International Transport Forum

The Impact of Mega-Ships

The Case of Gothenburg

Case-Specific Policy Analysis

OECD

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The International Transport Forum

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Case-Specific Policy Analysis Reports

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During this study visit, interviews were conducted with the following stakeholders: Magnus Kårestedt (Port of Gothenburg), Claes Sundmark (Port of Gothenburg), Jill Söderwall (Port of Gothenburg), Arvid Guthed (Port of Gothenburg), Magnus Nordfeldt (Port of Gothenburg), Viktor Allgurén (Port of Gothenburg), Marcus Andersson (APM Terminals Gothenburg), Keld Pedersson (APM Terminals Gothenburg), Mikael Nyman (CFL Cargo), Bertil Hallman (Swedish Transport Administration), Bengt Rydhed (Swedish Transport Administration), Johan Wedel (Business Region Göteborg), Svante Altås (SCT Transport), Agneta Carlsson (Swedish Society for Nature Conservation), Christer Ågren (AirClim), Mikael Eisner (DB Schenker Logistics), Stefan Eglinger (Urban Transport Administration, City of Gothenburg).

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Executive summary

What we did

This study aims to assess the impact of mega-ships on the city of Gothenburg, Sweden. It was carried out as part of a programme on the impact of mega-ships at the International Transport Forum (ITF) at the OECD. It draws on a study visit to Gothenburg and a series of interviews with relevant stakeholders.

What we found

The Port of Gothenburg is the incontestable gateway to Sweden. As the country's largest port by far, it is responsible for handling 57% of Sweden's container traffic. The port is thus a critical asset for the Gothenburg region and the national economy as a whole, considering the relatively high share of maritime transport costs in the goods value of Sweden's main export products. Exemplary in various respects, the port of Gothenburg is widely recognised for its advanced policies with regards to mitigating air emissions and its high share of rail in the hinterland transport modal split.

The most important challenge for Gothenburg is to keep attracting direct calls from ocean going vessels. Direct calls are considered of utmost importance by large Swedish shippers, because they reduce risks, costs and time in comparison to the option of transshipment and feedering via other European ports. As Asia is the main export market of Swedish industry for containerised goods, attracting direct calls means in practice attracting the mega-containerships that are deployed on the Asia-North Europe trade lane. Gothenburg has been successful in attracting some of these direct calls, in part thanks to its container terminal upgrades and sound performance indicators.

In order to continue attracting direct calls, improvements to the maritime access to the port of Gothenburg would be necessary. There are constraints to the depth of the port access channel and the depth of the container berths, which means that many ship types cannot call Gothenburg when fully loaded, or even half loaded in some circumstances. For the moment this is not a major problem, but various developments will require deepening the access channel and berth. The emergence of mega-containerships has cascading effects, i.e. the average ship size will increase on all trade lanes. As trade growth and the concomitant demand for container services will eventually increase, so will the utilisation rates of container ships, which means that these ships will be more fully loaded. The port concentration tendencies of increasing container ship size will mean that Gothenburg will have to improve maritime access if it would like to remain competitive with other North European ports.

Another condition for attracting direct calls is more focus in Swedish ports policies. Despite Gothenburg's dominance in the national ports system, this is not officially recognised. As a result, various new container port projects have emerged in Sweden, backed by local governments that own these ports and that consider them interesting local revenue sources. This fragmentation could mean a duplication of infrastructures and risk of deconcentration of cargo flows. This might undermine the possibility of Gothenburg to attract direct calls, for which sufficient cargo volumes are needed.

What we recommend

Develop a focused national ports policy for Sweden

An effective national ports policy would include a clear articulation of the roles each port is expected to fulfil for the Swedish economy, as well as in which sector and in particular the container sector. A common understanding should be developed between local, region and national governments, so that a national focus will not be undermined by local planning permits for port expansions. Within this national ports policy the need for Swedish shippers to have at least one container port with direct calls from its main trade partners, in particular from Asia, should be recognised. As such, Gothenburg should be acknowledged as a strategic gateway for trade and freight for the whole country.

Make it easier for the Port of Gothenburg to attract direct calls by container ships

Assisting the Port of Gothenburg's to attract more direct calls should include developing a proactive approach to the project to deepen the fairway and container berths. Translate this priority in clear public investment decisions, e.g. with respect to improving maritime access, hinterland connectivity, dry port development and short sea shipping.

Resolve bottlenecks related to mega-ships

The handling of mega-ships would be accommodated by facilitating longer trains and by resolving remaining bottlenecks in the railway network. In order to increase utilisation of infrastructure, projects to increase containerisation of main export products such as forestry products could be stimulated.

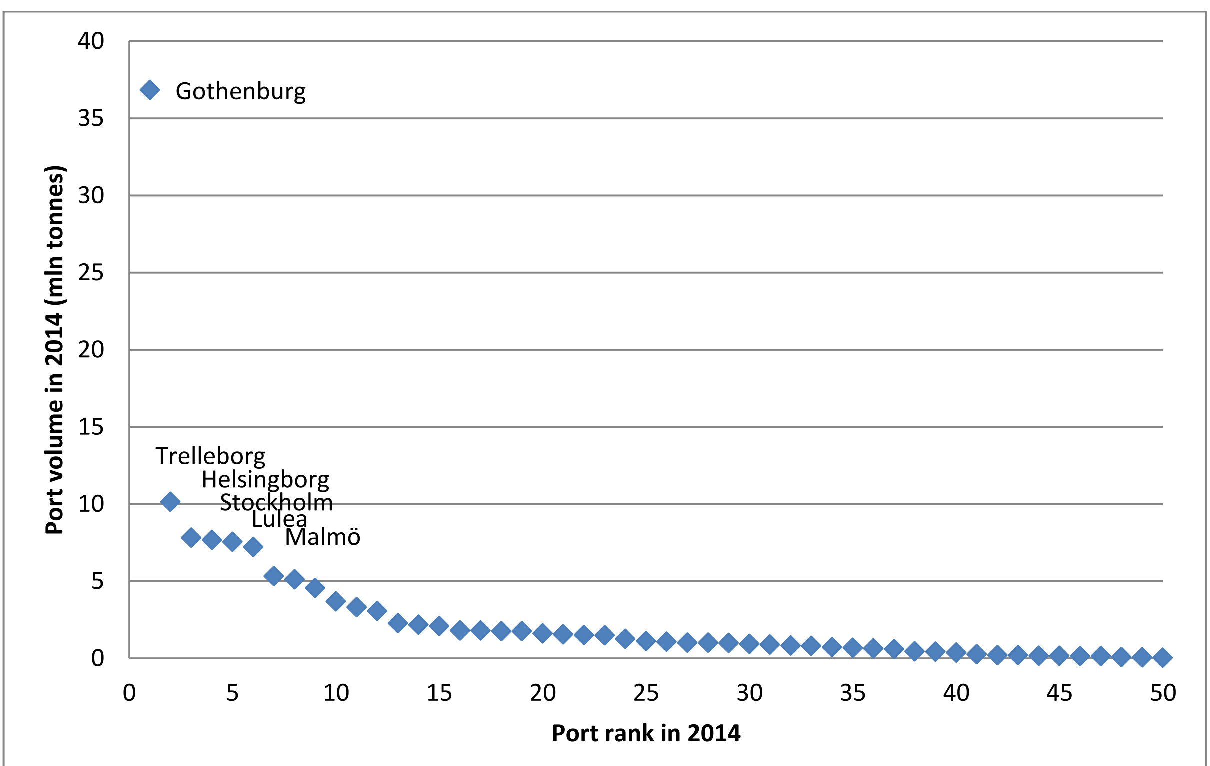
Port of Gothenburg: Profile and performance

Port profile: Major gateway to the Baltic Sea area

Gothenburg is by far the most important of the 52 cargo ports in Sweden, handling approximately 37 million tonnes in 2014. This represents 27% of total port volume in Sweden and more than the four next-largest ports together (Figure 1). More than half of the cargo handled at the Port of Gothenburg is liquid bulk, but the port also handles other cargo types, principally containers and roll-on/roll-off (Ro/Ro) cargo. Its cargo mix is more balanced than the other ports in Sweden, which are generally specialised in one particular cargo type: Ro/Ro in the case of Trelleborg and Helsingborg, and dry bulk in Lulea (Figure 2).

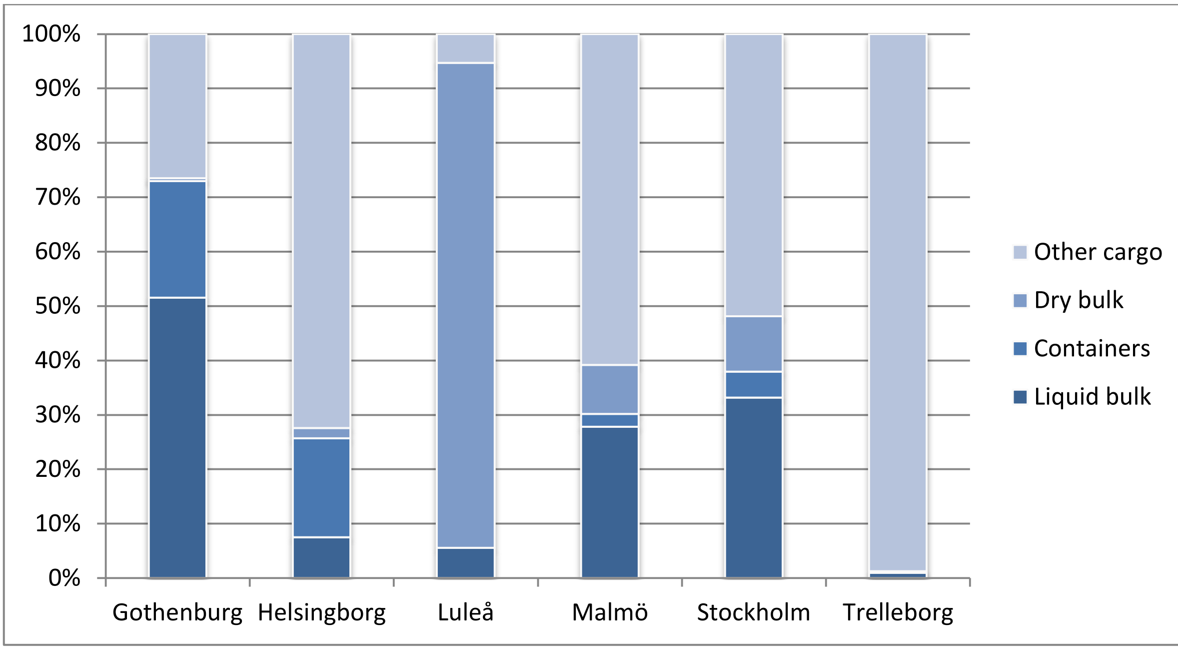
The dominance of Gothenburg is even stronger in the container sector, where it handles almost 60% of Swedish volumes. The number of containers (TEUs) handled in Gothenburg was 837 000 in 2014, four times more than the second largest Swedish container port, Helsingborg. Within the Baltic Sea area, Gothenburg is the third largest container port, after the Polish ports of Gdansk and Gdynia (Figure 3). The emergence of Gdansk and Gdynia is fairly recent, and the result of spectacular volume growth as compared to the average growth rates of Baltic Sea ports.

Figure 1. **Ports in Sweden and their cargo volumes (2014)**



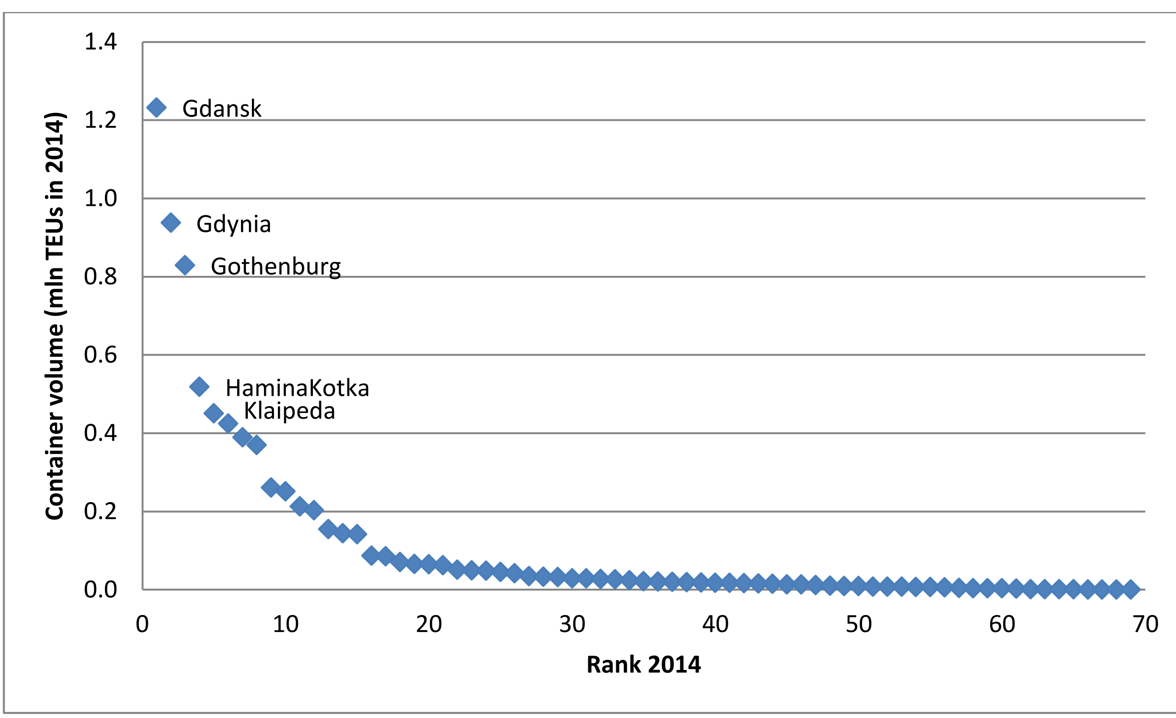
Source: Own elaborations based on data from Eurostat.

Figure 2. **Cargo composition of main ports in Sweden (2014)**



Source: Own elaborations based on data from Eurostat.

Figure 3. **Container ports in the Baltic Sea area (2014)**



Source: Own elaborations based on data from Eurostat.

The port activity in Gothenburg has a substantial economic impact. The economic impact of ports can be assessed in different ways. Common indicators in economic impact assessments include employment, value added, tax income and the trade facilitating effects. This section will briefly highlight some of the findings relevant to Gothenburg.

Gothenburg counted approximately 22 000 port-related jobs in 2011, which represents 8% of the regional employment, according to a study carried out by the port authority (Edman, 2012). In this study, both direct and indirect jobs resulting from port activities in the city were taken into consideration. The results are based on a listing of all companies involved in ports and logistics, based on the Port of Gothenburg' business experience, and validated through industry newspapers and other external sources. In this study (Edman, 2012), direct jobs would not have existed if it was not for the port, and indirect jobs exist partly because of port activities. The study found that 8 074 people are directly employed at the port in 78 companies specialised in port activities. An additional 14 065 people are employed indirectly in 245 companies with activities related to port activities, such as logistics. This figure does not take into account induced effects. In total, 323 companies in the Gothenburg region can be considered to be fully or partly dependent on the port's business, the most important of which are indicated in Table 1.

Table 1. **Top employers for jobs linked to port activities in the Gothenburg region**

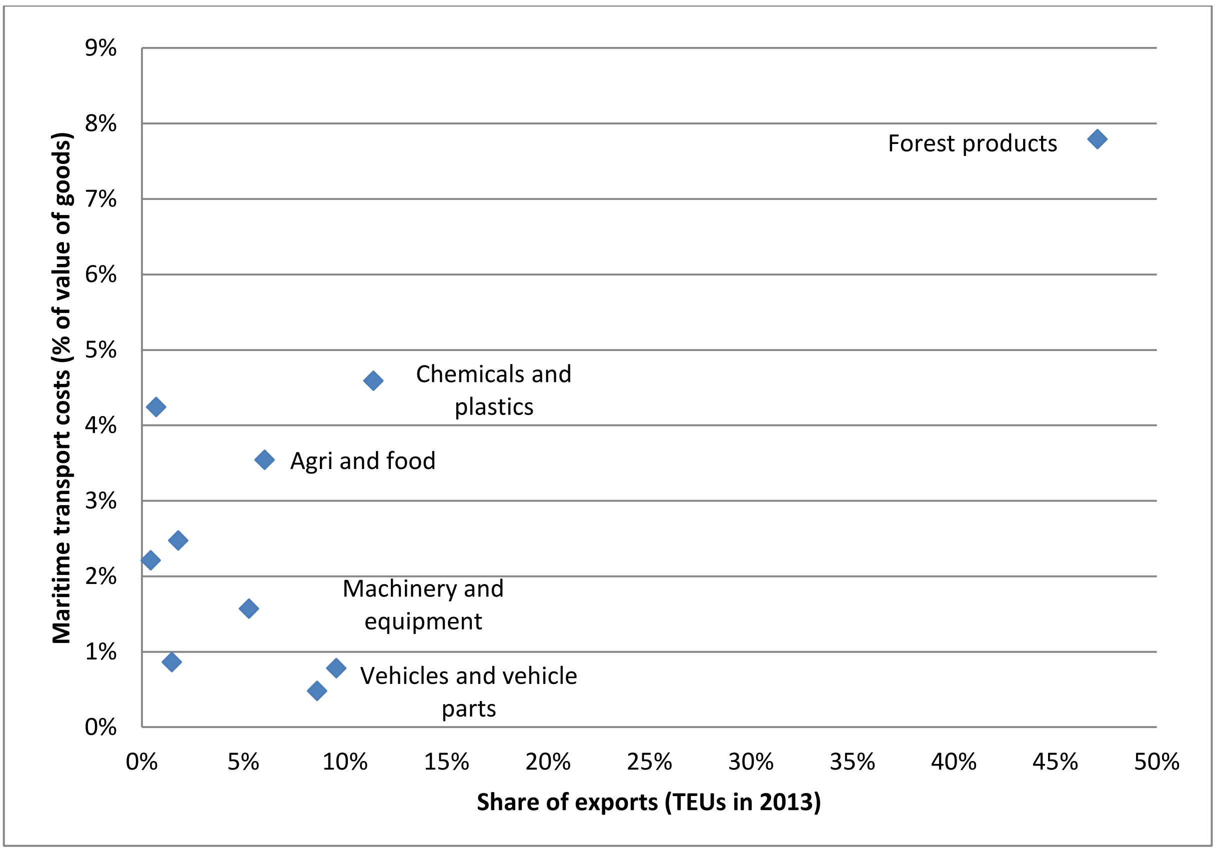
Direct	Indirect
Stena Line AB	Schenker AB
APM Terminals	Volvo Logistics Corporation
Swedish Customs	Stena Scandinavia
Älvsborg Ro/Ro	DHL Global Forwarding (Sweden) AB
Preemraff	Concordia Maritime
ST1 Refinery AB	Geodis Wilson Sweden AB
DFDS Seaways AB	Swedish Maritime Administration
Donsötank AB	Cargotech
Damen Shiprepair Götaverken	Kuehne + Nagel
Göteborgs Hamn AB	Wärtsilä

Source: Port of Gothenburg, 2012.

Gothenburg is the centre for logistics and maritime studies in Sweden and also one of the region's biggest producers for shipping patents. In Sweden, 41% of students enrolled in degrees specialised in maritime transportation and logistics live in Gothenburg. In terms of knowledge production and technology, the region is also one of the world leaders for patent production in relation to these sectors. According to the OECD patent database, it is also the sixth largest region for shipping patents production, totalling 1.5% of world production between 2005 and 2007 (OECD, 2014).

Efficient port operations and low maritime trade costs are essential for the external trade of Sweden. For many of the goods exported from Sweden by container the maritime trade costs represent a relatively large share of the total goods value. This is particularly the case for the two most important export goods: forest products, and chemicals and plastics. Forest products represented 47% of the goods exported in containers; maritime trade costs as share of the value of these goods was around 7.8%. Chemicals and plastics made up 11% of the goods exported in containers; maritime trade costs as share of the value of these goods was around 4.6% (Figure 4). These so-called ad valorem costs for both sectors are much higher than the average ad valorem costs for shipped goods. Hence, the composition of the exported goods from Sweden is such that maritime transport costs are more important determinants in their price and thus in their global competitiveness. If the maritime transport options available to Sweden are costly, the competitiveness of Sweden's main exporting sectors will deteriorate. The Port of Gothenburg evidently plays a crucial role in this, since it handles 60% of the containers in Sweden.

Figure 4. **Maritime transport costs as share of goods value of main exporting sectors in Sweden**



Source: Own elaborations based on data from OECD Maritime Trade Cost database and data from Port of Gothenburg.

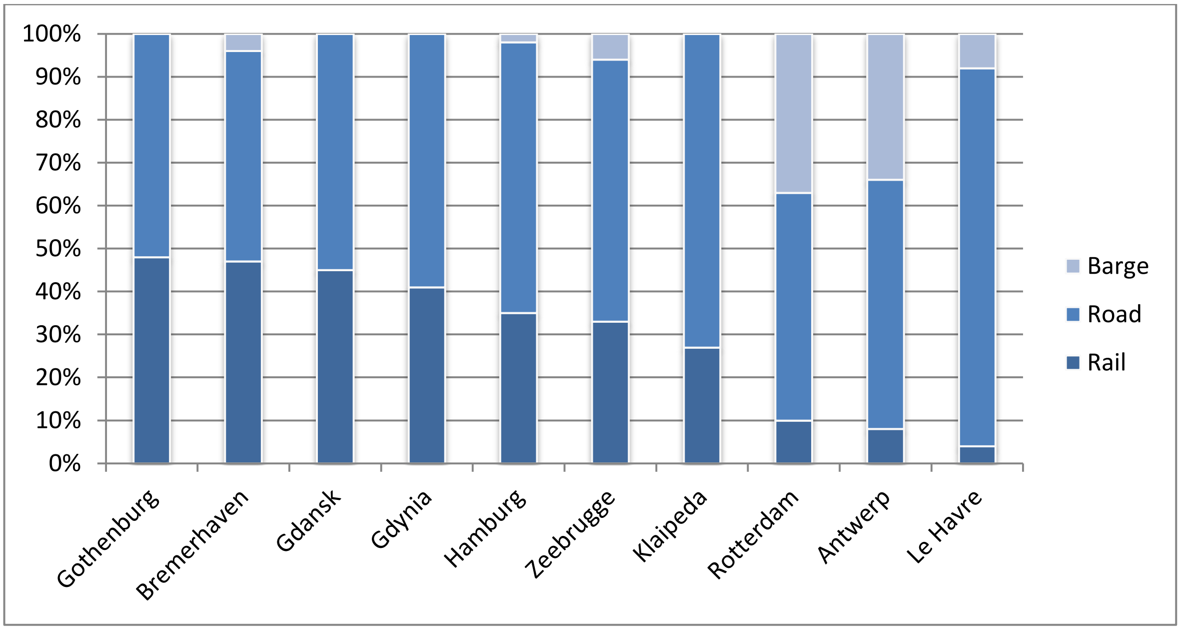
High share of hinterland rail transport

The Port of Gothenburg distinguishes itself on the international stage by its advanced policy making, in particular with respect to port hinterland transport by rail and green port policies. Although an important port in Swedish perspective and within the Baltic Sea area, Gothenburg is a relatively small port internationally speaking. Gothenburg's innovative policy practices, however, contribute to its prominence.

The Port of Gothenburg has managed to develop a fine-tuned rail and dry-ports network throughout Sweden which enables a modal-split for rail of 48% for container freight, which is a high share compared to other ports in North Europe (Figure 5). Gothenburg offers 24 daily shuttles to locations all around the country with overall 70 trains running per day. Most of the shuttles have a frequency of five or more departures per week in each direction. This system ensures smooth and efficient freight handling for

Swedish and foreign shippers. It has become an important condition for direct calls from mega-ships, with carriers such as Maersk making intensive use of these services.

Figure 5. **Hinterland modal splits in main North European ports (2013)**

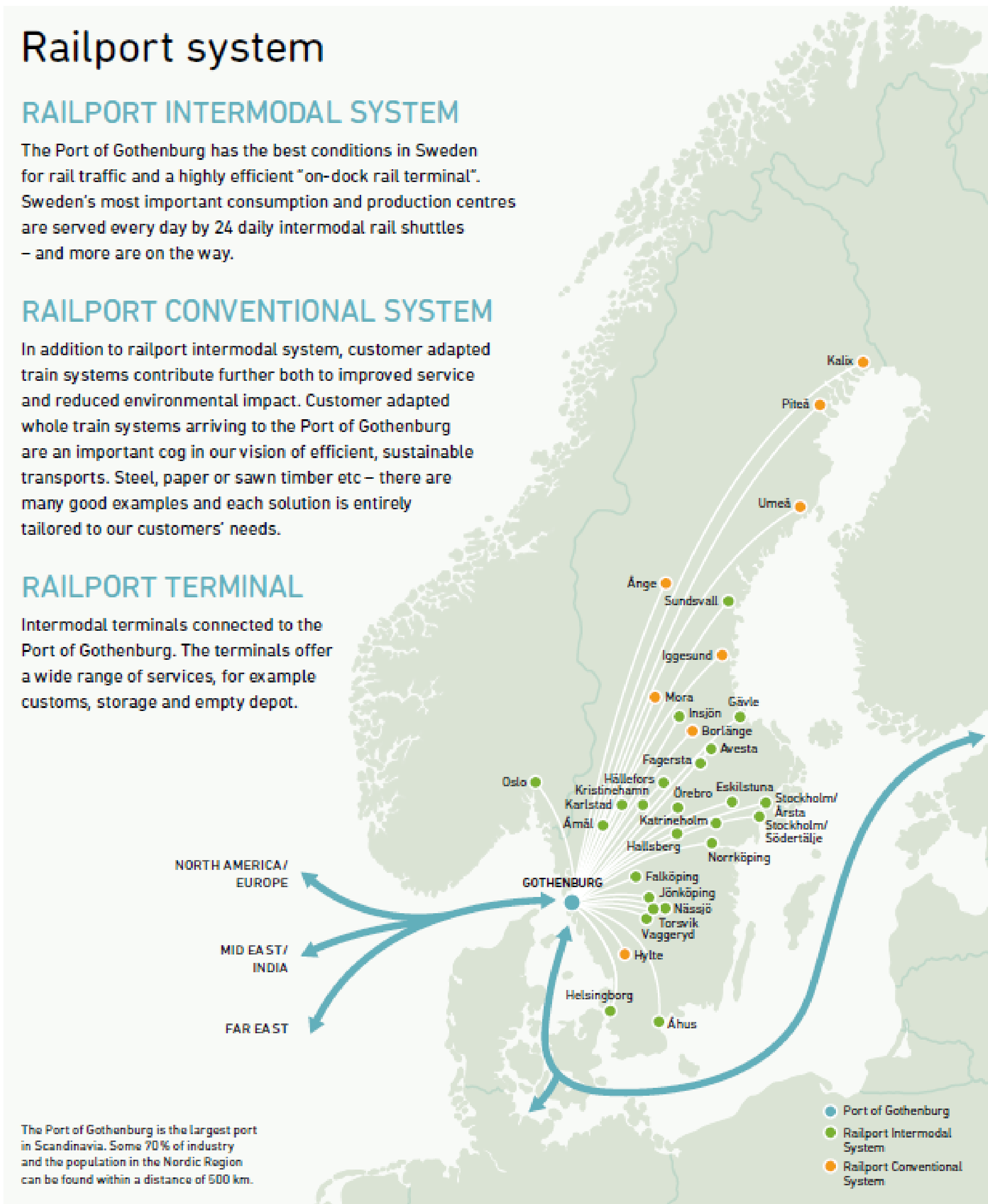


Source: Own elaborations based on port data.

The success of the port hinterland rail connections can be explained by competition in freight rail services and the customised services by lean railway operators. It was enabled by the introduction of competition, following railway deregulation in the 1990s, and facilitated by the development of dry ports in the main production and consumption centres in Sweden. The country counts 25 of these platforms today. The integration of railway and trucking services by individual logistics operators played an important part as well, because this meant that the client only had to do one booking from point A to point B, even if its shipment used both modes. In addition, the establishment of one separate and neutral body for arranging traffic from the rail shunting yards to the port made the service more efficient. The smoothness of operations can also be explained by the fact that the system is operated by relatively small companies that are efficient, flexible and customer-oriented. The rail shuttle system works thanks to co-operation between the Port of Gothenburg, the railport terminals, several rail operators, cargo owners and the national rail administration. The port does not take part in the financing of the terminals and has no direct involvement in rail shuttle or inland terminal operations, but is active in promoting their services (Bask et al., 2014).

The railport system is organised in a comprehensive way to provide the best service possible for all types of cargo, ensuring flexibility and capacity where needed. It is divided in two parts, each dedicated to different types of traffic: the intermodal container shuttles serves dry-ports while conventional traffic is constituted of freight trains carrying cargo in bulk so it can be reconditioned or unitised at the port. Most of the train lines serve long distance destinations but there are also shuttles available to serve much shorter distances usually operated by road. The reason for the system's competiveness over short distances results from innovative operation planning where the capacity of shuttles travelling longer distances is used in collaboration. This set-up allows for balancing goods flows in combination with the use of overcapacity. When volumes are decreasing there are capacity surpluses. However, the system is expandable, so there is also enough available unutilised capacity in times of increasing volumes. The rationale for this is that operators add capacity by either adding wagons or increasing frequency. Either way, there are possibilities for available capacity at intermediate nodes and stops. The shortest shuttle runs a distance of about 10 kilometres within the city of Gothenburg (Bergqvist and Flodén, 2010).

Figure 6. **Railport system network**



Source: Port of Gothenburg.

At the frontier of green port policies

The Port of Gothenburg has positioned itself earlier than most ports as a green port, designing and implementing innovative policies to mitigate local environmental impacts of shipping. As such, it has been and continues to be at the frontier of green port policy making, e.g. with regards to air emissions and other green policies.

Mitigating air emissions

Following pilots beginning in 1989 (Box 1), the Port of Gothenburg has put in place an innovative policy of using on-shore power supply the early 2000s. Vessels at quay typically use their diesel engines to meet energy needs for functions such as lighting, heating and air conditioning. This use of the diesel engine is a source of considerable local air pollution and greenhouse gas emissions. The Port of Gothenburg was the first in the world to propose that vessels be connected to the local energy network, which made it possible for these vessels to shut off their engines during their stay in the port (called "cold ironing"). This service was proposed for Ro/Ro vessels, in which Gothenburg still has large coverage, when compared to other ports (Table 2).

Table 2. **Shore power facilities in ports**

Port	Country	Ship type	Traffic share of terminal(s) with shore power (%)	Frequency of use shore power facilities (%)
Antwerp	Belgium	Containers	n.a.	0
Prince Rupert	Canada	Containers	n.a.	(25)
Shanghai	China	Containers	n.a.	(25)
Shekou	China	Containers	n.a.	(25)
Long Beach	USA	Containers	100	50
Los Angeles	USA	Containers	n.a.	(25)
Oakland	USA	Containers	100	38
Zeebrugge	Belgium	Ro/Ro	28	45
Luebeck	Germany	Ro/Ro	n.a.	11
Kemi	Finland	Ro/Ro	100	55
Osaka	Japan	Ro/Ro	n.a.	(25)
Gothenburg	Sweden	Ro/Ro	100	40
Trelleborg	Sweden	Ro/Ro	34	0
Tacoma	USA	Ro/Ro	8	100
Long Beach	Ro/Ro	Tankers	n.a.	0

Note: The Port of Long Beach does not track data on-shore power visits, but under the shore power regulation, fleets must plug in 50% of their visits. The estimation of usage of container terminals at the Port of Oakland is based on statistics from January-July 2014. The percentages between brackets are assumptions, as the ports in question never responded to our inquiry.
Source: Merk, 2014.

Box 1. **The history of shore power in Gothenburg**

As early as 1989, the Port of Gothenburg provided electricity to ships calling at the port, but only through several low-voltage cables that did not cover all energy needs. Following the initiative of a large paper manufacturing company, Stora Enso, which sought to improve the carbon footprint of transporting its products, the port began designing a more efficient system in partnership with several navigation companies and Asea Brown Boveri (ABB), a company specialising in electrical products. Operational since 2000, this newer system uses a single high-voltage cable providing 6.6 to 10 KW 50 Hz, which can power an entire ship from these platforms on the docks. The vessels are therefore able to stop their engines, resulting in a significant reduction in both noise and carbon emissions. The Port of Gothenburg estimated that a vessel not connected to an on-shore power grid emits about 25 tonnes of carbon dioxide, 520 kg of nitrogen oxides and 22 kg of particulate matter during its stop. This innovation thus benefits both the environment in terms of climate change, and quality of life and work of the populations on or near the port (residents, dockworkers and ships' crews). Today, one in three ships calling at the Port of Gothenburg uses the connection for shore-side electricity, but this proportion is likely to increase. Roll-on/Roll-off ships and ferries are the most frequent users of the new system because the links they provide are back and forth, but all categories of ships may benefit from this new technology. While connecting to the grid requires vessels to invest in technology to use the new system, costs for retrofitting vessels can be offset by the likely savings in fuel.

Through this programme, the Port of Gothenburg has acquired a first-mover technology advantage in connecting the vessels to shore-side electricity. This system is also present in other ports, such as Antwerp, Zeebrugge and Lübeck. However, a significant barrier to technology diffusion is the non-harmonisation of international electricity standards, with some parts of the world using 50 Hz systems and others using 60 Hz systems. This problem hinders retrofitting vessels, although attempts are underway to harmonise. Because of its pioneering role in this technology, the Port of Gothenburg was chosen as the leader of the Working Group on on-shore power supply created by the World Port Climate Initiative.

Differential tariffs as a tool for greening the port

Gothenburg has also been taking position against boat emissions threatening the regional ecosystem and city inhabitants' health by introducing differential tariffs for shippers and giving them incentives to use cleaner fuels when they come to the port. Starting on a voluntary basis, these initiatives have been introduced by all major ports in Sweden. The Port of Gothenburg has had sulphur charges and nitric oxide discounts since 1998. Up to 2010, a surcharge of SEK 0.20 per gross tonnage (GT) was levied for ships using fuels with sulphur content superior to 0.5% by weight. This was reduced by 50% from 2010-2014. This policy was also targeting emissions of nitrous oxides, offering rebates for ships making efforts to reduce their NO_x emissions under 10g per kilowatt-hour from SEK 0.20 per GT to SEK 0.05 per GT depending on the level of emissions under that threshold.

Continuing with this strategy, the port changed its tariff structure in 2015 so it would be based on the Environmental Ship Index (ESI) and the Clean Shipping Index (CSI) classifications for ships. Ships with 30 points or more following the ESI standards receive a 10% discount on port dues based on their gross tonnage. Similarly, ships achieving the CSI green standard are allowed a 10% rebate on port dues based on the same measure. Discounts also apply to ships using liquefied natural gas (LNG) as a fuel with 20% of general ports tariffs up to the end of 2018. There have been different assessments of these environmentally differentiated port dues. According to Swahn (2002), they have imposed strong incentives for reducing emissions, whereas Kageson (1999) states that the dues were not differentiated enough to present an actual incentive for ship operators to reduce emissions.

Green bunkering

Bunkering often poses a range of pollutant risks, not the least of which is oil spills. A series of important measures can be taken in bunkering ports to ensure that the risk of oil spills is drastically reduced. The Port of Gothenburg, through which passes around half of Sweden’s oil imports, has undertaken a range of measures to ensure that gases and oils are not inadvertently discharged into the environment during bunkering.

As part of its ‘Green Bunkering’ project, the port introduced a stringent set of rules in 1999 that encompasses a wide range of activities including requiring the installation of electronic overflow alarms, the carriage of at least 50 metres of oil booms with absorptive material, and the vetting of all bunker barges by the Port Authority. The port has also mandated oil spill prevention equipment for bunker installations and that all bunker operators attend training programs to learn safe bunkering techniques. Gothenburg has argued for the expansion of green bunkering practices to the rest of Sweden, supporting a 2011 bill to require regular pressure testing in Swedish bunkers in order to prevent oil spills.

Wildlife and biodiversity preservation

The Port of Gothenburg also undertakes a series of initiatives to mitigate the port's impact on wildlife and flora around the port. Among such projects, the recreation of seven reefs to compensate the effects of the first deepening of the fairway was undertaken in 2003. The new reefs were soon repopulated by lobsters whose habitat was threatened in some parts by the dredging process. In 2013, an application was launched to build a wetland pool for birds and other wild fauna and flora next to the port in the area of Torsviken. The project is scheduled to be completed by 2016-2017. Since the 1970s and up to 2009, the Port of Gothenburg had a permit to deposit polluted dredging spoils at Torsviken. The material has mainly been placed in an embanked area at the southern end of the bay. The port now wants to cover the spoils and, as much as possible, reinstate the area to its original condition with a rich variety of wildlife and birdlife.

Impacts of mega-ships on the Port of Gothenburg

The increase in ship size especially in the container segment over the last few years brings many new challenges to the Port of Gothenburg, like it does to other major ports in Northern Europe. The main challenge is depth. Mega-containerships access to the port is really limited by the current capacity at the container terminal and the port's fairway, even though both were dredged just over ten years ago. Ship size is also creating stress on terminals and transport connections to and from the port. While there is enough capacity to accommodate them, the problem is the imbalance; when the calls are too few and their arrivals create large peaks. If the port and shippers do not necessarily want mega-ships, they do want as many direct calls as possible and on many strategic routes, such as the Asia-Europe route; so accommodating mega-ships is becoming a major issue to ensure reliable connections for Swedish external trade.

Maritime access

The Port of Gothenburg has the ambition to have as many direct calls from ocean going vessels as possible. This ambition is based on their understanding of the preferences of the major shippers and cargo owners currently using the Port of Gothenburg. For shippers, direct calls are important for three different reasons: risk, time and cost. The risk of mishaps in supply chains is considerably higher if goods are transshipped in a large hub port in Europe and feedered to Sweden, as compared to direct calls. These disruptions could be caused by congestion and delays in the transshipment port. Several large shippers that have experienced direct calls to Gothenburg and indirect calls confirm that these differences are substantial. These mishaps are difficult to solve as they occur, because of problems with traceability of containers and the impossibility to reorganise just-in-time-planning on such short notice.

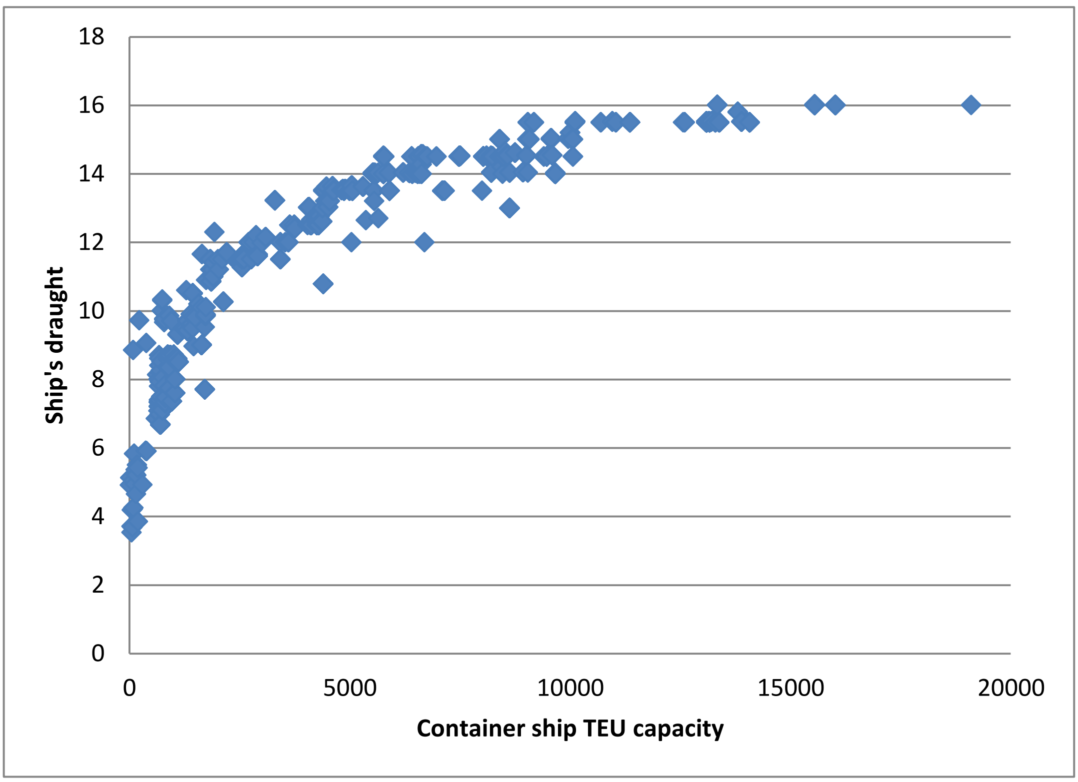
Direct calls in many cases also lead to short transport times. This is due to the higher speed and frequency of train connections in Sweden in comparison with short sea shipping, and because of the buffer of two to three days that the container would stay in a transshipment port before being transshipped. Although feeder connections between main hub ports and Swedish ports have relatively high frequencies, many of the feeder services are dedicated services for specific carriers and uncommon feeder services, which means that missing a connection could result in the loss of several days.

Gothenburg’s ambition for direct calls and its predominant external trade relations with Asia, leave it little choice but to attract mega-ships. Its main connections are with Asia: the share of exported containers to Asia is 43%, generating substantially higher volumes than exports within Europe (16%) or to North America (11%). In terms of volumes and distance, the Asia-North Europe maritime route involves the deployment of the largest containerships (with capacity of 18 000 to 19 200 TEUs): the capacity of an average containership deployed on this route is 11 750 TEU, as compared to 8 574 for Asia-Med routes and 6 636 for Transpacific routes (ITF/OECD, 2015).

Gothenburg has managed to be included in direct loops from Asia. The acquisition of the container terminal by APM Terminals and its terminal upgrades have facilitated direct Far East-Europe calls from Maersk, including from their new Triple E-vessels, and MSC with their Oscar-type ship, which has been integrated in the 2M schedule. In the summer 2015 the G6 Alliance added Gothenburg to one of its Asia-Europe loops, which means that Gothenburg has currently two weekly direct container services to Asia.

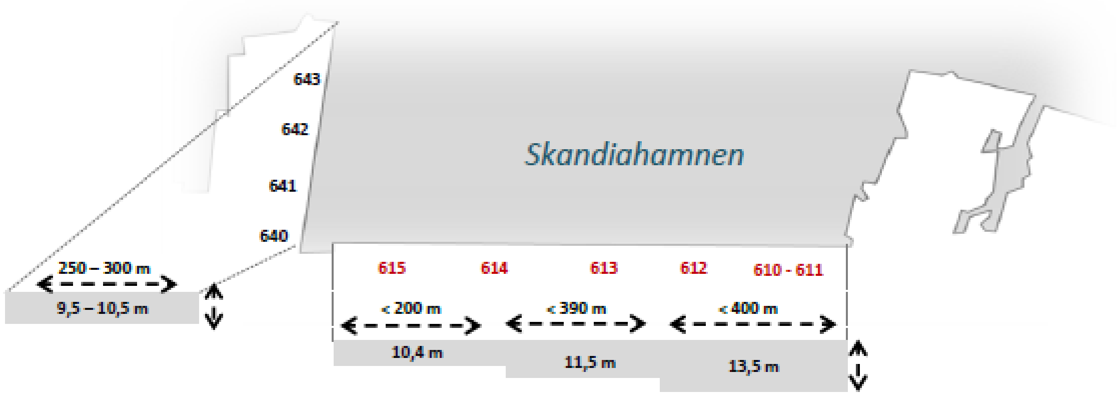
The mega-ships used on the Asia-North Europe route need sufficient depth of the port access, channel and berths. These containerships have a draught of 16 metres (Figure 7), which poses a challenge for Gothenburg. The port access channel can accommodate a vessel draught up to 18.9 metres until it separates in two distinct channels. The northern channel, leading to the crude oil terminal at Torshamnspiren, is up to 20.5 metres deep. The southern channel, where depth reduces to 15.8 metres halfway from the split, is as deep as 14.7 metres before reaching the terminal and as deep 14.2 metres at the east end of the container terminal. This is currently the maximum depth available for large containerships. In other parts of the terminal, water is shallower with a depth ranging from 10-12 metres. This implies that the port can only accommodate one mega-containership at a time, namely at berths 612, 611 and 610 (Figure 8).

Figure 7. **Average ship draught in function of capacity (in TEUs)**



Source: Own elaborations.

Figure 8. **Berth depth at the container terminal in Gothenburg**



Source: Port of Gothenburg.

Despite insufficient draught, Gothenburg has been able to get direct calls due to its position in the loop configuration. Both the 2M and G6 loops call at three other North European ports before calling Gothenburg, and call at two other ports before departing to Asia. As such, the mega-ships arrive in Gothenburg relatively lightly loaded: the 2M ships will have unloaded most of the cargo coming from Asia in ports like Rotterdam, Felixstowe and Bremerhaven, whereas the G6 ships will have unloaded in Rotterdam, Hamburg and Gdansk. The export cargo from Gothenburg will fill the ship to some extent, but most of the filling up of the ships actually takes place in the ports placed after Gothenburg: in Wilhelmshaven and Le Havre for 2M, in Antwerp and Southampton for G6. Currently, around 2 50-3 000 moves are connected to handling mega-ships in Gothenburg, which represents around 10- 15% of the ship capacity. It is estimated that mega-ships cannot be more than 50% loaded when calling the Port of Gothenburg which means it would reach a depth of around 13.2 metres. If the same ship was loaded up to 75%, it would have a depth around 14.9 metres and 16.5 metres if the ship was fully loaded. This is not only the case for mega-ships but also for ships with much lower capacity (Table 3).

Table 3. **Vessels that can be accommodated at the Port of Gothenburg**

Ship Capacity (TEU)	Maximum draught (metres)	75% load	50% load
≥ 20 000	18.0	16.2	14.4
15 000 – 20 000	16.5	14.9	13.2
10 000 – 15 000	16.0	14.4	12.8
5 000 – 10 000	15.5	14.0	12.4
3 000 – 5 000	14.0	12.6	11.2
2 000 – 3 000	13.9	12.5	11.1

Source: Palsson et al., 2015.

In the future, it is unlikely that Gothenburg will be able to attract mega-ships if it does not provide more depth. There are two main developments that will drive the need for deeper access channel and container berths: higher utilisation rates of ships and further increases in vessel size.

First, utilisation rates of mega-ships are currently relatively low. Due to container fleet overcapacity, container lines have difficulties filling up their ships, resulting in ships that frequently have utilisation rates below 80%. In this context, mega-ships have not yet been loaded to their maximum. Analysis of call sizes related to container ships shows that there is a clear link between a ship's TEU capacity and port call size up to approximately 10 000 TEUs, but not when this threshold is exceeded. This is a temporary phenomenon. Mega-ships can only be profitable when fully utilised, without too many port calls. This means that the call size of mega-ships should normally rise substantially in the coming years. This tendency might be complicated, to some extent, by the large fleet overcapacity, but this could be tackled, in part, by reducing the number of loops.

Second, the average size of container ships is set to grow due to the ships that have been ordered and will be delivered in the coming years. In 2015, the average ship size on the Far East – North Europe Route is 11 750 TEUs. In a scenario of container fleet growth in line with market demand, the average ship size on that route could reach 14 674 TEUs. In more aggressive market scenarios the average capacity could be 16 730 TEUs with vessels that might have 24 000 TEU capacity (ITF/OECD, 2015). Introduction of a new generation of container ship might also increase the draught requirements of ports; different designs of ships with capacity of 24-25 000 TEUs have been floated, some of which assume that the maximum draught will remain 16 metres, whereas others assume a deeper draughts. For example, if a ship of over 20 000 TEUs would have a maximum draught of 18 metres, this would mean 16.2 metres if loaded to 75%, and a draught of 14.4 metres if loaded to 50%. As part of the container ship size increases, the average size of ships on all the other trade lanes will also increase, including on north-south routes and Europe-North American routes. A consequence of these cascading effects is that Gothenburg might lose direct calls for trade lanes where it has limited amounts of cargo, as has happened with routes to Latin America in the past: the cargo volumes no longer justified a direct call to Gothenburg.

Port concentration tendencies will increase the urgency for Gothenburg to improve its attractiveness. Over the long run, larger ships have increased port concentration tendencies: not all ports have been able to adjust to requirements needed for larger ships, and the only way that larger ships can be made profitable is by reducing the average time in ports; this means quicker turnaround times and less port calls. Although the introduction of the new generation of 18 000-19 000 TEUs containerships has not yet led to port concentration, it is likely that this will happen in the short to medium term. Overcapacity and low fuel costs might slow down this development at this moment, but if supply and demand for container capacity will be more balanced eventually, a logical tendency would be to concentrate cargo in a few main ports in order to reduce port time and maximise utilisation of the ship. If at this point the Port of Gothenburg would be constrained by its depth, it could easily lose its direct calls.

Depth issues related to other ship types

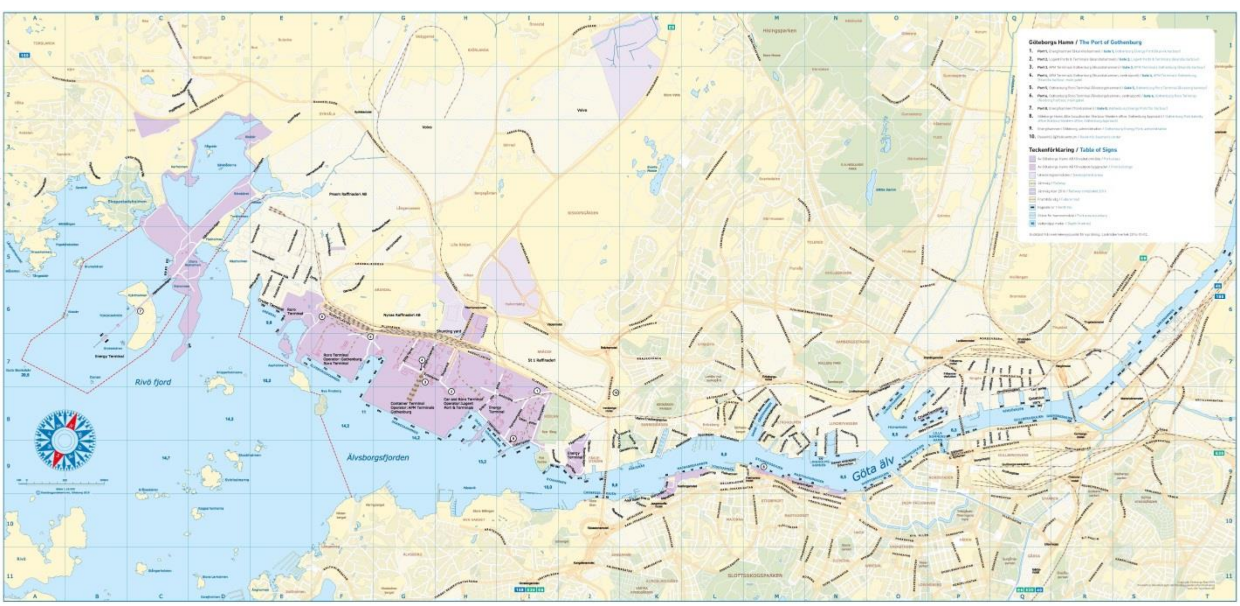
If depth is an issue in particular for the container segment, it is also the case for oil activities at the port. The crude oil terminal at Torshamnen has a very large storage capacity of 800 000 cubic metres but it is already losing business because of restricted depth as well. The maximum depth there is 20.5 metres so it is problematic to receive heavily loaded Very Large Crude Carriers (VLCCs). Another terminal in Skarvik Harbour is also limited to Aframax size ships. Two jetties dedicated to energy are located closer to the city and need to be moved because of a lack of capacity, which also implies a loss in business.

Despite the fact that the issues of port access are particularly pressing in the container segment, Gothenburg is also an important passenger port encountering access and capacity restrictions in that field. It will further be challenged by future land reclamations in the city and needs to seek solutions to prevent business loss.

Cruise ships are getting ever larger and the access to most available cruise terminals in Gothenburg is currently limited by the main city bridge, whose height is too low for them to pass under. This implies that size requires most of the recent ships to call in the working port. In the city centre, ships can call in front of the Port Authority and at Frihamnen where three berths are available (107, 108 and 109), water also remains rather shallow - 9 metres deep - so the largest ships cannot berth there either. At the east end of the working port, Arendal Terminal allows cruise ships to berth in front of the Volvo museum further away from the city centre. Water is also not deep enough with ship draught limited to 9.3 metres. Consequently there is the option to occasionally call at the APMT Container Terminal for the largest ships as they cannot fit anywhere else (i.e. Queen Mary 2 called there since it has a draught of ten metres).

In terms of other passenger transport, there are two ferry terminals operated by Stena Line in Gothenburg. This constitutes an important part of the ports' business activity and the company is the largest employer in the region for jobs directly related to port business, with 1 650 employees. The two terminals are located close to the city centre east and west of the Port of Gothenburg's general quarters. The eastern one is dedicated to traffic going to Kiel in Germany with seven departures a week and the western one is dedicated to traffic going to Frederikshavn in Denmark, offering three daily connections from Gothenburg. The terminals have respectively draughts of 8 metres and 7.6 metres which implies that there are no access restrictions due to depth, the largest ferries in Europe having a depth below 7 metres. All terminals are shown on Figure 9.

Figure 9. **Map of terminals at the Port of Gothenburg**



Source: Port of Gothenburg.

The whole setting of the port is subject to change as the city wants to reclaim the land on the water's edge because it is an attractive location with great real estate value for development. Two plots that belong to the port are concerned: the Stena Line Denmark ferry terminal (by 2026) and berths 107, 108, 109 in the city centre at Frihamnen. A few port buildings are also located at Frihamnen, which house the only cruise passenger terminal in Gothenburg. A study has been conducted to determine what would be the best option for cruise passenger terminals in the city. The report weighed all the elements that matter to cruise tourism: proximity to the city centre, good transport connections, environmental quality, state of infrastructure and investment required, etc. It concluded that the best option for cruise shipping was keeping Arendal and Frihamnen as the two main cruise terminals. This conclusion was also reached in light of future developments of the commercial port that do not offer more capacity for cruise traffic at other locations. No decision on relocation has been taken to date and new discussions on the issue are still needed, weighing the importance the Port of Gothenburg wants to give to cruise tourism and the opportunity costs it generates. Concerning ferry terminal, the main suggestion thus far is to move it to the Germany terminal. However no study has been conducted on relocation options and no feasibility assessment of this project is available. If optimisation of the Germany terminal could be possible, it is not yet known if there is sufficient capacity to accommodate all of the ferry traffic to both destinations.

Infrastructure and terminal operations

Mega-ships bring with them the requirements to upgrade terminals, the need for faster turnaround times and well-organised container yards that can act as buffers for peaks related to mega-ships.

Container terminal upgrades

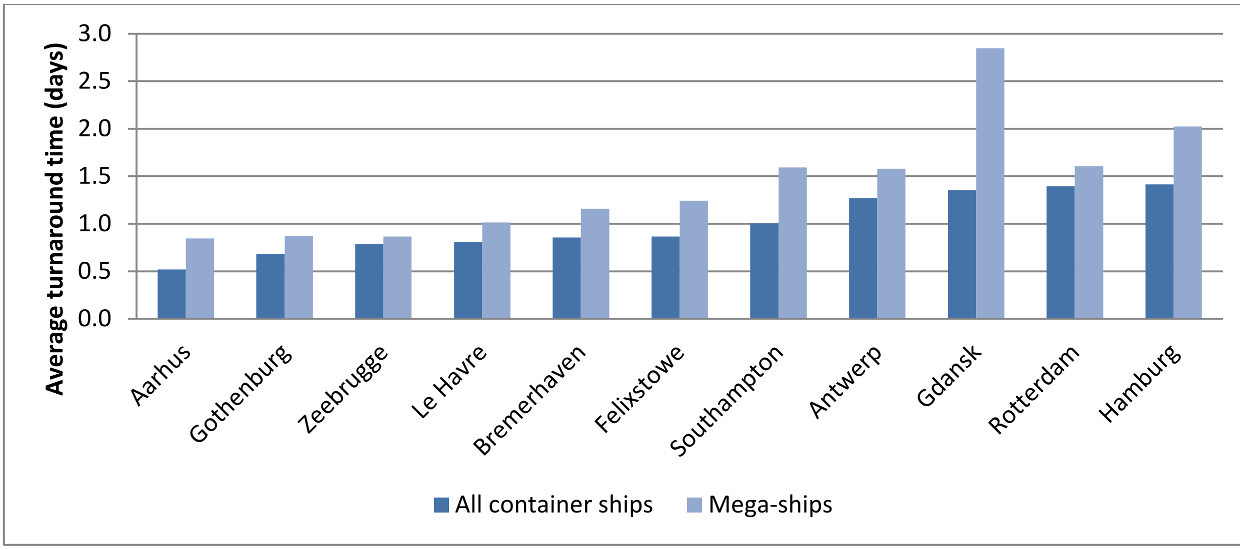
The Port of Gothenburg is the only port in Sweden able to accommodate the largest ocean going vessels. It is also the only one with handling capacity of 2.2-2.4 million TEUs per year. This was enabled by important investments from the new terminal operator APM Terminals, which acquired the concession contract to operate the 80-hectare container terminal at the Port of Gothenburg for 25 years, starting January 2012. The contract was awarded by the port to the terminal operator with the ambition to consolidate the port's position as the main container port in Sweden and Scandinavia, but also to maintain it as a major international port. The company agreed to invest USD 115 million in infrastructure improvements over five years from the start of the concession, which contributed to make the terminal mega-ship ready and enhanced its capacity with around 80% of reworks on the terminal surface.

Various infrastructure and equipment upgrades and renewals were made in the context of the investment plan. The berths are now able to handle a very large ship and several smaller ones at the same time with ten ship-to-shore (STS) cranes available, five of which are Super-Post-Panamax cranes. APM took over the three STS cranes bought by the port in 2006 and its latest additions are two of the largest cranes in the world with a maximum height of 127 metres fixed on a 650 metres rail track. They have an outreach of 22 containers and a height under spreader of 45 metres. The yard was also strengthened and the surface flattened so that containers can now be stacked three high instead of two which enables a 30% increase in capacity. Two new rail gantries were purchased to replace two older ones, as well as 12 new straddle carriers. Improvements to the terminal gate were also completed in 2015.

In terms of turnaround times, mega-ships require higher port performance. As port time presents considerable costs to container carriers, they look for the terminals with the highest productivity, so that their port time is minimised. Some sort of efficiency frontier is the ideal of some carriers of 6 000 container moves per day, which translates into a berth productivity of 250 moves per hour per ship, which is a benchmark that is not actually reached in any container terminal. The closest to this value is the APM Terminal in Yokohama that has realised berth productivity of 180 in 2014.

The Port of Gothenburg scores reasonably well with respect to main performance indicators. Its turnaround time for container ships was 15.6 hours in 2014, according to data from the Port of Gothenburg. This is favourable in comparison with other North European ports. A similarly good performance is visible when zoomed in on mega-ships: their turnaround time takes on average 0.87 days, which is one of the lowest scores in North Europe (Figure 10). These scores might be explained in part by the lower call sizes of Gothenburg – and other well-performing ports like Aarhus and Zeebrugge – in comparison to ports such as Hamburg and Rotterdam that generally handle more containers per call, and so need more time. The crane productivity in Gothenburg is 26 moves per hour, which is slightly below the average of crane productivities found in main port terminals handling mega-ships (Merk, forthcoming). We estimate the berth productivity for container ships in Gothenburg to be 70 moves per hour and per ship in 2014. Terminal upgrades, including in STS cranes, which were undertaken since 2014, might have improved berth productivity in the meantime.

Figure 10. **Ship turnaround times in main North European container ports**



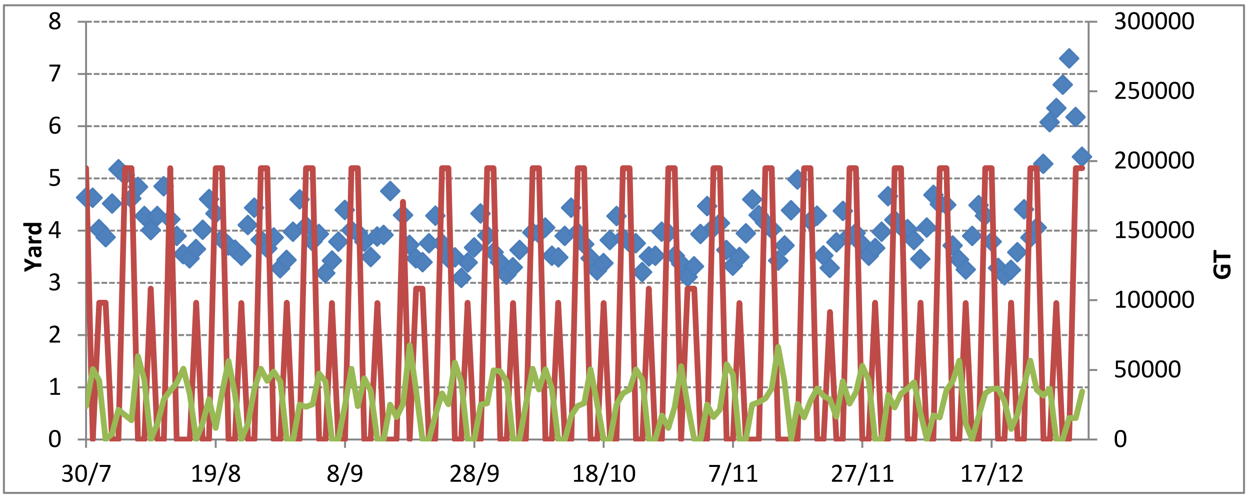
Source: Own elaborations based on data from Lloyds Intelligence Unit.

Yard operations

Recent terminal upgrade investments at the terminal imply that there is enough space and capacity to deal with the un-loading and up-loading of large ships and storing containers. The greater stress on infrastructure comes from the imbalance in large ship calls if they call at the port only once a week. As the port previously experienced this, it was possible to highlight the impacts that a single call has on infrastructure.

The container yard in Gothenburg acts as a buffer for the peaks related to the arrival of mega-ships. Put more generally: in port terminals with one weekly call of a mega-containership, such as the case of Gothenburg in 2014, there seems to be a cyclical seven-day pattern in yard utilisation. This also becomes apparent from close examination of container dwell times in the container yard that reach their maximum value just before the arrival of a mega-ship, gradually decline over the next days, but rise again in the days leading up to the next arrival of a mega-ship (Figure 11).

Figure 11. **Relation between yard dwell times and mega-ship arrivals**



Note: The red lines correspond to ships with gross tonnage (GT) > 50,000; the green lines to ships < 50,000; the blue dots to average yard days. The left axis represents the average duration of container in the yard; the right axis represents the accumulated ship gross tonnage calling the port. The horizontal axis indicates days in 2014.
Source: Own elaborations based on terminal data.

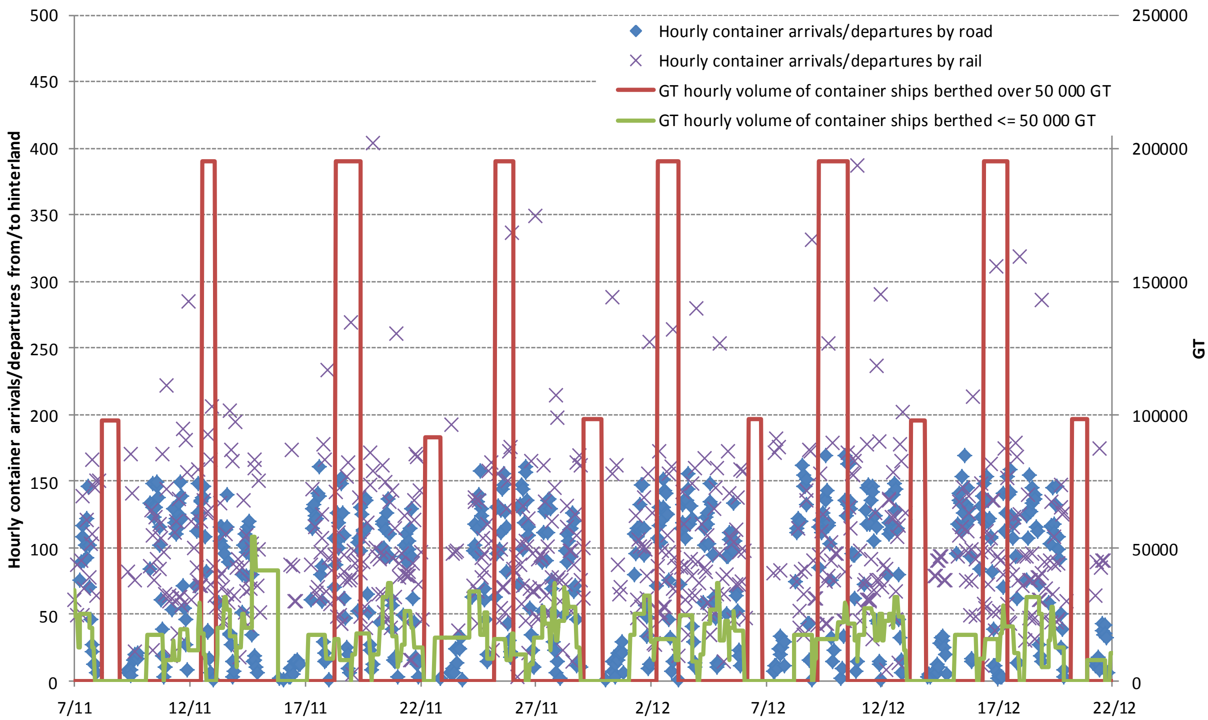
Transport to hinterland

As seen earlier, the Port of Gothenburg benefits from efficient and extensive freight services with its hinterland and the rest of Scandinavia. Still, as mega-ships bring in very large amounts of cargo all at once, they create some form of stress on the whole network, especially starting at truck and train gates. Part of the inefficiencies could be solved by a better optimisation of the system, however smooth handling of peaks in cargo volumes require flexibility that is difficult to achieve, especially if the imbalances are sharp with few calls far away in time from each other. The experience of the Port of Gothenburg with only one call from a Maersk Triple E vessel in 2014 can demonstrate this.

The handled cargo volumes at the Port of Gothenburg clearly impact the freight traffic volumes on the port hinterland connections. The increasing vessel size makes these impacts more pronounced due to larger volumes of cargo that are handled during one call.

A typical mega-ship call at the Port of Gothenburg creates a peak of cargo volumes in the days before and after the call, which need to be handled at the terminals and transported to or from the hinterland. The impacts that mega-ship calls create on the hinterland connections of the ports are clearly demonstrated in Figure 12. It shows weekly mega-ship calls, demonstrated by berthed volume of ships over 50 000 GT. It also shows container arrivals and departures by road and by rail. It can be observed that a weekly mega-ship call is associated with an increased number of containers arriving/leaving the port in the days before, after and during the call.

Figure 12. **Container mega-ship calls and hinterland transport volumes in the Port of Gothenburg** (7/11/2014- 22/12/2014)



Source: Own elaborations based on terminal data.

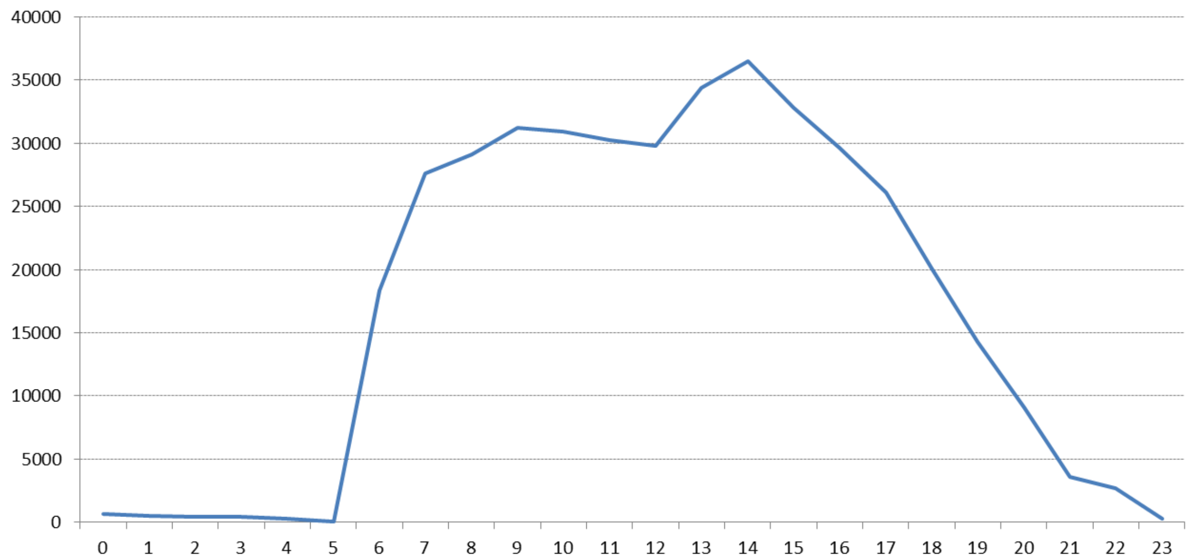
The peak pattern of the hinterland capacity utilisation that is shown here creates problems that relate to the uneven utilisation of hinterland transport resources. At some time periods the infrastructure and the transport equipment is underutilised, but at others a peak of use is observed.

Road: uneven distribution of flows

Currently the congestion-related delays are not an important issue for the Port of Gothenburg, because of sufficient road capacity in the northern, eastern and southern directions. The passenger car congestion has impacts on the port-related truck traffic only at certain times of the day, but this does not seem to cause substantial delays. Road hinterland connections should be able to handle the high cargo volumes that enter and leave the port in short periods of time (one-four days for one ship, depending on ship type). It is recognised by the stakeholders at the Port of Gothenburg that certain road access infrastructure improvements are necessary for this. The turnaround time at the gate is 18 minutes from gate to gate, but this does not take into account the time that the trucks spend before in the marshalling area, which can be substantial if there is a peak in cargo or congestion.

The data from the Port of Gothenburg show the time distribution of the truck arrivals and departures depending on the time of the day (Figure 13). It can be seen, that the peak hinterland cargo traffic in 2014 is at 2 p.m., which is a time of the day with almost no commuter traffic. At the same time there is very little hinterland traffic before 6 a.m. and after 8 p.m. The uneven time distribution of the road hinterland flows suggests that in addition to the access infrastructure improvements, existing capacity optimisation could have its place. The capacity optimisation could involve time-shifting measures for the road hinterland traffic.

Figure 13. **Cumulative container arrivals/departures by road transport per hour of day (2014)**



Source: Own elaborations based on terminal data.

An example of a capacity optimisation measure, which has place and time-shift impacts, at the Port of Gothenburg is used by companies (e.g. Schenker, who has warehouse adjacent to the port) for different reasons. One reason is to transport all goods to/from the logistics centres in bigger shipments, and then organise the smaller shipments to/from the end costumer through there. This reduces the impacts that the road congestion might have. In this case the impact of the mega-ships on the road network is minimised as well, because there could be a time difference of several days between a mega-ship call and the delivery to/from client. Often the freight volumes that are destined for warehouses further away pass through the road network immediately.

One of the problems present in the port is that the trucks are parked in areas not specifically designed for that use. Making those trucks use dedicated parking proves to be difficult, because these trucks are mostly foreign, and for them the cost is an issue. A capacity optimisation approach could help solving this problem as well.

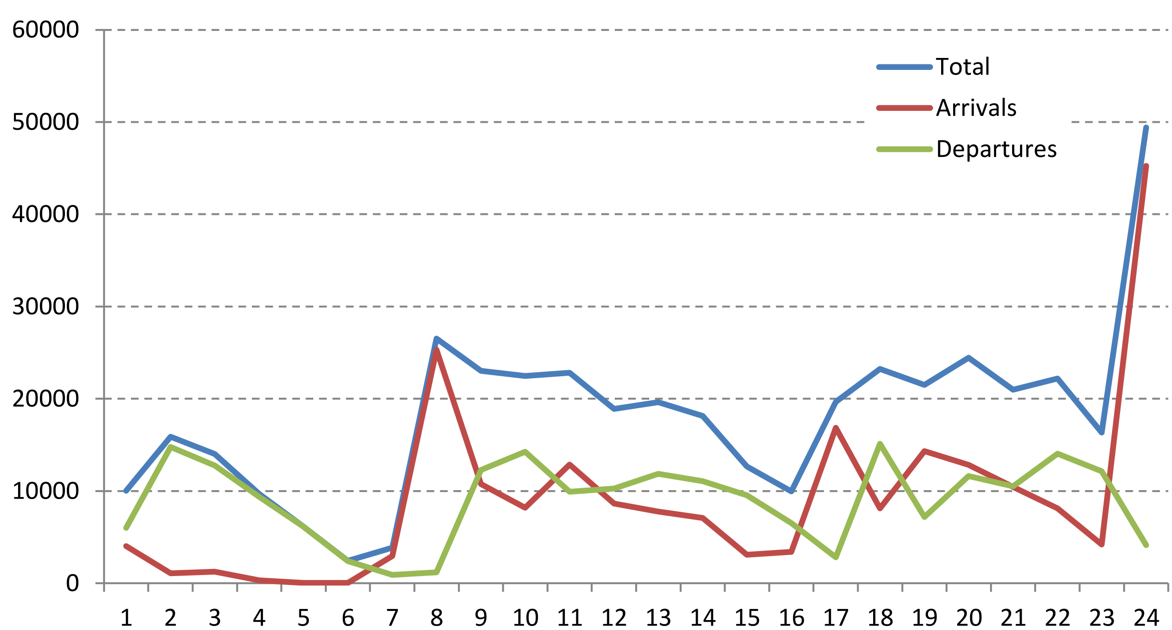
The geographical placement of the Port of Gothenburg in relation to the city is not favourable, because the hinterland connections pass through some parts of the city. This means that hinterland traffic impacts the inhabitants of the city. A peak pattern of the cargo flows that are associated with mega-ship calls means that the societal impacts follow the same pattern. At the same time, the city does not see specific congestion-related impacts of the mega-ships on the road network, because the traffic volumes arrive or are distributed with an advance or a delay over several days, as shown by the data presented in this section. The city recognises that the trucks on the road are not the cause of congestion; it is mainly caused by the commuter traffic. The city prefers to have the share of rail traffic as big as possible to minimise the impacts for inhabitants. This leads to the requirement of rail capacity expansion, which is currently in the works.

Rail: Optimising capacity

Rail is the dominant hinterland transport mode at the Port of Gothenburg especially for containers of which 48% reach or leave the port by train. The rail shuttle services, run by different rail operators, take the base volume of cargo, but the road transport, which is more flexible, is used for the rest. There are around 14 trains per day used for containers on and off and 25 available daily shuttles. Rail shuttles are usually scheduled daily at the same times every week, but if sufficient cargo volumes have not been accumulated, they could be cancelled. The loading levels of the trains are high on the days before and after arrival of mega-ships. If possible, an extra train service is sometimes added during high peak demand situations. Rail operators do not face the situation of backlogs, because when the trains are full, trucks can be used in a flexible manner to deal with these peak situations.

Rail operators have raised concerns about rail capacity. The train length is limited to 580-650 metres, depending on destination, and the number of slots is sometimes insufficient. Part of the problem is now solved thanks to the completion of new tracks at the terminal and their extension up to 750 metres as described earlier. Another problem is that the train slots must be booked at least five days in advance, which lowers the flexibility of the rail shuttle services. Also, electrification of the rail infrastructure in the port would allow streamlining rail operations. The distribution of the container arrivals and departures at the port depending on the time of the day in 2014 is shown in Figure 14. It can be seen that the container hinterland transport by rail is much more evenly distributed in time than that by road. Also, the rail network capacity utilisation during night time seems to be at a much higher level than that of road capacity. This allows suggesting that the impacts of eventual capacity optimisation measures would be limited.

Figure 14. **Cumulative container arrivals and departures by rail per hour of day (2014)**



Source: Own elaborations based on terminal data.

Specifically for rail shuttle services, the slots on the rail network can be scarce. To ensure profitable operation of the shuttle services, full train loads are a pre-requisite. Therefore, the increase in the ship size with its characteristic peak patterns encourages the rail shuttle service operators to prefer slots that are aligned with the calling times of the mega-ships. Rail operators still find that if upon arrival of this very large ship, the train utilisation rate is around 100% for import cargo, rates can be more problematic on its way back (sometimes as low as 60%). This is because cargo owners prefer that deliveries arrive a bit later in the week as opposed to earlier. Since they have five free days in the port for export cargo, they avoid having their cargo arrive too early in the port. This is less problematic if there are more direct mega-ship calls per week.

From the business perspective of road and rail hinterland transport operators, an increased number of mega-ship calls (ideally three at current capacity) would be advantageous. This would allow for better utilisation of the infrastructure and transport equipment: trucks and trains. The import/export cargo imbalance in freight trains would be resolved by more direct intercontinental calls, as the situation was much more balanced when two large ships per week were calling at the port. Freight rail operators have also solved these issues by new route configurations, such as triangular routes, so as to maximise the import cargo and export cargo. They are constantly developing and making more efficient "destination packages" by mixing road and rail. This suggests that the traditional train shuttle services are evolving into a more complex network, which could fix the lack of empty containers at the port and reload some before they get to the port.

Inland waterways: Additional transport mode

Certain hinterland destinations of the Port of Gothenburg could also be served by inland waterways transport in the long run, if the transport volumes would justify that. The Swedish Transport Administration sees a potential for inland waterways for certain cargo flows, because in some regions which could be served, the existing road or rail capacity cannot be increased. This is particularly relevant for wood products (e.g. timber, paper, biomass for energy product production).

Policies: Sustaining Gothenburg's pivotal position

The Port of Gothenburg is the largest gateway to Scandinavia and the most developed logistics area in the region. It already benefits from considerable infrastructure to handle containers from berth to destination and from origin to ship. To sustain its position, make the best use of this capacity and maximise returns on investments previously made in infrastructure for the port, it needs to be able to attract direct calls on strategic trading routes for Sweden's economy. Given ship size evolutions and current depth restrictions at the port, it will need to dredge its terminal and the fairway to ensure this is feasible in the future.

Ports policy in Sweden

The ports system in Sweden is fragmented in terms of policy: there is no clear recognition in policy frameworks of the dominant role that Gothenburg plays in the national ports system. As mentioned in the first section of this report, there are currently 52 seaports for cargo handling in Sweden, most of which handle marginal volumes. As local governments own these ports, there might be a tendency to keep these ports operational or even expand them, as they present a source of local revenue. Such a tendency is also apparent in Finland where local governments are similarly in charge of ports (Merk, Hilmola and Dubarle, 2012). Despite the clear dominance of Gothenburg, there is no official port hierarchy in Sweden that could determine which ports would have priority in terms of investments, expansions and improved hinterland connections.

Attempts to bring more focus to the national ports system in Sweden have not yet been realised. In 2006, a Port Strategy Commission was established to identify ports of particular strategic importance to the Swedish freight transport system and propose to the Government a list of ports that should be given priority over the others with regards to government-funded infrastructure. The national government considered that further development of these ports would be crucial for the Swedish industry to remain competitive in a global market. The commission selected ten main ports, namely Gothenburg, Helsingborg, Malmö, Trelleborg, Karlshamn in co-operation with Karlskrona, Norrkoping, Stockholm (Kapellskär), Gävle, Sundsvall and Luleå. These were officially listed in the Government Bill for Future Travel and Transportation (prop. 2008/09: 35). The report also identified the Port of Gothenburg as the main port in Sweden for container traffic and particularly strategic for that market segment. The report was discussed, but was not incorporated in policy frameworks. In reality, there are still 52 ports in Sweden that all keep investing in infrastructure, without a clear national strategy or regulation to limit the inefficiencies and possible duplication of infrastructure related to this. Ironically, it is the European Union that now provides the prioritisation of Swedish ports, through its TEN-T network of core ports. In this network, five Swedish ports were selected: Gothenburg, Copenhagen-Malmö, Trelleborg, Stockholm and Lulea.

As a consequence of the lack of a national ports policy, various other ports in Sweden aim to position themselves as gateway or transshipment ports for containers. This is the case of both Stockholm and Norrköping. The port authority of Stockholm is planning the construction of a new container port at Norvik Cape, north of Nynashamn, with the vision to become the container gateway to Stockholm and a transshipment port for feeder ships in the Baltic Sea.

A more focused national ports policy would not only help Gothenburg, but also the whole of Sweden. Even if the external trade of Sweden would grow at a steady pace in the coming decades, the volumes will be of such a nature that these could be pre-dominantly handled by Gothenburg. Various stakeholders have invested in building up the extensive rail connectivity with the major regional centres in Sweden. The previous section discussed benefits to freight rail services to Gothenburg. When connected to direct calls of deep sea vessels, this transport option is generally quicker and cheaper than the alternatives, such as feedering from other ports in Sweden to Gothenburg or another transshipment port like Rotterdam. As such this is an option that is preferred by most shippers in Sweden. Developing additional deep sea container capacity in other ports seems to suggest duplication and the risk of underutilisation, considering that Gothenburg will be realistically the only port in Sweden that could have direct calls from ocean-going vessels. A more focused national ports policy in Sweden could mean:

- a clear articulation of which ports are considered to fulfil which roles for the Swedish economy in the different sectors, in particular the container sector
- a recognition of the need for Swedish shippers to have at least one container port with direct calls from its main trade partners, in particular from Asia
- a translation of this priority in clear public investment decisions, e.g. with respect to improving maritime access, hinterland connectivity, dry port development and short sea shipping
- a common understanding between national government and the main local and regional governments concerned with such a strategy, ideally supported by these local governments, so that a national focus will not be undermined by local planning permits for port expansions.

Improving maritime access

The Port of Gothenburg acknowledges that improving its maritime access is crucial to improving its attractiveness. It has formulated maritime access as one of the four main objectives in its long term strategic vision, called "Generalplan 2035", and is preparing an official project proposal to be submitted to the national government. The national government will need to grant permission and might also co-finance the project. Part of this proposal should be a societal cost-benefit analysis and an environmental impact analysis.

Currently, two main scenarios are considered for the deepening of the fairway and the depth alongside the berths: 16.5 metres and 17.5 metres depth. The second scenario would mean that current mega-containerships would be able to call at Gothenburg fully loaded. Deepening of the berths would take place for the berths 610 to 615, so along the whole quay at the south side of the terminal, which would create a quay line of approximately 1 000 metres that would be mega-ship ready. In a first cost-benefit analysis carried out at behalf of the Swedish Transport Administration, the costs for these two scenarios were calculated to be SEK 3.6-3.8 billion (Table 4).

The report also provides a first assessment of the benefits that would result from the completion of such a project. Benefits are calculated on the basis of the difference in terms of shipping costs between direct calls and indirect calls (which include a maritime feeder leg between Rotterdam and Gothenburg). Such an approach could indeed indicate the benefits of the project, provided that door-to-door transport costs are taken into account. In case a substantial net benefit would result, the project proposal could be concretised and pro-actively put forward.

Table 4. **Estimated investment costs for a new deepening project for Skandiahamnen at the Port of Gothenburg (in billion SEK)**

Costs of	Option 16.5 metres	Option 17.5 metres
Fairway deepening	1.206	1.445
Quay deepening	2.373	2.440
Total costs	3.583	3.885

Source: Trafikverket, 2014.

At this stage, the Port of Gothenburg has conducted in part a cost-benefit analysis for the project and discussed with Swedish Transport Administration nationally and the Swedish Maritime Administration. The process to see the project implemented is still at its early stage in light of the remaining steps to be included in the regional and national transport infrastructure financing loop.

The first element to complete would be the technical specifications of the project and the financial plan setting out responsibilities and timing. The next step for the Swedish Transport Administration, together with the Swedish Maritime Administration and the Port of Gothenburg, would be to conduct an Environmental Impact Assessment, a necessary step to be granted construction permits.[1] Approval of the EIA is granted by the Land and Environment Court and its decisions can be appealed through the Land and Environment Court of Appeal. Once permits are granted and the physical and financial planning is completed, the project could secure funding from the national government, which might need inclusion in its National Infrastructure Plan 2018-2029 (see Box 2). There are also options to start the project faster than if it goes through the national fund allocation plan. One of the options would be for the Port of Gothenburg to begin investing in the project on its own and wait for reimbursement of the funds from the Swedish Transport Administration once new budgets are validated.

Regions compete for funding from the national government. Throughout the country, there are a number of ports which compete for the development of infrastructure. There is a need to build a strong case for Gothenburg and to show that beyond the essential character of the port for the region, it is also a major national asset whose development matters to the whole Swedish economy.

Box 2. **Infrastructure planning in Sweden**

In Sweden, the transport infrastructure planning, decision and implementation process is set out for 12 years. The current national plan covers the period 2014-2025. The system is completed by annual proposals of the Swedish Transport Administration to the Government on implementing measures to follow. Proposals are to be divided into several parts: one part relating to the first three years (years 1-3) including measures for which construction is ready to start and for the ones expected to start in following three years (years 4-6). These projects must already be sufficiently advanced in terms of physical and financial planning and must have passed the related checkpoints (cost-benefit analysis, physical and financial planning, environmental impact assessment, etc.). Based on these proposals, the Government takes decisions on the actions of the national plan that must be implemented over the first three years (years 1-3) and on the measures that should be prepared for the implementation of the following three years (years 4-6).

Decisions and judgments with financial implications relating to years 1-3 shall comply with the decisions parliament adopted on state budget and with the information the government has given to parliament in the previous budget. On the basis of the new long term plan, the Government took three different planning decisions in 2014: the National action plan for transport for the period 2014-2025 (years 1-12, updated approximately once per term), the financial plan for the period 2014-2016 (year 1-3, updated every year) and the financial plan for the period 2017-2019 (year 4-6, updated every year). The next national plan, following the review, suggestion and update process will be set for 2018-2029 and the dredging project which could be included has all the required documents to build a case for it by the end of 2016. This would mean that it would still have a year to promote it in front of the Swedish Transport Administration so that it is agreed on before all decisions for 2018 are taken.

In addition to the National plan, Swedish counties also develop their own plans for intermodal transport in the region on the basis of the same 12-year period. The central government has the final decision concerning funds allocation to both national and county plans. Until 2021, there should be no change in the distribution between counties decided in the context of the previous plan. The division of the funds for the period 2022-2025 should be set after the planning for this period has been set. The 2010-2021 plan had a budget of SEK 417 billion, the 2014-2025 plan has one of SEK 522 billion. The difference with what remains after the first four years will therefore be allocated to years 2022 to 2025, the annual average level of allocated funds to counties for this period is estimated to remain similar to previous years. Counties were due to submit new proposals for that period in spring 2015 and the central government is now working on defining final budget allocations for the counties to be able to set their plans within the following months. With the renewal of the national plan for 2018-2029, regional governments will have to define their new long term plans by the end of 2017 as well.

The national plan 2010-2021 identified projects to be implemented in the Västa Götaland region at a cost of approximately SEK 61 billion. Most of them should be completed by 2021, and the rest should require an extra SEK 10 billion in the last three years of the plan up to 2025. The county can also count on revenue from congestion charges in Gothenburg, which will contribute to an extra SEK 8 billion from 2010 to 2021, and on the additions of regional and local subsidies, co-financed projects and land revenues that bring another SEK 3.4 billion. Large projects, especially these included within the West Swedish Package various public institutions among which the City of Gothenburg, the Västra Götaland County Council, the County Council of Halland and the Gothenburg Region Association of Local Authorities have share responsibilities for the funding, finalising negotiations in 2011. These projects include the double siding of the Portrail and the Marieholm railway tunnel and new bridge to allow better connections between the port and the industrial sites.

Sustaining hinterland connectivity

Despite its successful historical development and good geographical coverage, the railport system still has the potential to develop. Expanding the system of rail shuttles to the segment of semi-trailers is a possibility that could substantially increase the scale of the Scandinavian rail shuttle systems. However, such a development poses some significant challenges since the semi-trailers segment is very different from containers in many aspects (Woxenius and Bergqvist, 2010). Up to now, the system has focused on transportation and increased volumes, and surprisingly few value-added services, such as storage of containers, customs clearance, and track and trace have been transferred from the main port to the dry ports despite the ambitions of the Port of Gothenburg. A market-share of 20% for the semi-trailer segment could double the volumes of the rail shuttle system (Bergqvist, 2008).

Close dry ports could play a very important role in the future as a result of expanding rail shuttle systems. The primary reason for this is that the close dry port is often located on a main railway line that is used by many of the rail shuttles in a dry port system. With increased co-ordination of different rail shuttle services, the need for system leadership becomes more obvious. As the system expands and includes more shuttles with increased volumes and maybe a combination of load units, handling the growth may become challenging for the main port. As the number of shuttles expands, the close dry port has the opportunity to utilise shuttles from distant dry ports using the same main railway line.

This arrangement enables the management to balance the unutilised capacity of different rail shuttles and improve the profitability of the entire rail shuttle system. Moreover, this framework facilitates attractive and profitable intermodal road-rail solutions for short distances where intermodal services are normally unprofitable. Scheduling and planning the time-schedule and production plan for the shuttles are essential from both a short and long-term perspective. A close dry port that has efficient and semi-automated handling equipment can help ameliorate buffering emergencies and problems in the main port. Through synchronisation of load units on the rail shuttles, the set-up can be optimised with regard to the handling equipment and the current status at the main port. Examples include sending blocks of rail shuttles instead of full length ones, separately sending different types of load units (e.g. semi-trailers and containers), and consolidating load units for a specific destination or individual ship (Bärthel and Woxenius 2004).

Another area in which the conductor can play an important role is security and inspections. Current and future demands set by laws, regulations, standards, and customer requirements concerning security drives much of the development that is currently taking place in ports. The overall goal to guarantee that goods handled at one port will not impose any threat or danger to other ports, carriers, etc. is being actively pursued at all ports today. Security checks and inspections are very expensive and consume a lot of time and space. Indeed, few ports have enough space and resources to adequately conduct these activities to a satisfying extent and level. In this sense, the conductor can relieve some of the stress on the main port by carrying out these activities at the dry ports and then guaranteeing safe transport to the main port by geo-fencing (Bergqvist and Woxenius, 2011).

Currently, a lack of suitable business models hampers the development of dry ports with more sophisticated services, thereby increasing the prospects for greater profitability. The system participants have set ambitious goals regarding what services should be developed at the dry ports. However, those services require investments and commitment between the dry ports and the main port. So far, the Port of Gothenburg has strategically decided to not own any of the dry ports. Instead, they have implemented the concept of a franchise, meaning that the business concept, information and communication technology (ICT) systems and quality standards are set by the Port of Gothenburg. This may facilitate the organisation of the system and rapid expansion, but it creates some challenges related to profit-sharing and investment-sharing (Bergqvist and Woxenius, 2011).

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NOTES

[1] In Sweden, the proposition offers should present alternatives so that the impact of several options can be weighed. In the case of the deepening project, a similar process to the cost benefit analysis should be undertaken. The process should assess the environmental impact of the "no alternative" option (no dredging) and theoretically of the developments that would be required at other ports to compensate for the lack of capacity in Gothenburg, as opposed to at least one alternative project in which deepening is conducted.

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The Impact of Mega-Ships:

The Case of Gothenburg

The port of Gothenburg is the incontestable gateway to Sweden. The most important challenge for Gothenburg is to keep attracting direct calls from ocean-going vessels, considered of utmost importance by Swedish industry. These direct calls are carried out by ever larger ships. What is needed to continue attracting them in the future? And what are the impacts of very large ships that will have to be taken into account? This report brings more clarity to these issues by assessing the various impacts the arrival of mega-ships has in Gothenburg. It analyses policies in place and provides recommendations on how to deal effectively with mega-ships in Sweden's largest port.

This report is part of the International Transport Forum's Case-Specific Policy Analysis series. These are topical studies on specific issues carried out by the ITF in agreement with local institutions.

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