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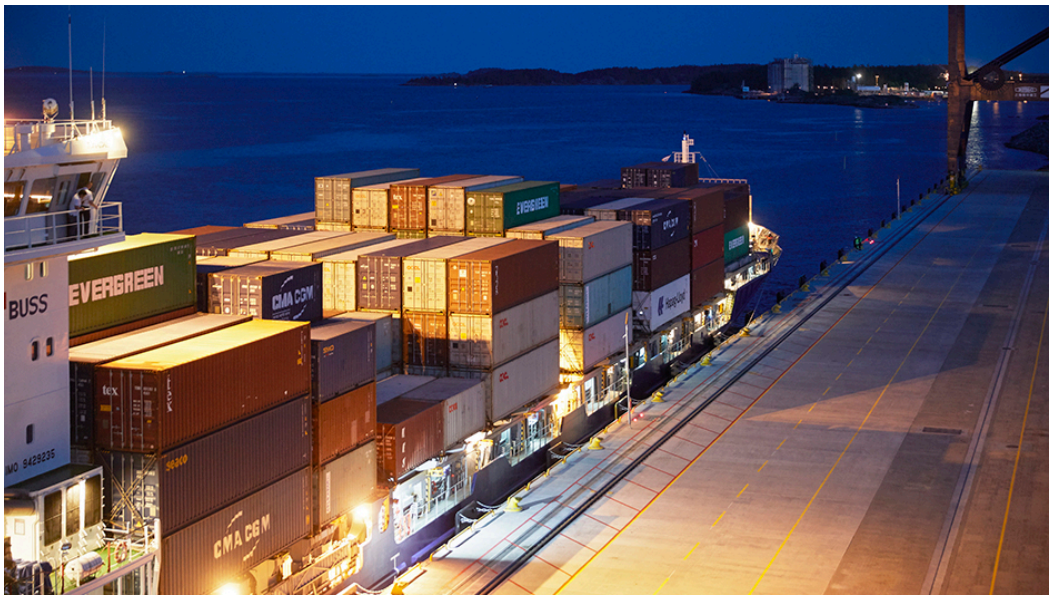

Improved transport efficiency through reduced empty positioning of containers

Transport buyers' perspective

Master's thesis in Supply Chain Management

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Abstract

Empty container repositioning (ECR) is mainly a result of the global trade imbalance but there are several regional issues where there is a potential for improvements.

This master thesis aims to investigate how transport buyers can reduce ESR by identifying actions, drivers and barriers in Sweden. In addition, the Covid-19 pandemic and its impact on container management have been discussed. Three actor groups were taken into consideration in this study: importers, exporters and freight forwarders. The study was performed by conducting interviews with nine transport buyers. The collected data and the literature study were used as a basis for the analysis and discussion.

Four drivers, four actions, and seven barriers were identified. Also, three impacts of how the Covid-19 pandemic has impacted ECR has been identified. Among the actions, street-turns was the most used action among the interviewed companies and is seen as one of the best methods to reduce ECR for transport buyers according to research. The barriers, such as container ownership mismatch, location mismatch and trade imbalance, are difficult to eliminate but it was concluded in this study that collaboration and transparent information among transport buyers are key factors that may reduce the impact of the barriers.

This study has shown that some transport buyers are working to reduce ECR whereas others are not involved in reducing ECR. Furthermore, freight forwarders have also proven to play an important role in reducing ECR among the transport buyers mainly because of their knowledge within container transport management but also as they have large client bases. Even though transport buyers are taking actions to reduce ECR, there is still room for improvement.

Keywords: Empty container repositioning, Transport buyer, Empty container management, Driver, Barrier, Action and Covid-19.

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Axel Karlander and August Tegbrant
Gothenburg, 2021

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1. Introduction

This part of the report includes a background to the study and the problems that are intended to be discussed.

1.1 Background

The shipping and port industry are shaped by globalization, logistics integration and containerization (Notteboom, 2004). One of the main driving forces is the large-scale adoption of containers, which started in the late 1960s. The market is substantially changing, therefore the companies involved in the container business are challenged to continuously improve their role in the value chain. The fastest growing sector in maritime industries is container shipping. Since 2000, the cargo volume has grown by an annual average rate of 11.2% (Feng & Chang, 2008). In 2013, 9 billion tonnes of goods were shipped by sea; that number is expected to reach between 19 and 24 billion tonnes by 2030 (Wong, Tai & Raman. 2015).

In ocean shipping, there is an asymmetric nature of global trade, leading to some terminals accumulating empty containers and other terminals short on empty containers (Xie, Liang, Ma & Yan, 2017). The imbalance is steadily increasing, and the cost of repositioning empty containers adds up to millions of dollars each month. Currently, the container flow between Europe-Asia and the Trans-Pacific trade is particularly imbalanced. Furthermore, there is uncertainty regarding the number of available empty containers in ports. Ocean carriers do not know when their customers will return the containers and how long time is needed for moving the containers to ports (Russell, Ruamsook & Roso, 2020). In addition, currently, the Covid-19 has created uncertainties in the global trade, and it is expected to have long-term effects. The Covid-19 is going to be the worst global economic crisis after the economic depression in the 1930s (Vidya & Prabheesh, 2020). The global trade in 2020 is at a significantly lower level than in previous years. Lockdowns have created serious supply chain disruptions and as a result, the volume of container shipping has decreased. According to Rusell et al. (2020), Covid-19 has made flexibility in port logistics even more important than ever.

According to Wong et al. (2015), the repositioning of containers is also affected by the cost for leasing and manufacturing of containers, low cost for manufacturing or leasing reduces the need for repositioning. It is hard to forecast the future demand for empty containers and if containers are not available, there is a risk for companies to face loss of sales (Lai, Lam & Chan, 1995). Kolar, Schramm & Prockl (2018) state that in 2016, 24,7% of all shipments port-to-port, consisted of empty containers. For land transport the number is even higher, the empty container transport amounts to 40-50% of the land container transport (Breakers, Janssens & Caris. 2011).

The global ECR problem is mainly based on a trade imbalance between ports and regions. Empty container shortages are created at export strong regions whereas a surplus is generated at import strong regions. According to Kolat et al. (2018), approximately 25% of the containers are empty for port-to-port, therefore there is a strong incentive for shipping lines and involved actors to reduce this number by a more efficient allocation of empty containers.

Several actors can influence the movement of empty containers. Key actors in container transport are customers, intermediaries, and transport operators (Lun, Lai & Cheng, 2010). Primary customers are

buyers and sellers of goods, if the export and import processes are not handled by the shippers themselves, they may be outsourced to intermediaries. An intermediary can be a third party working as a transport facilitator connecting shippers with carriers. Transport operators can be, apart from ocean carriers, inland waterway operators, road- and rail operators. But, it is the actors who own and/or lease the containers which are most affected by this issue, and hence research is focusing on the shipping lines' perspective of ECR (Legros, Bouchery, Fransoo. 2019). The authors have observed a gap in the literature and research where the transport buyers most often are excluded in the discussion of ECR. Furthermore, regional ECR, the movement of empty containers between actors such as importers, exporters, and container depots has not been as thoroughly investigated compared to global ECR. To further reduce the movement of empty containers, the role of the transport buyer should be explored, specifically opportunities to reduce ECR in Sweden.

1.2 Aim and Research Question

The study aims to explore how transport buyers can support reducing ECR. In line with this aim, the following research questions have been formulated, focusing on how transport buyers can influence ECR, specifically by understanding the activities taken, drivers and barriers, possible improvement actions, and their potential effects. In addition, the influence of the Covid-19 pandemic on transport buyer's ECR management has been investigated.

The following research questions have been formulated:

The first research question aims to understand the current ECR management from empirical findings. It will also be a foundation for the second and third research question.

RQ1: How are transport buyers managing empty container repositioning?

The second research question aims to investigate transport buyer's possibilities to reduce ECR in Sweden by identifying actions, drivers and barriers.

RQ2: How can transport buyers reduce empty container repositioning?

RQ2a) What are the drivers for transport buyers to reduce ECR?

RQ2b) What actions are available from a transport buyer's perspective to reduce ECR?

RQ2c) What barriers influence the transport buyers' possibilities to reduce ECR?

Container shipping is a vital part of the global production systems with vulnerable supply chains, the Covid-19 pandemic has distorted these supply chains and created major disruptions. The third research question, therefore, aims to gain an understanding of how the Covid-19 pandemic has impacted ECR for transport buyers.

RQ3: How has the Covid-19 pandemic influenced ECR management for transport buying companies?

2. Methodology

This chapter shows the working process and methods used to answer the research questions outlined in chapter 1.2. The working process consists of problem identification, literature study, and data collection. The literature study combined with the collected data is used as a foundation for the analysis and solutions.

2.1 Research design

The research design of this study is a case study based on interviews. According to Zainal (2007), a case study enables examination of data within a specific context. A case is often limited to a certain geographical area or a limited number of individuals as the study's subject. Further, a case study in its true essence is a method investigating real-life phenomena through contextual analysis of the conditions and relationships of the limited research subject. This study is limited to the transport buyers' perspective in Sweden. According to Fidel (1984) a case study can be used to identify general findings which not only apply to the individual cases. This is an important aspect of this study as it aims to gain an understanding from a more general standpoint rather than for only the case companies.

Once the problem statement was formed, a literature study was conducted. This in combination with the data collection formed a foundation for the analysis. See Figure 2.1 for the research process.

Figure 2.1: Research process

2.2 Literature study

A literature study was conducted to form a frame of reference. The search of the literature was primarily done through books and scientific articles within the areas of empty container repositioning**,** transport buyers, and container management**.** The books were recovered from Chalmers' library and the articles from Chalmers' library databases and Google Scholar. Furthermore, literature regarding scientific data collection was used to ensure the quality and validity of the methods used. The literature study was used to formulate interview questions and as a basis for the analysis and discussion.

The following examples of keywords for finding relevant articles were used:

- Empty container repositioning
- Container management
- Trade imbalance
- Intermodal transport
- Transport buyers

2.3 Data Collection

An interview is most useful when the research objectives focus on understanding opinions, attitudes, values, experiences, and the process. Further, the interviewees might be more open to an interview than other data gathering processes (Rowley, 2012). Even if the aim is to generate data to answer the research questions, the questions for the interview may not exactly match the research questions, they need to be adapted to encourage the interviewees to talk around the topic as well to gather the information that would not be brought up otherwise. According to Gill, Stewart, Treasure & Chadwick (2008), interviews are the most common method for data collection in qualitative research. It is believed that interviews provide a deeper understanding than purely quantitative methods.

An interview can be structured, unstructured, or semi/structured. A structured interview means that questions and possible answers were decided before the interview, hence there is less room for follow-up questions and further explanations of the answers. By using this method, large amounts of data can more easily be reviewed and analyzed compared to an unstructured method where the respondents can freely answer and provide further explanations of the answers. (Kvale, 2007; Lantz, 1993). A semi-structured method is a combination of a structured and an unstructured one, the interview starts with open questions, and then more specific questions are asked. The questions should be short and easy to understand without academic language.

The questions for the interview should be designed as followed Rowley (2012):

- it is not possible to answer yes/no
- are not leading or have implicit assumptions
- a question should not include more than one subject
- are not too general or too vague
- are not invasive in any sense

A semi-structured interview was used so that the interviewees could give more elaborate answers. The interview questions were prepared in advance and adapted depending on which actor group was interviewed. The interviews were conducted through a digital meeting and each company was interviewed once. In total, nine interviews were conducted, three interviews within each actor group. The interviews lasted between 30 minutes and one hour. The interviewed companies were selected based on two criteria: having or handling a container flow and operating in Sweden. With this selection, companies within different industries and sizes are included which provides an overall view.

Three actor groups were interviewed in this report: importers, exporters and freight forwarders. The actor groups provide different perspectives of container transport since the empty container management differs for each group. To keep the interviewed companies anonymous, the companies will be referred to as Imp1 for import company 1, Exp2 for exporter company 2, and Forw3 for freight forwarding company 3, etc. in the report. See Table 2.1 for summary of interviewees and their role.

Table 2.1: Interviewees and their role

Actor group	Company	Respondent's role	Date
Importer	Imp1	Freight Manager	4/3/2021
	Imp2	Logistics Operations Manager	23/3/2021
	Imp3	Business Developer	17/3/2021
Exporter	Exp1	Senior Manager Chartering and Logistics	9/3/2021
	Exp2	Purchasing Manager	10/3/2021
	Exp3	Commercial Manager Marine Business	30/3/2021
Freight Forwarder	Forw1	Product and Capacity Management	24/3/2021
	Forw2	Head of Intermodal Transport	5/3/2021
	Forw3	Key Account Manager	3/3/2021

2.4 Analysis

To analyze the findings, the interviews were transcribed. According to Kvale (2007), the transcribing process is an initial analysis itself which generally means a transaction from oral speech to written text. For this study, meaning condensation has been used which is to express the meaning of the interview into shorter formulations. Long statements were compressed to the main sense of what has been said. The data from each interview was summarized and categorized based on company, actor group, and the research questions into tables to get an overview of the data. The analysis was based on the literature review and collected data from the interviews. Firstly, the drivers, barriers and, actions were analyzed for each company to identify how contextual factors affect the companies' ability to reduce ECR. Secondly, the collected data was compared to the literature to find similarities and differences between the research and collected data. Lastly, the barriers' effect on the actions and how the barriers could be overcome was analyzed to identify the companies' potential to reduce ECR. In the analysis, the research questions were analyzed both separately but also together to find correlations. In addition, the Covid-19 pandemic and its impact on empty container management were analyzed.

2.5 Research Quality

To achieve a reliable study good validity and reliability are required. Validity refers to what extent what is supposed to be investigated is investigated and reliability determines how trustworthy the methods used have been (Patel and Davidsson, 2003). Lindstedt (2017) describes validity as the presence of systematic errors, for example by using an incorrect method or using the method incorrectly. Further, the reliability is affected by random errors or errors which cannot be affected. Regardless of which kind of errors are present in the study, it is important to be aware of it and make it clear that the errors exist. If the errors are being hidden, the trustworthiness of the study can be

considered low (Lindstedt. 2017). Taking this into consideration, objectivity and transparency will inform this study.

Validity can be divided into internal and external validity. Internal validity shows to what extent the study's different methods are suitable for the aim of the study and external validity shows how trustworthy the study's methods are in a general setting (Hernon and Schwartz, 2009). The internal validity of this study can be considered high as this is a qualitative study and therefore using interviews as a method will be suitable for this study. Furthermore, since the transport buyer's perspective is missing in the literature, the interviews are crucial for new perspectives. According to Gill, Stewart, Treasure, & Chadwick (2008), an interview study is an advantageous method for providing information when the degree of prior knowledge is low. All the interviewed persons in this study have knowledge and experience within container transport management and can therefore be seen as trustworthy.

3. Frame of reference

In this chapter theory regarding containerization, drivers, barriers and, actions to reduce ECR will be presented.

3.1 Containerization:

The container revolution started in 1956 when a crane lifted almost sixty aluminum truck bodies aboard a tanker ship in New Jersey. The ship sailed to Houston where trucks waited to load the metal boxes and haul them to their destinations (Levinson, 2016). Today, containerization is a worldwide transport system with a large number of coastal, domestic and intercontinental transport services (van Ham & Rijsenbrij, 2012). The container is the core of a highly automated system for moving goods with a minimum of complications and at a low cost. The container shaped the world economy by making shipping inexpensive, globalization was boosted by the maritime containers, enabling fast and reliable transport of raw materials, components, and semi-finished products to regions with attractive facilities for production. In reverse, the finished products are shipped from these regions to all over the world. Standardized container loading units have resulted in savings for all parties in the supply chain, facilitating simple handling through the entire transport process.

3.1.1 Containers

According to ISO, a container has to meet certain criteria such as: being a transport unit for durable performance, designed to be used with multiple modes of transport, and designed to be stuffed and emptied effortlessly. There are different types and sizes of containers that are suitable depending on the purpose which will be presented in the Table 3.1 (Lumsden, Stefansson & Woxenius. 2019).

Table 3.1: Container types

Container type	Description
Standard	The most common type of containers is standard containers which can have two standard sizes, 20 and 40ft length and 8ft width and height. These types of containers can handle dry cargo such as pallets and boxes. Because of their simple design and structure, these are cheaper compared to other containers with extra functionalities.
Reefer	The reefer containers have the same functionalities as a standard container except that the container is refrigerated or heated which makes it suitable for transporting temperature-sensitive cargo.
Open-top	The open-top containers have an open- top which can be useful when the cargo is too large to be stowed from the sides and therefore has to be stowed from the top.
Flat rack	Using the flat rack containers, the cargo can be stowed from both the top and the sides of the container. It is therefore useful for e.g. machinery or pipes. There are two different types of flat rack containers, collapsible or fixed-end. Being able to collapse the container makes transportation and storage of empty containers more efficient.

Tank	A tank container is a cylindrical vessel with a steel frame to fit the ISO standard. It is being used to ship or store liquids or gases. These containers can be fitted with a heating or cooling system if needed.
High cube	The high cube container has a height of 9ft 6 inches compared to a standard container's height of 8ft Usually, the high cube container has two different lengths, 40ft or 45ft.

3.1.2 Container Transport Chain

According to Song and Dong (2015), the container transport chain can be described as follows: the exporter needs to transport cargo and is therefore in need of an empty container which is most often provided by the ocean carrier. The empty container is transported either from the port or an inland terminal to the exporter. In this stage, the exporter has certain responsibilities such as creating a load plan, a document that shows how the container is stowed with cargo. This is important as the container is sealed once the stuffing is complete and the information cannot be confirmed before it reaches the importer (Lun et al., 2010). The exporter, therefore, plays an important role in the transport chain by providing correct information. The exporter can handle the shipment itself by having direct contact with the shipping lines and other actors or a transport facilitator such as a freight forwarder can be used. Then the freight forwarder can take care of choosing the mode of transport and providing additional services including for example customs clearance.

Thereafter the container is stuffed with the cargo at the exporter premises and transported to the origin port waiting for the vessel departure. After shipment on-board a vessel, the laden container will then reach the destination port and be transported to the importer's premises where it will be unloaded. The empty container is transported to the port or an inland container depot depending on where it is needed. Song and Dong (2015) states that there are two supply chains within the container transport chain: the forward chain supply chain of laden containers and the backward supply chain with empty containers. Because the transport of both laden and empty containers is using the same resources, the two different flows are hard to separate. One difference between the two flows is that the laden containers are driven by the customers and the empty containers by the ocean carriers. See Figure 3.1 for illustration of the container transport chain.

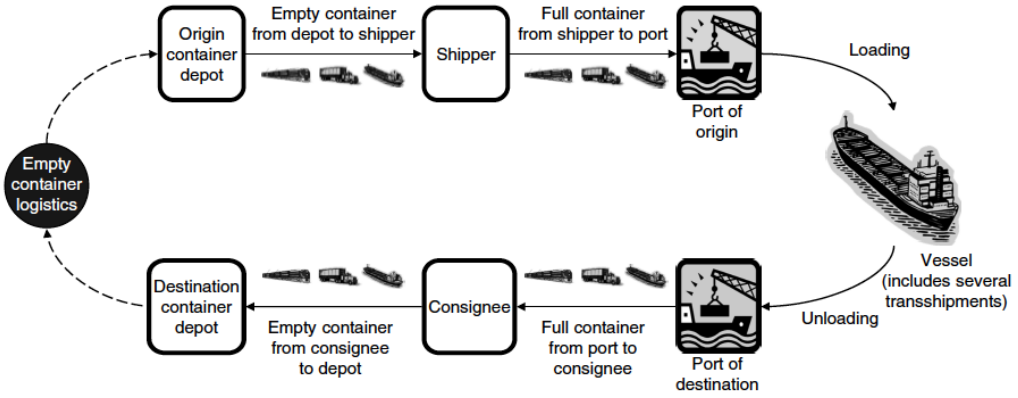

Figure 3.1: Container Transport Chain (Epstein et al. 2012)

Intermodal transport can be defined as the transportation of goods in the same loading unit from its origin to its final destination using at least two transport modes (Crainic & Kim, 2007). It is a general definition and it often refers to container transportation and takes place over long distances with several carriers involved. Container-based transportation has had remarkable consequences for ports and container terminals. To make intermodal transport possible, inland transport systems have to be constructed for handling containers.

The concept of a dry port is based on the idea that shippers can leave and/or collect goods as in a seaport, but in an inland intermodal terminal where the terminal has a direct railway connection with the seaport (Roso, 2009). A dry port must fit into the existing transport system and its transport modes. It enables the seaport to increase the throughput without an expansion and connects the port to areas outside the traditional hinterland. Further, a dry port is a crucial part of the logistics infrastructure, strengthening regional business and development.

Dry ports have a vital function in cross-border freight transport systems (Wei & Dong, 2019). Lack of inland import and export functions creates a bottleneck for the development of foreign economies. The hub function of a dry port enhances inland transport efficiency by utilizing the transshipment and connections of different transport modes (Wei & Dong, 2019).

Most of the imported and exported goods are transported by feeder vessels the first or last distance to the Swedish ports (Santen et al., 2018). The transshipment to/from the feeder vessels takes place in the large ports in northern Europe, such as Rotterdam. A trend is that Import-goods from Asia are unloaded in southern Europe and from there transported by train to Sweden in a larger sense. According to Santen et al. (2018), wood, paper, and steel add up to about two-thirds of the Swedish export. The majority of wood products and paper, going through the port of Gothenburg, comes from the middle part of Sweden. Ore is extracted in the north part of Sweden and the steel from the middle- and north part. A large part of the import to the port of Gothenburg is transported to the east coast.

3.1.3 Actors in the Container Transport Chain

In this section, the actors involved in the container transport chain are described.

Inland transport operators
Three different inland transport operators were identified in the literature: road-, rail- and inland waterway operators.

At the beginning and the end of the container transport chain, road transport is usually used. A Comprehensive road network with many alternative routes enables trucks to deliver “door-to-door” to shippers. Transporting the containers by truck is probably the most accessible alternative. A vast majority of the road operators are small firms, 99% of the companies have fewer than 50 employees (Lun et al., 2010)

Compared to road operators, there are only a few large size rail operators. Railways enable reliable transit times and utilize the landscape efficiently. Also, it is cost-effective when handling bulk material, relieving a large number of trucks in the road system (Lun et al., 2010).

Inland waterway transport is operated on natural rivers, artificial man-made canals, or an area of water close to shore (Lun et al., 2010). The inland waterways operators often carriage containers from a seaport to an inland depot and return empty containers. It is a viable part of several transport systems, competing with other inland transport modes such as rail and road. In Sweden, inland water transport has not previously been used. In 2021, the first inland water transport route for container transport will be established between Stockholm and Västerås. This can enable more efficient transports and reduce road congestion in the Stockholm region (Eriksson, 2021).

Shipping lines
Large carriers are dominating the world's container vessel fleet, operating with high-capacity vessels on the main trade routes, such as the Asia-Europe, trans-Pacific and trans-Atlantic routes (Lun et al., 2010). Traditionally, the ocean container carriers have provided liner services, but recently the major carriers have begun to offer door-to-door logistic solutions to shippers. To meet shipper’s increasing expectations, shipping lines are collaborating with independent inland transport operators and make use of intermodal transport systems. The relationship with logistic service providers has become important, unlike the intermodal transport managed by the shipping lines, the logistic services are performed by independent units. All shipping lines do not have their own logistic service unit, instead shipping lines like Hapag-Lloyd focus on their shipping and capacity for door-to-door deliveries. (Lun et al., 2010). Ocean carriers have two main customers: direct shippers and freight forwarders. An increase in outsourcing has led to 80% of the global container shipping being performed by freight forwarders (Balci, Caliskan & Yuen, 2019). It is therefore crucial for the ocean carriers to have a stable relationship with the freight forwarders to maintain large shipment volumes.

Some shipping lines are also involved in terminal operators' business. For example, COSCO-HIT in Hong Kong exclusively serves China Shipping and COSCO. Another example is APM Terminals, owned by Maersk Line, acting as terminal investors.

The alliances in liner shipping have various forms but the most common ones are global- or strategic alliances. Strategic alliances aim to utilize ships over particular routes including sailing schedules, joint terminals, and container coordination and co-operation in employment. It does not cover joint sales, joint ownership, and sharing of profit/losses. Alliance membership imposes that the member's use of a non-member carrier is restricted. The membership often includes five-year-agreements regarding provisions, such as notice and penalties, for withdrawal and ownership changes (Panayides & Wiedmer, 2011)

Various other types of agreements have developed through global alliances where vessel sharing and slot sharing are common. Slot sharing requires a fixed percentage of the vessel's container capacity to be exchanged during a given time between the carriers. On the other hand, vessel sharing entails that the collaborating companies operate together to fulfill the demand for a specific trade route, including joint optimization of the vessel departure times and the shipping orders (Panayides & Wiedmer, 2011).

According to Lin, Huang & Ng (2017), the competition in liner shipping has been a focus area in research for a long time. It has been conducted that some trade routes are characterized by loose oligopoly and other trade routes by tight oligopoly. The carriers build collaborative relationships with each other but at the same time, there is competition for maximizing their profits.

Port Operators

A port is an essential function for exchanging cargo between the ship and the shore (Lun et al., 2010). Ports can also be seen as a transshipment place where shipping routes are connected, liner shipping companies put a lot of effort into creating connections with port operators to facilitate transshipment operations. According to Liu (2010), container ports are complex with various activities, such as tugging, mending, pilotage, etc. Additionally, the container transport within the port can be performed by a port authority, inland logistic companies, or terminal operators. The different actors may have different objectives. A port authority's objective can be to maintain labor capacity, inland logistic companies want to improve reliability and the terminal operators' objective is to maximize profit.

Transport buyers

The transport buyer has the primary influence on transport operations, such as what mode to choose and what the requirements for the transport are. Independent if the transport buyer is a sender or receiver of goods, it must be a central company in the logistic system which makes them an important strategic actor in the transport chain (Santén, 2013).

The importers are the receiver of goods from abroad and the exporters are sending goods abroad. Exporting firms can improve the relationships with overseas customers by performing their channel functions in a sufficient manner. The improvement to its importing counterparts can be in the areas of pricing policy, sales training, product quality, etc. Management in importing firms is suggested to identify foreign supply partners motivated to invest in specific assets for the specific relationship (Skarmeas & Robson, 2008).

According to Lai, Xue & Hu (2018), a freight forwarder can be seen as the link between a goods owner and the shipping line and arranges the transport by either using its resources or through transport operators. Because of the competitive nature of the freight forwarding market with global and small actors, the smaller actors do not have the buying power as the global actors, it is common

that alliances are formed (Lai, Xue & Hu. 2018). Examples of freight forwarders activities according to Saeed (2012) are:

- Representing the customer and procuring the best transport modes where sea, road, and air transport are the most frequently used. Also choosing the optimal transport mode route.
- Providing services such as customs clearance and warehousing.
- Freight forwarders are often in close collaboration with importers and exporters to meet the different demands.

3.2 Empty container repositioning

The problem with ECR can be divided into three different perspectives, global, regional, and local. The global repositioning covers trade imbalances and the goal is to locate the empty container where they are best needed, reducing empty container transport which then can reduce the storage of empty containers at depots or terminals. The regional repositioning instead covers the movement of empty containers between actors such as importers, exporters, shippers, and container depots where the aim is to balance the demand between these actors and keep the cost at a minimum. Local repositioning means balancing the empty containers between container depots and the customers. (Kuzmicz & Pesch. 2019)

Empty container repositioning is an important subject within maritime transport as 20-25% of the containers shipped are being empty which is a major loss of revenue for the carriers as empty containers do not generate any revenue and still take up the same space and handling needed as a laden container Kolar, Schramm & Prockl (2018).

Kuzmicz and Pesch (2019) describes the actors in the handling of empty containers as importers, exporters, shipping lines, port authorities, container ports and inland depots, freight forwarders, inland transport operators, container leasing companies, customs and regulatory authorities, and inland terminal operators where the major actor is considered to be the shipping lines.

Breakers et al. (2011) describe the regional repositioning process as follows: once a container has been delivered and unloaded, it has to be picked up and moved. Most often this is performed by another truck. The empty container can be transported to the port as a part of the global repositioning of containers or a depot. Furthermore, empty containers are also being transported regionally to counteract the regional imbalances.

3.2.1 Cause of ECR

Basarici and Satir (2019) found three major reasons which are causing empty container repositioning (ECR): Trade imbalance, operational drivers, and market effect.

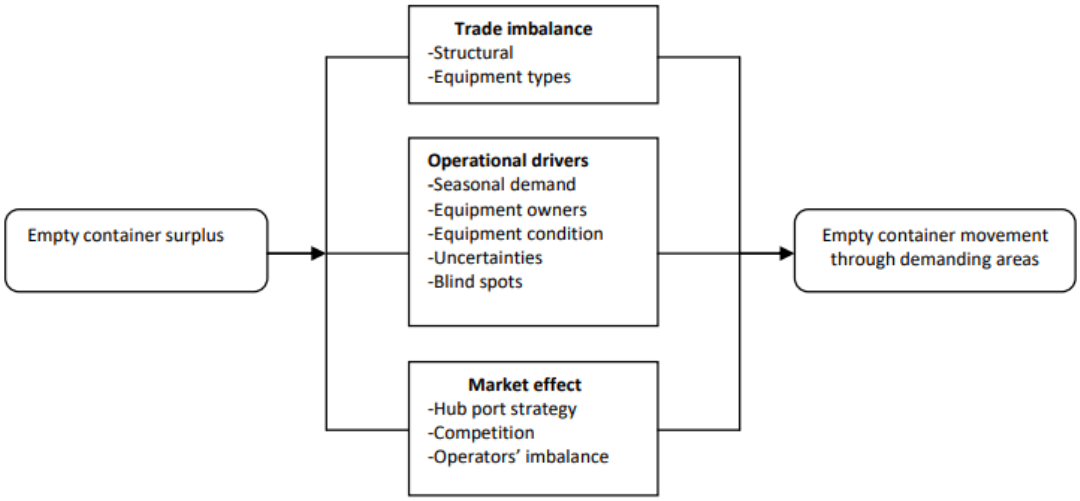

Figure 3.2: Causes of Empty Container Repositioning (Basarici and Satir, 2019)

Global trade imbalance

Political and economic factors are creating imbalances internationally which consequently causes an imbalance of empty containers. According to Song and Dong (2015) trade imbalance is the root cause of ECR. It is also affected by an imbalance in which degree regions are importing or exporting goods. One example is the Asia-Europe trade route where more goods are being exported from Asia to Europe than from Europe to Asia, see Table 3.2. Consequently, there is an imbalance of empty containers where Europe has a shortage and Asia a surplus (Basarici & Satir, 2019).

Table 3.2: Container traffic between Europe and overseas (Basarici and Satir, 2019)

Market	Export	Import	Imbalance
Europe-North America	2 824 459	2 496 601	+327 858
Europe-Asia	5 458 298	11 493 357	-6 035 059
Europa-SS Africa	1 093 687	591 975	+501 712
Europe-ISC/Middle East	2 483 922	1 527 035	+956 887
Intra Europe	1 026 767	736 689	+290 078
Europe-Centr. and S America	940 262	1 497 517	+557 255
Europe-Australia and Oceania	374 901	181 527	+193 374

Trade imbalance in Sweden

There is a variation in the need for empty repositioning of containers. The west coast has a relatively balanced goods flow compared to the east coast. Further, the port of Gothenburg, the largest port in Sweden, has more imports of 20ft containers than needed for export of 20ft containers. The need for 40ft containers is significant for the export, therefore 40ft containers are empty repositioned to the port of Gothenburg while empty 20ft containers are repositioned from the port of Gothenburg to other Swedish ports (Santén et al., 2018). In Table 3.3, statistics from Trafikanalys (2019) of import and export of containers to the largest ports in Sweden are presented.

Table 3.3: Container traffic in Sweden (Trafikanalys, 2019)

Geographical area	Import (Loaded containers)	Import (Empty containers)	Export (Loaded containers)	Export (Empty containers)
Göteborg	296 278	80 946	342 724	42 965
Malmö-Helsingborg	132 701	18 388	91 109	45 522
Södra ostkusten	55 599	8 311	48 021	15 738
Halmstad-Varberg	27 081	7 474	25 185	11 410
Hudiksvall-Gävle	24 473	78 393	85 738	3 726
TOTAL	536 132	193 512	592 777	119 361

There is also an imbalance in the demand for the different sizes and types of containers needed. There is for example a higher need for reefer containers in Thailand which is creating an imbalance between reefer and dry containers (Song and Dong, 2015). According to Basarici and Satir (2019), there is currently no solution to this problem academically nor industrially. Transport of empty containers may still be significant in routes without trade imbalance since different types of goods require different types of containers (Song & Carter, 2009).

Operational drivers

The maritime industry is affected by seasonality where there is either a higher or lower need for producing and shipping goods. E.g. holidays, vacations in industry, or when crops are being harvested. There are three main owners of containers: ship operators, container leasing companies, and warehousing companies. In the case where the container is being unloaded at a location different from the return location, it leads to empty container movement. Maintenance and repair of containers are impacting ECR. Factors such as smell, and age will decide the condition of the container. Some containers could not be used for specific goods even though they have been cleaned. (Basarici & Satir, 2019)

In container transport, there are several operational activities such as port handling, customs clearance and disruption in any of these steps that may cause additional empty container movement. Vessels may need to change their schedule due to uncertainties at the port. According to Song & Carter (2009), the most frequent phenomenon is probably demand uncertainties. The shipping market is very competitive and to cope with demand uncertainties, shipping lines have invested in spare capacity. Even in overall balanced routes, empty repositioning is crucial for the total cost. There are other disruptions as well, such as weather conditions and traffic congestions (Song & Carter, 2009). Lack of information and tracking systems is causing blind spots in the supply chain. Therefore, the shipping lines might not always be aware of the exact location of the container or when the container is expected to be returned (Basarici & Satir. 2019). Further, it also hinders ocean carriers' ability to improve container utilization (Song & Dong, 2015).

Market effect
Ship operators have developed strategies where the hubs are nodes for high-volume cargo to transfer to secondary routes in the transport network. According to Basarici & Satir (2019), the ship operators try to avoid storage costs resulting in uncertainty to match containers and cargo, especially in highly competitive environments. If there is an export need from a terminal, the empty container may be sent to this terminal from the hub.

Ship operators are operating on different strings where the competition can vary depending on the terminal. The competition can generate more empty containers in certain routes. Basarici and Satir (2019) state that there is an unwillingness to share containers between ship operators. There could be an imbalance between inbound and outbound traffic in a certain region for a ship operator, and consequently empty containers need to be transported. According to Song and Carter (2009), some carriers send the empty containers back as soon as possible while others may hold equipment for a month in hope that exporters will match their empties before sending them back.

3.2.3 Supply chain activities affecting ECR

Supply Chain Planning
Supply chain planning includes the coordination and integration of business activities from procurement of raw material to distribution of the final product to the end customer (Gupta & Maranas, 2003). Today's changing markets have made efficient and flexible supply chains critical for all businesses. The uncertainties can be divided into short- and long- term. Short-term uncertainties can be day-to-day variations, equipment failure, canceled orders, etc. Long-term uncertainties can be price fluctuations, production changes over a long time and seasonal demand variations. Transport is no longer treated separately from supply chains, it is a vital part and its development significantly influences the expanding global supply chains (Kuzmicz & Pesch, 2017).

The problem of empty container repositioning also has a negative impact on the shippers. Due to trade imbalances, there is a risk of insufficient quantity of containers at certain locations which consequently will affect an exporters ability to ship its goods in time. To cope with this problem of container unavailability, shippers can either make double bookings of containers and make last-minute cancelation or book an empty container even though the pick-up date is currently unknown. If exporters are taking these kinds of actions to secure empty containers, it will create further difficulties for shipping lines to forecast the demand for empty containers and consequently, the uncertainty regarding empty container availability will be aggravated (Ng, 2012)

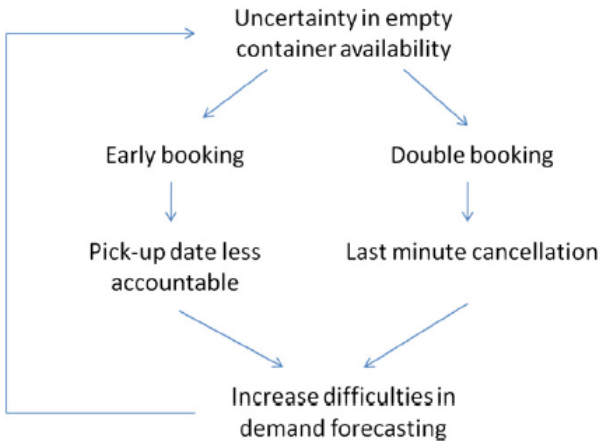

Figure 3.3: Container booking cycle (Ng, 2012)

To improve the accuracy of the demand for empty containers, shipping lines are using contracts with large shippers or freight forwarders where the shippers communicate the number of empty containers needed during a time period which then can reduce the uncertainties of empty containers. Furthermore, to remove the need of making bookings with multiple shipping lines, a business platform can be used to show the availability of empty containers for the different shipping lines. With higher transparency, the need for double bookings and also uncertainty in empty container availability is reduced (Ng, 2012). Zeng, Chan & Pawar (2020) emphasizes the need for an integrated business platform as the current container booking process involves several actors where the communication goes back and forth between the actors until the booking is completed. By having a centralized integrated system, the information flow would be improved along with higher transparency.

In the empty container handling, the importers also must take the detention fee and free days into consideration in the planning. Shipping lines can offer free time to the importer, which refers to the number of days the container can stay at the importer's premises without any cost. After that time, the importer must pay a detention fee for every day the container stays at the premises (Legros, Bouchery & Fransoo, 2016). Furthermore, Legros et al. (2016) state that there is a lack of incentive for importers to be more involved in the empty container management because of the detention fees. Consequently, a changed detention fee structure could increase the incentives for importers to be more involved in container management.

Forecasting

Forecasting is used as a basis for making decisions about future activities, where information assessment about how external factors can influence the upcoming operations is critical for qualified decision making (Jonsson & Mattsson, 2009). The forecasting concerns strategic, tactical, and operational decisions of the demand for a company's products. High demand uncertainty is directly connected to the ability to generate accurate forecasts.

According to Diaz, Talley & Tulpule (2011), ports forecasting future demand for containers has gained little attention in the literature. To know how many containers will be required in the future, container ports are usually using a statistical regression model for forecasting the volumes. Such statistical models consider international trade growth and macroeconomics variables. The 'shift and

share' model is also used by ports, this model forecasts international trade by major commodity, then the forecaster trade is divided into shares that would potentially be handled by a specific port.

It is difficult to forecast import since it is a volatile component that influences trade balances and fluctuations in GDP. Compared to other economic aggregations, such as private consumption and export, imports do not have reliable indicators. An often-used source of indicators is surveys, business, and consumer surveys that do not include future import information (Grimme, Lehmann & Noeller, 2018). Therefore, import expectations from firms and households are not available as a primary source of information. Expected exports of a foreign country are on the other hand determined by consumers and business confidence in its trading partners and the country's competitiveness position.

Ordering
Together with forecasting, customer order contains the information needed for the master production schedule. The ordering process varies considerably between different companies. In a manufacturing company, the order process starts with a customer's need and ends when the product has been delivered. If it is a standardized service, the need can directly result in an order. In other cases, the inquiry may be a request for quotation, which the supplier must answer to make it an order. The supplier must then make a general design, come up with a price offer and possible delivery dates (Jonsson & Mattsson, 2009).

3.2.4 Drivers to reduce ECR

Financial
Globally, approximately 25% of the containers in the maritime container flow is empty which is incurring large costs for the shipping lines where substantial cost savings can be achieved if ECR is reduced (Kolar et al., 2018). On a regional level, reducing ECR will benefit actors financially. From the transport buyer's perspective, the main empty container repositioning is being carried out to and from the port or container depot. By reducing ECR the transportation cost can be lowered. By increasing the utilization of the containers, the shipping lines can also reduce costs by not having to pay for gate fees and terminal handling costs of the container (Breakers et al., 2011)

Environmental
According to Li, Wang & Cook (2014), maritime transport constitutes for about 80% of the total merchandise trade volume. Having a green supply chain is becoming an increasing source of competitive advantage for companies and critical to sustaining the advantage. To create a successful green supply chain there is a need for collaboration between actors. The handling and movement of empty containers create environmental issues (Li et al. 2014). Efficient handling of empty containers is important for reducing carbon emissions where an operational activity-based method is to prefer (Song & Xu, 2012). Breakers et al. (2011) further state that a reduction in ECR also will reduce congestion and air pollution.

3.2.5 Actions to reduce ECR

This section presents methods to reduce ECR. Methods to reduce ECR from a transport buyer's perspective are limited in the literature and therefore a broader perspective of methods is presented below.

- **Street-turns**
- **Collaboration**
- **Foldable containers**
- **Connectainers**
- **Container substitution**
- **Grey box pools**

According to Legros et al. (2019), street-turns are considered to be one of the best methods to reduce empty container repositioning in the hinterland. Street-turn is a method where a collaboration between importers and exporters is utilized. After the importers' container has been unloaded, an exporting match in the nearby area is located to be used by the exporter. Street-turns reduce the need for empty repositioning of the container to a depot or the port (Kuzmicz & Pesch, 2019). It is not only beneficial for the importing company as the empty return cost can be eliminated but the shipping lines can reduce costs of sending back empty containers to exporting companies while simultaneously increasing the utilization of the containers (Legros et al., 2019). According to Legros et al. (2019), previous literature stated that a street-turn utilization of approximately 10% has been reported, whereas their study shows that a much higher number can be achieved if the importer is working proactively with the management of empty containers. It is also important to note that the potential of street-turns is highly dependent on the setting.

Legros et al. (2019) interviewed several shipping lines where some were reluctant to transfer the handling of empty containers to the consignees because they would lose control over the containers although cost savings and container utilization could be increased.

There are different types of collaboration within a supply chain: vertical and horizontal collaboration. Vertical collaboration means collaboration with customers or suppliers and horizontal means collaborating with competitors or other organizations (Barratt, 2004). According to Renko (2011), vertical collaboration is easier to establish than horizontal.

According to Scholten and Schilder (2015) collaboration in the supply chain has many advantages, such as finding synergies among actors and exchange of information which is important when trying to cope with disruptions in the supply chain and reduce the effect of the disruptions.

Container sharing has the potential of reducing the costs connected to empty container repositioning. This can be achieved through horizontal collaboration with the companies that own the containers. The collaboration can increase the backhauling which can contribute to the reduction in transportation of empty containers. Despite being able to reduce empty transport and transportation costs, Kuzmicz & Pesch (2019) states that routing optimization methods generally is better from an economic perspective than container sharing. In addition to street-turns and collaboration, which can be applicable for transport buyers, there are several other methods.

Foldable containers have several advantages compared to standard containers. Firstly, the storage space needed for a foldable container could be reduced by up to 75% depending on the design of the container. The benefits of this are more efficient storage of containers, reduced transport costs. One barrier to reach a wider implementation of the foldable containers is the production cost and because carriers already have invested in standard containers (Kuzmicz & Pesch. 2019). Moon, Ngoc & Konings. (2013) analyzed the costs related to foldable and standard containers and it showed that if the price of foldable containers could be lowered to 50% higher than a standard container, it would be beneficial from an economic perspective to use these.

Connectainers is a 20ft container that can be connected to another container to form a 40ft container. The connectainers have the same dimensions and quality such as water resistance as a regular container. It takes about 30 minutes for two connectainers to be fitted together (Kuzmicz & Pesch. 2019). By using container substitution two 20ft containers can be substituted to a 40ft container provided that the cargo can be transported in the same container. One barrier for this method to be used more frequently is the lack of substitution rules (Kuzmicz & Pesch, 2019).

Currently, the containers are owned by either a shipping line or a container leasing company. There is also an unwillingness to share containers between container owners which is creating additional complexity to increase the utilization of containers. A grey box pool removes the ownership of the containers to create a common container fleet and therefore the utilization of the containers can be increased (Boile, Theofanis & Mittal, 2004).

3.2.6 Barriers to reduce ECR

Five barriers to reduce ECR for transport buyers were identified in the literature which will be presented below.

- **Container ownership**
- **Timing mismatch**
- **Free time, demurrage, and detention fee**
- **Location mismatch**
- **Container type and condition**

Each container is owned or controlled by a shipping line. There is an unwillingness to share containers between the different shipping lines. Therefore, if an imported container is going to be reused for an export flow, there has to be a match of shipping lines for both flows. Otherwise, the importer has to reposition the empty container to the port and the exporter has to retrieve an empty container from the port which will result in additional container movement and costs (Monios & Wang, 2014)

Legros et al. (2019) interviewed several shipping lines where some were reluctant to transfer the handling of empty containers to the consignees because they would lose control over the containers even though cost savings and container utilization could be increased.

Legros et al. (2016) state that the current detention fee structure is a barrier for transport buyers to be more involved in empty container management. In a study performed by Legros et al. (2019), the detention fee was seen as one of the main barriers to use street-turns by importers. The reason behind

this is that the interviewed companies felt that there was not enough time to find an exporting match before incurring detention fees. Furthermore, shipping lines are planning to charge a fee for freight forwarders using street turns. According to Lopes (2019) and Mongelluzzo (2019), Maersk, HMM, and ZIM will charge 30-75 dollars for "reuse of equipment" in the US depending on the carrier.

Breakers et al. (2011) argued that timing mismatch is a barrier to reduce ECR when using street-turns. For it to be possible, the import and export flow needs to be aligned for the flows to match. If the flows do not match, there is an unwillingness to keep the container at the importers' premises for too long as detention fees can be charged. Resources, economic activities, and populations are randomly distributed around the globe. According to Rodrigue (2020), all activities are located somewhere, and each location has its characteristics, such as supply and demand for resources, products, labor, and services. Some locations have surpluses of different resources while other locations have deficits. The only way to create balance is by moving goods between locations with a surplus to the locations with a deficit. Furthermore, the movements have different scales, local, regional or global geographies (Rodrigue, 2020).

Legros et al. (2019) stated that handling and cleaning costs are seen as a barrier for transport buyers to increase the handling of empty containers, implement street-turns and consequently reduce ECR. Di Francesco (2007) states that inspection of containers can create problems when using street-turns. If the container used by the importer is not living up to the standard needed for the exporter, container availability can become a problem as the container might have to be repaired. This problem origins from the fact that the allocation of containers is planned before the inspection of the container are performed. Basarici & Satir (2019) stated that a mismatch of the type and size of containers can be a barrier to reduce ECR. If the container is going to be reused, there has to be a match of container type and size between the importer and exporter.

3.2.6 Covid-19 pandemic

The Covid-19 pandemic has distorted the global trade network and created major disruptions in the supply chains. Theoretically, the economic fundamentals may shift due to disruptions such as pandemics. Covid-19 has impacted world trade in several aspects. Vidya & Prabheesh (2020) present a study where trade between the world- leading economies such as Canada, the US, France, Germany, UK, Japan, India, and China has been analyzed. The network centrality parameters indicate that the overall trade density has reduced by more than 50% in Q1 2020 compared to 2018. Many countries are dependent on Chinese exports for production, therefore China is considered as the center in the trade network before the Covid-19 pandemic. Even though the pandemic originated in China in December 2019, their relative position in the trade network has not drastically changed. In contrast, South Korea has become a peripheral economy during Covid-19 from having been a center economy (Vidya & Prabheesh, 2020).

The Covid-19 pandemic and its impact on global supply chains have changed focus in the shipping industry, from capacity and vessels to individual containers. Exporters in Asia are trying to find available containers to load goods while other parts of the world, especially the US, struggle with a lack of infrastructure and workforce to handle surging inbound goods, delaying the return of empty containers (Leng, 2021).

The maritime container freight shipping has been boosted by strong demand for Chinese export during Covid-19, resulting in a shortage of vessels (eNCA, 2021). Also, there is a critical shortage of

containers in China, because many of them are taking longer in the US and Europe in the Covid-19 crisis (DW, 2021). The ports face huge problems, due to lockdowns and sick leaves, there is a shortage of staff resulting in ships having to wait for about 10 days to enter the port for unloading. Empty containers tend to be at sea much longer due to different kinds of delays, not only due to disruptions in ports but also on canals and inland transport (DW, 2021). The Freightos Baltic Container Index (FBX), which is an index of shipping cost, has almost quadrupled for the China-Europe route since the beginning of November. For the shipping lines, this means higher profits. Hapag Lloyd, Germany's largest container company, expects their earnings of at least €1.25 billion in the first quarter of 2021, compared with €160 million in the same period last year (DW, 2021).

One reason for the increased export from Asia is the rising need for medical equipment, in 2020, China exported 220 billion face masks. But, according to UniCredit Bank economist Andreas Rees, the most important reason is that people have re-allocated their demand. Instead of traveling and going to restaurants, people spend money on furniture, electronics, etc. Therefore, container demand has increased exponentially. It is expected that spending will normalize in the middle of 2021 (eNCA,2021).

Managers are expected to re-examine today's global production systems with complex value chains including international shipping of billions of components (Sarkis, Cohen, Dewick & Schröder, 2020). The Covid-19 pandemic exposes the vulnerability of relying on just-in-time delivery systems and resilience has become an important subject. Sarkis et al. (2020) believe that production systems and supply will be more localized in the future to avoid disruptions. On the other hand, Baldwin & Tomiura (2020) mean that supply chains were internationalized to improve their productivity and that a pandemic is not a justification for anti-globalism. Dual sourcing from multiple countries is an alternative to reduce dependency on specific countries, such as China.

4. Findings

This chapter presents the actors, drivers and barriers, action, and the Covid-19 pandemic related to the empty repositioning of containers.

4.1 Actors

In this section, a short company description and their empty container repositioning flow are presented. See Table 4.1 for overview of interviewed companies.

Table 4.1: Overview of interviewed companies

Company	**Business area**	**In-house container management or freight forwarder**
Imp1	Retail business	Freight forwarder
Imp2	Sports equipment	Freight forwarder
Imp3	Home furnishing	In-house
Exp1	Forest industry	Both
Exp2	Textile	Freight forwarder
Exp3	Forest industry	In-house
Forw1	Freight forwarder	N/A
Forw2	Freight forwarder	N/A
Forw3	Freight forwarder	N/A

4.1.1 Importers

Below, the importers are presented

Imp1
Imp1 has approximately 100 stores located in Sweden, Norway, and Poland. The stores sell a wide variety of products with a focus on homeowners and craftsmen. In 2013, Imp1 was involved in the expansion of a dry port close to Imp1's central warehouse to meet the increasing demand. Imp1 has a logistic function involved in a dry port operation. Also, a rail connection has been established from Germany to Sweden with three to four departures each week. The interviewed Freight Manager described that Imp1 imports about 60% of the goods from Asia, 35% from Europe, and the remaining 5% from Sweden. The total volume adds up to 12000 TEUs per year and all containers are sent to the central warehouse before distributing the goods to the stores.

From the port of Gothenburg, the goods are transported by train to the dry port and then to the central warehouse. The dry port is of great importance according to the Freight Manager for the handling of

empty containers, it is close to the central warehouse and increases the availability of empty containers.

After an import container has been unloaded at the central warehouse, Imp1 informs the freight forwarder that the container is ready for pick-up in the order management system. Imp1 has a close collaboration with Forw3, both parties are transparent with information in the order management system. Imp1 does not want to store empty containers at their central warehouse and aims to send the container to the dry port directly after it has been unloaded. The empty container is Forw3's responsibility after it has been unloaded by Imp1.

Imp2

Imp2 is a family-owned company that sells various kinds of sports equipment. The company mainly operates in Sweden but also has stores in Finland, Norway, and Denmark. The interview was conducted with the Logistic Operations Manager of Imp2. The majority of Imp2's goods are shipped from Asia to Sweden. The ship arrives at the port and from there the containers are transported by road to the distribution centers located two kilometers from the port. Imp2 has three distribution centers in proximity to the port from where all goods are distributed and transported to the stores. Imp2 imports approximately 5000 TEUs in one year, the volumes vary a lot over the year due to seasonality.

A freight forwarder has the responsibility for the container transports and Imp2 has no direct contact with the shipping lines. Imp2 fills in information in the freight forwarder's order management system, which in turn books the shipment with the shipping line. Some communication is also conducted by email and phone. A local hauler performs the transport between the port and distribution centers. The unloaded empty containers are transported back to the port by the truck delivering the containers with goods. The container is usually returned the same day after being unloaded.

Imp3

Imp3's business model aims to offer a wide range of home furnishings. Imp3 has stores all over the world. Imp3 has mainly import to Sweden, 25000 TEUs, but also exports 20000 TEUs from Sweden each year. The containers arrive at the ports in Gothenburg or Helsingborg. From Helsingborg, the goods are transported by train five times a week and the goods from Gothenburg are transported by rail to the central warehouse located in the south part of Sweden.

After the container has been unloaded it is returned to the port or used for the export flow. However, no information was provided on how often the imported container can be used for the export flow. Imp3 manages the logistics by themselves and there is no need for a freight forwarder, Imp3 contacts the shipping line directly and book transport from the port to the warehouse and back to the port at once. The imported goods mainly come from Asia.

Imp3 works with all the major shipping lines and strives for having a few partners with big container flows. Agreements are discussed every year and extensive contracts are seen as an enabler for creating synergies. The communication between Imp3's logistics department and the shipping lines is mainly by email, but there is an ongoing project for a more digitized integrated solution for the transport information. Imp3 publishes long-term forecasts four times a year and weekly short-term plans of container requirements. The shipping volumes are stable over the year and if changes occur, the shipping lines are informed.

4.1.2 Exporters

Below, the exporters are presented.

Exp1
Exp1 is a trading company that offers several products within the forest products supply chain such as pulp, paper and packaging, recovered material, and bioenergy. Exp1 is represented worldwide and has its own sales offices.

Exp1 uses both freight forwarders and their own logistics department to book shipments. As Exp1 is a trading company, they book spot shipments and by using a freight forwarder, they can get more buying power compared to going to the carriers directly. For the bigger goods flows, Exp1 can go directly to the carrier to book shipments. They do not own any containers. Exp1 communicates with the carrier either through the carrier's booking system or through email to a contact person. Most of the communication is done via email. Once the container has arrived at the exporter's premises, it is stuffed immediately and thereafter transported back to the port.

In the current situation, Exp1 needs to book large shipments a couple of months in advance because of the shortage of empty containers compared to before Covid-19 when a container could be booked 2-4 weeks in advance. Though it is not only the shortage of empty containers which is creating a problem, it is also the lack of space on-board vessels. Exp1 states that they are relatively small actors which hinders their ability to affect the availability of empty containers.

For their large export flows, Exp1 provides the shipping lines with forecasts on the number of empty containers needed during a period to ensure the availability of empty containers.

Exp2
Exp2 is a textile manufacturer and offers interior solutions. Their products are specialized for climate control and energy efficiency, where greenhouses are large customers. Exp2 has two production sites, the biggest one is located in Sweden and the other one in China.

The main container transport flow is from Sweden to the Netherlands. Every week, 2-3 containers are sent from Sweden to the Netherlands where Exp2 has its sales office, a lot of this transportation is by train. In addition to the main flow, 1-2 containers are sent weekly to the US, Mexico, Japan, China, or South Korea and sent by sea via the port of Gothenburg. Almost all the textile that is produced in Sweden is exported to foreign countries, usually the containers are used as intermediate storage at the factory site before being shipped. On average, the containers are loaded for 2 or 3 days before the freight forwarder picks them up.

Exp2 has a close relationship with a small freight forwarder based in Gothenburg. The container transport booking is performed by mail or phone, the freight forwarder receives a booking from Exp2 and takes over the responsibility from there. Exp2 has no information about the container transport process except the estimated time for the arrival of empty containers and the time for when the containers are picked up after being loaded with products. The demand for container transport is stable and if changes occur, the freight forwarder is contacted as early as possible.

Exp2 also has a container import flow from Turkey once a week, every sixth week the container is loaded with material from Sweden before sending it back to Turkey. The other five weeks, the

container is picked up empty and the freight forwarder transports it to the port. This is also coordinated by the freight forwarder.

Exp3
Exp3 has five business areas: forest, wood, pulp, paper, renewable energy, and purchasing and logistics. 14% of the products are sold in Sweden and the rest is exported, mainly to Europe.

Exp3 manages its own logistics and owns feeder vessels that transport containers from the northern part of Sweden, Sundsvall, and Umeå, to ports in Europe. Exp3 transports other company's goods as well which adds up to a total of 900-1000 TEUs weekly. In general, Exp3 contacts the shipping lines directly for the transport booking but if a freight forwarder can offer a better price Exp3 lets them do the bookings. Exp3 must import empty containers to fulfill the high export volumes from the north part of Sweden. Because Exp3 operates vessels from northern Sweden to Europe and back, they have the possibility to pick up empty containers from e.g. Stockholm and St. Petersburg which have an empty container surplus. A vast majority of the goods are loaded into containers at the port in northern Sweden, meaning that inland container transport is very unusual. Furthermore, a lot of import to northern Sweden does not arrive in containers. Exp3 has no import of containerized cargo but keeps track of companies that use containers for import to use those for export.

Exp3 uses several IT systems for container transport, one system internally and various EDI-systems against the shipping lines. Currently, there is an ongoing IT project to facilitate a more efficient transport booking process.

4.1.3 Freight Forwarders

Below, the freight forwarders are presented.

Forw1
Forw1 offers logistics solutions for companies in several industries. Forw1 makes use of sea, road, rail, and air transport to cover the entire supply chain.

Forw1 books a container at the shipping line and picks it up at a terminal after receiving a customer order. The container booking is performed through an EDI system and within 24 hours Forw1 receives the information from the shipping line, such as departure time and route. Forw1 uses EDI with its largest customers but otherwise, phone and email are used and Forw1 must fill in the information manually in their system.

Forw1 receives forecasts from the largest customers and with that information makes their forecast of the demand for containers. These forecasts are in turn sent to the shipping lines to ensure that the desired number of containers are available. Forw1 does not have much insight in the empty repositioning but tries to match import and export flows. For this to be possible, the import and export department has to collaborate to match both flows and also use the same shipping line for the import and export shipment. The main issue is to keep track of which ports that have surplus and deficits of empty containers.

Forw2
Forw2 offers services within construction, transport, and logistics container transport. Forw2 transport containers by both truck and rail. They also have two container depots in Sweden where containers can be stored, repaired, and inspected. Furthermore, Forw2 is operating two combi terminals where they offer services including loading of containers, stripping and stuffing of goods, customs clearance, and documentation handling.

When Forw2 receives a booking for a container transport, information regarding pick-up date, place of pick-up, destination, and empty return destination for the container are stated. The communication between the customers and Forw2 is mainly conducted through email and in some cases through Forw2's ordering system. Most often the container is returned to the same port where it was picked up. Forw2 uses a rail connecting from the port of Gothenburg to three locations in Sweden, two nearby Stockholm, and one nearby Jönköping. From these locations, the goods are transported by road to the end customer. Once the laden container has been emptied, the customer contacts Forw2 and it is returned to Forw2's combi terminal and then transported back to a container depot or port. One of the combi terminals is located in between the rail connections near Stockholm and the other one is located in Helsingborg. Once an import customer has emptied their container and Forw2 has an export transport from a customer in the area, the container can be transported directly to the exporter given that the export customer uses the same shipping line and agrees with the price. The exporting company inspects the container and if it is in poor condition it will be returned to the port and a new container will be transported to the exporter. Forw2 stated that they tried to send the imported container to an exporter as much as possible but no information regarding how common it is was provided. Furthermore, Forw2 has to contact the carrier and get confirmation that the exporting customer can use the same container.

Forw2 receives forecasts from their largest customers approximately 4-6 weeks before the vessel arrives. This facilitates the ability to manage fluctuations in demand. In case of large demand and if an exporter has a large number of shipments, Forw2 can save empty containers and use these in the export shipments. Bookings can also arrive the day before the shipment is supposed to take place, these kinds of bookings come from small customers. Forw2 has a large number of small customers, therefore short notice bookings are common.

Forw2 generally does not have any influence on where the container should be transported as the shipping lines are the owners of the containers. Therefore, Forw2 states that the shipping line has the final say if the empty container should be returned to the port where it was picked up or if it can be used for an export customer.

Forw3

Forw3 offers logistic solutions for both companies and private customers, such as air and ocean freight, 3PL, and intermodal transport solutions. In addition to their transport offerings, they have expertise within information services. Forw3 uses truck-, rail-, road- and air transport all over the world. Furthermore, Forw3 offers both Full Container Load and Less-than-container Load where the ocean transport is connected to their inland transport network.

When Forw3 receives a container transport order they book a container, pick it up at a container depot and transport it to the customer. The majority of the information goes through the order management system. The customer places an order in the system and fills in weight, volume, container number, etc. and Forw3 fills in the departure times. In the order management system, Forw3 receives forecasts from their largest customers for the coming 6 weeks, these forecasts are adjusted every week.

When the container has been unloaded, there are two options. If the export customer uses the same shipping line as the import customer, Forw3 can transport the container directly to a nearby customer, otherwise, it is returned to the port or depot. Forw3 did not provide any information about how often street-turns were used. If the container goes directly to a new customer, an inspection is made to ensure that it is in proper condition. It is Forw3's responsibility to ensure the condition of the container so if the new customer complaints, Forw3 has to take the container back to the depot and fix it. Forw3's container transport consists of about 75% import and the remaining 25% export. Most of the goods come from China, Forw3 transport containers from over 40 different ports in Asia where different shipping companies operate in each port.

4.2 ECR flows

Six types of ECR flows were identified from the interviews: import and export flow with and without a dry port, street-turn, and reusing containers internally which are summarized in Table 4.2. In Figure 4.1, 4.2, 4.3 and 4.4, the solid line indicates loaded container transport and the dotted line empty container transport.

Table 4.2: ECR flows

ECR flows	**Empirical data**
Flow 1a - import	Imp2, Imp3, all freight forwarders
Flow 1b - import with dry port	Imp1, Forw3
Flow 2a - export	All exporters, all freight forwarders
Flow 2b - export with dry port	Forw3
Flow 3 - street-turn	All freight forwarders, Exp1
Flow 4 - reusing container internally	Imp3, Exp2

4.2.1 Flow 1a and 1b - import

The most common ECR flow for importers is flow 1a where the loaded container is transported from the port to the importer. Once it has been unloaded, it is returned to the port. This was mainly the case for Imp2 and Imp3. Alternatively, as in Imp1, the empty container is transported to a dry port instead of being returned to the port (flow 1b). Imp1 and Imp2 use a freight forwarder to handle the container flow. When the container is unloaded, Imp1 and Imp2 contact the freight forwarder through an order management system that coordinates with a transport operator and the shipping line to return the container to the port. Imp3 who manages its own container flow contacts a transport operator and shipping line to return the container to the port. See Figure 4.1 for an illustration of flow 1a and 1b.

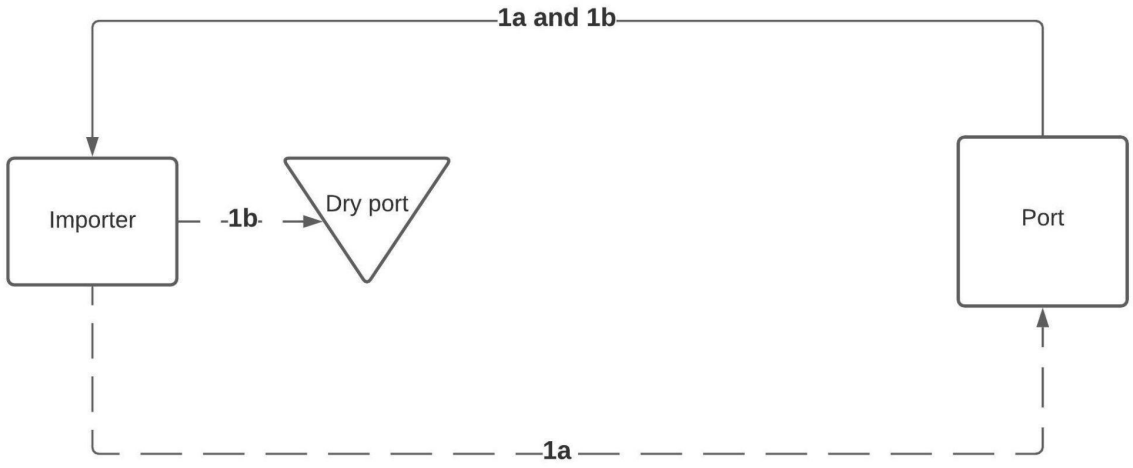

Figure 4.1: Import ECR flow.

4.2.2 Flow 2a and 2b - export

The most common flow for export flows is flow 2a where an empty container is transported from the port to the exporter. The container is loaded at the exporter's premises and thereafter returned to the port. Alternatively, the empty container can be picked up at a dry port instead of the port (flow 2b), but none of the interviewed exporters used this. Forw3, on the other hand, stated that they use a dry port to supply their export customers with empty containers when possible. The dry port can be used if there is a container ownership match between the container at the dry port and the export shipment. The information flow is similar to process 1. The exporter contacts the freight forwarder which then coordinates with a transport operator and the shipping line to pick up an empty container at the port or dry port. Afterward, the loaded container is transported back to the port. Flow 2a and 2b are illustrated in Figure 4.2.

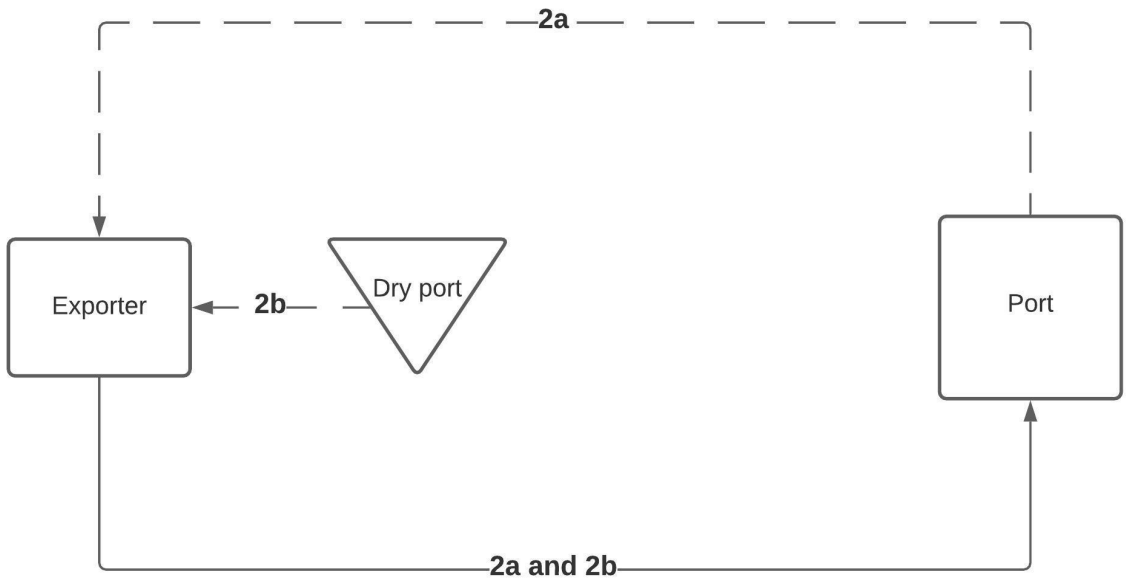

Figure 4.2: Export ECR flow

4.2.3 Flow 3 - street-turn

In flow 3, a loaded container is transported from the port to the importer's premises. Instead of returning the container to the port, as in process 1a, it is transported directly to an exporter and thereafter the loaded container is transported to the port. Before performing a street-turn, the freight forwarder or Exp1 needs to contact the shipping line and get confirmation that the container can be transported from the importer directly to the exporter. All the freight forwarders and Exp1 used this flow in combination with flow 1 and 2. See Figure 4.3 for illustration of flow 3.

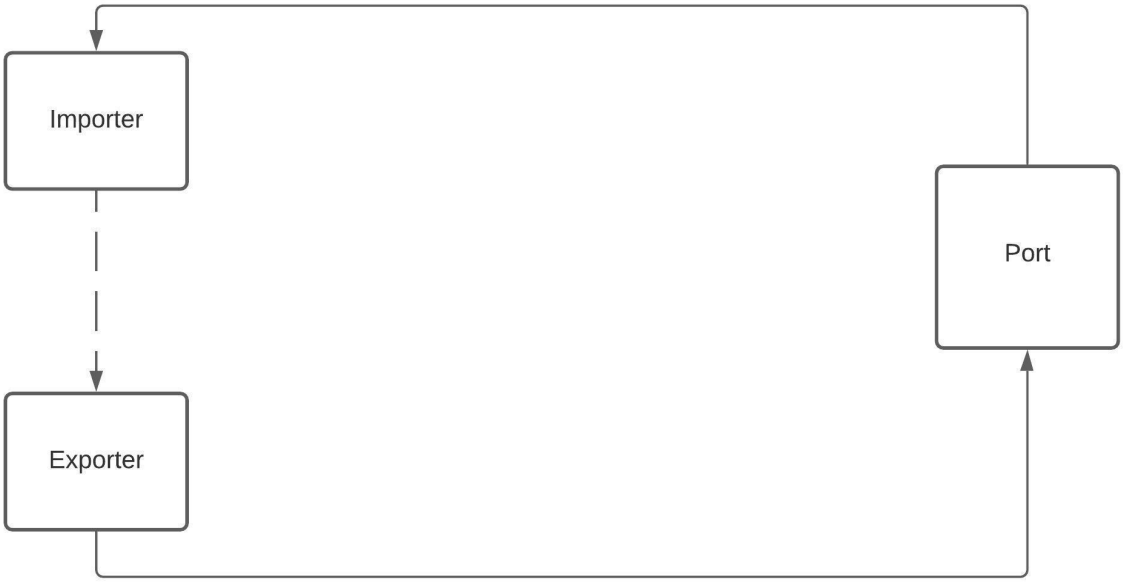

Figure 4.3: Street-turn ECR process

4.2.4 Flow 4 - reusing container internally

Two companies, Imp3 and Exp2, have both an import and export flow. Once an imported container has been unloaded, it is not returned to the port. Instead, it is loaded for the export flow and thereafter transported to the port. By using this flow, there is no need to return the empty imported container to the port and transport an empty container from the port to the company to the export flow. As for street-turns, the shipping line has to confirm that the container can be reused for the export flow. This process can only be used when a company has both an import and export flow. Also, using the same shipping line, container size, and type for the export and import flow. Therefore, this flow is not applicable for the other interviewed companies in the study. See figure 4.4 for illustration of flow 4.

Figure 4.4: Reusing container internally ECR flow

4.3 Drivers

In this section, the drivers for reducing empty container repositioning, from the perspective of transport buying companies, are presented. See Table 4.3 for summary of drivers to reduce ECR.

Table 4.3: Summary of drivers to reduce ECR.

Driver	**Empirical data**
Increase profit	All freight forwarders
Reduce empty repositioning cost	Exp1, Imp1
Increase empty container availability	Forw3, Forw1, Exp1
Environmental	All actors

4.3.1 Increase profit

All freight forwarders agreed that by reducing ECR, the profit can be increased. If street-turns are utilized where the empty container is transported directly from the importer to the exporter, the freight forwarder can reduce the empty repositioning cost and therefore increase the profit for the shipments. For instance, import customers pay for the transport of a container from the port to their premises, and back to the port. Instead of sending the container back empty, the freight forwarder can use the container for an export customer.

4.3.2 Reduce empty repositioning cost

Exp1 and Imp1 argued that the empty repositioning cost reduction is seen as a driver to reduce ECR. However, the companies who used a freight forwarder are not carrying the empty repositioning cost towards the transport operator, it is the freight forwarder who is carrying this cost and then invoicing the importer or exporter. Therefore, this driver is mostly applicable for the importers and exporters who are responsible for their own logistics because these companies can reduce the ECR cost directly.

4.3.3 Increase empty container availability

Exp1, Forw1, and Forw3 stated that a driver for reducing empty repositioning is to increase the availability of containers. Street-turns and container depots were mentioned as possible solutions to increase the availability. It is crucial for Forw1 and Forw3 to have available containers to be able to serve their customers since it is their responsibility to ensure transportation. Also, the importing and exporting companies are interested in container availability for selling or buying goods to suppliers and customers. Even if the freight forwarder has the main transport responsibility, Exp3 stated that they are working with container availability. Before the Covid-19 pandemic, the availability of empty containers was not seen as a problem for any company in this study. But since lockdowns and other disruptions caused by the Covid-19 pandemic have led to a shortage of empty containers, the companies have been more committed to finding available containers themselves.

4.3.4 Environmental

As with the financial perspective, all actors state that reducing environmental impact is a driver to reduce ECR but most of the interviewees argued that there has to be a financial win to ECR. The

financial and environmental impact are connected in the way that if ECR is reduced and fewer containers are being transported empty, the environmental impact will consequently be reduced. Exp2 stated that sustainability is getting increasingly more important where in some cases the customers are requiring Exp2 to declare the emissions from the transports and are expecting sustainability initiatives.

4.4 Actions

In this section, the different actors' actions for reducing empty container repositioning are presented. See Table 4.4 for summary of actions to reduce ECR.

Table 4.4: Summary of actions to reduce ECR

Action	**Empirical data**
Street-turn	All freight forwarders Exp1
Dry port	Forw3, Imp1
Reusing containers internally	Imp3, Exp2
Collaboration	Exp1, Forw3, Imp1

4.4.1 Street-turn

All the freight forwarders and Exp1 used street-turns to reduce ECR. The freight forwarders used their customer base to find possible matches between importing and exporting flows. To use street-turns, the freight forwarders have to get confirmation from the shipping line that the container can be transported directly from the importer to the exporter. Receiving confirmation from the shipping line is usually not a problem however the Covid-19 pandemic has made it more difficult to get confirmation because of the container shortage. The order management system and transparency of information were also stated as key components for making it possible to utilize street-turns. Information about container ownership, free days, and availability is needed for utilizing street-turns. Exp1 tried to find importers in the area to use street-turns. When asked if street-turns could be used, many saw it as a possibility if a collaboration with other actors in the area would be established. However, much of the responsibility of using street-turns is placed on the freight forwarder, therefore none of the other importing and exporting companies were using street-turns.

4.4.2 Dry port

Imp1 has a dry port located close to their central warehouse, the dry port is also used for storing empty containers and can therefore also be seen as a container depot. Forw3 is handling Imp1’s transport and can therefore utilize the container depot for other customers as well. The dry port currently has about 30 companies using it, meaning that Forw3 can store a large number of containers at the dry port, close to their customers. Thereby, the empty container transport becomes shorter compared to sending the container to the port and back again. Forw3 stated that to efficiently utilize a dry port, it is important that a large number of shipping lines, freight forwarders, importers, and exporters have a contract with the dry port to ensure a high degree of container availability.

4.4.3 Reusing container internally

This action can only be used for companies who have both an import and export flow which Exp2 and Imp3 had. The main method these two companies used to reduce ECR was to reuse the imported containers for the export flow. This method can be seen as a form of street-turn, but the containers are being used internally instead of being transported between two different companies. The benefit will also be similar to using street-turns for example the empty container transport to and from the port can be reduced. Exp2 had a relatively small export flow compared to the importing flow and therefore the opportunity to reuse the container did not occur very often. If the container is to be reused internally, the import and export flow must match from a time perspective, the container type, size, and ownership also have to match.

4..4 Collaboration

From the interviews, it was clear that collaboration with other actors was a key part for reducing ECR. Only Exp1 expressed they were collaborating horizontally by collaborating with importers in the area to increase the availability of empty containers. By doing this, Exp1 could utilize the importers' containers and use them for their export flow through a street-turn. This is beneficial for both companies as the cost of ECR is reduced. None of the other importers or exporters had any horizontal collaboration with other importers or exporters.

Instead, vertical collaboration was more common, mostly the collaboration with an importer/exporter and a freight forwarder. It was also expressed that having a close relationship with other actors could help overcome some of the barriers. For example, container ownership mismatch was a common barrier among the interviewed companies and Forw1 stated that this barrier could be reduced by working closely with customers and seeing the benefit of adapting the shipping lines used to reduce ECR through street-turns and consequently reducing costs and environmental impact. If a shipping line has not yet been booked for a future export shipment, it can be chosen according to the import shipment to match the shipping line for both flows as long. Once Exp1 has found a new supplier, then they are scanning the market to find new importing companies in the area to collaborate with to use the importer's container for their export flow. Imp3, which is handling its own logistics, is currently not collaborating with other importers or exporters to reduce ECR but is seeing it as a possibility to enter a collaboration with other companies in the area to reduce ESR by transporting their empty container to a nearby exporter.

4.5 Barriers

In this section, the barriers for reducing empty container repositioning are presented. See Table 4.5 for summary of barriers to reduce ECR.

Table 4.5: Summary of barriers to reduce ECR

Barrier	**Empirical data**
Container ownership mismatch	All freight forwarders Imp3 Exp1
Timing mismatch	Exp2
Trade imbalance	All freight forwarders Exp3
Spot shipments	Exp1 Imp3
Responsibility for ECR	Exp2 Imp2
Lack of transparency	Forw2 Exp3 Exp1
Location mismatch	Forw1 Exp3 Imp3

4.5.1 Container ownership mismatch

The container ownership mismatch was a commonly mentioned barrier to reduce empty repositioning which mostly applies to the freight forwarders and the companies who are handling their own logistics as they are the ones booking the transport with the shipping lines. All freight forwarders agreed that container ownership mismatch is a barrier to reduce ECR. To use street-turns or reuse containers internally, the shipping line used for the import and export flow has to match. Therefore, if there is a container ownership mismatch, the companies are unable to reuse the containers by using street-turns or reusing them internally. Forw2 for example argued that this is one of the main barriers to reducing ECR as they mostly use street-turns to reduce ECR and this can only be achieved if there is a match between the shipping lines for the import and export flow. Imp3 who has its own logistic function handling the container transport also mentioned the owner mismatch as a barrier.

4.5.2 Timing mismatch

Timing mismatch, when the importing and exporting flow does not match, was mentioned as a barrier to reduce ECR. It was only Exp2 who stated that this is a barrier; their import does not match their export considering the time aspect, the import container cannot be stored waiting for export goods, it is costly and additional administration is needed.

4.5.3 Trade imbalance

All freight forwarders agreed that the trade imbalance is the primary reason for the empty repositioning. But other actors as well, for instance, Exp3 makes use of the ports at the North-East coast of Sweden where there is an export surplus compared to import and thereby a need for empty containers. Also, the fact that a lot of the imported goods are not transported in a container to the final destination in the northern part of Sweden increases the trade imbalance of containers. Several of the interviewed companies are located in areas with a higher import flow than export and therefore it is not possible to reuse the container e.g. by using street-turns as there are not enough export operations in the area. Therefore, empty containers have to be transported to the port. It is not only the regional trade imbalance, leading to differences in the number of import vs export containers in ports, that causes empty repositioning.

4.5.4 Spot shipments

Small container flows and spot shipment is also seen as a barrier. Exp1 is partly working with spot-flows and it was stated that it is difficult to plan these in advance and consequently hard to optimize the flows. The reason why Exp1 uses spot-flows is that they have small customers with irregular flows. Exp1 stated that most of the optimization and reduction of ECR is therefore performed on the larger flows. Imp3 also argued that they are trying to avoid having small flows of containers and one of the reasons behind this is that when establishing large flows, it is easier to optimize and to find synergies for other actors in the transport chain, for example, the transport operators and shipping line can optimize their container flow by receiving information in advance.

4.5.5 Responsibility

A barrier that can hinder companies to reduce ECR is the company is not seeing ECR as their responsibility. A majority of the importers and exporters were using a freight forwarder to handle the container flow and therefore it is more difficult to impact ECR. Imp2 stated that it is the freight forwarders' or shipping lines' responsibility to reduce ECR and that Imp2 did not have a part in reducing ECR. Another aspect for Imp2 is that they have their distribution centers only 2km from the port and consequently it is difficult to reduce ECR. Therefore, Imp2 assigned the responsibility to other actors who have a better opportunity to reduce ECR. Exp2 also used a freight forwarder and argued in a similar way that most of the responsibility lies at the freight forwarder. Exp2 is not involved at all in the empty container management.

4.5.6 Lack of transparency

Several ways of communication were used including email, phone, and internal IT system. It was also stated that in order to improve ECR, being able to access relevant data when needed is crucial. The bookings are often done with short notice. Forw2 stated that they lacked information regarding free days for their customers which consequently made it more difficult to plan street-turns. Therefore, it was stated by Forw2 that an integrated IT system that more actors could access would increase the transparency and improve the ability to reduce ESR by finding more street-turn possibilities. Exp3 and Forw2 are currently working on implementing an integrated IT system to access more information which could influence the ability to reduce ECR. Another problem stated by Exp3 is that

companies have their own IT systems that are not integrated. Furthermore, Exp3 has different systems for different purposes which makes the information sharing more complex.

4.5.7 Location mismatch

Imp3 has an importing and exporting flow where the imported goods are mainly transported to the southern part of Sweden whereas the export operations are located in the northern part of Sweden. This structure was seen as a barrier to reduce ECR as if the containers needed to be reused, they had to be transported empty from the southern to the northern part of Sweden. Exp3 is also exporting products that are produced in the northern part of Sweden where the need for import is low.

4.6 Covid-19

In this section, the impacts of the Covid-19 pandemic related to empty container repositioning are presented.

Table 4.6: Covid-19 impacts on ECR

Covid-19 pandemic	**Empirical data**	**Impact**
Container shortage	All exporters and freight forwarders	Increased long-term planning Alternative transport
Shipping line's increasing control over containers	All freight forwarders Exp3, Imp3	Reduced possibility to reuse container More difficult to negotiate terms for free days and detention fees
Collaborating with other actors to ensure supply of empty containers	Exp3	Ensuring a supply of empty containers through new collaborations

4.6.1 Container shortage

All exporters and freight forwarders have been affected by the Covid-19 pandemic and the main issue is and has been container shortage. The ocean transport cost has increased, three times the original price as most. The shortage has made Exp1 increase the long-term planning to ensure availability and look for alternative options. For Forw3, the dry port has been more important than ever, it has increased the availability of empty containers. Exp2 has not significantly been affected by the shortage except from a few shipments with small quantities by road and air. Otherwise, Exp2 has been able to plan far ahead and the freight forwarder has a solid network in the transport business and has thereby been able to handle the container shortage. The importers have also been affected by container shortage, however, it is the container shortage overseas that has been a problem. The main problem for Imp1 has been the lack of containers in Asia for importing goods. Before the Covid-19 pandemic, it was possible to order containers with short notice if needed, now all companies are affected by the shortage and it is more difficult to make changes in the orders.

The container shortage and lockdowns have forced the transport buyers to use other transport modes than usual. Exp2 had to transport small quantities by truck and airplane. Exp1 has started to use more rail transport to avoid sea transport disruptions. Imp3's import from China has been heavily affected by the Covid-19 pandemic and it has not been possible to import enough goods by sea. Thereby, Imp3 has recently started to transport goods by rail from China to Europe. In addition, Imp3 purchased containers and chartered a ship from China to Europe with 1200 TEUs using a route that has not been used by Imp3 before because of the lack of empty containers and lack of space on vessels in China. Forw1 has chartered three vessels from Asia to Europe with 1800 TEUs each during the pandemic, rail- and road transport have also been used by Forw1 from Asia to Europe due to lockdowns in ports.

4.6.2 Shipping lines increasing control

Several of the interviewed companies have noticed that the shipping lines want more control over the containers, mainly because of the container shortage. Exp3 stated that due to the container shortage, the shipping companies want to send empty containers back to Asia directly instead of waiting for export goods. However, it did not affect the number of days the Exp3 could keep the container, instead it was more difficult to find empty containers. Exp3 also stated that the high freight rates from Asia to North America and Europe due to the Covid-19 pandemic has made the shipping lines sending empty containers back to Asia to increase the profit.

For Forw2 and Forw3, this has led to a reduction in the possibility to match the need for export with empty containers that have been used for import. Furthermore, Forw1 stated that it has been harder to negotiate the terms for longer free time which also shows that the shipping lines want more control over the containers. Imp1's handling of empty containers has not been affected significantly by Covid-19 due to the used dry port where they have a stock of empty containers. The contracts with the port of Gothenburg have not changed, Imp1 does not have to send back containers to the port due to the shortage caused by the Covid-19 pandemic.

4.6.3 Collaboration with other actors to ensure supply of empty containers

To solve the shortage issue, Exp3 has tried to find importing companies to collaborate with and use their containers for export. Except for that, none of the companies mentioned that they have started to collaborate with new actors to cope with the Covid-19 pandemic.

5. Analysis

To understand how transport buyers can reduce ECR, the drivers, actions and barriers, and the Covid-19 pandemic's impact on ECR are analyzed. Because the transport buyers' perspective of ECR is limited in the literature, the analysis is based on ECR literature from a broader perspective.

5.1 Drivers

In this section, the identified drivers are related to the literature to find differences and similarities. Further, the drivers and their impact on the transport buyers' actions to reduce ECR are discussed.

5.1.1 Financial

All actors argued that the financial perspective is an important driver to reduce ECR as it can reduce costs or increase profits which Breakers et al. (2011) confirms. However, during the interviews, it was not discussed how much of the costs could be reduced or how much the profit could be increased. It could be difficult to determine the cost savings because as the empty repositioning cost is lowered, other costs can arise such as handling cost and administration cost. It is also hard to determine how the potential cost savings should be shared between the actors.

Legros et al. (2019) state that the cost of handling the container by the importer compared to if the container is returned directly to the port is small. This is an important aspect to bring to the discussion because if there is only a small cost reduction to be achieved and it requires an empty container handling process to be put in place, the financial driver might not solely be enough to incentivize companies to further reduce ECR. Furthermore, there are external factors that can influence the financial incentive for transport buyers to reduce ECR. According to Mongelluzzo (2019) and Lopez (2019), fees for reusing containers are charged by some shipping lines in the U.S. If these fees are applied in Sweden, it will have an impact on how profitable it will be to reduce ECR in the future.

Street-turns, reusing the container internally and using a dry port can benefit multiple actors where transport buyers can reduce the cost of empty container transport and consequently the shipping lines can reduce the handling of containers and at the same time increase the utilization of containers (Legros et al., 2019). The fact that using street-turns benefits multiple actors is important if the use is going to be increased. The shipping lines have the final say on how the container is going to be handled and therefore can determine if street-turns can be used or not. Using street-turns not only benefits the transport buyer with reduced costs or increased profits but also benefits the shipping lines as they can reduce its handling cost and increase utilization of the equipment. This will bring further incentives to increase the use of street-turns. However, the fact that the shipping line can profit more by empty repositioning the container to another location will make this matter more complicated.

5.1.2 Environmental

Li, Wang & Cook (2014) state that operating a green supply chain is getting increasingly important to keep the sustainable competitive advantage, and to succeed, collaboration with other actors is crucial. All actors mentioned the environmental aspect as important, but the financial aspect was perceived as even more important. It was mentioned by Exp2 that several regulations must be followed and that transport emissions are a crucial part of the figures that needed to be reported. Therefore, it is likely that the environmental aspect will become even more important in the future and working actively

with this will be crucial to keep the sustainable competitive advantage. On the other hand, the financial aspect will always be more significant than the environmental, as noted from the interviews, which may result in less environmentally friendly alternatives to get a cheaper price.

5.1.3 Container availability

According to Ng (2012), container availability is closely related to the information flow. Exp1, Forw1, and Forw3 in this study mentioned container availability as a driver for reducing ECR. Common for these companies is that their core business is container management, therefore it can be assumed that this driver is most applicable for companies managing container flows. Even though the other companies did not clearly express container availability as a driver, all companies in this study mentioned container shortage as a problem during the Covid-19 pandemic which refers to container availability. The uncertainty in container availability can be reduced by higher transparency of information (Ng, 2012). Therefore, all companies can benefit from having an integrated IT system where the information on the availability of containers can be found.

5.2 Actions and Barriers

This section includes two parts for each action. First, each action is compared to the literature to identify differences and similarities. Second, the barriers that apply to each action are identified and the ways to overcome these barriers are discussed. Lastly, the actions are compared to understand the differences with regards implementation and the usefulness for transport buyers. Further, the barriers are compared to understand how transport buyers can reduce the barriers' impacts.

5.2.1 Street-turns

Some importers and exporters expressed that their ability to affect ECR is somewhat restricted and the main responsibility lies with the shipping lines or freight forwarders. Breakers et al. (2011) stated that consignees, in general, are not involved in empty container management and, therefore it is common that the containers are being transported directly back to the port or a depot which many of the importers and exporters agreed with.

Legros et al. (2019) stated that street-turns are the best method to reduce ECR in the hinterland and it was the most common method among the interviewed companies who are taking actions to reduce ECR. However, it was also made clear that the freight forwarders played a key part in using street-turns. Some importers and exporters who were using a freight forwarder argued that the freight forwarder had more responsibility for the empty container management and to utilize street-turns because it has both importing and exporting flows which can more easily be matched compared to if the importing and exporting companies would try to develop a street-turn process themselves. Exp1 was for some flows managing its own logistics and used street-turns as much as possible through scanning the area for importing companies where the containers could be reused. The ability of this exporting company to use street-turns is facilitated by the fact that they are a large company with many customers and suppliers. Because of the Covid-19 pandemic, where there is a lack of empty containers, using street-turns has become even more important as it is not only beneficial from a financial and environmental perspective, but it has also helped to ease the problem of empty container shortage. Forw1 expressed the exporting department has had difficulties finding empty containers and by using street-turns the availability of empty could therefore be increased. Street-turns were used

before the Covid-19 pandemic, but it has shown to be an effective method to reduce ECR and increase empty container availability which can become useful to manage future disruption.

Legros et al. (2019) argued that to increase the use of street-turns, the transport buyers had to actively work with proactive empty container management. Forw1 was working actively with trying to match the import and export flow to use street-turns and this would be hard to achieve if they were not working proactively with the container handling as it requires coordination to for example overcome the container ownership mismatch and timing mismatch. Exp2 on the other hand was not as involved in the empty container management but with a more proactive empty container handling, the ability to reduce ECR could be increased. This was also made clear from the interviews as when developing street-turns, many factors have to be considered such as paperwork, setting up a process and, collaborating with other actors such as freight forwarders and shipping lines.

In literature, the role of the freight forwarder of street-turns has often been excluded from the discussion. Most of the literature regarding regional ECR has been focused on the importer's role of street-turns such as Legros et al. (2019). However, the freight forwarder has proven, according to this study, to have more influence and are more involved in the street-turn process than the importers and exporters which shows that further studies involving the freight forwarders' perspective of ECR on a regional level would be valuable. However, Legros et al. (2016) argued that there is a potential to achieve a high percentage of street-turns but their study showed that the total cost of returning the container directly to the port compared to keeping the container and waiting for a match is small which can explain the lack of incentive to further increase the use of street-turns. All actors stated that the financial aspect was a driver to reduce ECR however it was not stated how much the financial winning as compared to not actively trying to reduce ECR.

Barriers related to street-turns

Six barriers can be applied to street-turns: ownership mismatch, timing mismatch, trade imbalance, spot shipments, lack of transparency, and location mismatch. See Table 5.1 for barriers and related to street-turns.

Table 5.1: Barriers and related to street-turns.

Barrier	**Ways to overcome**
Container ownership mismatch	Collaboration Transparency of information
Timing mismatch	Transparency of information
Trade imbalance	None
Spot shipments	Regularize flows
Lack of transparency	Information in advance Integrated IT system
Location mismatch	None

When the imported container and exported container are owned by different shipping lines and the container cannot be reused, also known as container ownership mismatch, was a barrier that was

discussed in several interviews, mainly from the freight forwarders. To use street-turns, this barrier can be considered as one of the most important to overcome, as it is a requirement that the ownership of the imported and exported container has to match. There were ways to overcome this barrier. One example expressed by a Forw1 was that the import and export department was working closely and if the large export volumes were booked with a specific shipping line, the import department tried to use the same shipping line to open up the opportunity to use street-turns. Forw2 tried to influence their customers to use specific shipping lines for their shipments to facilitate the use of street-turns. This will then bring benefit to the customer as lower haulage costs can be offered to the customer. According to Panayides & Wiedmer (2011), a strategic alliance implies that the use of non-member carriers is restricted and none of the actors in this study have any possibility to affect this. Therefore, the only way to cope with this barrier is to use the same shipping line for both import and export when utilizing street-turns. To ensure that the same shipping line can be used, transparent information is crucial, especially for the freight forwarders handling most of the booking processes.

Even though timing mismatch was only mentioned by one company in this study, an export company, it can be applied to importers and freight forwarders as well since all companies work with a transportation plan and as mentioned, the uncertainties make it hard to follow the plan. The timing mismatch barrier is, therefore, more complex than matching import and export. If street-turns were to be used, it also puts a lot of pressure on planning because once the imported container has been unloaded, the exporting company should have its products ready to be stuffed in a container. According to Kuzmicz et al. (2017), several uncertainties affect the planning process, such as day-to-day variations and equipment failure, that make it hard to follow the initial plan. The free time and detention fees add further complexity as the companies are unwilling to exceed the free time and be charged with a detention fee if the container is not being transported back to the port in time. To overcome this barrier, transparency of information is important. To plan for a street-turn, information regarding for example when the imported container has been unloaded, when the empty container can be stuffed at the exporting company, the number of free days has to be available. Using an integrated IT system where all the information is updated and available could therefore help to overcome this barrier. Transport buyers in general can have an important role for overcoming the timing mismatch by being more flexible with their transport requirements. For instance, if an exporter can extend the period of time for picking up a container, the possibility increases for freight forwarders to find a match with an importer and a street-turn can be used.

Even though all companies mentioned the trade imbalance as a barrier, it applies to the freight forwarders and companies who are handling their own logistics because these are the companies who are performing e.g. street-turns and the trade imbalance is hindering their ability to reduce ECR. Most of the interviewed companies were located in the southern part of Sweden where the import flow of containers is larger than the export. Therefore, the size of the export flows restricts the use of street-turns. There is nothing the transport buyers can do to affect the local trade imbalance as it is dependent on where importing and exporting companies are located. It is therefore important to maximize the possible number of street-turns performed in a specific area.

Spot shipment is a barrier that is hard to overcome, especially for Exp1, which is a trading company working with customers that have one-time needs for transportation for a certain route. For these transportations, Exp3 cannot plan the routes in advance and it is therefore hard to find importers in the nearby area to utilize street-turns. However, if an exporter is operating in an area with a large import flow, it can be easier to find empty containers from importers. If no collaboration has been established with an importer in the area, there can be problems finding an empty container within a short time

frame. Imp3 is using spot shipments but is trying to avoid them and argues that it is hard to optimize these flows because they cannot be planned. It can be concluded that street-turns are an action that is difficult to use for spot shipments to reduce ECR. Therefore, the most efficient approach to cope with this barrier is to avoid spot shipments by trying to use regular flows if possible.

The lack of transparency is closely related to communication. Because the communication is partly conducted by phone and email, especially with smaller customers, it is hard for the freight forwarders to optimize these transports since the information is not visible in an IT system in advance and it has to be filled in manually. These transporters are also often booked with short notice which makes it even harder to handle. However, IT systems were in some way used by all companies, but the main problem was that the companies have their own IT solutions that are not compatible with other actors. An exception from this is Forw3 that has an integrated order management system with Imp1, but still, Forw3 has several small customers where this IT solution cannot be used. This seems like an important issue since both Exp3 and Forw2 are currently working on implementing integrated IT systems. Therefore, transparency can be seen as a key factor for being able to use street-turns. Furthermore, Forw2 meant missing information hindered them from utilizing street-turn, such as the number of free days. If all the necessary information was provided, the ability to reduce ECR by using street-turn could potentially be higher.

As Rodrigue (2020) stated, the only way to overcome the surplus and deficits is by transport between locations. In this study, the main problem is the location of the raw materials for final goods in relation to the location of the customers. For instance, one of the importing companies also has a high export volume but the raw material is located in the north part of Sweden and the warehouses and majority of customers are located in the south part of Sweden. It is therefore difficult to match the import and export flows internally, leading to empty repositioning of containers. The location mismatch is related to the trade imbalance and it is a barrier that is hard to get around. For instance, the production of wood products is located where the resources are located, and the customers are located far from there. As Rodrigue (2020) states, different locations have different demands and resources. Imp3 and Exp3 expressed this as a barrier, probably because they are both operating in the north part of Sweden with long distances to the large ports and customers.

Even though the size and type of container were not stated as a barrier to use street-turns by the interviewed companies, Kuzmicz & Pesch (2019) argued that the container type and size are considered to be barriers to use street-turns. This is an aspect which has to be considered if street-turns are going to be used. However, one reason why this was not seen as a barrier can be that all freight forwarders had a large client base and therefore can still find matches for the different types and sizes of containers.

5.2.2 Dry port

According to Roso (2009), dry ports are an important part of the logistics infrastructure, which this study confirms. The interviewed companies that have access to a dry port also use it as a container depot. Therefore, it reduced the transportation of empty containers since it was located closer to the importers and exporters. Furthermore, it increases the availability of empty containers. When disruptions occur, such as the Covid-19 pandemic, the dry port can play an important role in ensuring empty containers to the exporters and freight forwarders.

Barriers related to dry port
Two barriers for using a dry port were identified: trade imbalance and container ownership mismatch. See Table 5.2 for barriers related to dry port

Table 5.2: Barriers related to dry port

Barrier	**Ways to overcome**
Trade imbalance	None
Container ownership mismatch	Collaboration Transparency of information

A barrier for utilizing a dry port is the trade imbalance between importing and exporting companies. To have both empty containers available at the dry port and a need for export of goods in these containers, there must be both import and export of containers in the nearby area. If there are more import operations in an area, containers have to be transported to the port as the export flow is too small. This barrier is not possible to overcome without a restructuring of the entire supply chain.

As for street-turns, the container ownership mismatch is a barrier that is hard to cope with. All companies utilizing the dry port have to be aware of which shipping line to book the transport with. Otherwise, the empty containers at the dry port cannot be used efficiently. The ownership mismatch can partly be solved by having a large number of shipping lines operating at the dry port. Also, a high degree of transparency is needed. For instance, if an exporting company wants to use a container from the dry port, information about which shipping line the available containers belong to must be provided before booking the transport.

5.2.3 Reusing containers internally

This can be seen as a type of street-turn as it is based on the same principle to reuse the imported container for the export flow but in this case, the empty container is used within the same companies as opposed to transporting the empty container between two companies. Imp3 and Exp2 both had import and export flows and for these companies and these companies both tried to use the imported containers for the export flow as much as possible. Both of the companies have spotted the opportunity to reuse the container internally, but it is restricted by mainly two barriers: location mismatch and timing mismatch. Exp2 is mainly importing goods but also has a relatively small export flow. It was stated that to reuse the container, the imported container has to match the export flow, and this is many times hard to achieve. However, Exp2 is importing and exporting from the same location which facilitates the use as the location mismatch is not seen as a barrier. Imp3 is having a relatively equal flow of import and export which can facilitate the reusing of empty containers, but the location mismatch is one of the main barriers as the import flow is located in southern Sweden and the export flow in northern Sweden. Because the import and export operations are located far apart, reusing containers internally might not be an optimal solution from an ECR perspective. However, Imp3 only uses ports in southern Sweden and therefore containers cannot yet be retrieved from the ports in northern Sweden due to low volumes in the northern region.

Barriers related to reusing containers internally
Four barriers for reusing containers internally were identified: trade imbalance, location mismatch, timing mismatch, and container ownership mismatch.

Table 5.3: Barriers related to reusing containers internally

Barrier	**Ways to overcome**
Trade imbalance	None
Location mismatch	None
Timing mismatch	Regularize flows Internal collaboration
Container ownership mismatch	Internal collaboration

Since Exp2 has a significantly larger import flow than export flow, there is an internal trade imbalance. This is similar to the trade imbalance barrier for street-turns as it restricts the number of containers that can be reused as there are not enough export operations to match the import. If the trade imbalance affects a company's ability to reuse the container internally it is only dependent on the individual company's operations. Imp3 reuses its container internally however the internal trade imbalance is not considered a barrier as the import and export flow is of equal size. This shows that internal trade imbalance is not a general barrier for all companies using this method but rather is a more company-specific barrier. As for street-turns, the trade imbalance in this instance is difficult to impact and the companies using this method have to focus on maximizing the use of this method.

Imp3 is reusing its imported container for the export flow. The importing operations are located in southern Sweden whereas the export is located in northern Sweden, leading to a location mismatch. This is adding further complexity to using this method compared to Exp2 which has both import and export operations in the same location. Because of the location mismatch for Imp3, the empty container needs to be transported from southern to northern Sweden to be reused. The planning process gets more complicated as not only the import and export flow have to match, the transportation between the two locations also needs to be included. Similar to the trade imbalance, this barrier is hard to overcome as it can only be done if either the import or export locations are moved.

As the location mismatch is a barrier for reusing the containers internally which is difficult to overcome, other options could be explored. Currently, for Imp3, only ports in southern Sweden are being used but if ports in northern Sweden are used for the export flow, the need of transporting containers between the import and export locations could be eliminated and consequently reducing ECR. This topic was discussed during the interview but the lack of volume from the northern port was seen as a barrier for this matter.

One of the main barriers that Exp2 stated for reusing the container internally is timing mismatch. As this is performed by a company internally, it can be more complex to match the export and import flow compared to if street-turn is used by a freight forwarder which can use its client base to find a match. Another aspect that can influence how well the different flows can be matched is the size of the flows. With large regular flows, there are more opportunities for companies to match the flows compared to small flows. Also, the regularity of the flows can have an impact on how well the flows can be aligned. Exp2 has a regular import flow of one container every week and this setting can

facilitate the use of reusing the container and the flows can more easily be planned. Furthermore, to reduce the problem of timing mismatch, it is important to have internal collaboration between the import and export department.

Container ownership mismatch was neither stated by Imp3 nor Exp2, however, it can become a barrier if the import and export operations are not aligned. Compared to street-turns, this will be overcome more easily as it only requires coordination within one company instead of between two companies.

As for street-turns, the container type and size can be considered a barrier to reuse containers but none of the interviewed companies stated this as a barrier. The reason behind this was not discussed during the interviews. However, managing this matter internally can be easier compared to having to match the container type and size between two companies.

5.2.4 Collaboration

It was made clear that collaboration with other actors is crucial for reducing ECR.
Barratt (2004) defines horizontal collaboration as collaborating with competitors or other actors. One company, Exp1 stated that they were trying to scan the market in proximity to the export flows to ensure a supply of empty containers. None of the other companies stated that there was any horizontal collaboration with other actors from an ECR perspective. Instead, most of the collaboration was vertical collaboration, defined by Barratt (2004) as collaborating with customers and suppliers. One of the reasons behind this can be the difficulty for importing and exporting companies to collaborate and reduce ECR themselves e.g. through street-turns as both flows need to be aligned and planned to develop an efficient street-turn (Kuzmicz, Pesach. 2019). Therefore, there is a higher number of vertical collaborations, mainly with a freight forwarder. The freight forwarder acts as an intermediary and can use its large customer base to reduce ECR. By collaborating with a freight forwarder, some of the barriers can be reduced. For example, timing mismatch, the difficulty to match the import and export flow can be reduced as the freight forwarder can use its customer base to find the best matches between importing and exporting flows instead.
It can also reduce the barrier of container ownership mismatch. Forw2 stated that container ownership mismatch was one of the main barriers to reduce ECR. Forw2 then tried to have a close relationship with its customers to better match the shipping lines used for the import and export flow. It was stated that it is important to make the customers understand the total cost of ownership and that even though a shipping line is more expensive, the total cost can be lowered if street-turns can be utilized and a lower haulage price can be offered to the customer. Forw2 also emphasized the importance of having more long-term collaborations with other actors and not just focusing on the short-term costs but instead focusing on reducing the total cost over time.

Apart from horizontal and vertical collaboration, having internal collaboration within the company was also stated as important, especially for the freight forwarders. Forw1 stated that the collaboration between the import and export department was important when trying to use street-turns, especially with regards to timing the import and export flow but also to overcome the container ownership mismatch barrier. It was stated that the container ownership mismatch could be reduced if the export department had a large export flow and communicated which shipping line was used. Then the import department could try to adapt to this and therefore reduce the problem of container ownership mismatch.

Scholten and Shilder (2015) stated that there are several benefits of collaborating within a supply chain, for example by finding synergies and sharing information. Some of the interviewed companies stated that lack of information hinders them from further being able to reduce ECR. A problem with information sharing is the unwillingness of sharing certain information because of the possibility of it reaching competitors. Therefore, being able to use an integrated IT platform was stated as something that could further increase the ability to reduce ECR.

Barriers related to collaboration
Three barriers for collaboration were identified: trade imbalance, responsibility, and spot shipments

Table 5.4: Barriers related to collaboration

Barrier	**Ways to overcome**
Trade imbalance	None
Responsibility	Increase awareness
Spot shipment	Regularize flows

The local trade imbalance in the area of operation for a company can restrict the possibility of collaboration. If an importer wants to collaborate with an exporter to e.g. use street-turns, the number of exporters available to collaborate with can be restricted if there is a majority of import operations in the area. The transport buyers do not have any possibility to impact the trade imbalance in an area and therefore this barrier cannot be overcome.

In this study, both Exp2 and Imp2 stated that their companies had no responsibility to reduce empty container repositioning. Therefore, it can be assumed that their interest in collaboration for reducing ECR is almost non-existent. On the other hand, Imp1 stated that their company is working on improving the logistics and have already established a close collaboration with Forw3. Therefore, it seems like the responsibility for reducing ECR is crucial for collaborating with other actors. To overcome this barrier, the awareness of the problem with ECR and each company's potential to contribute is important.

Using spot flows or irregular flows can become a barrier to initiate a collaboration with another company. To reduce ECR, there can be a need for planning, and it is difficult to plan for spot-flows. Depending on the company's situation, this barrier can vary in difficulty to overcome. Spot-flows might be necessary for some companies, e.g. Exp1 is a trading company and are not able to plan all the flows. However, if a company is using spot-flows because of poor planning, there is a better opportunity to regularize the flows and consequently increasing the possibility to initiate a collaboration by e.g. using street-turns.

5.2.5 Comparison of actions

If containers are being reused internally, the transport buyer is required to have both an import and export flow. Therefore, this method cannot be used to the same extent because of this restriction compared to e.g. street-turns, finding a match between an import and export flow can be easier when using street-turns as there are more possible matches compared to if it was going to be matched internally.

When reusing containers internally, the transport buyer does not have to share information with other companies and therefore it could be a good option for companies who are dealing with sensitive information. Lack of transparency of information was a common barrier for reducing ECR and by reusing containers internally, this is generally not a problem as it is coordinated internally. Street-turns can be used by all transport buyers and therefore have a greater potential to be implemented for all transport buyers.

Compared to street-turns, reusing containers internally can be easier to implement for transport buyers as it does not require involvement with other companies. As long as the transport buyers have both an import and export flow, they are able to reuse the containers. Street-turns, on the other hand, require some sort of collaboration with another actor. Either by collaboration horizontally with another importer or exporter, or vertically with a freight forwarder. This means that implementing a street-turn process can require more effort to set up. Using a dry port was also proven to reduce ECR but this is very difficult for an individual transport buyer to implement themselves.

5.2.6 Comparison of barriers

Trade imbalance and location mismatch are barriers that this study did not find any ways for transport buyers to overcome since it is a structural issue. The other barriers, on the other hand, can be reduced by transport buyers. Transport buyers can more easily reduce barriers such as timing mismatch and spot flows themselves more easily because it can be handled internally, compared to container ownership mismatch where the choice of shipping line might have to be coordinated between at least two companies.

The container ownership mismatch can be hard to overcome and affects freight forwarders and companies managing their own logistics. In the literature, the container ownership mismatch is briefly mentioned but no further investigations of its impact had been found. On the other hand, this study confirms that it is the most common barrier for transport buyers. To overcome the container ownership mismatch, it is important to increase the transparency of information since information is crucial for matching the import and export flows with the same shipping line.

The responsibility of reducing ECR, that is a barrier itself, is crucial for being able to overcome the other barriers. If a transport buyer does not feel responsible for reducing ECR, no actions to reduce ECR will be taken and the barriers will not be overcome.

5.3 Covid-19 pandemic

In this section, the Covid-19 pandemic and its impact on ECR will be analyzed. This is performed by relating the findings to the literature and analyzing how it can affect the transport buyers' future possibilities to reduce ECR.

Sarkis et al. (2020) stated that managers are expected to re-examine today's supply chains due to the Covid-19 pandemic and from the interviews, it is clear that the companies in this study have taken other solutions than the ordinary logistics into consideration. Asia is a crucial part of the supply chain for all companies in this study, especially the ones importing goods.

5.3.1 Container shortage

From the interviews, it is clear that the main problem for them during the pandemic is container shortage. All actors have mentioned that the availability of empty containers has been limited. The shortage of containers and vessels has several causes, one of them is that the demand for Chinese export has increased during Covid-19 (eNCA, 2021). People have re-allocated their demand due to the Covid-19 pandemic, instead of traveling people spend money on electronics, furniture, etc. Also, the need for medical supplies from China has made it even more difficult to ensure enough transport capacity. This is probably a temporary problem since these needs do not exist in a normal situation without a pandemic.

Container shortage has created many problems but at the same time, it has forced companies to use other methods to cope with the disruptions. Before the pandemic, there was no problem of receiving empty containers but now it can be very difficult. Forw1 stated that the export department has had difficulties getting empty containers and to cope with this situation, street-turns were used where the imported containers were sent directly to the exporter. This however does not only benefit by increasing the availability of empty containers to cope with the container shortage problem but does also reduce ECR and has a financial and environmental benefit. Having such a process in place will also be useful to cope with future disruptions.

The Covid-19 pandemic has forced several of the interviewed companies in this study to use other transport routes and transport modes than usual, mainly due to container shortage. The alternative to transporting by rail instead of the sea from Asia to Europe is mainly seen as a temporary solution for handling the shortage of empty containers during the pandemic by the companies in this study. At the same time, the dry-port-based cross-border logistics network is rapidly expanding in Asia (Wei & Dong, 2019). In the future, after the pandemic, the railway may be an alternative to air transport when disruptions occur. The alternative transport will affect the empty repositioning since new supply chains can arise, but in what way is hard to say.

5.3.2 Shipping lines' increased control over container

The shortage has made the shipping lines increase the control of their containers and reduced the transport buyers' possibility to match export and import. The freight forwarders are the ones coordinating the transports, therefore these actors have been most affected by the shipping lines' increased control and more empty containers are sent back to the port directly than before the pandemic thus limiting the possibilities for forwarders to influence ECR. An example is Forw2 who stated that it has been more difficult to utilize street-turns during the pandemic. To use street-turns, the freight forwarder has to contact the shipping line and get confirmation that the container can be moved directly from the importer to the exporter instead of to the port. Because of the empty container imbalance globally, the shipping lines have increased the control over the containers and consequently, street-turns cannot be used as much as before. Once the container shortage problem has been resolved the incentives to have increased control over the containers will most likely be lowered. However, Lopes (2019) and Mongelluzzo (2019) stated that shipping lines have begun to charge street-turn fees in the U.S which can be seen as a way to increase the control over the containers. Therefore, it is difficult to predict how the shipping lines will control their containers in the future.

Forw1 also stated that the shipping lines are trying to increase the control of the containers by trying to reduce the free days to get the containers faster to the port. Legros et al. (2019) state that a stricter

detention fee structure may also hinder the ability to reduce ECR, as less time is available to for example utilize street-turns. From a transport buyers' perspective, increasing the free days can make the transport buyers more flexible regarding container management. The shipping lines however will have decreased control over their equipment and fewer containers will be available as they will spend more time at the importer or exporter. The global shortage is thereby affecting the regional empty repositioning.

5.3.3 Collaboration with other actors to ensure supply of empty containers

The pandemic has made one of the exporting companies creating new collaborations to match export and import flows. According to Scholten & Schilder (2015), collaboration in the supply chain has many advantages, some of them are finding synergies and information-sharing that can be of great importance when handling disruptions. The exporting company may have found a more efficient way of working than before the pandemic when container shortage was not a problem.

5.4 Discussion

This section is based on the finding and analysis of this study. It focuses on getting a deeper understanding of differences between the companies and actor groups, incentives to reduce ECR, and impact of the Covid-19 pandemic in the future.

Differences between the companies and actor groups

This study is limited to three actor groups with three companies in each group. If a larger number of companies were studied, other problems might have been found. An example is that the interview companies in this study did not mention container size and container type as a barrier for reducing ECR, but it was identified in the literature as a barrier such as in Basarici & Satir (2019). The reason for this is that the importing and exporting companies in this study buy and sell goods that can be transported in a standard container. The outcome for this barrier would be different if the study included companies transporting goods with special needs, for instance, a company importing or exporting temperature-sensitive goods would have to use a reefer container. In that case, a standard container would not meet the requirements. Hence, utilizing street-turn would be even more difficult since the container type has to match.

However, there were differences between the importers, exporters, and freight forwarders in this study. There is a significant difference between importers/exporters using a freight forwarder and importers/exporters managing their own logistics. The importers/exporters using freight forwarders are not that involved in the container management. When a need for container transport arises, the transport is booked, and the freight forwarder manages the transportation from there. Therefore, the possibility to reduce ECR for importers/exporters using a freight forwarder is almost non-existing. On the other hand, importers/exporters managing their own logistics have a better possibility to reduce ECR since they are involved in container management. For instance, Imp3 has its own logistics function and has direct contact with the shipping lines but is not collaborating with other importers/exporters and are thereby missing the possibility of matching their container flows with others.

Freight forwarders have, according to this study, the best possibilities to reduce ECR. The main reason is that their core business is transportation coordination. The freight forwarders in this study have greater knowledge than importers and exporters in container management. Furthermore, the freight forwarders have a large contact network which facilitates the use of street-turns by matching their import customers with their export customers and thereby reducing ECR. Hence, it can be assumed that freight forwarders, in general, are the most important transport buyer actor for reducing ECR.

Incentives to reduce ECR

Among the transport buyers, the motivation to reduce ECR varied. Imp2 and Exp2 stated that reducing ECR was not their responsibility and it was instead the freight forwarders' and shipping lines' responsibility. For Exp2, the lack of motivation seemed to be partly derived from a lack of understanding of ECR. Without knowledge of the impact of ECR and what actions can be done to reduce it, it is difficult to have any motivation to reduce ECR. Here, the first step would be to increase the knowledge and make the companies understand the benefit not only for the individual companies but also from a more holistic perspective with reduced environmental impacts, etc. By understanding the benefit of reducing ECR, importers and exporters can become more flexible with the planning of shipments to reduce ECR. Here, the freight forwarders play an important role in spreading knowledge

as they are generally more involved in empty container management than the importers or exporters. Imp2 however had more knowledge of the ECR problem but the lack of motivation derived from how the logistics were set up. The company has its distribution centers approximately 2km from the port and all inbound containers are arriving at the same port. Because of the short distance to the port from the distribution center, there is a small room for improvement from an ECR perspective as the location has been optimally designed from an ECR perspective. However, locating the warehouses or distribution centers close to the port can be optimal from an ECR perspective but it can lead to increased transport by truck to the customers.

All actors stated that there is a financial and environmental benefit to reducing ECR as it will reduce the need for empty container transport to and from the port. However, it was not stated how much the cost savings could amount to. Legros et al. (2016) stated that the cost savings of reusing the container compared to returning it to the port is small which can restrict the increase of street-turns use. Something that can have a negative impact on the incentive to reduce ECR through using street-turns is the street-turn fees. The fee for reusing the container is charged by the shipping lines which have been implemented in the US Lopes (2019) and Mongelluzzo (2019). The street-turns fees do not seem to have reached Sweden as it has not been mentioned during any of the interviews. However, if this is being implemented in Sweden, it can disincentivize companies to reduce ECR as the financial gain will be reduced.

Furthermore, none of the transport buyers did not have any actual numbers of how often it is possible for them to reuse containers and thereby reduce the empty repositioning. The reason for this is hard to determine but it can be assumed that it has to do with their incentives to reduce ECR. If it would be a high-priority action, it is likely that the company would have focused more on keeping track of the numbers. For instance, Forw1 clarified that their main issue is to keep track of which ports have a deficit and surplus of empty containers, not the potential for reusing containers.

Impact of the Covid-19 pandemic in the future

The Covid-19 pandemic has created major disruptions in the supply chain globally. Before the pandemic, all of the companies agreed that empty container availability has not been any problem. As the pandemic struck, being able to find empty containers and space at vessels became a huge problem for many companies. Therefore, other options had to be explored such as finding alternative transport modes and finding new ways to ensure empty containers. As empty container availability was not a problem before, the motivation to reduce ECR for companies may have been lower as it only can bring financial and environmental benefits. During the pandemic, however, reducing ECR also could increase the container availability if e.g. street-turns or reusing the container internally was used. By being more or less forced to use these actions it can have a positive impact in the future as the companies can have increased the knowledge in the benefits of reducing ECR. Furthermore, if the container availability will be impacted by future disruptions, the transport buyers will have better options to handle the situation compared to before the pandemic.

6. Conclusion

The study aims to investigate how transport buyers can support reducing ECR in Sweden. This was performed by answering three research questions. The first question: "*How are transport buyers managing empty container repositioning?*" was answered by illustrating six different ECR flows, import flow and export flow with and without a dry port, street-turn and reusing containers internally. This showed that the transport buyers were using different ways to reposition empty containers. Import and export flows without using a dry port do not reduce ECR while the other ones can reduce ECR since the containers are not empty returned to the port.

The second research question, *"RQ2: How can transport buyers reduce empty container repositioning?*" aimed to identify drivers, action, and barriers to reduce ECR. Four drivers were identified, to increase profit, reduce ECR cost, increase empty container availability, and environment. All transport buyers agreed that the financial aspect, either reducing the cost of ECR or increasing profit, was the most important and that there has to be a financial win for the companies to reduce ECR. Another driver was reducing the environmental impact, however, this driver alone was not enough to incentivize the companies to reduce ECR. Furthermore, increasing the empty container availability was also seen as a driver which became even more important during the Covid-19 pandemic because of the empty container shortage. It has also shown to be important to have knowledge of empty container management. Without having the knowledge, it is difficult for transport buyers to see the benefits for reducing ECR. In this aspect, the freight forwarders, who have great experience and knowledge in container management, play an important role in spreading awareness.

Four actions, street-turns, dry port, reusing containers internally, and collaboration were identified where street-turn was the most common action among the transport buyers. One of the reasons behind this can be that all transport buyers are able to use street-turns. Reusing containers internally, on the other hand, can only be performed by transport buyers with both an import and export flow which restricts the use of this action. However, this action can be easier to implement as it does not require collaboration with other companies. Furthermore, it was also shown that freight forwarders play a key role in reducing ECR because they have knowledge and are involved in container management. This in combination with being able to use their customer bases to find matches between import and export has been important to reduce ECR. There is no action that can be applied to all situations. Instead, it is also important for transport buyers to review their current situation e.g. how the current container flow is set up, collaboration possibilities in the area. Thereafter, the different actions to reduce ECR should be evaluated to find the best option.

Seven barriers for reducing ECR were identified, container ownership mismatch, timing mismatch, trade imbalance, spot shipments, lack of transparency and, location mismatch. One of the most discussed barriers during the interviews was container ownership mismatch. For street-turns or reusing the container internally to be used, there has to be a match of shipping line between the import and export flow. Therefore, this barrier is crucial to overcome for transport buyers to reduce ECR. Transparent information and collaboration have proven to be crucial to overcoming several barriers to reduce ECR. In addition, if transport buyers' can be more flexible, ECR can be reduced by having more time to find a match between import and export flows.

To answer the third research question, "RQ3: *How has the Covid-19 pandemic influenced ECR management for transport buying companies?",* three impacts on how the Covid-19 pandemic has influenced ECR management have been identified, container shortage, shipping lines increased control of containers, and collaboration. The main issue has been the empty container shortage which has forced companies to find new ways of ensuring the supply of empty containers, by e.g. collaborating with other companies, which can have a positive effect on ECR. However, the shipping line has increased its control of the containers and therefore it has become more difficult to reuse containers and reduce ECR.

6.1 Future Research

In this study, it was shown that each action can bring a financial and environmental benefit as ECR is reduced. However, it did not include any calculations of cost reductions or profit increase for each action. By including this aspect, a deeper understanding of the potential of the actions can be achieved. Therefore, it is suggested that this aspect is included in future research. The shipping lines own the containers and have great power within container management, therefore it would be interesting to investigate how the transport buyers could collaborate with the shipping lines to reduce ECR.

To get a broader view of the transport buyers' perspective, involving different kinds of companies could contribute with new findings. All of the companies in this study used standard containers and therefore other barriers might occur if companies use different containers such as reefer containers. Reusing a reefer container can become more complex as standard containers are more commonly used and therefore other actions and barriers might be applied to these companies. Including a wider range of companies in future research could therefore bring a wider knowledge of how transport buyers can influence ECR.

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