Report on Case Study
"Empty Container Logistics: Hamburg–Baltic Sea Region"

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Table of Contents

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1 Introduction

The overall objective of WP 5.2 was to increase transparency on empty container logistics in general and with a special emphasis on specifics in the Baltic Sea Region (BSR). Therefore the first goal was to analyse empty container management in the BSR in terms of the actors involved, the reasons for empty movements, its impacts, and potential measures to mitigate negative effects. Results of this study were summarised and published in a report that can be downloaded from the TransBaltic homepage. Entitled "Empty Container Management in the BSR - Experiences and solutions from a multi-actor perspective," it provides a broad picture of empty flows and determining factors in the BSR. Based on this first study (the main results of which are summarised below) a case study was undertaken with a view to elaborating the different stakeholder perspectives that are relevant to empty container logistics as exemplified by relations between Hamburg and the BSR. This report deals mainly with the case study and the results are summarised in the following chapters.

Empty Container Management in the BSR – Experiences and solutions from a multi-actor perspective

The first study took a threefold approach. To investigate empty flows in the BSR, statistical data from Eurostat was used. Import and export flows were analysed at country and port level. A broad literature review was undertaken to amend the specific insights for the BSR as well as to provide a general overview of state-of-the-art empty container management. Based on these preliminary results a survey was conducted to record experiences and knowledge of the main players in the region. The main objective of the survey was to gain a comprehensive picture of different types of organisations dealing with maritime containers in the BSR. The picture serves as a multi-actor analysis on flows of empty containers in the BSR and a summary of the experience gained and strategies applied in empty container management.

Results of the data analysis provided a detailed picture of empty container flows at the national level as well as at the port level in the Baltic Sea Region. Especially the Baltic countries, Russia and, to a lesser extent, Poland and Finland, show a much higher share of empty containers leaving the country than entering it. Only for the Baltic ports of Germany and Sweden is the empty share of inbound containers larger than the empty share of outbound containers or, as in the case of Denmark, almost equal. The same can be observed at the port level. Especially Eastern European ports, such as St. Petersburg, Gdynia, Klaipeda and Tallinn report high shares of outbound empty containers.

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A literature review provided further insights on the main actors in empty container management. Two perspectives were found to lead toward a comprehensive picture: the empty container transport chain and container ownership. Also, a survey was conducted as a questionnaire to record the experiences and knowledge of the main players in the region. As for measures to mitigate negative impacts of empty flows, it is concluded that no one single measure has a crucial positive impact on empty container management. However, the answers of respondents suggest that a combination of measures is more promising. Also, the success of measures strongly depends on the perspective of the specific player, i.e. the choice of measures has to be related to the players involved.

In summary it can be stated that there are remarkable differences between the actors in the container transport chain when it comes to empty container logistics. In particular, strategies and measures to overcome negative impacts of empty containers are highly actor-dependent and thus require further investigation to make comprehensive recommendations. In this context, the stakeholder focus should be as comprehensive as possible to develop an integrated picture of the stakeholder perspectives in empty container logistics.

Stakeholder Perspectives in Empty Container Logistics between Hamburg and the BSR

Implications from theory and empirical findings showed that a crucial point in optimising empty container logistics is the different and partially conflicting perspectives of relevant stakeholders. This can be a barrier to implementing measures aimed at improving empty container logistics. Therefore a case study undertaken in cooperation with the Hamburg Port Authority, itself a partner in the TransBaltic project, was launched to increase transparency on relevant stakeholders, their interests and influence with regard to empty container logistics. This study focuses on the specific relationships of empty flows and related perspectives of involved stakeholders between Hamburg and the BSR.

First, empty flows between Hamburg and BSR ports were analysed in terms of container sizes and types. Based on findings from the data analysis, hotspot ports of empty flows in the BSR were identified along with associated relevant stakeholders. In a second step a series of interviews was conducted among stakeholders in Hamburg and the BSR such as shipping lines, feeder operators, terminal, depot and transport operators, container leasing companies, authorities, associations and other involved stakeholders.

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By elaborating the different perspectives of the various stakeholders in empty container logistics the aim was to identify the aspects that must be considered in preparation for and during the implementation of change processes in empty container logistics. Interviews consisted of two parts. The first part focused on empty container logistics processes that were discussed with interviewees. The result is detailed process charts providing insight into operational processes (physical and informational) relating to the various stakeholders involved. Second, qualitative questions were posed that focus on current issues as well as on factors influencing the design of empty container logistics.

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2 Background

The Baltic Sea Region witnesses a constant rise in containerised transport. Today, containers are handled in more than 60 ports across the region. As an economic area, the BSR is characterised by heterogeneous economic conditions and trade patterns due to the coexistence of geographically central and peripheral regions, structurally weak areas and large consumption centres as well as a wide range of different industries, from raw material producers to high-tech manufacturers.

In this setting, myriads of container movements of different types, sizes and qualities can be observed whereas the specific demand for and availability of container equipment can vary significantly between places. To balance supply and demand, empty containers have to be moved both within the region as well as with adjacent regions, especially from and to the large seaports of the north range. The share of empties of all containers transported in the BSR (21%–26% between 2005 and 2010) thereby exceeds numbers in the EU as well as globally (both around 20% between 2005 and 2010). Besides the rising trade volumes of containerised goods, which per se cause higher absolute numbers of empty containers, it is the strong imbalances of containerised trade flows that trigger empty container repositioning. Where containerised goods are imported, but fewer containerised goods are exported (and vice versa), empty containers have to be moved to places where they are needed for reloading. This circumstance is reflected in strong differences in the empty share of inbound and outbound container flows of countries and ports that can be observed in several countries in the BSR.

The repositioning of empty containers thereby causes negative effects, such as costs, environmental and socio-economic impacts and ties up transport and storage capacities. For 2010, worldwide costs for empty container repositioning were estimated at USD34.8 bn[1]. Mitigation measures are often difficult to implement, however. Reasons for that emanate from the inherent complexity of empty container management. Often, conflicting interests between companies along the container transport chain, such as shipping lines, terminal operators or forwarders, but also with other stakeholders such as regional authorities and residents, collide. Often a lack of transparency and knowledge on processes and actor interests is the problem. To increase transparency on decision making for stakeholders along

[1] Drewry 2011

the container transport chain, this case study was performed analysing empty container logistics processes as well as current issues in empty container logistics and influence factors to design empty container logistics. To increase overall significance of the results of this inherently complex topic the study focuses on empty container flows and actors involved between the Port of Hamburg and the Baltic Sea Region.

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3 Data analysis Hamburg – BSR

The Port of Hamburg is a major hub of containerised cargo destined for or returning from the BSR. In broad analysis of containerised cargo flows from Hamburg to the BSR and vice versa, around 50 ports have been identified as maintaining connections with the Port of Hamburg (for an overview, see Figure 1). Many of them, however, are small ports in terms of overall turnover. For a more concise analysis, therefore, only the TOP 15 ports in terms of container turnover have been further analysed in the context of this study. They are, in alphabetical order: Aarhus (DK), Copenhagen (DK), Gävle (SE), Gdynia (PL), Göteborg (SE), Hamina (FI), Helsinki (FI), Kaliningrad (RU), Klaipeda (LT), Kotka (FI), Oulu (FI), Rauma (FI), Riga (LV), St. Petersburg (RU) and Tallinn (EE).[2]

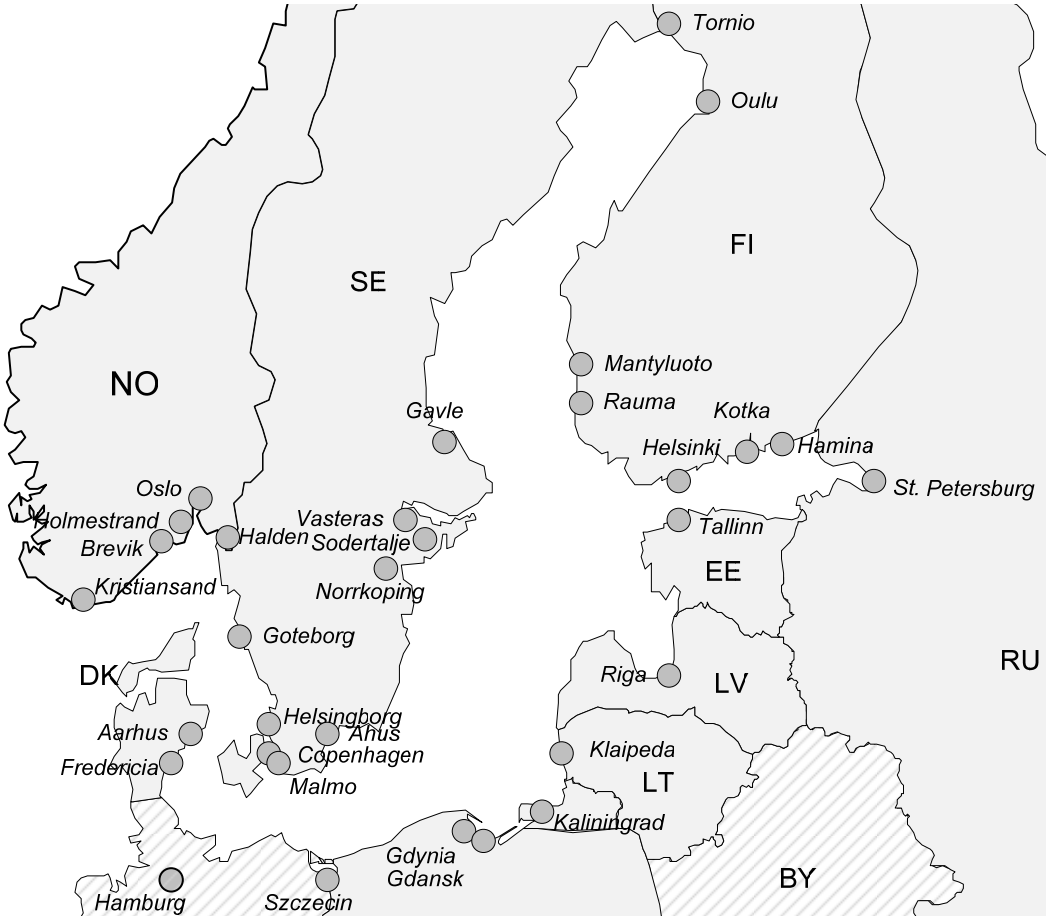

Figure 1: Ports in the BSR with relevant containerised cargo flows from or to the Port of Hamburg[2]

[2] In the course of 2011, the ports of Kotka and Hamina merged into the Port of HaminaKotka. The underlying data set, however, still distinguishes between the two ports.

With regard to the BSR, the port of Hamburg is a net importer of empty containers, i.e. the number of empties returning from the region (empty import) exceeds the number of empties shipped to the region (empty export). The comparison of import and export numbers of empty and loaded containers to and from the region show the following. In 2011, around 290,000 TEU were imported empty from the BSR, whereas only 41,000 TEU were exported to the region. The contrary situation can be observed when analyzing the numbers of loaded containers to and from the region. In 2011, around 487.000 TEU have been imported from the BSR to Hamburg, whereas around 800.000 TEU have been exported from Hamburg to the BSR. On the port level, it becomes clear that empty imports and exports between Hamburg and the BSR not only differ in terms of total numbers but also structural in terms of the ports of origin for empty imports and ports of destination for empty exports, respectively.

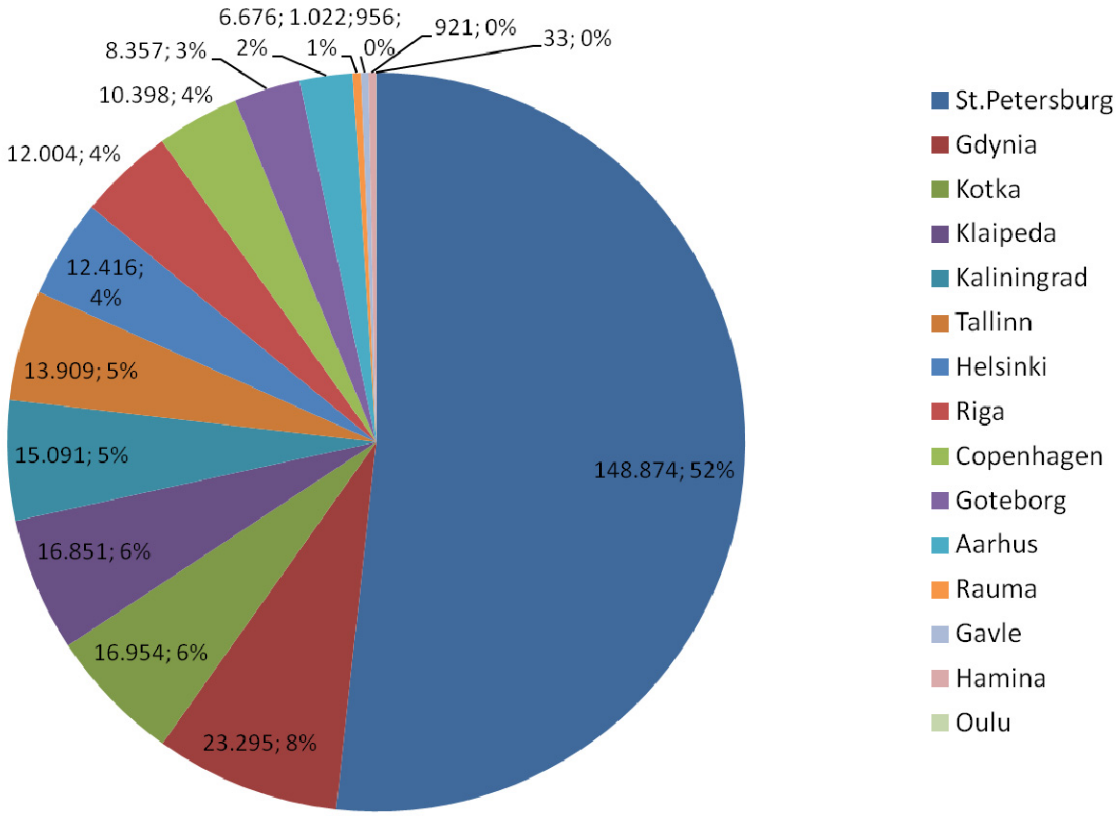

Figure 2: Import empties by TOP 15 Hamburg - BSR ports in 2011 (TEU) [2]

Empty imports show the dominant role of the port of St. Petersburg. More than 50% of the empty containers that reach Hamburg from the BSR originate from there. The remaining

half is distributed among a larger number of smaller ports in Poland, Scandinavia and the Baltic states with shares between 8% and 4%.

Empties leaving Hamburg for the Baltic Sea region, in contrast, lack an equally dominant player. Gdynia (28%) and Gothenburg (21%) together account for almost 50% of all containers leaving Hamburg for the BSR, however on a much lower scale compared to St. Petersburg on the export side. In total, both ports account for only little more than 20.000 TEU. The Finnish ports of Rauma (11%), Helsinki (9%) and Kotka (9%) account for another 30% of all empties leaving Hamburg for the BSR (c. 12,000 TEU in total).

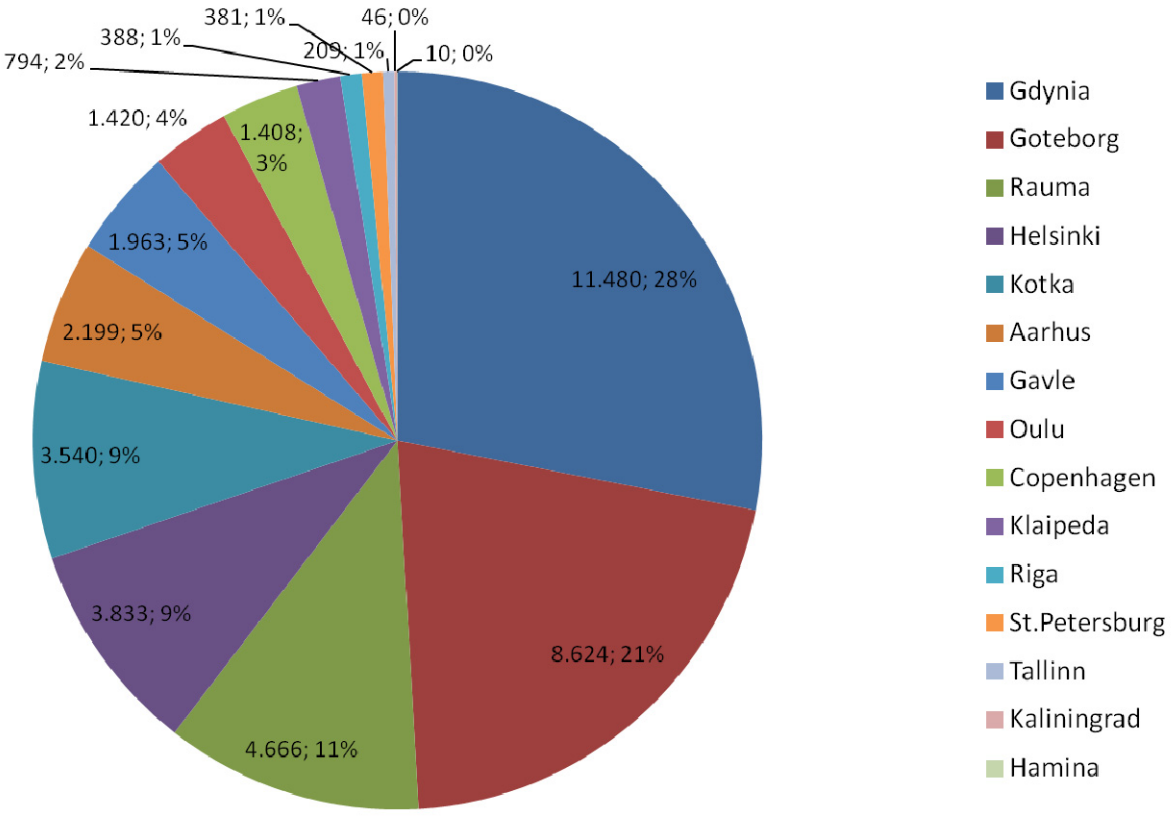

Figure 3: Export empties by TOP 15 Hamburg - BSR ports in 2011 (TEU)[2]

Another important influencing factor of empty repositioning is the type of container equipment. Import and export flows to and from Hamburg can vary significantly depending on the container type.

In the following, a distinction is drawn between standard containers, reefers and transport stillages.

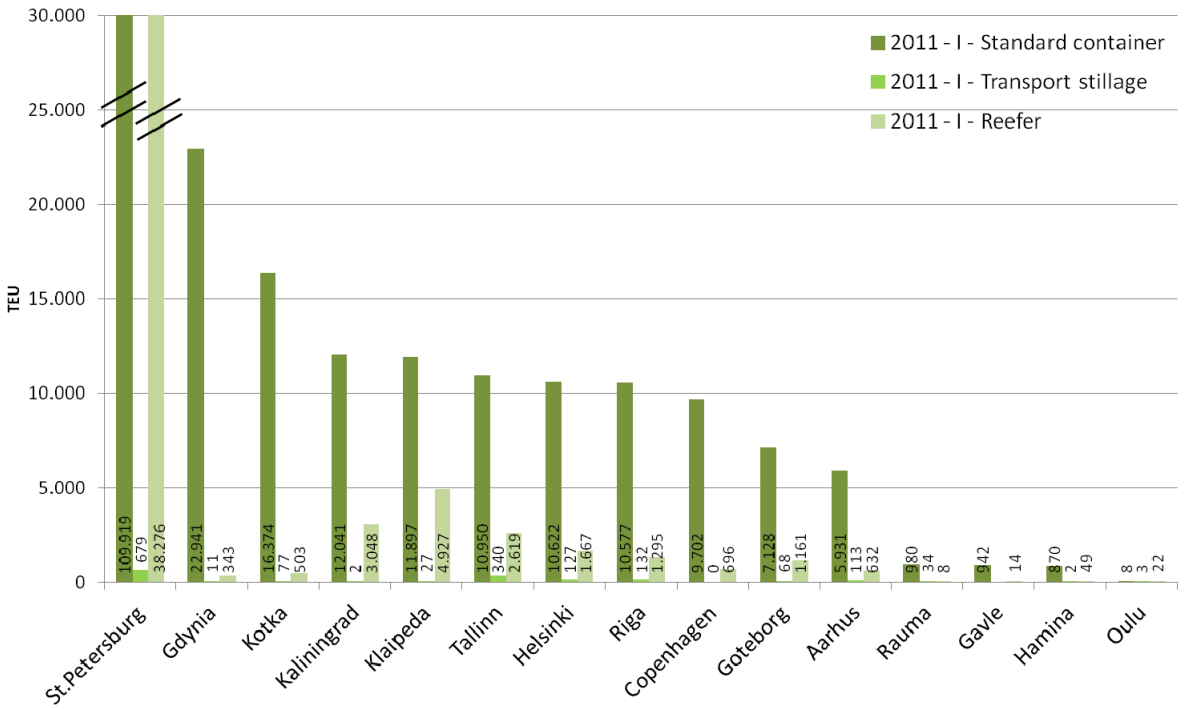

Figure 4: Import of empty containers by type and port in 2011 (TOP 15 Hamburg - BSR ports)[2]

Figure 4 shows the number of empty containers returning to Hamburg (import) from BSR ports. Here again, the dominant role of St. Petersburg (c. 110,000 TEU empty standard containers and c. 38,000 TEU reefers) becomes apparent. For standard containers, Gdynia and Kotka come second and third, total numbers however, only add up to one fifth or one sixth of the volumes of St. Petersburg, respectively. Some smaller ports such as Kaliningrad, Klaipeda, Tallinn, Helsinki, Riga and Copenhagen then follow with around 10,000 to 12,000 TEU p.a. For reefers, Klaipeda with around 5,000 TEU comes second, followed by Kaliningrad (c. 3,000 TEU) and Helsinki (c. 1,700 TEU). Transport stillages, which are used for example for tank containers, only play a minor role in empty flows – imports as well as exports – between Hamburg and the BSR.

Export flows of containers are, as explained before, much smaller than imports. St. Petersburg here only plays a minor role. Gothenburg (c. 8,300 TEU), Gdynia (6,400 TEU) and Rauma (c. 4,700 TEU) represent the TOP 3 in standard container export. For reefers, it is Gdynia (c. 4,800 TEU) followed by Aarhus (c. 1,000 TEU) and Copenhagen (c. 600 TEU).

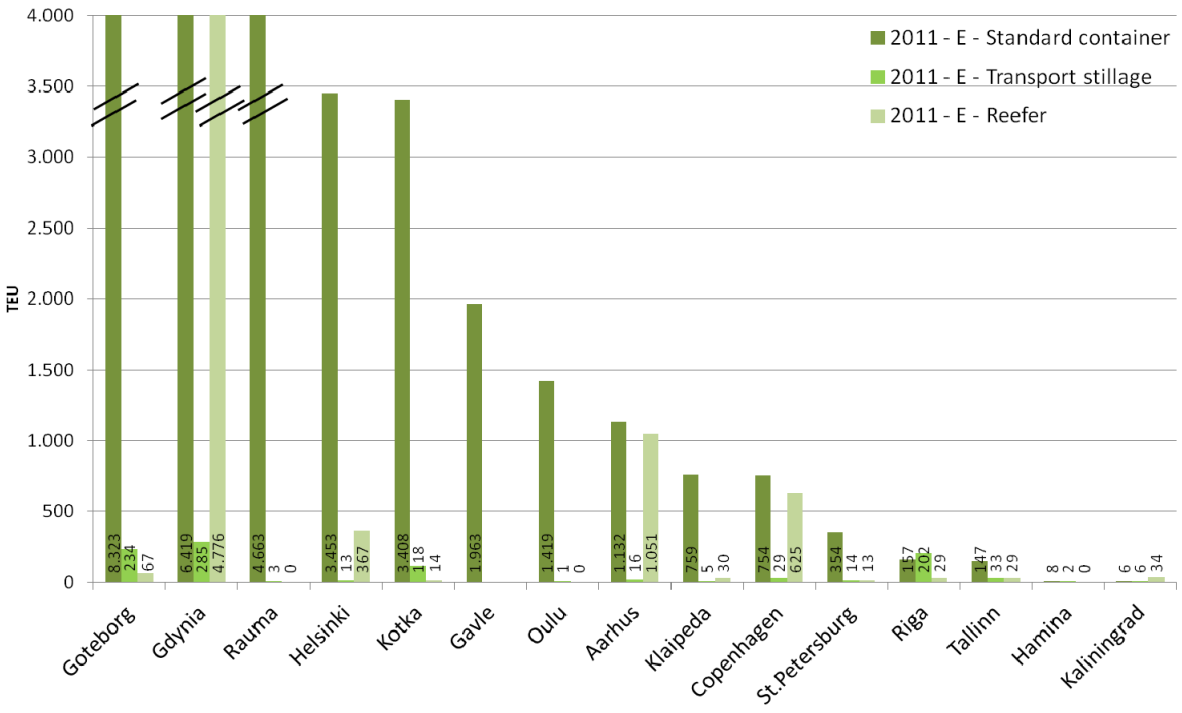

Figure 5: Exports of standard container by size (20'/40') and port in 2011 (TOP 15 Hamburg - BSR ports)[2]

Standard containers as well as reefers can further be distinguished into 20' and 40' containers. Reefers are, however, almost exclusively 40' containers. A distinction between different container sizes is in the following therefore only made for standard containers. For ease of comparison, units in Figure 6 and Figure 7 are, in contrast to the previous graphs, not TEU but actual numbers of containers.

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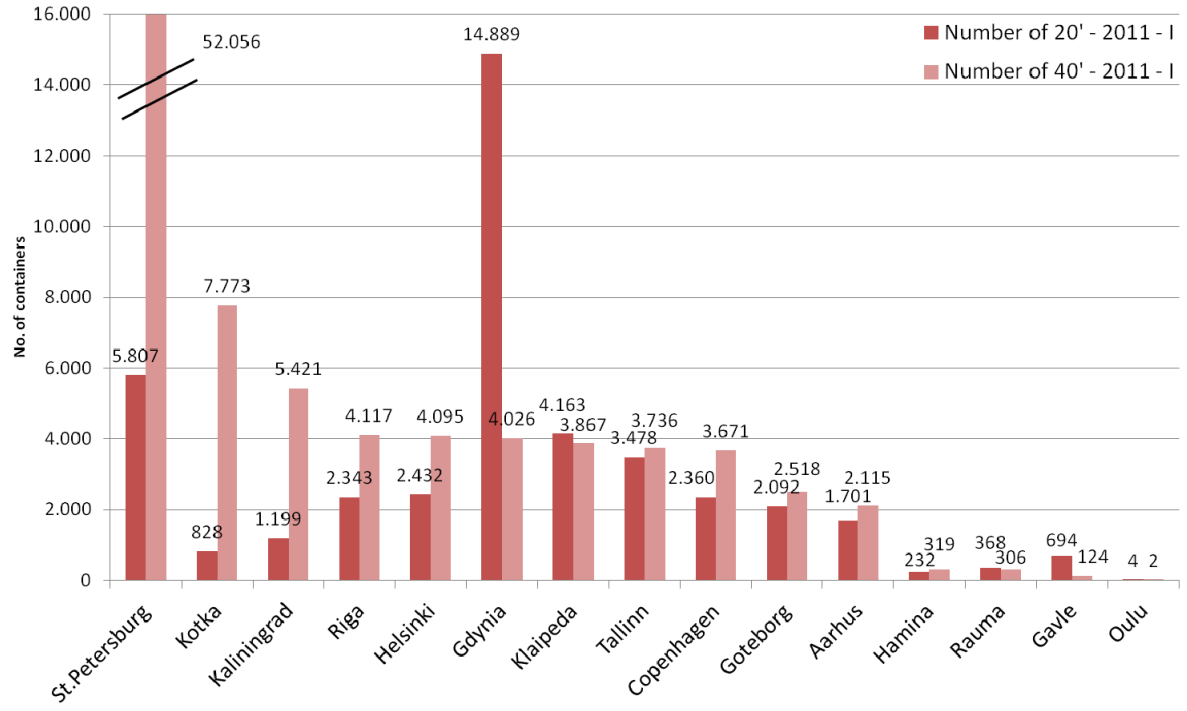

Figure 6: Container import by size and port in 2011 (TOP 15 Hamburg - BSR ports)[2]

Figure 6 shows the numbers of empty standard containers being imported from the BSR to Hamburg in 20' and 40' units. It becomes clear that the dominant role of St. Petersburg is especially induced by 40' containers returning to Hamburg (c. 52,000). In comparison, the number of 20' standard containers returning to Hamburg from St. Petersburg is much smaller, accounting for only around 10% of all St. Petersburg containers destined for Hamburg. Other important ports from where 40' standard containers are returned to Hamburg are Kotka (c. 7,800 containers) and Kaliningrad (c. 5,400 containers) followed by a group of six ports across the region with around 3,500 to 4,000 empty containers. The largest port for 20' standard containers destined for Hamburg is Gdynia with c. 15,000 empty boxes, followed by St. Petersburg (c. 5,800 containers), Klaipeda (c. 3,900 containers) and Tallinn (3,500 containers).

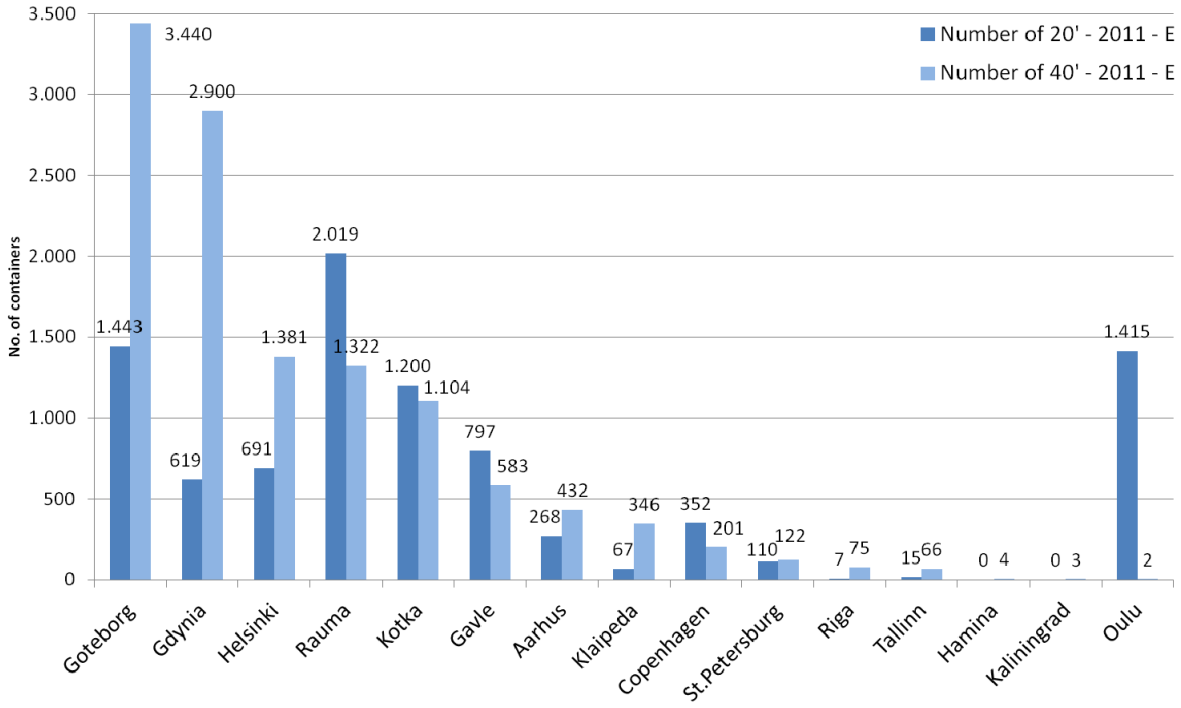

Figure 7: Container export by size and port in 2011 (TOP 15 Hamburg - BSR ports)[2]

Figure 7 shows the numbers of empty standard containers being exported from Hamburg to the BSR in 20' and 40' units. Comparably to the total numbers, the scale of empty export containers leaving Hamburg for the BSR is much smaller than import containers. Important ports receiving 40' standard empties from Hamburg are Gothenburg (c. 3,400), Gdynia (2,900) and Helsinki (c. 1,400). Rauma (c. 2,000), Gothenburg (c. 1,400) and Oulu (c. 1,400) are the largest receiving ports of 20' standard export containers ex Hamburg.

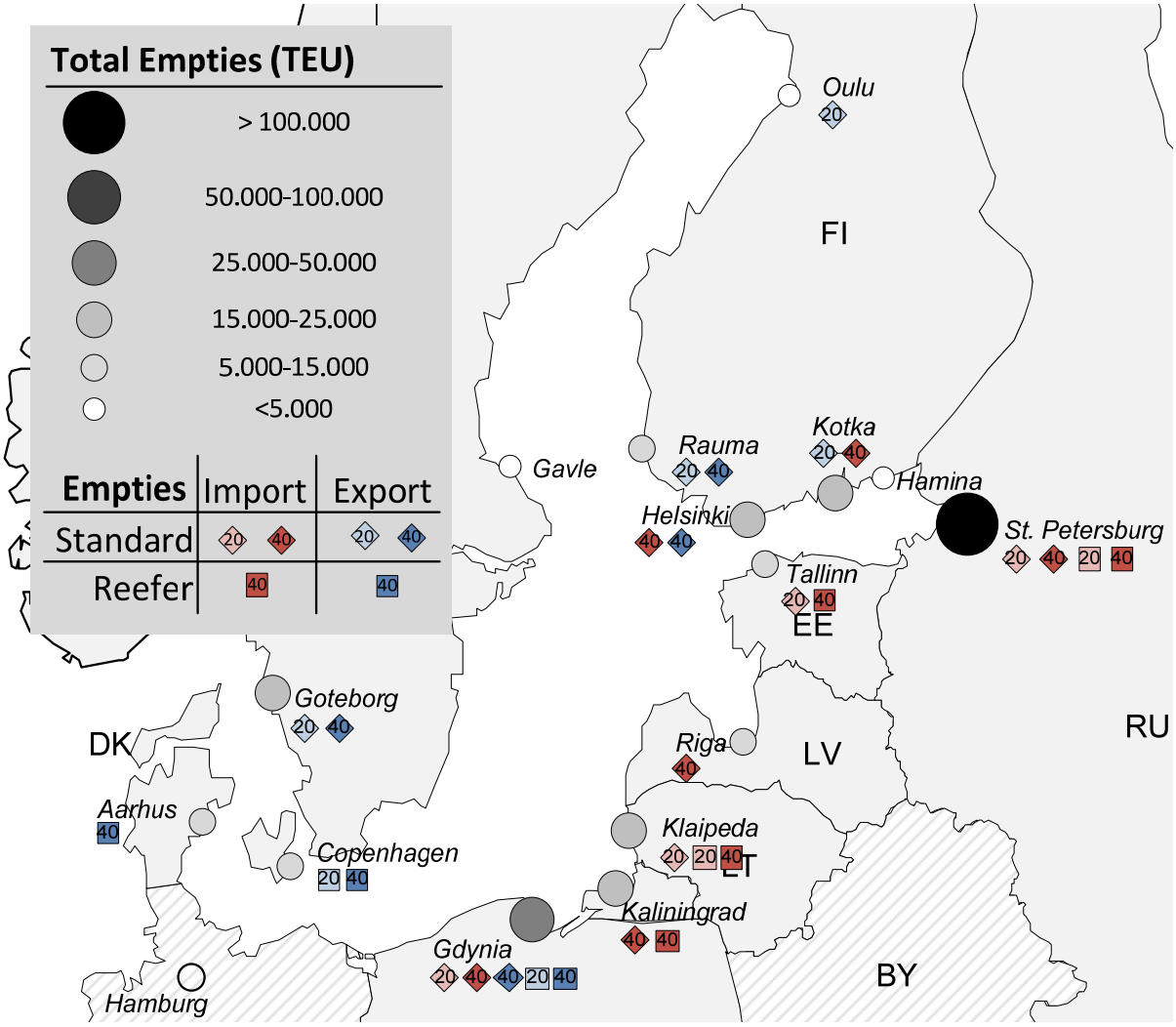

Figure 8: Empty containers Hamburg - BSR by type and direction (TOP 15 Hamburg - BSR ports)[2]

Summary

The Port of Hamburg is a major gateway to the BSR with feeder operators shipping loaded and empty containers to and from the region. Figure 8, which maps empty flows between Hamburg and the BSR, shows the diversity of empty equipment handled in the region in terms of the type of empty equipment, its scale as well as the direction of flows for major ports in the BSR. St. Petersburg is by far the largest port in terms of empty movements for standard containers as well as for reefers. So the vast majority of empty containers are imported, i.e. shipped back to Hamburg. Gdynia, the region's second largest port with regard to Hamburg especially receives empty reefers and 40' standard containers from Hamburg and ships back standard 20' and 40' containers. Southern Scandinavian ports such as Aarhus (40' reefers), Gothenburg (20' and 40' standards) and Copenhagen (20' and 40' reef-

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ers) are predominantly receivers of empty equipment. The Baltic ports of Tallinn, Riga and Klaipeda, being predominantly exporters of empties, ship empties (standard as well as reefers) back to Hamburg. Ports in the Gulf of Finland show a heterogeneous picture. Whereas the Port of Helsinki, which predominantly supplies the metropolitan region of Helsinki, imports and exports standard containers to and from Hamburg, the Port of HaminaKotka, predominantly a transhipment hub, ships 40' standard containers back to Hamburg and receives empty 20' standard boxes. Northern Finnish ports of Oulu and Rauma predominantly receive empty standard containers from Hamburg, e.g. for the export of containerised pulp and paper products.

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4 Stakeholders in the (empty) container maritime transport chain[3]

In the following the main players are briefly portrayed in general and - if applicable - with special regard to the BSR. Their role and relationship is presented in Figure 9.

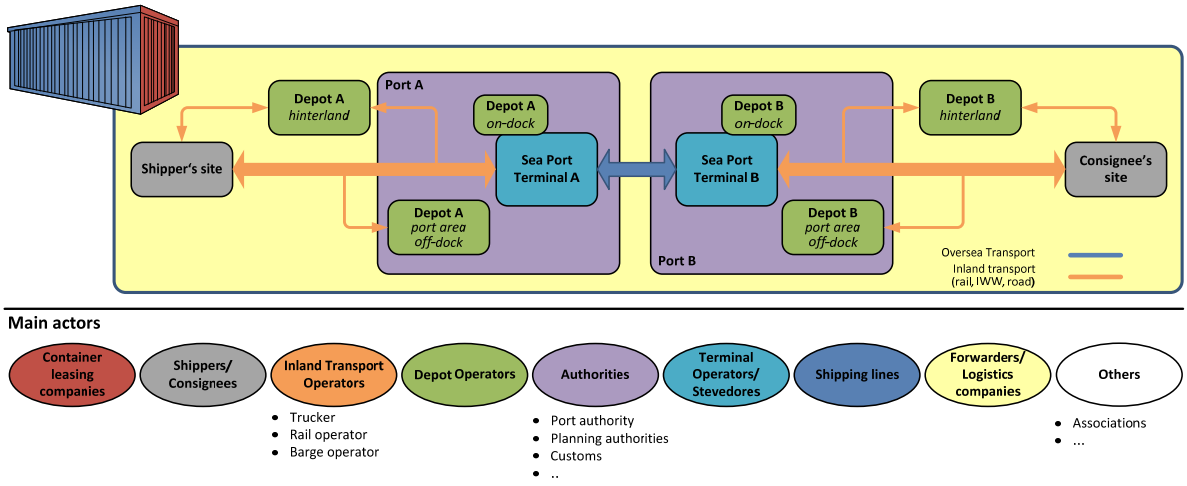


Figure 9: Generic actor groups of the (empty) container transport chain (author's design)

The *shippers* and *consignees* are companies (manufacturing, trading or others) demanding for transportation[4] to realise the import and export of their goods. In the BSR containerised goods are mainly manufactured goods. In some countries, a tendency towards containerisation of bulk and break-bulk products can be observed e.g. pulp, paper and sawn wood in Sweden or Finland[5].

Inland transport operators serve the different modes of inland transport: road, rail and inland waterway (IWW). In the BSR a huge number of road and rail operators serve the market. IWW plays no role, or only a minor role, in the region (the modal share of IWW in the Baltic states Estonia, Lithuania and Latvia as well as in Denmark, Norway and Sweden is zero, in Finland and Poland less than 1%). In contrast to this the countries where the main feeder ports are located have a significant share of inland waterway transport: the

[3] This chapter has partially been published as part of the first WP 5.2 report but for this issue been amended with insights from the interview series and recent publications.
[4] Talley 2009, p.69
[5] BMT 2006, pp. 74

Netherlands with a share of 33%, Belgium with around 18% and Germany with approximately 13% (all figures are for 2010[6]).

Operators of empty depots offer a storage service for transport operators along with services like maintenance, cleaning and repair. Empty depots are located either 'on-dock' inside the port terminal complex, 'off-dock' in the port area, or in the port hinterland. These players have access to important information on empty container shortages and surpluses[7]. In times of increasing vertical or intermodal integration of shipping lines, it is not uncommon for them to operate these depots themselves, hence empty depots are operated by independent depot operators or by operators affiliated to shipping lines. This also applies to terminal operators. Also, the depot operators are integrating their services so as to deal, for example, in containers and in leasing containers for niche markets (very small amounts).

The term *port* or *port authority* is used in different ways. There are four different port types to distinguish, whereas port authorities play different roles in terms of port management, ownership of infrastructure and suprastructure and service provision (see Table 1)[8]. In consequence, the involvement of port authorities in empty container management can be very different (see below).

	Port management	Ownership infrastructure	Ownership suprastructure	Service provision
Service port	Port authority	Public (government)	Public (government)	Port authority
Tool port	Port authority	Public (government)	Public (government)	Port authority operates port-owned equipment. Further services (e.g. stevedore) provided by private companies
Landlord port	Port authority	Public (government)	Private companies or public	Private companies
Private port	Private companies	Private companies	Private companies	Private companies

Table 1: Four types of ports (author's design based on Talley[8])

[6] Eurostat 2010b
[7] Veenstra 2005, p.70
[8] Talley 2009, pp.126

Baltic container ports are almost exclusively served by feeder operators and not directly connected with deep sea ports. This is the well-known hub and spoke system, where deep sea cargo is transhipped in hub ports in Belgium, the Netherlands and Germany to be further feedered to the BSR. There are around 50 container ports in the region (see Figure 1).

The *(sea) terminal operator* is responsible for loading and unloading ships and thereby creating port throughput. Depending on the port's size and functions, one or several terminals can be sited in one port[9]. In around 50 container handling ports in the BSR[10] a large number of terminal operators provide services. In some smaller ports, e.g. in Sweden or Finland, it is not uncommon for the (public) port authority to act as a service port and thus be responsible for all operations in the port.

Shipping lines provide maritime transportation services. Due to vertical or intermodal integration, shipping lines are further involved by, for example, owning container equipment, operating terminals, depots etc.[11] In this context it is important to distinguish between carrier and merchant haulage. Carrier haulage means that one of the transport operators - usually the shipping line – is contracted by the shipper and is thereby responsible to organise the whole transport chain, i.e. to subcontract transport operators of other parts of the transport chain. In the case of merchant haulage the shippers themselves remain in control of organising the transport and subcontract all involved transport operators[12] or a forwarder taking over that role. In the BSR some shipping lines subcontract *feeder operators* to serve certain routes. Some are served by the shipping lines themselves.

Another stakeholder organising door-to-door services for shippers is the *forwarders*. In case of merchant haulage they are the ones who organise the whole transport chain and subcontract all operational parties. In this context it is important to distinguish between sea freight forwarders, who tend to be globally operating companies such as Panalpina, Kühne + Nagel, etc., and hinterland forwarders who are in charge of the hinterland leg. They are subcontracted by global operating forwarders but also directly by the shipper. Sometimes they are also road rail or barge transport operators.

[9] Talley 2009, p. 94
[10] Breitzmann 2009, p.28
[11] Rodrigue, Notteboom 2007
[12] Veenstra 2005, pp.66

Finally there are parties involved by virtue of the impact occurring from empty movement or the impact that their decisions have on empty movements respectively. These are e.g. *regional authorities* that have an influence on port operations, like spatial or transport planning authorities[13]. Furthermore, some associations have a certain influence on empty container management, e.g. the container owners' association.

The ownership of marine (ISO) containers is mainly shared by *shipping lines* (56%) and *container leasing companies* (43%)[14]. A very small share is held by depot operators, large shippers and transport operators[15]. Container leasing companies' business is to lease containers (mainly) to shipping lines. They thereby provide a certain flexibility in the management of containerised assets in terms of the temporal and geographical dynamics of demand. They are globally operating companies[16]. Five leasing companies control about 60% of leasable container equipment. The 13 largest leasing companies account for about 90% of the global container leasing market, equivalent to 10.7 million TEU[16].

The two main owner groups pursue different and in some cases conflicting goals. Carriers consider containers as transportation equipment and their decision making in equipment management focuses on facilitating cargo flows and reducing transportation and handling costs. In contrast to this perspective, containers are the core competence of leasing companies. Ocean carriers increased their ownership in the years before the crisis 'following increasing integration tendencies and the use of tight management approaches like revenue management in their operations'. This phenomenon can be explained by the growing level of 'intermodal integration,' meaning that shipping lines collaborate closer with terminal operators as well as with inland operators[17]. In addition to this, some of the main ocean carriers have launched activities in the container manufacturing industry, underscoring the argument of intermodal or vertical integration. In terms of the ownership structure of the world container fleet between 2005 and 2009, a steady decrease in lessor ownership can be observed (see Figure 10). This was due to the vertical or intermodal integration of shipping lines. Other reasons were the increase of costs of new containers, the repositioning of empties and, in part, very low freight rates. In consequence the container leasing

[13] Hautau et al. 2008, p.29
[14] UNCTAD 2011, p.40
[15] Theofanis, Boile 2009
[16] Rodrigue, Notteboom 2007
[17] Rodrigue et al. 2009

business became less profitable[18]. After the economic crisis the situation changed. During 2009 container production almost came to a standstill. When trade demand recovered a shortage of containers was observed as production facilities could not serve the increased demand and slow steaming was continued. Leasing companies increased their share of the world container fleet while shipping lines maintained their absolute container numbers[19].

The relationship between shipping lines and leasing companies is obviously very close. There is a significant difference regarding the costs for repositioning of empty containers whether the shipping or the leasing companies bears it, because the latter has to hire container slots from the carrier for these transports. Even though shipping companies may try to pass repositioning costs on to the lessors, it is quite evident, that this is not a long-term policy as they are somehow dependent on the services of the lessors. In return, leasing companies are closely related to the carriers being their main client[20].

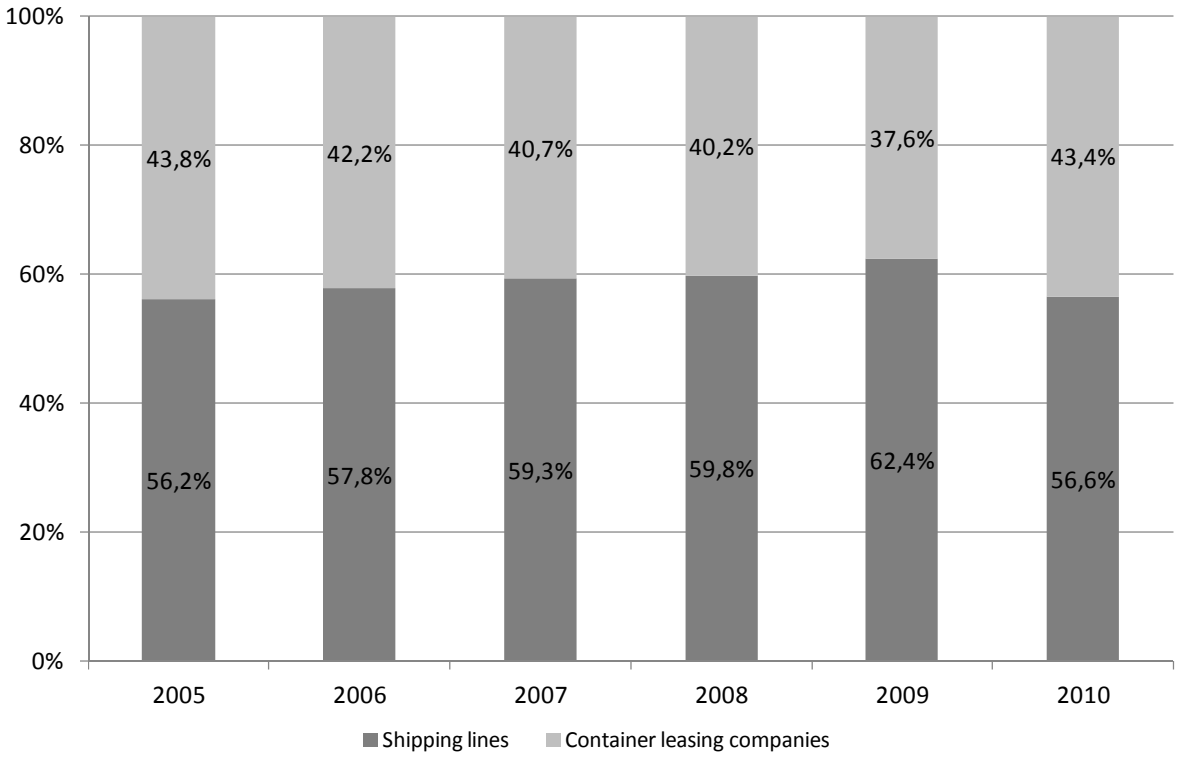


Figure 10: World container fleet ownership (author's design based on UNCTAD[14])

[18] Rodrigue et al. 2009
[19] UNCTAD 2011, pp.39
[20] Konings 2004, pp.86

5 Processes in empty container logistics

A process analysis was undertaken to elaborate the operational processes related to empty container logistics with a special focus on the different areas of responsibility of each stakeholder, their interfaces and the exchange of information[21]. Furthermore, strategic decisions exerting influence on operational processes were concluded from the interviews and are portrayed as follows:

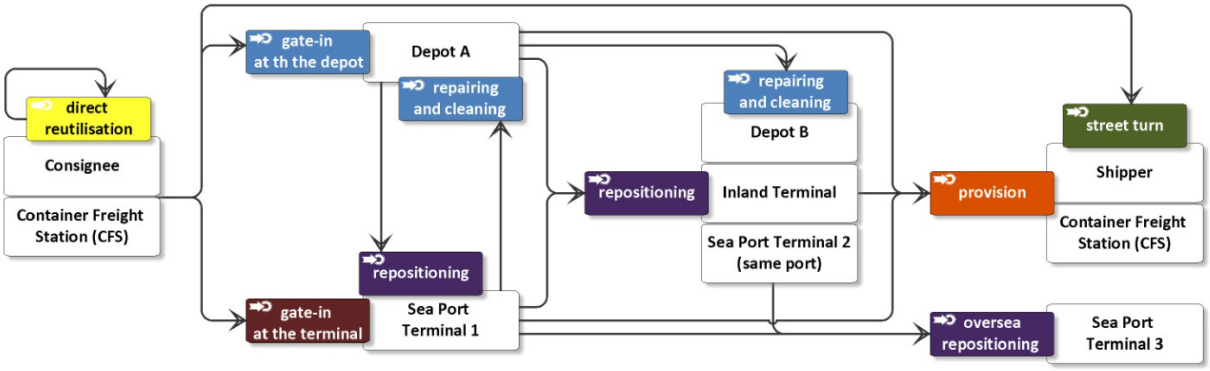


Figure 11: Overview on processes (author's design)

An overview of empty flows and related operational processes is shown in Figure 11. The flow chart starts with the initial process of the empty container transport chain: the container is emptied. In door-to-door and pier-to-door container services, containers are unloaded at the consignee's site whereas in door-to-pier and pier-to-pier container services, unloading happens at container freight stations (CFS). Up from there are firstly four alternatives to distinguish: the empty container (EC) is directly reused by the same company, brought to another shipper to be used there (the street turn), shipped to a depot or to the terminal[22]. Proceeding from the depot the EC is either brought directly to a shipper or CFS to be provided there. Or in case repositioning is needed before the EC can be provided, the EC is shipped to another depot (also called stock feeding), brought to an inland terminal or to a seaport terminal for further repositioning. In some cases the EC is brought to another depot if maintenance, repair or cleaning services cannot be provided at the original depot. Originating from the terminal, the EC is directly provided at consignees or CFSs or it is shipped to a depot in case the EC needs to be maintained, repaired or

[21] The process charts were discussed during the interview series and thus all results portrayed in the following are taken from these interviews if no other source is named.
[22] For the context of this description, the case of off-dock or hinterland depots was described. In case of on-dock depots some processes change or disappear.

cleaned. If repositioning is necessary before it can be provided it is brought to another depot, inland or seaport terminal by land transport[23] or by sea to another sea terminal.

Due to the fact that the direct utilisation of ECs does not lead to additional EC processes this alternative is not described further, though some aspects valid here are mentioned within the description of the street turn. All other processes are portrayed in the following. The street turn is described in an individual process chart. The two backhaul alternatives to the depot or terminal are described together. Further planning processes are portrayed that are required to initiate provision and necessary repositioning of ECs as well as the operational processes to realise provision and repositioning. In addition, information on lease and customs processes is provided. In order to focus on operational processes and reduce complexity, these two perspectives have been excluded from the process charts and related descriptions. Nevertheless both perspectives are part of the overall process and are thus described in brief. First, strategic reflections are portrayed for each process chart to introduce underlying decisions relating to operational processes.

Street turn

The street turn is a two-edged affair. It avoids empty transportation by shipping the EC directly to the next export location without backhaul transportation to depots or terminals and provision from these locations. This means a better capacity utilisation of transporting and forwarding companies which are the ones initiating street turn processes. Nevertheless this alternative does not include any checking processes in the depot, which might lead to quality complaints by the new shipper. For this reason it is handled with care by shipping lines responsible for the equipment not only in areas where the quality of container equipment is crucial. In recent years the share of street turns increased due to the fact that better capacity utilisation was desired by the shipping lines too and information exchange on that issue has improved as well. But street turns still do not have a high share: a range from 5% to 10% was mentioned by different interviewees in Hamburg. At other regions around the BSR this alternative is even more seldom or almost non-existent, e.g. in Finland as paper products require high quality standards of the container equipment and due to this, checking processes at the depot are preferred. The same two-edged perspective applies to the alternative of direct reutilisation of the EC by the consignee/shipper. In this context it has to be mentioned that import and export cargo of one shipper often re-

[23] The case of combined transport is not described in detail here and in the following descriptions.

quire different container types, sizes and quality grades, making this an infrequent alternative.

Processes related to the street turn are shown in Figure 13. For the street turn alternative there have to be two initial requirements: a container is emptied at a consignee's site and in a reasonable proximity cargo is available that requires the suitable container, size and quality grade. Reasonable proximity very much depends on the container availability in the region or the distance to the next seaport or hinterland depot/terminal. If forwarding companies or transporting companies on behalf of forwarders are the initiators of the street turns (merchant haulage) they first have to request the confirmation of the shipping line to use the equipment in this way. Information exchange is mostly realised by so-called street turn lists sent by email. Assuming that permission is provided the transport operator gets instructions to pick up the EC either by the forwarder (merchant haulage) or the shipping line (carrier's haulage). Very often the trucking company is advised to check the container roughly before transporting it. The street turn process ends with the container at the shipper's site.

Backhaul of empty containers

Backhaul processes to seaport terminals or depots are shown in Figure 14 with processes that follow the use of a container. First, some strategic reflections are summarised for a better understanding of the underlying decisions.

The case described here is that the depot and the seaport terminals are at two different locations which may, however, not always be the case. Often empty depots are situated on-dock i.e. on the sea terminal area. A detached operation may be argued by the following. The seaport terminal operator handles ECs from ship to land and vice-versa. Therefore buffering zones for full and empty containers are situated on the terminal area enabling the decoupling of connected transport systems which are at least sea and road transportation, very often rail and sometimes barge. Due to the fact that depot processes are less profitable than terminal processes in relation to required space, terminal operators – especially in ports where space is at a premium – prefer not to offer depot processes on the terminal. Thus empty depots are situated somewhere else in the port area either operated by independent parties or by parties affiliated to terminal operators or shipping lines. Nevertheless shipping lines prefer to have empty stocks and even depot services directly on the terminal as from there they can move their container fleets very flexibly and short-

term and throughput time decreases and becomes better predictable. Accordingly, space availability and influence of shipping lines or major shippers determine the location of empty depots in the port. In the hinterland, depots and terminal are often but not exclusively at the same location.

The location of dropping-off the EC is closely related to the EC strategy the shipping line is applying for that port or region. A determining factor is the balance of imports and exports leading to surplus or deficit areas with respect to ECs. Thus it can be a usual policy in surplus areas to bring almost all ECs back to the sea port terminal for further repositioning, e.g. back to Asia. In case the container most likely can be used for an export in the region it is worth to bring it into the depot to undergo regular maintenance, or if necessary repair and cleaning services. Another determining factor is the balance of required quality standards for export containers and the quality of repair services supplied in the region. If quality requirements cannot be served within the region the EC is shipped to another location to undergo repair or cleaning services there. Last but not least, labour costs also exert an influence on regional empty container strategies. Regions with high labour costs are not in favour for repair works, some shipping lines bring all damaged containers back to Asia where labour costs are lower. But already around the Baltic Sea the difference in labour costs can lead to empty movements.

The backhaul processes again start with an emptied container at the consignee or the CFS. The EC is picked up by a transport operator and shipped to the depot or seaport terminal[22], instructions already having been provided by consignment note. The drop-off location can be a region, a port, a specific depot or seaport terminal. If the EC is brought back to the seaport terminal, a gate-in note is first sent to the shipping, as a rule by EDI. The same process applies to ECs that enter the terminal from the sea. If there is no on-dock depot the container usually does not undergo standardised checking processes, only transportability or obvious shortcomings are checked by the seaport terminal operator. In some ports there are subcontracted companies or the shipping line itself checks the container in the terminal area. If there are any shortcomings the seaport terminal operator instructs the depot to check the container. If there are no shortcomings the shipping line is informed of the availability of the EC at the seaport terminal and the EC is buffered either in a dedicated area or in the normal stock. If the seaport terminal operator has already received the release note for this specific EC, it is possible to bring the EC already to the export area for a specific ship, or a train. If the EC is brought to an empty depot – or to the

terminal - a gate-in note is first sent to the shipping line by EDI. Then the depot operator carries out the standard EC checking processes as agreed with the shipping line. If there are no shortcomings the shipping line is informed accordingly. If there are shortcomings the depot operator proceeds according to the repair policy agreed with the shipping line. Sometimes there are agreements on an average fee paid for every container (damaged or not), or a threshold value below which the depot operator proceeds without any query. Above that threshold value or as usual process the depot operator sends a repair estimate, sometimes accompanied by digital photos, to the shipping line, usually by email. Sometimes further negotiations or even personal inspections by the shipping line follow this repair estimate. Then the shipping line decides on the specifics of the repair and cleaning processes and if these processes are to take place at the depot or at a different location. If it is decided to repair at another location a transport operator picks up the damaged EC at the depot and brings it to the seaport terminal for further repositioning. If repair takes place at the original depot, the shipping line is informed as soon the empty container is available. Sometimes ECs are exchanged between depots if one depot cannot offer all required services. Available ECs are mostly stored by shipping line, type, size and quality grade. Applied storing principles can also become a part of agreements between shipping lines and depot operators. Some shipping lines require first-in-first-out, other leave it to the depot operator.

Pre-planning of provision and repositioning

Processes of pre-planning provision and repositioning are shown in Figure 15, but first some remarks on crucial aspects with regard to this part of the overall process are given.

Usually empty container movements and processes are not detached from loaded container processes. Both are planned for one export shipment and thus agreements on the schedule of provision, drop-off location etc. are already fixed in the consignment note. Nevertheless, trade and equipment imbalances lead to empty movements that are not necessarily related to a specific export container although repositioned containers will eventually be used for export again. According to the experience of the shipping line the repositioning or evacuation of ECs on specific relations can be a standard process. Sometimes depot and terminal operators support shipping lines in monitoring their stocks as they also have knowledge and experience on the demand for ECs. Due to the fact that shipping lines earn higher revenues from loaded containers being transported on their ships, the evacuation of empties is sometimes initiated rather short-term to make use of free capacities. Some-

times the reason can also be that weight limits have already been reached and free slots could not be filled with loaded containers anyway. This also applies to rail operators and trains. These short-term demands might lead to peaks in capacity usage of depot and transport infrastructure as they sometimes have to prepare or transport a huge number of ECs to the seaport terminal in a very short time.

With regard to the availability of empties the strategy of shipping lines is crucial: how they build up their stocks of empties and, in particular, whether they release specific containers identified by container number from depots and terminals or just containers of a specific type, size and quality. The first case leads to complex requirements of depots or terminal operators as they must provide a specific container and potentially have additional handling requirements as a result, in contrast to the second case in which ECs have to fulfil certain requirements but are exchangeable.

Forwarders sometimes also have their own stocks of leased containers in the hinterland, so-called grey depots. Leased containers are not dropped off but stay in lease until they can be used for another export booking. Normally these grey depots are temporary storage slots at an inland terminal or the yard of a trucking company that is not intended for huge amounts of ECs.

Pre-planning processes start with the booking request of a shipper or CFS needing an EC for export cargo. If the export is organised by a forwarder (merchant haulage) confirmation for the equipment has first to be requested from the shipping line. The shipping line then checks the availability of the required EC (regarding type, size and quality). If the right EC is available the booking or equipment request is confirmed. In a second step the consignment note is created and sent to the shipper and transport operator. The shipper is then able to schedule the export and prepares the cargo. If the EC is not available the shipping line needs to initiate the repositioning of an EC. This process is closely related to standard repositioning or evacuation processes. Potential empty stocks have to be checked with regard to the specific requirements the EC must fulfil. Then the EC has to be ordered and transport and feeder operators instructed. The pre-planning is finalised with the scheduled transport.

Provision and repositioning of empty containers

Processes related to the provision and repositioning of ECs are shown Figure 16, but first here are some general remarks on that part of the overall process.

The specific schedule for container transportation requires the EC release note provided by the shipping line. The earlier this is sent to related parties (transport, feeder, depot and terminal operators), the better they can plan the utilisation of capacities. From the perspective of the shipping line it is rather the contrary, the later the release note is sent, the more flexibly they can plan their capacities (container equipment as well as ships). Consequences of these short-term demands are described above.

The initial process is the sending of the release note by the shipping line to related parties by EDI. This applies to all ECs: direct provision for export as well as repositioning. The depot operator then prepares the EC and brings it to an interchange area according to the transport mode involved. The same applies to the terminal operator who brings the EC to an interchange area in case of overland provision or repositioning. For repositioning by sea it makes a difference which stakeholder operates the ship. If a feeder operator is involved they are the ones creating the loading plan and executing the transport. If the shipping line is operating the ship, the terminal operator creates the loading plan and the shipping line executes the transport. In both cases the terminal operator loads the EC onto the ship. Repositioning by sea in this description ends with the available container in another sea terminal, even though it should be stated that here the usual terminal processes (see backhaul processes) start again. In the case of overland transportation[23] (provision and repositioning of ECs) the truck, train or barge operator picks up the EC from the interchange areas at the depot and terminal for further transportation. Then the container is either provided at the shipper's site or CFS for export or available at the depot to be provided from there or at the seaport terminal for further repositioning.

Lease processes

When it comes to lease processes, container leasing companies and shipping lines are the stakeholders most involved, with further depot operators playing a role. In this context, the different kinds of leasing arrangements should be considered first: there are master leases, long- or dry-term leases and short-term leases[24]. Normally a new built container is leased by long-term or dry lease. Dry leases last over 5 to 8 years. The lessor purchases the containers, but the shipping line performs all the management activities. After this first period the container usually passes over to a master lease contract. Master leases are short- to medium-term and fleet management responsibilities are completely covered by

[24] Theofanis & Boile, 2009

the lessor. Furthermore, master leases comprise complex arrangements concerning on-hire and off-hire of equipment, as well as debits and credits depending on the location and the equipment's condition at the time of interchange. Sometimes containers are leased for a short period like a single trip or a round trip. These short-term leases or spot market leases serve acute demands of operators. In case the container is leased one-way for repositioning this is called cabotage. The empty container has to be repositioned either by the lessor or the shipping line and to avoid empty transportation the container is offered to the cabotage market. Sometimes forwarders or inland transport operators are acting as caboteur companies actively demanding these cabotage containers.

Differences between leasing contracts mainly relate to the arrangement's duration, responsibilities for repositioning and for maintenance and repair[24]. Crucial conditions are the location to drop off and to pick up the container. To avoid containers being off-hired at a place that is not favoured by the lessor, especially in a surplus area, drop-off and pick-up charges are part of the leases as well as a specific quota to determine the number of containers that can be off-hired at a certain place[25].

Operational processes differing from the ones described above mainly occur after drop-off of master lease containers, during dry leases or after drop-off of spot lease containers. Drop-off of the container is then usually at a depot to ensure a professional statement on the quality of the container. The depot operator undertakes the checking procedures agreed for the container and then sends a repair estimate to the shipping line, which has to compare that to the terms agreed in the lease contract. Then negotiations between shipping lines and container leasing companies start. Finally, the depot operator receives instructions on how to proceed.

Customs processes

Normally empty containers are regarded as load units with respect to customs procedures. They may be imported/ exported for temporary use (also called temporary admission) if they are once licensed. By registration at the Bureau International des Containers (B.I.C.) they get a so-called prefix - a seven-character number – that enables customs to handle them more easily. If they are not registered in this way, what often is the case with so-called shippers own containers they have to apply in a specific procedure for temporary

[25] LeDam Hanh, 2003

use every time they are imported or exported. In case the container itself is the traded good, customs procedures are similar to other goods which are imported or exported. Depending on the customs processes it sometimes has to be checked if the container is really empty, e.g. at the gates to get out of the freeport zone in Hamburg. Then customs officials have to open every container leaving the port to make sure that it is really empty.

Processes charts

The notation of the following process charts is displayed in Figure 12.

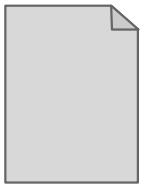
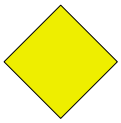
Symbol	Explanation
	Activity
	Data object
	Gateway
	Start Event
	End Event
	Flow of activities
	Flow of information

Figure 12: Notation of process charts

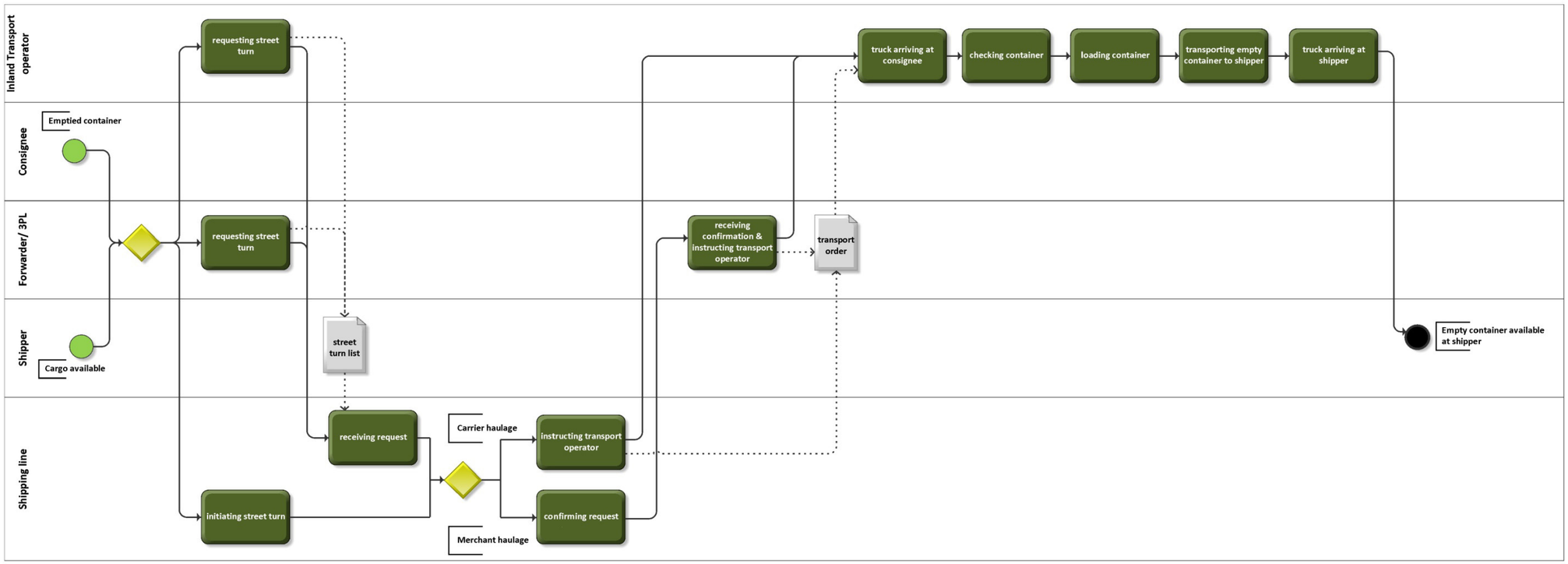


Figure 13: Chart of street turn processes (author's design, *to be printed in A3*)

Backhaul of empty containers

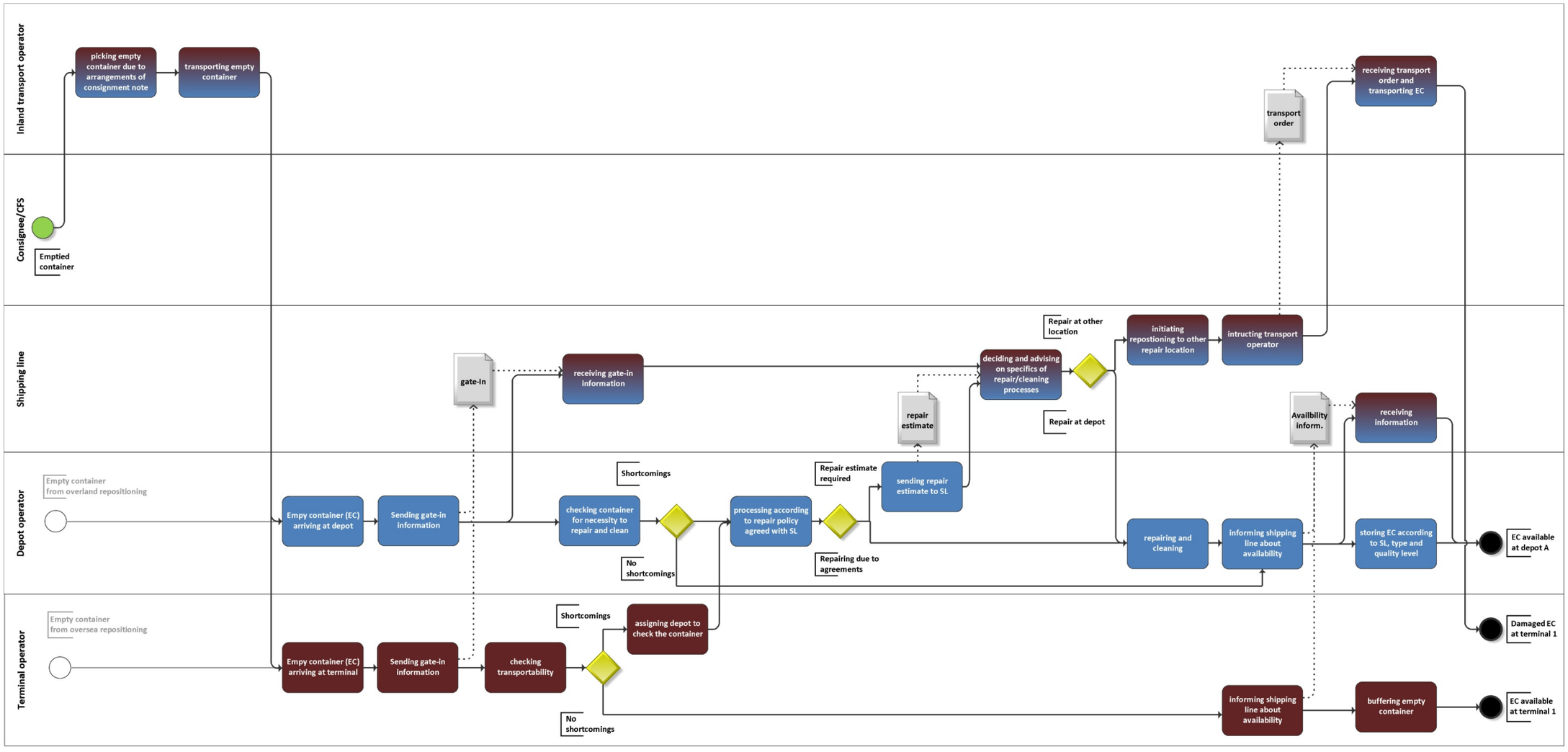


Figure 14: Chart of backhaul processes to the depot and terminal (author's design, *to be printed in A3*)

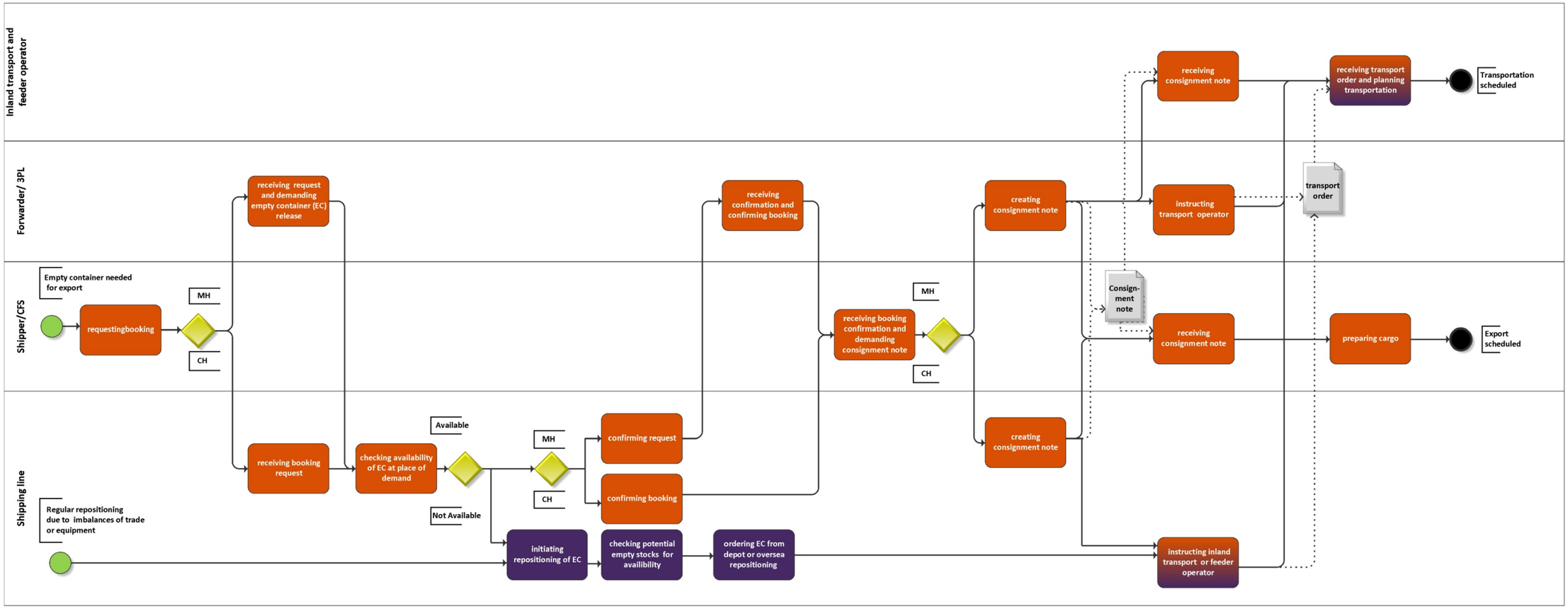


Figure 15: Chart of pre-planning processes of empty container provision and repositioning (author's design, *to be printed in A3*)

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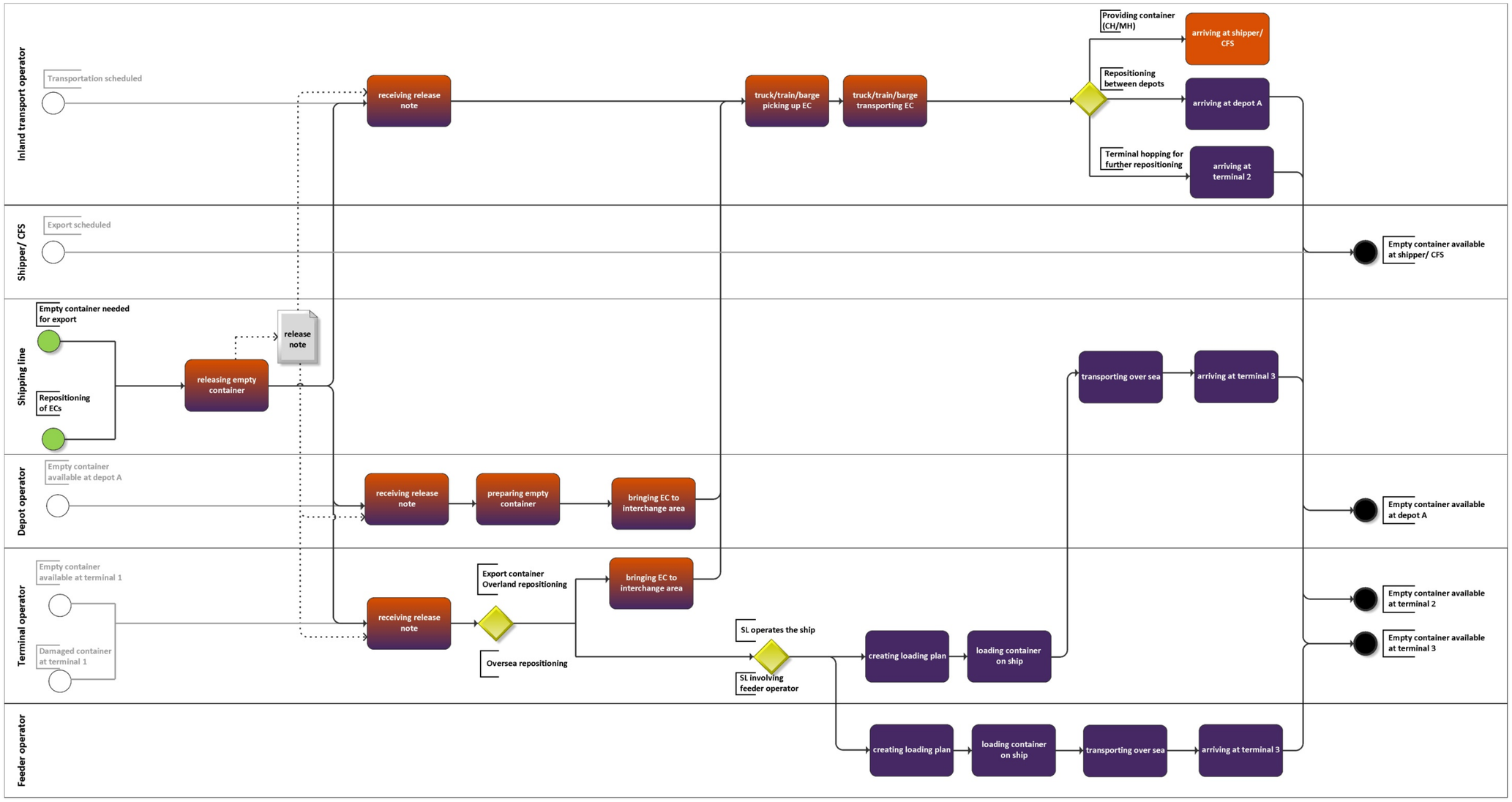

Figure 16: Chart of provision and repositioning processes (author's design, *to be printed in A3*)

6 Perspectives of different stakeholders

During the interview series, stakeholders in the different actor groups such as shipping lines, feeder operators, terminal, depot and transport operators, container leasing companies, authorities, associations and other involved stakeholders were interviewed.

Interviewees were asked to report on current issues/hot topics with regard to empty container logistics. This question was aimed at identifying the stakeholders' main challenges. Issues applying to logistics optimisation in general and independent of this context, such as cost reduction, the qualification of human resources and the standardisation of information flows, were identified during the interview series. Here, the cost aspect eventually means reduction of repositioning costs, which mainly affects the shipping line responsible for the repositioning processes. As the exchange of information affects all actors, standardisation of information flow was mentioned during almost every interview as a crucial factor. In relation to steering mechanisms of container transport chains and thereby addressing the shipping lines as key players in this respect, the following issues were mentioned by almost all terminal, transport and depot operators interviewed. They were that the scheduling of empty flows must permit planning in time and thereby increase capacity planning and utilisation. Furthermore, the traceability of containers and the transparency on processes and volumes for all actors were again referred to by again almost all terminal, transport and depot operators interviewed. Several issues were named that mainly affect stakeholders involved in port-related operational processes (shipping lines as well as terminal, depot and transport operators). They are integrated capacity utilisation – improving a balanced utilisation of port infrastructure and suprastructure -, increased space efficiency at the terminal and decreased throughput time in the depot or terminal. With regard to the port but mainly valid for the Port of Hamburg are the following issues. The image of empty containers in terms of imparting the necessity of empty container logistics as an essential factor to enable good full container logistics was mentioned during almost all interviews with stakeholders in Hamburg. Due to the fact that full container handling (but also some other port activities) lead to higher revenues with respect to the required space and operating empty container depots is a space-intensive business, this leads to the issue of space availability for depots in the port being brought up by almost all port actors. Some of them additionally mentioned the trimodal accessibility of depots as an important issue to ensure flexibility and the potential for modal shift. In relation to the bad image of empties another issue was brought up by a few actors involved in associations linking the

port business with societal interests. This is the negative environmental and socio-economic impact of empty flows. This issue likewise applies more to Hamburg, where port and residential areas are growing close to each other and negative impacts such as atmospheric pollution, noise and unsightly stacks of containers affect local residents directly. Finally, some issues referred to the hinterland area, mainly brought up by transport operators, shipping lines and container leasing companies. One is the increase of the network density of hinterland container depots, which in Hamburg is closely related to the issue of dry port development in the hinterland. Another in this context is container availability in the hinterland, in particular that of special equipment. Last but not least the quality of container equipment was mentioned as an important issue, especially by the shipping lines and forwarders.

Another focus of the interview series was to derive influencing factors with respect to the design of empty container logistics. At first, interviewed parties were asked to name key players in this respect and factors that constituted their power. They mentioned the shipping lines first due to the fact that they control container assets. This applies both to the half of the worldwide container fleet they own directly and to the other half that they lease from container leasing companies. Resulting from this control of container assets and their functioning as carrier's haulage, shipping lines furthermore control strategic steering processes regarding the worldwide flow of (empty) containers. So the main drivers are repositioning due to the imbalance of trade and the imbalance of container equipment (due to different requirements regarding sizes and types) and labour costs (for e.g. maintenance and repair), quality of service in certain ports and container production costs. Interview partners were further asked to name other factors constituting influence as well as their scope of action and underlying influencing factors to design empty container logistics. The factor control of operational processes, which is closely related to pricing, was named very often, especially in relation to terminal and depot operators who handle the containers and have a big influence on throughput time in the port. They also serve short-term demands of shipping lines when they optimise the utilisation of ship capacities by filling ships with empties for repositioning if there is no loaded cargo available or the ship's weight limits have been reached. This also applies to rail operations in the hinterland where due to capacity optimisation ad hoc demands can emerge. The market situation also plays a major role, as in a somewhat fragmented market like the road transport market operational processes can more easily be substituted in the short term by competitors even

though road transport operators with a high share of loadings may also exert influence. Some factors relating to interrelations between different stakeholders were mentioned such as the pressure that one party exerts due to contractual relations. In this context vertical and horizontal integration was named as an important influencing factor. As for horizontal integration, some shipping lines are organised in alliances or other kinds of collaboration to create synergies with respect to empty container repositioning, e.g. they have agreements on cabotage, which in this context is a one-way spot lease of the container owning shipping line to a shipping line which has a loaded container on that specific basis. Also, other stakeholders integrate horizontally e.g. terminal operators to develop their common hinterland as well as almost all actor groups joining associations. With regard to vertical integration this applies very often among certain stakeholders, especially the triangle: shipping lines, terminal operators (seaborne and hinterland) and depot operators. With regard to the cargo owners the shipper's specific demand was named as an influencing factor in particular but not exclusively if they are transporting large volumes. Their specifics exert influence on the quality requirements for the empty container. That leads to requirements along the whole transport chain. The shipping line has to monitor not only container size and type when repositioning but also different quality levels for a cargo range from scrap metal to units of stored blood. This further leads to the necessity of sorting the container in the depot (sometimes also at the terminal) not only by shipping line, size and type but likewise by up to sometimes five quality criteria. That is one reason for the space intensity of this business. Another factor mentioned is the degree of integration in the port community. Many agreements and orders rely on trust and informal relations or personal contacts that sometimes are built up over years. Knowledge and competence of empty container patterns was also mentioned frequently as an influencing factor. Also, the political framework setting was named by a few interview partners. Especially in ports, urban and transport planning authorities can exert influence by decisions they take with regard to e.g. transport infrastructure or general port development. In particular the control of space resources, which is the case in landlord ports, was named as a very important influencing factor for designing empty container logistics.

7 Summary

This case study comprehensively analysed the empty container flows between the Port of Hamburg and the BSR. Results from a data analysis, mapping empty flows between Hamburg and the BSR, show the diversity of empty equipment handled in the region and identify the hotspots of empty flows. St. Petersburg is by far the largest port in terms of empty movements for standard containers as well as for reefers. There the vast majority of empty containers is imported, i.e. shipped back to Hamburg. Gdynia, the region's second largest port with regard to Hamburg especially receives empty reefers and 40' standard containers from Hamburg and ships back standard 20' and 40' containers. Southern Scandinavian ports such as Aarhus (40' reefers), Gothenburg (20' and 40' standards) and Copenhagen (20' and 40' reefers) are predominantly receivers of empty equipment. The Baltic ports of Tallinn, Riga and Klaipeda, being predominantly exporters of empties, ship empties (standard as well as reefers) back to Hamburg. Ports in the Gulf of Finland show a heterogeneous picture. Whereas the Port of Helsinki, which predominantly supplies the Helsinki metropolitan region, imports and exports standard containers to and from Hamburg, the Port of HaminaKotka, predominantly a transhipment hub, ships 40' standard containers back to Hamburg and receives empty 20' standard boxes. The northern Finnish ports of Oulo and Rauma predominantly receive empty standard containers from Hamburg, e.g. for the export of containerised pulp and paper products.

Along these hotspots relevant stakeholders were identified. A representative number of them were interviewed to portray the operational processes of empty container logistics and underlying decision gates exerting remarkable influence. Furthermore, relevant issues related to empty container logistics from different stakeholder perspectives as well as factors constituting influence were identified and discussed during the interview series. Several decision gates underlying to the operational processes were identified and described. The following aspects were identified as crucial issues of empty container logistics by the stakeholders interviewed:

- standardisation of information flow,
- announcement of empty flows,
- traceability of containers,
- transparency on processes and volumes,
- integrated capacity utilisation,

- space efficiency at the terminal,
- throughput time in the depot,
- image of empty containers,
- space availability for depots in the port,
- container availability in the hinterland,
- quality of container equipment.

The following power factors constituting influence for empty container logistics design were identified:

- container ownership,
- strategic process power,
- operational process power and pricing,
- market share,
- horizontal integration,
- vertical integration,
- demand-side power,
- informal connectivity,
- knowledge and competence,
- political power.

In a next step it is planned to ask the stakeholders for a qualitative evaluation of the aspects identified during the interviews to allow each stakeholder to evaluate these issues in comparison. This evaluation will serve as a basis for deriving adequate stakeholder involvement strategies for possible later undertakings in empty container logistics by the Port of Hamburg as well as by actors in the Baltic Sea Region.

List of figures

List of tables

List of abbreviations

B.I.C.	Bureau International des Containers
BSR	Baltic Sea Region
CFS	Container freight station
CH	Carrier haulage
DK	Denmark
EC	Empty container
EDI	Eletronic Data Interchange
EE	Estonia
EU	European Union
FI	Finland

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ICT	Information and Communication Technology
IICL	Institute of International Container Lessors
ISO	International Organization for Standardization
IWW	Inland Waterway
LT	Lithuania
LV	Latvia
Mgmt	Managerial and Organisational Measures
MH	Merchant haulage
PL	Poland
Pric	Pricing Measures
RFID	Radio Frequency Identification
RU	Russia
SE	Sweden
SL	Shipping line
Tec	Technological Measures
TEU	Twenty-foot Equivalent Unit
UNCTAD	United Nations Conference on Trade and Development
VCY	Virtual Container Yard

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