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Reducing Unnecessary Empty Container Repositioning: The Role of Seaports and Inland Terminals

Master's Thesis in Supply Chain Management

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Abstract

International trade has steadily been growing for several decades. This creates new challenges for both seaports and inland terminals, as they need to adapt to manage the growing number of goods. Containerization has been a solution to the increasing amount of trade, allowing faster operations at the terminals and facilitating intermodal transport. However, this has also caused a need for unnecessary movements and handling of empty containers, leading to increased costs, congestion, and emissions.

This report has investigated how empty container repositioning (ECR) can be reduced from a seaport and inland terminal perspective. The report further identifies drivers and barriers for reducing ECR and how seaport and inland terminals can reduce ECR. The research is focused in a Swedish context, where five Swedish seaports and four inland terminals have been interviewed. The findings have then been compared with existing literature.

The empirical findings have shown that the current role for seaports and inland terminals is primarily to facilitate intermodal transport. Further, several drivers and barriers for reducing ECR were identified, where the most highlighted driver was potential to increase volume and the strongest barrier was lack of visibility. Lastly, even though several strategies were found to reduce ECR, it was found that seaport and inland terminals cannot perform these strategies alone. However, they can facilitate and coordinate these strategies in collaboration with other actors, where the interest and involvement is specific to each respective seaport or inland terminal.

Keywords: empty container repositioning, seaport, inland terminal, intermodal transport, reusing empty containers, empty container management, container ownership, collaboration, container transport chain.

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Sandra Johansson
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Gothenburg, 2022

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1 INTRODUCTION

The following chapter introduces the context of the subject of this report. It further provides a description of the challenges which the thesis intends to highlight. To conclude the chapter, the aim is specified with three central research questions and a description of the limitations for the thesis is presented.

1.1 Background

The world's global trade and economic growth is strongly interconnected, where global trade has dynamically increased since the post war time. The ongoing globalisation and the extension of international division of labour entails an increasing demand for maritime transport (Grossmann et al., 2007). The international maritime trade has had an overall steady annual growth during the last two decades (United Nations Conference on Trade and Development [UNCTAD], 2021) and corresponds to approximately 90% of the world's trade market (Nagurney, 2021).

The increasing trade of goods (SCB, 2021b) creates new challenges for seaports. Seaports operate as logistics platforms and connect maritime and inland transport, meaning that the seaports are an essential part of the supply chain (Carbone & De Martino, 2003). Seaports need to address challenges such as terminal capacity, equipment to handle larger ships, and inland access (Khaslavskaya & Roso, 2020). According to Khaslavskaya and Roso (2020), the overall performance of the seaport is affected by the inland access to where distribution of goods to and from the hinterland is essential. This is supported by Jeevan et al., (2019), who provide a study on the importance of a dry port and the competitiveness of a seaport. Khaslavskaya and Roso (2020) further address this challenge in relation to environmental impact to where a dry port is suggested to have potential benefits.

The increase in maritime transportation and the requirements set on the industry created a need for a large-scale standardised transport solution. Containerization was a solution to this. The standardised container allows for transport across the world, faster loading and unloading at seaports, and promotes intermodal transportation solutions. At this point in time, 60% of all goods are transported by containers (Nagurney, 2021). However, the increased usage of containers also causes empty containers being stored and transported and followingly having both environmental and economic effects on all actors in the container transport supply chain (Song & Dong, 2015). This challenge is in literature referred to as empty container repositioning, or ECR.

The increase in empty containers located at seaports and inland terminals causes congestion at these locations and subsequently increases emissions because of unnecessary movement and handling. The handling, storage and management of empty containers uses the resources of terminals and are therefore a cost derived from inefficiencies (Song & Dong, 2015). According to Song and Dong (2015), the root cause for ECR is natural trade imbalances. This occurs where importing regions have less corresponding export while other regions, which are mainly exporting goods, have less import and followingly have a shortage of containers (Zhang et al., 2018). However, Song and Dong (2015) further state dynamic operations, uncertainties, size and type, visibility, and operation practises as further causes for ECR, all of which have improvement possibilities.

In recent times, there are incentives for addressing the challenges of ECR in the seaports and inland terminals. The port of Los Angeles intends to start with fees to shipping lines if an empty container has stayed at the port for nine days or longer, aiming to unlock space in the port and increase the fluidity (The Maritime Executive, 2021). The port of Shanghai is instead investing in opening an empty container transportation centre that will handle the northeast Asia area (Si, 2021). Journals and literature covering the topic shows that the issue is well discussed. Song and Dong (2015) provide a general discussion of causes and solutions for ECR. Lee and Moon (2020) use a more focused approach where they explore the possibilities of foldable containers to reduce cost caused by ECR when demand is uncertain. Research has also been performed from a forwarder perspective, where Yang et al. (2021) explores asymmetric information and find that information asymmetry impacts the cost of ECR.

In regard to the Swedish maritime context, Hellekant and Rudal (2021) provide the perspective of shipping lines, where they find how ECR is handled in an interrelated and iterative way. They identify potential strategies to reduce ECR, where they further discuss the potential impact of each strategy. The authors also highlight the complexity of ECR. In addition, Karlander and Tegbrant (2021) provide the transport buyers perspective of ECR, including the importer, exporter, and freight forwarder. They have identified drivers, barriers, and activities, and found varying degrees of how, and if, these actors are involved in reducing ECR. The authors highlighted the freight forwarder as an important actor as they have comprehensive knowledge in container transport management and a large client network. As both the perspective of shipping lines and transport buyers has been provided, this report adds the perspective of seaport and inland terminals. By adding this perspective, the overall understanding of how each involved actor affects ECR, and how they are intertwined, is increased.

1.2 Aim

The purpose of this thesis is to provide further understanding of the role seaports and inland terminals can take in reducing ECR.

The first research question intends to form an understanding of the role which seaports and inland terminals have in container management today as well as the most central activities in container management for these two actors.

RQ1. *How does the current role of seaports and inland terminals relate to container management?*

To gain a better understanding of the context surrounding seaports and inland terminals, the second research question aims to answer what drivers and barriers these actors are facing today in relation to ECR.

RQ2. *What are the current drivers and barriers for seaports and inland terminals to reduce ECR?*

While the first and the second research question relates to the current role of seaports and inland terminals in container management as well as current drivers and barriers, the third research question relates to future possibilities for these actors to reduce ECR.

RQ3. *How can seaports and inland terminals contribute to reducing ECR?*

1.3 Limitations

The thesis is geographically limited to analysing seaports and inland terminals located in Sweden. Because of the fewer publications available with this geographical limitation, publications with a global perspective will be used. As Swedish seaports are relatively small, this will be taken in consideration when studying available literature on the subject.

It is further important to note that this thesis is being performed during the ongoing Covid-19 pandemic. Even though the effects of the pandemic are not in focus, it is still important to note that any results could be affected by this.

2 FRAME OF REFERENCE

This chapter contains the frame of reference for this report. It includes topics such as the container transport chain, supply chain collaboration, empty container management and strategies to reduce empty container repositioning.

2.1 The Container Transport Chain

The development within the shipping industry has created the need for a standardised solution to transport goods in an efficient way. The development has resulted in the solution referred to as containerization. This has allowed transport of goods through thousands of inland terminals while utilising different modes of transport (van Ham & Rijsenbrij, 2012). Containerization has facilitated the possibilities for import and export throughout the world, which has increased international economy and trade.

Song and Dong (2015) present a well-used depiction of the container transport chain where the flow of laden and empty containers is included, see Figure 2.1. According to the authors, the main actors involved are the following: shipping lines, port authorities and terminal operators, depot operators, freight forwarders, inland transport operators, consignors, and consignees. To exemplify the flow of containers, the natural point of departure would be at the consignor, as this is where the shipment is initiated. The empty container is provided by a shipping line and is transported from an inland depot or a seaport. The goods can be stuffed in the container at the consignor location, a depot, or the seaport where stuffing at a depot or seaport requires the goods to meet the container. The laden container is transported to the seaport awaiting shipment. When arriving at the destination seaport, the container can be destuffed, or transported to a depot or to the consignee, and followingly be destuffed at these locations. The empty container will be transported to a depot or seaport for preparation to be reused.

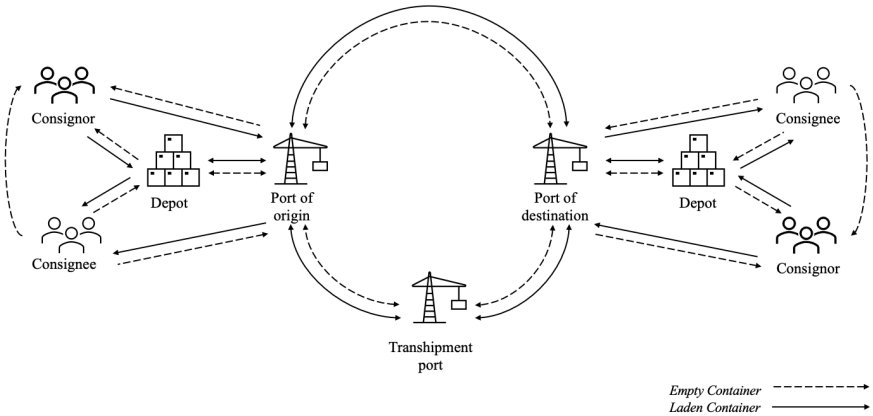

Figure 2.1 - The container transport chain (Song & Dong, 2015)

The container transport chain is characterised by the driver for container movement, i.e., who initiates the movement. The flow can be separated as the laden container flow and the empty container flow, where the latter is not driven by customer demand (Song & Dong, 2015). Followingly, the laden and empty containers use the same resources whereas one is merely causing cost. According to Song and Dong (2015), the cost has become a problem for the container shipping industry, where the cost for ECR has a large effect on the profitability and revenue of shipping lines. The shipping lines as stakeholders are the main actors in the container transport chain as they are the primary container owner and bearer of cost derived from especially ECR (Song & Dong, 2015). This is due to the shipping lines being the actor who operates the shipping routes and consequently also operates their respective container fleet (Song & Dong, 2015), as well as manages empty containers (Ng, 2012). In summary, shipping lines are asset heavy which puts further pressure on their ability to achieve efficient operations (Van den Berg & De Langen, 2015). According to Talley and Ng (2018), the objective of the shipping lines is to minimise logistics cost. In comparison, the objective of the forwarders is to maximise profits while the seaports and inland terminals aim to maximise throughput in the terminals (Talley & Ng, 2018).

2.1.1 Seaports

The economic growth and increased demand for maritime transportation increases the challenges faced by seaports. Crainic et al. (1993) portray the seaports as the main entry and exit point as it is at this stage where international transportation and land transportation meet. Seaports act as nodes and are integrated and a part of the supply chains of others, where the seaport's performance affects the outcome of the consignee (Song & Panayides, 2008). Subsequently, the seaport offering, and performance becomes increasingly important to the competitiveness of the seaport. Song and Panayides (2008) found that the competitiveness of the seaport is largely dependent on the seaport's ability to integrate in the global supply chain. The authors present further considerations such as technological advancements, offered services, relationships with other actors, and intermodal transport offering, all of which affect the competitiveness of the seaport. During the development of containerization, seaports have been forced to increase their ability to handle large vessels and followingly, a large number of containers, which further challenges the operational environment (van Ham & Rijsenbrij, 2012).

The seaport's role in the supply chain is dependent on two main factors: geographical connections and available infrastructure, as well as the performance at the port (Carbone & De Martino, 2003). Followingly, the infrastructure affects the attractiveness of the seaports for all actors or certain supply chains, while the performance of the port influences the customer satisfaction and competitiveness of the port (Carbone & De Martino, 2003). The land responsibilities such as investments, and seaport operations and performance, can be reliant on the same, or a different actor. This distinction can be described through the classification of operational port and landlord port (“Ports Primer: 3.1 Port Operations”, n.d.). The operational seaport is owned and operated by the port authority. The landlord seaport has a port authority,

however, is managed by an external company, the terminal or port operator, where the seaport operations and performance rely upon this actor. Followingly, the specific role of the port authority will depend on the seaport in question. This distinction can also be applied to inland terminals.

2.1.2 Inland Terminals

There is a shift of focus in transport development, where inland solutions have gained more attention. The main reasons for this are a need for intermodal transport solutions, complex freight distribution, and lack of capacity (Notteboom & Rodrigue, 2009). This is supported by Boile et al. (2008) who describes how warehouses and distribution centres are moving more inland since the areas around seaports are both scarce and expensive. Roso (2007) explains how it also is of high importance for seaports to have inland access, where inland intermodal terminals become important nodes in the overall transport chain. Notteboom and Rodrigue (2009) further describe drivers to establish inland terminals, such as reducing congestion and energy consumption.

Roso (2007) presents the concept of dry ports. Dry ports are inland terminals which act as an extended seaport and are more focused on efficiency and improvement than conventional inland terminals. They aim to increase efficiency in container flows and communication. The performance of a seaport is affected by the quality of both the access to the dry port and modal shift. Transportation to and from the seaport should be organised and reliable with high capacity (Roso, 2007). Dry ports have been developed to increase the competitiveness of a seaport by facilitating an increase in service levels, capacities, storage areas and effectiveness in hinterland transport (Lättilä et al., 2013). Jeevan et al. (2019) describes how dry ports are facilitating the connected seaports capacity through handling a growing number of containers from the hinterland. The authors further describe how dry ports are supporting the seaport by handling matters such as late changes in shipping lines, demands for extended space for transhipment containers and more flexibility for overall seaport operations. Consequently, it is of importance to balance the link between the seaport and dry port to enhance the advantages for all included actors, not just for the seaport.

2.2 Supply Chain Collaboration

Supply chain collaboration has increased in popularity as it has the potential to realise benefits which otherwise would not have been achievable. As described by Lambert and Cooper (2000), the success of an organisation is highly affected by its supply network. The authors make the following statement:

> *"individual businesses no longer compete as solely autonomous entities, but rather as supply chains"*
> (Lambert & Cooper, 2000, pp.65)

Companies and organisations leverage other competencies and reach benefits to both, or all parties involved. Such collaboration can be described as either vertical or horizontal collaboration. Figure 2.2 presents these types of collaboration as described by Barratt (2004).

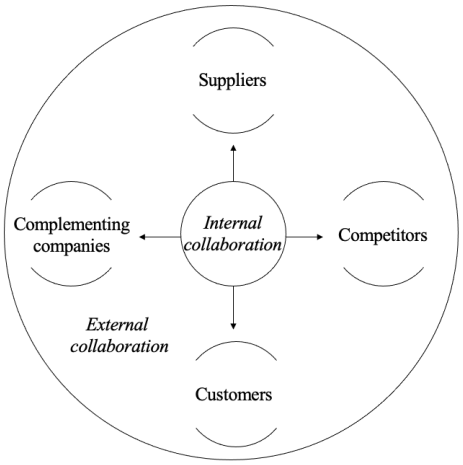

Figure 2.2 - Horizontal and vertical supply chain collaboration as according to Barratt (2004)

2.2.1 Vertical Collaboration

Vertical collaboration is the more common form of collaboration and the essence of supply chain management. Saenz et al. (2015) describes how vertical collaboration is a necessity and ground for providing and creating the links and collaboration which is required to achieve a distribution network. Cruijssen et al. (2007) states that vertical collaboration is described by the term supply chain management and state that:

> *"supply chain management is aimed at installing beneficial partnerships and seamless linkages among multiple parties operating at different levels of the supply chain to avoid unnecessary logistics cost"*
> (Cruijssen et al., 2007, pp.23)

Barratt (2004) described that the type of collaboration can allow companies to coordinate supply and demand through achieving customer relationship management, collaborative demand planning and forecasting as well as supplier and production planning, and collaborative transportation. The author further makes the distinction of internal and external collaboration. Internal collaboration relates to the collaboration between functions within an organisation. External collaboration regards the collaboration between a company and its customers and suppliers, as illustrated in Figure 2.2. For the scope of this thesis, vertical collaboration will refer to the latter, i.e., external collaboration.

2.2.2 Horizontal Collaboration

According to literature, horizontal collaboration is not as common as vertical collaboration, although it has gained interest in recent studies. In the literature review by Cruijssen et al. (2007), horizontal cooperation is explained as:

> *"competing or unrelated companies that share private information, facilities, or resources to reduce costs or improve services"*
> (Cruijssen et al., 2007, p.23)

This entails cooperation between actors such as competitors, or cooperation between actors whose products are complementary to each other (Cruijssen et al., 2007; Barratt, 2004). The authors present three main opportunities which can be achieved by horizontal collaboration. These are cost and productivity, customer service, and market position. According to Cruijssen et al. (2007), such cooperation which results in sharing of resources has the potential for cost savings on account of the higher degree of utilisation, i.e., economies of scale and scope. Collaboration is also argued to reduce investment costs because of sharing resources. Cruijssen et al. (2007) also argues that benefits do not merely relate to direct effect on cost. The authors further describe how collaborating companies with overlapping markets can increase their service offering towards each respective market by virtue of utilising the knowledge and resources of each other. As a result, companies can focus on core competencies and develop these whiles not sacrificing available service offerings towards the customer.

In the paper by Song et al. (2015), current literature and a case study is provided on the topic of horizontal collaboration. However, the authors use the term co-opetition which is described to summarise cooperation and competition. The aim of the paper is to examine the impact the seaport size has on the motivation to enter a co-opetition. The authors found that the size of the seaports did not motivate co-opetition. Rather, it influences the interest to adopt co-opetition. Motivational factors found in the examined cases were relating to service offerings and level of competition, similar to the benefits provided by Cruijssen et al. (2007). According to Cruijssen et al. (2007), horizontal collaboration is common in maritime shipping where shipping lines use conferences where the aim is to gain leverage when negotiating as well as increase service level towards their customers. A further example provided by Erdoğan & Kabadurmuş (2019) and mentioned by Song and Dong (2015), is the sharing of containers when an actor such as a shipping line shares their resource, i.e., containers, with another actor which is not able to supply according to their demand.

2.2.3 Success Factors for Collaboration

In the paper by Barratt (2004), the author provides elements which are important for collaboration. The factor, which is given high importance relates to culture, where it is argued that elements such as trust, openness and communication are vital. To achieve such a culture, the author further argues cross-functional activities, alignment of processes and decision making, and KPIs are necessary. If able to shift from the status quo, it is also important to be able to sustain the change. According to Barratt (2004), this becomes more strategic. Sustaining

the change sets pressure on focus, where commitment both in resources and processes becomes increasingly important. Furthermore, even though technology can be an important aid, it is argued that focusing on this can limit the success of the collaboration as the purpose is shadowed by costly and demanding implementation processes of digital tools.

2.3 Empty Container Management

As the container transport chain describes an overview over the flow of containers, empty container management aims to provide a further detailed description over the flow of empty containers, the function of depots, and the causes for ECR. Kuzmicz and Pesch (2019) provides an example of four flows which take place when the container has become empty at the consignee, see Figure 2.3. Repositioning can take place by road, rail, or sea, where the container is transported from the consignee:

I. back to the seaport awaiting global repositioning

II. back to an owner of the container, such as a shipping line located locally or globally

III. to a depot where the container is stored awaiting future demand

IV. to a consignor where there is current demand, i.e., triangulation or street turn

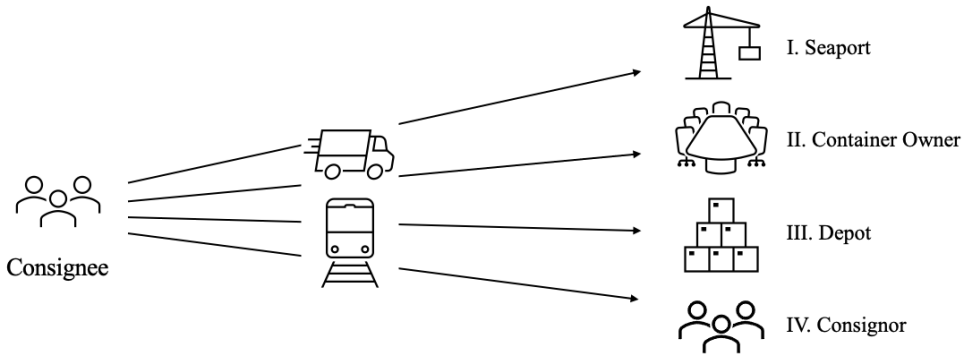

Figure 2.3 - Movement patterns of a container post destuffing

2.3.1 Depots

Crainic et al. (1993) describes how both inland and seaport depots are used to balance the container flows. They are used as a transit area and storing of empty containers. This is supported by Theofanis & Boile (2009) who describe that empty containers are stored in depots while they are waiting for a new assignment. One of the primary causes for storing empty containers for a longer period of time is due to a low demand in export, entailing that seaports have to store empty containers. Usually, shipping lines rent a space for their containers in a depot, where capacity is based on their overall demand (Crainic et al., 1993). Olivo et al. (2015) further adds how shipping companies must also decide the quantity of each container type to store in the depot.

Boile et al. (2008) describes how depots have been developed from a need for more space in the seaport area. The authors mean that this need comes from an expansion of the seaport's operations, including distribution, repackaging, and consolidation. Therefore, in some seaports, the storage of empty containers has been moved to an area close to the terminal. Subsequently, the scarce area at the terminal is made available for other operations, while not compromising the visibility and control for the seaport.

Since the area adjacent to the seaport usually is expensive and scarce, it is not unusual for customers to move their businesses inland. This means longer distances when transporting empty containers between the depots and regional customers, leading to more pollution and costs (Boile et al., 2008). Therefore, there are incentives to move depots inland with shorter distances to import and export customers. An inland depot, just as a seaport depot, is an area for storing empty containers for shipping companies to be able to meet upcoming demand (Olivo et al., 2015). Boile et al (2008) describes how this can lead to saved costs, higher service level towards customers, less fuel consumption and pollution and decreasing congestion in the hinterland. The authors further explain how these potential advantages affect different kinds of actors, such as terminal operators, port authorities and import and export companies.

2.3.2 Empty Container Repositioning, ECR

Empty container logistics is one segment of the total global container logistics, meaning empty containers being moved, stored, and distributed between different actors (Furió et al., 2013). As ECR does not bring revenue such as the laden container do, the shipping companies have interest in reducing the costs attached to the empty containers (Furió et al., 2013). However, reducing ECR is also in the interest of depot operations, since storing empty containers is also a major cost (Olivo et al., 2005). Dong and Song (2009) adds how a more efficient ECR also leads to better utilisation rates of the containers and reduces idle time.

All actors in the maritime supply chain are affected by ECR. The issue becomes increasingly complex when aiming to balance the strive for low cost while meeting customer demand (Ng, 2012). According to Ng (2012), the amount of ECR is growing along with the growth of global trade. The author further describes how the movement of empty containers between different regions has become a complex and expensive problem for all actors in the maritime logistics industry. This is supported by Song and Dong (2015) who further add the sustainability aspects, where reducing ECR would lead to reduced fuel consumption, emissions, and congestion. Moreover, Ng (2012) describes how the movement of empty containers increases congestion in the hinterland. The flow of empty containers is usually more unstable, and erratic compared with the flow of laden containers. This is partly a result of the low prioritisation of empty containers where they are put on vessels just before departure if there is available capacity on board (Ng, 2012; Liang et al., 2021). This further results in storage and repositioning costs when there is not enough capacity for all empty containers (Liang et al., 2021). Table 2.1 presents a summary of the drivers and barriers for reducing ECR which were found in literature.

Table 2.1 - Summary of drivers and barriers for reducing ECR

Drivers		**Barriers**	
Reduced cost	*Furió et al. (2013), Olivo et al. (2005), Ng (2012), Talley & Ng (2018), Van den Berg & De Langen (2015), Song & Dong (2015), Deidda et al. (2008)*	Dynamic operations	*Crainic et al. (1993), Song and Dong (2015), Theofanis & Boile (2009), Kuzmicz & Pesch (2019)*
Reduce excess of empty containers	*Song and Dong (2015), Zhang et al. (2018), Theofanis and Boile (2009)*	Low prioritization of empty containers	*Ng (2012), Liang et al. (2021)*
Increase container utalization	*Dong and Song (2009), Jula et al. (2006)*	Lack of visability	*Gnimpieba et al. (2015), Song and Dong (2015), Garg et al. (2021)*
Increase sustainability	*Chang et al. (2008), Ng (2012), Song & Dong (2015), Jula et al. (2006)*	Mismatch of size and type	*Kuzmicz & Pesch (2019), Song and Dong (2015)*
Better utalization of space	*Boile et al. (2008), Lee & Moon, (2020), Ng (2012), Liang et al. (2021), Jeevan et al. (2019)*	Mismatch in ownership	*Braekers et al. (2011), Jula et al. (2006), Kuzmics and Pesch (2019)*
Better utalization of resources, i.e. labour	*Braekers et al. (2011)*		

2.3.3 Causes for ECR

Song and Dong (2015) present a summary of the causes for ECR: trade imbalance, dynamic operations, uncertainties, size and type, visibility, and operation practises. According to the authors, the main causes are trade imbalance, dynamic operations, and uncertainties. Although these are important factors affecting ECR, as they are dependent on time and space, it follows that they are limited in regard to improvement possibilities. Size and type, visibility, and operation practices have larger improvement possibilities, however, all six factors will followingly be presented.

Trade imbalances means that there is a mismatch between import and export (Song & Dong, 2015). Song and Dong (2015) state that there has been a rapid economic growth in China during the last three decades, where the container traffic both to and from China has increased. Additionally, the growth of China's exports has led to trade imbalances to Europe and North America, respectively. This means that Asian seaports have been lacking empty containers while European and American seaports have experienced an excess in empty containers. Focusing on Swedish development, it is apparent that the value of export is higher than import (SCB, 2021a). According to SCB (2021a), the Swedish exporting of goods and services is reliant on the world economy, meaning that if other countries' economies are decreasing, the demand for Swedish goods and services will do the same. The economy of European countries is particularly important since it is these countries who are importing Swedish goods and services (SCB, 2021a).

Dynamic operations are described as the characteristic caused by the geographical dependency of transport (Song & Dong, 2015). This entails long transit times which causes lead times of weeks or even months. Ultimately, it is caused by the trade imbalances, which further causes the need for repositioning empty containers. Song and Dong (2015) further describe how the changing imbalance of empty containers further adds to the dynamic environment. This causes the operations to change and therefore requires adaptability. The authors further describe how the factors of time, space and volume hinders the ability to match the supply and demand of empty containers. Followingly, there is a need to make the repositioning of containers in

advance to the locations where they are both expected and forecasted (Crainic et al., 1993). In the study by Crainic et al. (1993), the authors present a general modelling framework and a mathematical formulation for planning in this type of environment. Followingly, the characteristic related to the ECR issue limits the options to where the use of one single model is not possible. The authors emphasise the importance and need of planning at several levels such as at the strategic, tactical, and operational level. Theofanis and Boile (2009) further adds that the dynamic nature of ECR increases the complexity for shipping lines as it is their responsibility and cost. Followingly, it is the shipping lines who make the strategic decisions of how to cope with imbalances caused by import and export dominant regions. Table 2.2 presents the strategic alternatives presented by Theofanis and Boile (2009), of how to cope with the imbalances.

Table 2.2 - Strategic alternatives for shipping lines

Import dominant	**Export dominant**
Reposition form export dominant region	Reposition from import dominant region
Coordinate needs with other shipping line	Coordinate needs with other shipping line
Off-hire	Lease
Depot	Purchase
Sell	

The need for placing containers based on need and forecast further depicts the uncertainties. Uncertainties in forecasting increases the risk of unnecessary repositioning (Crainic et al., 1993). Forecasting needs to take potential customer demand into account and is referred to by Song and Dong (2015) as "*the interface with external environment*" and has a more fundamental effect. Even though the customer is known, the day of pick-up of the container is usually not, causing further uncertainties to when the container is needed. Additionally, the authors describe the uncertainties as derived from daily operations such as equipment failure, labour issues, seaport congestion or bad weather. All these factors can cause delays in the flow. As a result, the delays increase the need for repositioning of containers if they are at risk of not arriving to ensure service towards the customer. The unique context of the shipping industry further makes the flow vulnerable to economic and political status, where this can prohibit the import and export processes from functioning (Song & Dong, 2015). The recent study by Yang et al. (2021) provides a discussion relating to the asymmetric information which closely relates to the factor of uncertainty. They find that the degree of asymmetric information affects the cost of ECR as well as that there is a willingness to pay for information to reduce the uncertainty.

Another cause of ECR is the variation in size and type of containers since containers are designed for different purposes and requirements of goods. Different purposes refer to different utilisation of containers, for example general dry cargo or more distinctive uses which require refrigerated or hazmat containers (Chang et al., 2008). Vidović et al. (2011) describes the several sizes of containers which are determined by the International Standards Organisation (ISO). These are classified in different groups, such as 10ft, 20ft, 40ft, 45ft etc., where the 20ft

and 40ft containers are the most used in a global context. The categorising of containers by ISO is based on Twenty-foot Equivalent Units (TEU), aiming to enhance comparison between different container systems (Chang et al., 2008). Song and Dong (2015) mention how 20 ft containers are usually used for goods with high volumetric mass density whereas 40ft containers are used for goods with low volumetric mass density. Therefore, the scarcity of empty containers is a result of mismatches of size or type (Song & Dong, 2015).

Lack of visibility entails the inability of tracking and knowing where each specific container is located (Song & Dong, 2015). Not knowing the exact location of each container limits the ability for actors to manage their container fleet and followingly increases ECR. The authors refer to this as blind spots, which describes how the lack of visibility occurs between certain nodes. Development in technology has increased the opportunities which increases the interest in this possibility. RFID tags are used to track goods and cargo through recording when passed through a certain point. However, researchers are exploring the applicability of combining this technology to GPS (Global Positioning System) and IoT (Internet of Things) with the aim of improving track and trace opportunities and utilise the benefits of such technological development (He et al., 2009; Gnimpieba et al., 2015; Garg et al., 2021).

2.4 Strategies for Reducing ECR

Reduced ECR can be achieved through internal and external strategies. Internal approaches entail within the business, whereas external approaches can be achieved both through vertical or horizontal collaboration (Song & Dong, 2015). In the academic literature there are examples of both internal and external strategies for making container management more efficient. Vertical and horizontal collaboration is described in section 2.2 Supply Chain Collaboration. Digitalisation is presented as both an internal and external strategy. Strategies for reducing empty containers is primarily presented as an external strategy, although can be facilitated internally. Both digitalisation and reusing of empty containers are presented below.

2.4.1 Digitalisation in the Container Transport Chain

As supply chains become increasingly complex, the pressure on efficient systems increases. This sets further requirements on the ability to view, handle and transfer information in organisations as well as between actor boundaries. Digitalisation as a strategy to reduce ECR could be, as described, implemented both internally and externally, where the comprehensiveness of such solutions could be what differentiates the two. Followingly, requirements on digital systems, track and trace, automation and blockchain are presented below.

Stefansson and Lumsden (2009) describe how systems need to interact with technology in infrastructure to achieve dynamic transportation solutions. In this, seaports and inland terminals are important functions. The authors describe how interaction between systems and infrastructural technology requires sensors, cameras, and databases to position vehicles, and in extension, also track goods. The authors further argue that this has potential to increase

efficiency in transport and resource utilisation and reduce vulnerability of supply chains as the ability to detect and react to disturbances can be increased.

Track and trace does not merely increase visibility and traceability of goods but can also increase the efficiency of container fleet handling. The advent within track and trace is derived from the development of IoT, where the ability to store, transfer and share data is the main facilitator (Gnimpieba et al., 2015). In the paper by Gnimpieba et al. (2015), a cloud-based platform for real time geopositioning of goods is presented, i.e., a type of track and trace system. According to the authors, the use of such a platform could support the complexity of a supply chain through assisting the coordination through allowing all actors to access the location of the goods or the container. Based on this reasoning, this could allow actors to make decisions relating to ECR in real time, which could reduce the degree of guessing when making operational decisions relating to empty container supply and demand. Garg et al. (2021) argues that although the solutions using GPS and RFID provide easy monitoring solutions, they are in general complex and slow. Additionally, most systems do not allow monitoring across actor's boundaries, i.e., do not allow complete supply chain monitoring and only allows each actor to monitor their own shipment. This is due to the development of such systems being done with the of benefiting one sole actor or entity (Garg et al., 2021). However, Garg et al. (2021) does agree with Gnimpieba et al. (2015) in that there are both operational and strategic benefits in these types of systems. The ability of making data driven decisions could increase utilisation and productivity of resources.

Literature relating to digitalisation and maritime shipping primarily relates to track and trace initiatives. However, the European Commission (2019) has addressed the topic where they have produced action plans including seaports. It is stated in the report that automation systems are expected to be implemented into the market where they cover real-time monitoring as well as automation of operations such as docking. The European Commission's (2019) motivation for automated and connected solutions relates to safety, sustainability, and an increased efficiency of transport solutions.

Gathering and using data naturally opens the aspect of how to share and make use of the data gathered by others. Blockchain is argued by Garg et al. (2021) to provide a trustworthy service which makes it possible to share information across actor boundaries without sacrificing the security of each actor's data. Furthermore, the authors argue that it is the fourth party logistics provider (4PL) who should be the enabler for such a system as it can be used as their primary interface and resource to serve their customers, i.e., actors in the distribution network. However, as argued by Pu and Lam (2020), it is critical that blockchain is used by the majority, as it is ineffectual otherwise. It is also argued that to reduce paperwork, share information and automate processes, it is necessary that blockchain is integrated in seaports systems which requires educating these actors. Philipp (2020) describes how small seaports have little to no knowledge about these types of advanced digital solutions and followingly are not ready to realise the benefits of blockchain. However, to achieve a more secure, optimised, and sustainable transport chain, it is necessary that even smaller seaports are developed in these aspects (Philipp, 2020).

2.4.2 Reusing of Empty Containers

Jula et al. (2006) describes how reusing empty containers has a major impact of reducing the amount and cost of transportation. The authors mean that the imported empty containers can be reused directly for export without being transported to the seaport or inland terminal in between, aiming to reduce congestion in the areas surrounding the seaport terminals. Even though reusing empty containers is valued by all involved actors, it is also accompanied by challenges. These challenges consist of operational issues, such as mismatching in import and export, location, ownership, and container type. To achieve reusing empty containers in an efficient and reliable way, these issues need to be addressed first. The authors state that reusing empty containers consist of two optimisation concepts: street turns and depot direct, which will followingly be described.

2.4.2.1 Street turns

Street turn is also referred to as match back or triangulation. The concept, described by Jula et al. (2006), refers to when an empty container is moved directly from the consignee to the consignor without being transported to a seaport or inland terminal in between. Figure 2.4 illustrates the two ways street turns can be achieved where a) illustrates the flow where a seaport is used and b) illustrates a container flow using an inland terminal. This entails that movement of empty containers is reduced, since the container is not transported back and forth to the terminals (Jula et al., 2006). Street turns are also used as a strategy that allows shipping lines to save operation costs (Deidda et al., 2008). Braekers et al. (2011) further adds that when container responsibility is transferred between actors, the associated paperwork is decreased as a result.

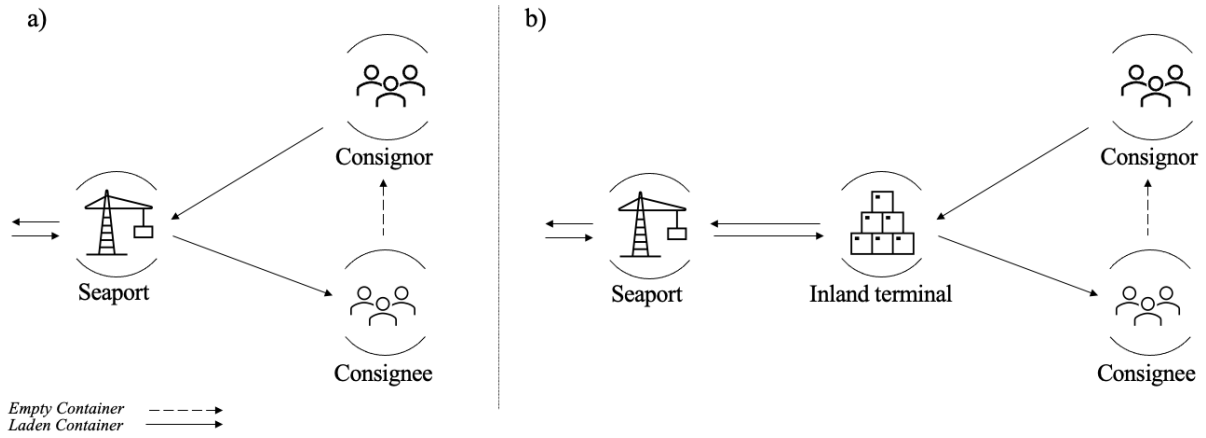

Figure 2.4 - Street turn with and without inland terminal or depot as described by Braekers et al. (2011)

Planning the routes is time-consuming, since it requires aligning the routes over a large area and if last-minute changes appear, the original plan becomes unusable (Deidda et al., 2008). Kuzmicz and Pesch (2019) explains how digital systems can be used as a tool to match container demand and supply. The system requires up-to-date information about the containers

and can be helpful when planning the routes of containers. The authors also describe barriers, such as mismatches in container type, time, and space. Braekers et al. (2011) further adds how container ownership plays a role. However, when street turns are achieved, it leads to advantages such as decreased traffic congestion, noise, and emissions (Jula et al., 2006).

2.4.2.2 Depot direct

Erdoğan and Kabadurmuş (2019) refers to depot direct as creating a point of supply of empty containers. Erdoğan and Kabadurmuş (2019) describes how it does not have the same limitations of time and space as street turns, as the containers are available when needed. However, depot direct does not have the positive impact on cost as street turns. The authors further highlight other positive outcomes of depot direct, such as reduced congestion and increased buffer capacity in the terminals. This is supported by Jula et al. (2006), who further adds how it enables drop-off and pick-up of empty containers outside opening hours of the terminal or when it is congested.

Olivo et al. (2015) describe how inland depots usually require lower storage payment than seaport depots, which is described to increase the incentive for shipping lines to utilise inland depots. The authors further describe how empty containers are transported from an import customer to the inland depot, then further transported to an export customer. Typically, the number of empty containers moved from import customers to export customers differs. In consequence, some depots are storing an excessive number of empty containers while other depots are experiencing a deficit. Therefore, there is a need for inland ECR to assure there is an adequate number of empty containers in the inland depots while reducing empty container operations and associated costs (Olivo et al., 2015). Due to the high competitiveness of the market, unfulfilled demand for empty containers is supplied by competing inland depots, which creates the need for storing enough (Olivo et al., 2015).

Olivo et al. (2015) further explains that even though there is a close link between inland and seaport repositioning, it is approached by separate divisions in shipping lines. These divisions are usually working independently when optimising empty container movements. Often, the optimal alternative for the seaport is suboptimal for the inland terminal and vice versa (Olivo et al., 2015). Olivo et al. (2015) uses the example of how the maritime divisions aim to comprehensively move empty containers from import heavy inland regions to the seaport, while the inland divisions aim to save an amount of the empty containers inland to supply for future export.

2.4.3 Container Type

Kuzmicz and Pesch (2019) describes container substitution as a further strategy to reduce ECR. The authors exemplify this by explaining how instead of using two 20-ft containers, one single 40-ft container could be used for the same demand when not limited by volume or weight restrictions. Chang et al. (2008) explains how the number of empty container trips to and from terminals is decreased significantly when utilising substitution of empty containers. Therefore, empty travelling cost for shipping companies is decreased when utilisation of container

substitutions is increased. The authors further add how this leads to decreased congestion, noise and emissions. However, Kuzmics and Pesch (2019) describes how this strategy can be limited by the content in contracts between container owners and container users. The contracts can include topics such as damaged containers, insurance, responsibility, and time constraints of returning containers.

Foldable containers are also presented by Kuzmicz and Pesch (2019) as a strategy to reduce ECR. The use of foldable containers is a way to reduce the physical space required when storing and transporting empty containers. Whether the standard container is laden or not, does not affect the physical space needed and therefore, as stated by Erdoğan & Kabadurmuş (2019), the empty container is as costly to transport as the loaded container. The space required by the foldable container can be reduced by 75% (Erdoğan & Kabadurmuş, 2019), which reduces the required space at seaports, inland terminals and on ships significantly (Lee & Moon, 2020; Ng, 2012; Liang et al., 2021).

Even though foldable containers bring significant physical benefits, they can be costly. Erdoğan & Kabadurmuş (2019) describes the vulnerability of this type of container and the added cost related to maintenance, production and purchasing. Furthermore, Lee and Moon (2020) add the operational cost derived from the need of folding and unfolding the container. The authors argue the importance of this cost relating to the effect it might have on the widespread adoption of the container type. In the study by Erdoğan & Kabadurmuş (2019), the authors present that leasing foldable containers is preferred when the aim is to reduce the total cost of ECR. When this is not an option, it is more profitable to purchase standard containers. In the even more recent study by Liang et al. (2021), the authors present how the profitability of foldable containers relates to the potential increase in shipping demand. Followingly, the authors present a stepwise increase in shipping demand and the corresponding profitability of foldable containers. In the study, it is assumed that foldable containers are folded and stored at the seaport. Further, Lee and Moon (2020) present that the related cost of foldable containers have high importance and effect on the profitability of adoption. However, Liang et al. (2021) state that the implementation of foldable containers can reduce the total cost of ECR and in addition, can reduce the uncertainty related to ECR.

3. METHODOLOGY

The following chapter presents how this thesis was performed. It includes a description of how data was collected and a planned schedule of the different steps throughout the process.

3.1 Research design

This thesis is following an overall abductive research approach. An abductive approach is described by Dubois and Gadde (2002) to be an integrated approach, meaning that empirical observations and theory are intertwined. According to the authors, this approach enables a broader understanding of both theory and empirical findings. They further explain how both theory and empirical observations are linked, where one cannot be understood without the other. See Figure 3.1 for a more detailed description of the research process of this thesis.

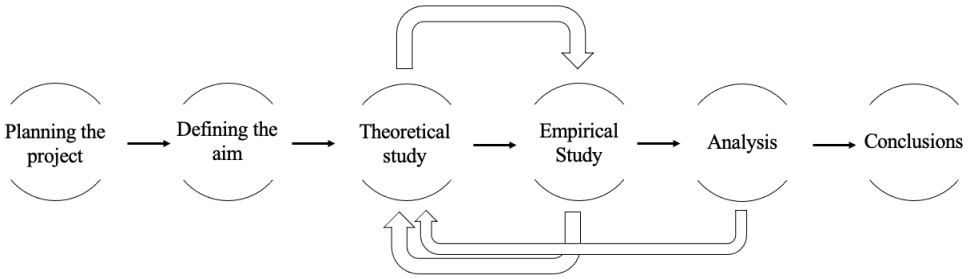

Figure 3.1 - A depiction of the research design for the thesis, illustrating the 'back and forth' method presented by Dubois and Gadde (2002)

3.2 Preparation

To set the scope for the thesis, a planning rapport was conducted. The planning report included a brief introduction and background, which facilitated deciding the preliminary aim, research questions and limitations of the report. This further acted as a guide for the rest of the content during the actual report. The layout of how to continue the process was also set at this stage, where a timetable was performed, including internal and external deadlines for the different stages/phases during the thesis.

3.3 Data collection

The data has been collected with a qualitative focus as described by Creswell (2014). This encompasses how questions and procedures develop over time. Merriam and Tisdell (2015) describes it as inquiring the topic in a systematic way. The authors further emphasise how qualitative research focuses on understanding how experiences can be interpreted, such as how people with their own words explain their experiences. This is further supported by Teherani

et al. (2015) who exemplifies how qualitative research emphasises how organisations operate or how interactions affect relationships. Furthermore, a qualitative focus limits the research of the specific subject while maintaining a comprehensive and holistic approach (Rutberg & Bouikidis, 2018)

3.3.1 Literature study

The frame of reference has been conducted through a literature study. The primary sources were business journals, and scientific articles collected through Chalmers library, Google Scholar and Science Direct between January and May of 2022. The keywords to find relevant sources are the following: empty container repositioning, reusing empty containers, street turns, depot direct, empty container management, collaboration, container transport chain, and combinations of these keywords. The frame of reference was initially used as a foundation to develop the interview questions. The theoretical findings further facilitated an understanding of the empirical findings. In addition, the theoretical findings were used during analysis of the empirical findings where similarities and exceptions could be identified.

3.3.2 Interviews

The interviews were performed in a semi structured manner, which is described by Merriam and Tisdell (2015) to enable the interviewees to respond more freely to the questions. It further allows for new questions building on the answers of the interviewee and their experiences and perceptions.

A template containing broader interview questions was prepared, with the ambition to meet the aim of this report. The interview questions were formulated in a general way and covered different aspects of each research question, see Appendix I. The questions were adjusted according to both the role of the interviewee, but also to the type of actor where the interviewee belonged. Therefore, all questions in Appendix I was not asked to all interviewees.

The interviewees were contacted through email in the beginning of the thesis and the interviews were conducted between the 4th and 24th of March 2022. As it was requested by some interviewees, the main topics for the interview were shared with the interviewees three days prior to the interview to allow for some and equal preparation. All interviews were performed remotely through the digital platform Teams, due to Covid-19 restrictions and long distances, and lasted for approximately 1 hour, respectively. They were performed by the authors of this report, where one asked the questions and the other transcribed the answers in real time due to not recording the interviews. The aim of not recording the interviews was for the interviewees to speak more freely, as recording the interviews could entail a risk of more restricted answers.

3.3.3 Selection of Interviewees

The thesis is limited to a Swedish context, where all interviewees are placed at different locations in Sweden. The aim has been to gather data from terminals placed in north (3 terminals) and south (6 terminals) of Sweden and to include a mix of both bigger and smaller terminals to gain a broader perspective. Interviews were held with inland terminals authorities,

inland terminal operators, seaport terminal operators, and seaport authorities. A compilation of the interviews can be found in Table 3.1 and Table 3.2 respectively.

Table 3.1 - Case description of the interviewed seaport

Case	Data collection	Container handling	Import/Export	Description
Seaport - Sp A	Interview with a Sales Executive on March 8th, 2022	High	Balanced	Bulk cargo, general cargo, RoRo-traffic
Seaport - Sp B	Interview with a Market Director on March 11th, 2022	Low	Balanced	Bulk cargo, general cargo, RoRo-traffic
Seaport - Sp C	Interview with a Senior Manager Market Development on March 14th, 2022 Interview with a Market Analyst on March 16th, 2022	High	Balanced	Bulk cargo, general cargo, RoRo-traffic
Seaport - Sp D	Interview with a Marketing and Sales Officer on March 18th, 2022	Low	Primarily import	Bulk cargo, general cargo, RoRo-traffic
Seaport - Sp E	Interview with the Head of Forwarding on March 22nd, 2022	Low	Primarily export	Bulk cargo, general cargo, RoRo-traffic *The actor also operates as a shipping line and goods owner.
				High > 100 000 TEU/år *Low* < 100 000 TEU/år

Table 3.2 - Case description of the interviewed inland terminals

Case	Data collection	Container handling	Import/Export	Description
Inland Terminal - IT A	Interview with a Project Coordinator on March 4th, 2022	Low	Primarily export	Does not classify as a dry port
Inland Terminal - IT B	Interview with a Logistics Development Manager on March 8th, 2022	Low	Primarily import	Classifies as a dry port
Inland Terminal - IT C	Interview with a Market Strategist on March 14th, 2022	N/A*	N/A*	Does not classify as a dry port.
Inland Terminal - IT D	Interview with a Department Manager on March 24th, 2022	Low	Primarily export	Does not classify as a dry port *The actor also operates as a transport operator
** No current container traffic*				*High* > 100 000 TEU/år *Low* < 100 000 TEU/år

3.4 Analysis

The analysis was initiated as the transcription process was commenced. The transcription of the interviews was performed by one of the authors while, as stated, the other held the interview. Following each of the ten interviews, a thorough review of the transcription was performed. This was done to revise the data and make any additions where data had been missed or was incomplete. In addition, some statements were supplemented by the context in which they were made to make correct judgement of the data if reading the transcript after

some time. This could be quick side notes or vocal emphasis made by the interviewee, alternatively, key words which statements aimed to reference back to.

During the time the interview rounds were conducted, the 'back and forth' method described by Dubois and Gadde (2002) was realised. This entailed discussing the empirical findings, supplementing with further readings based on the empirical findings, followed by revisiting the interview template. This resulted in adjustments to the template to explore different findings as well as abandoned initial hypotheses. This included a focus on specific operations in the terminals such as how lifts are initiated, as the initial hypothesis related to internal ways to reduce ECR. However, as it was found that handling is minimised already, focus shifted to how the actors can contribute to reducing ECR. As stated, this shift resulted in corresponding changes in the interview template.

The gathered data was also organised with a three-stage approach with the use of excel where each stage corresponds to its own set of excel sheets. In all stages the data was separated based on actor type, i.e., seaport or inland terminal, as well as interviewee. The first stage contained the first sorting of data which was based on the relevance to each research question. In the second stage, additional sheets were created, and the second sorting was performed. This filtered and categorised the data based on common topics such as ECR drivers, ECR barriers, triangulation, track and trace, and objective. This filtering of data was used to perform the third stage of the analysis. These sheets contained one research question each, where the gathered data was analysed to find key similarities and differences. This was used to create tables such as the tables presented in the empirical findings and analysis of the report. As the interview rounds were completed, analysis of the gathered data was done in a further holistic approach where it was compared to the theoretical findings. This facilitated a comparative process where the seaports and inland terminal's role was compared with the drivers and barriers for reducing ECR. This could be analysed in relation to identified strategies.

3.5 Research Quality

Abowits and Toole (2010) describes the importance of measuring validity and reliability. This is supported by Merriam and Tisdell (2015), who adds that this is needed for the report to be trustworthy and credible. Therefore, these aspects needed to be considered throughout the process.

Validity is described by Merriam and Tisdell (2015) to ensure that results are correct and match reality. If this is not the case, this is an indicator that there is a systematic error in the measuring of data, which affects the results (Abowits & Toole, 2010). Merriam and Tisdell (2015) describes several methods to ensure validity, where triangulation was one of them. Triangulation means that multiple ways of gathering data are used to be able to compare and cross-check the findings from each source. For this thesis, the data is collected from interviews, academic literature, and organisational documents such as yearly reports. These were compared with each other during the process. As several interviews were performed in each respective actor group, i.e., seaport and inland terminal, the validity of the results is increased as it ensures

comparison of the results. Additionally, for each topic in theoretical findings, several academic reports were used as sources to further ensure validity.

According to Merriam and Tisdell (2015), reliability refers to how well the results can be replicated if the study would repeat itself. The authors describe a dilemma of reliability in research design as this assumes that there is one objective reality. Therefore, performing an exact same study twice should provide the same results. The authors further describe how this is not applicable to qualitative research, as it aims to provide description and information about the world as it is experienced. This could include different experiences of the same event, which followingly, makes achieving the exact result challenging (Merriam & Tisdell, 2015). Therefore, it is highlighted by Merriam and Tisdell (2015) to rather seek consistency of the result based on the gathered data. The authors further provide different methods to ensure reliability, where triangulation is one. Triangulation has been considered throughout the report, as described, and is therefore considered to be applicable for the reliability of this thesis.

4 EMPIRICAL FINDINGS AND ANALYSIS

The following chapter presents the empirical findings. Initially, the role of seaports and inland terminals in a physical and managerial perspective is presented. Thereafter, the drivers and barriers for reducing ECR are presented. Lastly, the current and potential strategies found to reduce ECR are presented. Throughout the chapter, the findings are analysed and contrasted to earlier literature.

4.1 The Role and Central Activities

The description of the physical container flow through the seaports and inland terminals, as well as these actors' role in this flow, provides an understanding of how these actors relate to ECR. In addition, central activities, i.e., depots, stuffing and destuffing, are also described as it adds insight into how seaports and inland terminals manage containers.

4.1.1 The Seaport Container Flow

All interviewed seaports presented a similar description of actors involved in the container flow. Ultimately, it included shipping lines, forwarders, railway operators and owners of the goods, similar to what is described by Song and Dong (2015). Seaports have a preliminary list of which shipping lines and what ships are expected and planned to arrive at the seaport. However, as there are uncertainties in the exact arrival date and content of the vessel, the seaports are notified by the shipping lines, including expected arrival and content, when the ships are approaching the seaport. One day prior to arrival the seaports receive more detailed information. This information is used by the seaports through planning how to receive the vessel. It also gives the seaports the information of what exact container is planned to be lifted on or off the vessel. When the container has been docked, the seaport knows where each container should be moved based on whether the container is laden or empty. In general, the seaport is informed about pickup by the actor which is picking up the container. Four flows have been identified when the container arrives at the seaport. The flows are illustrated in Figure 4.1 and a more detailed description of each flow is followingly described.

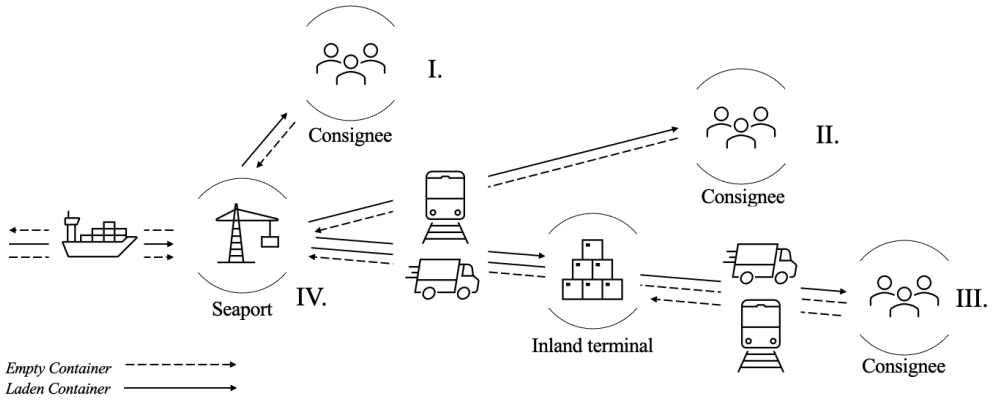

Figure 4.1 - Visual depiction of the most common import container flows through a seaport

I. When importing and exporting companies are located adjacent to the seaports, the container transport chain is relatively short. The laden container is initially placed in a yard and then transported directly from the seaport to the consignee where it is destuffed. Thereafter, the container is typically transported back to the seaport.

When importing and exporting companies are located inland, the container can be transported directly to the customer or using an inland terminal.

II. When transported directly, the laden container can be destuffed in the seaport, allowing the goods to be transported without the use of the container. If not, the laden container is picked up by a truck or train. This is determined ahead of time and in accordance with the request of the consignor and consignee. A general rule of thumb is that trucks are used for goods transported within 15 miles.

III. The laden container can also be transported to an inland terminal. It is then initially placed in the yard awaiting pickup by a forwarder. After being transported to the inland terminal, the laden container can be destuffed or change mode of transport.

IV. When shipping lines reposition containers in response to imbalances in import and export flows, the seaports receive empty containers. The empty containers are either placed in the depot at the seaport or transported further and stored in a depot located inland.

The seaports expressed that they manage the container while it is within the boundaries of the seaport and are not involved in the movements of the container when it has passed through the gates. According to all seaports, the export flow is similar to the import flow but in the opposite direction.

4.1.2 The Role of Seaports

All respondents agreed that seaports act as nodes in the supply chain, where the purpose is to facilitate transport for their customers, i.e., owners of the goods or the shipping lines. This is achieved through facilitating intermodal solutions, offering depot and handling container operations such as stuffing and destuffing. This goes in line with Song and Panayides (2008), who described how seaports act as nodes in the supply chain. One seaport (Sp E) also offered more comprehensive logistics solutions for their customers as their role is more comprehensive, where they also act as a shipping line.

When asked about who they see as their customer, a common answer among all respondents was the owner of the goods. Additionally, shipping lines are seen as a customer by all respondents apart from one seaport (Sp B) who strictly focused on the owner of the goods. In fact, two of the seaports (Sp C, E) see the shipping lines as partners. Another actor, with whom all respondents emphasised an important relationship was the railway operator. The relationship between seaport and railway operators was described as cooperative. The reason for this was that they can bring volume to each other. There was one exception to this (Sp E), who viewed the railway operator as a supplier.

As it is evident that the primary role of a seaport is to facilitate intermodal transport solutions, their role relating to containers can be seen as quite limited. In contrast to Song and Panayides (2008), who emphasise how competitiveness is affected by the seaport's ability to integrate in the supply chain, it is understood that seaports only manage containers while they are within the limits of the seaport. Following the logic provided by these authors, it should be in the interest of seaports to integrate their operations further in the supply chain to increase their competitiveness in the industry.

It is also apparent that the primary focus within the seaport is to move the containers as little as possible, and followingly, only lift the containers as requested by the shipping line, forwarder, or the consignor and consignee. This is in line with the objectives presented by Talley and Ng (2018), i.e., seaports aim to maximise throughput and shipping lines aim to minimise cost. In addition, the factor presented by Song and Dong (2015), i.e., shipping lines carry the cost of ECR, further limits the interest and role of seaports as efficient container management outside of the seaport does not affect their income.

4.1.3 The Inland Terminal Container Flow

The physical container flow through the inland terminals was more dependent on the specific inland terminal. Except for the largest flows, it was expressed that the inland terminals do not know who the content of the container belongs to, nor are they interested. However, they do know what the container contains such that a decision of where the container should be placed can be made. This includes if the container is empty, weight and type of goods, i.e., hazardous, or not. Figure 4.2 illustrates four identified flows with a more detailed description below.

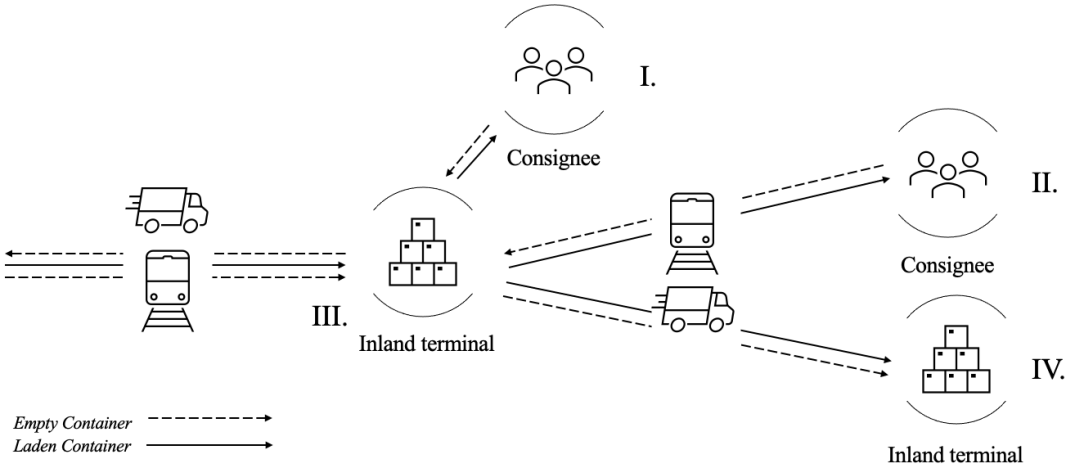

Figure 4.2 - Visual depiction of the most common container flows through an inland terminal

I. In this flow, the owner of goods is located adjacent to the inland terminal. Therefore, the container is destuffed in, or adjacent to, the inland terminal. As a result, the container transport chain is shorter. The operator has a more comprehensive dialogue with the owner of the goods rather than a forwarder.

II. In this flow, the container arrives at the location and is lifted and handled at the request of the consignor and consignee. The inland terminal receives the information of the actor providing or collecting the container, including what exact container should be lifted on or off the vehicle, i.e., truck or train. When the container is destuffed at the inland terminal, the container is placed in the depot or picked up by the train operator or haulage company, at the request of a forwarder.

III. The container can also arrive at the inland terminal as empty. In this case, the container is either relocated to the inland terminal and placed in a depot or be stuffed directly and await further transport.

IV. A container can also require relocating a longer distance and followingly require relocation to another inland terminal. In this case, the container could be placed in a depot, change mode of transport, stuff or destuff at the other inland terminal.

When the container has left the premises of the inland terminal, the remaining part of the container transport chain is unknown. This implies that the inland terminal only has information about the container transport chain until the container reaches the inland terminal and not when it has left. One interviewee (IT B) described how the transport of goods is predominantly arranged by a forwarder who organises the transport to and from the inland terminal. This includes booking of railway operators and shipping lines. The primary function regarding the physical flow is described to be to change the mode of transport, i.e., lift containers on and off trains. No interviewee made a significant difference in the import and export flow.

4.1.4 The Role of Inland Terminals

The view of an inland terminal role varied among the interviewees. The interviewed inland terminals' primary purpose is to facilitate intermodal transport. What differentiates the inland terminals the most is to what extent they provide storage and offer services such as stuffing and destuffing containers as well as the support they offer surrounding actors. The role they take could be described as a supporting node in the supply chain, similar to the description by Roso (2007). One interviewee (IT B) further explained how they have taken on a broader role than merely being a node and are active in future developments and initiatives such as creating new logistics solutions. This could be an effect from being a dry port, such as described by Roso (2007), where they have a further focus on efficiency and improvements in the container flows. Another interviewee (IT C) further expressed how it is of high importance for them to provide competitive neutrality towards all actors, meaning that the aim is to not favour any actors to maintain a broad customer base. In contrast to the other interviewed inland terminals, this interviewee highlighted that they do not strive to engage too much in other actors' business. Rather, they aim to ensure a well-functioning flow in the terminal. This shows the varying degree of involvement with other actors in their container flows, and as expected based on the description of dry ports by Roso (2007), the dry port is more engaged.

The inland terminals interviewed had similar relationships as the ones found at the seaports. A difference is their distance to shipping lines, as inland terminals primarily communicate with forwarders and railway operators, and the owner of the goods. It was emphasised that the relationship between inland terminal and railway is highly valued, as volume is supplied by this actor. The argument made by Carbone and De Martino (2003) that geographical connectivity is important in the role of the seaport, could also be applied to the inland terminal. The railway network either makes the inland terminal accessible or not. This in turn, is crucial in the connectivity of the seaport as it determines transport and accessibility inland. Without the availability of well-suited railway solutions, the inland terminal loses value in the container transport chain. In addition, it was expressed that there is a trend for shipping lines to step into the role of forwarders, which results in a relationship between the shipping line and inland terminal.

As for the seaports, the inland terminals' role in relation to container movements can be interpreted as limited. Similar to the seaports, they aim to move the containers as little as possible and followingly perform lifts based on orders received by the actor who is picking up the container, i.e., haulier or railway operator. As they cannot see the container transport chain once it has left the terminal, the ability to affect ECR outside its gates also appears to be limited.

4.1.5 Central Activities in the Terminals

Central activities which have important purposes relating to container management in seaport and inland terminals are the operations of the depot and stuffing and destuffing of the containers. These activities are further described below.

Similar to Crainic et al. (1993), the depot is described by the interviewees as empty container storage and a transit area, but also to provide a buffer and to support fluctuations in demand. The depot availability is dependent on the specific terminal. The land available for depot operations is first and foremost determined by seaport or inland terminal authorities. How to utilise the land and how to divide the capacity between shipping lines is determined by the terminal operator. Although, for some terminals, the authority and the operator are the same actor. One seaport (Sp C) expressed how the capacity available for each shipping line is determined by the volume each shipping line transports over dock. This is in line with Crainic et al. (1993) who describes the link between shipping lines demand and available capacity in a depot. One seaport (Sp D) expressed that they have not yet reached their limits in terms of depot capacity and therefore do not have the need to restrict the shipping lines and the number of empty containers they store at the seaport.

Most interviewees, both seaport and inland terminal, pick the container from the depot according to first in first out, FIFO. For one seaport (Sp A) it is related to the rate set up between the terminal operator and the shipping line where the empty containers have a restriction based on the number of days they are standing still in the seaport. Other seaports restrict the shipping lines based on volume and followingly do not drive movement to the same extent. However, it was made clear by the interviewees that the quality of containers deteriorates over time. Therefore, this is a driver for the terminal operators and shipping lines to move the containers and not keep them for an excessive amount of time.

All interviewees, both seaport and inland terminals, agreed that stuffing and destuffing are highly important service offerings to have available towards the customer. Most seaports highlighted that they do not have a preference where in the supply chain these service offerings take place, meaning that it is rather a decision in the hands of the consignee or consignor. Inland terminals explained how the stuffing and destuffing of containers is an important function and followingly are dependent on the forwarders and shipping line's ability to provide empty containers. Based on this, it seems as the stuffing and destuffing of containers is mostly in the interest of inland terminals where it has a larger effect on their revenue. Therefore, it becomes an important offering. In contrast, most seaports do not focus on specific operations. Rather, they are more focused on flows and larger volumes. In contrast, one seaport interviewee (Sp A) stated that they want to perform the service as it allows them to gain control in the operations within the seaport. The aim is to create a tighter supply chain and reduce dependability on others, such as haulage companies. As closing times on vessels are strict, it is critical that the containers are stuffed and ready to be loaded on the vessel. This is a way to ensure that the seaport can deliver good service to the consignors and reduce the risk of delays which reflect poorly on the seaport. Interestingly, another interviewee (Sp D) expressed how shipping lines are aware of the performance of the seaports, which is a further motivation to ensure efficient operations and reduce unnecessary ECR.

Another inland terminal interviewee (IT C) described how the majority of containerized goods are already destuffed before reaching their facilities and therefore, they do not handle a large number of containers at their inland terminal. However, it was clear that the purpose of this

inland terminal was similar to the others, with the distinction of transporting the goods without the use of containers. The reason for this was mainly due to shipping lines not wanting to use this route for their containers. This describes the complexity of the container transport chain, where flows are not based on available routes, but is more complex. The use of inland terminals is highly affected by the choice of seaport where transport needs to be economically reasonable for shipping lines. However, factors such as relationships among actors in the network can also have an effect.

4.2 Drivers and barriers to Reduce ECR

The interviews have provided both drivers and barriers for seaports and inland terminals to reduce ECR. A summary is provided in Table 4.1 and Table 4.2, where the estimated strength of each driver and barrier can be observed.

4.2.1 Drivers

There are two drivers which stand out, cost and potential to increase volume, as they were mentioned by most interviewees. Other drivers which were mentioned are limited space, sustainability, limited resources, competitiveness, and excess of empty containers. A summary is provided in Table 4.1 below, where a low incentive is seen as where there are benefits, while a high incentive could drive the actor to act.

Table 4.1 - Summary of the drivers mentioned by each interviewee

	Found in literature	Seaport - Sp A	Seaport - Sp B	Seaport - Sp C	Seaport - Sp D	Seaport - Sp E	Inland Terminal - IT A	Inland Terminal - IT B	Inland Terminal - IT C	Inland Terminal - IT D
Reduce cost	X	H	H	H		H				
Reduce excess of empty containers	X				H					
Increased volume	X	H	H	H	H			H		
Increase sustainability	X			L		L				
Increase competitiveness		H								
Increase container utalisation	X									
Better utalisation of space	X	H	L	L	L				L	
Better utalisation of resources, i.e. labour	X	H						L	L	

H = High incentive; L = Low incentive

Cost was mentioned as a driver for reducing ECR by most of the seaports, as there is potential to save money. This is supported by literature where most papers discussing the subject of ECR, relate it to cost and saving potentials for all actors involved. One seaport interviewee (Sp B) expressed that one does not compete with logistics as this is about saving money. The interviewee meant that logistics is not the factor in which their customers compete and that it is in their interest to reduce cost collectively. As a result, reducing ECR is seen as a joint interest

to reduce costs for all. This is in line with the emphasis made by Cruijssen et al. (2007) and the cost savings potentials which can be achieved through collaboration. It was also expressed how the labour costs in the seaport are high, and where small mistakes can cause expenses to escalate. This increased their interest to reduce ECR as it would make their use of resources more efficient. The possibilities for reduced labour cost and increased utilisation were also factors which are mentioned as drivers by Breakers et al. (2011) who expressed the incentive to want to reduce the amount of paperwork.

Potential to increase volumes was explained by all interviewees as improving efficiency through reducing unnecessary ECR. Although, one interviewee (Sp C) referred to this driver as an ultimatum, where there is an interest in reducing ECR if there is a possibility that volume could increase as a result. Two interviewees further made the clarification that increasing efficiency and reducing ECR in the seaport does not directly increase their revenue. However, it allows them to increase their capacity and as a result, increase volume through the seaport. This is in line with Song and Dong (2015) and Boile et al. (2008), where both papers state that well-suited practices, visibility, and control are important factors. The aspect of increasing volume as a driver was not found in literature. However, it does closely relate to cost which is supported by many authors as a driver for reducing ECR. This difference as to why the interviewees focus on volume could be explained by the seaport and terminal objective described by Talley and Ng (2018), and followingly, it would be a natural focus to increase volume as a strategy to maximise throughput, and not merely focusing on reducing cost.

Better utilisation of limited resources, such as railways and lack of chauffeurs of both trucks and trains, were mentioned by several interviewees as a driver. The importance of using these in an efficient way was stressed by the interviewees, meaning that empty containers should not be using the resources to the extent that they are today as they are not creating revenue. A further limited resource mentioned by many interviewees was space as it restricts their ability to store empty containers. The limited space increases the requirements for efficient operations, including ECR, which increases the incentive not to store excessive amounts of containers. Furthermore, operations become slower when the terminals become crowded where one interviewee (Sp D) suggests that 80% occupancy rate is best. Even though seaports and inland terminals aim for increased volume, unnecessary handling of containers, such as when two containers are used in the flow where only one is needed, crowds the limited space which can affect the efficiency of all operations and followingly could risk effect total throughput.

Sustainability as a driver to reduce ECR was briefly mentioned by several of the interviewees, where the expected environmental benefits are in line with what is described by authors such as Song and Dong (2015) and Ng (2012). One interviewee (Sp C) described how sustainability is a trend and expected by the customers, which increases the incentive for most actors in the transport chain. Initiatives for increasing sustainability such as the one presented by the European Commission (2019), could further explain why sustainability is seen as a trend. However, it is not clear whether this driver is derived internally or externally, i.e., from the values of the organisation or a necessity to stay competitive.

Competitiveness on its own was mentioned by several interviewees, where one could relate it to ECR. This interviewee meant that it is important to prove to customers that their operations are handled efficiently as customers can use alternative solutions, similar to what is argued by Carbone and De Martino (2003) in that terminal performance affects customer satisfaction. The interviewee further explained that inefficient ECR causes idle in the seaport which is very costly. Furthermore, increased handling of a container increases the cost for the shipping lines using the seaport which could cause the shipping lines to search for other transport solutions. This is in line with Song and Panayides (2008) and Carbone and De Martino (2003) who stress the importance of seaport and inland terminal performance and its effect on market competitiveness. In contrast, the other interviewees who did not see competitiveness as a driver for reducing ECR, believed that it is more important to keep empty containers to supply market demand. Followingly, competitiveness was expressed as ensuring container supply and therefore, wanted to prioritise this rather than reducing empty containers.

One interviewee mentioned that there is an excess of empty containers in the seaport caused by imbalance in import and export. It was expressed that the problem is worsened as empty containers are not prioritised on ships and are, as a result, left at the seaport. This was described as the interviewees primary driver for reducing ECR as it becomes a problem in their daily operations. According to literature, this imbalance is a cause for ECR and is limited in terms of improvement possibilities as it is dependent on time and space. However, the low prioritisation from shipping lines of empty containers, supported by both Ng (2012) and Liang et al. (2021), makes ECR increasingly complex for a predominantly importing seaport.

As supported by literature, cost is the most apparent driver for reducing ECR. The shipping industry and the objective for seaports and inland terminals does not differ from other industries in that the main objective is to reduce cost and maximise throughput and utilisation of resources. Interestingly, the aspect of sustainability is not emphasised in the interviews as in literature. Rather, sustainability was mentioned as a secondary driver of reducing ECR, where the primary driver was reducing costs. Furthermore, in literature, the aspects mentioned such as better utilisation of space and resources were described as separate drivers. However, in many interviews, these aspects are, as sustainability, a way to reduce cost. A driver not found in the interviews was that reducing ECR could increase utilisation of containers. This could relate to their role, as neither seaports nor inland terminals own containers. Therefore, it is not in their primary interest to increase utilisation of this resource. Rather, as found, it is in their interest to use their resources efficiently such as space and labour.

Based on the interviews, it is apparent that there are more drivers for reducing ECR for seaports than for inland terminals. This could be due to the containers using more resources in a seaport as they have larger depots and handle larger volumes. Followingly, handling empty containers could have a larger impact on seaports result. In contrast, inland terminals have smaller depots and therefore have lower interest in ECR. However, an exception to this is the inland terminal which classifies as a dry port. This inland terminal shares the seaport's primary incentive, i.e., to achieve increased volume.

4.2.2 Barriers

All respondents were asked about the barriers for reducing ECR which they have experienced. In general, the barriers were specific to the seaport or inland terminals and were most commonly mentioned twice with the exception of lack of visibility and mismatch. The barriers found were competitive neutrality, container quality, dynamic operations, invoice per lift, lack of visibility, low prioritisation, mismatch, and outdated ways of working. A summary is found in Table 4.2 where a low barrier is seen as a factor which increases complexity although does not necessarily limit their interest, while a high barrier could limit the actor's interest to act.

Table 4.2 - Summary of the barriers mentioned by each interviewee

	Found in literature	Seaport - Sp A	Seaport - Sp B	Seaport - Sp C	Seaport - Sp D	Seaport - Sp E	Inland Terminal - IT A	Inland Terminal - IT B	Inland Terminal - IT C	Inland Terminal - IT D
Competitive neutrality				H				H		
Container quality		L				L				
Dynamic operations	X				L	L				
Invoice per lift		H		H						
Lack of visability	X	H		H		L		H		H
Low prioritisation of empty containers	X				H					
Mismatch of ownership	X	L						L	L	L
Mismatch of size and type	X	L						L	L	L
Outdated ways of working		L							L	

H = High barrier; L = Low barrier

The barrier which was predominantly mentioned was lack of visibility. One interviewee stressed (Sp C) that temporary transferral of container responsibility i.e., forwarders or haulage contractors, complicates the ability to make decisions regarding ECR. This is supported by Hellekant and Rudal (2021) who provides the shipping lines perspective and explains how shipping lines lose visibility once the container exits the seaport. It was also highlighted by the two of the interviewees that there is a lack of transparency of the container route. The inland terminal interviewee (IT B) mentioned how visibility is drastically reduced once the container exits their premise. It was also mentioned how some transhipments could be avoided if increasing the degree of transparency in the overall container journey. The further explanation provided by Garg et al. (2021), in that visibility stays within actor boundaries, further adds to the complexity. Consequently, there is limited knowledge among all actors of where containers are or going to be.

Container mismatch relates to size and type but also container ownership, barriers which were found in the papers by both Jula et al. (2006) and Kuzmicz and Pesch (2019). One interviewee (IT B) expressed that some containers are always transported empty back as they are specific to the purpose. A second interviewee (IT D) agreed that the size and type limited possibilities

to reduce ECR and further explained that shipping lines, i.e., the owner of the container, limit possibilities further. The consensus is that a container owned by one shipping line cannot be used to transport goods which are booked with another shipping line. This results in not being able to reuse the container even though other conditions, such as size, are met. Two seaports described how some goods require a certain container quality. These requirements can be strict depending on the type of goods. As a result, an excess of empty containers are moved as a preventative measure against the risk of some containers not meeting the quality requirements. This aspect of container quality was not found in literature.

Two seaports describe that they invoice their customers based on the number of lifts they perform. Both interviewees explained how this is an important aspect to understand and take into consideration. Followingly, it could limit the seaports in wanting to reduce the number of lifts in the terminal as it affects their main source of income. Furthermore, not only reducing the amount of handling, but reducing the number of times a container enters the seaport also reduces the seaports income. Adding the perspective of competitiveness, it could be seen that the resistance in wanting to reduce the number of lifts could affect the operational efficiency portrayed towards the shipping lines. The focus of minimising container handling and the barrier of invoicing per lift could be seen as contradictory. However, minimising the amount of handling within a seaport or inland terminal relates to maximising the utilisation of their resources, e.g., labour and machinery. Invoicing based on the number of lifts rather creates the drive for maximising the number of unique containers where the key is to handle each respective container as little as possible.

Competitive neutrality was mentioned by two interviewees. Both expressed how their ability to reduce ECR is limited by their role. As their aim is to be a neutral party in the transport chain of goods and containers, they are hesitant to take a part in initiatives to reduce ECR. However, it was expressed that this barrier does not apply to any initiative taken by other actors and that they see the benefits of reducing ECR in general. This is an aspect which was not found in literature. Their view on their role in the container transport chain acts as a barrier for reducing ECR as they have low interest when it comes to affecting import and export flows or management of containers outside of the terminal.

Outdated way of working in the industry overall was mentioned by two interviewees. The interviewees explained how working with pen and papers is still common practise and expressed the need for general digitalisation. Manual routines were explained to be inefficient use of resources and limit the ability to share information within and outside of the organisation. Resource utilisation and information sharing were both seen as important facilitators for reducing ECR.

Most barriers for reducing ECR are perceived as low. There does not seem to be a difference in the barriers found for seaports and inland terminals. Interestingly, some barriers mentioned by the interviewees were not found in literature. Literature relating to inland terminals and seaports and their relation to inland terminals seems to be limited. This could be the reason

why these specific barriers were not found in literature as they closely relate to the role and objectives of these actors.

4.3 Reducing ECR

The most prominent strategy to reduce ECR is to reuse empty containers. Both the theoretical findings and the interviews suggest that this can be achieved through street turns. Additional found strategies which could further reduce ECR include digitalisation, track and trace, foldable containers, relocation of import and export and ways to reduce the effect of container mismatch.

4.3.1 Interaction and Collaboration with Other Actors

From the interviews it is found that collaboration could be important to facilitate street turns and efficient depot operations, as this is found to have a potential to reduce ECR. Therefore, the current level of interaction between involved actors is important to gain a better understanding of how this collaboration could be achieved.

4.3.1.1 The Current Interaction with Shipping Lines

Interaction with the shipping lines is viewed as a way for seaports and inland terminals to manage empty containers. This was managed in different levels and relates to the operational performance in the terminals. Most of the interviewees viewed the interaction as assisting the shipping lines and offering supporting services. As an example, it was explained how seaports and shipping lines interact through systems they use. One interviewee (Sp A) describes how the shipping lines have access into the seaports system to be able to see the status of containers including the amount of container placed in their depot. In further detail, the shipping lines can see both sizes and types, as well as what containers are export and import containers.

Another supporting service offering available to shipping lines is to monitor the level of empty containers in the seaport depots. This is based on experience and knowledge of the seaports where they can provide more value for the shipping lines. As they are close to the depots, they have more visibility at the point in question which the shipping lines do not always have. The seaport terminal operators can help the shipping lines in communicating if their depot has reached a critical level, even though the exact amount within the capacity is determined by the shipping lines, as described by Olivo et al (2015). The aim of the service is to increase the total volume passing through the seaport.

Several seaport interviewees mentioned how they keep a continuous dialogue with shipping lines. This includes how the container flows can be optimised and more efficient. It was highlighted by one interviewee (Sp C) how the dialogue with bigger flows of goods is prioritised over small flows of goods. These types of dialogues aim to find how the seaport can facilitate container transport flows through discussing available capacity at the seaports and what services they can provide. Furthermore, the continuous dialogue included how the shipping lines can match different exporting and importing seaports. However, there is some hesitance to this, as one interviewee (Sp C) expressed the risk of making the flows “too

efficient" in that a seaport could reduce their opportunity to handle each container and followingly eliminate part of their revenue. Therefore, as expressed by several interviewees, this interaction needs to result in the possibility to increase volume and not merely reduce the number of lifts at a seaport, as this is in their primary interest. Followingly, there is some conflict between reducing ECR and revenue.

In contrast to the majority, one seaport has regular interaction with other seaports as they have an extensive role, acting as both a terminal operator and shipping line. The interviewee (Sp E) explained how they have close collaboration with other shipping lines, to utilise their capacity on their vessels and vice versa. As they are dominant in export, the interviewee described how they need to actively search for import flows, aiming to use the import containers when they become empty for their export flows. This regular interaction increases their ability to utilise their resources, i.e., their vessels and containers. It was highlighted how this is both good for the environment and cost effective, which is the main drivers for this interaction and collaboration.

4.3.1.2 Developing the Interaction with Shipping Lines

Collaboration with the aim of making depot management more efficient can be seen as relating primarily to shipping lines as it is their resource which the depot aims to increase utilisation of. Shipping lines are highly dependent on seaports and inland terminals, as they act as important nodes in the container transport chain. However, there is a mutual dependency, where the terminals also need shipping lines to gain volumes through the terminals, i.e., indirect revenue. Due to the high competitiveness of seaports, there are incentives to increase collaboration even further with shipping lines to create a lock-in effect and ensure volumes. Increasing collaboration with shipping lines can be compared to what Cruijssen et al. (2007) describes as horizontal collaboration, since there is a mutual dependency in these relationships. Horizontal collaboration involves actors whose products are complementary to each other (Cruijssen et al.,2007; Barratt, 2004), which is similar to the relationship between shipping lines and seaports.

There are several benefits because of horizontal collaboration, including saved cost, increased productivity, customer service and market position. Horizontal collaboration includes sharing resources to save cost due to a higher utilisation rate (Cruijssen et al., 2007). As described previously, the seaport terminal operators already assist shipping lines in the depot operations, by continuous dialogue including making warnings when the stored containers have reached a critical level. Still, as one interviewee (Sp C) stressed, all decisions are still made by the shipping lines, while the seaports only assist. Increasing the horizontal collaboration could mean authorising depot decisions to the terminal operators. This could increase the utilisation of knowledge as described by Cruijssen et al. (2007), to where the insight could be shared horizontally with other complementing actors such as forwarders or other bookers of transport. Cruijssen et al. (2007) further explains how horizontal collaboration enables each actor to focus on their core competencies and increase their service offerings in the market. For shipping lines this is described as operating shipping routes (Song & Dong, 2015) and reducing logistics cost

for shipping lines (Talley & Ng, 2018), resulting in service offerings in each market increasing. The core competencies for seaports and inland terminals are, as mentioned, related to facilitating transport for their customers within their gates, i.e., providing intermodal transport, depot operations and other services.

Seaports and inland terminals could further coordinate between different shipping lines, in terms of sharing resources to facilitate empty container management. This example could also be equated as horizontal collaboration as it also includes complementing actors (Cruijssen et al., 2007). Sharing resources when the other actor is lacking is an example of a horizontal collaboration (Erdoğan & Kabadurmuş, 2019; Song & Dong, 2015). In this example, the terminal operator would be the coordinator of the resource sharing since they have comprehensive information of all resources inside their gate.

4.3.1.3 The Current Interaction with Goods Owners

Several interviewees describe how the import and export flows belong to the owner of the goods, meaning that containers are merely a resource to facilitate transport of these flows. Therefore, rather than interacting with shipping lines, seaports and inland terminals interact and keep a continuous dialogue with the owner of the goods. As a result, they are not limited by working with flows belonging to a shipping line.

The most unique way of interacting with the owner of the goods was described by a seaport (Sp B). The interviewee explained how they have created focus groups consisting of owners of goods. The primary goal of these groups is to optimise their container flows through investigating how they can in an efficient way use the same shipping lines and containers for their goods, resulting in less unnecessary transports and operations. The interviewee expressed a contrasting view on the shipping lines where they are seen as being volatile, meaning that the shipping lines adapt their routes to where the goods are located. This was used as the reasoning for focusing on the owner of the goods rather than the shipping lines when it comes to strategic dialogues. Therefore, the seaport aimed to coordinate flows through their terminal with the aim of achieving a more efficient flow. To some extent, it is expected that the shipping lines respond and want to be the provider of sea transport. It is also mentioned that shipping lines are invited to the discussion with the intention of coordinating flows with one shipping line, i.e., use the same shipping line and container transport chain for import and export flows. Ultimately, the aim is to increase the total volume passing through the seaport.

Several interviewees described similar strategies where their aim is also to match different flows of goods. One interviewee (Sp A) described how the seaport acts as a hub, meaning that they have a central part of the flow of goods. It was also explained how they take an active role in searching for new goods and creating new container flows through recommendations to improve circulation of the containers and increase volume handled in the seaport. The interviewee further described how they are looking for opportunities to match import and export flows to become more efficient where ECR could be reduced.

An inland terminal interviewee (IT B) described how they are actively encouraging owners of goods to establish their businesses near the terminal. The inland terminal handles both import and export, which is used as an argument for convincing owners of goods to establish nearby. This leads to even better possibilities to match import and export flows, as it was explained by the interviewee, that volume creates volume. This implies that the already existing flows attract other owners of goods to also utilise these flows as well, leading to further increased volumes through the terminal. Furthermore, as another inland terminal interviewee (IT C) highlighted the importance of marketing local solutions for these actors for them to choose their terminal, aiming to increase the volume. The interviewee implied that owners of goods are striving to utilise local logistics solutions, meaning that the inland terminal or seaport is placed in proximity to the owners of goods. The inland terminal explained how they are not offering any transport solution. However, they can leverage their insight and knowledge to act as further facilitators for owners of goods. This is done through investigating flows, both current and future, and offering strategic connections.

4.3.1.4 Developing the Interaction to Facilitate Street Turns

Collaboration with the aim of achieving street turns is primarily with the goods owners as it is highly dependent on this actor and their goods. This can be compared to vertical collaboration, which is described by Cruijssen et al. (2007) and Barratt (2004) as collaboration between organisation, and customer or supplier. Several of the seaport interviewees consider the owners of goods as an important customer where the relationship is similar to what is defined by these authors.

The main purpose of the described interaction, i.e., vertical collaboration, between the terminals and owners of goods was to match import and export flows, such as through street turns. By increasing vertical collaboration, the terminal operators can take a more coordinating role facilitating street turns as they have a dialogue with both import and export goods owners. Although the existing collaboration is similar to street turn strategy, there is a difference in that street turns imply excluding unnecessary movements through the terminals. The primary aim for the seaports and inland terminal was to increase the volume passing the respective terminal, therefore there seems to be a reluctance to coordinate for street turns if it results in reduced volume. Street turns seem to be a higher driver for shipping lines as it is described by Deidda et al. (2008) to reduce their logistics costs. However, Hellekant and Rudal (2021) state that street turns are rarely initiated by the shipping lines, which indicates a low interest. Coordinating for street turns requires administrative work, where cost savings are not a guarantee. Based on the perceived low interests of shipping lines, the strategy provides an opportunity for the terminals to increase vertical collaboration with owners of goods. This in turn, increases the reach and size of the terminals network which reduces liability on few actors. This advantage is supported by Lambert and Cooper (2000) who describes how organisations benefit through its network.

4.3.2 Digitalisation

Several interviewees expressed how they are currently using old ways of working. This was expressed as prohibiting their ability to share information and provide visibility along the container transport chain which in return, results in unnecessary container repositioning. However, when further asked what digitalisation would entail to each interviewee, regardless of whether an inland terminal or a seaport, the answer was quite different. Some had aspirations of completely integrated supply chain solutions where they play an important role in providing information, while others described using digital tools in contrast to pen and paper.

For some interviewees, digitalisation entailed a terminal operating system, TOS, which allows for more efficient movements within the premises. One seaport terminal operator (Sp A) gave a similar description as Stefansson and Lumsden (2009). Investments in a TOS system is highly relevant as it is a way to ensure that seaports can cope with the increasing volumes in the future as well as the digital requirements set by other actors in the supply chain. Short-term, such a system is further expected to reduce the amount of container repositioning in the seaport because of increasing visibility within the yard. However, the statement made by the interviewee describes a certain level of digital development as a necessity to cope with increasing volumes expected in the long-term.

Other interviewees described similar aspirations as the one described with a TOS system but through a track and trace system. One seaport interviewee (Sp D) explained how their internal system allows them to know the flows passing through their port at all times, allowing them to know what containers to move ahead of time, similar to the actor tailored monitoring systems described by Garg et al. (2021). However, most interviewees described a more comprehensive system. One interviewee (Sp C) expressed how track and trace would be a competitive advantage for their seaport. The system would be tailored to the needs of their customers and followingly, described as a strategy to provide added value to their customer. This also describes a monitoring system tailored to a few actors. Although it was further described that this allows their customers to improve their flows as it makes it possible for their customers to see where there is an excess number of empty containers. Without this visibility, customers such as shipping lines or bookers of transport, are not always aware of where containers are located. This is because responsibility is transferred between actors in the container transport chain, where the container is returned to the owner, principally the shipping line, once the booking is complete. As a result, repositioning is done from locations further away than necessary which increases ECR. However, as argued by Garg et al. (2021), this could limit the ability to monitor across boundaries and followingly, only benefit single supply chains. The system could increase competitiveness for the seaport provider as it is a service requested by shipping lines, forwarders, and customers. The high degree of tailoring of the system could increase the competitive advantage as it has the potential to create a lock-in effect. On the other hand, the system boundaries and the following exclusion of some actors could further limit the ability to reduce ECR.

One interviewee (Sp D) described how a comprehensive track and trace system is not of interest to seaports in general, as the primary interest for them is to know when vessels are arriving at their seaports, not to know the exact location of each container. In contrast, another interviewee (Sp A) further expressed how there is an interest in knowing the whole container transport chain. Providing information such as the container's origin, the goods origin or how it is purchased, could provide a basis for avoiding transhipments. In this, digitalisation and track and trace systems are important facilitators. However, according to the majority, track and trace is primarily requested by the owner of the goods, who want a better understanding of the location of their goods to achieve better planning in their operations. There is also expressed interest from the shipping lines as track and trace could allow them to increase the visibility of their containers and followingly, increase the possibility to perform street turns. However, even though there is low interest in track and trace from a seaport and inland terminal perspective, most interviewees expressed that there is an interest in sharing information between actors with the aim of benefiting all. Followingly, even though the interviewees do not have their own interest, they see it as approaching a necessity. It could also be added that the findings presented by Yang et al. (2021) in that there is a willingness to pay for transparency, could incentivise seaports and inland terminals further to provide information. As argued by Stefansson and Lumsden (2009), seaport and inland terminals are important nodes to increase container utilisation and achieve efficiency in transportation. It is apparent that the seaport and inland terminals are aware of their importance to achieve the level of visibility which is sought after.

One interviewee (Sp C) further described that the primary interest is sharing between actors in the same supply chain. They further made the clarification that there is no interest in sharing information between competing actors such as between seaports. Another inland terminal interviewee (IT C) described that there is hesitance, as it is not clear how to share information such that all are benefited as some data is sensitive. Therefore, some are reluctant to share all the data and information which they have. Sensitive information could be data such that complete transparency in container and goods flow are achieved, i.e., customer id, route, and volume. It was also expressed that some see a risk in shipping lines and customers being able to see all container and goods flows. They believe that too much transparency could result in customers and competitors seeing alternative solutions than using their terminal and followingly, losing flows. Hesitance in sharing information is the most prominent barrier found in literature. As supported by Philipp (2020), an important aspect in reluctancy in sharing information is knowledge. Followingly, it could be argued that increasing knowledge along the supply chain is important if the aim is to achieve traceability throughout.

As there is resistance in sharing information, it is somewhat unclear who could gather and supply information from all parties involved with sharing information. One interviewee (Sp A) expressed blockchain as a solution to this. However, even though blockchain could be used, some uncertainty was expressed in that knowledge of what blockchain solutions could imply is lacking, as in line with Philipp (2020). Furthermore, in contrast to what is proposed by Garg et al. (2021), it was suggested that shipping lines are good at blockchain solutions and followingly could be the actor providing such a solution. The reason for this belief could be that shipping lines are seen as the actor which has the most interest in traceability and

followingly, have the largest incentive to invest. However, it could also be argued that shipping lines have strong self-interest and would have low trust from other actors in creating a system that benefits all.

Overall, the current level of digitalisation within the seaport and inland terminal is far from the level of digital infrastructure presented by Stefansson and Lumsden (2009) and reaching such a level would require costly investments. In addition, there are reasons to believe that the development and trends in maritime shipping will increase the need for transparency to be able to cope with increasing volumes. On the other hand, even though investments are required to achieve such digital infrastructure, investment in digital solutions could hinder the success of collaboration, as argued by Barratt (2004). With that said, as some seaports and inland terminals are further ahead than others, shipping lines and customers who want this type of visibility might gravitate towards using these seaports and inland terminals instead. Followingly, it could be argued that there will become a new bare minimum when it comes to digitalisation where it is no longer acceptable that operations such as container check-ins are performed by pen and paper as this risks becoming a deal breaker.

4.3.3 Other Strategies

Two interviewees described how container mismatch regarding size and type is a problem. As a solution to this, one interviewee (Sp A) described how they use refrigerated containers to transport goods which do not necessarily have these requirements. To do so, they turn the cooling system off. This relates to container substitution, as described by Kuzmicz and Pesch (2019) as using a container for other purposes than first intended. This is a way of reusing empty containers and increasing container utilisation. Hellekant and Rudal (2021), state that this strategy has a high impact on reducing ECR, although not that common. More common was the substitution between container sizes. In the interviews of this study, substituting between container sizes is common practice, although not primarily described as a strategy for reducing ECR. Rather, it was described as a way to cope. With that said, this could be as the perspective of Hellekant and Rudal (2021) is based on the shipping line. Therefore, this difference could be derived from the difference in actor perspective.

A further suggestion to reduce ECR was to relocate import and export. The interviewee (IT C) expressed that this targets the primary cause for ECR, i.e., imbalance in import and export. However, given the role of seaports and inland terminals in the container transport chain, it could be argued that this is outside of the scope of their role. Further, their role relating to this strategy could therefore be assumed to be limited to provide recommendations.

Lastly, a strategy mentioned in literature was foldable containers. Interestingly, no interviewee had knowledge about these types of containers. There is a clear advantage that follows with foldable containers, i.e., reducing storing space, as described by Kuzmicz and Pesch (2019). Further, it was explained how foldable containers can reduce the total cost of ECR (Liang et al., 2021). Even though this is not a current strategy used by the interviewees, it does not exclude the possibilities for future implementation of foldable containers in Swedish seaports

and inland terminals. However, Hellekant and Rudal (2021) state that even though there is a perceived high impact of foldable containers to reduce ECR, the feasibility of such implementation is low. Since containers are a resource of shipping lines, it could be argued that foldable containers are not likely to be implemented by any other actor than shipping lines. However, to have any effect on landside ECR the location of folding the container is of interest. Here, inland terminals or seaports may have a role. It is therefore interesting to note that these actors do not foresee needing such equipment.

5 DISCUSSION

The following chapter presents a discussion based on the findings and the analysis provided in the previous chapter. Firstly, a brief comment is provided regarding the effect of Covid-19. Thereafter, a discussion relating to the role of the seaports and inland terminals is provided, highlighting the drivers and barriers found. Further, the found strategies are related to these drivers and barriers as well as the role. Lastly, a discussion of seaports and inland terminals' potential role and effect in the bigger network is presented.

5.1 Effects of Covid-19

It was observed that Covid-19 has influenced the characteristics and needs of maritime shipping, and in turn, also container management. These effects were an increase in pricing and delays in the container transport flows. Results show that the aspect of pricing and delays has caused scarcity of containers which has increased usage of container substitution. Followingly, in addition to pricing and delays, another result of the pandemic is redrawing of shipping routes. One inland terminal (IT C) expressed that the seaport located in proximity, lost their container flow because of these new characteristics. This is an example of the unique vulnerability to economic and political status as described by Song and Dong (2015). Regarding ECR, effects are perceived to be limited. The pandemic has caused increased demand as well as new requirements on digitalisation. With that said, initiatives to reduce ECR are not observed to have any significant differences before and during Covid-19.

5.2 Seaports and Inland Terminals Interest in ECR

As the focus is on Swedish seaports and inland terminals, it is natural to assume that this could influence the empirical findings of the report, as Swedish seaports are small relative to global seaports. In connection with the highly competitive shipping market in Sweden, the setting could be regarded as different in comparison to the context of most of the available literature, as these in majority cover global and larger seaports. The overall Swedish import and export is generally balanced. Even so, there are regional differences that cause imbalances as surrounding demographics can cause different balances to be observed in different regions. Furthermore, it is found that in seaports where there is a balance between import and export, ECR can still be observed. Therefore, strategies such as street turns are not used in flows, they could have been. This could be as these interviewees are limiting their involvement to suggesting flows and regard the barriers as stronger than the drivers to actively reduce ECR. A further impacting aspect is the comprehensiveness of the inland terminals, where only one classifies as a dry port. In turn, this could influence the current interest perceived by these actors.

The report has found that the primary role for seaports and inland terminals is to facilitate transport. Despite this, all interviewees had some type of involvement with the surrounding actors. However, the interviewees which argued their limited effect based this on their lack of responsibilities in relation to containers. Although this was a common finding among all interviewees, a key difference is the varying degree of involvement in the container transport chain. This results in a difference in whether the primary role is limited to facilitator and node, or whether the role has a larger impact on the surrounding network in the decisions and operations they perform.

It could be interpreted that there is a relation between the role and the incentives for reducing ECR. When having a passive role, it was more apparent that the responsibility of ECR and management of containers was not considered to be within the role of the seaport or inland terminal. Additionally, the interest in container transport before and after the seaport or inland terminal was limited where most of the responsibilities are referred to the shipping lines, forwarders, or transport operators. The container is not regarded as the seaports or inland terminals resource and followingly, the terminals are not affected by if the container is laden or empty, nor are they affected by how the container has been transported to the terminals. However, when comparing this to the findings of Hellekant and Rudal (2021), the placement of the responsibilities of inland container management becomes unclear. The authors found that shipping lines involvement and role is reduced when the container is transported inland, and followingly, shipping line's role is also limited. Therefore, it could be argued that there is space for another actor to increase involvement in these domestic transports. Although, given the current division of responsibilities, it is suggested by Karlander and Tegbrant (2021) that it is the forwarder which has the largest opportunities as they have a sufficient network, when based on current role. However, as there is a trend of shipping lines challenging boundaries of their role and stepping into the role of forwarder, and the fact that seaports and inland terminals have a varying degree of involvement, shows that the boundaries, objectives, and interest are not static. Therefore, given the right incentives, there are opportunities for change of the status quo.

The primary objective of maximising throughput and the most apparent barrier of invoicing per lift, are closely related to the drivers of reducing ECR and the role in the surrounding network. Even though invoicing per lift was not mentioned by all interviewees, it was strongly emphasised by few, and therefore is an important barrier to consider. The reason for it not being mentioned by all could be as it is regarded as sensitive. The topic of ECR relates closely to sustainability which could be a contributing factor in hesitating to make statements on the topic of the primary source of revenue and its relation to ECR. As found, this barrier limits the interest which these actors have in reducing ECR as the risk of losing volume is expressed. Followingly, incentives with a direct relation to these actors are important to create interest.

5.3 How to Facilitate Efficient ECR

The findings of the report shows that the strategies which are of greatest interest to seaports and inland terminals are ways of reusing empty containers and increasing digitalisation.

Strategies such as foldable containers, relocating import and export, and reducing the effect of container mismatch are strategies which are portrayed as having considerable potential in literature. It could be argued to be natural that seaports and inland terminals do not show much interest in these strategies as they could be regarded as outside of the possible scope of their roles. As found by Hellekant and Rudal (2021), a foldable container is a high impact solution to achieve better space utilisation. However, it does bring other requirements such as machinery which requires extensive investments for seaports and inland terminals to cope with such a container type. In addition, the strategy could increase the effect of mismatch in container size and type as another container type is added to the rotation. The complexity of this solution could be a reason for the lack of knowledge and interest from seaports and inland terminals as it might not be a feasible solution, which was also discussed by Hellekant and Rudal (2021) from the shipping lines perspective. It could also be, as suggested by Hellekant and Rudal (2021), that the strategy requires higher-level decision makers to get involved which further adds to the low feasibility of this solution.

5.3.1 Facilitating Depot Operations

The results show that depots are an important operation in the terminals and influence empty container management. In literature, the use of depot direct is more emphasised as a specific strategy for ECR, described by Erdoğan and Kabadurmuş (2019) to create a point of supply of empty containers. Given the insight and knowledge of the actors' seaports and inland terminals, they could either be a supplier or facilitator of such a strategy. As the primary advantage of depot direct is to reduce congestion at seaports, the supplier of a depot direct might be more feasible to be done by inland terminals. However, the findings, both empirical and theoretical, show that depot operations are not lucrative which can explain low interest to increase depot operations. Therefore, it is more feasible that seaports or inland terminals would facilitate operations rather than assume the responsibility of operating the depot direct strategy.

Facilitating depot direct could entail sharing their knowledge, as the terminal operators have insight in local container transport flows. They could provide recommendations for the container levels in the depots. Seaports or inland terminals could also assume the responsibility of calling containers from the depot to the terminals as needed. This would address the barrier of limited space, as it allows seaports and inland terminals to better utilise their capacity and provide potential for further increased volume. Further, even though the terminal operators would not increase their income from facilitating depot direct operations, it is a way to increase collaboration with shipping lines since it benefits their interests. This collaboration could therefore lead to increased volume due to the following dependency from shipping lines. Also, it reduces the risk of shipping lines shifting seaports for their container flows.

Increasing the use of depot direct opens the opportunity to achieve a synergy effect if foldable containers were to be introduced. Hellekant and Rudal (2021) suggest that in that case, folding and unfolding of containers could be performed inland which could allow for better utilisation of space at the seaport. However, our findings show that the companies located adjacent to seaports and inland terminals are highly dependent on each other. The volumes which these

companies provide are important for the seaports and inland terminals where the companies are mutually dependent on the service and close supply chain which they offer in return. Followingly, moving container storage away from the seaport could risk affecting these collaborations and therefore one could assume that this strategy would have some resistance.

5.3.2 Facilitating Street Turns

As for depot direct, it can be argued that increasing the use of street turns could potentially also lead to increased volume in the terminals. However, the results show that the barrier of invoicing per lift is of great importance to these actors, as their income is mainly dependent on how many lifts are performed, regardless of if the containers are laden or empty. This heavily affects their desires to engage in strategies such as street turns, as if it leads to less opportunities to handle each unique container, their income is also reduced for that specific container. It could be argued that for the terminal operators to facilitate street turns, the following requirement is that the increased capacity must be also utilised for them to not lose revenue. As discussed, this was not mentioned by all interviewees, however, it can be assumed that this is a stronger barrier than the other incentives to reduce ECR. Therefore, this barrier needs to be overcome for the terminal operators to be motivated in taking a more coordinating role.

5.3.3 Collaboration and Digitalisation

Increasing both horizontal and vertical collaboration has been suggested to be a way to facilitate depot direct and street turns respectively. Consequently, as reusing empty containers is the primary aim, the included drivers and barriers are the same for depot direct and street turns. Increasing collaboration enables the opportunity to increase volume further, as it leads to a more established network. However, it was found that competitive neutrality was an important factor for some which might limit collaboration. The aim with competitive neutrality is to maintain well-functioning relationships, where it plays an important role in limiting the dependability on specific shipping lines. Relating to collaboration, promoting a neutral approach could limit the ability to drive strategic relationships with some. Therefore, balancing a competitively neutral approach with a collaborative approach could be viewed as contradictory. Adding the perspective presented by Karlander and Tegbrant (2021), who describe how forwarders and importing and exporting companies look for coordinating shipping lines in their choice when booking their transport, it could be argued that seaports and inland terminals should remain neutral. This leaves the coordinating role to the actor who books the transport. With that said, some seaports and inland terminals expressed an interest in growing their role and ‘climbing up the supply chain’. However, a way of increasing service in their role could be to facilitate visibility and increase the service provided to all in that way. When wanting to be open for all and not favouring an actor, as well as playing a part in suggesting flows, the objective becomes unclear.

The results show that the primary aim of track and trace is to increase visibility where it is predominantly the owner of goods which benefits. Increasing visibility could allow for better planning of resources and prohibit containers being transported empty one way. However, one could also argue that track and trace is a facilitator for reusing empty containers and to

collaborate, where reduced ECR becomes a secondary effect. As found, different actors assuming responsibility of the container, blurs the container transport chain which limits actors' ability to coordinate. Both seaports and inland terminals see what is incoming and outgoing. However, seaports and inland terminals knowledge of containers is non-existent once the container exits their premises. Although, the interest in knowing such information was also limited.

It is evident from the interviews that digitalisation and track and trace initiatives are of great interest in the supply chain as a whole. It has also been made clear that seaports and inland terminals see that their possibilities to benefit from such a system is limited. Followingly, it is not in their primary interest to develop such a system. With that said, it is understood that track and trace, i.e., increase visibility and transparency, is something which is of interest to customers, i.e., owners of goods. It is also of interest to shipping lines as it also allows for better planning and utilisation of their resources, i.e., the container, which more closely relates to ECR. However, the statement that shipping lines could be a provider of such a system, is met by contradicting statements. As found, a strong barrier for reducing ECR is the lack of information, where flaws in the transparency of the container fleet was expressed as a strong factor limiting abilities to coordinate. Similarly, it was found by Hellekant and Rudal (2021) how these are the same incentives for shipping lines to implement internet-based systems. As the seaports and inland terminals which were more interested in track and trace initiatives saw the system as a competitive advantage, its ability to reduce ECR could be discussed. Creating a tailored system which provides visibility if a shipping line uses their system, could increase visibility in the transport chain through that specific seaport. It could be argued that it would further increase lock-in effect.

5.4 Broadening the Role of Seaport and Inland Terminal

The findings show that there are contradictions in the current role of seaports and inland terminals and the strategies which are discussed. However, as some portray an interest in broadening their role in that they can take a further active role, seaports and inland terminals' contribution to reducing ECR becomes more feasible. Taking a coordinating role with the aim of achieving street turns could be benefitted by the geographical location of seaports and inland terminals, i.e, dividing inland and maritime transport, and providing access to the hinterland. The expressed interest in gaining dependability of other actors in the transport chain further increases the possibilities for seaports and inland terminals to develop their current role, i.e., not limit themselves to facilitator of intermodal transport. Nonetheless, the findings presented by Karlander and Tegbrant (2021), show the beneficial network position of the forwarder, which the seaport and inland terminal would compete with. In addition, as the shipping lines are stepping into the forwarder role, there is high competition when it comes to these types of coordinating roles.

With that said, the future role of the seaport and inland terminal could be highly dependent on the specific actor. As for some, the organisational transformation it would require to take such a responsibility could be regarded as too far outside the scope of their current role and

objectives. The actor who showed most interest in comprehensive and widespread systems such as track and trace, was also an actor which had a further focus on increasing their customer service with the secondary aim to achieve a lock-in effect. This further shows the difference among one actor group, in this case seaports, which adds complexity when addressing strategies from the perspective of one specific actor group.

The knowledge which can be provided by seaports and inland terminals could be of high value for the complete container transport chain. In performing street turns, the current role and limited knowledge of where the container is going, naturally limits the involvement of planning street turns. Rather, an assumption could be that this should be performed by the actor booking the transport, i.e., the forwarder as according to Karlander and Tegbrant (2021), or a 4PL provider as presented by Garg et al. (2021). Both forwarders and 4PL providers are described to have access to a wide network and can limit the effect of mismatch in container ownership. With that said, coordinating for street turns is possible when planning is made prior to booking the container. However, as found, part of the service offering of seaports and inland terminals is to suggest flows and answer to what they have available in the depot. Followingly, increasing visibility in such a way that shipping lines and bookers of transports, are aware of where containers are located, could possibly reduce planning uncertainties. Therefore, through digitalisation and common internet-based systems, seaports and inland terminals could assist the container transport chain by providing transparency, with the added benefit of improved service offerings towards their customer in their daily operations. Transparency could reduce the effect of transferral of container responsibility when relocating containers. In turn, this could reduce ECR in the cases where closer containers could be used instead.

Achieving good collaboration requires trust, openness, and communication, as suggested by Barratt (2004). The results suggest that seaports and inland terminals communicate with both competing and supporting actors. However, the differences in objectives, blurred boundaries of current and future responsibilities, could affect trust and openness, and in turn affect the ability to collaborate. These factors could also be seen to affect the interest and willingness to collaborate. Song et al. (2015) found that service offering, and level of competition could drive collaboration, where the size of the terminal could further influence the interest. Size as an influence to collaborate was also found in the empirical findings. This was seen where larger seaports showed less interest in collaborating with smaller seaports or inland terminals as there were less perceived benefits in doing so. Following this, it could be argued that given the size difference in actors in the Swedish context, achieving horizontal collaboration could be challenging. As presented by Barratt (2004), mutual KPIs are necessary which further shows that there needs to be mutual benefits for collaboration to be achievable. This is also applicable to horizontal collaboration between different actor types such as between seaport and shipping line. Relating to the difference in objective, merely creating a reduction in ECR, is not seen to be a strong enough mutual benefit. This, as merely reducing ECR from a terminal perspective risk having a negative effect on revenue. Consequently, collaboration between different actors in size and type, adds further complexity to reduce ECR.

6 CONCLUSIONS

The purpose of this study is to add to the understanding of how seaports and inland terminals can reduce ECR. To understand the role which seaports and inland terminals can take in reducing ECR, it is relevant to understand the role which these actors have in the container transport chain. Both seaports and inland terminals are primarily found to be facilitators of intermodal transport. Relating to container management and ECR, both actors have a varying degree of involvement where no actor is the same. This adds further complexity in describing their role in the complete network. The degree of interaction with other actors in the network is highly dependent on the specific actor in question. Some have limited interaction while others have regular interaction and a larger effect on the management and operations of surrounding actors. The size of the seaport and inland terminal is found to affect the focus of each respective actor where larger seaports and inland terminals focus on increasing volume. Rather than total volume, smaller seaports and inland terminals are focused on specific services and operations which they perform towards their respective customers. Furthermore, seaports are seen to have more interaction with shipping lines while inland terminals have more interaction with forwarders and transport operators such as railway operators. In this, inland terminals are highly dependent on the railway network and the route which are set up while seaports show a dependency on either shipping lines or owner of the goods. Some seaports and inland terminals exploit benefits derived from not solely being a terminal operator. These actors show benefits in being able to coordinate further and take active decisions rather than providing suggestions to the surrounding network.

Understanding the surrounding environment of seaports and inland terminals, and the drivers and barriers relating to ECR, provides further understanding to current operations and future possibilities. The strongest barriers found that could limit seaports and inland terminals' willingness to reduce ECR is lack of visibility, invoice per lift and providing competitive neutrality. Lack of visibility means that coordinating between actors becomes complex. Invoice per lift refers to the potential risk of losing income. This can be observed through the hesitance to make container flows ‘too efficient’ and in turn, reducing the number of times the container enters the terminal. Competitive neutrality hinders increased collaboration with the aim of reducing ECR. Followingly, there is a hesitation to favour a few actors and would require equal collaboration with all. Barriers which are found to increase complexity are the container quality, dynamic operations, low prioritisation of empty containers, mismatch in ownership, size and type, and outdated ways of working. The strongest drivers for reducing ECR is the possibility to reduce cost and to increase volume through the terminal. Reducing cost primarily relates to the complete network, as ECR is merely a cost. Subsequently, it is in the interest of seaports and inland terminals. Increased volume can be achieved through reducing unnecessary handling and achieving better utilisation of capacity. In turn, terminals can increase throughput in terms of total volume and customers. Further drivers are reducing excess of empty

containers, increasing sustainability, increasing competitiveness, and better utilisation of space and labour.

Six strategies for reducing ECR were found, i.e., digitalisation, reusing of containers through street turns or depot direct, foldable containers, relocation of import and export, and increasing usage of specific container types. Given the identified role of seaports and inland terminals as well as the drivers and barriers influencing these actors, it is found that seaports and inland terminals can facilitate reusing of containers. Facilitating reusing of containers can be done through playing a part in street turns, depot direct and the use of digital solutions through increasing the level of digitalisation in their operations. It was further found that seaports and inland terminals have the potential to gather information which could be valuable in a shared system including all actors in the container transport network. It was also found that for some seaports and inland terminals, stepping into a further coordinating role could bring benefits in their competitiveness as well as reduce ECR through facilitating street turns or depot direct. This, as they can coordinate flows between importing and exporting owners of goods and help shipping lines in coordinating their import and export flows.

This study has heavily focused on the specific actors' seaports and inland terminals and their ability to reduce ECR. However, it is clear that reducing ECR cannot be reduced to one or two actors. To reduce ECR, it requires collective interest by all actors involved. Furthermore, the findings show that there is high dependability on each other where the network is heavily intertwined. Adding the size difference of actors in the network, finding collective benefits or interest could be challenging. The interest of larger actors to collaborate with smaller actors is found to be met with some scepticism, as potential benefits between the two are not seen to be mutual. Therefore, it is believed that there is large hesitance in being the actor who initiates change. Achieving mutual and collective benefits is necessary to make increased collaboration feasible.

6.1 Further Research

This study has found that there is interest in collaborating between actor boundaries. It is also found that digital solutions such as track and trace systems and other systems for sharing data are believed to be a part of the future. Therefore, further investigating what type of data is needed to reduce ECR, as well as a comparison of what data all actors in the container transport network are willing to share would provide further understanding to how such a system should be realised. It could further add an understanding of who should be the initiator of such a system as well as the comprehensiveness of it.

As it is found that the railway is of high importance as it facilitates geographical connectivity inland, the railway operator could be an actor worth exploring further. Based on the unclear boundaries related to responsibility and the high dependability between included actors in the container transport chain, this additional perspective could provide further understanding to container management and ECR. It could also be interpreted that the railway operator has

further knowledge as they receive the booking of containers and therefore, could provide beneficial information when aiming to reduce ECR in the complete network.

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APPENDIX I - Interview Template

Context giving questions

- What is your role as seaport/inland terminal operator/authority?
- Who do you see as your customer?
- How is the balance between import and export?
    - Differences in container types, size and ownership?

The container flow through the terminal

- Could you provide an example of what the import flow of containers could look like?
    - What activities are included?
    - When a container is destuffed at the terminal, does the specific container have an assignment afterwards, or what happens next?
- Could you provide an example of what the export flow of containers could look like?
    - Do you have a preference for where the containers are stuffed?

Activities for container management

- How do you work with depots?
    - Whose are they?
    - How is the capacity in the depot determined?
    - How do you pick a container in the depot?
    - Does the operations in the depot affect the rest of the productivity in the port?
        - Separate or shared resources?
    - Have you heard of the term “grace period”?

The information flow

- By whom do you receive the information that a container should move?
- Are empty containers moved based on forecast or actual demand?

Collaboration

- What does your collaboration with other actors look like?
    - Dialogue with other seaports/inland terminals/railway operators/goods owners?
    - Involvement/effect/support, compete, division of responsibilities?

ECR

- Does empty container repositioning hinder or affect you in any way?
    - Why/why not?
    - Is it something which you prioritise?
    - Is there anything you do or prioritise which has a negative effect on empty container repositioning?
- What strategies/solutions have you heard of to reduce the handling of empty containers?
    - Do you have an interest in strategy x?
    - If strategy x was to be used to a greater extent, how would that impact your role?
    - How could you facilitate the use of strategy x?

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