, 2025)

Problem Definition

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

The current process of shipping IFM involves many steps before placing IFM in a container (Figure 2). Before IFM is shipped, the container must undergo extensive cleaning, repairs, and preparation to ensure the required health standards of grade S. While the entire process is necessary, it results in reduced efficiency across the supply chain. Due to its relevance to this process, IFM will be used as a case study.

Several studies have proposed methods to speed up this process. Kuo et al. (2025) developed a CAD-transformer capable of identifying defects to classify the container's grade. Furthermore, Kokvin et al. (2013) and Mughal and Sziebig (2014) designed robots to clean freight containers autonomously. Despite these solutions, Maersk currently has not yet implemented any of such technologies. To address this gap, this project aims to investigate the available solutions and assess their practical implementation at the context of the case company.

To increase efficiency of the cleaning process, I aim to identify the implementation gap and strengthen the understanding of Maersk's needs within the cleaning process. Besides exploring opportunities within the cleaning process itself, a broader perspective on Maersk's supply chain is needed. The bottlenecks i

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project (1 sentence. As you graduate as an industrial design engineer, your assignment will start with a verb (Investigate/Design/Validate/Create), and you may use the format:
(Investigate/Design/Validate/Create) a (what will be the deliverable →prototype/roadmap/process/ intervention /approach/guideline/strategy/…) to (what should it do →(create/understand/evaluate/validate/ improve/execute/ analyse/…) (the objective → experience/value/process/product/…) for (whom → target group/client/…) in (what context).

Design a more efficient process cargo container cleaning process and a corresponding roadmap to improve the supply chain for Maersk in the context of shipping infant formula milk.

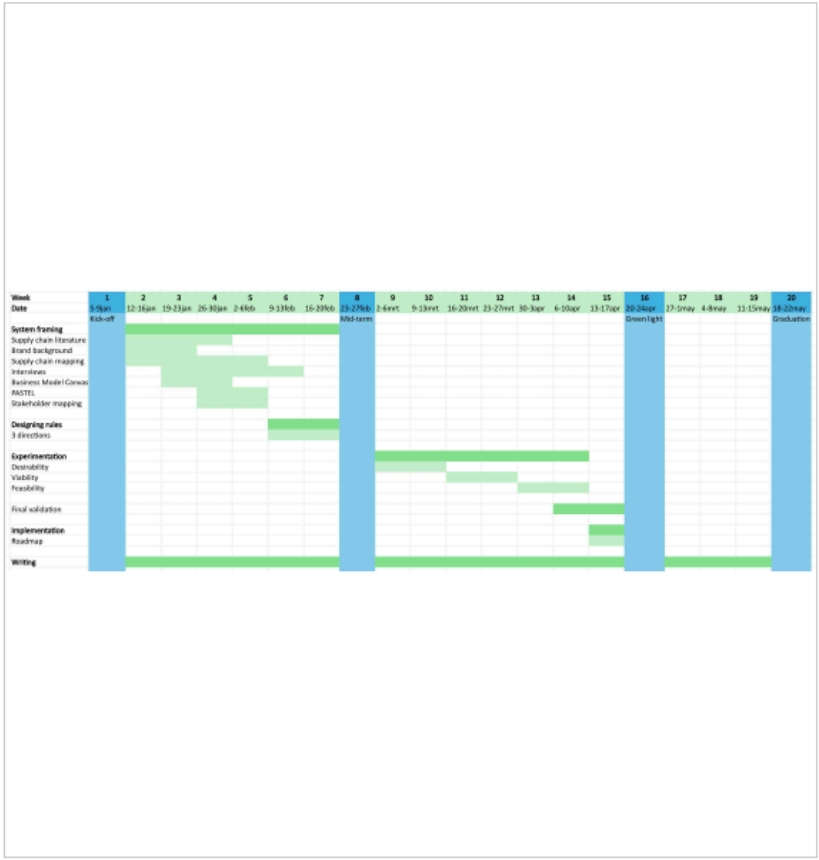
Explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words).

The project starts with a deep dive into the supply chain management literature, particularly the cleaning procedure. Within six weeks of research, a reframed design statement will be developed. During this period, various analyzing tools can be used to understand the implementation gap and explore the case study, such as interviews, touchpoint analysis, and a PESTEL-analysis on trends in the container industry. This approach ensures the problem is thoroughly investigated from multiple perspectives and the brand's vision is integrated in the design process.

After reframing, a brainstorming phase takes place, followed by different design sprints of two weeks for desirability, viability and feasibility. After these sprints, the direction of the final concept will be clearer and can be pursued. Different prototypes will be created and tested, with the type of prototypes depending on the project's direction. In the last stage, the crucial implementation steps for the final design will be defined.

Project planning

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include the **Kick-off, Midterm Evaluation, Green Light** and **Finalisation** (ceremony). Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities). Add (an image of) the planning in the box below. If it is not readable, you can add the planning as an attachment to My Case along with this Proposal.*



Motivation and personal ambitions

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

Optionally, describe whether you have some (max 5) personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology (200 words max).

I would like to start with this project, because I find it interesting to dive in a complex problem. During internships earlier in my studies, I worked for smaller companies. For my graduation project, I like to see how the complex problems are addressed within larger organisations. Next to this, I think the constraints the project brings, add another layer to the problem. With the required health standards, the project gets more complicated on top of the logistic supply chain puzzle. The combination of these factors creates an interesting design problem I am eager to tackle. I am also curious to see what a strategic designer can add in a larger company that is not used to employees with a design background

Personal learning ambitions:
1. Learn and gain experience about the corporate structure within larger organisations.
2. Learn about how design thinking and strategic design fit in these larger organisations.
3. Learn more about supply chains and how to design within and for them.

Appendix B: MCIC specifications

MAERSK

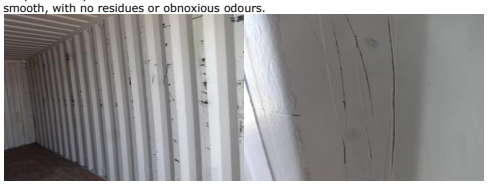
GRADE M – Food Grade container
Panels are rust free and in acceptable condition. Previous cargo labels are removed.



Floor gouges are acceptable per MCIC. No protruding floor retainers, splinters or uneven board heights. No obnoxious odours or transferable stains.



Interior panels may have minor scratches but are rust free. The interior surfaces are clean and smooth, with no residues or obnoxious odours.



Classification: Public

MAERSK

Panels with glue and ex-IMO labels are not acceptable.



GRADE S – Flexi tank Shipments and Premium Food Grade container
Grade S container side walls are dent free, and according to customers requirements. Walls are free of patches and insert repairs.



Door recess is present for bulkhead installation, where required, and in acceptable condition.



Classification: Public

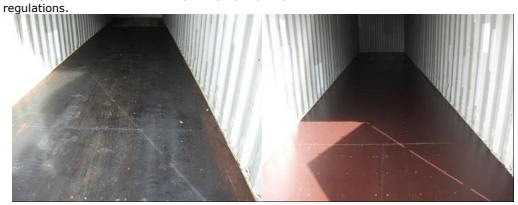
MAERSK



Cargo spillage that has hardened or cargo packaging that has bonded to the floor may be repaired by sanding or cleaning. The most cost-efficient repair must be chosen to be able to categorize as Grade E or Q. Floor coating the units may assist to achieve a higher-grade standard of S, M or K.



Applying a Maersk approved floor coating helps to reduce cleaning at next depot call. Most powder-like cargo residues may be washed or blown out. Thick oil, non-water-soluble residues may be scooped up or scraped out and remaining residue removed with thinners and rags. Residues should always be properly disposed of, in accordance with local regulations.

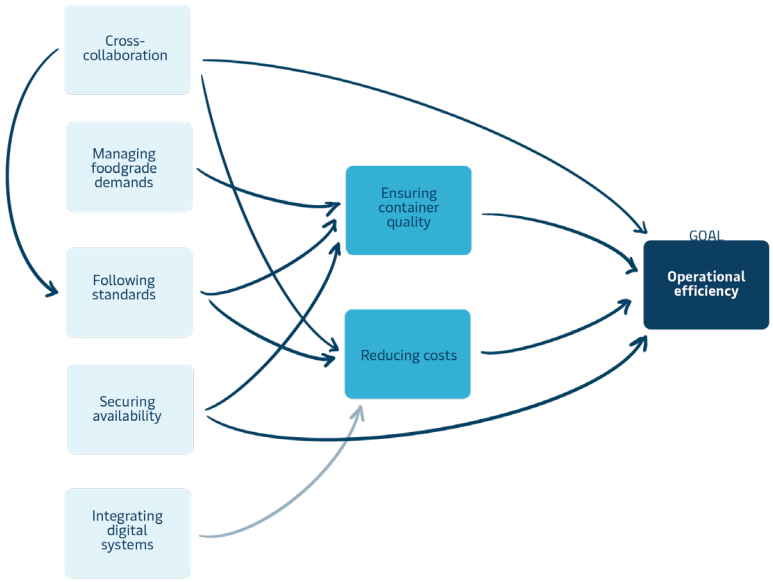


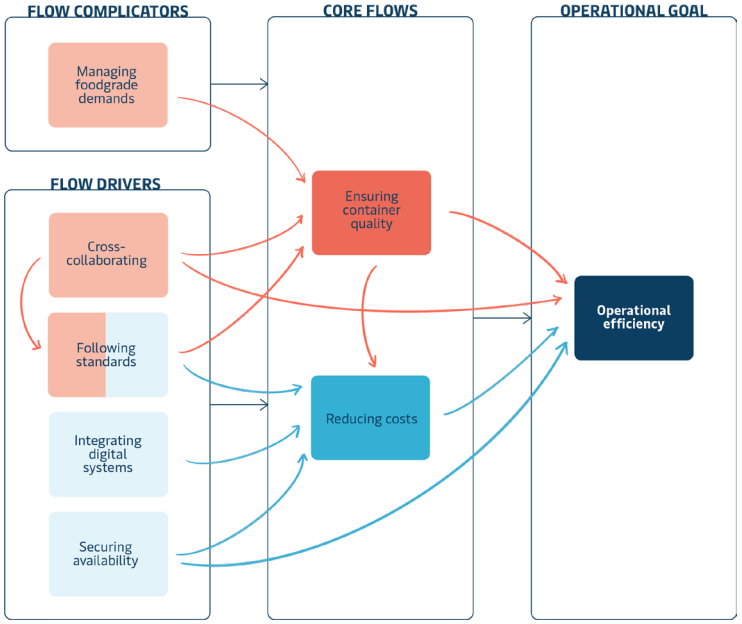
Classification: Public

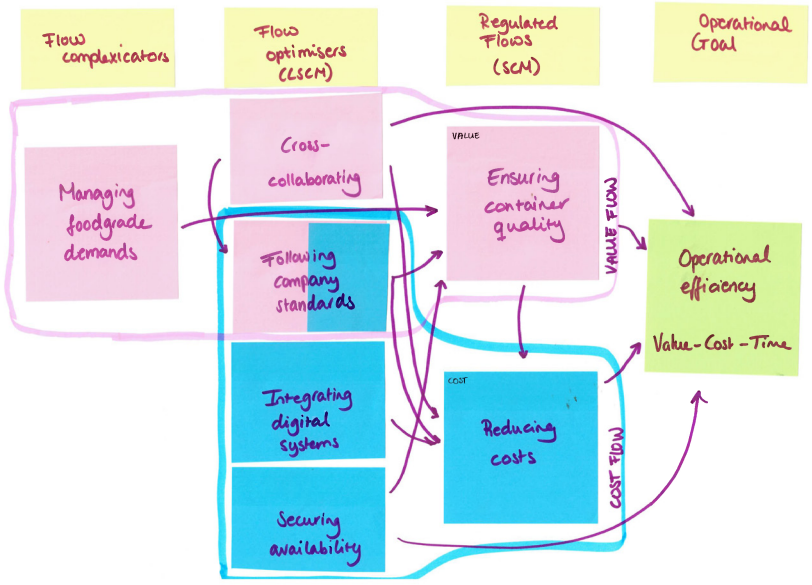
Appendix C: Rejection codes

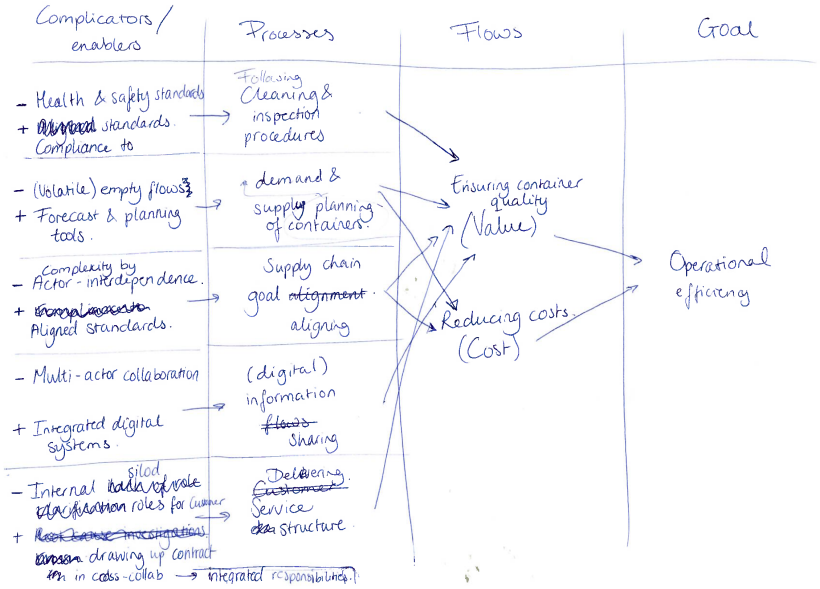
Reden afkeur	Label
Vies	1
Ongedierte	2
Gat in dak	3
Ingelast stuk	4
Kitnaden	5
Hang- en sluitwerk	6
Beschadigingen	7
Roest	8
Afbladderende verf	9
Vloer	10
Vette vloer	11
Scheur lasnaad	12
Algehele staat	13
Laswerk	14
Vervuild met restproduct	15
Olierestanten	16
Geur	17
Afkeur laadlokatie	18
Lakschade	19

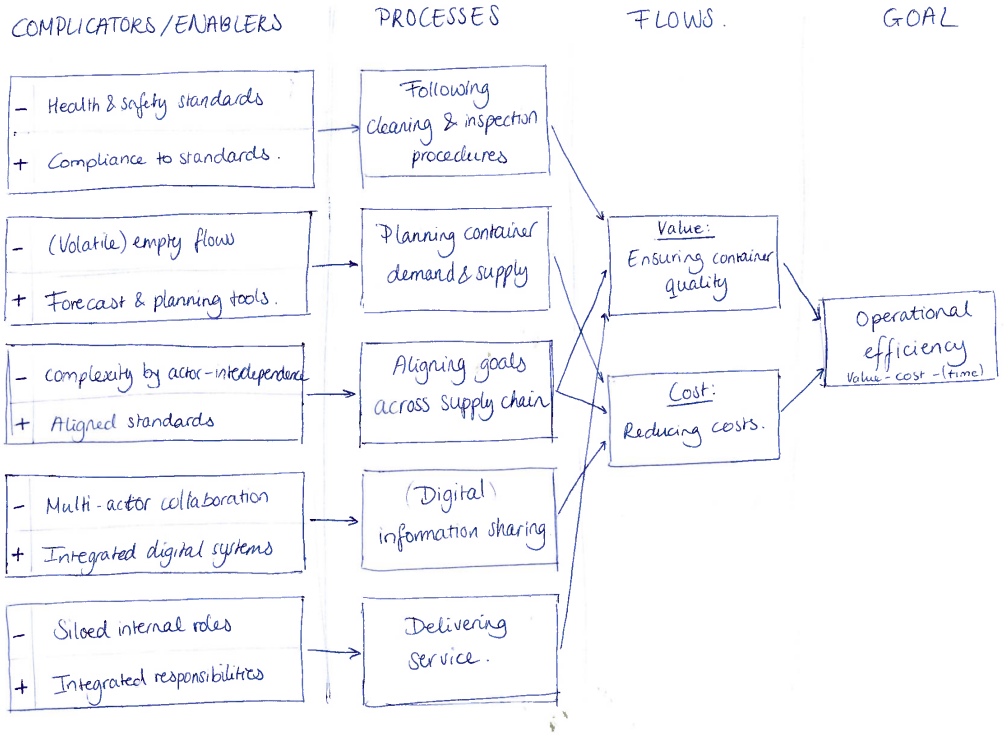
Appendix D: Draft frameworks

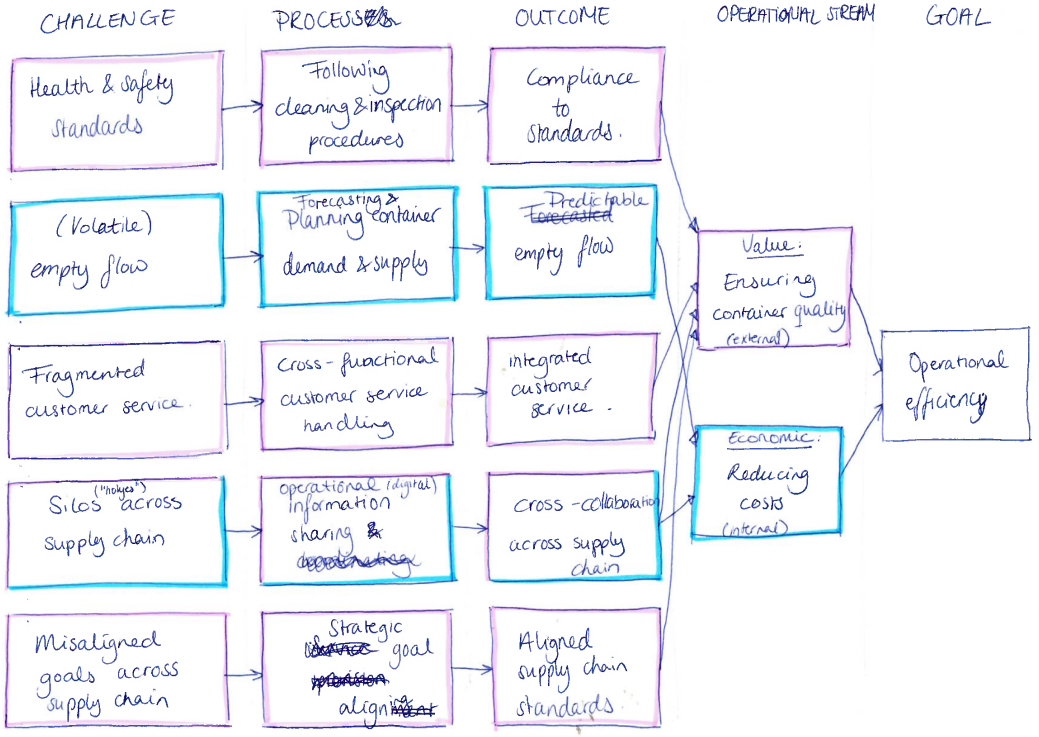









COMPLICATORS / ENABLERS
PROCESSES
FLOWS.
GOAL
- Health & safety standards
+ Compliance to standards.
- (Volatile) empty flows
+ Forecast & planning tools.
- complexity by actor-interdependence
+ Aligned standards
- Multi-actor collaboration
+ Integrated digital systems
- Siloed internal roles
+ Integrated responsibilities
Following clearing & inspection procedures
Planning container demand & supply
Aligning goals across supply chain
(Digital) information sharing
Delivering service.
Value:
Ensuring container quality
Cost:
Reducing costs.
Operational efficiency
Value - cost - (time)


CHALLENGE
PROCESSES
OUTCOME
OPERATIONAL STREAM
GOAL
Health & Safety Standards
(Volatile) empty flow
Fragmented customer service
Silos ("hokjes") across supply chain
Misaligned goals across supply chain
Following clearing & inspection procedures
Forecasting & Planning container demand & supply
Cross-functional customer service handling
operational (digital) information sharing
Strategic goal alignment
Compliance to Standards.
Predictable Forecasted empty flow
integrated customer service.
Cross-collaboration across supply chain
Aligned supply chain standards
Value:
Ensuring container quality (external)
Economic:
Reducing costs (internal)
Operational efficiency

Appendix E: Search terms literature review

- Business relationships management
- Cargo container cleaning
- Competitive advantage Porter
- Complex system design
- Container inland transport
- Container shipment
- Containers for storage or transport
- Containers history
- Core business relationships
- Cross-collaboration AND interviews
- Cross-collaboration AND research
- Customer satisfaction AND supply chain
- Fragmentation AND silos
- Goal alignment theory
- HACCP regulations containers
- HACCP sea containers
- HACCP shipping
- HACCP shipping cleaning tracking
- Hazop analysis
- Hazop analysis risk assessment
- Hazop AND supply chain
- Just-in-time supply chain
- Kaizen methodology
- Kaizen methodology supply chain
- Lean management
- Lean management AND supply chain
- Lean management in supply chains
- Lean management supply chain improvement
- Lean supply chain management
- Lean supply chain management impact
- Lean supply chain management practices
- Lean thinking
- Logistics supply chain management
- Oligopoly
- Oligopoly market structure characteristics
- Origin shipping alliances
- Porter value chain model
- Process improvement
- Roles and relationship framework
- Service level agreements
- Service level agreement supply chain
- Service level agreement AND satisfaction
- Service ecosystem
- Shipping containers history
- Shipping companies competitiveness
- Shipping lines
- Shipping lines alliances
- Supply chain improvement
- Supply chain management
- Supply chain management challenges
- Supply chain management efficiency
- Supply chain management strategy
- Supply chain management practices
- Supply chain mapping
- Supply chain network design
- Supply chain resilience
- Supply chain resilience logistics
- Supply chain risk management
- Supply chain risks
- Supply chain value
- Value chain
- Value co-creation and actor interdependence

Appendix F: Definitions supply chain management

Source	Defenition of supply chain management
Anaba et al., 2024	Supply chain management encompasses coordinating and integrating these activities across the supply chain, including procurement, production, distribution, and customer service.
Ballou, 2007	Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies.
Cooper et al., 1997	Supply chain management is the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers.
Kain & Verma, 2018	Supply chain management whose totally focus on material flow from supplier to customer and information flow from customer to supplier.
Li et al., 2005	The systemic, strategic coordination of the traditional business functions and tactics across these businesses functions within a particular organization and across businesses within the supply chain for the purposes of improving the long-term performance of the individual organizations and the supply chain as a whole.
Mangan & Lalwani, 2016	Supply chain management is the management, across and within a network of upstream and downstream organisations, of both relationships and flows of material, information and resources. The purposes of SCM are to create value, enhance efficiency, and satisfy customers.
Mentzer et al., 2001	Supply chain management can be classified into three categories: a management philosophy, implementation of a management philosophy and a set of management processes.
Truong et al., 2017	SCM aims at improving the sourcing of raw materials, the production and the distribution of products/services to customers
Wieland, 2020	SCM through the lens of panarchy theory allows us to explain changes in the supply chain that had appeared to be spontaneous phenomena and how the supply chain contributes to changes in the wider contextual environment.

Appendix G: Interview protocol

Introduction

Thank you for your participation. I will shortly introduce myself. My name is Tesse, I am writing my thesis at Maersk in the equipment team. I study at the TU Delft, with the master's direction Strategic Product Design. For my thesis, I am researching the efficiency of the foodgrade container supply chain. Especially the containers for FrieslandCampina are relevant, since these have very specific requirements. The questions in this interview are created to gain deeper insight in this supply chain and will take approximately 45-60 minutes.

This interview is confidential and anonymous. All the answers you give are also anonymised afterwards and are paraphrased when they are used in the report. I will write down notes during this interview, but the interview is not recorded. You can skip any question and any answer can be removed either during the interview or after the interview. Like discussed, you can access the informed consent form at any time. If everything is okay, we will start with the interview.

Interview questions:

Opening
- Can you introduce yourself?
- What is your position in the foodgrade supply chain? How often do you see foodgrade containers with your job?
- How long have you been in this position?

Executing container check (compliance to standards & misaligned goals across supply chain)
- Can you walk me through a check for foodgrade containers?
- When and where do you check the container on foodgrade quality?
- Why do you execute this check?
- What do you check during this quality check?
- What are the challenges during these checks?

- How do you measure whether a foodgrade container has the correct quality?
- How do the foodgrade demands influence the way you execute a check?
- Which standards for foodgrade containers do you use in your company?
- How did these standards emerge?
- How do people use and comply to these standards?
- To what extent do you feel like the standards match the customer's wishes?
- What are moments that you don't use these standards and why do you not apply the standards in such moments?
- How would you change the standards to ensure compliance?
- What do you notice now that there is a new container fleet of Maersk?

- How would you change the standards and/or the check to make it more efficient?
- How do all checkpoints contribute to the foodgrade quality of containers?

Cross-collaboration across supply chain & aligned supply chain standards
- Who do you work with in the foodgrade container supply chain? Like gate keepers, depot, inland depot, truck drivers or warehouse.
- How did you align the goal in your collaboration?
- To what extent do all stakeholders know and understand these goals?
- To what extent do all stakeholders use the goals in their daily business?
- How do you experience these collaborations?
- What are challenges in these collaborations?
- What would you change in these collaborations?

Sharing operational information
- How do you share information with others?
- What digital platforms/apps/websites do you use?
- How are these platforms related to each other?
- When do you use each platform?
- Who can access these platforms?
- How do these digital platforms contribute to your work?
- Which platforms would you consider relevant in your job?
- How would you change the digital interaction?

Rejections after checks – only relevant for STAR mechanic, inland depot, truck driver and FrieslandCampina

- What are the most occurring rejection reasons for foodgrade containers? (if possible, provide an example)
- What are causes that can increase the amount of rejections?
- How often do you reject containers?
- Why do you think rejections occur?
- How would you prevent rejections?

Forecasting & planning – only relevant for mechanic STAR & inland depot

- To what extent do you always have containers that can be used as a foodgrade container?
- How large is the back-up of your foodgrade containers in general?
- Who oversees the stock?
- What do you do when you are out of foodgrade containers?
- How often do you get new stock?

Integrated customer service – only relevant for FrieslandCampina

- How do you feel about the customer service from Maersk?
- What do you expect from the customer service/points of contact?
- What are your regular points of contact?
- What do you need from the customer service section of Maersk?
- Why did you choose Maersk as your shipping line?
- Would you choose Maersk again and why?
- To what extent are Maersk's container criteria clear for FrieslandCampina?
- How often do you change your specifications?

Integrated customer service – only relevant for Maersk's customer service and sales

- How do you draw up a contact for customers?
- What specifications is the contract based on?
- With whom do you collaborate within Maersk to draw up the contract?
- What are the points of contact within Maersk for FrieslandCampina/customers?
- How do you feel about the shared responsibility?
- Who handles complaints?
- What is the procedure for complaint handling?
- What are usual complaints from customers?
- What is the difference between the responsibilities of operational, customer service and sales?
- To what extent is this structure clear to customers according to you?
- How often do you work together and for what reasons?

Closing interview

- Overall, what can be done to enhance the efficiency in the foodgrade container supply chain?
- Does anything come to mind that we did not discuss but you still want to share?
- Do you have any questions?

Closing

Thank you very much for participating in this interview. If anything comes to mind that you want to share, feel free to contact me. This also includes withdrawing answers, like discussed at the start of the interview.

Appendix H: HREC application

I. Applicant Information

PROJECT TITLE:	Increasing the efficiency of the food grade container cleaning process
Research period: *Over what period of time will this specific part of the research take place*	7 January 2026 – 22 May 2026
Faculty:	Industrial Design Engineering
Department:	Design, organisation and strategy
Type of the research project: *(Bachelor's, Master's, DreamTeam, PhD, PostDoc, Senior Researcher, Organisational etc.)*	Master's thesis
Funder of research: *(EU, NWO, TUD, other – in which case please elaborate)*	TUD
Name of Corresponding Researcher: *(If different from the Responsible Researcher)*	Tesse Wolthaus
E-mail Corresponding Researcher: *(If different from the Responsible Researcher)*	
Position of Corresponding Researcher: *(Masters, DreamTeam, PhD, PostDoc, Assistant/ Associate/ Full Professor)*	Masters
Name of Responsible Researcher: ***Note:** all student work must have a named Responsible Researcher to approve, sign and submit this application*	Shahrokh Nikou
E-mail of Responsible Researcher: *Please ensure that an institutional email address (**no Gmail, Yahoo, etc.**) is used for all project documentation/ communications including Informed Consent materials*	
Position of Responsible Researcher : *(PhD, PostDoc, Associate/ Assistant/ Full Professor)*	Assistant Professor

II. Research Overview

***NOTE:** You can find more guidance on completing this checklist here*

a) Please summarise your research very briefly (100-200 words)

What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbrevations)
For this project, I am diving into the cleaning supply chain of food grade containers. There are two main research steps that include people, shadowing and interviewing. To gain deeper understanding of the process, I will shadow employees during the cleaning of some containers. I will also interview some people about the process and the up- and downstream processes in the supply chain to extend the research over the supply chain instead of one key activity. The interviewees are mainly employees of A.P. Moller-Maersk or clients of the company. They will mainly be recruited through my supervisor at Maersk or other Maersk contacts. I will also interview some colleagues from the team where my internships takes place at Maersk. If needed, I will also validate my design with people working in the container cleaning supply chain. The participants for the validation interview will be similar to the participants used for the interview during the research phase.

b) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbrevations)

c) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an HREC Amendment Form as a submission through LabServant.

III. Risk Assessment and Mitigation Plan

NOTE: You can find more guidance on completing this checklist here

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of **Personally Identifiable Information (PII)** and/or **Personally Identifiable Research Data (PIRD)** which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alignment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that **you're much more likely to need to resubmit your application if you neglect to identify potential risks**, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] [1] *If yes, please include the graduation agreement in this application*	**Yes**		1. The company might have different interests in the research. Maersk might want to have raw data of interviews e.g., to make sure they can fully understand and use the outcomes in the future. 2. With using the project in the future, the company might also steer the project towards a more beneficial business outcome then the academic side that might come up during the process. 3. Furthermore, there is a risk of data sharing between TUD and Maersk, because some information might be confidential.	1. Data shared with Maersk will be made unidentifiable to make sure participants are not identifiable. Maersk will not get the raw interview data, only the adjusted version without personal information. If in some cases it is impossible to make PII untraceable, because there are only a few people who know about the topic, the participant will be informed prior to shadowing or interviewing. Besides, it will be made clear at all interviews or shadowing interactions that participation is voluntarily. 2. To ensure the project will keep the academic relevance, the TUD will be kept in		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
				the loop to discuss the progress of the project. Through (bi)weekly meetings, the academic process will be monitored. 3. During the project, there will be regular checks whether information is confidential. There will be a final check before the green light meeting, to make sure the definite decision is used in the final process of the graduation project.		
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		**No**				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		**No**				
B: Location						
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?		**No**				
5. Will the research take place in a country or countries outside the EU?		**No**				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		**No**				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		**No**				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?		**No**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*		**No**				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?	**Yes**		There are employees from a partner company collaborating in the research, this makes them easier to identify through the role description. Furthermore, there will not be that much participants in the interview, which also makes them easier to identify.	All names or other personal information will be replaced with neutral pseudonyms. No personal information will be shared with others. Job titles will be generalized, to make identification harder. If specific quotes are used, these will be paraphrased to make sure it is untraceable. Furthermore, all participants will be informed that participating is voluntarily. If in some cases this is not possible, because there are only a few specialists in that field, the participant will be informed about this prior to shadowing or interviewing. Furthermore, data will not be shared categorized by company, but by topic. This makes it harder to identify participants.		
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups		**No**				
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)	**Yes**		1. Participants will be partially recruited through my supervisor at Maersk. This makes it easier for Maersk to identify participants. 2. It also can lead towards a selection bias, because my supervisor might (unintentionally) lean more towards people he knows better e.g. 3. Participants might feel pressured into participating in the project, because they are asked through my supervisor.	1. Like mentioned above, information will be shared fully anonymously. Furthermore, the gathered information will be used on topic base instead of company or team base. This makes sure that the information is harder to identify. 2. To prevent selection bias, I will reach out towards random team members within teams that my supervisor suggests. 3. During recruitment, I will make sure my supervisor will start the contact, but I will take over afterwards. This makes it possible		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
				to share that participation is fully voluntarily and refusing participation will not be shared with my supervisor or any other members of the company or involved members of the project.		
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		**No**				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		**No**				
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		**No**				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? *If yes see here to determine whether medical ethical approval is required*		**No**				
17. Will blood or tissue samples be obtained from participants? *If yes see here to determine whether medical ethical approval is required*		**No**				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		**No**				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		**No**				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)	**Yes**		During the thesis, some confidential information of Maersk might be used or discussed. This might be a risk to the company, because this can lead towards leaking business insights.	To make sure confidentiality will be kept, regular discussions with Maersk will be held where confidentiality will be discussed. Final agreement on this will be discussed before the green light meeting to make sure the confidentiality is applied to the final results. This way, business insights will not leak.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		**No**				
22. Does your research investigate causes or areas of conflict? *If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.*		**No**				
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		**No**				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		**No**				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		**No**				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		**No**				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		**No**				
• Was the device built in-house?						
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed **device report***						
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*						
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	**Yes**		N/A, appropriate distance will be held, but COVID considerations are not necessary anymore in 2026.	N/A, if the national health guidelines change in the upcoming months, these will be applied in the project. Larger distances or online interviews will be used as back-up in case the guidelines change.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or** b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?		**No**				
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	**Yes**		There will be a list of participants with name and email addresses. This will be used to contact them for appointments for interviews or follow-up questions. There is of course the risk of leaking personal data from the participants when this data is stored for administrative purposes.	To make sure PII will not leak, data will be responsibly managed. The data management plan will be made in DMPonline. The PII will not be shared with others but myself. The data will be stored in a confidential excel on the Maersk laptop. By putting the confidential label up, others cannot access the file. All the personal information will be deleted after May 22. The personal data will be stored in a different file then the file with research outcomes. With this, the PII will be held apart from others.		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?	**Yes**		There will be some photos and videos made during shadowing. This might make it easier to identify participants.	To make sure that people are not identifiable from the photos and videos, only photos of the back of people are made or of parts of their body which are also unidentifiable (e.g. hands). Participants will also be informed beforehand and can refuse taking photos or videos. The photos and videos will also be stored in a confidential file on the Maerks laptop. Only unidentifiable photos and videos will be used in the report. If needed, these photos and videos are (partially blurred) to make sure people are fully unidentifiable.		
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		**No**				
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	**Yes**		The research findings will be published in the TU Delft repository. Publishing the report there might lead towards sharing confidential information of the company or participants in shadowing or interviews.	To prevent unveiling business insights, confidentiality will be discussed before the green light meeting. This makes sure that the final report does not consist of confidential business insights.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
				To prevent personal information to leak, all personal information will be kept out of the report. Furthermore, information will be clustered per topic instead of per company. This way, gathered information from interviewees will be harder to trace.		
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?	**Yes**		1. The research will be archived at Maersk for internal use. The risk is that people might speculate if personal information is identiable. 2. Furthermore, the research could be interpreted differently then initially meant.	1. To make sure that it is impossible to identify participants, personal information will be made untraceable. Only unidentifiable information will be archived. 2. The goals and outcomes of the research should be stated clearly. The intentions should not be speculative, but immediately clear.		

H: More on Informed Consent and Data Management

NOTE: You can find guidance and templates for preparing your Informed Consent materials) here

Your research involves human participants as Research Subjects if you are recruiting them or actively involving or influencing, manipulating or directing them in any way in your research activities. This means you must seek informed consent and agree/ implement appropriate safeguards regardless of whether you are collecting any PIRD.

Where you are also collecting PIRD, and using Informed Consent as the legal basis for your research, you need to also make sure that your IC materials are clear on any related risks and the mitigating measures you will take – including through responsible data management.

Got a comment on this checklist or the HREC process? You can leave your comments here

IV. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (if different from the Responsible Researcher) (print)

Signature of Corresponding Researcher:

Date: 12 January 2026

Name of Responsible Researcher (print)

Shahrokh Nikou
Signature (or upload consent by mail) Responsible Researcher:

Date: 12.01.2026

V. Completing your HREC application

Please use the following list to check that you have provided all relevant documentation

Required:

- **Always:** This completed HREC checklist
- **Always:** A data management plan (reviewed, where necessary, by a data-steward)
- **Usually:** A complete Informed Consent form (including Participant Information) and/or Opening Statement (for online consent)

Date 12-Mar-2026
Correspondence hrec@tudelft.nl

TU Delft Delft University of Technology

Human Research Ethics Committee TU Delft
(http://hrec.tudelft.nl)

Visiting address
Jaffalaan 5 (building 31)
2628 BX Delft

Postal address
P.O. Box 5015 2600 GA Delft
The Netherlands

Ethics Approval Application: Increase the efficiency of the food grade container cleaning process
Applicant: Wolthaus, Tesse

Dear Tesse Wolthaus,

It is a pleasure to inform you that your application mentioned above has been approved.

Thanks very much for your submission to the HREC which has been conditionally approved. We do additionally advise the following:

1. Do not use a laptop as data storage. Use TUD OneDrive instead.

Good luck with your research!

Sincerely,

Dr. C. Shelley-Egan
Chair HREC
Faculty of Technology, Policy and Management

Appendix I: Informed consent form

You are being invited to participate in a research study *titled Increasing the efficiency of the food grade container cleaning process*. This study is being done by Tesse Wolthaus and Shahrokh Nikou from the TU Delft and A.P. Moller-Maersk.

The purpose of this research study is to gain deeper understanding in the supply chain of food grade containers and will take you approximately 30 minutes to complete. The data will be used for redesigning the supply chain of food grade containers to improve the efficiency of the cleaning process. Furthermore, the results will be used for writing the thesis report, published at the TU Delft repository and used for internal purposes at A.P. Moller-Maersk. We will be asking you to show how steps of the supply chain are done and some questions about the food grade supply chain. All activities and questions will be based on the supply chain, and no personal information will be asked.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by making all answers anonymously and use them theme organized. If quotes are used, these will be paraphrased. All other personal information (name and email address) will be temporarily stored in a confidential file, which will be deleted after the research closes on May 22.

Your participation in this study is entirely voluntary, and you can withdraw at any time. You are free to omit any questions. If you do not want your name and email address stored, these can be removed at any time.

Tesse Wolthaus
t.a.m.wolthaus@student.tudelft.nl

Shahrokh Nikou
s.n.nikou@tudelft.nl

Signatures

_____	_____	_____
Name of participant [printed]	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Tesse Wolthaus		12-01-2026
Researcher name [printed]	Signature	Date

Study contact details for further information:
Tesse Wolthaus
+31648421056
t.a.m.wolthaus@student.tudelft.nl

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated 12/01/2026, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves: an interview recorded with written notes and/or a shadowing activity recorded with written notes and video recordings and photos. The recordings will be of activities where people are not identifiable, e.g. only hands or the back of the person will be visible.	☐	☐
4. I understand that the study will end at May 22.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
5. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) such as name and email address and associated personally identifiable research data (PIRD) photos and video recordings with the potential risk of my identity being revealed with the publishing of the report publicly at the TU Delft repository and A.P. Moller-Maersk.	☐	☐
6. I understand that some of this PIRD is considered as sensitive data within GDPR legislation, specifically professional opinions and experiences.	☐	☐
7. I understand that the following steps will be taken to minimise the threat of a data breach, and protect my identity in the event of such a breach - Anonymous data collection - Confidential files with limited access for the researchers - Paraphrasing quotes - Preventing identifiable parts of the body on photos and videos. Otherwise blur these parts.	☐	☐
8. I understand that personal information collected about me that can identify me, such as name and email address, will not be shared beyond the study team.	☐	☐
9. I understand that the (identifiable) personal data I provide will be destroyed at May 22	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
10. I understand that after the research study the de-identified information I provide will be used for a thesis report published on the TU Delft repository and used internally at A.P. Moller-Maersk. All PIRD will be made unidentifiable by blurring photos/videos if identifiable parts are present. Furthermore, quotes will be paraphrased and information will be shared theme organized, which makes it harder to identify participants.	☐	☐
11. I agree that my responses, views or other input can be quoted anonymously, paraphrased in research outputs	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
12. I give permission for the de-identified notes, photos and videos that I provide to be archived in TU Delft and Maersk repository so it can be used for future research and learning.	☐	☐
13. I understand that access to the TU Delft repository is open to everyone and the Maersk repository is only open to employees of Maersk.	☐	☐

Appendix J: Interview results per stakeholder group

Interview results per stakeholder group
The interviews gave insights per stakeholder group. The perspectives on the foodgrade container supply chain for FrieslandCampina differ per stakeholder group. Therefore, the core insights per stakeholder group are explained in this section.

Sales
From sales perspective, it was interesting that the participant stated that FrieslandCampina is very flexible in their specifications and Maersk can easily deliver these specifications. Furthermore, sales stated that the sales department has to trust the operational departments, because they are in charge of executing the operations discussed in the contract with the customer.

CX
The biggest struggle that CX points are that the customer has different expectations of the container quality then Maersk has. CX cannot do anything with the container quality, since they only focus on customer experience, but they see this frequently in complaints from FrieslandCampina. Another problem CX experiences is that FrieslandCampina contacts all kinds of departments, and even different people within departments, when things go wrong. They try to get the answer they want, and if needed they try many channels. However, CX does not always see what other departments they contact, even though CX is FrieslandCampina's point of communication within Maersk.

Equipment
Equipment states that it is sometimes hard to manage the standards sales sells to the customer. However, if this happens, it should always be aligned internally first, before going to the customer. It is logical that different departments have a different view on the containers, because they all have access to other systems within Maersk. This makes it hard to see where and with what other departments experience problems.

EMR
The EMR department experiences increased strictness of FrieslandCampina, which causes many rejections. According to EMR, many rejections are wrongful and FrieslandCampina does this without informing Maersk. About the standards used, EMR states: "we need a clear definition". Currently, there is no clarity about this.

The reason the rejections occur is mainly because of judgemental errors. Employees all use and understand the requirements differently, leading to uncertainties and ultimately to rejections.

Furthermore, EMR struggles with unclarity from other departments internally. Many decisions or agreements are not documented, which makes it hard for EMR to serve the customer.

STAR
STAR works on behalf of Maersk, leading to this depot executing Maersk's agreements with FrieslandCampina. STAR is only informed when rejections occur, or when the requirements change. To give STAR regular updates on the forecast, there are two meetings per week between STAR and equipment. This helps STAR prepare containers with the correct grade.

Inland depot
The inland depots use the standards they received from FrieslandCampina. They assume that FrieslandCampina has agreed on this with Maersk and therefore use these standards.
The depots only accept containers that are completely spotless, which differs from Maersk's standards.

Furthermore, the inland depots do not know what happens at the other parts in the supply chain. They are only informed when rejections occur. The other way, the inland depots inform the customer when rejections occur.

FrieslandCampina
FrieslandCampina shared during the interview that they currently reject one in five containers from all shipping lines, which is caused by the strictness of the Chinese regulations. They are not going to loosen their requirements, because the risk is too big for FrieslandCampina.

When FrieslandCampina receives milk from farmers, they must produce. According to the employees, this makes it impossible for

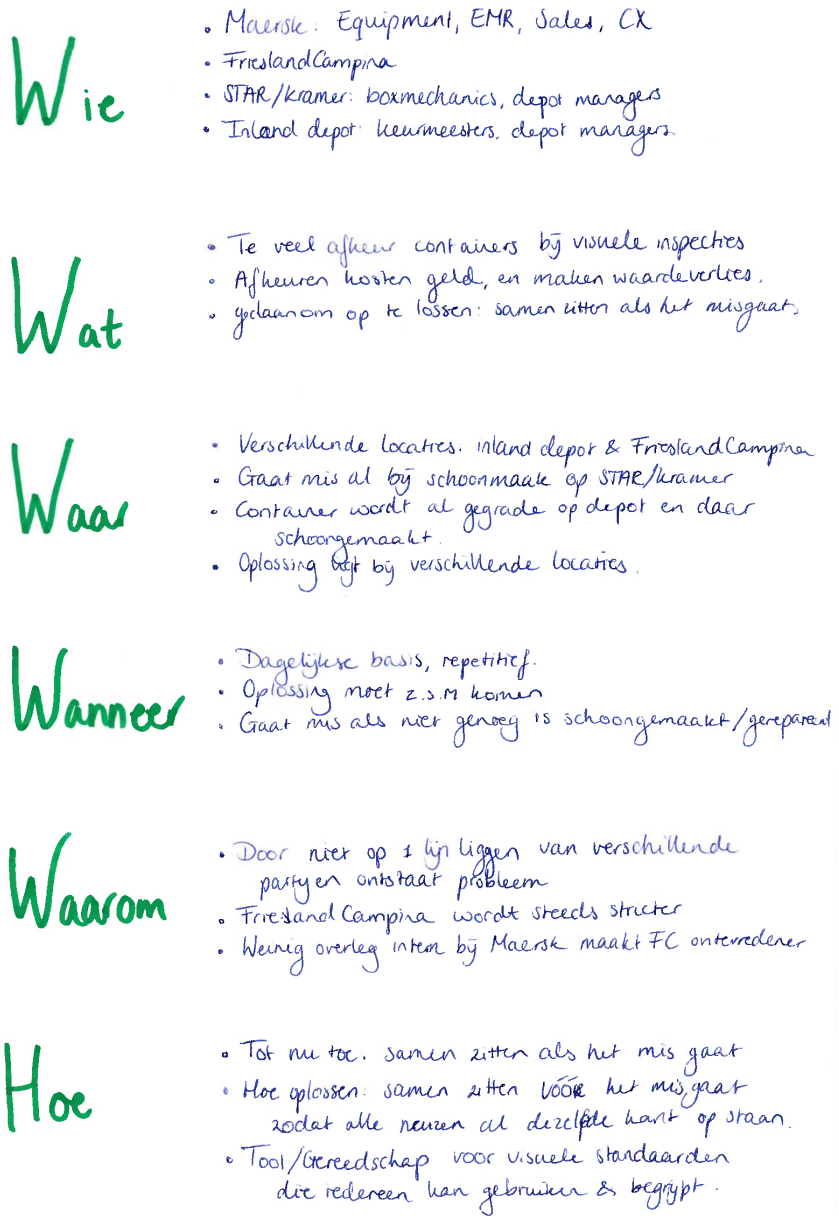
FrieslandCampina to forecast when they need containers. However, they do expect containers when they ask for them.

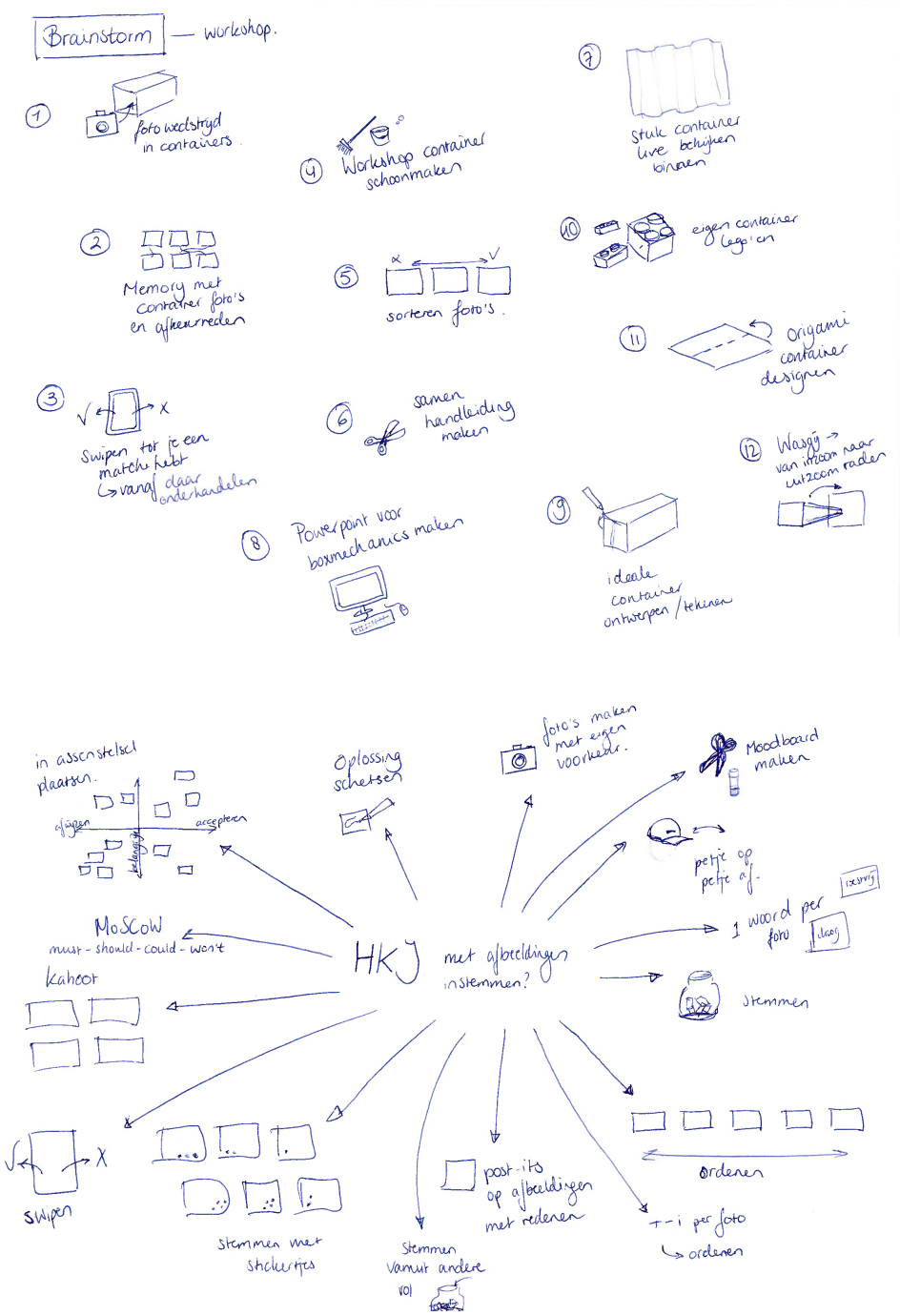
When rejections occur, they find it hard to connect with Maersk. Their reaction time is slow, making the rejections more frustrating. When a container is rejected, FrieslandCampina wants a replacement container as soon as possible, because they also have to meet their planned transports. FrieslandCampina does not bear the costs of rejections, because the shipping lines take care of the transport.

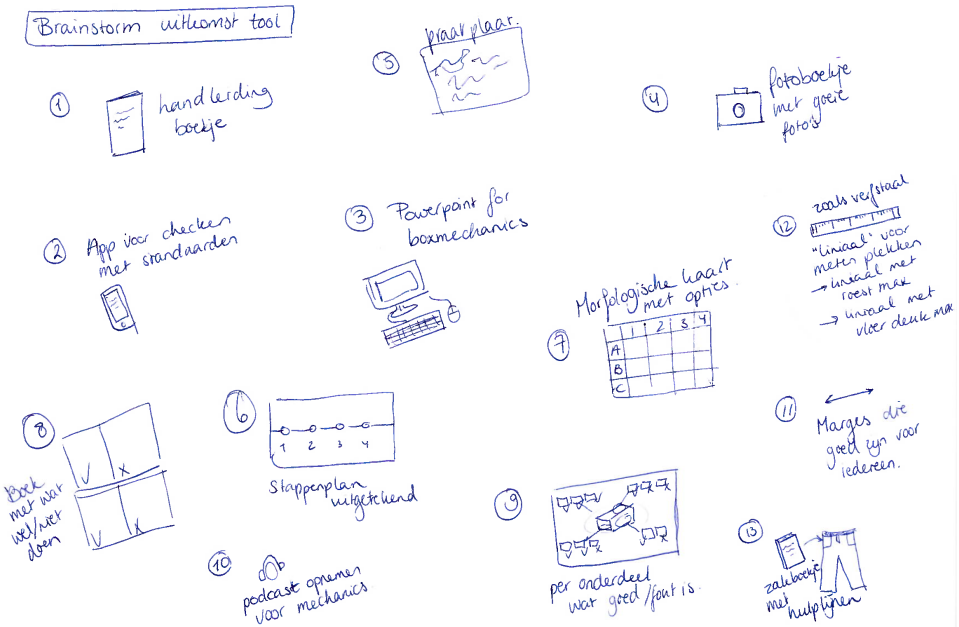
Appendix K: Interview codes

See the attached excel with the interview codes.

Appendix L: Brainstorming methods




Brainstorm — workshop.
1 foto wedstryd in containers.
2 Memory met container foto's en afkeurreden
3 Swipen tot je een match hebt
↳ vanaf daar onderhandelen
4 Workshop container schoonmaken
5 sorteren foto's.
6 samen handleiding maken
7 stuk container live bekijken binnen
8 Powerpoint voor boxmechanics maken
9 ideale container ontwerpen / tekenen
10 eigen container lego'en
11 origami container designen
12 Wasgij → van inzoom naar uitzoom raden
13 op elkaars rug tekenen als communicatie
14 Filmpje maken om te laten zien wat je wil/niet wil
15 Iconen / pictogrammen gebruiken, max X p.p.
16 Route op de grond tapen
17 Storyboard maken
18 Metaforen op foto's.
19 Meeting in de container
20 film kijken in container
21 foto's clusteren op ergste afkeurreden
22 stoplicht checks.
22 S superheld analyse.
hoe zou die het oplossen?
HKJ met afbeeldingen instemmen?
in assenstelsel plaatsen.
afgijen
accepteren
belangrijk
Oplossing schetsen
foto's maken met eigen voorkeur.
Moodboard maken
petje op petje af.
1 woord per foto
stemmen
MoSCoW
must - should - could - won't
Kahoot
swipen
stemmen met stickertjes
stemmen vanuit andere rol
post-its op afbeeldingen met redenen
ordenen
+-i per foto
↳ ordenen


Brainstorm uitkomst tool
1 handlerding boekje
2 App voor checken met standaarden
3 Powerpoint for boxmechanics
4 fotoboekje met goeie foto's
5 praat plaat.
6 Stappenplan uitgetekend
7 Morfologische kaart met opties.
8 Boek met wat wel/wat doen
9 per onderdeel wat goed/fout is.
10 podcast opnemen voor mechanics
11 Marges die goed zijn voor iedereen.
12 zoals verfstaal
"liniaal" voor meten plekken
→ liniaal met roest max
→ liniaal met vloer deuk max
13 zakboekje met hulplijnen

Appendix M: First workshop design

FrieslandCampina session

① Introduction + rules (no interrupting / judging)

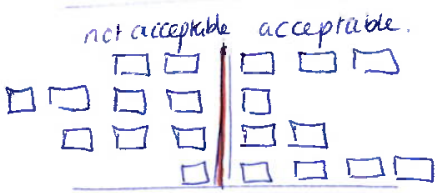
② Icebreaker

③ Problem → • Not problem-oriented
• Creating a visual tool to guide the standards

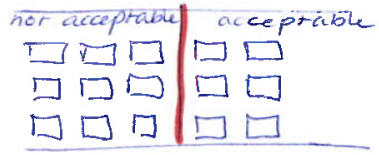
④ Visual inspection inside container photo → what do you check, highlight on picture.
→ Goal: warming up, what are we looking at.



⑤ Doing visual inspections → 4 x 5 foto's (roof, floor, wall, general)
deuken, krassen, roest, vreigheid, algehele staat.
↳ sort them from worst to best and choose line of acceptance.
↳ put a sticky note on the "rejected" containers with the reason

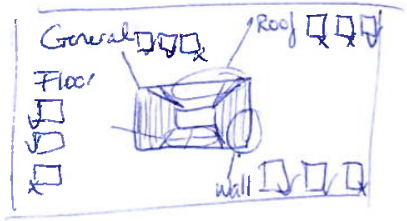


⑥ Compare everybody's findings & put them on a flip over / board.
→ group discussion to see differences between stakeholders.



⑦ Make sure all containers are inspected similarly, by discussing differences between stakeholders.

⑧ Tool to align standards



⑨ Closing

Appendix N: Set-up workshop session 1

Problem addressed
The situation between FrieslandCampina and Maersk has currently escalated. To de-escalate this problem, internal alignment is necessary. However, currently there are many different communication channels. This makes the communication towards FrieslandCampina messy from Maersk's side. So, the problem we will tackle is: "Unclear internal communication channels for FrieslandCampina." While the question can be: "How can we create clear internal communication channels for FrieslandCampina?"

Prepare before workshop starts:
- Write down problem statement in the workshop room
- A0 sheets
- A0 sheet with C-box: x-axis of cost, y-axis of customer satisfaction
- A0 sheet with entire supply chain for customer
- A0 sheet with departments and lines to connect these
- A0 sheet a row for each participant to put their action points
- Enough post-its
- At least one marker per person
- A0 sheet with 4 sections, expectations learning and contributions, learnings, challenges.

Part 1 – Introduction
Output goal: Getting all participants informed and aligned about the goal of the workshop
Time: 5 min
Materials: -

Purpose: The introduction informs the participants about the goal of the workshop. This ensures that they all understand the goal and they know what is expected of them. Furthermore it also helps setting their expectations.

Step by step:
1. Start with introducing yourself
2. When you are introduced, make sure all participants know each other's name. Probably this is the case, but if not, let everybody introduces themselves. Also let people something about themselves to ensure they know who their fellow participants are.
3. Introduce the goal of the workshop: currently there are many unclear communication channels with FrieslandCampina. Both internal and to FrieslandCampina. With this workshop, the goal is to research the cause(s) of these unclear communication channels and to build a way of working forward by look into the occurrence of this problem in the supply chain followed by creating action points for all participants to create clear communication channels.

Part 2 – Icebreaker (learning and contribution expectations)
Output goal: Warm-up and setting expectations
Time: 5
Materials: A0 sheet divided in four fields and the questions, post-its, markers

Purpose: Getting to know everybody's expectations. This helps validating the workshop afterwards. When knowing the expectations, it can be seen whether their expectations meet the outcomes or that the workshop must be designed differently.

Step by step:
1. Explain to the participants that in this workshop only one answer/problem/idea per post-it can be written down. If you have a second idea, put it on a second post-it.
2. Explain the rules of the workshop: this workshop is meant to create an open space for ideas, so don't point fingers and listen to each other. Do not interrupt others.
3. After telling people the introduction, ask them the following questions: 'what do you expect to learn today?' and 'what do you expect to contribute?'
4. Let everybody answer the questions by putting their answers on post-its and put those on the A0.

Part 3 – Problem generating
Output goal: Generating problems from all different perspectives
Time: 5 min
Materials: post-its, A1 sheet, markers

Purpose: To find the underlaying problems behind the problem of the unclear internal communication channels. These problems show the root cause of the unclear internal communication channels that evolved.

Step by step:
1. Write down the problem situation before the workshop starts
2. Set a timer of 5 minutes for yourself as workshop host
3. Ask participants to write down all problems they experience with the internal communication. Make sure they write down everything that comes to mind and do not judge their problems already before writing them down.
4. When people start struggling with writing problems down, give them stimulative questions. Such as:
    a. I feel there is lack of ...
    b. I feel there is too much ...
    c. Others from my department experience
    d. The internal communication channels are currently unclear because ...
    e. The unclear channels arise from ...
    f. For me, this is unclear ...
5. When the timer goes of, make sure people write down their last problem
6. Wrap up this part by letting all participants look at what other wrote down.

Part 4 – Clustering problems
Output goal: Clusters with overarching themes of occurring problems
Time: 5-10 min (done after 20 min)
Materials: A0 with all problems on post-its from part 3, post-its, markers

Purpose: Find overarching themes that show the root causes of the problem and gain shared understanding of these themes. Besides, it creates an overview of the output in part 3.

Step by step:
1. Remind the participants of the problem you are working on: tackling the problem of unclear communication channels for FrieslandCampina.
2. Explain that these many problems have overarching themes.
3. Ask the participants to cluster the problems in groups with similar or overlapping themes.
4. If you are done clustering, check whether all post-its are in a cluster, otherwise create a 'left-over' cluster.
5. If all clusters are created, generate names per cluster. Draw a line around each cluster with the cluster name.
6. Check whether everybody agrees on the created clusters.

Part 5 – Mapping the clusters
Output goal: Identify the most pressing root causes that cause unclear communication channels
Time: max. 10 min (done after 30 min)
Materials: A0 sheet with C-box: x-axis of cost, y-axis of customer satisfaction, post-its, markers

Purpose: To identify the most pressing root causes by placing them in a C-box. This C-box has two axes, the x-axis will be on cost, while the y-axis is based on customer satisfaction. Maersk is a profit driven company, therefore cost savings are important. At the same time, customers are needed within Maersk to gain profit, which makes customer satisfaction highly important. The bottom left axis will show what problems have the highest impact on making losses and lower the customer satisfaction most. The problem in the left bottom corner should be addressed and be brought towards the top right corner.

Step by step:
1. Explain to the participants that they will map the clusters created in part 4 on two axes, one of cost and one of customer satisfaction. The middle is neutral for both.
2. Explain what each axis mean and why this is important
3. Make the participant write down the names of each cluster on a post-it and place those on the two axes.
4. When all post-its are placed, make sure all participants agree on the placement of the clusters on the axes

Part 6 – Diving into the core problem
Output goal: Identifying where the problem occurs across the supply chain
Time: 10 min (done after 40 min)
Materials: A0 with prepared supply chain, post-its, markers

Purpose: When the theme of the most pressing problem is chosen, there has to be a solution created to solve the unclear communication channels. Therefore, all activities across the supply chain have to be reviewed to ensure that everybody understands how this problem emerges throughout the supply chain. Participants can put post-its with the problems on the supply chain, to share the problems they experience. Besides, this also shows what moments are crucial for preventing unclear communication channels.

Step by step:
1. Explain that the chosen direction will be addressed.
2. Explain the entire supply chain for the customer that is written down on the A0 sheet. This consists of every step from

starting the contract with a customer until the container that arrives at the customer's warehouse.
3. Start writing down problems on post-its
4. Make sure all participants look at different parts of the supply chain and share their perspective.
5. When everybody is done, let the participants look at the problems given.

Part 7 – Discussing responsibilities
Output goal: Align responsibilities to ensure clear communication channels
Time: 10 min (done after 50 min)
Materials: A0 with different departments present, post-its, markers

Purpose: After putting down all the problems or unclarities in the supply chain, it is important these are (partially) solved. Otherwise, the unclear communication channels keep existing, which is something that must be prevented. To do so, it is important to map the problems on the departments, to ensure that everybody is aligned on where certain responsibilities lay. This creates an overview of who should address which problems to improve the communication channels.

Step by step:
1. Remind the participants of the goal of the workshop: to create clear communication channels.
2. Explain to the participants how the map works and that problems can be a responsibility of one department, but also of multiple departments. This creates a shared responsibility.
3. Let the participants get the problems from the supply chain and divide them per department on the map.
4. Make sure everybody agrees in these placements.

Part 8 – Action plan
Output goal: Action points that all participants can work with to improve the communication channels
Time: 5 min (done after 55 min)
Materials: A0 with a row for each participant's action points, post-its, markers

Purpose: Creating clear action points for each participant to improve the overall communication channels. By putting down action points, it is tangible what each participant has to do to improve the channels. This also creates a clear conclusion for the participants.

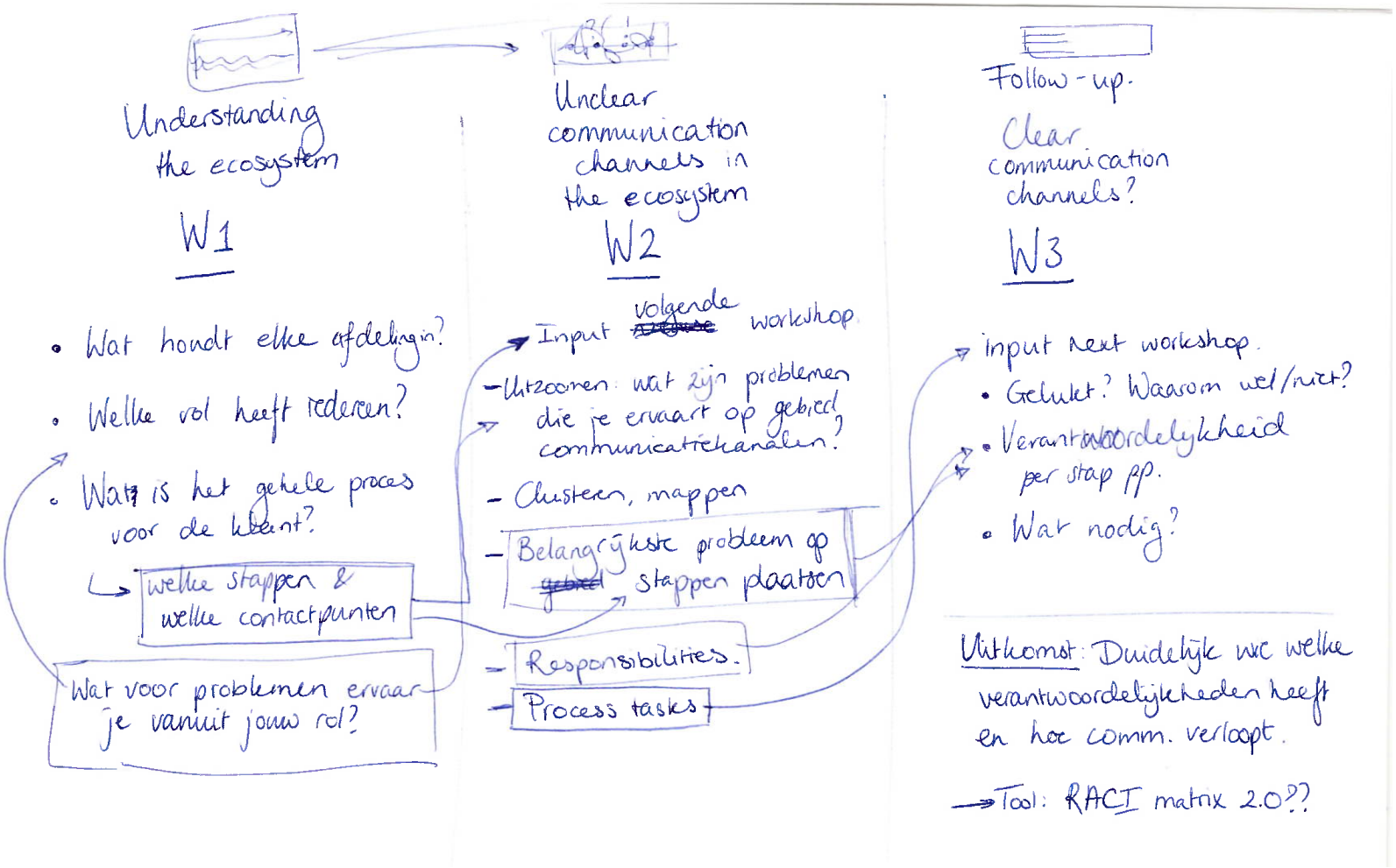
Step by step:
1. Let all participants write down the actions they have according to the responsibilities put down in part 7. One action point per post-it.
2. Let everybody put the post-its behind their name to make it visible what everybody will work on.
3. Let everybody explain what their action points are.
4. If necessary, let the other participants add points.

Part 9 – Wrap-up
Output goal: Wrapping up to make all participants leave content.
Time: 5 min (done after 60 min)
Materials: A0 sheet from part 2, post-its, markers

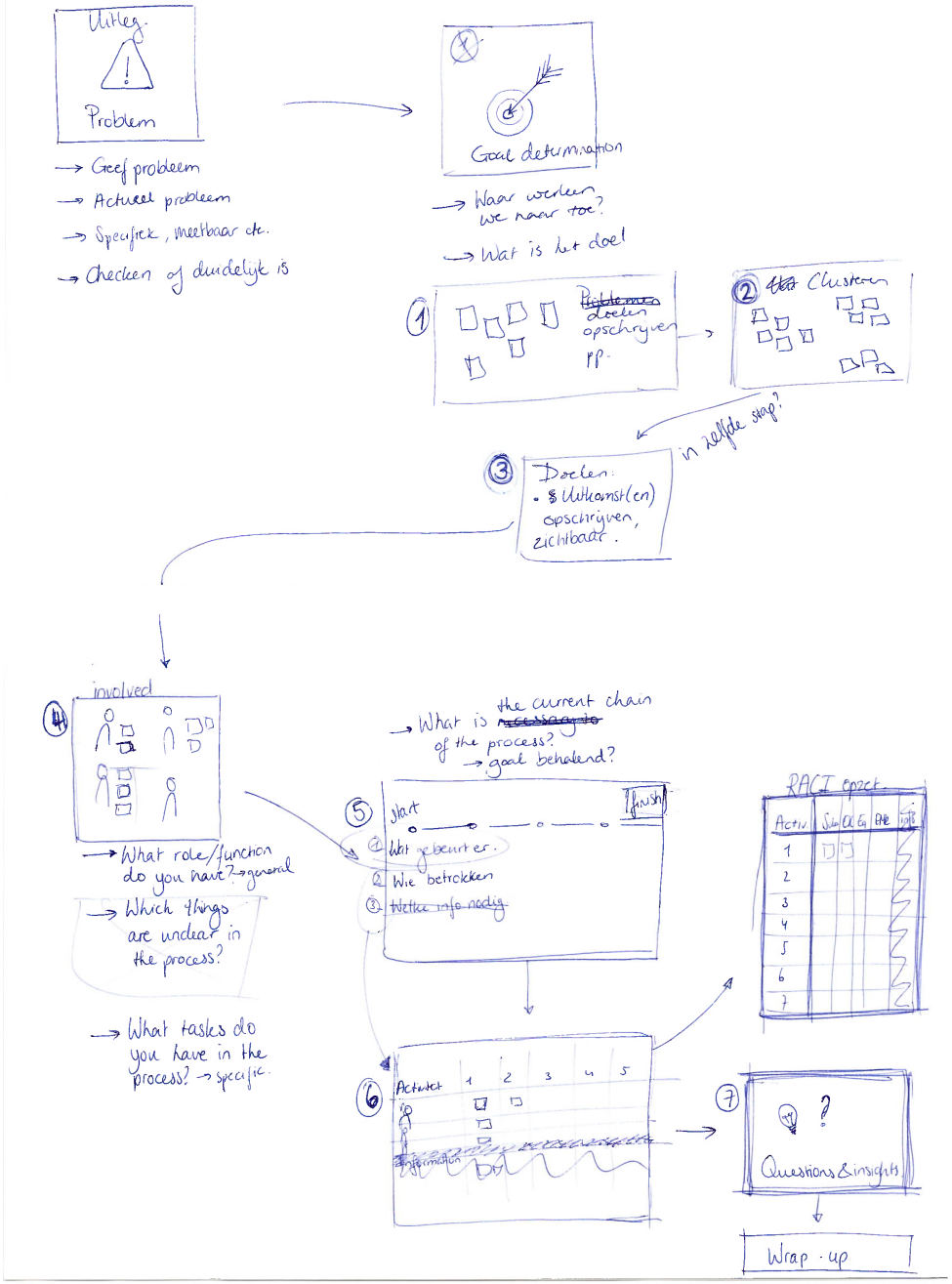
Purpose: The idea of this part is to wrap-up the workshop and validate the expectations of the beginning. Besides letting the participants know that they have worked really hard and did a lot of useful things, it is important to understand their learnings to validate the workshop.

Step by step:
1. Thank all people for participating and ask whether people still have questions or things they want to share
2. Ask people as a final assignment to answer the reflection questions from the beginning. These questions are as follows: 'what did you learn during this workshop? What new perspectives did it bring?' and 'what challenges do you see in achieving the goal of today's workshop?'
3. Ask people whether they are okay in doing a follow-up workshop to revise the outcomes of this workshop.
4. Mention you will send an invite to all participants for this second workshop over 2/3 weeks.

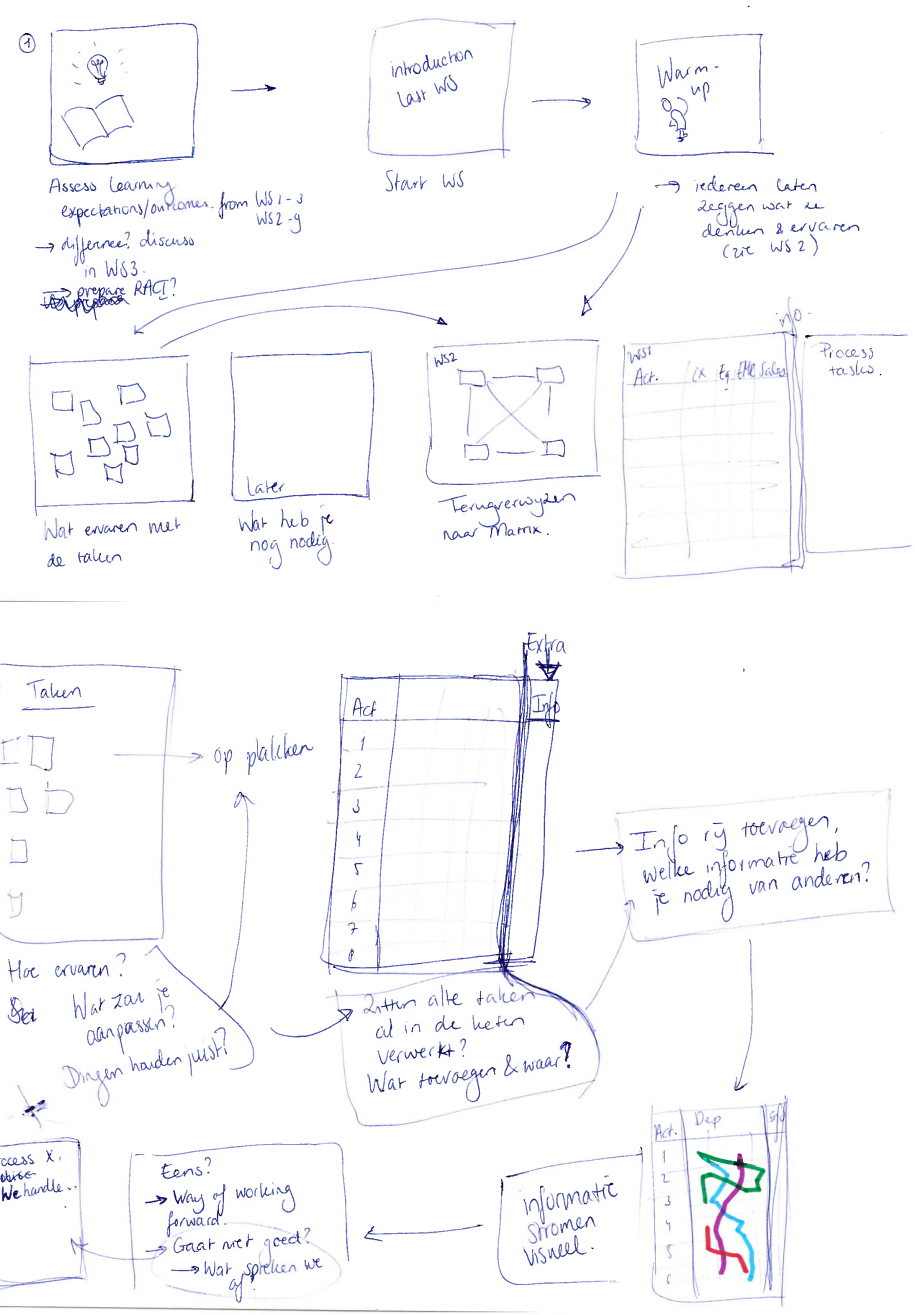
Appendix O: Designing Workshop 1 and 3



Workshop 1: identify & map.

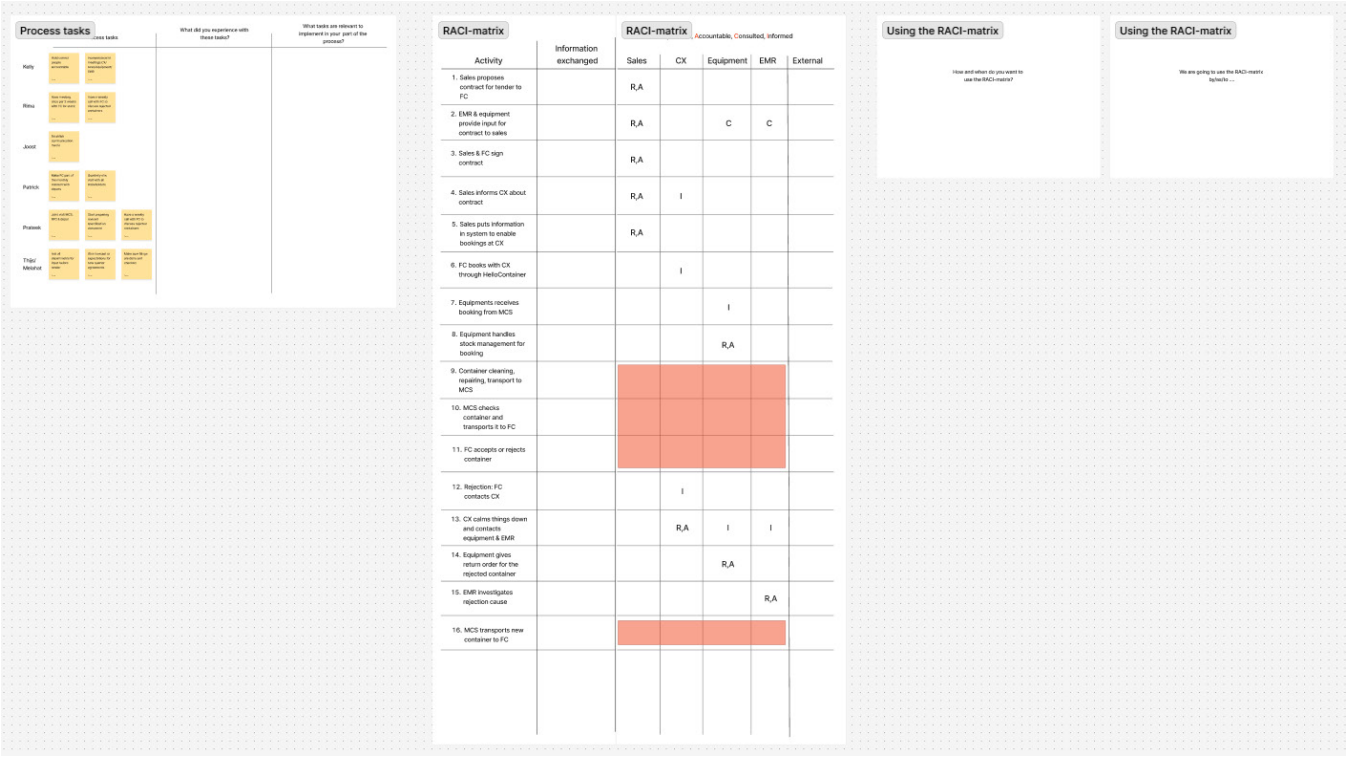


Workshop 3: iterate & evaluate.



Appendix P: Set-up workshop session 2

Overall goal:
Getting a clear agreement on the communication streams with FrieslandCampina and make the information streams visual for you. This is done by diving into the supply chain used during the previous workshop, complemented by a RACI-matrix.



Materials:
The workshop will be held partially online. The participant of the CX department can only join online. Therefore, this workshop will not use any markers, post-its and flip-over sheets, but is held on Figjam.

On the Figjam board it is important that the workfield are closed before using them. This way, the participants do not get distracted or overwhelmed by all different frames in the Figjam.

Prepared in Figjam:
- Photos of worksheets in first workshop
- Template 1.1
- Template 2.1
- Template 2.5
- Template 3.4

Part 1 – Introduction
Output goal: Getting all participants informed and aligned about the goal of the workshop
Time: 5 min
Materials: Photo's previous workshop

Purpose: The introduction informs the participants about the goal of the workshop and gives a recap of the last workshop. This ensures that they all understand the goal and they know what is expected of them. Furthermore, it also helps setting their expectations.

Step-by-step:
1. Start with introducing yourself and do a round to ensure all participants know each other.
2. Give a recap of the previous workshop: The workshop focused on analysing the underlaying problem with FrieslandCampina that lead to unclear communication channels. Rejections were a core problem, and we used this cluster to see what problems occur in the entire supply chain. From here, we looked at responsible departments for each of these problems. Finally, you have written down process tasks per person that help creating better and more clear communication in supply chain for FrieslandCampina.
3. Introduce the goal of the workshop: Getting a clear agreement on the communications streams with FrieslandCampina and make the information streams visual for you. We will do that by diving into the supply chain we used last time, complemented by a RACI-matrix.

Part 2 – Icebreaker
Output goal: Warm-up and setting expectations
Time: 5 min
Materials: Template 1.1

Purpose: Getting to know everybody's expectations. This helps validating the workshop afterwards. When knowing the expectations, it can be seen whether their expectations meet the outcomes or that the workshop must be designed differently.

Step-by-step:
1. Explain to the participants that in this workshop only one answer/problem/idea per post-it can be written down. If you have a second idea, put it on a second post-it.
2. Explain the rules of the workshop: this workshop is meant to create an open space for ideas, so don't point fingers and listen to each other. Do not interrupt others.
3. After telling people the introduction, ask them the following questions: 'what do you expect to learn today?' and 'what do you expect to contribute?'
4. Let everybody answer the questions by putting their answers on post-its and put those on the miro board.

Part 3 – Process tasks evaluation
Output goal: Evaluated and improved process tasks for the supply chain
Time: 10 min
Materials: Process tasks template, process tasks of previous workshops

Purpose: The process tasks of the participants have to be evaluated to check whether they work or need to be adjusted. This part focuses on the experiences the participants had with their tasks and lets them rethink the tasks to optimise them for the supply chain.

Step-by-step:
1. Discuss the process tasks written down by the participants shortly
2. Ask the participants to answer the two questions on the board: 'What did you experience with these tasks?' and 'What tasks are relevant to implement in the supply chain?'.
3. Set a timer for 4 minutes.
4. When participants have not executed the task, let them answer the first questions with their expectation.
5. When time is up, let the participants share their biggest insides.
6. Move towards part 4, focusing on the actual supply chain.

Part 4 – Writing down what information is exchanged
Output goal: An overview of the information exchanged in the entire supply chain.
Time: 10 min
Materials: Part of template 2.1

Purpose: This step makes the participants discuss what information should be exchanged in each step of the supply chain, which leads to alignment among the stakeholders.

Step-by-step:
1. Explain that the entire supply chain from the previous workshop is written down.
2. At each step information can be exchanged. Let the participants write down the information they think is exchanged on post-its for 2 minutes.
3. After the two minutes, go over the post-its

with the participants and ensure that all participants agree.
4. Once all information and steps are correct, make a bridge to part 5

Part 5 – Process task implementation
Output goal: Implementing process tasks in the supply chain
Time: 5 min
Materials: Improved process tasks of part 3, full information matrix

Purpose: By implementing the process tasks, the supply chain becomes complete. This leads to a full and correct overview for the participants.

Step-by-step:
1. Look at the process tasks written down at the relevant-section in part 3.
2. Ask the participants whether the process tasks are already in the supply chain and if not, to put them in the supply chain on a logical place.
3. Once all process tasks are placed in the supply chain, discuss with the participants whether the new tasks are relevant according to the participants and whether they are in the correct place.
4. If needed, adjust some placements of process tasks until all participants agree.

Part 6 – Completing the RACI-matrix
Output goal: A complete RACI-matrix with the new process tasks
Time: 5 min
Materials: Template part 5

Purpose: The RACI-matrix was already set-up beforehand, but with the new tasks, this has to be completed. This step provides time to both explain the RACI-matrix, check it's correctness with the participants and complete it for the new process tasks.

Step-by-step:
1. Explain the function of the RACI-matrix. There are four different roles in the RACI-matrix: responsible, accountable, consulted and informed.
2. Ask the participants to go over the matrix to ensure they agree with the divided responsibilities per person.
3. The responsibilities per activity are already put down, but this also has to be done for the new added tasks, so ask the participants to add this.
4. Once done, go over the new divided responsibilities with the group and make sure all participants agree.

Part 7 – Visualising process parts and contact points
Output goal: Visual process parts and contact points in the RACI-matrix
Time: 5 min
Materials: Full RACI-matrix of part 6.

Purpose: By visualising the different process parts within the supply chain, it is clear for the participants how the process flows. The different parts of the contract, bookings and rejections are put down, which shows where all responsibilities lay. Furthermore, the contact points are also visualised at the same time to create awareness of the points of contact for the customer.

Step-by-step:
1. Explain that the process exists of three core parts: contract, bookings and rejections. Ask the participants to draw lines before the activity box to divide different parts. Give each part a colour.
2. Once all parts are divided, also ask the participants to draw a circle in the matrix around the contact points with customers.
3. When both the different process parts and the contact points are drawn, ask the participants whether they feel like the entire chain is complete. If so, wrap up the RACI-matrix.



Part 8 – Creating an agreement
Output goal: An agreement on how and when to use the RACI-matrix
Time: 5 min
Materials: Template 3.4

Purpose: Once the RACI-matrix is created, this is the agreement on how all departments act in the supply chain. However, it is important to discuss how this matrix is going to be used in the future. When are they going to look back at this? The participants can decide this with each other.

Step-by-step:
1. Explain to the participants that the RACI-matrix is the agreement on how to work in the supply chain, but that it is also a tool.
2. Ask the participants to answer the question: 'how and when do you want to use the RACI-matrix?'. Give them examples, like you can reflect on it once a year and adjust it, only use it with new-joiners, use it every meeting as a reflection moment, or only refer to it once problems occur.
3. Once all participants have placed some post-its, ask the group to come to one agreement by completing the following sentence: 'We are going to use the RACI-matrix by/as/to/when/etc. ....'.

Part 9 – Learnings & challenges
Output goal: Validation input
Time: 3 min
Materials: Template 2.5

Purpose: The idea of this part is to wrap-up the workshop and validate the expectations of the beginning. Besides letting the participants know that they have worked really hard and did a lot of useful things, it is important to understand their learnings to validate the workshop.

Step-by-step:
1. Ask people as a final assignment to answer the reflection questions from the beginning. These questions are as follows: 'what did you learn during this workshop? What new perspectives did it bring?' and 'what challenges do you see in achieving the goal of today's workshop?'

Part 10 – Wrap-up
Output goal: Let all participants leave content
Time: 2 min
Materials: -

Purpose: By wrapping the workshop up, all participants can share their last thoughts and it is clear that the workshop comes to an end. This makes the participants leave the room content.

Step-by-step:
1. Explain that the RACI-matrix is the product they developed together and can use in the process for foodgrade for FrieslandCampina. Tell the participants that you will make a neat version of the matrix and send it to everyone by email after the workshop.
2. Thank all people for participating and ask whether people still have questions or things they want to share.
3. Close the workshop.