BARGE COLLABORATIONS WITHIN CONTAINER LOGISTICS

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SKYLINE

Master Thesis Leon de Vries

A COLLABORATION TO INCREASE THE EFFICIENCY OF BARGES AND BARGE PLANNING.

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Abstract

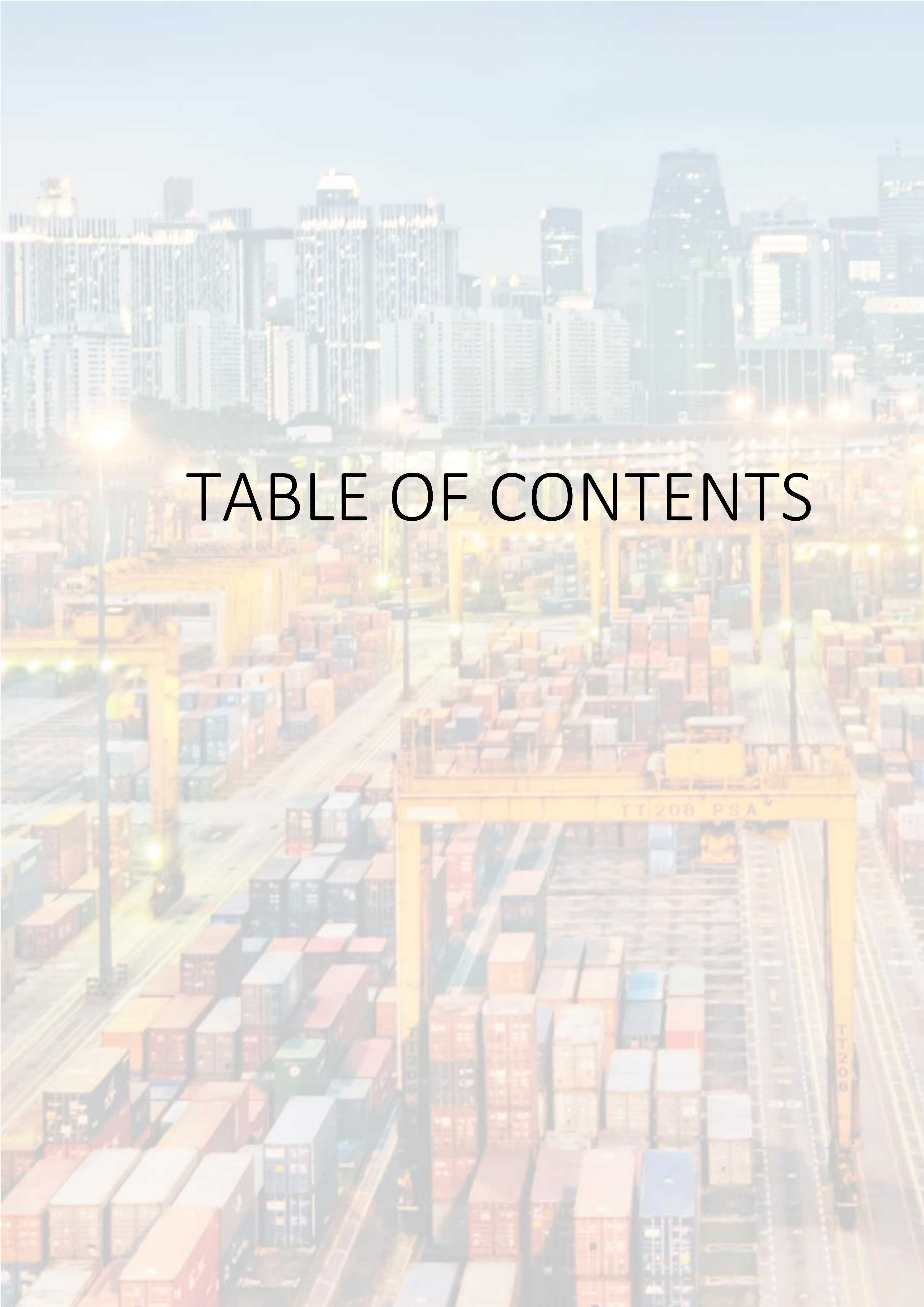
The Netherlands is a logistics-oriented country, with Rotterdam having the biggest port of Europe. From the port a part of the cargo is transshipped to another sea vessel, another part is transported to the hinterland. Containers offer a solution for this intermodal transport on barges, trucks and trains to the hinterland. Due to congestions at the port and on the road, an efficiency cycle is needed to improve hinterland transportation. The most inland container terminals, who offer this transportation services, are clustered around the same waterways, which opens the opportunity for collaborations.

In this study a theoretical framework is constructed for creating, analysing and evaluating logistics collaboration for container transport based on known literature and some cases. This framework defines five pillars: Activities, Parties, Profits, Information, and Insight which together describe the fundament parts for a (successful) collaboration.

By combining the framework with the knowledge of hinterland processes, the framework is translated into a tool for designing container barge collaborations. This tool is applied to a case study in Zeeuws-Vlaanderen for sharing capacity on barge voyages. Afterwards this case study is evaluated with data analysis and interviews. The data analysis indicated that some of the goals have been met (more voyages, less terminals calls in the port), and some of them haven't (modal shift and sharing empty equipment). The interviews support these results and the trusts all parties have in the collaboration.

The case study showed that the tool helped constructing a successful collaboration. But it also emphasized the importance of the information sharing mechanism to make sure all parties have the necessary information to efficiently execute their activities within the collaboration.

Next to the framework there are some extra elements which can contribute to the success or failure of the collaboration: the presence of a good business case; the availability of trust between the parties, and a working IT system to support the information flow.



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Chapter 1. INTRODUCTION

1.1 BACKGROUND

CONTAINER TRANSPORT

Nowadays a lot of goods are internationally transported in sea freight containers. This containerization started around the 1830s and is standardized in 1968 in ISO668. This standard describes the containers as we know them these days, where the most seen containers are the 20ft dry box and 40ft high cube containers. On May 3th 1966 the first containership (MS Fairland) arrived in Rotterdam (Port of Rotterdam, n.d.), the 50 years since then, the Port of Rotterdam was always the biggest port in Europe: it occupies the 9th place on the overall world ranking and the 11th for container transport, which was good for a throughput of 7.329 thousand containers and 12.235 thousand TEU in 2015 (Port of Rotterdam, 2015). In 2015 there were 7.398 visits of containerships in the port of Rotterdam, this equals to more than 20 sea ships each day of the year.

One part of the incoming containers is transhipped to another sea ship, the remaining containers go to the hinterland. This hinterland transport can be done by different modalities: truck, barge and train. In Rotterdam the road was the most used (54% of the cargo) for the transportation from and to the port, but also barges are responsible for a large portion (35%) containers and the remaining transport is done by rail (Bureau Voorlichting Binnenvaart, n.d.).

Due to several reasons, such as the environment and costs, the Port of Rotterdam and the Dutch government are stimulating a modal shift from truck to barge or rail. A main cause prioritizing road over water transport are the congestion problems on the waterside. A lot of shippers still use road transport to prevent those delays and possible missed sea ship connections.

There are a lot of different stakeholders in a hinterland container transportation, with several mutual contractual relationships for transporting a container with a barge to the end location (Douma, 2008). Besides this there are a lot of competing companies that are executing the same or similar transportation services.

As shown in Figure 1 the most container terminals in the hinterland are clustered around the same canals or rivers. Barges sail past several container terminals before reaching the Port of Rotterdam (or Antwerp). Some sluices, bridges and water levels could give a limitation on the loading capacity of the barge. It is possible the barge can add an extra layer of containers halfway its trip.

FIGURE 1 BARGE TERMINALS IN THE

COFANO

Cofano is a small to medium company, with around 80 employees, specialized in software development. They develop software for two different markets: quality management and the logistics industry. This study focuses on the logics part of the company. The goal of the company is to create (for the sector) innovative software, to improve the efficiency of a single entity in the supply chain or the whole chain as total.

They do this with web-based Software as a Service (SaaS) solutions where the following points are key factors during development:

- Intelligence (automatic planning)
- Integrations (prevent retyping information)
- Ease of use (everyone should be able to work with it)

One of the biggest applications Cofano develops and sells is Stack, an application to support the intermodal container supply chain. This application is used by different container terminals, forwarders and barge operators to support their primary process, this encapsulates order entry, planning, executing, monitoring and invoicing the transport of containers.

Besides just building customer requirements, Cofano is pro-actively searching for ways to improve its software, even without a request from the customers.

1.2 RESEARCH

RESEARCH GOAL

For hinterland transport there is an opportunity for sharing container cargo among barges. By sharing cargo the planners can increase the utilisation of the barges, achieve a modal shift from road to water, and the port calls can be minimalized[1] which helps with the congestion in the port.

The goal is to develop a system that enables barge planners to collaborate and share capacity to increase the individual and overall efficiency of the barges and barge planning.

RESEARCH QUESTIONS

This goal results in the following main research question and the corresponding sub-questions:

RQ: How to organise an inter-organisation collaboration for capacity sharing on container vessels between barge planners to increase the individual and overall efficiency of the barges and barge planning.

SQ1: What are the basic processes of barge and truck planning for container transport?

SQ2: What is already known about sharing capacity among the horizontal supply chain?

SQ3: What are the requirements for a tool for sharing barge capacity on barges?

SQ4: How can the tool be applied to a case study?

SQ5: What can be learned from this case study?

RESEARCH SCOPE

In order to prevent a scope drift, the research will focus on possible collaborations within Belgium and The Netherlands and their corresponding main ports Antwerp and Rotterdam. Besides the geographical scoping, the other scope will limit the research to container transport and excluding other forms of cargo as bulk and break bulk.

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[1] Most of the time a barge carries containers for multiple terminals, they must go to all these terminals. The lower the amount of terminal calls the easier the global planning gets.

RESEARCH STRUCTURE

The answers of each individual sub question will lead to the final answer of the request question, and the solution for the research goal. In Figure 2 you find how the individual sub questions map together to the final research question, and how the research questions map to the individual chapters of this thesis.

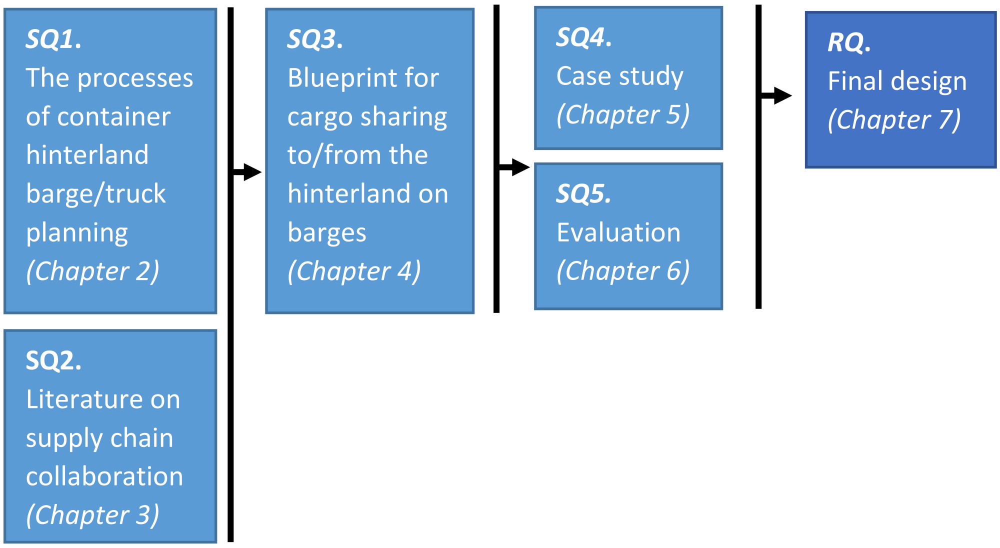

FIGURE 2 RESEARCH STRUCTURE

1.3 RESEARCH METHODOLOGY

This research is structed as a Design Science, over time multiple researchers investigated Design Science as a Research Methodology. The framework used for this research is constructed by Peffers, Tuunanen, Rothenberger, & Chatterjee (2007). In their work they compared and combined multiple models and strategies in a final design, that leads and structures a design science research.

The framework consists of seven separate activities which are executed in a continuous iteration. Besides these seven activities they defined four separate "entry points" from where the processed can be started (Figure 3)

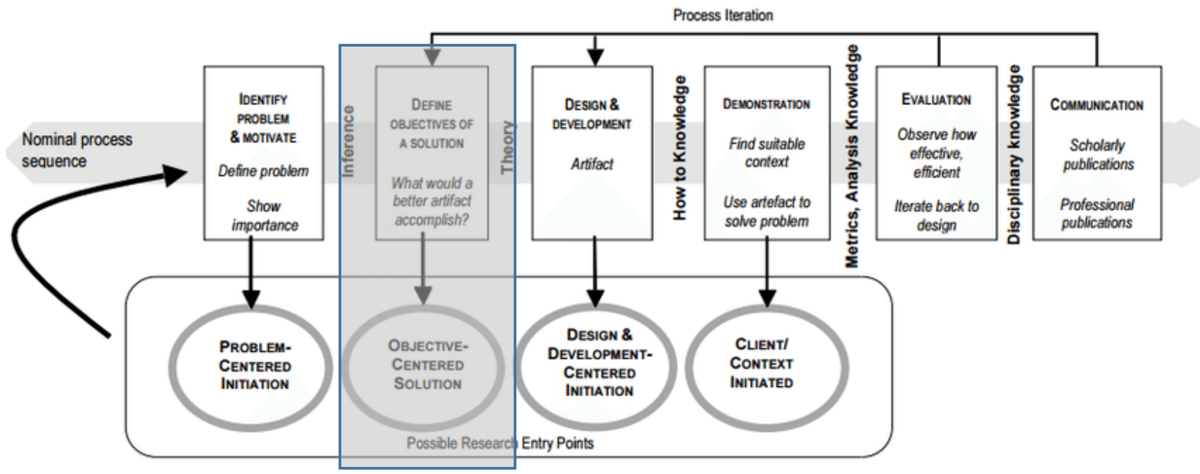

FIGURE 3 RESEARCH METHODOLOGY

The need for this thesis is triggered by a “real-word” request for an artefact. Based on this need the research is constructed. According to Peffer this results in an object centred approach, and therefore entering the “process” at the second step (Define objectives of a solution). From this step we move outward to identify the problem that the artefact should solve in phase 1 and after clarifying the objects the design will be started in phase 3.

Problem identification and motivation (phase 1)

The first activity in the model is the *Problem identification and motivation*. This phase is used to define and describe the research problem and justify the value of a solution. This phase will be covered in the beginning of this thesis: Chapter 1 and Chapter 2

Define the objectives for a solution (phase 2)

The second activity is to *Define the objectives for a solution*, where quantitative or qualitative objective should be made. These objectives should be inferred from the problem identification and result in an artefact that meets the research goal. The objectives mentioned can be found in Chapter 3.

Design and development (Phase 3)

The next activity, the third, is *Design and development.* The creation and development of the artefact based on the objectives defined in the previous stage, this can be found together with the case study and prototype in Chapter 4.

Demonstration (Phase 4)

The following phase, *Demonstration,* is the fourth. In this phase the use of the artefact to solve one or more instances of the problem is demonstrated. This can be done by a case study or simulations. The demonstration is combined with the case study in Chapter 5.

Evaluation (Phase 5)

Following by the fifth activity *Evaluation*, where the effectiveness of the artefact is measured and analysed. This can be a quantitative analysis e.g. by measuring the performance or a conceptually by evaluate empirical evidence or logical proof. The evaluation can be found in Chapter 6.

Communication (Phase 6)

The last activity is the *communication* activity, where findings in a strutted matter are shared and published. The communication part for this research will result in a written master thesis describing the design process and a defence presentation when finalizing the research wilt de results in Chapter 7.

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Chapter 2.
BASIC PROCESSES OF HINTERLAND TRANSPORTATION

2.1 HINTERLAND TRANSPORTATION

This chapter is written based on my experience and gained knowledge in the last 5 years working at Cofano and by executing fit-gap analyses and describing processes of different inland terminals. Afterwards it is validated by the following fields experts: Marco Huijsman, Logistics consultant; Richard Klaassen, terminal manager at MCT and Rick Lubbers, Lead Engineer at Cofano

DEFINITION

Hinterland transport is the transportation of goods from a seaport land inward and vice versa. Hinterland transport can be defined into three categories: import, export and repositioning. The import containers arrive full at a seaport and are transported (filled with goods) to an inland location where the goods will be stripped[2] from the container, and afterwards the container will be returned empty to an allocated depot (usually in a seaport). For export the process is the other way around, where an empty container should be transported to a location where the container is stuffed with goods, followed by a full transport to a seaport where the container will be loaded on a sea vessel. The reposition transports is moving empty containers from/to another depot to balance the empty stock.

Besides the actual transport categories, there is also a category depending on who is giving the order and paying for the transport. This can be defined in: Carrier Haulage, Merchant Haulage and Merchant inspired Carrier Haulage. The difference between these options depend on if the shipping company (The party executing the sea transport / owner of the container) orders the transport of a container or the merchant (a trader or person, their agents or anyone acting on their behalf, owning or entitled to possession of the goods) doing it.

These full and empty container transports can be executed by different modalities such as barge, train or truck or a combination of these. There are two actors for executing these container transportations: operators (barge, truck, rail) or inland terminals.

In the Netherlands the majority of the transport is been orchestrated by truck operators or terminals located in the hinterland. Truck operators most times offer a direct trucking solution, in this case the container is directly transported from the seaport to the consignee, stripped or stuffed a transported back. While inland terminals use their terminal for temporary storage of the container before it is stripped or stuffed. In this case, the container is first transported to an inland terminal by barge or rail, and later there is “last-mile trucking” to transport container to and from the consignee for stuffing and stripping also known as pre and on carriage.

There is a difference in The Netherlands/Belgium and Germany, because in Germany inland terminals most times do not offer any transportation, but only the terminal activities. The transport will be booked at different parties such as barge/truck operators or it is outsourced to a freight forwarder.

ACTORS

Within the logistic sector there are multiple actors, below you will find the most relevant for this thesis:

- Inland Container Terminal
  A location to store and process containers in the hinterland
- Barge / Truck Operator
  A transporter of containers by the defined modality

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[2] For putting goods in a container and getting goods out of a container the terms stuffing and stripping are used, to prevent the confusing with loading and unloading containers on and from barges.

- Forwarder
  A third party orchestrating the total transport of goods
- Shipping Company
  The operator of the sea transport and most times the owner of the container
- Consignee / Consignor
  The parties who sent and receives the goods in the container.

HINTERLAND TRANSPORT COMBINATIONS

In this subchapter the most commonly used combinations of transport for an inland terminal are described: Import Roundtrip, Import Single trip, Export Round, export Single trip and repositioning.

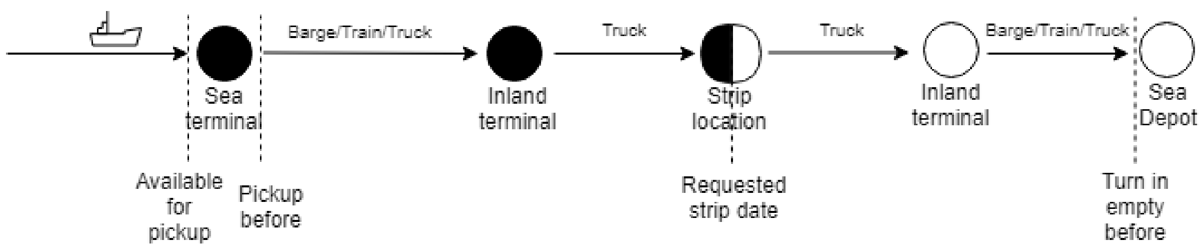
IMPORT ROUNDTRIP

The most simple and straightforward transport combination of a container is a full import roundtrip. The goods are shipped from a part of the world to a seaport and from there the full container is transported to the consignee where it is stripped. The empty container is transported back to the seaport. This process is described in detail below:

A full container is delivered by a sea vessel at a sea terminal (e.g. Antwerp or Rotterdam). As soon as the container is on the ground and the customs cleared the container, it can be transported to an inland terminal. This transport can be executed by barge, train or truck. Barge transport is the cheapest but also the slowest, Truck transport is the most expensive but the fastest. Train transport is in between on either price and speed.

At the Inland terminal additional activities are offered, like ventilation, physical inspection, fumigation. Afterwards the container is transported to the customer where it is stripped of its goods. After the stripping the container is transported empty to the inland terminal, where again some tasks can be executed e.g. cleaning or repairing the container. Finally the empty container is returned to the seaport.

Within this process there are some time constraints that must be considered:



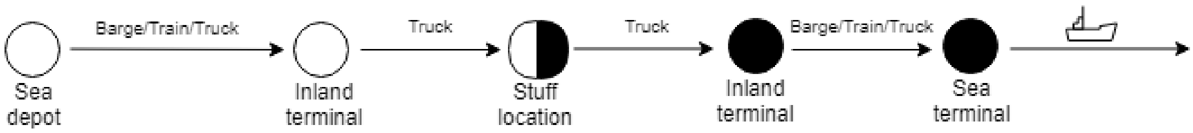
The container can only be picked up when it is physically available and when the container is released by customs. The container should be picked-up before a specific date, otherwise storage costs must be paid to the sea terminal (demurrage). These demurrage costs are (most times) calculated in *days after the container arrived* so if the container arrived at 11-11-2018 00:05 on the terminal and there are 5 demurrage free days, the container should be collected at latest at 11-11-2018 23:59.

The next deadline is the date the consignee requested the container to be stripped at their location. This point of time is determined by production processes and warehouse planning at the consignee.

The last date is the turn-in empty before, is when the empty equipment should be back in the seaport. This date is determined by the shipping line and can be calculated on several ways, e.g. *days after full container arrived in seaport* or *days after the container is stripped.* There are high penalties if you return the empty equipment later then agreed ($50 – 100$ per day).

EXPORT ROUNDTRIP

The opposite of an import roundtrip is an export roundtrip, where goods are transported to another part of the world. The flow is exactly the opposite of the previous import flow, first an empty container is transported to the inland terminal, and later trucked to the consignee where the container is stuffed. Afterwards the full container is transported full via the inland terminal to a sea terminal.



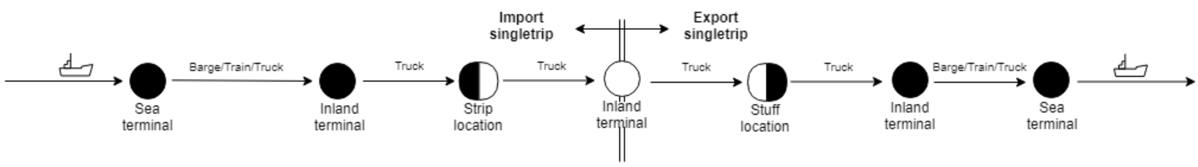
An empty container should be collected from a depot and transported to the inland terminal. Just like the import scenario, there is a time constraint. If you pick up the empty equipment to early, you can receive a financial penalty.

After the empty equipment is collected it is trucked to the consignee address where the container is stuffed. The stuffed container is returned to the inland terminal, where it is transported to the seaport. There are two time-constraints at the seaport: you cannot deliver the container to soon, and you should deliver it before the closing. If you are to early you must pay demurrage, if you are too late, the container literally misses "the boat".

IMPORT/EXPORT SINGLETRIP

Instead of picking up the empty container at the seaport or returning an empty container to the seaport, it is also possible under certain conditions to keep the container on the inland terminal. In this case it only takes a single trip to execute the transport (only one instead of two transports) from/to the inland terminal and the seaport.

By combining two import/export single trips you can decrease the amount of empty container transports for the total flow. An example combination of two single trips can be found below:



To facilitate this process official approval of the shipping company is required, to keep the container on the terminal and to reuse it, there are several ways this permission can be granted:

- Reuse
  The normal detention and demurrage agreements are still valid, but you can request a reuse at the shipping company.
- Merchant depot
  It is possible to have a depot for a specific merchant / shipping company combination. Where all containers for the merchant have a higher detention and can be reused.

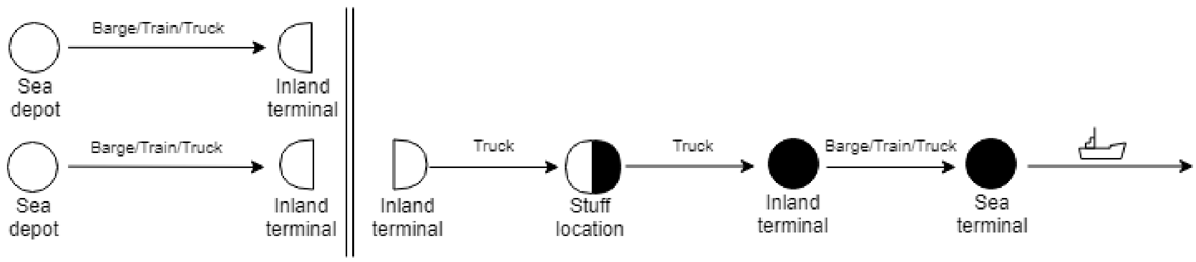
- Carrier depot
  The other type of depot, is to have a depot for a shipping company that isn't merchant dependent.

For the last two options also, other detention agreements will be applicable e.g. all containers can stay 20, 30 or even 90 days in depot.

Besides the time constraints for reusing a container there are also constraints of shipping company and container types. There are some collaborations between shipping companies and therefore equipment of these carriers can be interchanged, but only with permission. Also, other restrictions on equipment are relevant, e.g. size/type, the cleaning of tank containers, PTI (setting the temperature configuration) of reefers but also the class & grade and the previous cargo in the container.

REPOSITIONING

The last transport option is a situation of export order where in advance empty equipment is moved from a sea depot to the inland depot. Where for an export booking the equipment can be used from the depot. With this construction there is a larger stock of empty equipment available at the inland terminal and therefore carriers can anticipate quicker for export orders for the specific customers.



ORDER

Based on the different flows as described above orders will be placed for transporting the containers. The following steps can be extracted during this process, depending on the customers and companies some steps can be omitted or combined:

- The first (optional) step is the reservation phase, in this step an indication is given of how much containers should be transported in the coming period (2 to 4 weeks).
- Later, a draft booking can be made with the bare minimum information of the transport that should be executed.
- Based on this draft booking actual container transports can be planned on barges and trains. During time the bookings will be complimented, and the barge/train planning will be refined.
- And short before the actual execution of the order (1 or 2days), the complete order will be checked: e.g. if the container is available for transport and if all information is correct. If it isn't possible to transport the container by barge anymore, it will be moved to the truck planning.

Based on the different working process at different companies, some steps can be combined or be executed by the same or different people.

2.2 PLANNING & MONITORING

The main administration process of hinterland transportation is the planning and monitoring of the transport. In hinterland transportation three modalities of combinations with them are used for the transport of containers: barge, train and truck. Each of these modalities has his own characteristics for capacity, speed and costs. In the Netherlands and Belgium, the amount of transports by barge is significantly higher than in other EU seaports as Hamburg and Bremerhaven. In 2013, 54% of the hinterland transport in Rotterdam was transported by road, 35% by barge and 11% over rail for Antwerp this was respectively 57% road, 36% water and 7% rail. And for Hamburg and Bremerhaven this was 59%, 2% and 39% and 50%, 3% and 47%. (Bureau Voorlichting Binnenvaart, n.d.)

BARGE TRANSPORT

Barge transport is an important part of the hinterland network of the Port of Rotterdam and the Port of Antwerp. The hinterland barge connections can be divided into two different types: dedicated services for a specific inland terminal; services that call one or more inland terminals they pass. In the figure below, you find a barge schedule for a hinterland service from Rotterdam to the northern part of the Netherlands. You find two barges, each with their schedules for calling ports/terminals. The second barge is at Wed. 12th December in Amsterdam, 24 hours later it is in Harlingen at HOV terminals, and after that it sails to Rotterdam where it calls 8 terminals.

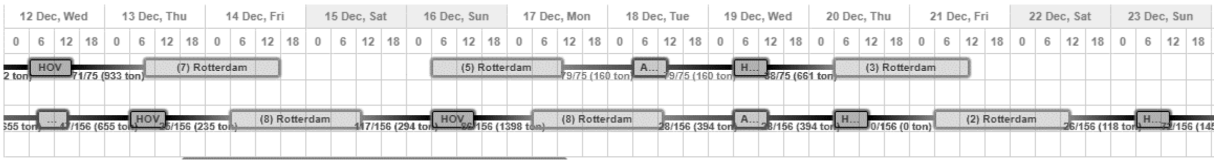


FIGURE 4 FIXED BARGE SCHEDULE

Besides the fixed schedules, there are also "ad hoc" barges which sail on ad-hoc base when additional capacity is required.

Schedules are usually known and planned for a longer time frame. In the first case only the port call Rotterdam and the inland terminals are known. Over time containers are planned on the voyage and calls in the port can be decided. Based on these planned calls, appointments at the specific terminals are made for loading/unloading the planned containers. In general, 8-12 hours upon arrival in Rotterdam the barge and the load and unload list should be preannounced.

Barge transport is relatively cheap (with a good barge utilisation) and a rigid transportation method. With the pre-known schedules and fixed capacity, it is good to have a schedule into the future. On the other side it is slow, and very depended on the individual quay planning of the (sea) terminals.

Depending on the agreements between all parties, different structures of hiring barges can exist for the hinterland transportation in the Netherlands:

STRICTLY SEPERATED

At the strictly separated construction the barge operator fulfils everything related to the barge planning and the inland terminal only manages the handling and storage at the container terminal. They are strictly separated and do get both their own "orders".

COMBINED

The opposite construction is where the container terminal also offers their own barging and charters a barge and does the full planning of the schedules, calls and containers by themselves.

HYBRID – OUTSOURCED

A more hybrid solution is where the inland terminal offers barges transport but outsources this to a barge operator. The inland terminal passes all the orders to the barge operator and the barge operator makes the full planning.

HYBRID – COMBINED PLANNING

The last combination is where there is a combined container planning between the barge operator and the inland terminal. The inland terminals do a “pre-planning” where they plan the containers on specific voyages, and they send a full manifest to the barge operator. Afterwards the barge operator finalizes the planning and arrange the exact schedule and calls in the seaport.

TRUCK TRANSPORT

Contradicting to barge planning, truck planning does not work based on a fixed schedule. Truck planning is mostly planned from 2 days into advance till the day itself. The capacity is most times also, each day based on the number of trips a different number of trucks is used/charters is hired.

Truck planning is very flexible and ad-hoc, therefore it is the fastest way to transport a container from A to B. But on the other side it is a lot more expensive, and due to the flexibility more difficult to make “combination trips”, to optimize the truck utilization.

TRAIN TRANSPORT

A train planning looks in the principle on a barge planning: there is a fixed schedule and capacity available. Only instead of a schedule to Rotterdam, the specific terminals are most times already known in advanced and a train makes less calls in a port. There are also more constraints on the actual loading of the containers on the train wagons. Where a barge has a total capacity for weight and space, are there for a train also limits per wagon on weight, space and dangerous goods.

MODALITY SUMMARY

In the summary below the factors costs, speed, flexibility and capacity are rated for the different modalities. An example with concrete values can be found in the case later in this thesis.

Modality	Costs	Speed	Flexibility	Capacity
Barge	1	3	2	1
Train	2	2	3	2
Truck	3	1	1	3

* 1 is best - 3 is bad

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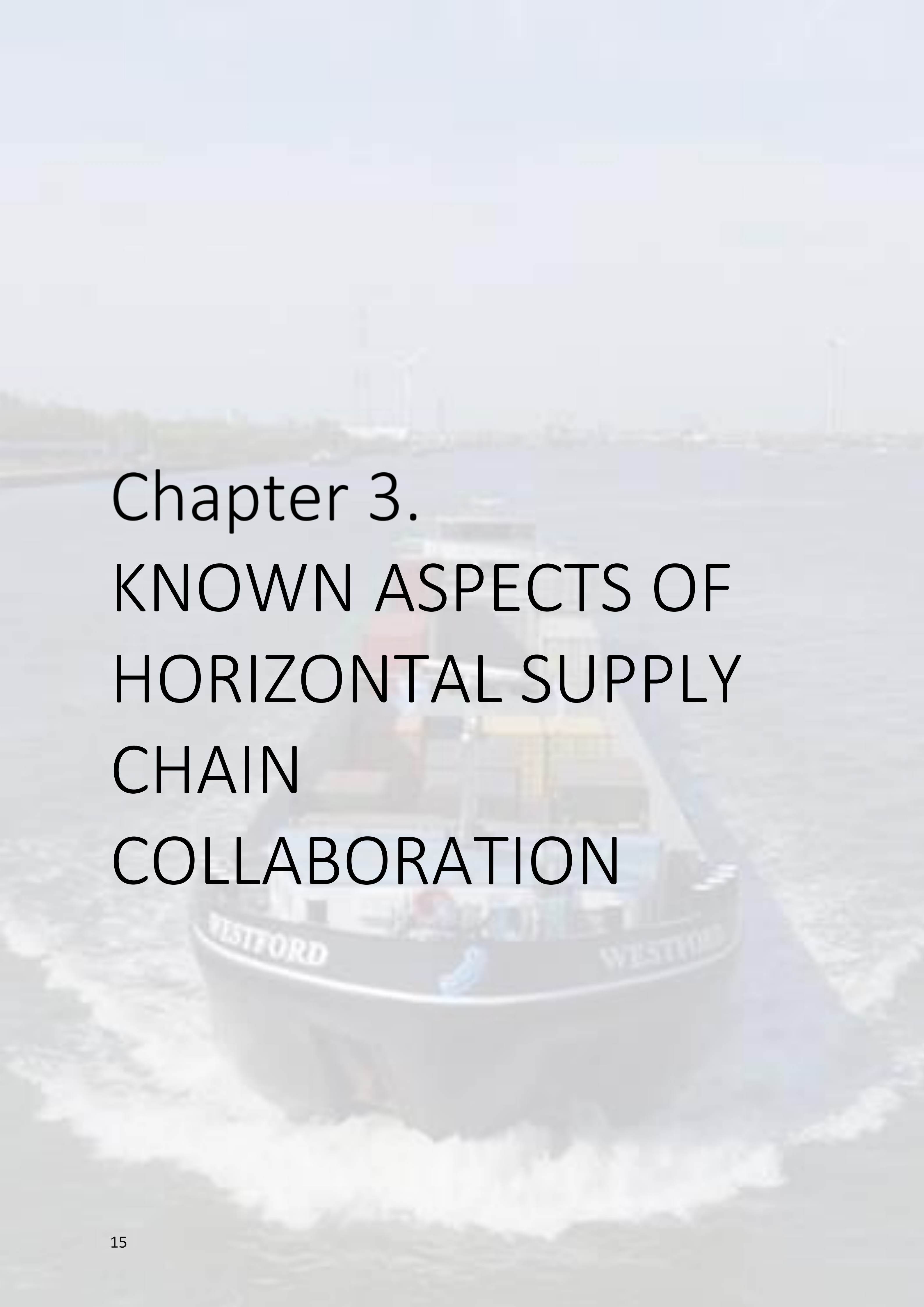


Chapter 3.
KNOWN ASPECTS OF HORIZONTAL SUPPLY CHAIN COLLABORATION

3.1 COLLABORATION IN SUPPLY CHAIN

This chapter goes deeper into what is already known about horizontal supply chain collaboration. The chapter is divided into two parts. The first part constructs a theoretical framework on how to successfully implement a horizontal supply chain collaboration tool, out of known literature. The second part reflects this framework onto two cases relevant to cargo sharing on barges. Based on these outcomes a framework is created with guidelines for a horizontal supply chain collaboration.

3.2 THEORETICAL FRAMEWORK

Supply chain collaboration means when at two or more parties are working together to create competitive advantage and create higher profits then can be achieved by acting alone (Simatupang & Sridharan, 2002).

For a long time, people are doing research into supply chain collaboration. The concept of working together, and all the problems relevant to it are extensive researched. But most of the time, those researches don't extent any further than a conceptual or abstract result. In the next two paragraphs two of these frameworks are described: first one from Doukidis, Matopoulos, Vlachopoulou, Manthou, & Manos (2007) and secondly Simatupang & Sridharan (2005a).

DOUKIDIS 2007

A general framework for supply chain collaboration is proposed by Doukidis et al. (2007), their framework is based on earlier research and existing literature. The framework distinguishes two different pillars within the supply chain collaboration: designing & governing supply chain activities and Establishing & maintaining supply chain relationships. This framework is described in Figure 5.

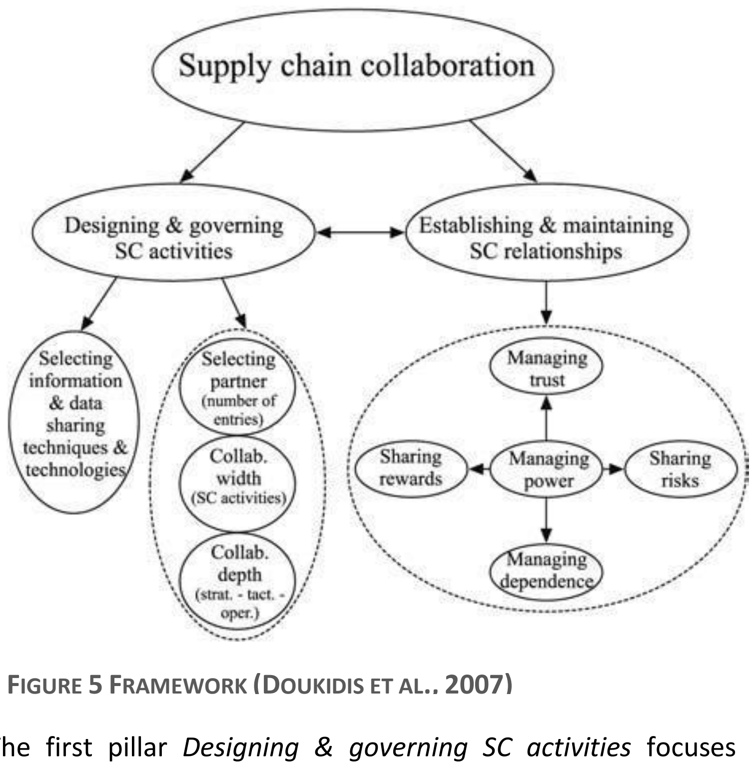


FIGURE 5 FRAMEWORK (DOUKIDIS ET AL.. 2007)

The first pillar *Designing & governing SC activities* focuses on how to design and construct a collaboration: what is the scope of the collaboration; between which parties; what information is needed; and how is this information shared between the relevant parties.

The second pillar named *Establishing & maintaining SC relationships* relates to the business and political aspects of successfully implementing the choices made in the first pillar.

DESIGN AND GOVERNMENT OF SUPPLY CHAIN ACTIVITIES

This part describes three activities for selection and defining the depth and width of the collaboration. At first you must determine the best partners for the collaboration, it is important that the parties have a good fit on business perspective. The width of the collaboration determines on which parts and process the collaboration reflects: which activities suits for a collaboration and which activities stay internal. The depth of the collaboration describes if the collaboration is on strategic, tactical or operational level.

The combination of these three elements determine how complex the collaboration is: The more parties, the more the depth and the wider the collaboration the more complex the collaboration will be.

Besides the determination of the complexity and scope of the collaboration, is it also important to determine which information is necessary to support the collaboration; which information is necessary in each state of the process; and how can this information be shared between the relevant parties. On this front there are some technical limits, because it is depending on the software systems all partners in the collaboration are using.

ESTABLISHING AND MAINTAINING SUPPLY CHAIN RELATIONSHIPS.

The second pillar of the framework relates to a more intangible part of the collaboration. The main goal of this pillar is to create a balance between risk and reward within the partnership. The combination of trust, risks, dependence and rewards should be balanced out for everyone for a collaboration to success. The bigger the risks and dependences are the higher the rewards and trusts should be. If for one or multiple parties in the collaboration these factors do not balance out, these parties lose their insensitive to work together and there is a high change the collaboration will fail.

SIMATUPANG & SRIDHARAN 2005

The second model we look at is the Collaborative Supply Chain Framework (Simatupang & Sridharan, 2005b) based on the principle of taking an reciprocal instead of unilateral approach. In their framework they describe five main features, which they identified as necessary to improve a collaboration through reflection on a partnership. The features interact with each other and influences the overall impact together.

The five features they distinguish are:

1. a collaborative performance system (CPS)
2. information sharing
3. decision synchronization
4. incentive alignment
5. integrated supply chain processes

How these features influence each other can be found in Figure 6.

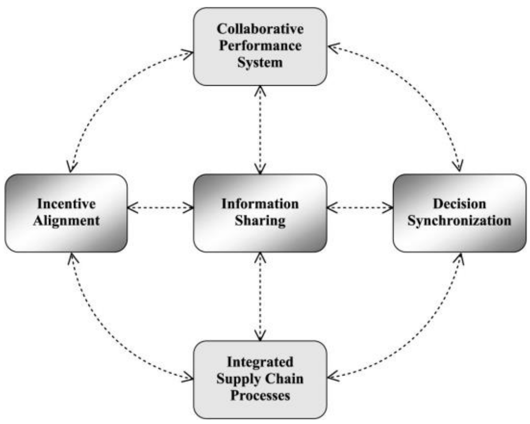


FIGURE 6 COLLABORATIVE SUPPLY CHAIN FRAMEWORK (SIMATUPANG & SRIDHARAN, 2005B)

A COLLABORATIVE PERFORMANCE SYSTEM (CPS)

This feature indicates a process for determining KPIs and metrics for performance indication for the full supply chain. It guides all participating parties to think about all the gains over the whole chain, and to determine together what the mutual objective is of the collaboration. The mutual object can relate to customer service, price, supply chain costs and responsiveness

INFORMATION SHARING

Visibility is an important part in supply chain collaboration. Therefore, it is important to share (the relevant) private data across all partners systems. Enabling monitoring through the full supply chain. All partners should be able to have view on the big picture to make decisions based on the metrics determined at the CPS. Based on relevancy, accuracy, timeliness and reliability, can be determined how relevant and useful the information is for the whole chain. New web technologies can support information sharing, to make it easier and faster to get data across all partners.

DECISION SYNCHRONIZATION

This feature describes the ability for all partners to make decisions together to improve the overall profitability of the partnership. The difficulty within this decision-making strategy, is that different parties often can make different part of a decision, and often de criteria in making decisions conflict with each other. Therefore, it is important that all parties agree on joint decision process to optimize the overall performance.

INCENTIVE ALIGNMENT

Incentive alignment references to sharing all the costs, risks and benefits along all parties involved. It is important everyone bears an equal risk and costs, and everyone is aligned with the mutual strategic objectives. The goal of incentive alignment is that every partner act in a way that gains benefits to multiple parties in the collaboration.

INTEGRATED SUPPLY CHAIN PROCESSES

The goal of the integrated supply chain process is to align the process in such a way that is optimized over the whole chain and aim to achieve the KPI's as stated in the collaborative performance system.

3.3 COLLABORATION FRAMEWORK

The previous studies describe in their own way the importance of and the elements relevant to supply chain collaboration. In this section both researches are compared and categorised into single focus points.

In Figure 7 & Figure 8 the connection points between the two models are visualized. The elements describing the same subject, but also elements that cannot be found in the other model are identified.

INFORMATION (ORANGE)

Simatupang describes the importance of "*Selecting information & data sharing techniques & technologies"* while Doukidis just call it "*Information Sharing"*. Both call the importance of identifying the data to share and how to share it between all participating parties.

PROFITS (PURPLE)

Both authors describe this subject, where Simatupang entitle it with *"Sharing rewards"* and *"Sharing risks"*, does Doukidis mention the same item with "*Incentive Alignment"*. This subject describes all the gains all the different parties get from the collaboration, and all the costs every party has. The costs and gains should be in balance, and therefore all parties should have a positive profit from the collaboration.

ACTIVITIES (GREEN)

Important for every collaboration is to determine which activities are part of the collaboration and what the responsibilities (related to this activities) of each party are. Simatupang covers this part with determining the *collaboration width* and *collaboration depth* (activities and strategic, tactic and operation depth). While Doukidis has the element "*Integrated Supply Chain processes*" for structuring the processed relevant for the collaboration and the interconnection

PARTIES (RED)

For the collaboration it is relevant to select which parties are participating into the collaboration, and if it is possible to align all these parties according to the top mentioned activities

INSIGHT (YELLOW)

Doukidis describes a last element, not mentioned by Simatupang. He says beside determining what to share, and how to work together, is it import to have insight into the whole collaboration. It should be transparent for each party what the costs and gains are from each party related to their contribution. This is necessary for maintaining trust between all parties.

Note that in Figure 7 & Figure 8 the relation between the coloured elements do not corresponds with each other. This can be explained by the fact that Simatupang made the diagram more on a hierarchical level, and Doukidis modelled their elements on a process level. Therefore the relations described in both models are from different perspectives, and therefore they do not match.

FRAMEWORK

Based on the five activities extracted from the two difference models, and framework can be created for describing and identifying the elements related to the collaboration.

Parties	**Party A**	**Party B**	**Party C**
	What is connecting all parties in the collaboration.		
Activities	Activities executed by Party A	-	-
	All activities covering the collaboration		
Profits	Gains & Costs for Party A	-	-
	Global gains & Costs for whole collaboration		
Information	Information needed / received by Party A	-	
	Information needed for the whole collaboration and global way of sharing it		
Insight	How party A shares and gets insight of the collaboration		
	How do get all parties get the same insight in the collaboration.		

The framework consists of four different pillars supporting each separate party, but also the collaboration as one. The framework can be used to evaluate existing collaborations or to mark all checkboxes for a new one.

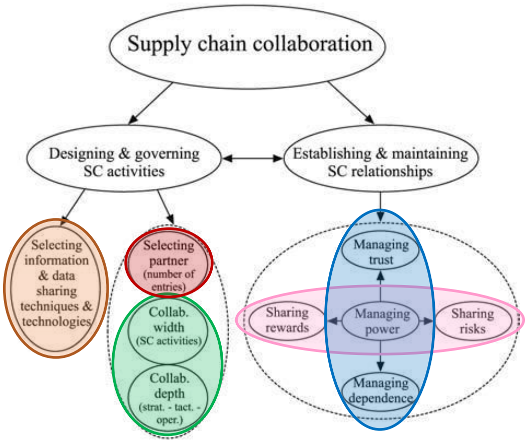


Figure 7 Simatupang & Sridharan 2005

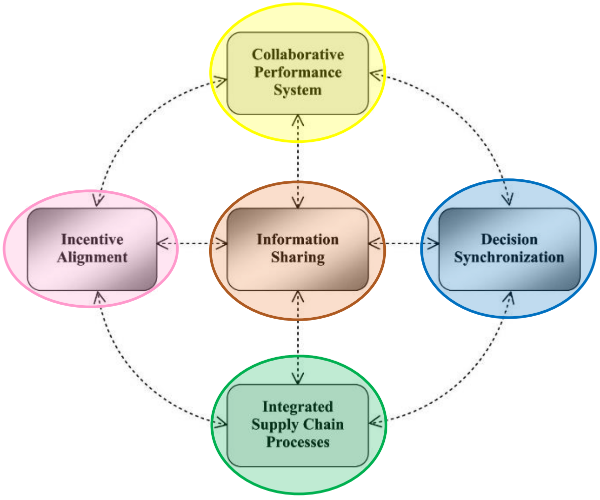


Figure 8 Doukidis 2007

3.4 CASES

In this chapter two different cases related to supply chain collaboration are analysed based on the theoretical framework from the previous chapter. The findings of these cases are combined with the framework and are the base for the next chapter.

WAAROM NOG LEGE KILOMETERS (KLOOSTERBOER / MCT)

This case was a collaboration between Kloosterboer Vlissingen, Markiezaat Container Terminal (MCT) and Honkoop barging. The knowledge of this case is achieved by interviewing Richard Klaassen, terminal manager of MCT at the time.

Kloosterboer Vlissingen received a large amount of import reefer container with fish from Rotterdam. Those containers were shipped by barge to Vlissingen (Kloosterboer); stripped (unloaded) in Vlissingen; and went empty back to Rotterdam. There was a large volume of transport of empty containers (at least 45containers a week) that had to be shipped back to Rotterdam. Where Kloosterboer had a large amount of import reefer containers, MCT had mostly an export flow of reefer containers to Rotterdam, which they retrieved empty stock from Rotterdam.

The barges from Vlissingen to Rotterdam are passing the MCT terminal in Bergen op Zoom (see Figure 9 (Dynamisch & Vaarwegen, 2013)). So instead of two empty trips they made a collaboration of transporting the empty containers from Vlissingen to Bergen op Zoom. The total empty transport costs decrease significant.

To make this possible there were at least two other parties relevant: The shipping company, as owner of the container; and the barge operator, as transporter.

The shipping company ordered every empty container to go back to Rotterdam, especially reefers because they need to be cleaned and a PTI after they can be re-used. Also, the barge operator is relevant, because they are transporting the container and need to make an extra stop to unload containers.

With the following structure the collaboration was profitable for every partner:

- The shipping company allowed Kloosterboer to clean and PTI the reefer containers. This was cheaper than doing it in Rotterdam (for the tasks itself and it saves a handling in Rotterdam) and gave extra business to Kloosterboer

- The shipping company allowed to return all containers to the MCT depot. This saved them another handling in Rotterdam, the one for MCT picking up empty stock.
- Kloosterboer paid Honkoop half of the normal fee plus 5 euro to transport a container to Bergen op Zoom instead of Rotterdam
- MCT emptied the barge with all the reefers and filled the barge with full containers for Rotterdam. They paid half or the normal fee plus 5 euro to transport these containers to Rotterdam.
- Honkoop had to make an extra stop in Bergen op Zoom but received at the end 10 euro extra per container.

Therefore, all collaborating parties gained profit from the collaboration.

To keep the information flow easy and clear, there was one barge sailing a week for this collaboration. Every week Kloosterboer shipped 45 reefers to Bergen op Zoom, and every week MCT shipped 45 full containers on the same barge to Rotterdam. There wasn't much information sharing necessary, except a simple manifest from Kloosterboer to MCT with all container numbers on board. No sensitive information needed to be shared to execute the processes.

There were some problems with this collaboration, these problems originated in the parties that weren't participating in the collaboration but were influenced by it. In this case Kloosterboer and MCT both used another barge operator for their normal operator. For the case they worked together with the barge operator of Kloosterboer (Honkoop). Therefore, the normal partner of MCT, was receiving 45 containers less each week, and therefore getting less volume, while their competitor got those extra containers for a larger fee (10 euro's extra). Also, the two barge operators where conflicting when they arrived both simultaneously at MCT and one of them had to wait.

The proposed solution to this, was for the barge operators to share this extra traffic, but both barge operators did want to work together for this.

The collaboration isn't active anymore, later Kloosterboer received their own export flow of reefer containers, and therefore it was cheaper for them to reuse them their self instead of shipping them to Bergen op Zoom.

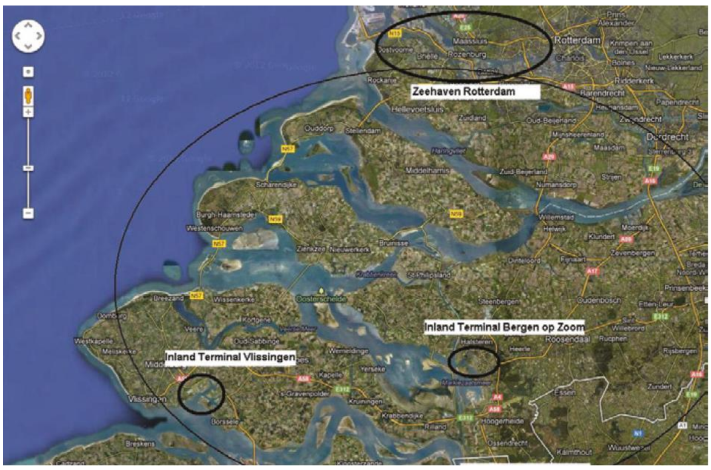


FIGURE 9 (DYNAMISCH & VAARWEGEN, 2013)

ANALYSING THE CASE

The case is reflected to the framework defined in the previous chapter. Below you can find the framework filled in for the case with MCT, Kloosterboer and Honkoop.

Parties	MCT	Kloosterboer	Honkoop
	All companies are into container reefer transport near Zeeland to Rotterdam.		
Activities	Shipping 45 full containers from Bergen op Zoom to Rotterdam.	Shipping 45 clean empty reefers from Vlissingen to Bergen op zoom	Transporting containers from Vlissingen via Bergen op zoom tor otterdam.
Profits	Paying less for the normal transport costs from BoZ to Rotterdam & empty reefers stock	Paying less for the return of empty reefer containers.	Getting more money for the same activities
	Overall less empty transport		
Information	No additional information	Unload list for MCT	No additional information
	Together they determine on a static barge schedule from Vlissingen to MCT		
Insight			
	All parties knew the savings from each other, through the static form of the collaboration, and fixed agreements of capacity.		

The collaboration ended because one of the key points disappeared: the profits for one of the parties in the collaboration. Kloosterboer got their own export flow for the Reefer containers, and therefore it was more profitable to use the empty stock themselves and returning the Reefers full to Rotterdam instead of empty to Bergen op Zoom. By this situational change, the collaboration wasn't viable anymore and therefore stopped.

The case mentions one aspect that had impact on the case but doesn't come forward in the framework. There are two more parties connected to the collaboration who aren't actively participating: the shipping company (as the owner of the container) and the normal barge operator of MCT.

The first one, the shipping company, is relevant for the collaboration, because without the shipping company the collaboration isn't possible (they determined if the container may be shipped to MCT instead of Rotterdam). But they aren't actively participating in the collaboration or getting profit out of it. The activities they do for this collaboration fall within their normal business activities; they only must agree with it.

The second party, the normal barge operator of MCT, is on the other side of the collaboration. The collaboration does not depend on their choices, but they are influenced by the collaboration. The activities of the collaboration have impact on their normal business operations, and therefore they can try to "obstruct" the collaboration.

Barge Cloud (BTT & OCT)

The second case to be analysed is Barge Cloud, a collaboration between the BIM (Brabant Intermodal) which is a subsidiary of Barge Terminal Tilburg, Oosterhout Container Terminal, Inland Terminal Veghel and ROC Waalwijk. The goal of the collaboration was by working together to achieve reducing road transport; less empty kilometres and reducing CO2 emissions. The project was defined into two parts, a collaboration between Oosterhout and Tilburg; and Veghel and Waalwijk (Figure 10). For this case analysis we focus on the collaboration between Oosterhout and Tilburg (orange line in Figure 10) connected by the Wilhemlinakanaal. The knowledge of this case is gained by an interview with Iwan Maessen the Manager Terminals for BTT.

Figure 10 Geographical representation of BargeCloud

The goal of the project was to make a most optimal planning to transport containers to the port of Rotterdam, this by having a shared planning of all containers. In previous attempts their IT systems came up as the bottleneck for a successful collaboration, because they couldn't share the information needed. Therefore, the parties develop together an IT system named BargeCloud that connects to their inhouse systems. BargeCloud has three parts: order overview, call creating and voyage overview. The planners of the companies used this tool to group containers and book them per group on a voyage and have an insight in the orders and voyages of the other terminals.

The difficult part was that the collaboration was aiming for an overall improvement, while the planners were still working for a specific terminal. The collaboration was between two competing container terminals, and the planners were still planning to transport their own containers a good as possible. Besides the planning problem, the terminals could see each other's orders which could expose sensitive information about customers and quantities.

Due to these problems there wasn't any trust between the parties and the tool never came further then the "prototype" stage, and the collaboration never started.

Analysing the case

The case is reflected to the framework defined in the previous chapter. Below you can find the framework filled in for the case with BTT and Oosterhout.

When looking at the framework, you see both parties are exactly doing the same activities and sharing the same information for the collaboration. But still the collaboration failed.

Both parties were responsible for the same activities, while also they had the profits on the same position. Based on the activities the planners of BTT want to plan as much as possible of their containers on the voyages to gain a profit as high as possible, the planners from OCT did the same for their containers. This works if there is enough capacity for transporting all the containers, but when there is more cargo then transport opportunities there is a dilemma, because both planners want to transport their own containers.

Another factor was the need to share a lot of information, but it wasn't possible to exactly monitor the gains and losses of both parties neither to give the planners KPI's to work on. So even though the information sharing, and the theoretical profits were very good, the collaboration failed because of conflicting interests while executing the activities and the lack of insight and KPI's for solving this.

Parties	BTT	OCT
	Transporting containers over the Wilhelminakanaal	
Activities	Planning (shared) orders on (shared) voyages	Planning (shared) orders on (shared) voyages
	Shared barge planning	
Profits	Cheaper and more reliable barge transport to Rotterdam	Cheaper and more reliable barge transport to Rotterdam
	Less calls in port of Rotterdam, higher barge utilisation	
Information	All orders & voyages	All orders & voyages
	Shared and combined voyages	
Insight	Own gains from collaboration	Own gains from collaboration
	Executed planning	

Improvements framework

Based on the knowledge gained by analysing the two cases, some lessons can be learned, and improvements can be made on the framework. The first case has one key point that wasn't in the framework: Other parties which are not participating in the collaboration but are affected by it.

The second case mainly shows us that the activities executed by the collaboration should be clearly defined by scope and conflict of interest.

Both cases show a key element that is also missing in the framework: guarantees, for MCT there is the guarantee they can transport a *X* number of containers on the vessels and they receive an X number of empty reefers. For the second case there wasn't a guarantee for each party about what they get (or should deliver) in the collaboration. These guarantees can be mentioned under each pillar, that there may be a minimum guarantee before the party may accept the collaboration.

Chapter 4. CONCEPT FOR CARGO SHARING

4.1 REFINED FRAMEWORK

The framework as defined in the previous chapter will be the base for the concept for cargo sharing, the lessons learned from the cases are incorporated in the framework. You can find the refined framework below:

Parties	**Party A**	**Party B**	**Party C**	**Related Party**
	What is connecting all parties in the collaboration.			
Activities	Activities executed by Party A	-	-	
	All activities covering the collaboration			
Profits	Gains & Costs for Party A.	-	-	The costs unrelated parties (can)have
	Global gains & Costs for whole collaboration			
Information	Information needed / received by Party A	-	-	
	Information needed for the whole collaboration and global way of sharing it			
Insight	How party A shares and gets insight of the collaboration	-	-	
	How do get all parties get the same insight in the collaboration.			

4.2 IDENTIFYING KEYPOINTS

The requirements will be constructed by using the 5 pillars (Parties, Activities, Profit, Information and Insight) from the framework and reflecting this to the context and theoretical knowledge from Chapter 2.

The artefact for sharing cargo will be defined for customers of Cofano. They want to optimize profit and efficiency within their current way of working by making collaborations with other parties. These collaborations should focus on sharing barge capacity but keeping their current assurance of capacity and flexibility

PARTIES

The first step is to determine the parties related to the collaboration. Within the logistic chain there are multiple actor that could be related to collaborations, such as: transporters (Barge/truck operators), terminals, consignor, consignee, carrier/shipping company.

Within the logistic sector as described in Chapter 2, the role of actors can differ per company. Some terminals also exploit their own barge operations, while others offer truck transporting, and some only offer terminal operations. To handle these flexibilities, roles are defined instead of specific actors. Multiple rules can be executed by the same company or even the same person. Within this scope and context, the following roles can be defined:

- Barge Service (supplier)
  Managing the planning and operating of barges
- Transport customer (consumer)
  Have a need to transport containers between container Terminals.

Because of the high connectivity in the supply chain there are always related parties that are not part of the collaboration. The other parties that may be impacted the most are:

- Deepsea terminals
  Due the consolidation of the cargo there will be less calls in the port.
- Nonparticipating Barge services
  By the collaboration, containers are shared between the participating parties and therefore other barge services may lose cargo.

BARGE SERVICE

The barge service is the role for the party that is offering barge transports on a ship. The party with this role manages the schedule, capacity, and restrictions on the service. This party also ensures everything that has to do with the ship, such as stowage, planning, barge handlings in the seaport. This is the *supplier* role in the collaboration, because it offers a service.

TRANSPORT CUSTOMER

The transport customer is the role for the party with the need to transport containers between two container terminals. This role is the *consumer* because they want to consume a service for transport. The customer is in charge over and responsible for making sure the container is on time to be picked up and to offer enough information for the supplier to transport it.

A company can fulfil one or both roles, depending on how they want to participate they can be joining the collaboration as on or both roles, e.g. an inland container terminal can exploit a barge service but also want to place containers on order services from other parties in the collaboration. In the interaction are always exactly two parties involved even if the collaboration exists of more parties (Figure 11).

ACTIVITIES

Within the collaboration each party has its own activities for making the collaboration possible.

BARGE SERVICE

- Barge Schedule Planning
  Defining the schedules of the barges, and the appointments at the terminals.
- Barge Container Planning
  Plan containers on specific voyages to be transported
- Monitor Execution
  Monitor the schedule and container planning, and see what containers are loaded.

TRANSPORT CUSTOMER

- Order Entry
  Processing order information and collecting all information required for transport
- Barge Container Planning (Optional)
  (Optionally) planning orders on specific voyages
- Monitoring the execution
  Monitor the container planning, to see when containers arrive and when containers are loaded

PROFITS

Each role should profit from the collaboration, if a party fulfils more than one role, it will have the profit from both roles. The overall gains within the collaboration are: a more efficient barge planning (higher utilisation, less calls); less empty transport; and less trucking kilometres.

BARGE SERVICE

The barge service will receive more cargo and therefore get more business. By having a good information sharing solution in the collaboration, they will have more and better data that allows them to make a better planning. Also, should the collaboration and information help them to achieve a higher utilisation on their barges.

TRANSPORT CUSTOMER

The transport customer will have more voyages (and thus capacity) to plan/transport containers on. Which will allow them to transport more containers by barge instead of truck. By this more efficient planning the schedule will be more reliable and having more sailings. Also, by the more efficient barge planning the transport customer can profit from a lower transport price.

RELATED: DEEPSEA TERMINALS

The deep-sea terminal will have a positive profit: they get more efficient calls with more containers, because the collaboration allows to make a better that is also more efficient and reliable for the deep-sea terminal

RELATED: NONPARTICIPATING BARGE SERVICES

The nonparticipating barges service can have a negative profit, due the fact they can lose cargo because the collaboration is able to move more cargo then the parties individually before.

INFORMATION

The support the activities from the actors there should be an information flow within the collaboration to make it data elements that should be shared to support the activities, and the role that is responsible for possible, below you find the different the data

TRANSPORT ORDERS

The *consumer* is responsible for delivering transport orders with all the information needed to execute the transport, such as: origin and destination terminal, container number, references, weight, dangerous goods, timing restrictions etc. It is to the *consumer* to only decide if they: only share planned orders or; to also share unplanned orders.

BARGE SCHEDULES

The barges schedules should be supplied by the *barge service,* this information should include all the information of a barge voyage to draw a schedule on the plan board: locations and times where the barge (optionally) stops and the available capacity. And if there are any, it should share the planning restrictions on the service: can the *consumer* freely plan; can the consumer plan on reservation; or is not allowed to plan.

BARGE PLANNING

Actual list of which containers are transported on which voyage, is determined by the *supplier.* But depending on the agreements within the collaboration the planning can also be defined by the *consumer*. In all cases the *supplier* can update the planning of a barge voyage, depending on the restriction can the *consumer* always plan, never plan or only plan on reservation. If they plan on reservation the planning is accepted by the *supplier.* The planning contains a specific barge service and the order(s) that should be transported on that service.

EXECUTION INFORMATION
Besides planning information there is also "execution information" telling when and which containers are loaded on or unloaded from the barge. This information can be supplied by the *consumer* and the *supplier and* help the other party and themselves with the operation.

INTERACTION
Within the collaboration, even if it exists of three or more parties, the information defined above is only related to two parties involved. Therefore, all communication only needs to take place between two parties: one supplier and one consumer (Figure 11)

A possible information flow is illustrated in Figure 12. This is only one of the many possibilities how the information can be shared. In Appendix I a more detailed data model for the information interchange is described.

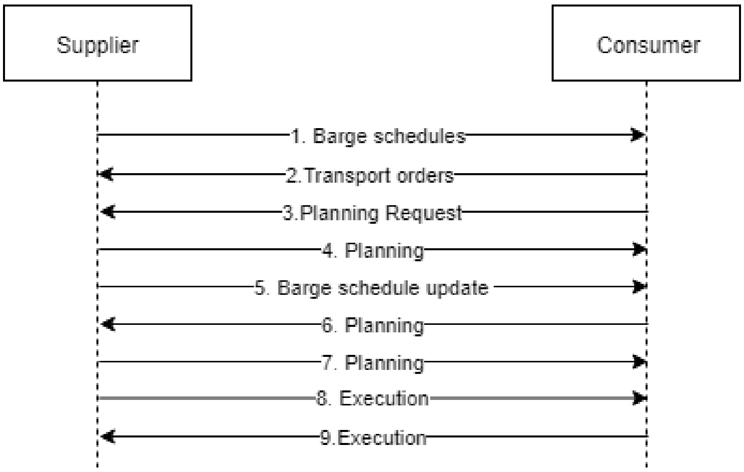


FIGURE 12 INFORMATION FLOW

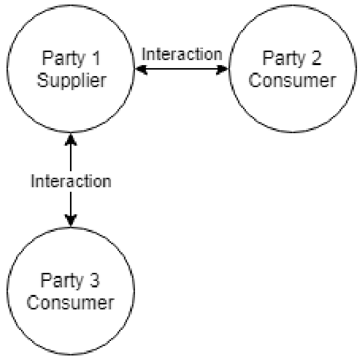


FIGURE 11 INTERACTION DIAGRAM

If information is relevant for multiple parties, it should be sent separately to all parties to make sure the sending party has all control over who is receiving the information. Besides the type of information also the "speed" and the availability of the information or relevant. A barge planning is a dynamic process that is continuously changing (2.2), and therefore is it important to make sure the information is available within a reasonable time at the other party (0 to 15 minutes)

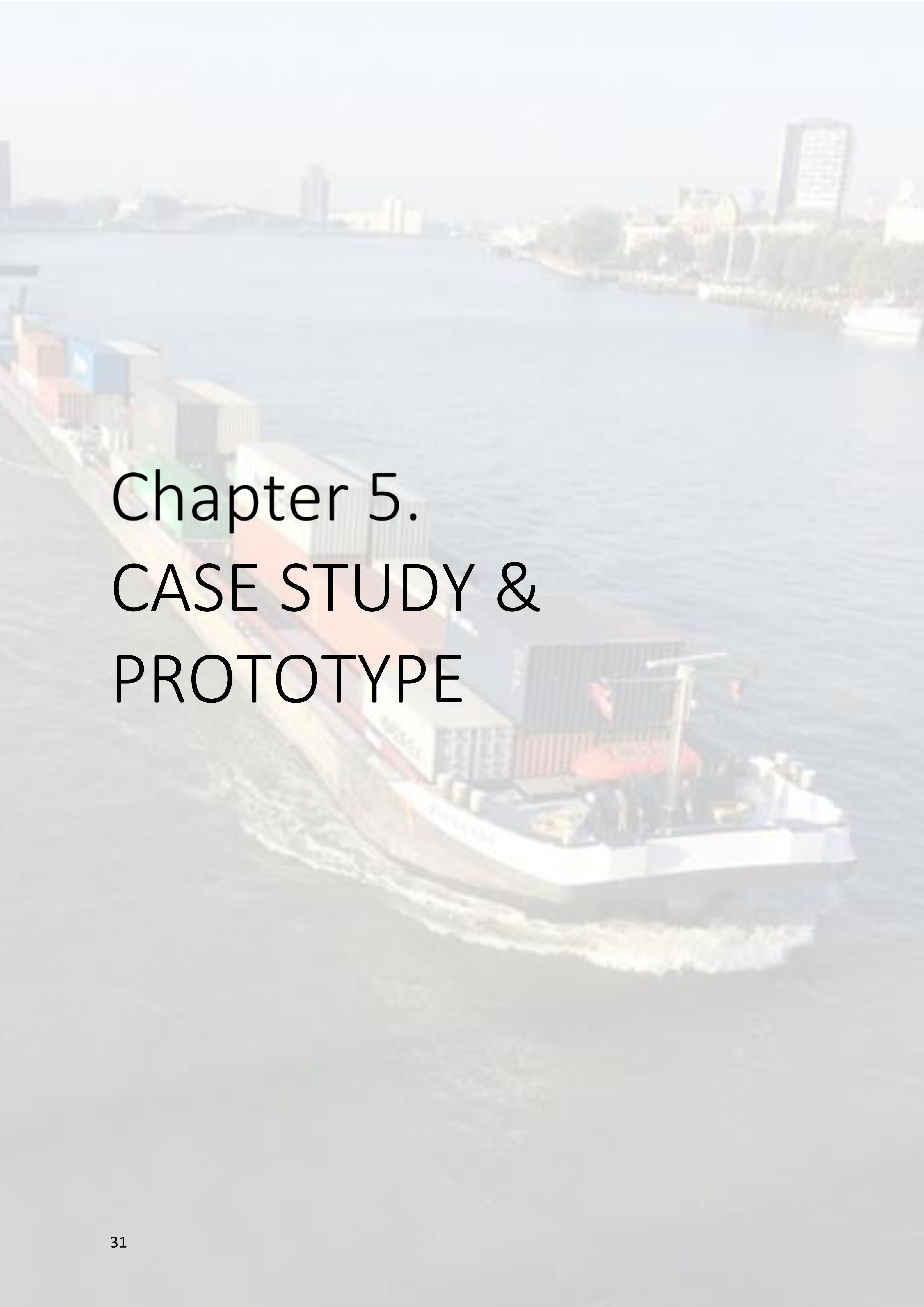
INSIGHT
It isn't necessary that all parties know the exact profit and gains of all the other parties in the collaboration. The most important part is that the guarantees that they wanted for the collaboration are met and that that they make a profit based on these guarantees within the collaboration. Based on the information they receive all the information can be deducted to determine the profitability from each party for themselves.

4.3 SCHEMATIC OVERVIEW

Based on the previous sections the framework as defined in 4.1 can be completed further based on the specific topic of cargo sharing on barges. This concept implementation of the framework can work as a structured way to explore, explain and execute specific cases for barge collaboration; to guide during the design; and support the evaluation of the collaboration among all important pillars.

Below you find the overview of the concept implementation in the framework, where each specific pillar is described for all defined roles.:

Parties	Barge Service	Transport Customer	Nonparticipating Barge Services	Deepsea terminals
	Operating container barge transport in the same region (same water roads)			
Activities	- Barge Schedule Planning - Barge container Planning - Execution Monitoring	- Order Entry - Barge Container Planning (optional) - Execution Monitoring		
	The transport of containers for A to B			
Profits	+ More cargo & business + Better information and more efficient planning	+ More voyages + Cheaper transport + More reliable transport	- Less cargo	+ more efficient terminal calls
	More voyages, more efficient planning			
Information	-> Barge Schedules <-> Barge Planning <-> Execution Information	-> Transport Orders <-> Barge Planning <-> Execution Information		
	All information sharing is always between two related parties. And should be as "real-time" as possible.			
Insight				
	All parties get their insight based on the information shared to execute the defined activities.			



Chapter 5.
CASE STUDY & PROTOTYPE

In the previous chapter a concept is defined to guide a collaboration for container cargo sharing on barges. This concept is still an abstract model only describing on theoretical assumptions how the collaboration should look and work.

Cofano has multiple customers throughout the Benelux, some clustered together or clustered with other logistics container transportation or storage companies. There are multiple clusters that could profit from collaborations, and due new regulations in the seaports (minimum call sizes and stagnations) the urge to work together increases everywhere.

For this research one case study is selected on which the abstract model will be applied to. A prototype implementation will be made and tried out in a real situation.

5.1 BARGE COLLABORATION ZEEUWS-VLAANDEREN

The selected case is a collaboration between a barge operator and multiple container terminals situated in and near Zeeuws-Vlaanderen. These parties saw the opportunity for a collaboration

The related parties are:

- Trimodal Container terminal Terneuzen (3MCT)
  A new container terminal in Westdorpe (green marker in Figure 13)
- Verbrugge Marine
  A container terminal in Terneuzen (yellow marker in Figure 13)
- Stukwerkers
  A container terminal situated in Gert (orange marker in Figure 13)
- Danser
  A barge operator, offering services in the mentioned region, and for the mentioned terminals

In Figure 13 you can find a geographical situation of the mentioned parties, and the sailing route connecting them.

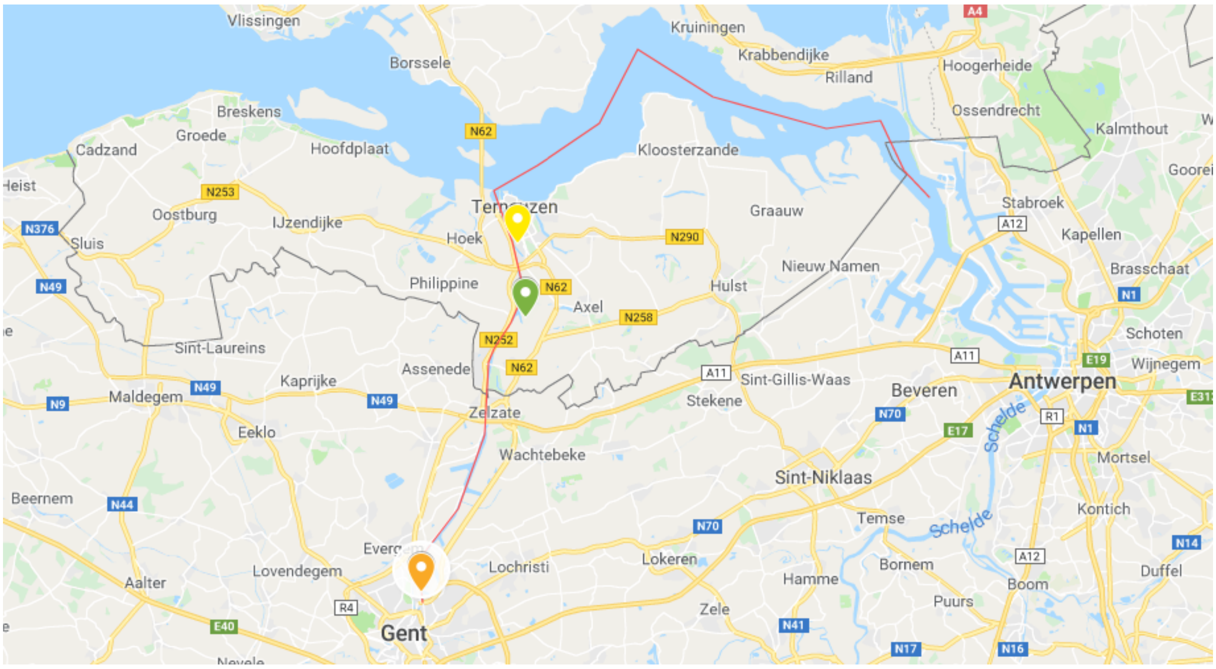


FIGURE 13 GEOGRAPHICAL VIEW OF THE CASE STUDY

All parties are independent companies, with their own (competing) customer base. The only connecting element between them, is the region in which they operate, and the barge operator Danser which is offering the barging service to the several terminals. At this moment the barging services for the terminals aren't executed on a similar way. For example, 3mct hires just a dedicated barge, and does the planning of the containers themselves, but Verbrugge gives Danser a list of all to be transported containers, and Danser plans the containers barges.

From the related parties is Danser using their own software system, 3MCT and Verbrugge are already using the terminal operating system from Cofano, while Stukwerkers is now in the implementation phase.

Begin situation

In the begin situation all terminals have their own dedicated barge connection between the (hinterland) terminal and Antwerp/Rotterdam. Each terminal has their own barge and/or fixed capacity. These connections are used for the transport of full and empty equipment from and to the port as part of a total roundtrip. If an inland terminal has more transport needs then barge capacity, they will use trucks for the transport. If there aren't enough containers, the barge will just sail with less container on board and is at these moments underutilised.

In this begin situation container terminals do not share barge capacity and do not interchange empty stock or other containers. As visually illustrated in Figure 14, each terminal has their own dedicated fixed schedule, they can plan containers on this schedule, themselves or together with Danser.

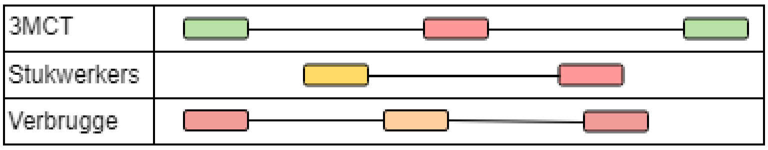


Figure 14 Begin situation

Each terminal individually does not know the schedule and/or available capacity from the other terminals. The only party with the insight in all schedules is Danser, but they do not know the orders that still have to be planned or the urgency of the orders.

Desired situation

At this moment Danser is the party with the most insight in what everyone is doing. Based on the cargo and planning they say they initiated the initiative for all parties to work together.

Based on the insight Danser had, the parties assumed possible gains on the following subjects:

Higher utilisation

By having a better insight in available capacity, the unused capacity can be used if another party "on the route" has more capacity available.

Modal shift / more schedules

If connections are shared, there are more connections to/from Antwerp, and therefore there is a higher chance container can fit on a barge.

Call optimization

By bundling containers to the same terminal in Antwerp, minimalize the calls to deliver the same number of containers.

LESS EMPTY TRANSPORT

By sharing empty stock, the total transport of empty containers can be reduced.

The overall goal of the case study is for the different parties to share barge capacity in order to have a more efficient transport. This can be achieved to move from dedicated barge connections to shared barge connections (see Figure 15)

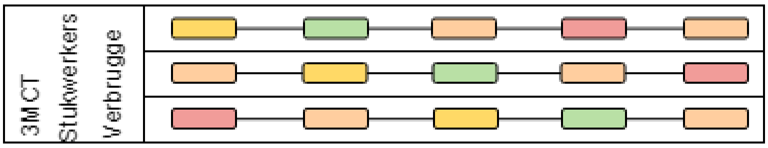


FIGURE 15 DESIRED SITUATION

To define and describe the collaboration the concept framework from section 4.3 is used. First all pillars will be described individually, and afterwards the framework will be filled in

PARTIES

The parties relevant, in the context of the case study, can be categorised according to the roles as defined in Chapter 4: Transport Customers and Barge services. In this case all the terminals fall under the transport customers, and Danser is the only barge customer.

TRANSPORT CUSTOMER

- Trimodal Container terminal Terneuzen (3MCT)
- Verbrugge
- Stukwerkers

BARGE SERVICE

- Danser

OTHER PARTIES

- Nonparticipating Barge Services
  At this moment all terminals are already doing all barge transport by Danser, therefore there aren't any other barge operators that are losing "work".
- Deepsea terminals
  Because there is only one barge service, Danser, they can manage slots and calls at deep-sea terminals, this should improve but the responsibility can be shifted to Danser.

ACTIVITIES

For the concept all activities for a specific role are defined. Some activities are optional and depending on the specific agreements between the parties and their way of working.

BARGE SERVICE (DANSER)

Danser, as barge operator, is executing all activities as described in the concept.

- Barge Schedule Planning
  Defining the schedules of the barges, and the appointments at the terminals.
- Barge Container Planning
  Plan containers on specific voyages to be transported.
- Monitor Execution
  Monitor the schedule and container planning, and see what containers are loaded.

TRANSPORT CUSTOMER (3MCT, VERBRUGGE, STUKWERKERS)
This part is a bit more divided, where all transport customers execute the first two activities:

- Order Entry
  Processing order information and collecting all information required for transport.
- Monitoring the execution
  Monitor the container planning, to see when containers arrive and when containers are loaded.

The last, optional, activity is only relevant for 3MCT, because they operate a joined container planning with Danser.

- Barge Container Planning (Optional)
  Optionally already planning orders on specific voyages.

Within the activities, one specific barge schedule can be relevant for multiple transport customers, and the barge container planning can modify/restrict the available capacity for other customers.

PROFITS
The profit for this case study is the same as the ones described in Chapter 4. The guarantees within the collaboration is based on two elements:

- The available capacity
- The frequency of the voyages

It is important that the transport customers have a fixed available capacity, this capacity is available until a specific deadline, and after that the available space can filled up by other participants.

INFORMATION
As described all the information only flows between two parties: transport customer and barge service, because there is only one barge service in this case study. Therefore, all communication is always between Danser and a terminal, and these are two different companies, and have different systems. To make sure the activities work seamless together a system integration in necessary. All information as described in Appendix I should be shared between the parties.

INSIGHT
If all the information as described in the model is shared, each party should have enough insights to ensure that their guaranties are met; and to determine their own profits from the collaboration.

CASE STUDY FRAMEWORK

Parties	Danser	3MCT	Verbrugge	Stukwerkers	Deepsea terminals
	Operating in Zeeuws-Vlaanderen				
Activities	- Barge Schedule Planning - Barge container Planning - Execution Monitoring	- Order Entry - Barge Container Planning - Execution Monitoring	- Order Entry - Execution Monitoring	- Order Entry - Execution Monitoring	
	The transport of containers for within the same Region to/from Antwerp and Rotterdam				
Profits	+ More cargo & business + Better information and more efficient planning	+ More voyages + Cheaper transport + More reliable transport	+ More voyages + Cheaper transport + More reliable transport	+ More voyages + Cheaper transport + More reliable transport	+ more efficient terminal calls
	More voyages, more efficient planning				
Information	-> Barge Schedules <-> Barge Planning <-> Execution Information	-> Transport Orders <-> Barge Planning <-> Execution Information	-> Transport Orders <- Barge Planning <-> Execution Information	-> Transport Orders <- Barge Planning <-> Execution Information	
	Information is shared between the terminal & Danser				
Insight					
	All parties get their insight based on the information shared to execute the defined activities.				

5.2 COLLABORATION STARTUP

The collaboration consists of one barge operator and three container terminals. All these parties want to work together, but all terminals are on a different stage with the maturity of their software systems. But for a good outcome there should be a good information integration according to the framework.

Therefore, with the prototype, we start with two parties to try out the information sharing. One of the parties should be a barge service, in this case Danser, because it is the central hub of the information sharing. As terminal 3MCT is used, because it is the most willingly for software changes because they are a new terminal still getting to work to define their processes. Besides it is the most complex and executes the most different activities in the collaboration. So, all the different activities the other terminals could execute in the collaboration are also covered.

Only when eliminating 3 of the 5 parties, the collaboration would look like a normal customer/supplier relationship. All pillars of the framework should still be met, and therefore the information and gains should still be there. To try-out and start the collaboration, Verbrugge and Stukwerkers will continue by manually communicating with Danser, while Danser and 3MCT get a fully integrated system integration (Figure 16). This means 3MCT will have enough information to benefit from the other voyages, but Verbrugge and Stukwerkers still need to manually call and communicate with Danser to determine if there is extra capacity available.

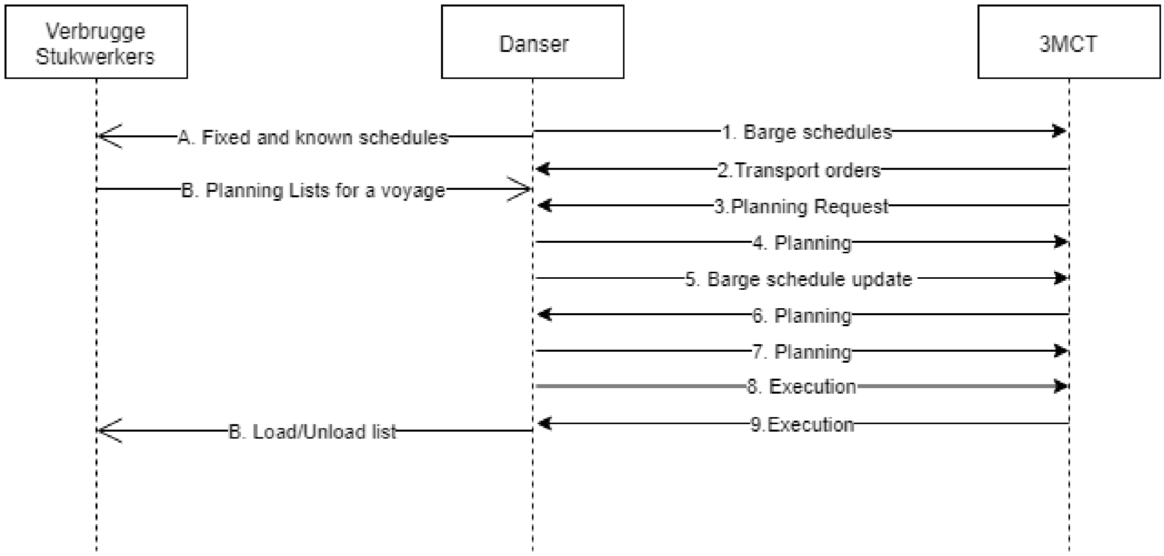


FIGURE 16 INFORMATION SHARING DURING PROTOTYPE

All pillars of the solution have an organisational and technical part. The amount of organisational and technical change that is required, depends on the pillar and the current situation of the parties. For the prototype the organisational elements are identified and described but is to the parties themselves to implement these changes[3]. The technical part will be described in more depth and implemented as part of this research.

[3] Change management is very important part of new projects, but to the magnitude of the subject it is out of scope for this research.

5.3 ORGANISATIONAL

For the organisational part of the collaboration, is important that everything is clear to the persons who are doing work related to the collaboration.

- Parties
  It is important that everyone knows which parties are participating, what their role is in the collaboration, and what "guarantees" they have.
- Activities
  The activities that relate to the collaboration, should be changed so the processes do not only look internally but should be changed according to the collaboration
- Profits
  Each company must decide when and how they make profit from the collaboration and agree with all the other parties to guaranties that ensures profit for everyone.
- Information
  What information do you want to share with whom,
- Insight
  The company should make processes in place to monitor and check the insights and monitor if the collaboration is going according intentions or agreements.

During the case study Verbrugge and Stukwerkers only need to be aware of the new situation, but they keep working on the same way as they were used to. But for the final situation all parties are participating and should come to an agreement about the guarantees and processes. In the prototype Danser will offer a guaranteed barge capacity to 3MCT for transporting containers from Westdorpe to Antwerp. But Danser has the freedom to divide the containers over separate barges. Also 48 hours before departure Danser can use the unused capacity for other containers.

For the planning activities is 3MCT sending all container transports (also unplanned transports) to Danser, with the necessary information to plan. 3MCT can plan the container transports on their dedicated capacity, but Danser can also plan transports on other barges they have in the same region.

Due these agreements it is already possible for Danser and 3MCT to make a more efficient planning, by combine containers on other vessels they have in the same region. And 3MCT has still their guaranteed capacity.

5.4 TECHNICAL PROTOTYPE

For the technical part we purely focus to an integration between Danser and 3MCT. Danser has their own inhouse system called DaVe, which they use for a long period and has been made *"homemade"* for their requirements. The integration options in DaVe are limited and mostly restricted to current implementations they already have: EDI[4] and a single API. Developing new integration methods is difficult and time consuming due the limited availability of the software engineer that can work on their system. While the system used by 3MCT is a cloud-based application, developed by new technologies and able to integrate through webservices and APIs. Both applications maintain a different technology stack, but also have a different perspective on functionality. In Appendix II & III a more detailed description of the functionality of both systems is given.

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[4] In the logistics sector an often used, verbose, technic for interchange data is the EDIFACT standard (Electronic Data Interchange for Administration, Commerce and Transport) origination from 1987 (United Nations, 1987).

Both applications do have the functionality to support the activities needed by each party for the collaboration. Danser has the functionality for the planning of barge schedules and containers and can register and monitor the execution of the transport. 3MCT also can create orders; plan containers on new or existing voyages; and monitor and register the execution. But both parties should be able to seamless share the information needed to work together, therefore an integration between two systems should be build.

The prototype has been built in an agile way, by testing and continuously improving the communication link. This chapter will describe which information, and how the information will be shared and the challenges occurred during the process.

INTERCHANGE METHOD

In appendix I is the needed information flow, to support all activities, described. All this information should be shared between DaVe (Danser) and STACK (3MCT). To exchange this information, a communication channel should be available between the systems. DaVe has a limited support for interchanging data and can only offer the following techniques per message type:

- Transport Orders (Receiving)
    - EDI (IFTMIN), through FTP
- Barge Schedules (Sending)
    - EDI (IFTSTA), through FTP
    - API (JSON), through HTTPS
- Execution (Sending/Receiving)
    - EDI (CODECO), through FTP

For all EDI messages DaVe can return an APERAK message, containing possible are errors while processing the messages. STACK can handle and send several kinds of messages, through custom integration layers. Therefore, the prototype uses the message formats and interchange methods defined and supported by Danser.

MESSAGES

For each data set described in Appendix I must be defined how (the format) information is shared and interpreted so both systems have the correct information.

TRANSPORT ORDERS & BARGE PLANNING

The base layer of the integration is sharing transport orders, they are needed so both parties know about which containers they are talking. And in the case of 3MCT and Danser, the planned and unplanned orders from 3MCT should be shared so Danser can also plan the containers themselves.

The order model at Danser is straightforward, containing a: from and to location; container number some meta information; and a voyage number. While a single order at 3MCT can contain multiple barge transport (roundtrip), which are two single orders at Danser's perspective.

In Appendix IV the specifications for the IFTMIN message for DaVe are defined. This was the only way of sending transport orders to Danser via a system integration, and therefore this is used as the message format.

The following different events are defined for sending the message to Danser:

1. When a new dossier is created
2. When an existing dossier is saved
3. When a container is removed

4. When a container is planned

Due the different granularity of the concept *order,* a translation must be made from a Stack order to a DaVe order. In Figure 17 and Figure 18 a schematic view of the structure of orders in Stack and DaVe is added. The orange marked part is what this thesis calls an order, namely the single transport of a container per barge on one leg (from A to B).

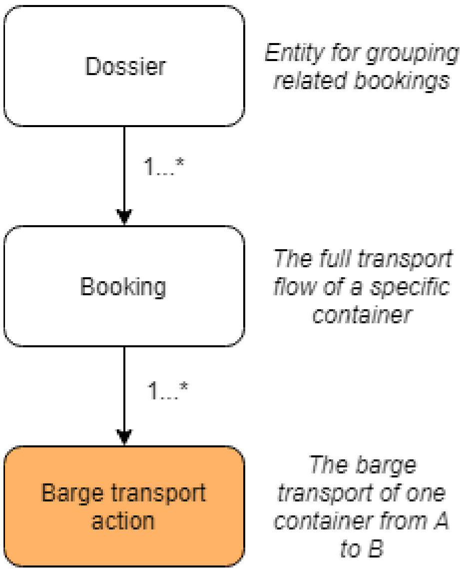


FIGURE 18 ORDERS IN STACK

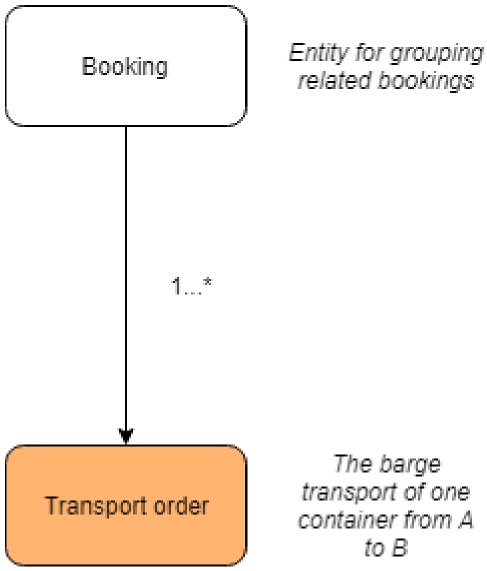


FIGURE 17 ORDERS IN DAVE

The EDI acknowledge functionality of DaVe cannot notice if a new EDI messages does not trigger any changes. Every message received for an order, must be confirmed even if there aren't any changes. The difficulty in the translation, is that Stack handles saving and editing on dossier level, and deleting on container level, while DaVe does all the actions on Transport Order level. To not overflow the planners at Danser with information, STACK should not send the same message more than once.

On the other hand, is it important that when the planners of both companies are communicating, they know about with orders in their system they are talking about. So, there should be a correct translation with id's between orders so both systems can group and handle it, but the planners still know where to find them in their own application.

Another challenge is to make sure that entities such as container type, shipping company, sea vessel are shared in such a way both systems know which entity in their system is meant.

For the implementation a solution has been chosen where all events translate back to a changed dossier. For all barge transport actions in that dossier an EDI Message (IFTMIN) should be created. The IFTMIN contains information of the transport; a reference for grouping the transports in DaVe; and the DaVe voyage number the container may already be planned on. For every generated message, a check is done if the same message is already sent earlier, if it is the case the message should not be send. A schematic overview over this flow can be found in Figure 19.

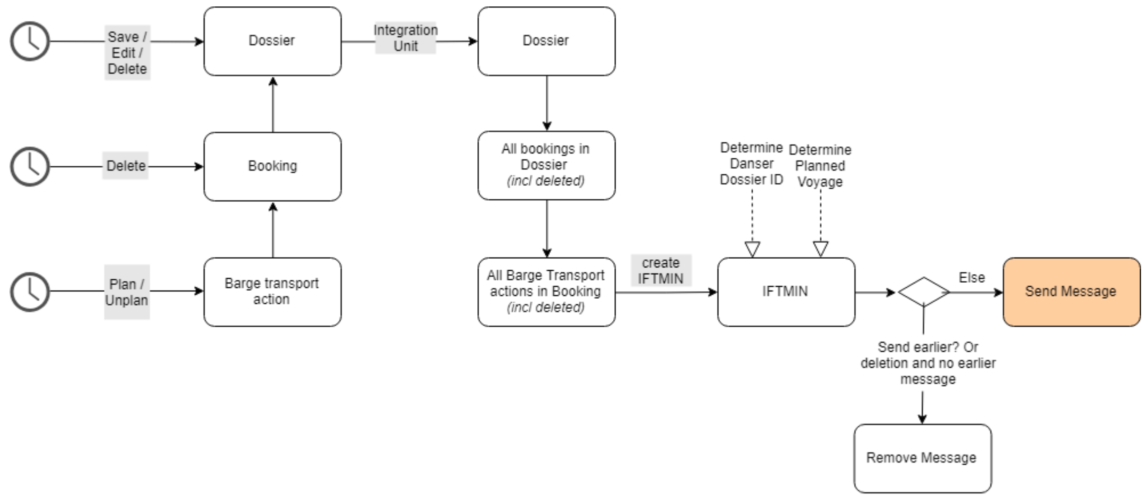


FIGURE 19 ORDERS INTEGRATION FLOW STACK -> DAVE

BARGE SCHEDULES & BARGE PLANNING

Besides the interchange of transport orders, also barge schedules should be shared between Danser and 3MCT. While the transport orders are coming from 3MCT and are pushed to Danser, the barge schedules are shared the other way around: Danser defines the schedules, and 3MCT receives them.

The information of the schedules is necessary for 3MCT to know where to plan on, but also to have the insight in when containers are arriving/departing. They need this information to inform their customers and to plan their terminal operation.

Danser already has an integration of sharing voyages, this is a JSON messages send over a HTTP connection. This integration could be reused with some small changes: an example of the JSON message is attached in Appendix V. The challenge with sharing this information is that DaVe uses a different model to represent a barge schedule then STACK does.

In STACK a barge schedule is represented by a collection of port stops for a specific barge, if those stops are connected you can transport containers over them. The stops are always chronological order, and you can only plan containers on a voyage that matches the port stops.

In DaVe barge schedules are modelled as a list of voyages, where a voyage goes from one port to another port and have a list of containers to load and unload. The dates in a voyage aren't required and aren't validated for correctness.

To interchange the schedules, a mapping should be made from the voyages from DaVe to the port stops in STACK. This is necessary to show a correct schedule and processing changes in the schedule in STACK. In Figure 20 you can find a schematic overview of how the translation of different Danser voyages should translate to port calls in STACK.

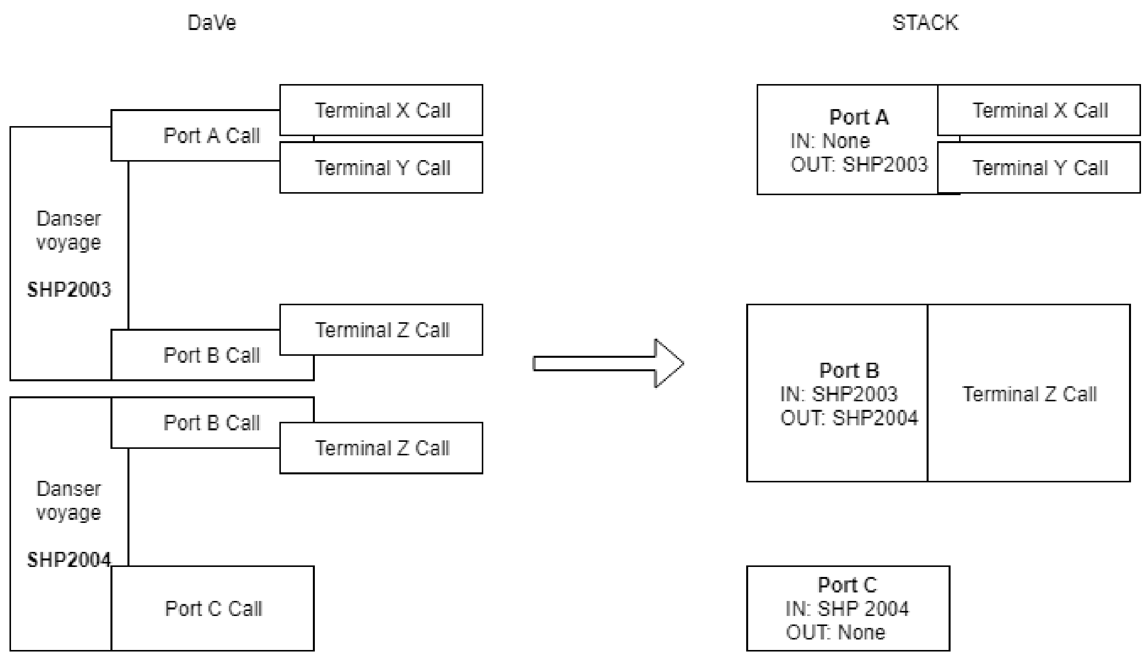


FIGURE 20 SCHEMATIC OVERVIEW DIFFERENCES IN MODEL

EXECUTION

Both Danser and 3MCT are already sharing execution information such as gate-moves in the form of CODECOs with other parties. Danser is receiving them from the deep-sea terminals to process the loading of containers and sending them to customers. And 3MCT is sending them to deep-sea carriers. For other customers STACK already has the functionality to also receive CODECO files and process them.

Therefore, the easiest and fastest way of sharing execution information, is by setting up the default EDI CODECO setup both applications already have in place

CHALLENGES

Within the information sharing and implementation of the integration multiple challenges appeared, the most difficult issues to solve are described below:

USING DIFFERENT NAMES/CODES FOR OBJECTS

Both systems used different codes and names for objects, in one system the company *Mediterranean Shipping Company S.A.* is called *MSC* while in the other system I was called *Med Ship Company*. But also standardized items as container numbers, can be send in different formats, e.g. a normal 20 feet container can be described as: 20ft Dry Van; 20DV; 22G1.

For each object a specific standard is decided and both sides should keep this standard:

- Date & Times: The format of *yyyyMMddHHmm* in the local time zone
- Container types: ISO Codes
- Terminal locations: UNLO BICS code
- Ports: UNLO code
- Shipping Company: SCAC Code
- Sea ship: The callsign
- Dangerous goods: UNDG Number

The biggest problems occurred with a non-matching set of sea ships, because the 3MCT dataset didn't contain all the callsigns of the sea ships. But by manually fixing these mismatches the error rate dropped to an average of 1 per week.

To identify these problems, DaVe rejects messages if there are any unknown objects and sends a return message (APERAK) with the error message. This error message is shown in STACK and should be solved by the planners. The other way around when STACK receives a message with an unknown object it gets stuck in the inbox, can be corrected manually.

IF INFORMATION IS PENDING FOR CONFIRMATION, IT IS NOT SENT BACK

Another challenge occurred, is that in DaVe all messages must be approved. If a new planning was made by 3MCT, the planner at Danser should approve the messages before the changes are implemented throughout the system.

But if in the meanwhile the planner changes something in a schedule, the schedule with current planning was sent back to 3MCT, without those (just planned) containers. STACK processed the messages and removed those containers from the voyage.

Therefore, the planning changes 3MCT was making, were made undone by the system because of the contradicting messages. This created a lot of frustration by the planners of 3MCT and was working against the collaboration.

As a solution Danser implemented a feature that new voyages will not generate updates until all pending EDI messages are processed. This adds a delay in the information, but ensures the information received is accurate and up to date. The fix solved to solution and frustration with the planners on this point.

SCHEDULES IN AN INVALID STATE

Because of the lack of validation and restrictions in voyages, the planners at Danser had the habit of changing voyages only when necessary. This means if a barge is delayed, they change a date into the future, but do not validate if the new date does not conflict with other voyages or with the voyage internally.

But every change is directly synchronized with 3MCT, which has a stricter barge planning. This resulted in a situation where their system tries to change to an impossible state and the integration rejects the changes. Or the planning is changed in a still possible scenario, but the following steps cannot be processed anymore.

Due to these scenarios the barge schedules for 3MCT got stuck and weren't useful, while the planners at Danser did not notice it. It wasn't possible to add more constraints to DaVe for validating the voyages, but by creating awareness at Danser, the planners are modifying the voyages in a more consistent way to prevent this effect from happening.

INCONSISTENCE IN DATA

Due the lack of validation and restrictions, another problem can occur in the voyage messages. A message can conflict with itself, for example containing a date for departing at 20-03 and a date of arrival on 19-03. These conflicting messages cannot be processed by STACK and are therefore rejected.

DaVe was sending multiple voyages/barges in a single request to STACK, but in case of a single inconsistency the whole message was rejected. To prevent the whole integration to stop, because of one single inconsistency in a voyage Danser changes the way of sending voyages to one barge per time, and therefore correct voyages will still be processed.

TRANSLATING VOYAGES TO STOPS

Instead of stops, the model of DaVe works with voyages. To be able to process the message the voyages are translated to stops as described earlier. There are two challenging elements.

The first is if multiple voyages are talking about the same stops. There are simple scenario's such as: Voyage 1: A -> B; Voyage 2 -> B -> C, should result in three stops: A -> B -> C. But in case of a multi stop voyage: Voyage 1: A -> B -> C; Voyage 2: C -> B -> A; this could result in three different things: A -> B -> C -> B -> A but also A -> C -> B -> A or A -> B -> C -> A.

Depending on the amount of load or unload cargo at a specific terminal, can be defined which of the three combinations the two voyages should result to.

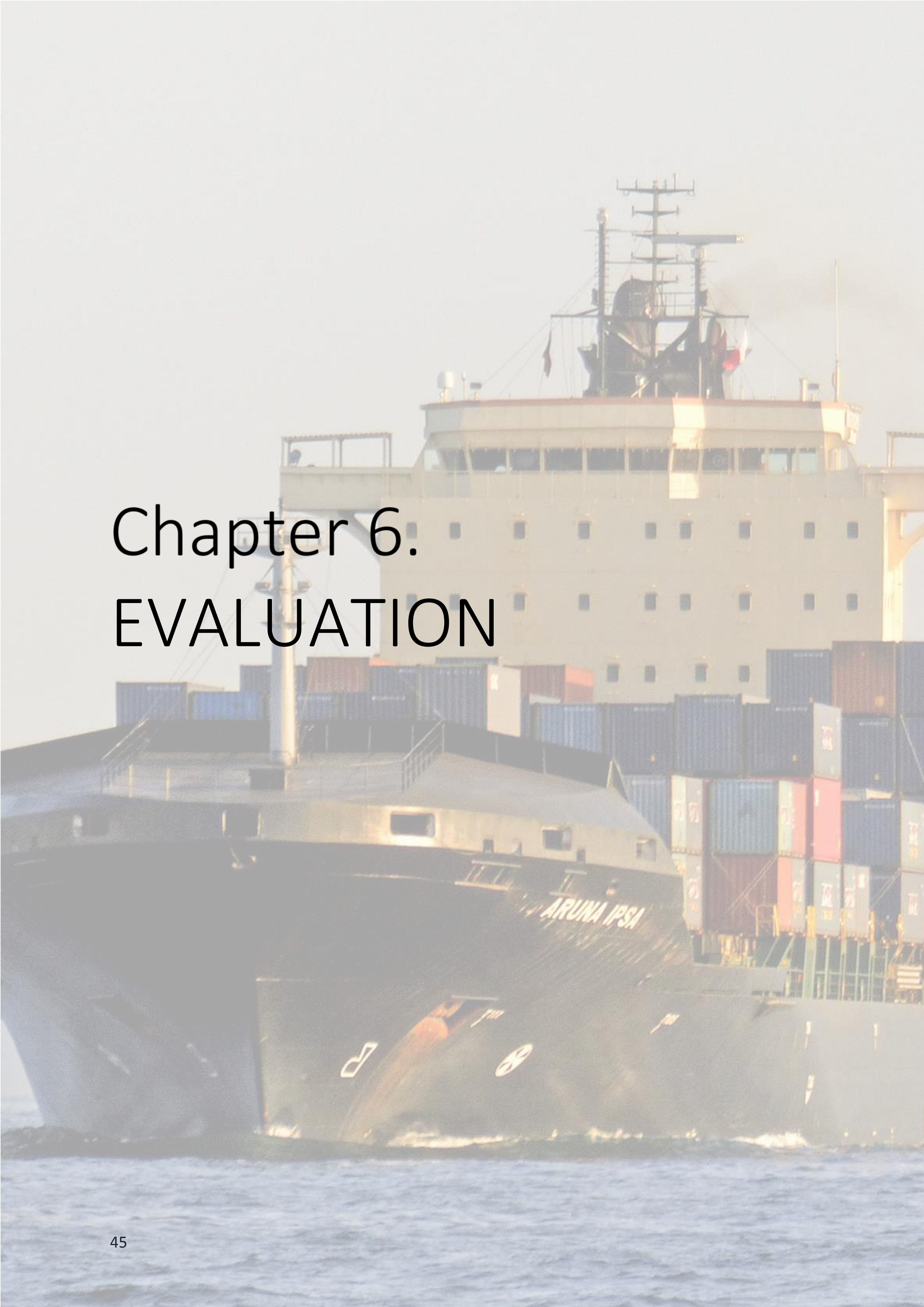
The other problem is the shifting of voyages over time. If you receive the following items: Voyage 1: A -> B; Voyage 2 -> B -> C, if location B is for voyage 1 and 2 at the same time, they can be merged. If there is a gap of several days it should result in the stops A -> B ….. B -> C. But if the second voyage is placed back in time so both B calls should overlap, it is hard to determine if those calls should be merged.

RESPONSE ON A RESPONSE

Each message Danser receives is creating an approval line in DaVe, even if nothing is changed. With following the example flow, Danser will receive unnecessary messages:

1. STACK creates an order and sent it to DaVe.
2. DaVe plans the order on a voyage
3. STACK process the information and plans the order also on the voyage
4. STACK notifies a change in an order (the planning), and sent a new message to DaVe

In the last step Dave will receive an order update, based on its own action. This creates an overflow on messages for the planner of Danser. To prevent this, stack added a constraint that messages are only sent if the event was created by a manual user or an integration with another party then Danser. By adding this constraint, the number of "useless" messages for the planner at Danser was decreased.



Chapter 6. EVALUATION

In this chapter the case study & prototype from Chapter 5 will be evaluated. The evaluation is structed based on the pillars of the framework. The importance of each pillar should be reviewed, this makes the following 7 evaluation points

- Parties
  Are the right parties working together?
- Activities
  Are the activities clearly defined and executed?
- Profits
  Are the profits achieved as defined in the goals in Chapter 5?
- Information
  Is all needed information available to execute the activities?
- Insight
  Do all parties have enough insight to evaluate the collaboration?

- Other
  Was something missing in the initial design?

The evaluation is split into three sections: a data analysis for a quantitative evaluation; and interviews and general impression for the qualitative information.

The first section 6.1 Data analysis focuses on the profits while the two sections thereafter: 6.2 Interviews & 6.3 General focus more on the rest of the pillars

6.1 DATA ANALYSIS

To evaluate if the profits are met the individual goals as defined in section 5.1 will be analysed.

For a quantitative analysis on the goals, there is data necessary from the collaboration. There are 4 parties relevant for the collaboration: 3MCT, Danser, Stukwerkers and Verbrugge. Stukwerkers and Verbrugge worked for a long time without a system (using excel sheets) and closed systems and there is no historical information available for these terminals. Danser and 3MCT were able to provide information relevant to the voyages over the last year to analyse the effects of the collaboration.

3MCT is a new container terminal and is only existing and using the system for one year (the first booking originates from February 23th 2018 at 11:42). Since then there are 25.322 bookings in the system, containing 31836 barge transports and 9304 truck transports. A booking is always based on a container and consists of one or more transports of this container. Before the start of the system 3MCT was starting-up and using excel sheets, this information wasn't structured and is therefore left out of the evaluation.

For the analysis a fixed period from 05-03-2018 till 01-04-2019 is used. By selecting this range, the first weeks are excluded when 3MCT was still starting up, and incomplete weeks are excluded at the end. In the first period the voyages of 3MCT aren't in the Danser dataset available, and therefore missing in those analyses. All data was gathered in April 2019.

The data from 3MCT originates from two entities: voyages and bookings. All the information from voyages is weekly grouped by the arrival time of the voyage at 3MCT (indicated with (eta)), the bookings are grouped by creation date (indicated with (b)). The difference between the creation date and the ETA is on average 12.5 days.

The data from Danser consist of voyages and calls, as such modelled in their system DaVe. Some of this data needs to be translated to be able to compare and relate it to the 3MCT data. Mainly on the part where 3MCT sees a rotation in Antwerp/Rotterdam as one, while Danser separates this into an inbound and an outbound voyage where a single terminal call can be found duplicated in both voyages.

Those inbound and outbound voyages are combined based on time and location, in order to have an accurate comparison with the information from 3MCT

At first, we will analyse each individual goal as mentioned earlier. The defined goals were:

- Higher utilisation
  By having a better insight in available capacity, the rest capacity can be used if another party "on the route" has more capacity available.
- Modal shift / More Schedules
  If connections are shared, there are more connections to/from Antwerp, and therefore there is a higher chance container can fit on a barge.
- Call optimization
  By bundling containers to the same terminal in Antwerp, minimize the calls to deliver the same number of containers.
- Less empty transport
  By sharing empty stock, the total transport of empty containers can be reduced.

The overall goal of the case study is for the different parties to share barge capacity in order to have a more efficient transport.

HIGHER UTILISATION

Due to the use of different barges with different capacity and the use of one or multiple push-barges *(Dutch: duwbakken)*, is it hard to determine the utilisation of the barges. During the period of the case study Danser decided based on the amount of orders which and how much barges they used for the transport. Due this organisational change, and the export limitations of their software system, is it hard to determine what the available capacity for each voyage was and to see if the utilisation over time changed.

It is possible to see that the amount of calls per Voyage stayed roughly the same over the whole period (Figure 21) while the number of transports and increased since the collaboration with 3MCT started (Figure 22). In Figure 23 you can see that although the number of terminals that should be called increased, the number of calls per rotation didn't.

This indicates the fact that instead of using larger barges or push barges, smaller ships make more rotations to have a higher utilisation and a lower call size in the ports.

Overall there is the impression that the utilisation increased, but it isn't possible to conclude it from the available data.

MODAL SHIFT / MORE SCHEDULES

As visible in Figure 25 since the start of the collaboration (August 2018), the number of voyages increased overtime, while the total amount of transports (Figure 27) even decrease a bit. And even despite that the number of containers transported on these voyages decreased (Figure 29). This decrease of barge transports can be originated to the introduction of a rail connection to the terminal (Figure 28), due to this extra modality is it hard to determine if the extra voyages introduce a modal shift from truck to barge due to this collaboration. The start of the railway and connection was already planned before the barge collaboration was founded. Another reason for the shift could be another type of others from another customer, as visible in Figure 26 the ratio between the different customers changes over time. So, there are more voyages available but the modal shift as anticipated didn't happened. Figure 28 even shows the contractionary the barge volume decreases while truck and train increase.

The introduction of the train connection was already planned before the start of the collaboration, to transport containers with a higher reliability and speed. A large part of the containers contain sugar from the Zeeland Suiker Terminal, but due to the low sugar production there was a decrease in the amount of containers to be transported (Boederij.nl, 2019). Because the train has a fixed schedule, and higher cost, more containers are moved to the train and the volumes on the barges decreases

Call Optimization

The increase in voyages and the collaboration, should be able to optimize the amount of calls that has to be made in Antwerp. In Figure 24 you find the amount of calls made for each voyage in the port of Antwerp. The amount of calls for each voyage, decreased clearly over time. The trendline shows the decrease starts around the start of the collaboration in august, when also the number of voyages increases. This indicates the number of calls in the port decreases and there is a more optimal planning in the port.

Less empty transport

Within the whole collaboration, there was no empty stock exchange between the participating parties. There wasn't a single exchange of goods between the terminals, based on the analysed dataset. This due missing information in the process and model, the reason and solution is more explained in the next two sections: 6.2 and **Fout! Verwijzingsbron niet gevonden.**.

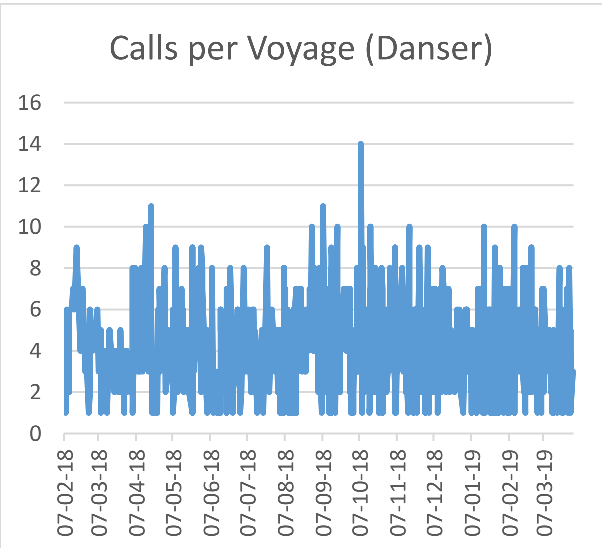


Figure 21 Danser: Amount of Calls for each voyage

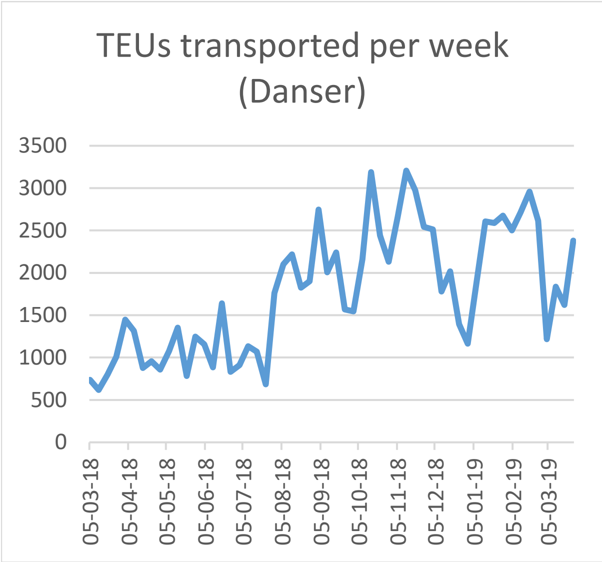


FIGURE 22 DANSER: AMOUNT OF TEU TRANSPORTED PER WEEK

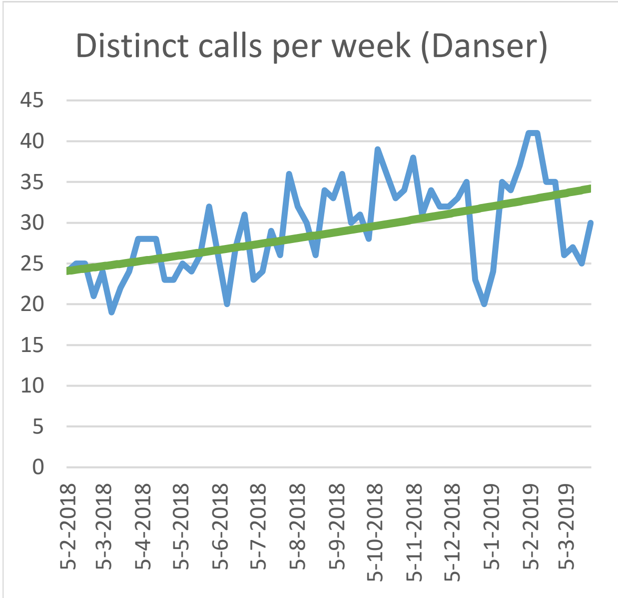


FIGURE 23 DANSER: DISTINCT CALLS PER WEEK

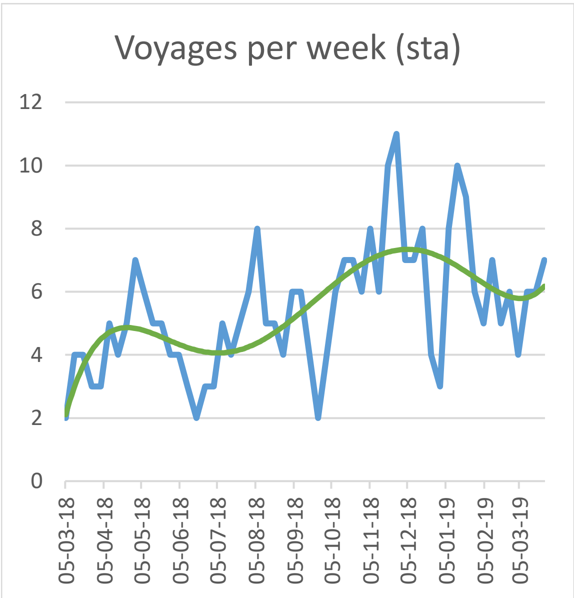


FIGURE 25 3MCT: NUMBER OF VOYAGES PER WEEK

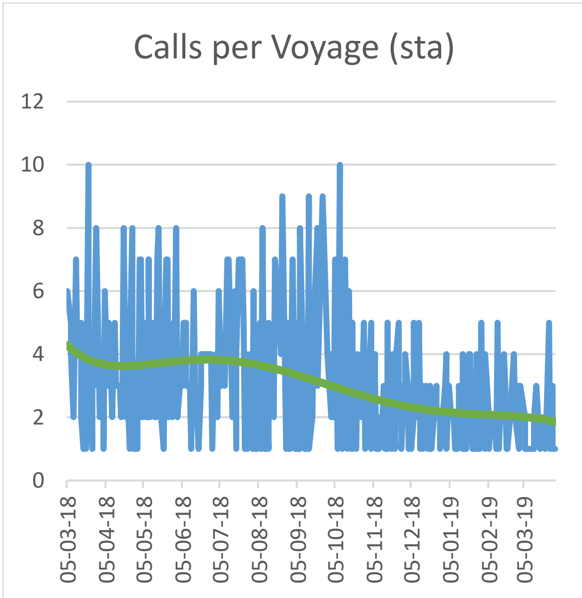


FIGURE 24 3MCT: AMOUNT OF CALLS PER VOYAGE IN

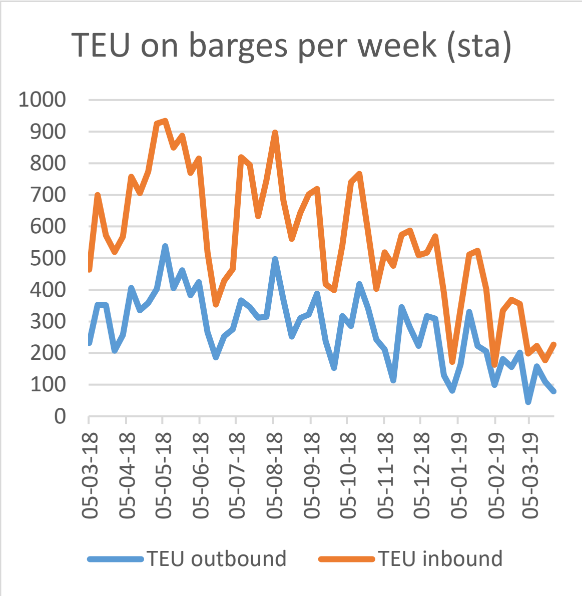


FIGURE 29 3MCT: AMOUNT OF TEU INBOUND AND OUTBOUND TO/FROM 3MCT ON BARGES PER WEEK

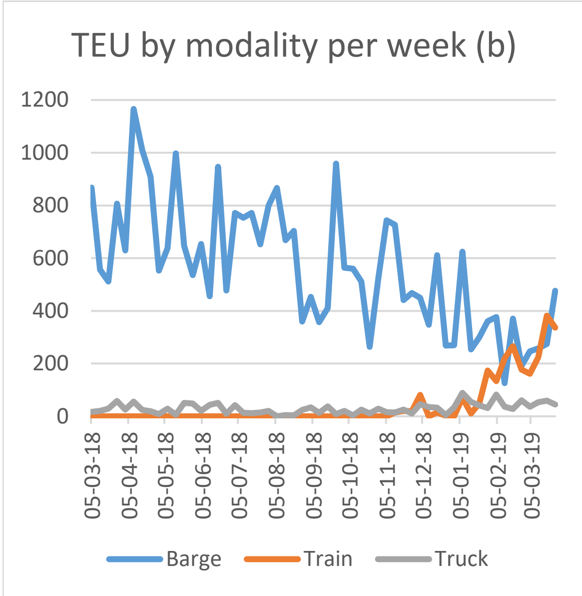


FIGURE 28 3MCT: AMOUNT OF TEU TRANSPORTED FOR EACH MODALITY PER WEEK

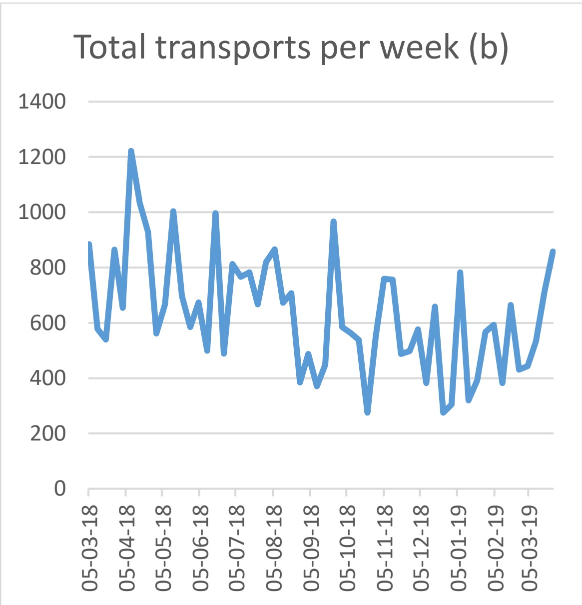


FIGURE 27 3MCT: TEU TRANSPORT OF ALL MODALITIES PER WEEK

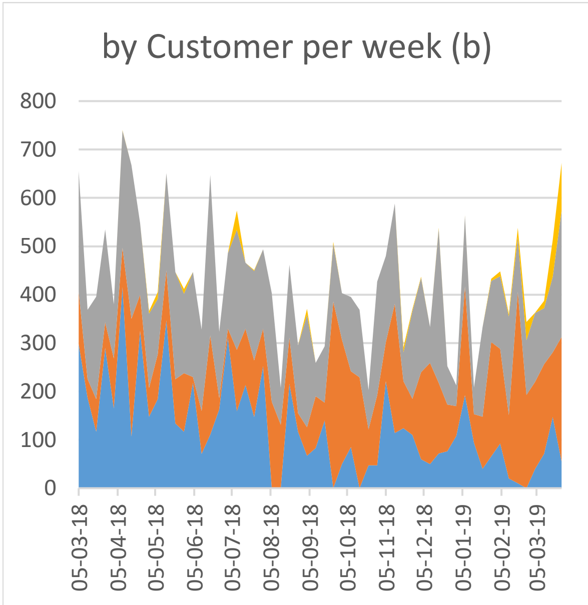


FIGURE 26 3MCT: AMOUNT OF ORDERS MADE BY DIFFERENT CUSTOMERS PER WEEK

6.2 INTERVIEWS

To determine the efficiency of the collaboration, interviews have been conducted with 3 persons related to the collaboration. In Appendix VI, you can find the questions asked. The questions are based on the framework as defined in Chapter 4, to be sure to cover all pillars. Below you will find the summary of each interview.

PLANNER DANSER (TIM VAN ANDEL)

Danser operates in a corridor in the region of Zeeuws-Vlaanderen, before the real collaboration started there was a low volume of cargo with some by Danser offered sailings. In the same period when the collaboration started 3MCT has a large new volume and the volume on Gent was increasing due to the new hub function of the terminal. Therefore, the total Volume in the hub was almost doubled.

In the beginning 3MCT had 2 dedicated voyages which they could plan and fill for themselves. For each change in the planning a new manifest was sent by mail or changes were called through. All information and planning from Verbrugge also are processed manually (excel sheets / emails). In this situation there was a low number of voyages and they had a large amount of calls in the Ports.

After the integration and collaboration with 3MCT, the information flow improved, and more / better information was available at both parties. This saved a lot of default communication about new orders and on which voyages an order was planned. Also, the integration of the voyages helps because both parties always know when and where a container will be transported.

By the higher volume and the flexibility at 3MCT the ships could sailing on a higher frequency and have less calls in the Port. For 3MCT it increased from two voyages to six voyages each week. Due this the quality of the barge service increased significantly, because it is more reliable due to the less calls and there are more voyages to plan on. This is an advantage for all parties in the collaboration.

Due to the type of cargo, the utilisation of the barges didn't increase. 3MCT has many heavy containers, while at first the barges had a higher utilisation on TEU, it shifted to a higher utilisation on weight.

It is a good partnership and therefore it helps, everybody is honest and open to each other. The capacity of 3MCT decreased to the introduction of the train. This was known at the beginning of the collaboration, and therefore the decrease in transports was expected.

The sharing of empty equipment could improve the collaboration even further, but there is an organisational challenge to make this possible with the shipping companies and to make sure the available containers and needed containers are from the same category. Only if those agreements are there new technical and information sharing is necessary to make this possible.

PLANNER 3MCT (VINCENT ANDRIESSEN)

Before 3MCT was in the collaboration it was working with Transbox (currently Contargo), for mainly transporting containers between Antwerp and Westdorpe. In this scenario 3MCT had dedicated barges, and they combined all containers on these barges. This the advantages of fully freedom and control of the planning of the barge but also the risk of the high call sizes. The information necessary was manually send by mail with excel sheets, and for all changes new information had to be sent. This was very labour intensive and error sensitive when there were multiple changes.

Afterwards 3MCT started with Danser with also a dedicated barge, which the same way of working as with Transbox. But also labour intensive, high changes on problems due to the call size and a lot of manual labour by sharing the information.

Shortly after the changes from Transbox to Danser, a single barge was transporting all containers from the same region to minimize the call size in the port of Antwerp. And because of the information sharing, the making the planning became a lot easier and it is easier to meet the port requirements of minimum call sizes.

In the future it would be useful to share a “Empty stock overview” between all terminals, so also empty stock could be interchanged. At this moment there is no insight / information available about the empty stock at other locations. And if the other terminals in the collaboration are also sharing all information, the empty transport can be reduced because of reuses. But to optimize this situation the empty stock information should also be available.

The collaboration is working, on the side of 3MCT. Only the data information exchange could be improved by resolving some problems with execution information and the amount of not relevant information that is shared should be reduced.

STACK CONSULTANT FOR 3MCT (MAARTEN VAN UEM)

Maarten wasn’t at the first meetings where the collaboration was discussed and the parts the both agreed on. But before the collaboration all the planning was manually done, and information was shared by phone and email. Information was also shared this way what added a delay, because most question couldn’t be answered directly, and someone must search for the answer and then communicate this back. The only insight in the efficiency of the barge planning was the plan screen from 3MCT, with their dedicated barges.

After the system integration it saved also a lot of time at the side of Danser. The orders and the return of the container numbers loaded on a vessel were shared automatically. This reduced the amount of errors made and saved a lot of time.

And because Danser had more information, they could also help 3MCT plan their containers, with the correct agreements and information sharing 3MCT was still in control of their barge planning but Danser can help with a more efficient planning.

If more companies should join the collaboration in the same way, the collaboration will probably be more efficient. By more cargo through the collaboration, Danser can offer more voyages and therefore make a more frequent and flexible schedule

To improve the collaboration there should be a better and more accurate system for warnings and errors, that when something goes wrong in execution or information sharing the relevant parties are informed. This way some mistakes and problems can be avoided and resolved earlier in the process. Also, a better logging of what is changed and what had been done by the other party could be useful. At this moment only the “now” situation is available, but if voyages are delayed or containers are re-planned you do not know, the historical information is stored but not presented to the end-user.

6.3 GENERAL PERCEPTION COFANO

The implementation of the prototype was a continuous process at Danser and 3MCT. After the prototype between those two parties was implemented, Danser decided with Verbrugge to also start with the system integration at the terminals from Verbrugge. And the success of the current steps is used to motivate Stukwerkers to speed up with the integration of their new IT system so they can also join the system integrations. Danser is also trying to apply the same principle in a different region with terminals in Ghlin and Liege.

And based on the success so far Cofano is receiving other requests to implement and try-out and implement similar integrations and collaborations for other customers in the Netherlands.

6.4 EVALUATION SUMMARY

In this evaluation we looked from three different perspectives to the case study: with a data analysis; with interviews; and the general perception. These three combined will give us an overall evaluation of the case study. Based on all three perspectives the general conclusion can be made that the case study has a positive outcome.

PARTIES

Based on the interviews, everyone indicates that the trust between the parties is important. Also indicate they that if more (similar) parties would participate it the total collaboration would improve. During the case study this trust was available and therefore surprises were prevented (e.g. by starting the rail services from 3MCT).

ACTIVITIES

The barge schedule planning and barge container planning activities are working as it should, but all sides indicate the importance of the information sharing. If the information sharing isn't implemented/working correctly the activities are getting problems because of the lack of insight.

PROFITS

During the interviews everyone indicates they have the impression all parties profit from the collaboration.

The data analysis shows that the amount of calls for each Rotation in the seaports (Antwerp/Rotterdam) is decreased for 3MCT and for the whole collaboration the amount of calls in a rotation stayed the same while the amount of transports and the number of different terminals increased.

Also, the number of voyages in the region is increased, offering more flexibility and more departure times for crucial containers. Unfortunately, it isn't possible to determine the utilisation of the voyages, due changing capacity and the use of push barges.

But on the data analysis can be determined that the reuse of empty stock within the collaboration hasn't been done at all. This is also confirmed during the interviews, where is mentioned more gains can be made by sharing empty stock between the terminals. At this moment there isn't enough insight in the available empty stock to make this possible, this may be cause due the fact that this goal was defined in the case study but wasn't considered when designing the concept for cargo sharing in Chapter 4

INFORMATION

According to the interviews and the data analyse the information is almost the most important pillar to support all other pillars. Without the correct and on-time information it was hard to execute the activities and gain the profits. The data analyse also shows that the moment when the system integrations where implemented and improved the efficiency also increased.

INSIGHT

Due to the information sharing all interviewed persons indicate they have enough insight in the collaboration to evaluate it. And there is a good transparency between the parties to share their expectations (e.g. about the start of a train service at 3MCT).

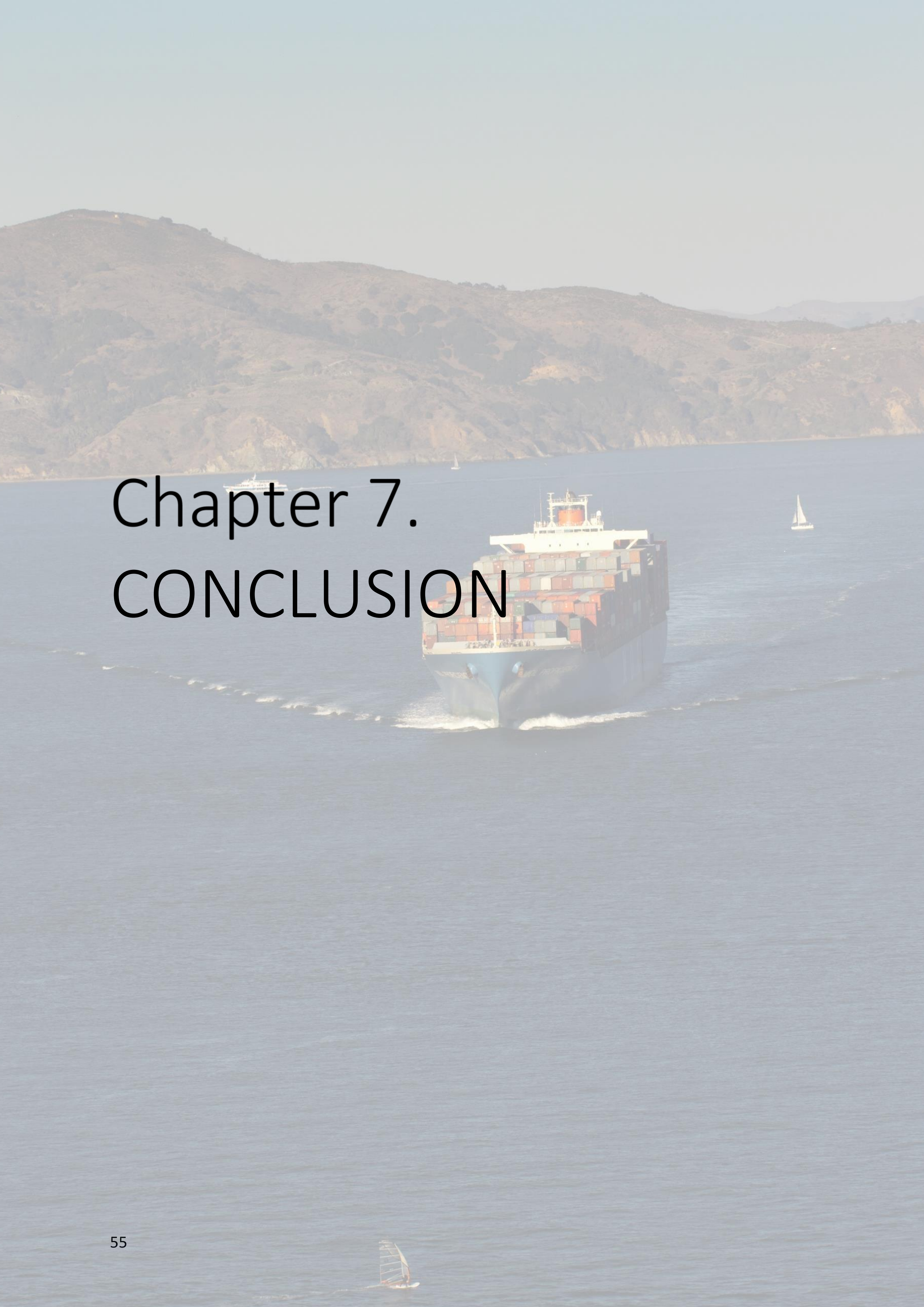
OTHER

One important element everyone mentioned about the collaboration is the exchange of empty stock. This goal wasn't considered when designing the cargo sharing concept and therefore there were not gains at all on this aspect. The framework should be a bit more focussed on the goals within the profits pillar.

Overall all the interviewed persons indicate the collaboration as a success, also all of them emphasize on the need of information sharing during the collaboration, because the accurate information made it possible to execute the described activities. And by improving the information sharing the collaboration could even be better.

All the interviewed persons state that the collaboration will be more efficient with more parties involved, if those parties are also sharing the same data as Danser and 3MCT during the case study.

Besides the state goals in the beginning of the case study, also time savings in mentioned at 3MCT and Danser. Those time savings are due to the fact of the activities for transporting containers now only must be executed once instead by both parties and due to the better information sharing all parties always have all the information they need



Chapter 7. CONCLUSION

7.1 CONCLUSION

The goal of the research was stated as follow:

> "To develop a system that enables barge planners to collaborate and share capacity to increase the individual and overall efficiency of the barges and barge planning."

Based on this goal multiple sub-questions are constructed that together lead to the answer of the research question. Below you will find each sub-question answered, leading to the conclusion.

SQ1: WHAT ARE THE BASIC PROCESSES OF BARGE & TRUCK PLANNING FOR CONTAINER TRANSPORT?

In Chapter 1 the basics of container hinterland and container planning is described based on a field study validated by field experts. The relevant actors are identified: Inland Container Terminal, Barge / Truck Operator*,* Forwarder, Shipping Company, and Consignee / Consignor. And the different types of transports as Import Roundtrip, Import Single trip, Export Round, export Single trip, and repositioning are described.

SQ2: WHAT IS ALREADY KNOWN ABOUT SHARING CAPACITY AMONG THE HORIZONTAL SUPPLY CHAIN?

In the literature several authors described the importance of collaboration in a supply chain (Doukidis et al., 2007; Simatupang & Sridharan, 2005b). These frameworks and models are analysed and combined into a global framework that points out all important elements for a supply chain collaboration and can be used as guideline to create or evaluate collaborations.

Based on the framework constructed on literature, two different cases about collaboration in the supply chain are analysed based on the framework, based on this analysis the framework is extended to take the new findings into account.

The refined framework defines 5 pillars:

- Parties, *parties working in the collaboration, and related parties that could be impacted.*
- Activities, *all activities that each party (individual and together) should execute to make the collaboration successful.*
- Profits, *the individual and collective profits that will encounter through the collaboration.*
- Information, *all the information and how it is shared which is needed to execute the activities and realise the profits.*
- Insight, *the transparency and insight each party should have, to validate the effectiveness and correctness of the collaboration and previous mentioned pillars.*

SQ3: WHAT ARE THE REQUIREMENTS FOR A TOOL FOR SHARING BARGE CAPACITY ON BARGES?

Based on the results from SQ1 and SQ2 a collaboration framework for barge transport could be constructed. This guides through all the requirements for setting-up a collaboration for sharing containers on barges in the hinterland transport. The constructed framework leans on the 5 different pillars which should be determined for all parties in the collaboration. An overview of the framework can be found below:

Parties	**Barge Service**	**Transport Customer**	**Nonparticipating Barge Services**	**Deepsea terminals**
	Operating container barge transport in the same region (same water roads)			

Activities	- Barge Schedule Planning - Barge container Planning - Execution Monitoring	- Order Entry - Barge Container Planning (optional) - Execution Monitoring		
	The transport of containers for A to B			
Profits	+ More cargo & business + Better information and more efficient planning	+ More voyages + Cheaper transport + More reliable transport	- Less cargo	+ more efficient terminal calls
	More voyages, more efficient planning			
Information	-> Barge Schedules <-> Barge Planning <-> Execution Information	-> Transport Orders <-> Barge Planning <-> Execution Information		
	All information sharing is always between two related parties. And should be as "real-time" as possible.			
Insight				
	All parties get their insight based on the information shared to execute the defined activities.			

SQ4: How can the tool be applied to a case study?

In the south-west of the Netherlands and the northern part of Belgium, there was a need/question for a collaboration between several container terminals and a barge operator for sharing cargo to optimize the voyages in the region. Based on the previous defined framework all important elements for the case study were defined and described.

By designing collaborations based on the tool, there were key pointers for how the collaboration should work and on which processes should be focused. Based on the tool the processes within the companies, the guaranties for transparency and profits, and the processes for information sharing, where described and implemented.

The tool gives good guidelines for focus points, but the interpretation still had to be done. This interpretation is subject to the type of companies to work with, the available IT systems, but also the context and already planned future developments.

The collaboration started on the organisational part in August 2018. In the period afterwards a system integration was built between two parties within the collaboration. Afterwards the collaboration and integration were evaluated with a data analysis and interviews with the planners.

SQ5: What can be learned from the case study?

In the evaluation of the case study, several conclusions could be drawn. At first the importance and relevance of a good and accurate information sharing mechanism between the system is evident. All the other pillars (parties, activities, insight and profits) are based on the fact that the information is correct and timely available. This indicates that all pillars aren't standing independent but building upon each other.

Also is it important to align the implementation with the goals, as stated by the collaborating parties. One of these stated goals, the sharing of empty stock, wasn't participated for the concept for cargo sharing and therefore also not met. By having a better alignment this could have been prevented or seen up-front.

But overall by taking the elements from the framework into account, a successful collaboration has been created.

7.2 DISCUSSION

This study has extracted a framework from literature, improved it based on case studies, and evaluated it with a prototype during a case study. Apart from the answers to the research questions stated in the previous section, several claims can be made based on the experiences and outcomes of this study. We will discuss collaboration, success & fail factors and the broader applicability of the framework.

Collaboration

One could argue that the case study and tool, as presented, aren't a real collaboration. This due to the nature of the structure given by the tool, one could easily interpret it for a normal partnership between, in this case, the barge operator and the terminals. The tool created by the framework, guides to a structure that fits the current way of working. People have a resistance to change (Dent & Goldberg, 2016). To make the chance of succeeding as high as possible, the resistance and thus the changes should be as low as possible. To do this the new processes should be as close as possible to the normal way of working of the companies.

The definition of collaboration used in this research: *"two or more parties are working together to create competitive advantage and create higher profits then can be achieved by acting alone (Simatupang & Sridharan, 2002).",* states that each situation when two or more parties achieve more than one on his own, indicates towards an collaboration. During the evaluation of the case study the people involved indicated based on the way of working together they improved in relation to the situation before, and when more parties would start working the same way everyone should benefit from it. Also there isn't one party that could orchestrate this on his own, there is knowledge and collaboration necessary from all participating parties to make sure all parties have the correct understanding and responsibilities about the collaboration and way of working. Therefore, although opinions may differ, the author states the framework and the case study as a collaboration within the logistics.

Success & Fail factors

The framework describes the pillars which contribute strongly to the success of the collaboration, but also some components from which the existence (or lack of) can be related to the failure of a collaboration. Besides these pillars, the author identified three other components that seems relevant for collaborations. These three components are described below:

BUSINESS CASE

The analysed cases, the theory, and the prototype during the case study, indicate a strong element for success is a business case for every party in the collaboration, i.e., all parties profit form it in some way. This profit can consist of: getting more business, able to work more efficient, achieve a higher quality, reduce costs, or just increase the prices.

This solid business case is important to get a collaboration started, but also to keep a collaboration going on. When looking at the cases in section 3.4, the first case (Waarom nog lege kilometers (Kloosterboer / MCT)) did start with a good business case for all parties, but when the context changed and the business case for one party changed (they could reuse empty containers themselves) the collaboration also collapsed. And for the second case (Barge Cloud (BTT & OCT)) there was never a good business case and therefore the collaboration even never got past the prototyping phase.

The case study implemented in Chapter 5 ensured a solid business case, that enabled the collaboration to get starting. The interviews indicate the business case will only grow if more parties participate. But also, in this scenario if the business case disappears, e.g. by having cheaper transport options for the terminals, or getting not enough cargo for Danser, then the whole collaboration will stop.

TRUST

Trust is another important factor, but the component trust doesn't seem as straightforward as the business case, described above. The presence of a business case enables the collaboration, and the lack/disappearance of a business case make the collaboration stop. Therefore, the business case is during the whole collaboration (and before) equally important. But the trust component shows a higher importance in the beginning.

When looking at the processes of hinterland transport (described in section 2.1) it shows us that each party has his own internal way of working, and these processes give the planners the feeling that they are in control. For a collaboration there is often need for a different way of working to support the activities as defined in the framework. For this different way of working, the processes are now depending on different persons (from different companies), which can give the planners a feeling of being out of control.

Before the start of the collaboration there should be trust, between the management of the parties, of working together, but also between the people that will be executing the activities that should enable the collaboration. An important element for trust on the level of the individual employee is the insurance that their job will not negatively be impacted by the collaboration.

As soon as the new activities and process are in place, this trust component is already there. But if there are any changes in the activities or other elements that can impact the collaboration the trust component should be re-established again.

When looking at the case between Danser and 3MCT, in the beginning the planners at Danser had a great sense of "loss of control", but by meetings and showing the information through the process, and manually validating the results, the trust in the other parties and the collaboration increased until it worked as intended. There was a threshold the trust had to pass before the collaboration, but as soon as the collaboration started the meetings and validation wasn't necessary anymore. The other way around 3MCT started a train service which resulted in a decrease in cargo transported by barge. This impacted Danser, because they had to anticipate by using different ships or getting cargo elsewhere.

By the transparency of both parties, there was trust to start the collaboration, and trust when the parameters within the collaboration changed. This trust ensured the other parties and made sure the collaboration would continue.

IT

Another key element that can be identified is the IT component. To be able to plan and monitor, the correct information should be available at the correct time. For the planning the schedules should be there, and for the execution the container information is needed.

An IT integration is crucial for a successful collaboration. Within Information Technology it isn't technically difficult to share data across multiple systems and companies, but the challenge is to get the information translated into a way both systems understand, and both systems are talking about the same entities. The problems which occur most times originate in the old-fashioned IT systems, with limited possibilities for information sharing and the high costs and time for requesting new features.

There are a lot of different forms of IT integration, the simplest is just manually sharing excel sheets with the necessary information. If there are clear moments when the information is needed, and fixed capacity agreements this is possible. But in a lot of cases there is more automatic / real-time information need, resulting in communication through EDI, webservices, or other automatically send information.

During the case there was a need for real-time information sharing, but after the implementation the fact that the information was shared automatically appeared more important than it was real-time. During the case there was a delay of 5 to 20 minutes because of an EDI batch processor. This delay was acceptable for the planners and it was more important that they knew that within this period all information was automatically shared.

The upfront challenges are to share the information, but the important part is to make sure that any problems that will occur through the information sharing are identified and solved quickly. Even if the parties trust each other, there is a very profitable business case, and all the other pillars of the framework are there, if the necessary information isn't available the collaboration will not work. Or worse the trust will decrease and business case will collapse.

APPLICABILITY

Although the outcome of this case study is positive, it does not ensure all collaborations designed, based on the guidelines of the tool, are successful. There are a lot of different parameters which define the collaboration and influence the effect of the framework. Next some parameters that can have an impact will be discussed.

MORE BARGE OPERATORS

The case consisted of only one barge operator offering the transport opportunities. The question is how the trust and profits will relate when multiple barge operators offering transports. The assumption is that if the transports they offer are competing, it is an extra challenge to ensure the profits for each party, and prevent competing within the collaboration. Competition during the collaboration can change or remove business cases from other parties. In those cases the insights, as described in the framework, should be extra important. If the transports aren't competing, e.g. one offers a line to Rotterdam and the other to Antwerp, less problems are foreseen.

DIFFERENT DESTINATIONS

In the case study all containers depart from different terminals but have the same destination: the port of Antwerp. The complexity added when having multiple destinations (Rotterdam, Antwerp, Moerdijk) isn’t described or validated during the research. The assumption is that when separating the flows, analysing, and treating them as separate collaborations it is possible to add this.

GEOGRAPHICAL SITUATION

In this study several cases are described where the transport is already passing the other locations within the collaboration. This adds minimal extra time and costs to the transport, because all extra activities are related to the transport of the cargo within the collaboration. But in case of a collaboration where more “extra kilometres” are needed for the transport, this can make it harder to make the collaboration possible due to the extra costs.

On the other hand geographical situations can also add extra opportunities to the collaboration, within several area’s there are bridges and locks that do not allow to carry the maximum capacity containers on a barge, so these barges always have available capacity on parts of their route that can contribute to a collaboration. In the Netherlands all shipping routes have a CEMT classification, which define the restrictions for each waterway (Figure 30).

In Figure 31 you find the classification of the Dutch waterways, this show that on a trip from Enschede to Rotterdam the Twentekanaal (from Enschede to Lochem) has a lower classification then the rest of the route. Depending on the water level, it is sometimes possible to carry an extra layer of containers after this point. So even though for Enschede the barge is fully utilized, due to geographical reasons on a later part of the route there can be spare capacity. This can stimulate a collaboration because it is easier to make a business case.

CEMT-klasse	breedte (m)	lengte (m)	diepgang (m)		strijkhoogte (m)	laadverm. (ton)	motorverm. (kW)	boegschroef (kW)
			geladen	leeg				
I	5,05	38,5	2,5	1,2	4,25	365	175	100
II	6,6	50 - 55	2,6	1,4	5,25	535 - 615	240 - 300	130
III	8,2	67 - 85	2,7	1,5	5,35	910 - 1250	490 - 640	160 - 210
IV	9,5	80 -105	3,0	1,6	5,55	1370 - 2040	750 - 1070	250
Va	11,4	110 - 135	3,5	1,8	6,40	2900 - 3735	1375 - 1750	435 - 705
VIa	17,0	135	4,0	2,0	8,75	6000	2400	1135

FIGURE 30 WATERWAY CHARACTERISTICS CEMT CLASSIFICATION (RIJKSWATERSTAAT, 2011)

FIGURE 31 CEMT CLASSIFICATION DUTCH WATERWAYS 2008

CAPACITY

The available cargo and capacity are relevant for the collaboration. In all situations described in this study, there was enough capacity to transport all cargo for all parties as agreed in the collaboration. But there is a new type of problems if within the collaboration there should be a choice which containers should be taken. If all cargo is equal and the selection can be divided equally it shouldn't be a problem. But if there is a difference within the priority of the cargo (detention costs, reefers, or just important customers) or a difference in time when each party can offer the booking, one single party can always become the "second choice". This can lead to an unfulfilled business case and a lack in trust for a single partner within the collaboration, and eventually will result in a failed collaboration.

7.3 RECOMMENDATIONS

Based on the earlier mentioned discussions and limitations the following recommendations can be made for scientific and practical use of the results of this research.

SCIENTIFIC

The framework reflects to the models found in the literature and is now only tested within the context of barge collaborations. The same framework could be used to do a literature review within collaborations on a larger scale, and to map other logistic collaborations on the framework, to be analysed and compared.

The tool is now designed and validated in one case study. By executing more various case studies, the model can be validated more broadly and elaborate more on the scalability factors in the discussion section.

PRACTICE

The tool describes a collaboration as an agreement between multiple parties, with the information flow as a peer to peer process. Due this nature there is no central hub or entity to organize and streamline the collaboration. Within the collaboration according to the tool all parties are equal and must decide how and which information they want to share. This generates technical and organisational challenges for each individual party.

Even though this self-governance structure I recommend a 3th party with a total overview of the (possible) collaboration, to help setting up and structuring the total collaboration and the needed informational flow. When creating the collaboration, the focus is mainly on the profits for each party, but when these are defined, the activities and information should be aligned to achieve these profits.

A large part of the collaboration is the alignment of the activities and information flow, which is heavily integrated with the software from Cofano. Therefore, should Cofano offer to their customers the service to help and improve with collaborations based on the knowledge they already have. By offering this service they are getting acquainted by others in the collaboration who may not (yet) use Cofano software.

The implementation of the collaboration should happen in an agile way, but one should be aware, once the business starts working within the collaboration there should be any big problems, and any problem should be resolved quickly. This to ensure the trust and motivation of the planners working within the collaboration.

Chapter 8. SOURCES

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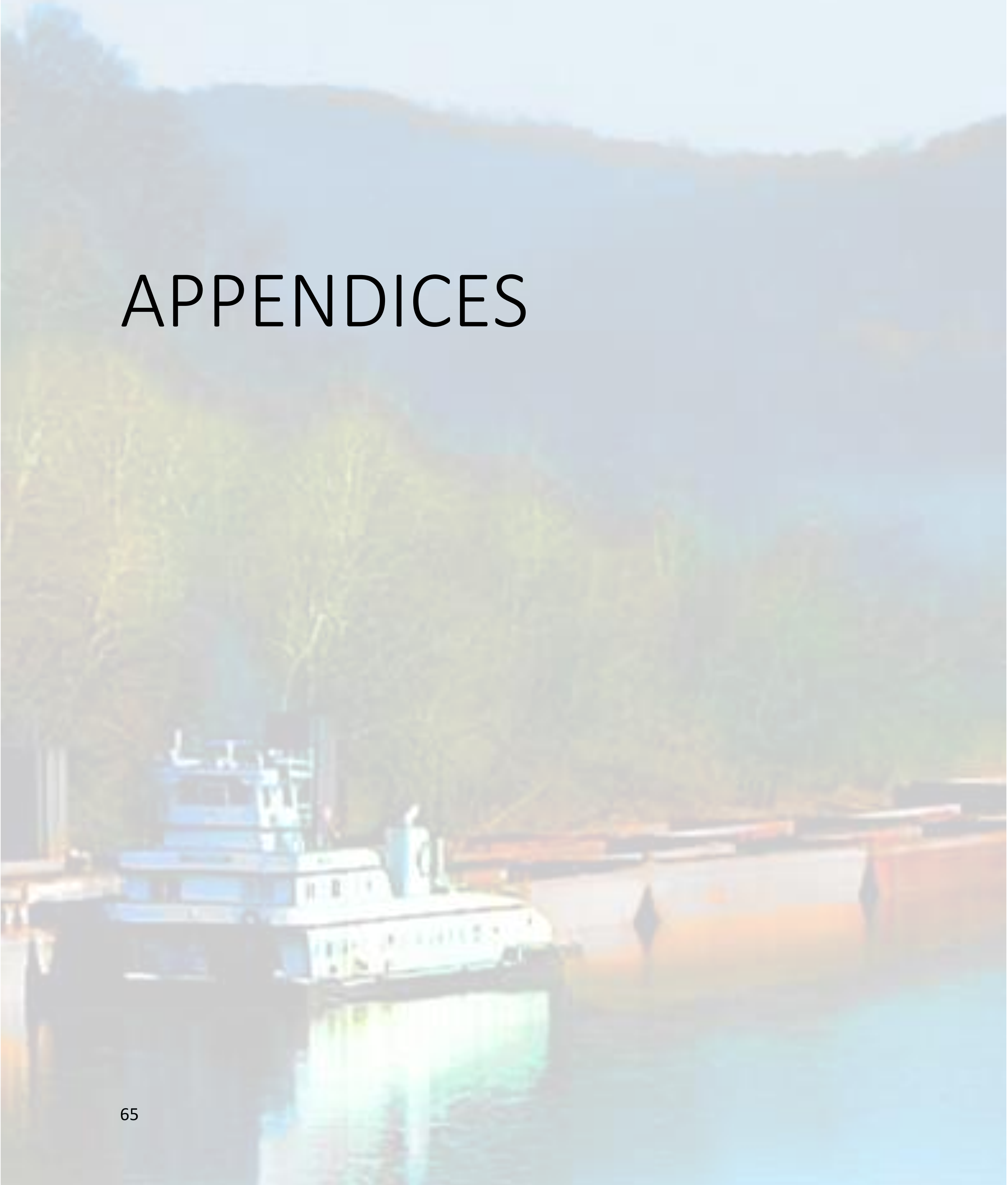
IMAGES

Container Barge, on the Meuse at Liege by Dave Collier- https://flic.kr/p/tQm51u

Container Stack by Blake Thornberry - - https://flic.kr/p/gyXWaf

Container Ship 'Maribo Maersk' - Prinses Amaliahaven - Port of Rotterdam by Frans Berkelaar - https://flic.kr/p/VSHhYq

APPENDICES



I. INFORMATION FLOW

1. BARGE SCHEDULES (SUPPLIER -> CONSUMER)

First multiple barge schedules are sent to the *consumer*, the example is a voyage named CET19001 that stops in Westdorpe, Terneuzen and Antwerp, from Westdorpe to Terneuzen is 156 available, and after Terneuzen only 124. There are no plan restrictions on this voyage, so both parties can plan on this voyage.

Voyage: CET19001			
Ship	Cetus		
Restrictions	None		
Stops	Westdorpe	02-01-2019 00:00 t/m 02-01-2019 06:00	156 TEU
	Terneuzen	03-01-2019 00:00 t/m 02-01-2019 03:00	124 TEU
	Antwerp	04-01-2019 10:00 t/m 01-01-2019 13:00	

2. TRANSPORT ORDERS (CONSUMER -> SUPPLIER)

On the other side the consumer sends unplanned orders to the supplier, this makes it possible for the supplier to also plan the orders on barges (e.g. for voyages with a restriction: NO_PLANNING). The transport should be from 3MCT to K1742, and the container (FBIU 048376 1) is available after 01-01-2019 10:00 and should be in Antwerp before 06-01-2019 22:00. The container is full (20.125KG) and there is a dangerous good in the container with UNDG code 0012(0). This should be enough information to plan and transport the container.

Transport 1001				
From	3MCT		Reference	3259-12-OUT
To	K1742		Container number	FBIU 048376 1
Available from	01-01-2019 10:00		State	Full
Delivery before	06-01-2019 22:00		Weight	20.125kg
Pickup reference	3259		UNDG	0012(0)
Dropoff reference	ANT123451			

3. PLANNING REQUEST (CONSUMER -> SUPPLIER)

The consumer requests to place the container on a voyage that has a restriction. In the follow table one container is add as reservation to the voyage AIY19002 and one is removed from the reservation, to be loaded in Rotterdam.

Planning			
Voyage	AIY19002		
Ship	Aiyana		
Time	03-01-2019 22:00		
Location	Rotterdam		
Load	Transport 2001	RESERVATION	NEW
	Transport 2002	RESERVATION	REMOVE

4. PLANNING (SUPPLIER -> CONSUMER)

The supplier can send a new planning message to add containers on a specific voyage. This message contains the new and existing containers that are planned on the voyage.

Planning			
Voyage	CET19001		
Ship	Cetus		
Time	02-01-2019 06:00		
Location	Westdorpe		
Load	Transport 1001	CONFIRMED	NEW
	Transport 1002	CONFIRMED	EXISTING

5. PLANNING (SUPPLIER -> CONSUMER)

If another consumer or the supplier itself plans something on a voyage that isn't relevant for the customer, the capacity available for the consumer decreases. A new schedule is sent with the decreased available capacity.

Note: The planning of the consumer itself does not affect to total capacity available for that consumer.

Voyage: CET19001			
Ship	Cetus		
Restrictions	None		
Stops	Westdorpe	02-01-2019 00:00 t/m 02-01-2019 06:00	156 TEU
	Terneuzen	03-01-2019 00:00 t/m 02-01-2019 03:00	114 TEU
	Antwerp	04-01-2019 10:00 t/m 01-01-2019 13:00	

6. PLANNING (CONSUMER -> SUPPLIER)

7. PLANNING (SUPPLIER -> CONSUMER)

See point 4 & 5

8. EXECUTION (SUPPLIER -> CONSUMER)

9. EXECUTION (CONSUMER -> SUPPLIER)

Besides the planning it is possible for the supplier and consumer to pass through information about loaded and unloaded containers.

Execute transport: 1001	
Container number	FBIU 048376 1
Reference	3259-12-OUT
Type	Loaded / Unloaded
Date	04-01-2019 11:34

II. SYSTEM IMPRESSION STACK (3MCT)

In this appendix the functionality related to the barge planning of STACK, the terminal operating system of 3MCT, will be explained.

ORDER ENTRY

The order entry module is the core of the system from 3MCT. From the order entry all other modules are filled with information. An example order can be found in Figure 32, it is an import container arriving with the sea ship ONE GRUS to Quay 913 in Antwerp, and from there it should be barged to 3MCT. At this moment it is planned on the barge TBN, and afterwards it goes to the location Swagemakers by Truck.

The block for the barge transport will be input for the barging module, and the block for the truck transport will be send to the trucking module. It is possible to have multiple barging transports in a single booking (in case of a roundtrip the full pickup and the empty return).

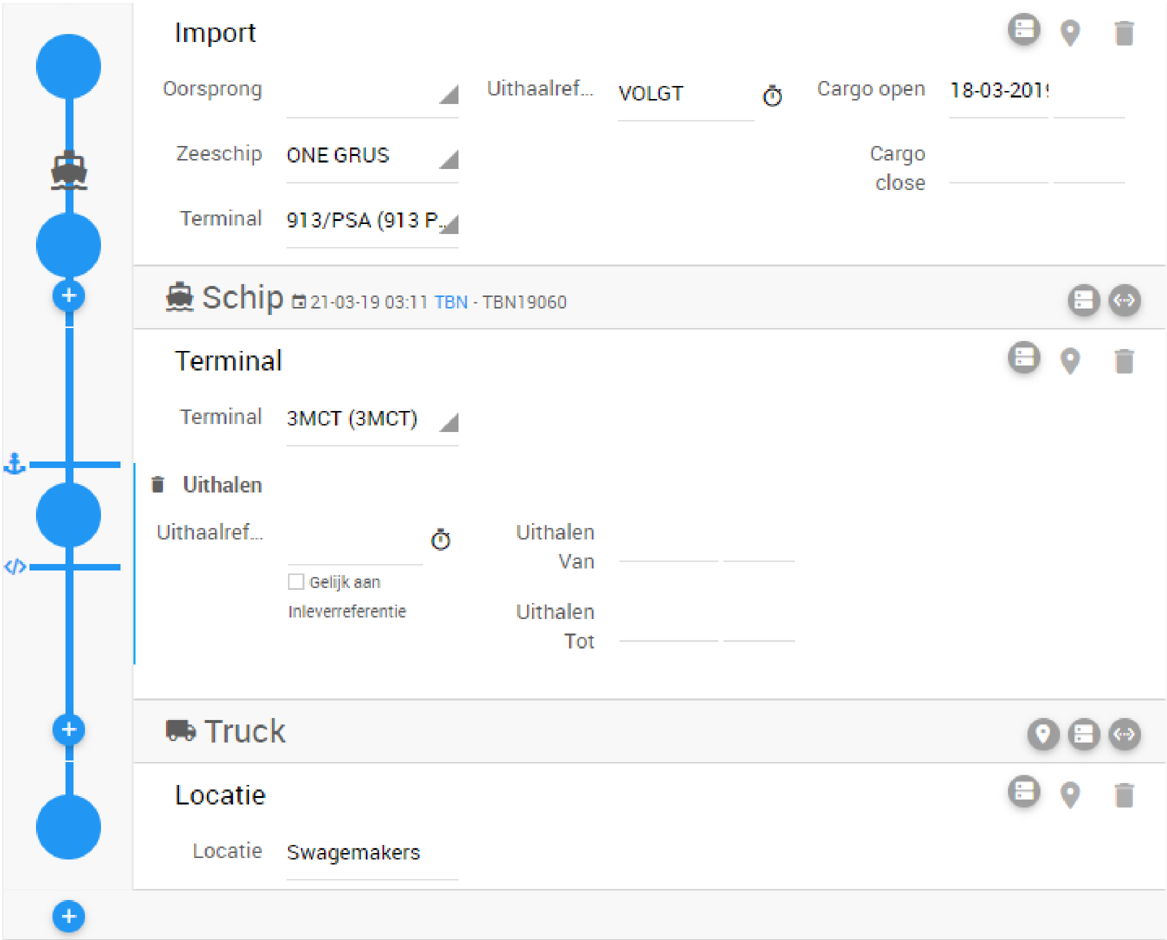


FIGURE 32 ORDER ENTRY 3MCT

BARGE PLANNING

The system of 3MCT has all functionality to make barge schedules and to plan containers on the voyages. The screen consists of three sections (see Figure 33): Barge Schedule; Stop Information; Unplanned orders.

1. **Barge Schedule**
   On the vertical axis all active ships are represented, and on the horizontal axis you can find

the time. On the plan board you find "port stops" and if there is a line between two stops it shows the option to ship containers between those lines. The colours on the plan board stand for a specific location: in the screenshot red represents Antwerp and green Westdorpe. As soon as a voyage is process it will be greyed out.

2. **Voyage information**
   By clicking on a stop you get the next section with stop information. This section can be divided into four parts: stop summary, load list, unload list and edit. By default, it starts at the summary, here you can find how many containers must be loaded; for which terminals they are; how many containers must be unloaded; and where the come from. The load and unload list show a list of all containers to be loaded or unloaded at the stop (Figure 33) and offer the possibility to create excel manifest and send the manifest to other parties; and the last one is the edit tab, that allow you modify the port stop by example changing the dates or adding voyages numbers.
3. **Unplanned list**
   The last section shows all unplanned barge transport actions that still must be planned on a voyage. By drag and drop the unplanned orders can be planned on the specific voyages by dropping it on the start or stop point in the schedule.

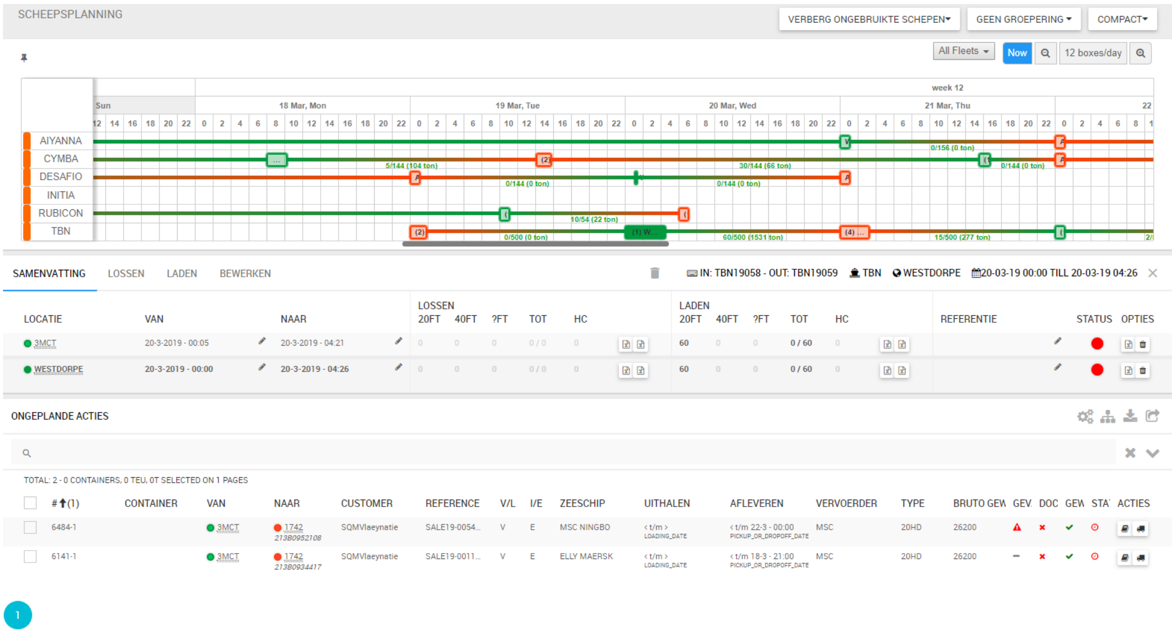


FIGURE 33 BARGE PLANNING STACK

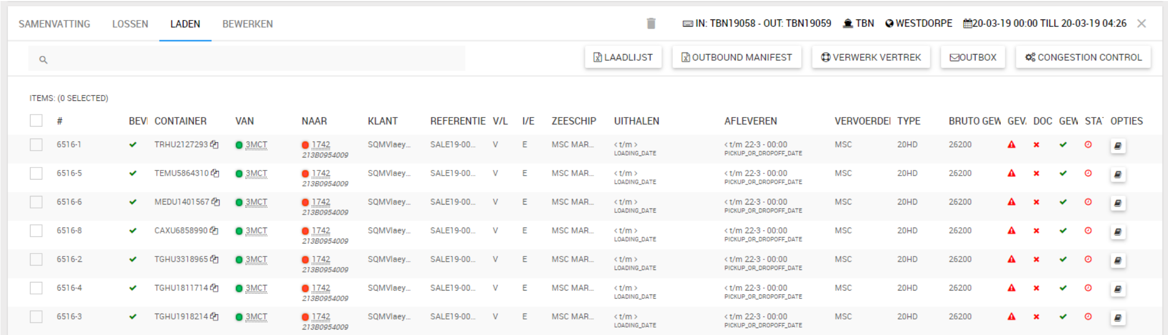


FIGURE 34 LOAD LIST OF PORT STOP

EXECUTION

Within the application the execution / progress of the barges and containers on them can be followed. The most used option is to process the arrival or departure of a barge as total through the terminal app or the functionality in the barge planning (Figure 35). This screen is also used to make sure all container numbers are known when processing incoming vessel.

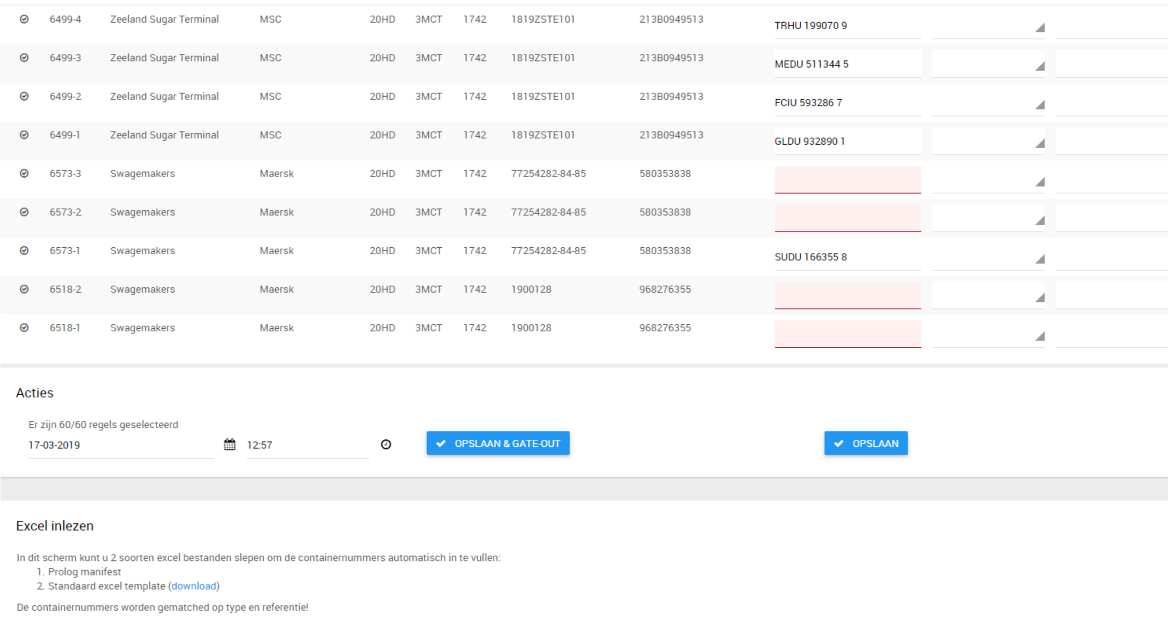


FIGURE 35 PROCESS ARRIVAL/DEPARTURE OF VESSEL IN STACK

EDI (INBOX/OUTBOX)

Cofano STACK has a flexible inbox/outbox system which allows it to dynamically add different integrations with different messages formats and communication channels without having to change the codebase of the application. For each integration is it possible to determine if the incoming messages should be manually checked or are processed automatically throughout the system.

III. SYSTEM IMPRESSION DAVE (DANSER)

In this appendix the global working of DaVe, the system used by Danser, is explained based on functionality and screenshots.

GLOBAL PLAN BOARD

DaVe has a global plan board (see Figure 36) which is their main screen. It is separated in four rows:

1. **Voyages**
   For each barge or region all voyages are displayed in the first row. In this part also new voyages can be added; existing voyages can be modified; messages can be sent to terminals and customers and even the preannouncements can be sent by using the context menu behind the right mouse click.
2. **Voyage Parts**
   All planned customers bookings for the selected voyages are displayed in the second row. By using the context menu several actions can be execute as confirming EDI bookings, or removing/editing the booking
3. **Container information**
   The third part shows a summary of all cargo on the voyages grouped by size, full/empty and weight.
4. **Orders**
   The last part shows all the unplanned orders for the specific barge or region, also all new bookings coming in through EDI are visible here and should be acknowledged.

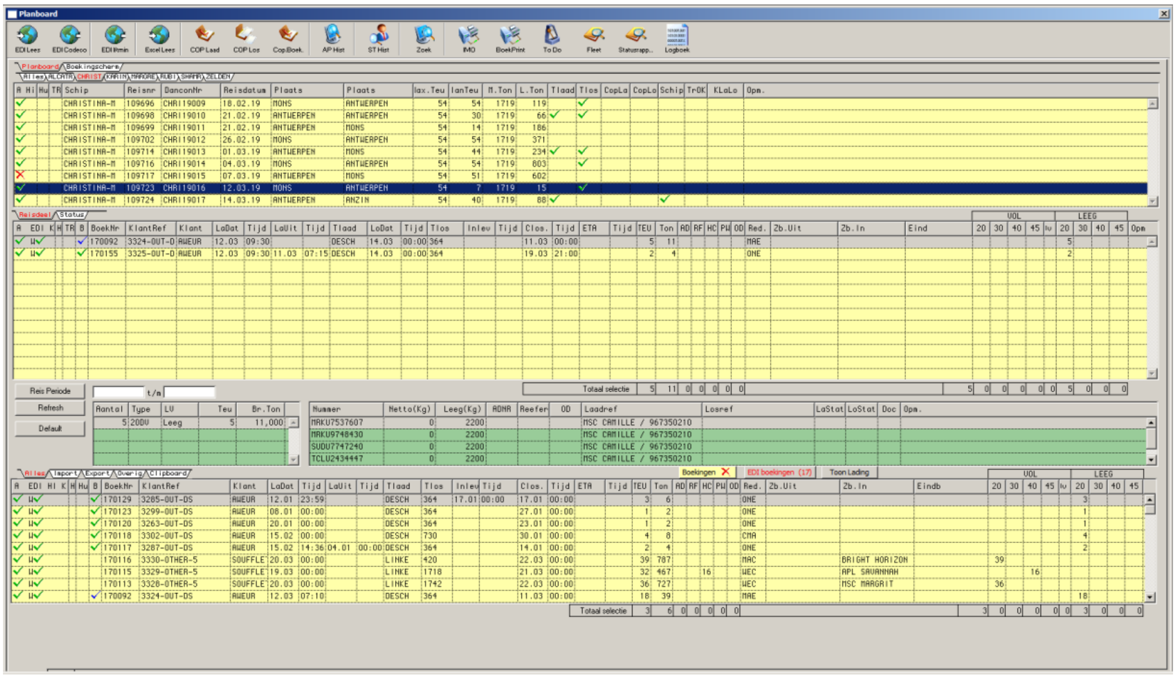


FIGURE 36 GLOBAL PLAN BOARD DAVE

VOYAGE INFORMATION

Based on the specific bookings, Danser creates Voyages for a region (called "*vaargebied*" in Dutch"). A voyage is always from a city to another city, with optionally stops in between, called Port Calls (the fields at the left top in Figure 37).

A voyage always gets a barge name and a previous voyage, this is a manual action. And there aren't any checks the previous voyage is before the new voyages.

Multiple customers/clients can send in orders for the same region.

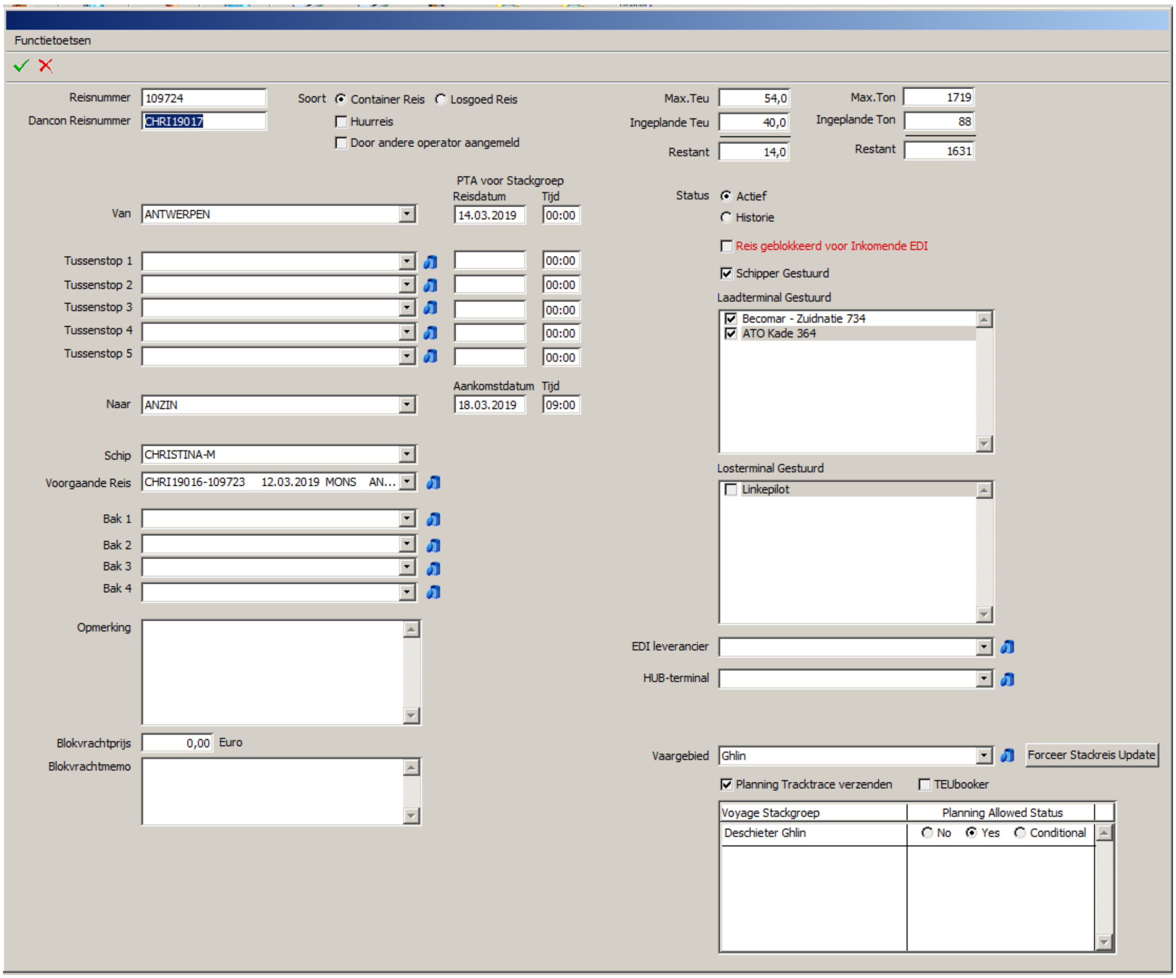


FIGURE 37 VOYAGE SCREEN

PLANNING

Based the unplanned orders, a planning for the coming days is made, by looking at information such as loading date, closing, calls that are already there; size and weight. Based on the actual cargo planned on a voyages terminal calls are registered in the system.

For Danser the terminal calls are the leading information about the vessel, and the port calls are only suggestive information. It is possible a voyage will go via multiple ports, but the order isn't known yet, based on the planned containers and the created terminal calls the actual order and route of the barge is known.

DaVe does not have any validations and registrations to validate if the given time planning for port- and terminal calls are correct. The responsibility for correct information lays fully by the planner who is doing the planning.

EDI

All incoming messages in DaVe must be confirmed before they go through the system. If an order isn't confirmed yet they will appear red in the system (see Figure 38). The planner must confirm the message manually to accept it. They also have the possibility to accept it with changes or to decline it. In Figure 39 you find a screenshot of the approval functionality where in this case 15 of the 16 containers are being removed.

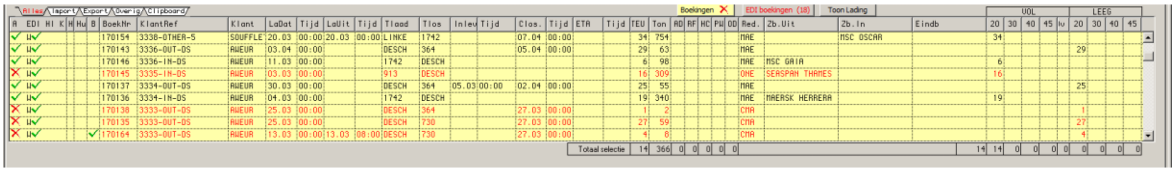


FIGURE 38 UNPLANNED ORDERS WITH PENDING EDI MESSAGES

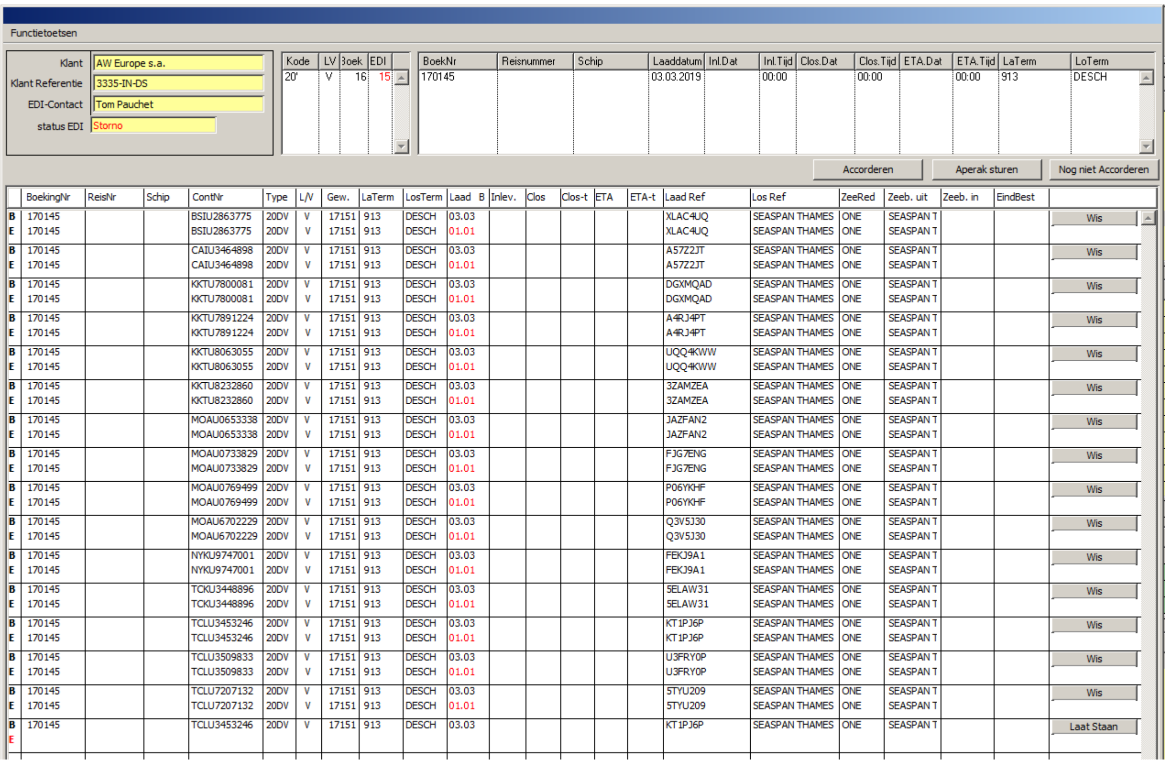


FIGURE 39 REVIEWING EDI MESSAGES DAVE

PROCESSING EXECUTION (CODECO)

DaVe has the functionality to receive and send CODECO messages, which are container gate-in/gate-out report messages defined by the UN/EDIFACT specification. From some container terminals Danser receives load messages when containers are loaded on the barges including their container numbers.

For terminals that does not support this functionality the planner enters this information manually in DaVe, to make sure all containers and moves are registered. DaVe can also send this information to their customers in the same CODECO message (see Figure 40)

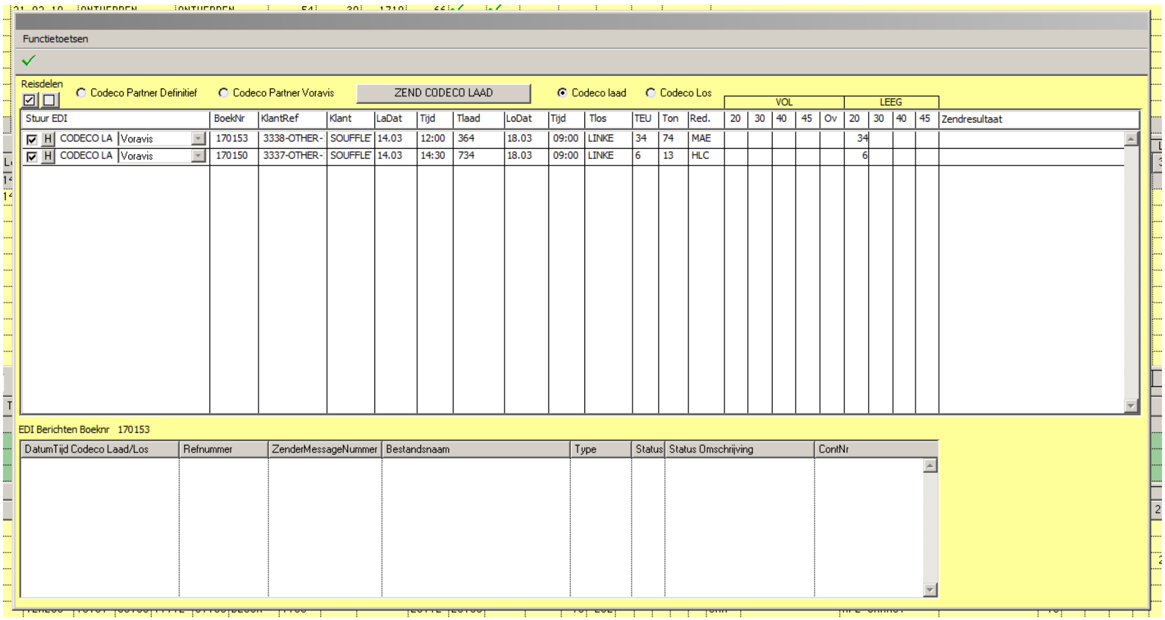
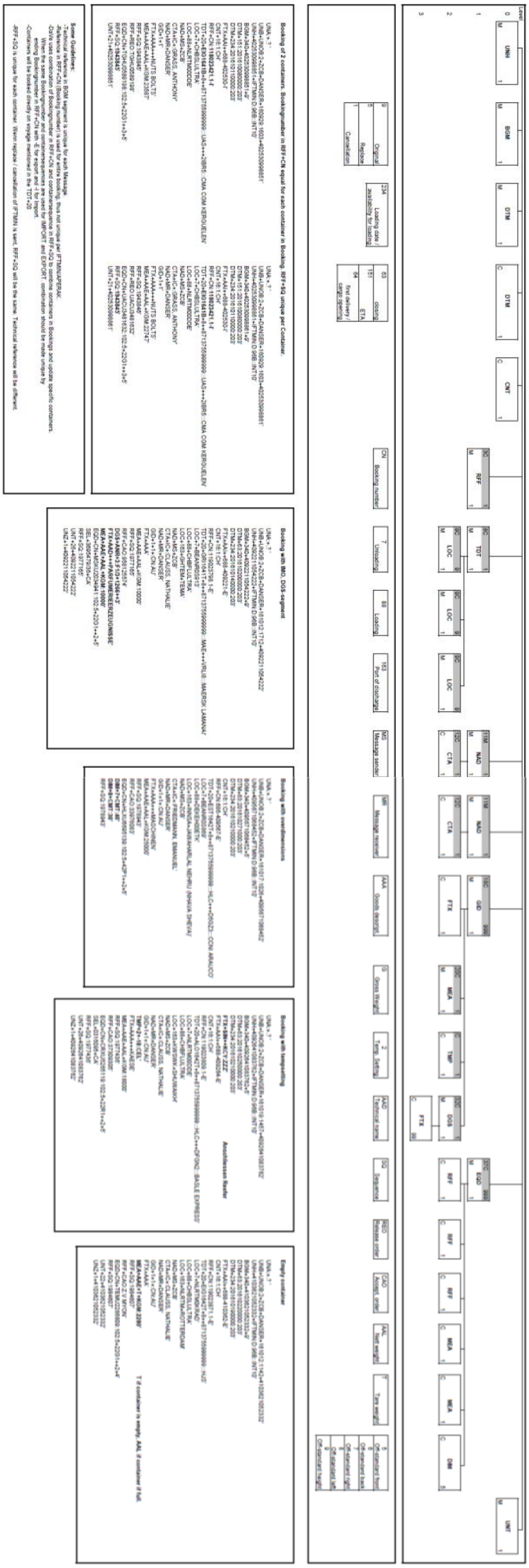


FIGURE 40 CODECO SCREEN DAVE

IV. IFTMIN SPECIFICATION DAVE



V. DANSER VOYAGE JSON


```
[{
  "timestamp": "2019-03-19 09:48",
  "sendbatchnumber": 7814,
  "statusupdatecounter": 114,
  "voyagekey": 872143,
  "previousvoyagekey": 872061,
  "corridor": 201,
  "voyagenumber": 169619,
  "previousvoyagenumber": 169607,
        "voyagenumberdancon": "CYM19034",
        "previousvoyagenumberdancon": "CYM19033",
        "voyagesupplier": "DANSERBNLX",
        "vesselkey": 4421,
        "vesseleni": "6004275",
        "vesselname": "CYMBA",
        "voycapteutotal": 144,
        "voycaptontotal": 2690,
        "voyplannedteustack": 3,
        "voyplannedtonstack": 47,
        "voyplannedteuother": 118,
        "voyplannedtonother": 2080,
        "planningallowed": "YES",
        "ports": [{
                "portname": "WESTDORPE",
                "portunlo": "NLWDP",
                "pta": "2019-03-21 15:30"
        },
        {
                "portname": "ANTWERPEN",
                "portunlo": "BEANR",
                "pta": "2019-03-22 00:00"
        }],
        "stops": [{
                "terminalkey": 5766,
                "terminalbics": "NLWDP03MCT",
                "terminalname": "3MCT Trimodal Container Term.",
                "pta": "2019-03-20 15:41",
                "loadingnumber": 3,
                "loadingcontaineridstack": [X,Y,Z]
        },
        {
                "terminalkey": 5486,
                "terminalbics": "BEANR01718",
                "terminalname": "PSA 1718 MPET East",
                "pta": "2019-03-22 00:00",
                "unloadingnumber": 2,
                "unloadingcontaineridstack": [Q, R]
        }]
 }]
```

VI. INTERVIEW QUESTIONS

For convenience for the interviewed person the questions were asked in Dutch. To prevent missing context during the translation, the original asked questions are added below.

HOE WAS DE SITUATIE VOOR DE SAMENWERKING?

- Werkten de partijen toen ook al samen? En/of welke andere partijen waren daarbij betrokken.
- Wat waren de activiteiten die toen gedaan worden t.b.v. het vervoer van containers van 3MCT?
- Waar zaten de grootste winsten en kosten in de situatie? Waar werd veel verspild en waar werd efficiënt gewerkt?
- Hoe werd de benodigde informatie voor de bargeplanning uitgewisseld, en wat voor effect had dat op het geheel?
- Hoe was er inzicht op de efficiëntie van de bargeplanning?

Bij samenwerking, zonder systeemintegratie?

- Hoe werkende partijen (Danser & 3MCT) samen zonder systeemintegratie, welke activiteiten deden beide partijen?
- Welke winsten werden er behaald t.o.v. voor de samenwerking?
- Hoe werd de benodigde informatie voor de bargeplanning uitgewisseld, en wat voor effect had dat op het geheel?
- Was er inzicht op de efficiëntie van de samenwerking en bargeplanning?

BIJ SAMENWERKING, MET SYSTEEM INTEGRATIE?

- Zijn de activiteiten aangepast sinds de systeemintegratie beter werkt?
- Kunnen er andere/extra/meer winsten behaald worden door de betere systeem koppeling?
- Wat voor effect heeft het nu de informatie door systeem koppeling wordt uitgewisseld? En ontbreekt er nog informatie die beter ook automatisch uitgewisseld kon worden?
- Was er inzicht op de efficiëntie van de samenwerking en bargeplanning?

MOGELIJKE TOEKOMST?

- Zouden er dingen veranderen indien ook andere partijen op deze manier gaan meewerken (zoals terminals in gent en Vlissingen)?
- Zou de efficiënt verhoogd kunnen worden als andere partijen op deze manier gaan meewerken?
- Indien er dingen kunnen veranderen, zou er dan ook andere informatie nodig zijn?
- Is er dan ook een andere manier nodig om de efficiënt van de samenwerking en bargeplanning te bepalen?

ALGEMEEN?

- Zijn er dingen veranderd ten opzichte van hoe in het begin de bedoeling was dat de samenwerking zou gaan zijn?
- Wat is de algemene mening over de samenwerking?
- Wat is de algemene mening over de systeemintegratie?
- Welke dingen zouden verbeterd kunnen worden?