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ALTERNATIVE SUPPLY CHAIN DESIGNS FOR CONTAINERIZED CARGO FROM CHINA TO PERIPHERAL REGIONS IN EUROPE

Final report of the SeaConAZ project

Financed by the TRANSPORT 2025 program of the Research Council of Norway

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SHORT SUMMARY

The Asia-Europe container trade is second only to the trans-Pacific trade in terms of volume transported. In the typical structure of the supply chains associated with the Asia to Europe inbound container trade, containers are stuffed in China, and the cargo is subsequently cross-docked at a major European logistics hub or a distribution center closer to the customer for further distribution to the final retailing points. However, this solution may not be optimal from the perspective of total logistics cost and CO2 emissions. Upstream buyer consolidation at the origin and/or a downstream intermodal system at the destination have been regarded as potential solutions that improve the performance of supply chains under certain circumstances. The present research identifies new supply chain solutions in sea-based China-Europe cargo flows. Based on the identified new solutions, the performance of potential solutions in terms of logistics cost and CO2 emissions can be compared with those of more traditional solutions, thus revealing under which circumstances the new solutions may be preferable. The core of this research is based on case studies obtained from Scandinavian chain retailers as well as a large number of interviews with central actors in the China-Europe trades, with particular focus on cargo-flows destined for peripheral regions of Europe, represented by Scandinavia and Ireland. The findings suggest that the solutions characterized by upstream buyer consolidation and a downstream rail-based or maritime feeder-based systems may have positive impacts on logistics cost and CO2 emissions. The analysis suggests that such new solutions might be desirable as an alternative to the usual arrangements in this China-Europe container trade, in particular in situations where there are limited order quantities from each vendor, there are many different vendors located within a

confined geographical region in China, where total order volumes are big enough from one region in China to achieve a sufficient utilization of consolidated containers, where cargo is characterized by small units which are not palletized, where the final retailing points are far from Central-European logistics hubs, and where the majority of the importers' cargo-flow is sourced in China

PREFACE

This report, along with the PhD thesis written by Ning Lin, forms the main output from the SeaConAZ project Exploring the potential for making sea containers go all the way (A-Z) through the supply chain), which has been funded by the Research Council of Norway under the Transport 2025 program. The report is co-authored by representatives from the consortium partners which at the end of the project has been:

Møreforsking Molde AS (project owner), Norway
Molde University College – Specialized University in Logistics, Norway
Gothenburg University, Sweden
TNO, The Netherlands
The Institute of Transport Economics (TØI), Norway
Liverpool John Moores University, UK
Newcastle University, UK

Beijing, Newcastle, Liverpool, Delft, Gothenburg, Oslo, Molde, June 2019

The authors

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SUMMARY

The Asia-Europe container trade is second only to the trans-Pacific trade in terms of volume transported. In the typical structure of the supply chains associated with the Asia to Europe container trade, containers are stuffed in China, and the cargo is subsequently cross-docked at a major European logistics hub or a distribution centre closer to the customer for further distribution to the final retailing points. However, this solution may not be optimal from the perspective of total logistics cost and CO2 emissions. Upstream buyer consolidation at the origin and/or a downstream intermodal system at the destination and/or reconsolidation in a main European hub have been regarded as potential solutions for improving the performance of supply chains under certain circumstances. The present research identifies new supply chain solutions in sea-based China-Europe cargo flows. Based on the identified new solutions, the performance of potential solutions in terms of logistics cost and CO2 emissions can be compared with those of more traditional solutions and to reveal the occasions that suit the new solutions. The core of this research is based on case studies obtained from Scandinavian retailers as well as a large number of interviews with central actors in the China-Europe trades, with particular focus on cargo-flows destined for peripheral regions of Europe, represented by Scandinavia and Ireland. The findings suggest that the solutions characterized by upstream buyer consolidation and a downstream rail-based or maritime based intermodal systems may have positive impacts on logistics cost and CO2 emissions. The analysis suggests that such new solutions might be desirable as an alternative to the usual arrangements in this China-Europe container trade, in particular in situations where there are limited order quantities from each vendor, there are many different vendors located within a confined geographical region in China, where total order volumes are big enough from one region in China to achieve a sufficient utilization of consolidated containers, where cargo is characterized by small units which are not palletized, where the final retailing points are far from Central-European logistics hubs, and where the majority of the importers' cargo-flow is sourced in China.

1 INTRODUCTION

1.1 THE SEACONAZ PROJECT; AIMS AND RESEARCH QUESTIONS

Road transport is currently growing faster than sea transport in European and Norwegian freight, contrary to political aims of moving cargo from road to sea. Sea containers coming from China to Europe are typically stuffed at the location of the manufacturer in China, and the consignments are thereafter split in logistics hubs in Europe and then consolidated into shipments with a final retailing point as the destination. This is what we call the "business-as-usual" (BAU) solution – illustrated in Figure 1. The problem is that this consolidated shipment quite often go by road onto its final destination, effectively contributing to more congested road networks at a higher societal cost than if it was transported at sea on maritime feeder links or by rail. As indicated by the supply chain elements with a bold lining in Figure 1, only a limited part of the supply chain uses intermodal containers suited for sea transport.

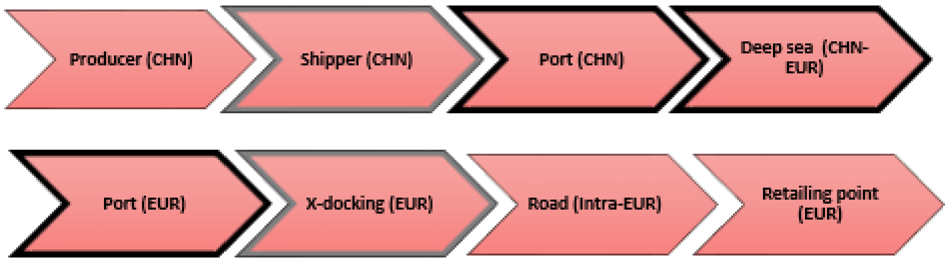

Figure 1 The Business-as-usual (BAU) supply chain

A few retailers have tested an alternative way to design such an intercontinental supply chain by cross-docking and consolidating cargo from many different manufacturers in China into intermodal containers destined for one or a small set of geographically close retailers on the European side. This is what we call the SeaConAZ concept. It eliminates the need for splitting the container when it arrives at the European logistics hub, and it enhances the competitiveness of container feeder operations versus land-based modes. Effectively a larger part of the supply chain entails sea containers under this concept (Figure 2).

Figure 2 The SeaConAZ supply chain[1]

[1] The contents of the second box has been changes from "X-docking (EUR)" to "X-docking (CHN)" after submission of the project outline (HMH 100615)

Normally, an efficient maritime operations and rail operations would outperform road transport in terms of emissions per tonnekilometer. A successful implementation of the SeaConAZ concept would therefore mean lower emissions and a smaller footprint of freight transport activities related to these supply chains.

The SeaConAZ project was established to explore whether such an alternative approach could be justified from both an environmental and a financial perspective. Important research angles were also related to who the key decisionmakers of relevant supply chain designs are, and for which type of actors and cargo such solutions would be suitable.

The main research questions addressed in the project has been:

RQ1 To what extent do solutions similar to the SeaConAZ concept exist today?
RQ2 Who are the key decision-makers related to a potential re-design of the container supply chains?
RQ3 To which extent would the SeaConAS concept have potential for enhancing logistical efficiency and lowering societal costs?
RQ4 Which are the impediments and bottlenecks that need to be overcome in order to facilitate a shift from the BAU-solution to the SeaConAZ solution?

The research questions have been analysed from both a qualitative and a quantitative perspective. The main tool for the qualitative analysis has been a series of interviews and other communication with central actors in the relevant trade – both on the Chinese and on the European side. This primary information has been put into a scientific context through literature surveys. The quantitative analyses related to environmental and financial performance of the supply chains have been made through the development of comprehensive models developed in the PhD project. The academic partners in the project have all contributed to the perspectives through their expert knowledge related to these supply chains in general, and in particular issues pertaining to the regions where they are located. All partners have contributed with the recruitment of central informants and through conducting interviews and collecting case material.

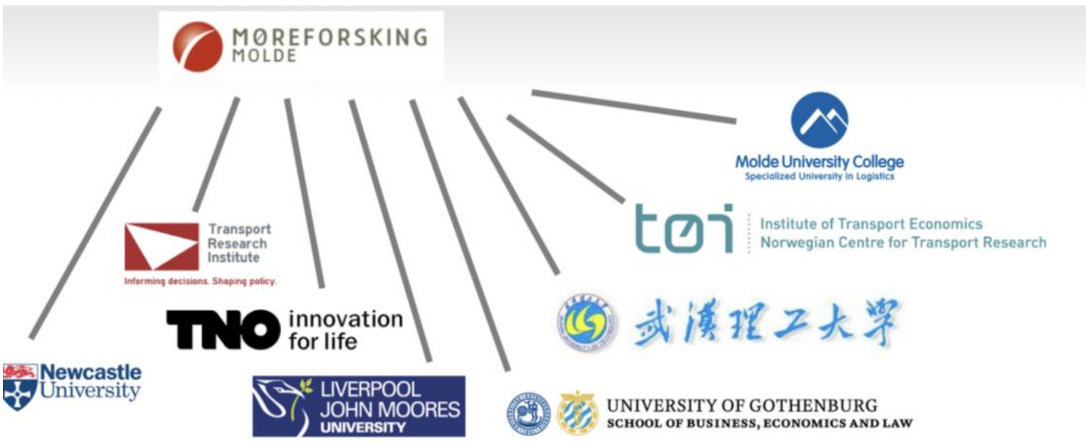

Figure 3 The SeaConAZ project consortium

1.2 THE SEACONAZ PROJECT CONSORTIUM PARTNERS

Møreforsking Molde AS has been the project leader. Molde University College has hosted and tutored the PhD candidate and admitted him to their PhD Logistics program. The consortium has changed somewhat over the 4 year project period. In the first phase, Wuhan University of Technology (China) and Edinburgh Napier University (Scotland) participated, but they left the project after two years. The early phases of the project revealed that the SeaConAZ concept might be most suitable to peripheral regions of Europe. It became clear that a particular focus on Scandinavia and Ireland would be most interesting, and therefore Newcastle University was recruited to the project to cover "Case Ireland", since they had good knowledge about, and contacts within the Irish logistics industry. Liverpool John Moores University, TNO, Gothenburg University and The Institute of Transport Economics have been partners for the whole project period.

1.3 THE SEACONAZ PHD PROJECT

A main deliverable from this project is the PhD project fully funded by the Research Council of Norway. Dr. Ning Lin successfully defended his thesis called *«The performance of upstream buyer consolidation in China-Scandinavian containerized trades»* in June 2019. The thesis and its content is not contained in this report, and could only be briefly referred to here because it is currently under review processes for publication in journals. The thesis and related papers therefore constitute an important supplement to this report as documentation of the project outcomes.

Research gap 1: New supply chain solutions in sea-based China-Europe cargo flows	RQ1: Which innovative supply chain solutions in sea-based China-Europe cargo flows could be identified?	Paper 1: Supply Chain Solutions to Upstream Buyer Consolidation with green and resilient supply chain designs in the China-Europe Containerized Cargo flows
Research gap 2: The influence of upstream buyer consolidation on supply chain performance in terms of cost	RQ2: To what extent does upstream buyer consolidation influence supply chain performance in terms of cost?	Paper 2: The Positive Impact of an Upstream Buyer Consolidation and Downstream Intermodal Rail-Based Solution on Logistics Cost in the China-Europe Container Trade
Research gap 3: The influence of upstream buyer consolidation on supply chain performance in terms of environment	RQ3: To what extent does upstream buyer consolidation influence supply chain performance in terms of environment?	Paper 3: CO_2 Emissions Mitigation Potential of Buyer Consolidation and Rail-based Intermodal Transport in the China-Europe Container Supply Chains
Research gap 4: The occasions to which upstream store-level consolidation can apply	RQ4: To what extent does upstream store-level consolidation influence supply chain performance?	Paper 4: Evaluation of Asia-Europe sea container supply chain configurations – The impact of upstream store-level consolidation activity on supply chain performance

Figure 4 **The structure of Ning Lin's PhD thesis based on this project**[2]

[2] Papers 1 and 4 are co-authored by Ning Lin and Harald M. Hjelle. Paper 2 is co-authored by Ning Lin, Harald M. Hjelle and Rickard Bergqvist. Paper 3 is written solely by Ning Lin.

1.4 BACKGROUND ON CHINA-EUROPE TRADE[3]

This PhD project aims to explore the impacts of upstream store-level/buyer consolidation activity in the origin country on the overall performance of an Asia-Scandinavia supply chain in terms of logistics cost, lead-time and CO2 emissions.

1.4.1 TRENDS IN CHINA-EUROPE TRADES

This section illustrates the changes in terms of cargo value in the China-Europe trade. Based on the data provided by Eurostat (2018a), both Europe and China are the important ones in the international trade due to the reason that they are the top two largest exporters in the world, representing approximately one third of world exports in 2017. The largest is China (17%) followed by the EU-28 (16%). They are also big as importers. EU-28 and China constitutes 15% and 12% of world imports respectively in the same year. In terms of extra-EU imports, China was the largest trading partner of the EU during the past decade. China's share has been around 20% since 2015, in front of the second largest partner, the United States (around 14%). For more detailed information, please refer to Table 1. EUs imports from China has increased by 50% over the last decade (Figure 5), Norway's imports from China has grown with 110% over the same period (Figure 6).

Table 1 Evolution of trade flows from China and USA to EU-28 in billion EUR

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
EU-28's Imports from China	249.1	215.3	283.9	295.1	292.1	280.1	302.5	351.0	345.1	374.8
EU-28's Imports from the World	1, 585.2	1,235.6	1,531.5	1,730.0	1,798.8	1,687.7	1,692.8	1,730.5	1,713.4	1,858.3
China's share in extra-EU imports (%)	15.71	17.42	18.54	17.06	16.24	16.60	17.87	20.29	20.14	20.17
USA's share in extra-EU imports (%)	11.53	12.57	11.42	11.23	11.64	11.82	12.36	14.41	14.62	13.79

Adapted from Eurostat (2018b) and Eurostat (2018c)

[3] This section is mainly based on the introduction of Dr. Ning Lin's PhD thesis.

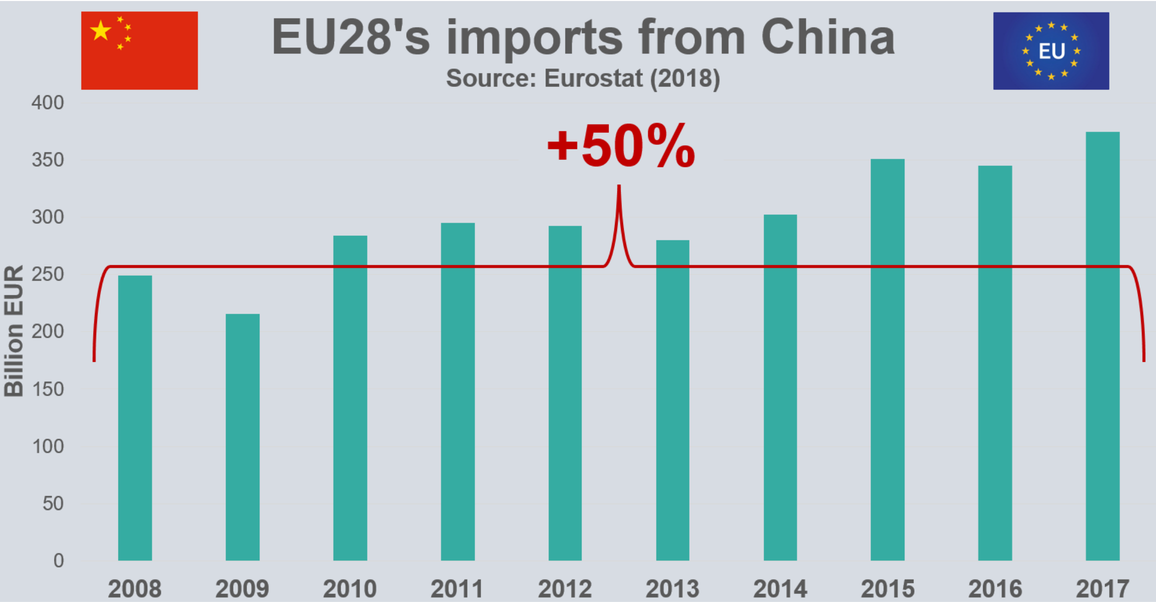

Figure 5 **EU28 imports from China 2008-2017**

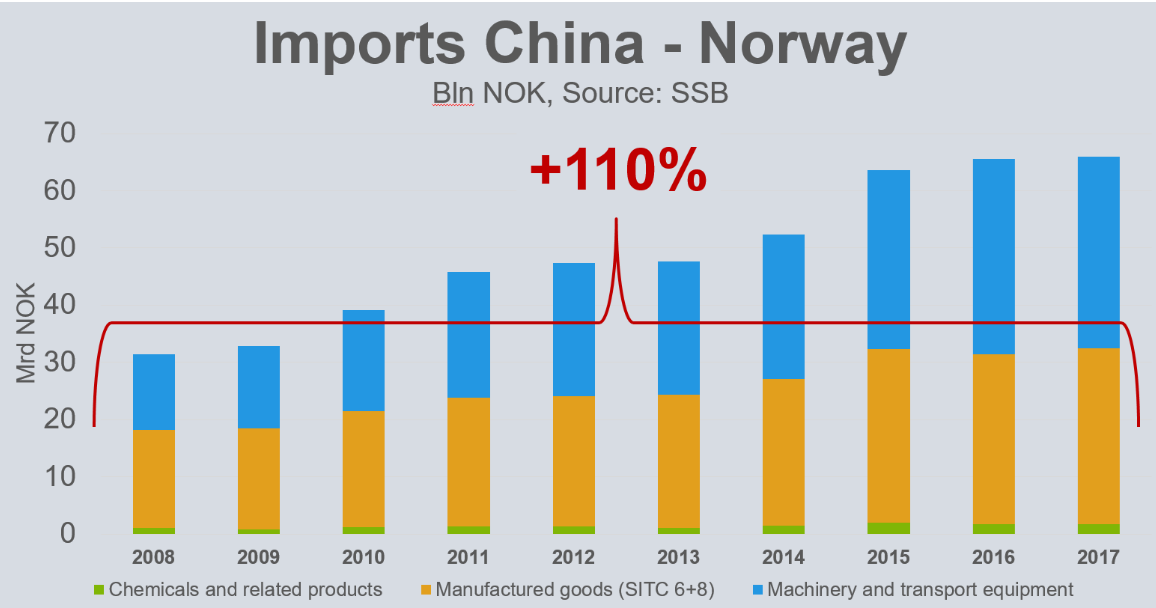

Figure 6 **Norway's imports from China 2008-2017**

In addition, as shown in Table 2, manufactured goods dominate the cargo flows from China to Europe during the past decade. Based on Standard International Trade Classification (SITC), around 97% of imports from China in 2017 are manufactured goods, in which 'machinery and vehicles' (section 7 in SITC) and 'other manufactured goods' (section 6 and 8 in SITC) represents 52% and 40% of total imports from China. Therefore, investigating logistics solutions for manufactured goods arouses strong interest of the author.

Table 2 Trade flows from China to EU-28 by commodity group, in billion EUR

SITC	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
5 Chemicals and related products	9.3	8.0	11.0	13.1	13.0	13.2	14.3	16.3	16.1	18.2
6 Manufactured goods classified chiefly by material	36.8	24.7	32.9	37.5	36.2	35.1	40.4	45.4	44.1	46.6
7 Machinery and transport equipment	115.3	102.0	145.1	144.8	146.2	139.2	146.9	176.0	173.9	195.0
8 Miscellaneous manufactured articles	79.1	74.1	86.6	89.2	88.0	844.0	92.4	104.0	101.3	104.8
Total imports	249.1	215.3	283.9	295.1	292.1	271.9	302.5	351.0	345.1	374.8
Share of manufactured goods (%)	96.55	96.98	97.08	96.44	97.02	97.07	97.19	97.35	97.19	97.28

Adapted from Eurostat (2018d)

Norway and Sweden are the two main destination countries considered in this project. When it comes to the trade flows from China to Norway, the former is the third largest trading partner of the latter, in terms of imports of goods. China constitutes 9.8% of Norway's total imports in 2017 after Sweden (11.5%) and Germany (11.1%) (SSB, 2018d). In terms of cargo types imported from China, as illustrated in Table 3, manufactured goods also dominate the cargo flows, fluctuating around 98% during the past decade.

Table 3 Trade flows from China to Norway by commodity group, in billion NOK

SITC	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
5 Chemicals and related products	1.0	0.8	1.2	1.3	1.3	1.1	1.4	2.0	1.7	1.7
6 Manufactured goods classified chiefly by material	4.1	3.7	4.6	5.6	6.0	5.4	6.2	7.6	7.3	7.4
7 Machinery and transport equipment	13.2	14.4	17.6	22.0	22.0	23.3	25.2	31.3	34.2	33.6
8 Miscellaneous manufactured articles	13.1	13.9	15.7	16.9	16.8	17.8	19.5	22.7	22.4	23.3
Total imports	32.1	33.4	39.7	46.5	47.0	48.5	53.4	64.8	67.1	67.2
Share of manufactured goods (%)	97.92	98.29	98.44	98.53	98.24	98.05	97.98	98.22	97.72	98.13

Adapted from SSB (2018a)

When it comes to the trade flows from China to Sweden, the former is the fifth largest trading partner of the latter, in terms of imports of goods. China constitutes 5.2% of Sweden's total imports in 2017 after Germany (18.9%), Netherlands (8.9%), Norway (8.1%) and Denmark (7.2%) (SCB, 2018). In terms of cargo types imported from China, as illustrated in Table 4, manufactured goods also dominate the cargo flows, fluctuating around 97% during the past decade.

Table 4 Trade flows from China to Sweden by commodity group, in billion SEK

SITC	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
5 Chemicals and related products, n.e.s.	0.9	0.8	0.9	1.1	1.1	1.1	1.2	1.3	1.4	1.5
6 Manufactured goods classif. by material	6.9	5.7	7.3	7.6	8.4	7.3	8.5	10.0	9.8	11.0
7 Machinery and transport equipment	17.6	16.4	21.4	21.2	21.2	21.0	23.3	26.9	25.1	26.3
8 miscellaneous manufactured articles	19.0	18.7	21.7	21.9	21.3	21.0	24.1	28.6	27.3	28.0
9 goods not classified elsewhere	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total imports	45.4	42.7	52.3	53.0	53.0	51.5	58.4	68.3	65.2	68.2
Share of manufactured goods (%)	97.81	97.62	97.92	97.84	98.00	97.91	97.56	97.75	97.68	97.83

Adapted from (SCB, 2019)

1.4.2 TRENDS IN THE LOGISTICS OF CHINA-EUROPE TRADES

The maritime trade between Asia and Europe may be traced back to 1st century BC or even earlier: the maritime silk road that connected Asia, Europe and North Africa (Liao, 2014). Bagged, crated and barreled cargo was stored in a warehouse close to a seaport until a ship was available. The loading and unloading of ships was very labor intensive, which leaded to long ship waiting time and high risk of accident and theft (WSC, 2018). This process is the so-called break bulk shipping. Although this historical manner of transport is still used nowadays, the shipping industry has changed dramatically since the introduction of container ships in 1956 and the agreement of a set of international standards for container sizes in 1970 (Eurostat, 2017a). As a result, the market share of container shipping in total international seaborne trade increased from 2.8% (102 million tonnes) in 1980 to 16.7% (1720 million tonnes) in 2016 in terms of tonnage (UNCTAD, 2017).

When it comes to the trade flows by mode of transport from China to Europe, as can be seen from Table 5, the total cargo value transported by sea increased from 151.7 billion euros in 2008 to 225.2 billion euros in 2017. Even so, sea transport always represents around 60% of cargo imported into the EU-28 from China during this period. By contrast, the market share of air transport increased during this period from less than 20% to nearly 25%. Moreover, although only a small share of cargo is transported by rail, rail freight sector witnessed a dramatic upward trend in both cargo volume and market share since 2014 (Figure 8). The significantly reduced freight rate and emissions compared to air transport and shortened lead-time compared to sea transport may be the reasons that increasing amount of cargo goes by rail.

Table 5 Trade flows from China to EU-28 by mode of transport

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Cargo value in billion EUR									
Total	249.1	215.3	283.9	295.1	292.1	280.1	302.5	351.0	345.1	374.8
Sea	151.7	127	171.9	182.4	171.9	162.4	183.4	218.2	213.7	225.2
Air	48.5	42.9	58.8	59.5	61.4	62.6	67.2	83.9	83.5	93.1
Rail	1.6	1.3	1.8	1.4	1.3	1.4	2.3	3.9	5.6	8.9
Others	47.3	44.1	51.4	51.8	57.5	53.7	49.6	45.0	42.3	47.6
	Percentage (%)									
Sea	60.90	58.99	60.54	61.82	58.85	57.98	60.63	62.16	61.93	60.08
Air	19.47	19.93	20.71	20.17	21.02	22.35	22.22	23.90	24.20	24.84
Rail	0.64	0.60	0.63	0.47	0.45	0.50	0.76	1.11	1.62	2.37
Others	18.99	20.47	18.11	17.54	19.69	19.18	16.39	12.83	12.25	12.71

Adapted from Eurostat (2018e)

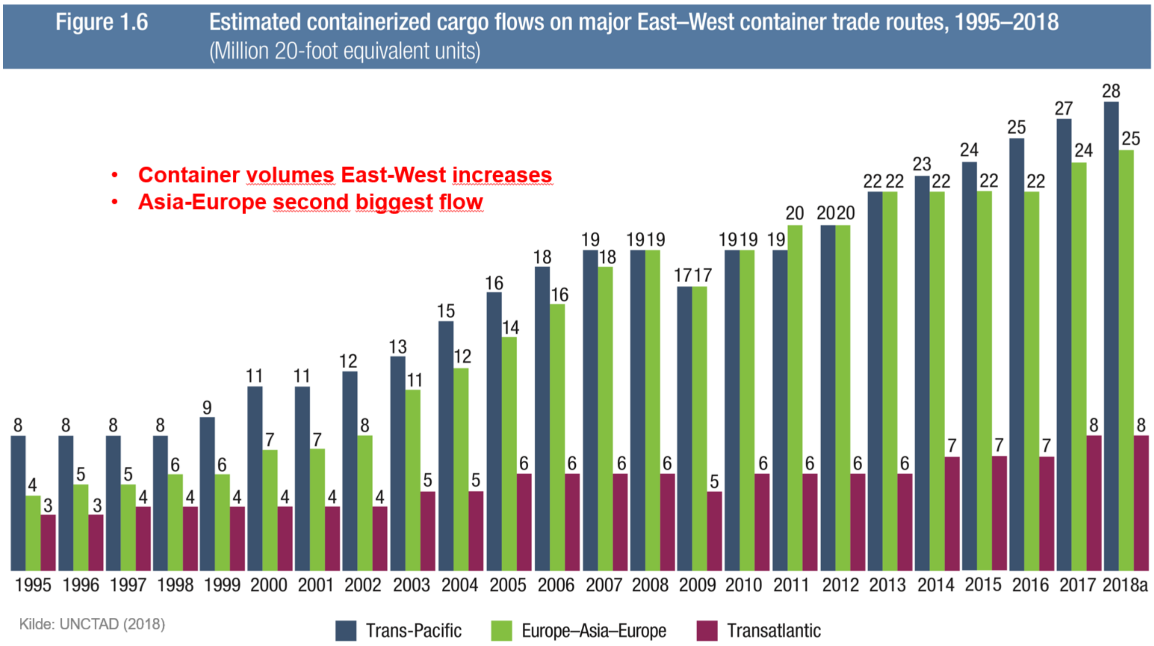

Figure 7 **World East-West container flows 1995-2018 (Source: UNCTAD 2018)**

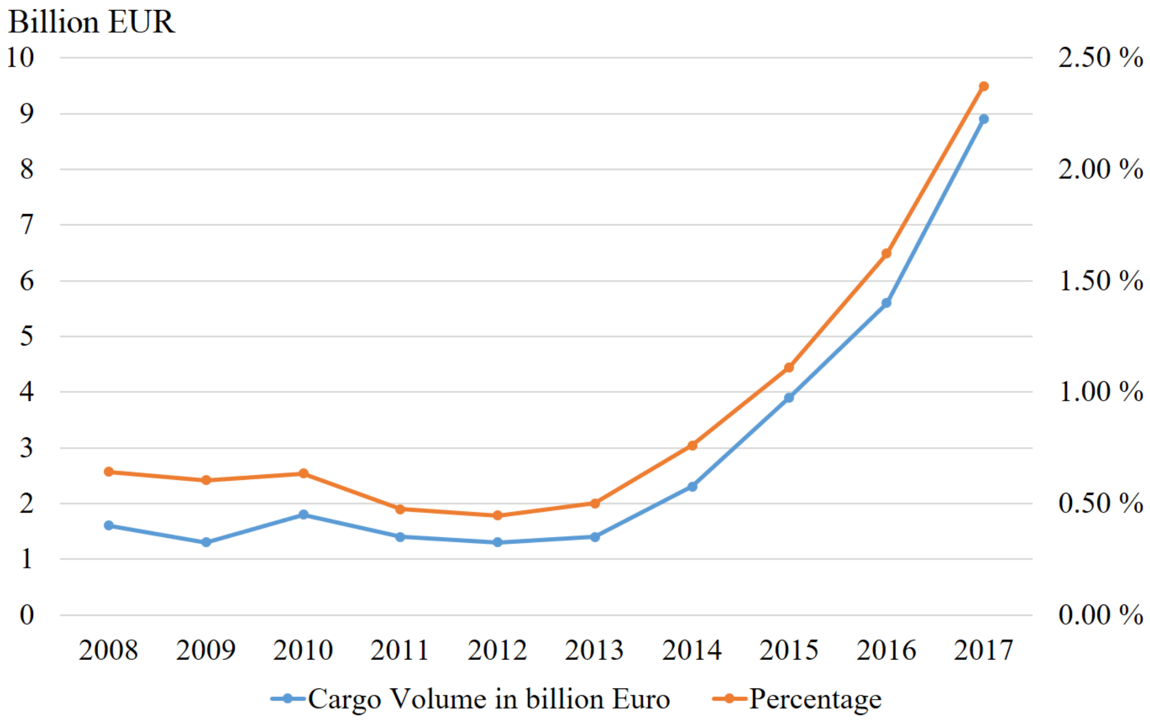

Figure 8 **Emerging rail services**

As illustrated in Table 1-6, sea transport dominates the cargo flows from China to Norway. Its market share was always higher than 80% of total cargo volume in tonnage. Other modes in Table 6 represent rail, air, mail, own propulsion, etc.

Table 6 Trade flows from China to Norway by mode of transport

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Cargo volume in thousand tonnes									
Total	734.2	611.0	742.8	840.6	906.9	857.9	990.7	1009.1	1067.6	1005.2
Sea	614.4	494.2	614.5	702.5	759.1	705.2	821.4	832.7	892.3	819.0
Others	119.8	116.8	128.3	138.2	147.8	152.8	169.3	176.4	175.3	186.2
	Percentage (%)									
Sea	83.68	80.88	82.73	83.56	83.70	82.20	82.91	82.52	83.58	81.48
Others	16.32	19.12	17.27	16.44	16.30	17.80	17.09	17.48	16.42	18.52

Adapted from SSB (2018b)

When it comes to the trade flows by mode of transport from China to Sweden, as can be seen from

Table 7, the total cargo volume transported by sea was always around 90% during the past decade. Other modes in

Table 7 represent rail, air, mail, own propulsion, etc.

Table 7 Trade flows from China to Sweden by mode of transport

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
	Cargo volume in thousand tonnes									
Total	1,178	875	1,109	1,182	1,131	1,088	1,203	1,179	1,175	1,207
Sea	1,056.2	778.7	944.9	1,041.5	1,009.8	1,007.1	1,119.8	1,092.4	1,083.8	1,098.2
Others	122.0	96.3	163.6	140.8	121.7	80.5	83.0	86.6	91.6	108.6
	Percentage (%)									
Sea	89.64	88.99	85.24	88.09	89.24	92.60	93.10	92.65	92.21	91.00
Others	10.36	11.01	14.76	11.91	10.76	7.40	6.90	7.35	7.79	9.00

Adapted from Eurostat (2018e)

Recently, industrial actors and researchers consider whether the advantages of global sourcing outperforms its disadvantages. Lengthened supply chains may result in negative impact on lead-time, delivery precision, quality and flexibility (Nujen et al., 2018, Stentoft et al., 2016). In addition, increased salary in traditional low-cost countries (Bals et al., 2015) and the concerns relating to possibly reduced competence due to remoteness to skilled workers (Fratocchi et al., 2016), R&D resources (Arlbjørn and Mikkelsen, 2014) and manufacturing facilities (Canham and T. Hamilton, 2013) make business owners to re-consider their sourcing strategy. Because of these reasons, companies consider to shift functions/operations back to their original locations and/or neighboring countries. In addition, advanced techniques may lower production cost in high-cost countries and make the back-sourcing strategy feasible. Big data, intelligent robots, additive manufacturing, etc. may facilitate the reinvention of manufacturing industry (Moradlou and Backhouse, 2016). This new trend brings challenges to the new solutions studied in this PhD project because the advantage of store/DC-level consolidation service in terms of cost reduction may be weakened if they procure from domestic or neighboring markets.

1.4.3 ENVIRONMENTAL ASPECTS OF CHINA-EUROPE TRADES

With the development of international trade, freight transport has become an increasingly important polluter and contributor to global warming. Most vehicles for freight transport, like trucks, container ships and airplanes rely on fossil energy to operate, which leads to air pollution and global warning. The transport sector produced around 23% of total energy-related CO2 emissions in 2010 globally, which was equal to approximately 7.0 Gt CO2e of direct GHG emissions (IPCC, 2015). In particular, container transport activity has increased significantly over the past decade. Container throughput in the Port of Shanghai, one of the major ports in China, increased by 43.6% from 28.0 million TEU in 2008 (SIPG, 2009) to 40.2 million TEU in 2017 (SIPG, 2018). On the European side, the Port of Rotterdam, the largest container port in Europe (Rotterdam Port, 2017), also witnessed a growth from 10.8 million TEU in 2008 (Rotterdam Port, 2009) to 13.7 million TEU in 2017 (RotterdamPort, 2018), which means 26.9% increase during the past 10 years. This increase is partly due to the increased flows from Asia. This trend leads to steadily increased CO2 emissions from container transport and handling activity.

In order to reduce CO_2 emissions, since the late 1990s, certain policy initiatives try to raise people's awareness and set regulations to reduce GHG emissions. Examples of such policies are 1) the international of Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) (UN, 1997); 2) the Paris Agreement; And 3) the EU's White Paper on transport, that set a target: "30% of road freight over 300 km should shift to other modes, like rail or waterborne transport by 2030, and more than 50 % by 2050" (EuropeanCommission, 2011).

The literature also reports on plentiful studies aiming to mitigate CO_2 emissions from the transport sector by greening the supply chain (Sheu and Talley, 2011, Paul and Richard, 2003). Many studies focus on greening each of the individual supply chain elements: e.g. by mitigating CO_2 emissions through improved product design (Oakley, 1993), by using biofuels (Liaquat et al., 2010) and issuing governmental policies like private vehicle control, fuel economy regulation, differentiated fuel taxes (Yan and Crookes, 2009), optimizing warehousing activities by using proper handling equipment, temperature, lighting conditions and green energy (Marchant and Baker, 2010), better routing and scheduling of vehicles (Eglese and Black, 2010). Other authors have focused on economic incentives - increases in taxation impelling companies to use vehicle capacity efficiently and giving drivers an incentive to drive fuel-efficiently (McKinnon, 2008). Other means of reducing emissions include collaboration between actors (Robert et al., 2007), using more efficient vehicles, training drivers (McKinnon, 2010) and adopting intermodal logistics solutions (Wee et al., 2005, Bergqvist and Behrends, 2011). Acciaro and McKinnon (2015) suggests that flexible regulatory instruments should be proposed for emission reduction because significant differences exist among ships in different sizes, ages, speeds, ownerships and trade routes.

Facilitating a modal shift from road to rail and/ or short-sea shipping has received a lot of attention. Woodburn and Whiteing (2010) suggested shifting cargo from road to rail as one of the most effective strategies for reducing CO_2 emissions from the freight transport sector. However, the initiative of modal shift from road to rail meets challenges. As illustrated in

Table 8, road transport has dominated freight transport market. The shares of rail transport in EU-28 and Norway have remained at low levels during the past more than one decade. In addition, although the rail transport in Sweden develops better than that in Norway and the EU, there is a downward trend in its market share since 2012. The reason may be that road transport outperform rail-based intermodal transport over short distances in terms of cost (Resor et al., 2004) and lead-time (Danielis et al., 2005, Samimi et al., 2010). However, 46% of transportation demand in the EU are transports over 150 km to 500 km (Ye et al., 2014). Compared with the traditional LCL solution, the new alternative solutions studied in this research may facilitate the use of rail-based intermodal transport, thereby reducing downstream CO2 emissions. The reason is that all cargo is consolidated at origin based on the demand of buyer's DC at destination. Without the need of reconsolidation for consignees close to a port of destination (POD), the new solutions enable containers to be transshipped directly from ships to trains. The eliminated pre-haulage increases competitiveness of rail-based intermodal transport.

Table 8 Modal split of freight transport in EU-28, Sweden and Norway, in percentage (%)

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EU-28	Rail	17.9[e]	18.3[e]	18.2[e]	18.1[e]	16.9	17.4	18.7	18.5[e]	18.2[e]	18.4[e]	18.3[e]	17.4[e]
	Road	75.6[e]	75.5[e]	75.5[e]	75.5[e]	77	75.7	75.1	74.7[e]	74.9[e]	74.9[e]	75.3[e]	76.4[e]
	Inland Waterways	6.4[e]	6.2[e]	6.3[e]	6.4[e]	6.2	6.9	6.3	6.8[e]	6.9[e]	6.7[e]	6.5[e]	6.2[e]
Sweden	Rail	32.5	32.2	32.7	31.9	33.3	35.6	34.8	35.8	33.7	30.4	29.6	29.4
	Road	67.5	67.8	67.3	68.1	66.7	64.4	65.2	64.2	66.3	69.6	70.4	70.5
	Inland Waterways	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
Norway	Rail	15.7	15.8	16.4	15.6	16.4	15.4	15.8	14.8	13.3	13.7	12.9	13
	Road	84.3	84.2	83.6	84.4	83.6	84.6	84.2	85.2	86.7	86.3	87.1	87
	Inland Waterways	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Adapted from Eurostat (2017b)

Notes: e=estimated, n/a=not applicable

Although many evidences, e.g. Stocker et al. (2013), indicate that man-made emissions of greenhouse gases have changed the climate, it is complicated to adapt transport infrastructure to these expected climate changes because long-term weather prediction is too different to be accurate enough for use by transport asset owners and network managers. However, manageable environmental risks should be considered in both the siting of transport networks and the design specifications of specific assets. This ensures that infrastructure continues to operate under a range of expected risks and the impact of extreme weather events are also constrained (ITF, 2015). In addition, the potential economic and social benefits from shifting low cost and low durability roads to more durable and more expensive ones are studied (ITF, 2017).

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1.6 CENTRAL FINDINGS AND REFLECTIONS

In this report we have included a chapter addressing the various variants of the SeaConAZ concept that we have come across through the project, and analyzed there in the context of the scientific literature. Then we add two sections analyzing the role of the central European hubs and how they contribute to the feeder part of this trade. Here we also provide perspective on issues which apply to the logistics of peripheral regions in Europe, exemplified by Scandinavia and Ireland. We also discuss how the SeaConAZ concept would be more or less relevant to different product types or logistics network designs. The last section of this report has a particular focus on Irish logistics, which is also of particular interest currently, as Ireland stands be heavily influenced by the potential Brexit solutions at the moment. As stated before, much of the project is also documented through the PhD thesis written as part of the project. Here we will try to summarize the findings related to the research questions asked in the project application.

1.6.1 SEACONAZ TYPE OF SOLUTIONS ARE PROVIDED IN THE MARKET, BUT DOES NOT FIT ALL TYPES OF CARGO AND ALL TYPES OF ACTORS

From our interviews with central actors in Scandinavia, The Netherlands, UK, Ireland and China we get the impression that SeaConAZ type of solutions are offered in the market today, mainly by the Chinese branches of international logistics actors. These actors could be global logistics providers or LSPs with a more limited presence in European regions. As far as we can tell, no Chinese actors provide such services. The Chinese-owned logistics industry is dominated by many small actors who usually offer their services as sub-contractors to Chinese manufacturers or major international logistics companies. The scope of services provided under the buyer consolidation label varies a lot. The core services include consolidation, warehousing and customs clearance, -but some cargo-owners also outsource other value added services, like labelling, and following up of order fulfilment by manufacturers. This could e.g. mean that the LSP has access to production orders and sends reminders to suppiers if shipments do not arrive on time at the consolidation center. It seems that smaller cargo-owners are more likely to outsource a wider scope of services to LSPs with a presence in China, because they would not have the necessary resources to carry out these activities themselves.

Some of our respondents use buyer consolidation services, some have used them, but stopped applying them – and others have never used such services. Based on the feedback we have gotten, it seems that such services is most suitable under the following circumstances:

1. **There are limited order quantities from each vendor** – too small to utilize regular FCL-services
2. **There are many different vendors,** but they are still located within a **confined geographical region** in China
3. **Total order volumes are big enough** from one region in China to achieve a sufficient utilization of consolidated containers
4. Cargo is characterized by **small units which are not palletized** (this makes cargo handling costly in European side)
5. **The final retailing points are far from Central-European logistics hubs** (e.g. Scandinavia, Ireland)
6. The **majority of the importers cargo-flow is sourced in China**, - this means that there is a limited need for consolidation with cargo from other areas
7. There is a **limited need for building up stocks** on the European side. If such a need is present, the benefits from buyers consolidation would be smaller, because one would be able to utilize standard FCL services in stead
8. There is **little need for replenishment** within seasons. As buyers consolidation normally makes lead times longer, this solution would be less suitable under such circumstances.
9. There is **little need for spare-parts with short lead-times.**

From the Scandinavian cargo-owners interviewed, it is seems that for actors who does not belong to global or European retailing chains, most of the cross-docking of cargo on the European side is done in Scandinavia and not central Europe. The containers arriving from Asia would either be shifted to a feeder service in a central European port (e.g. Rotterdam or Hamburg), or arrive in Gothenburg by the deep sea vessel. The feedering could be done by a maritime feeder service, by train or by road. In the Irish case, a significant part of the cargo arrives via RoRo-services from the UK after the cargo has been cross-docked at a logistics hub in England. This may change significantly if the UK leaves the EU (Brexit), then our informants tells us that most cargo, which is now land-bridged via England, would arrive directly to Irish ports by container feeder lines to a larger extent. This would most often mean that cargo is cross-docked in a central European hub-port, but buyer's consolidation solutions may also become more attractive for Ireland under such a scenario.

1.6.2 KEY DECISION-MAKERS RELATED TO A POTENTIAL RE-DESIGN OF THE CONTAINER SUPPLY CHAINS?

From our interviews and data gathering it is quite clear that the key decisions related the design of relevant supply chains from China to Europe are situated at the importer side (i.e. European actors). This is mainly also reflected through the most typical Incoterms applied in these trades. FOB or EXW and similar, seem to be the dominant terms. We have, however, not been able to trace a systematic account of Incoterms applied, nor on any trends with respect to this. When asked about who the key decision-makers are, both LSPs and cargo-owners reply that this is the importing cargo-owners, i.e. the European retailing actors. It is, however, also a clear conclusion that the LSPs play an active role in designing the supply chain solutions, by offering their advice, and providing their expertise and knowledge about e.g. local logistics in China.

Type goods	Load carrier	Main freight mode	Incoterm
Grocery	20 & 40 foot containers	Sea freight and rail "Silk route"	FOB
Specialised goods (bikes, sport articles, tents, etc.)	40 foot containers	Sea freight	FOB
Textiles, decorations and ornaments for home	40 foot containers	Sea freight	FOB
Specialised goods rucksacks and bags	20 foot containers	Sea freight	CF
Parcels with profiles, pens, flags, etc.	Parcels	Air freight- TNT and UPS	CF
Tools (international label) and less frequent goods	20 foot containers	Sea freight and cross- docking in NL	CIF
Tools (private label), Nordic hub, Oslo	20 foot containers	Sea freight	FOB

Figure 9 Freight modes and Incoterms applied by Norwegian respondents. Cargo owner importing cargo from China

In general, it seems that the actors that we have interviewed are quite satisfied with the way logistics services in the China-Europe trades work, and it seems that the services provided are good and stable. This does not mean that they are without disruptions, but it seems that the LSPs are able to provide good backup solutions when problems occur with the standard arrangements. Some of the actors we have spoken to mention the bankruptcy of the Hanjin Line in 2006 as an example of a major disruption, which has made some retailing chains change their supply chain and sourcing strategies, by only dealing with actors with a solid financial position, and by maintaining at least two parallel agreements/supply chains to enhance resilience.

1.6.3 THE SEACONAZ CONCEPT MAY HAVE POTENTIAL FOR ENHANCING LOGISTICAL EFFICIENCY AND LOWERING CO2 EMISSIONS

Developing a cost model for comparing upstream buyer consolidation solutions to traditional LCL and FCL solutions has been a major element of the PhD project. Through this analysis it is quite clear that there could be substantial cost savings related to such a solution under certain circumstances. One example is provided in Figure 10. However, the cost saving potential would be dependent on several critical factors, e.g.

- The deep sea Asia-Europa container shipping rate levels
    - Low rates generally makes cargo consolidation activities less profitable, because the costs of consolidation is not offset by savings in the container rates

- Many actors would prefer to send half-full containers as FCL under such a regime. Several respondents have confirmed that this has been a typical attitude under the relatively low freight levels we have seen since the financial crisis
- Increasing rates would enhance the potential for SeaConAZ type solutions

- Exchange rates and relative wage rates
    - This concept moves activity from Europe to China. This has partially this has been motivated by lower wages in China
    - Growing wage rates in China, and/or less favorable exchange rates may jeopardize the potential savings of upstream buyer consolidation

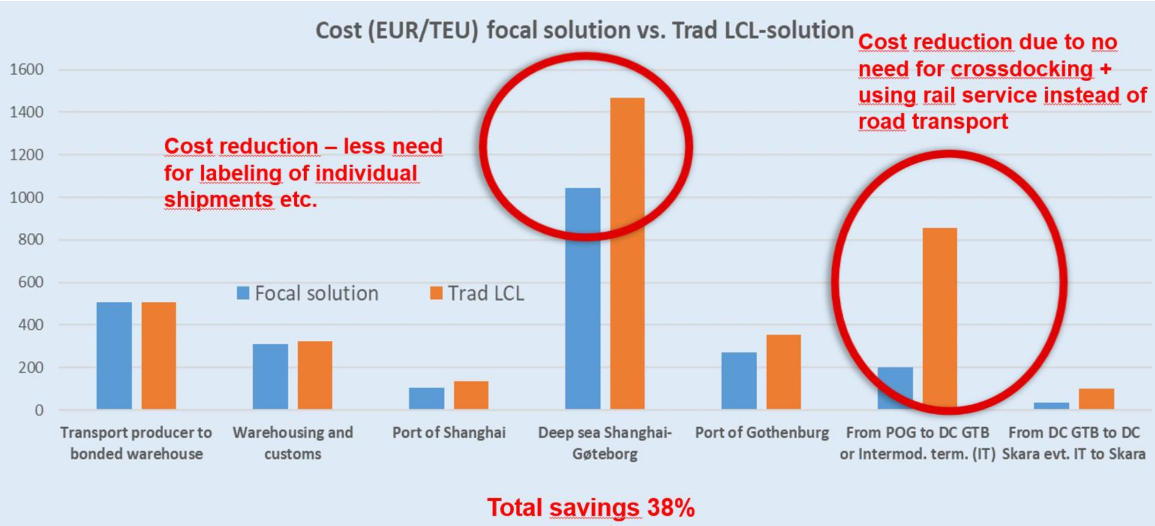

Figure 10 **Example of cost reductions with upstream buyer consolidation. Figures based on a case study from Ning Lin's PhD thesis (2019)**

The PhD project has also involved the development of models for detailed comparative analysis of the CO2-emissions under different supply chain designs. Whereas the cost-saving potential of upstream buyer consolidation solutions could be demonstrated through the cost models, the outcome of a comparative analysis for CO2-emissions is not quite clear. Generally, efficiency gains e.g. related to better capacity utilization would also mean lower CO2-emissions, but the fact that this concept involves moving logistics activities from Europe to China, also means that the typical electricity mix in these areas would play an important role. China has much more of its electricity produced from coal-fired power-plants and therefore the CO2-emissions related to electricity (needed for warehousing activities) would be higher under a SeaConAZ type of solution. This may or may not be offset by the fact that this solution facilitates more energy efficient transport solutions on the European side. In Figure 11 and Figure 12 two alternative variants of supply chains are presented, the latter with a maritime feedering solution, providing substantial reductions in emissions of CO2. The achieved utilization rate of containers may also be very critical for the outcome of comparative CO2-emissions.

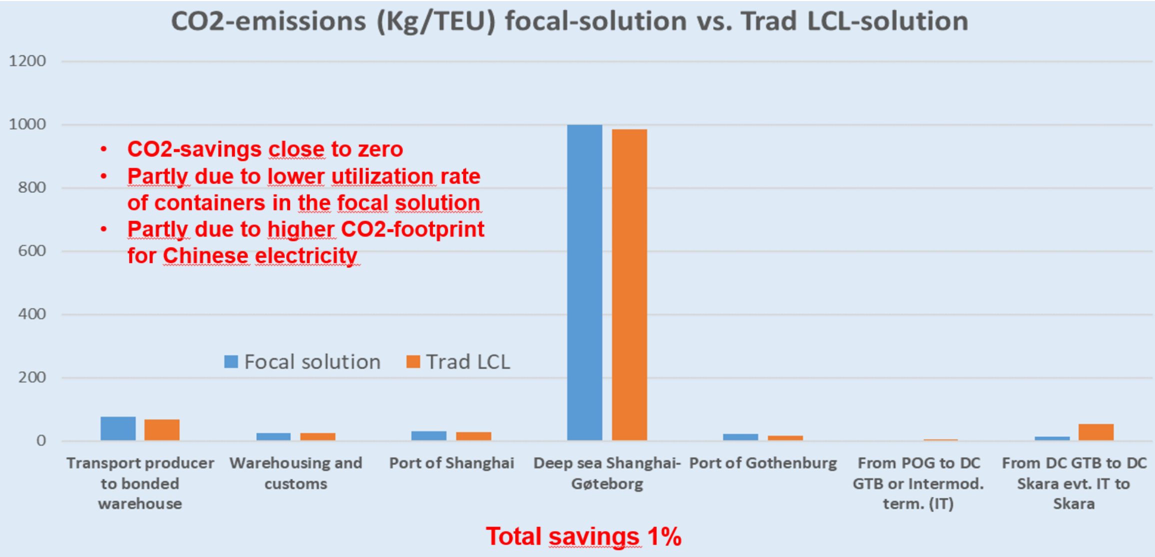

Figure 11 Example of CO2-account of upstream buyer consolidation. Figures based on a case study from Ning Lin's PhD thesis (2019).[4]

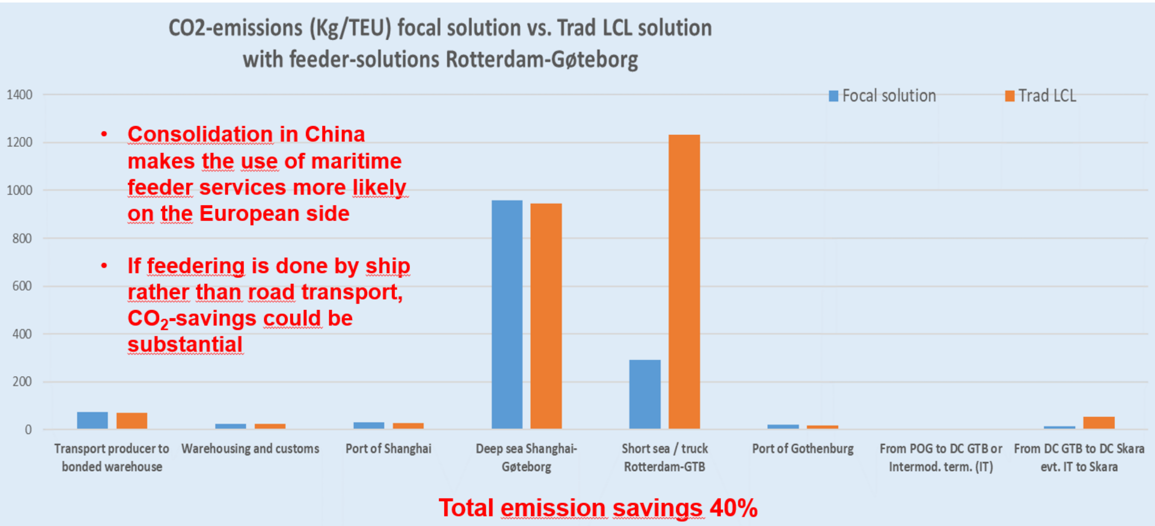

Figure 12 Example of CO2-account of upstream buyer consolidation. Figures based on a case study from Ning Lin's PhD thesis (2019), but with alternative feedering solution.

1.6.4 ADDITIONAL REFLECTIONS

We also wanted to explore the potential for policy actions that would help promoting SeaConAZ type of solutions. This was added into our interview guides, which means that both logistics actors and cargo owners were asked about this. None of the respondents had any suggestions in this respect.

[4] "Trad LCL-solution" means "Traditional less-than-containerload solution"

Some extra perspectives worth mentioning have occurred during our interviews:

- **Ireland and Brexit**
  - BREXIT may make SeaConAZ type of solutions more interesting to Irish actors – since relying on logistics-services in England becomes less favourable
  - The choice may be to do e.g .market adaptations and cross-docking in China or in continental hubs

- **Back-shoring of production from China to Europe**
  - We have asked actors if they are able to identify a trend related to back-shoring of production from China to Europe
  - Some respondents have given examples of such back-shoring taking place to East Europe
  - However, this does not seem to be mainly cost-motivated. The main motivation is shorter lead-times and the possibility of smaller order quantities (agility)
  - The back-shoring to Europe is not a major trend yet, but may be fueled by the Sino-US dispute on terms of trade and resulting protectionistic actions.

- **Will the growth of China-Europe rail services be a game-changer?**
  - The Chinese Belt-and-Road initiative / The new silk route has also been a focus area in our later interviews.
  - New railway services from China has been established, and transport volumes are growing fast.
  - It seems that these services are mainly an alternative to air transport, more than sea transport. Freight rates seem to be much closer to air fares than to sea fares. A typical use of these services is as a backup solution whenever a shipment misses the scheduled deep sea service from China to Europe. The rail service could then save 2-3 weeks compared to the sea service, and still be substantially cheaper than air alternatives.
  - The environmental friendliness of these services is questionable, partly due to the energy mix in affected areas of the train routes (especially the southern alternatives), and partly due to the fact that the last miles of the transport to peripheral regions in Europe is often done by truck. For China-Scandinavia trades using these new railway links, cargo may very well be cross-docked e.g. in Poland and brought to Sweden and Norway by truck. The attractiveness of using railways on this last leg may be better when the Fehmarn-link is finished. This would significantly improve the environmental performance of these services.

2 UPSTREAM BUYER CONSOLIDATION IN THE ASIA-EUROPE CONTAINER TRADES[5]

2.1 SUMMARY OF SECTION 2

The Asia-Europe container trade is the most important trade in the world in terms of volumes transported (overtaking the Trans-Pacific trade in 2014). The typical structure of the supply chains associated with this trade is that containers are stuffed in China and the cargo is subsequently cross-docked at a major European logistics hub or closer to the customer, for further shipment to the final retailing point. This may be one of the reasons why short sea container shipping has only a limited market share of intra-European cargo flows, since once cargo is unloaded from containers, it is more likely to be forwarded by land-based modes of transport. Paving the way for a greater proportion of cargo being cross-docked in China rather than Europe, may prove to be more cost-efficient and less environmentally damaging than the typical solution. This section discusses four main comparative differences between the typical solution and alternative solutions such as buyers' consolidation and concludes that new alternative solutions are worth investigating further. The potential shift from the typical solution to new alternatives is dependent on the identification of key decision makers in the design of these supply chains and a careful analysis of bottlenecks and impediments that must be overcome to facilitate this shift.

2.2 INTRODUCTION

Worldwide containerised trade in 2014 was estimated to have increased by 5.3% from 2013, and reached 171 million TEUs. More specifically, containerised trade volumes have increased by 7.5% and 6.3% in the Asia–Europe and transpacific head haul journeys respectively. The pursuit of less expensive sources of supply by European importers is the main driving force that has boosted the Asia-Europe trade, with an increasing number of European retailers having chosen to source from Asia. The higher growth rate in the Asia-Europe trade means that in 2014, at 22.4 million TEUs, it now exceeds the Trans-Pacific trade (22.2 million TEUs) in terms of volumes transported (UNCTAD, 2015).

Sea containers coming from China to Europe are typically stuffed at the location of the manufacturer in China. And the consignments are thereafter transshipped in logistics hubs in Europe. Reconsolidation according to the final destinations are typically conducted in logistics hubs in central Europe or consolidation centers in destination countries. This is what we label as the "business-as-usual" (BAU) solution. The problem is that these reconsolidated shipments are most often moved by road to their final destinations, even if sea transport could provide a less costly and better environmental solution. The BAU solution using road transport effectively contributes to more congested road networks at both higher logistics costs and societal cost than if these cargoes were transported by sea on maritime feeder links. Therefore, it is important to explore possible and preferable alternative solutions to the BAU setup.

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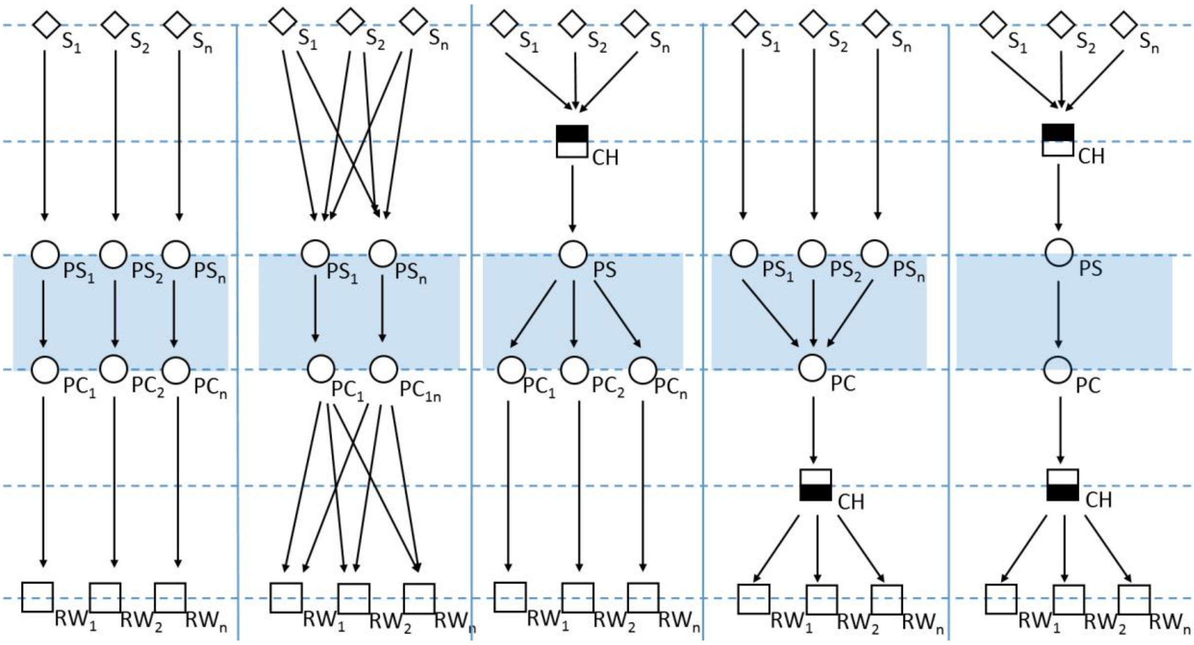
[5] This section is mainly based on Ning Lin, Harald Martin Hjelle, Kevin Cullinane, Olav Eidhammer, Rickard Bergqvist, Yuhong Wang, Zaili Yang, Zhuohua Qu (2016); *Upstream Buyer Consolidation and Downstream Short Sea Shipping in the Asia-Europe Sea Container Supply Chain An Exploratory Study*. Presented at IAME 2016 in Hamburg.

2.3 ASIA-EUROPE SEA CONTAINER SUPPLY CHAIN CONFIGURATIONS

In terms of global supply chain management, Cheong *et al*.(2007) considered a network design model by deciding the number and location of consolidation hubs to minimize the total logistics cost of international inbound logistics. Moreover, a number of researchers have proposed frameworks for supply chain strategy selection in relation to different aspects such as air-freight or sea-freight, centralised or decentralised inventory holding and lean and/or agile supply chains (Lovell et al., 2005, Martin et al., 2006).



Key:

S	Suppliers
CH	Consolidation Hub
PS	Ports in Suppliers' Countries
PC	Main Port in Customers' Countries
RW	Regional Warehouse
	Sea Transport

Solution (1) Solution (2) Solution (3) Solution (4) Solution (5)

Figure 13 Five Asia-Europe container supply chain solutions (adapted from Creazza *et al*., 2010)

On the basis of a literature review and interviews with logistics services providers (LSPs), Creazza *et al*. (2010) mapped five containerised sea-based supply chain configurations from Asian factories to European retailers. The framework proposed for the supply chain design and setup process was based on characteristics of the business environment relating to a pure cost perspective. These five configurations are as follows: (1) direct deliveries with FCL from individual suppliers to retailer's regional warehouses (RW); (2) direct deliveries with LCL from individual suppliers to retailer's RWs; (3) a one echelon supply chain with consolidation hub in the Far East; (4) a one echelon supply chain with consolidation hub in Europe; and (5) a two echelon supply chain with consolidation hubs in both the Far East and Europe – see Figure 13. All these configurations differ in terms of complexity, lead-time, risk of delay and cost structure. Supply chain lead-times tend to increase with an increasing number of transit nodes. That is to say, direct deliveries with FCL from suppliers to RWs (Solution 1) generally lead to the least complexity, risk of delay and shortest supply chain lead-times. However, it does not always imply the most cost-efficient supply chain solution (Zeng and Rossetti, 2003). In addition, pursuing economics of scale in transportation by means of reducing shipment frequency will definitely lead to an increase of inventory cost. However, the research conducted by Creazza *et al*. (2010) only considered supply chains from suppliers to retailer RWs, with an important segment of these Asia-Europe container supply chains being ignored – the final leg from RWs to retail stores. In addition, because of the typical location of RWs in Europe, road haulage is usually employed in the last segment of these supply chains, which is typically more environmentally damaging than short sea shipping (SSS) (Hjelle, 2014).

Bygballe *et al*. (2012) discussed the pros and cons of different Asia-Europe container supply chains. They described four supply chain configurations within the context of containerised sea-based supply chains from Chinese suppliers to Norwegian retailers, based on their working experience and observations on a focal company. The benefits and drawbacks of each configuration is discussed from both a logistics cost and a customer service perspective. This focal Norwegian retailer adopts four supply chain configurations according to different cargoes: (1) deliveries between individual producers and retail stores; (2) consolidation in the customer country; (3) consolidation in the supplier country; and (4) consolidation in both countries, which are similar to solutions (1), (4), (3) and (5) as mentioned earlier. Compared with the research conducted by Creazza *et al*. (2010), Bygballe *et al*. (2012) also takes the customer service issue into account. However, this does not imply that the latter applied a more holistic perspective than the former, as the latter only considered four supply chain configurations. The differences in dimensions and configurations make the findings of these two papers different to some extent. For instance, solution (5) in Creazza *et al*. (2010) is not cost-efficient under any circumstances when compared with other solutions. At the same time, Bygballe, *et al*. (2012) proposes that solution (4) is the most appropriate design for high-value products that are moved in lower volumes. Moreover, neither studies consider the possibility of adopting less environmentally damaging transport solutions after consignments arrive in Europe.

The research presented herein will explore new alternative supply chain solutions based on primary information collected from interviews with logistics service providers (LSPs) and cargo owners (COs) involved in the China-Europe trades. An important objective of the section is to analyse the pros and cons of different alternative container supply chain solutions.

2.3.1 THE POTENTIAL OF SHORT SEA SHIPPING

To different degrees, the alternative supply chain configurations discussed above may facilitate short sea shipping (SSS) for the European part of the supply chain. Since around 70% of industrial production in Europe is located within 150-200 kilometres of the sea, it has been argued that the geography of Europe should favour short sea shipping (SUÁREZ-ALEMÁN et al., 2013). In addition, SSS is broadly regarded as a less environmentally damaging (Vanherle, 2008, Hjelle and Fridell, 2012, Hjelle, 2014) and economically competitive (Delhaye et al., 2010) mode of transport, at least compared with road haulage. The main comparative drawbacks of SSS are typically that it has low frequency, weaker reliability and longer door-to-door transit time (EU-COMMISSION, 2002, Medda and Trujillo, 2010). These problems may not be insurmountable, however, and many researchers have proposed solutions that tackle these drawbacks (Button and Drexler, 2005, Notteboom, 2006, Vernimmen et al., 2007, Vanherle, 2008).

2.3.2 METHODOLOGY

In order to investigate the new alternatives to the BAU solution in terms of containerised sea-based supply chains from Chinese suppliers to European retailers, a series of 10 interviews with COs and LSPs were conducted in the UK, Netherlands, Norway, Sweden and China. All informants are at management level and involved in the cargo flows from Asia to Europe. All interviews were conducted according to a semi-structured interview guide based on the literature review and the main research questions. This guide was developed in English. However, interviews were conducted in the native language of the respondents (English, Dutch, Norwegian, Swedish and Chinese). After each interview, the interviewer took responsibility for transcribing and later translating the transcripts into English. For reasons of commercial confidentiality, the names of the respondents and focal companies have been anonymized. However, the roles and background of respondents and the relevant business of these focal companies are described in the final transcripts. All interviews have been conducted in the following manner:

- All interviews are made with audio recording, and conducted according to a common interview guide
- Interviews were made in the native language of the respondent
- Transcripts of the interviews were made, based on the audio recordings
- All transcripts were e-mailed to the informants for verification and corrections
- After the final version of the transcript is agreed upon by the interviewer and the respondent, the audio-file was deleted
- The quality-checked transcribed interview was then translated into English
- All interviews were made face-to-face or via telephone/video-link
- The duration of the interviews was between 20 and 50 minutes
- Interviews were conducted between November 2015 and January 2016

2.3.3 PRESENTING DATA

Based on these exploratory interviews, the authors identify five different Asia-Europe containerised sea-based supply chain solutions currently in use, including one BAU solution and four alternative supply chain solutions that serve to illustrate the principle of upstream consolidation. The Concept BAU (Section 4.1) and Concept C (Section 4.5) are similar to solution (4) and solution (5) in Figure 13 respectively, although previous literature did not clearly mention which transport mode(s) (sea, rail or road) is/are adopted within the European leg. Other solutions (Concept A1, A2 and B) are to be considered new findings/concepts.

2.3.4 CONCEPT BAU: CONSOLIDATION IN CUSTOMER COUNTRY

Company A is a Norwegian textile retail chain offering a large variety of curtains, bed sets and other useful interior products for the home. It has more than 130 wholly-owned stores across the country. They typically ask LSPs to transport FCL shipments (40 feet containers) from China to Norway which have not been opened in other places in Europe. After containers arrive at their main warehouse in Norway, it is cross-docked for final shipment. Cargo is distributed by PostNord via road transport during this final leg. This is represented by supply chain a) in Figure 14.

2.3.5 CONCEPT A1: UPSTREAM CONSOLIDATION FOR ONE BUYER

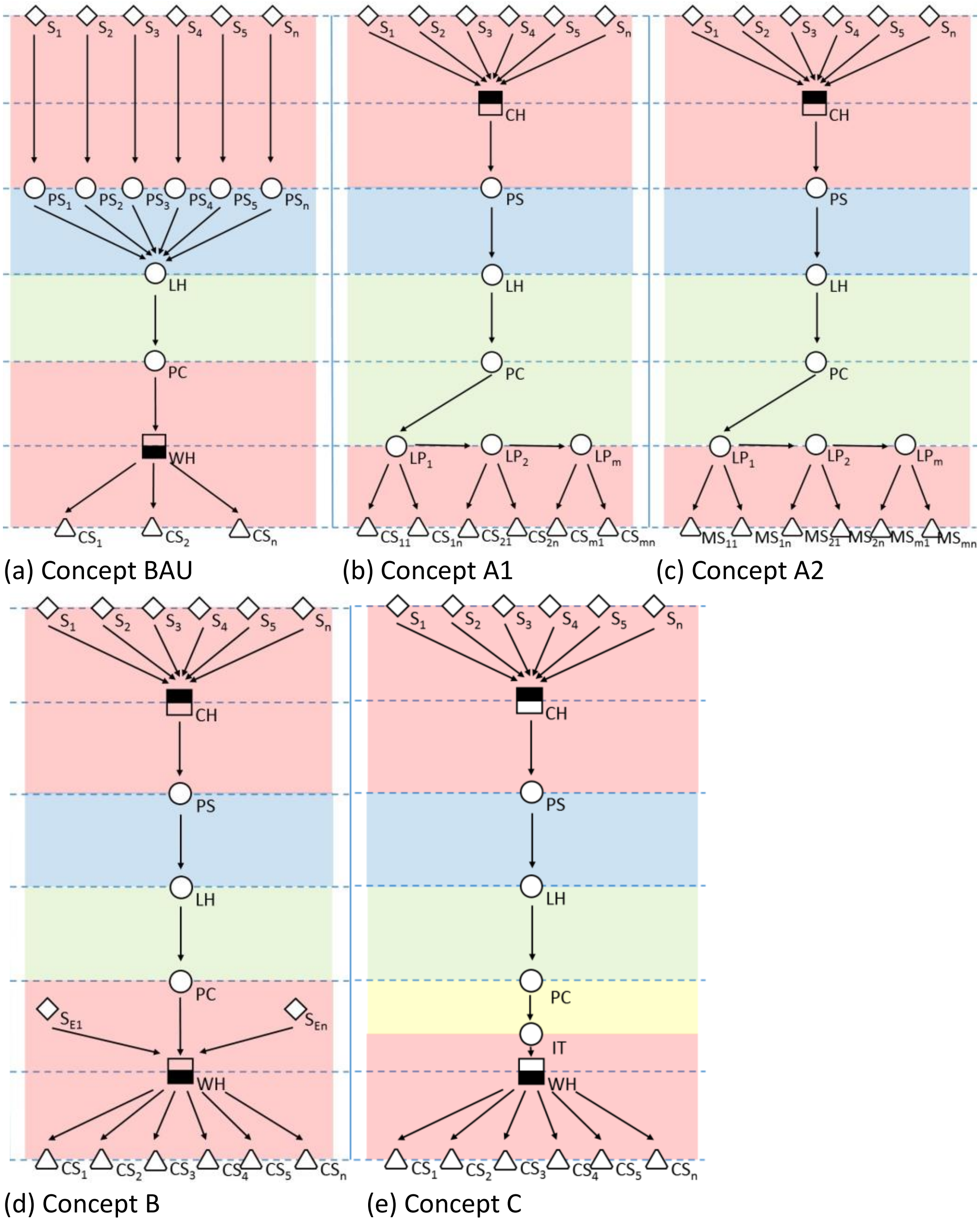
Company B is a Norwegian no-frills supermarket with cut-price articles sold in approximately 200 shops located all over Norway. They are cross-docking products from different plants in Shanghai and Ningbo in China. Load carrying units from China to Norway are 40 feet containers loaded with palletized products for the shops. Each loaded pallet is dedicated for a certain shop. Without having been split elsewhere in Europe, after arriving at the Port of Borg in Norway, containers are transported by NorLines along the coast to the nearest port for each store. Therefore, this solution dramatically decreases road travel distance to the shops compared with the BAU solution. This respondent also mentioned that there are certain LSPs, including Greencarrier and ColliCare, that have been offering upstream buyer consolidation in China for many years in Shenzhen, Shanghai and Hong Kong. Moreover, this business enables them to obtain increasing volumes and establish new offices in the Far East for offering these services. This is represented by supply chain b) in Figure 14.

2.3.6 CONCEPT A2: UPSTREAM CONSOLIDATION FOR A GROUP OF BUYERS

Company C is an LSP headquartered in Norway and have their own warehouses, distribution centers, and trailers in Norway and Sweden. They also have buyer consolidation in China. Their containers are normally transported by Maersk or Hanjin. After arriving at Rotterdam, containers are transshipped at Hogezoom onto short sea ships operated either by Unifeeder or themselves for final destinations in Norway. These short sea ships either go directly via a milk run route to 3 or 4 customers where the goods are delivered, or it goes to their warehouse in the Oslo area, from where they distribute all over Norway. In addition, one shopping mall contains a large number of stores. Company C can arrange all deliveries for a shopping mall under one contract. After containers arrive at a mall, their employees can unpack and label goods in this mall and place them in stores. This is represented by supply chain c) in Figure 14.

2.3.7 CONCEPT B: UPSTREAM AND DOWNSTREAM BUYER CONSOLIDATION

This supply chain solution also includes consolidation with European suppliers. Before transport to Norway the products are consolidated in China. At the warehouse in Norway the products from China will be consolidated with other products from Europe or Norway before being distributed to shops. This is represented by supply chain d) in Figure 14.



Key:

S	Suppliers
S_E	European Suppliers
CH	Consolidation Hub
PS	Ports in Suppliers' Countries
LH	Logistics Hub in Europe
PC	Main Port in Customers' Countries
IT	Intermodal Terminal
WH	Buyers' Warehouse
LP	Local Ports
CS	Stores Belonging to The Same Chain
MS	Different Stores in One Shopping Mall
	Road Transport
	Intercontinental Deep Sea Transport
	Short Sea Transport
	Rail Transport

Figure 14 Asian-Europe sea container supply chain solutions

2.3.8 UPSTREAM AND DOWNSTREAM BUYER CONSOLIDATION WITH HYBRID SOLUTION IN EUROPE

Company D offers all kinds of professional and DIY projects in Norway, Sweden and Poland at competitive prices. DB Schenker has been a long-term partner of this focal company since the beginning of the 1990s and helps them to consolidate in China according to buyer requirements. In the European leg of this supply chain, the Port of Gothenburg is the container unloading port. Company D has one central warehouse / DC which is located in Skara, Sweden that serves all markets, including Norway, Sweden and Poland. From the Port of Gothenburg the company uses a daily rail-based intermodal solution to a dryport located in Falköping, about 25km from the central warehouse. The rail-based intermodal solution enables cost-efficient and less environmentally damaging transport and higher service quality through the use of the dry port in Falköping as a buffer for full containers and as a depot for empty containers (Monios and Bergqvist, 2015). The final distribution from the central warehouse to the company's stores is made by road. However, the company is currently investigating the possible future use of rail-based intermodal solutions for stores in northern Sweden and Norway. This is represented by supply chain e) in Figure 14.

2.4 DISCUSSION

Based on the sea container supply chain configurations proposed by Creazza *et al*. (2010) and Bygballe *et al*. (2012), and the outcomes from exploratory interviews illustrated in Section 4, alternative solutions that are characterized by upstream buyer consolidation and downstream short sea shipping can be reviewed. In this section, the pros and cons of these solutions are discussed, the key potential decision-makers behind a shift from the BAU solution to new alternatives can be identified and the impediments that could challenge such a shift of supply chain design and setup can be explored.

2.4.1 STRENGTHS AND WEAKNESSES OF THE IDENTIFIED SUPPLY CHAIN DESIGNS

Most of the respondents confirm that the BAU solution is the prevailing supply chain organization in the market. One of the respondents, however, reports that there is already a substantial amount of cargo that is consolidated in China, based on customer preferences, and afterwards shipped to Rotterdam for distribution. This respondent perceives that there are many competitors when he offers the Concept A1 solution to his customers in the Netherlands. Concept A2 is the least frequently used for the reason that stores are not willing to share sensitive information with external parties, especially other stores located in the same shopping mall, who might be their competitors. In addition, the potentially higher risk of disturbances with cargo of other stores and the fact that stores needs to decide on order much earlier are also the impediments of the implementation of the Concept A2. Therefore, only a handful of companies agree to consolidate together. The widespread use of the BAU solution shows that it should have certain advantages. In what follows, the comparative advantages and disadvantages of Concept BAU are assessed vis a vis upstream buyer consolidation or short sea shipping.

Responsiveness. Sending cargoes from local distribution centers in Europe may reduce lead-times compared with sending cargoes from the Far East every time (taking at least 21 days from China to the UK). Accordingly, higher responsiveness and agility is achieved by the BAU solution because of its ability to meet changes in customer demand.

Lead-time. Road transportation is normally faster than short sea shipping. One of our respondents points out that if ships leave Rotterdam on a Friday, they will arrive in the south of Norway on Sunday. Cargo can then be delivered on Monday for customers located in the south of Norway, in 2-3 days for the middle part of Norway (Bergen and Ålesund) and in 4-5 days for customers in the extreme north. At the same time, the lead-time for SSS is around 6-7 days for the extreme north part of Norway, though waterborne transport is only 50% of the cost of road transport.

Punctuality. Ship delivery times are not as precise as those of trucks. One respondent suggested that some clients, like Nike, are very strict in terms of time constraints. They request products to be delivered at shops by 10:00 am. For this reason, his company has taken the decision to use road transport.

Simplicity. Trucks can easily deliver a door-to-door service. Road-based transportation has better hinterland access than its water-based counterpart. If LSPs shift from the BAU solution to any of the alternatives, they still need trucks to deliver cargo from a local port to destinations (stores). In addition, more connection nodes means greater possibilities for delay.
By contrast, alternative solutions also have certain comparative advantages. The following are the advantages associated with combining upstream buyer consolidation and short sea shipping.

Logistics cost. Due to the consolidation of freight in Asia, the transportation of the cargo from the consolidation center in Asia to the final destinations has huge potential for economics of scale (Bygballe et al., 2012). In addition, transporting containers in Europe by short sea shipping is normally cheaper than trucks (Delhaye et al., 2010).

Inventory cost. Inventory cost can be considerably lower in the Far East, mainly because of the lower costs of labor and warehousing. By arranging consolidation in Asia, COs and LSPs can position the most intensive logistics work where the labor cost is the cheapest.

Environment. Making a shift from road to short sea shipping in Europe is a major characteristic of Concept A1 and A2. Many researchers have made comparisons between short sea shipping (SSS) and road transport in terms of CO_2e emissions per metric ton-kilometer. Generally speaking, the former performs better (Hjelle and Fridell, 2012, Hjelle, 2014). The emissions of SSS causes less local impact than road transportation unless inland waterways are located in the middle of cities or fairways lie close to the coast (Hjelle, 2014). In addition, the new legislation, SECA Directive 2012/33/EU (EU-COMMISSION, 2010), was published in 17 November 2012, amending Council Directive 1999/32/EC about the sulphur content of marine fuels. That is to say, SSS performance in terms of sulphur emissions should have improved since 1 January 2015 in the North Sea, the Baltic Sea and the English Channel (cf. Cullinane and Bergqvist, 2014).

Respondents describe several cases where their customers focus on the environmental aspect when designing their supply chains. A paper manufacturer is one of them. All their transport from Hogezoom and Hayen (Netherlands) to Norway and Sweden originally went by road. They reorganized their production to fit their pallets to containers. These changes required some investment, but they have won this investment back within a short period because this "greener" transport is also cheaper. SSS has thus created a "win-win" situation, both for the operator and for the environment. Toyota also considers environmental performance in their distribution chains. Spare parts for the Norwegian market are supplied from Brussels. Earlier they utilized 12-

15 trailers every week, driving 1500 kilometers one way to Norway. Now these cargoes are shipped by sea in 45 feet containers. The same goes for IKEA who also focus on environmental performance, as they prefer to send their cargoes for the Norwegian market by sea; directly from Baltic producers to their Norwegian warehouses.

Security wait time. For security reasons, the EU needs to screen containers coming into the EU. That is to say, containers delivered to Norway from Asia adopting the BAU solution, with a consolidation center near a logistics hub, might be screened twice: once in the central European logistics hub and once in Norway. However, containers coming to Norway under the alternative solutions will be screened only once, in Norway, because containers move through the logistics hub under the "in transit" regime, thereby reducing the total security screening time. In addition, the upcoming regulations by IMO (2014) about weight verification will become legally binding on 1 July 2016. Given that, weights need to be verified at or near point of departure, consolidation in Europe means weight verification should be conducted again in Europe, as it could become a combined activity or service of consolidation. Therefore, upstream buyer consolidation has advantages in both cost and time saving in this aspect.

Upstream buyer consolidation and downstream short sea shipping are two main characteristics of the alternative solutions. On the one hand, SSS may have an advantage in terms of environmental sustainability and cost saving. The slightly increased transit time associated with the leg from logistics hub in Europe to final destination can be compensated for by more advanced planning systems. Making a shift from road to sea is feasible and can lead to a "win-win" situation, both for cargo owners and for the environment. This has been attested to by some of the early movers.

On the other hand, upstream buyer consolidation also brings other benefits. As discussed above, to shift consolidation center from Europe to China may reduce logistics cost and inventory cost. If there is no inventory kept in Europe under this scenario, however, such a shift may have a negative impact on customer service. Therefore, cargo owners should balance the tradeoff between cost and customer service level. It is also possible to adopt a hybrid solution. Different products may require different supply chain configurations with different responsiveness. For products with stable demand and limited customization, upstream buyer consolidation may provide a suitable solution. More specifically, according to Creazza *et al*. (2010) and Bygballe *et al*. (2012), upstream buyer consolidation suits products with the following characteristics: (1) high overall annual demand, (2) low annual average demand between a supplier and a store, (3) medium value products, (4) low supplier dispersion, (5) high labor cost differential between supplier country and customer country.

2.4.2 WHO IS THE DECISION MAKER?

Based on the discussion above, new alternative solutions with upstream buyer consolidation and downstream short sea shipping may have many advantages including cost efficiency and lower environmental impact. A potential redesign of supply chains could therefore be desirable. Identifying the key decision-makers in the design of such supply chains is therefore of interest. According to our findings, decision makers can be different in various cases.

The specific Incoterms which are applied in each trade plays an important role in the determination of the central decision-maker. For instance, under EXW, European buyers have full control of this supply chain. By contrast, Asian sellers are responsible for designing the Asian-

Europe supply chain when the DDP Incoterm is used. Certain professional cargo owners with good supply chain management knowledge and competence seem to choose to take care of the design by themselves. In this situation, the cargo owner (buyer or supplier) is the decision-maker. However, sometimes, cargo-owners choose to outsource their logistics operations and the actual design of the supply chain. In this case, the LSPs make the decisions. However, it is not common that they do this all on their own. Typically, LSPs propose solutions to cargo owners, who ultimately make the final decision.

2.4.3 IMPEDIMENTS TO UPSTREAM BUYER CONSOLIDATION

According to the experience of respondents, the process of making a shift from the BAU solution to these new alternative supply chain solutions may face several impediments. The most prominent reported impediments are:

- **Unwillingness of sharing data.** In terms of Concept A2, the biggest challenge is that stores need to share information with external parties. Revealing traded quantities, especially with direct competitors within the same shopping center ,may prove an impediment to the realisation of such a concept.
- **Vested interests.** Some powerful vested interests might oppose the change from the BAU solution to these alternatives. They may be European consolidation hubs / distribution centers and large truck companies. More specifically, if consolidation hubs are relocated in China and local distribution shifts from road to sea, the profitability of European companies may be undermined by these alternative supply chain solutions.
- **Lack of awareness.** LSP respondents complained that one difficulty is to get into a dialogue with their customers. Normally, the first thing their customers will consider is the ocean freight rate. However, this rate is only a small part of the overall picture. They do not always see the benefit of shifting consolidation center from Europe to China. Customers are also reluctant to share information about the full costs of the whole supply chain.
- **Longstanding working habits.** Some European retailers want to do the local distribution themselves, because they think it is better for them to have more control over the consolidation center. They are used to having the consolidation center in Europe instead of at the other side of the world, where they may have more limited control.
- **Knowing too little about medium and small cities in Europe.** One respondent explained that, taking Norway as an example, when shippers from China type in "Norway" in their system they only see Oslo. Therefore, everything goes to Oslo, even if the cargo needs to arrive in Trondheim. The only destination available in the system is "Oslo". That is where containers will be unloaded from ships. Thus, these containers are more likely to go by road during the final leg.

2.5 CONCLUDING REMARKS AND IMPLICATIONS

In this section we have mapped the most typical Asia-Europe containerised sea-based supply chain solutions (the BAU solution) against identified alternative solutions based on a literature review and interviews with mid and high-level managers in COs and LSPs involved in the cargo flows from Asia to Europe. Based on these findings, certain main comparative advantages of these solutions are discussed. Based on this exploratory study, it is concluded that new alternative solutions are worthy of further investigation, mainly due to the potential for gains in cost-efficiency and lower environmental impacts. The added complexity may be addressed by the support of more sophisticated information systems. Potentially lower customer service can also be avoided. The shift from the BAU solution needs to be initiated by key decision makers. The potential change-makers may be different actors according to which Incoterms are applied, and to what extent actors have outsourced their logistics services. A number of impediments have also been identified that need to be overcome in order to facilitate such a shift towards upstream consolidation solutions.

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3 EUROPEAN HUB ANALYSIS PART 1[6]

3.1 SUMMARY EUROPEAN HUB ANALYSIS PART 1

The focus of the project is on exploring the potential of a system changing approach, where the point of cross-docking and consolidation of less-than full containers consignments (LCL) into full container load (FCL) for retailing points is moved from Europe to China.

This section provides an analysis of the role of the European hubs in the feeder market China to North-Europe, exemplified by the role of the Port of Rotterdam.

The results show that almost all cargo going from China to North-Europe is cross-docked or deconsolidated and consolidated in a European hub. For Norway, Rotterdam is the most important hub in North-West Europe, because of its connectivity, the mature applicability of fiscal features such as fiscal representation and VAT reverse charge, and the complementarity of being also a powerful short sea hub. Almost all containerized cargo going from China via Rotterdam to Norway is going by maritime feeder links to the final destination. This might be different for alternative hubs located closer to the final destination, such as Gothenburg or Hamburg.

The analysis also identifies a number of developments which are important to acknowledge. The first development is the shift in the feeder market. Dedicated feedering – feeder services being operated by the deep sea ocean carrier – is increasingly growing relative to common feeder operators without a substantial equity interest of ocean carriers. As a result, the common feeder operators are shifting their focus towards more short sea shipping and integration of services for deep sea and shortsea container shipments.

The second development is the shift in shipping from consolidating smaller shipments (less-than container loads or LCL) towards ordering full container loads (FCL). Some Chinese factories simply enforce ordering full container loads. Moreover, the low sea rates in ocean transport make it more attractive for shippers to pay for a full container load and avoid consolidation processes, even if the container is not completely filled.

The third development is the link between chain ownership and the choice of Incoterms. Either the buyer wants more control and chooses for EXW (Ex-works) or FCA (Free Carrier) conditions, whereas EXW does hardly happen in Chinese imports because of the lack of transparency in the organization of the hinterland transport in China. Or, the buyer lets the seller organize the end-to-end transport and DDP terms (Delivered Duty Paid) are chosen. Also in fast growing ecommerce fulfilment, DDP is becoming the standard.

[6] This section is based on a restricted project report written by TNO. Information that could be linked to the informants is deleted or re-written in an anonymized form. The data collection for this analysis was conducted in 2016.

3.2 INTRODUCTION

3.2.1 BACKGROUND

The volume of sea containers going from Asia to Europe is the most important trade in the world (UNCTAD, 2015). Sea containers associated with this trade are typically stuffed in China and thereafter transshipped in logistics hubs in North-West Europe with a retailing point as the final destination. Reconsolidation of shipments takes place in these hubs or in consolidation centers in destination countries. Business-as-usual (BAU) is the name of this solution. The problem is that these reconsolidated shipments are most often moved to their final destinations by road, even if sea transport could provide a less costly and better environmental solution (Lin, et al., 2016). Only a limited part of the supply chain uses intermodal containers suited for sea transport (SeaConAZ, 2014). Once the cargo is unloaded from containers, it is more likely to be forwarded by land-based modes of transport. This may be one of the reasons why short sea container shipping has only a limited market share of intra-European cargo flows. Paving the way for a greater proportion of cargo being cross-docked in China rather than Europe, may prove to be more cost-efficient and less environmentally damaging than the typical solution (Lin, et al., 2016).

If the typical organization of container supply chains from China to Norway could be changed into intermodal containers destined for one or a small set of geographically close retailers on the European side (Eidhammer, Hovi, & Askildsen, 2012), emissions from freight transport and logistics costs for Norwegian retailers could be reduced (Lin, et al., 2016). This would also strengthen the competitive position of maritime service providers (SeaConAZ, 2014). This is the SeaConAZ concept. It eliminates the need for splitting the container when it arrives at the European logistics hub, and it enhances the competitiveness of container feeder operations versus land-based modes. The key issue is to explore what it would take to make more sea containers go all the way from China to Norwegian retailers, with references to similar structures pertaining to Swedish and UK markets (SeaConAZ, 2014).

3.2.2 RESEARCH QUESTIONS

This research explores the potential of a system changing approach, where the point of cross-docking and consolidation of less-than full container consignments (LCL) into full container loads (FCL) for retailing points is moved from Europe to China (SeaConAZ, 2014). TNO is one of the partners of this research and focuses on the European hubs. The far majority of containerized trade going from China to Norway is transshipped in a European hub, which means that the European hubs are an important part in the supply chain. Research questions considered in the European hub analysis are:

1. To what extent are intercontinental containers with cargo destined for Swedish, UK/Irish and Norwegian retailers forwarded from the European hub-port by maritime feeder links today?
2. Where are the containers with cargo destined for Swedish, UK/Irish and Norwegian retailers stripped and cross-docked today?
3. To what extent is such cargo, after cross-docking in Europe, forwarded through maritime transport alternatives?
4. Could the degree of dominance of the BAU-solution be linked to the Incoterms applied in relevant markets?

5. Could trends with respect to the typical Incoterms applied in these trades be identified?

These research questions need different methodological approaches. In the next section this will be discussed.

3.2.3 METHODOLOGY FOR THE HUB ANALYSIS

In order to answer the research questions mentioned above, the methodology for the hub analysis will be explained. Most of the general questions are of an explorative nature. The key challenge is to learn enough about the way the relevant supply chains operate, who the key actors are, and how the actual design of the supply chain comes about. Many of the outcomes would therefore be of a qualitative nature (SeaConAZ, 2014), but quantitative analysis will play an important role in answering some of the questions. The more qualitative questions will be answered through research interviews with central actors. Interviewees will be recruited among actors in the relevant logistics industries and among shippers (SeaConAZ, 2014).

For this research, existing literature is used too to validate and compliment the information from the interviews. A number of interviews with central actors have been conducted, mainly with Dutch or international LSPs. Their identity is not revealed in this report, they will appear under names like “LSP-NL1”. The Port of Rotterdam and the Customs Administration of The Netherlands has also provided data. The desk research and the interviews are the starting point for this research.

Based on the interviews and desk research, seven different trade-lane configurations have been constructed to model consolidation and deconsolidation of shipments throughout the tradelane China-Norway. Trends and findings from interviews have an impact on the use and applicability of each of the seven configurations.

The research has some limitations. The first limitation is that the hub analysis is only done for Rotterdam and not for other hubs such as Hamburg or Gothenburg. The second limitation is that the focus is on the operations within the hub of Rotterdam. Knowledge about consolidation in China is missing. Furthermore, a note has to be made about the low sea shipping rates at the moment.

3.3 FEEDER MARKET CHINA TO NORTH-EUROPE

This chapter describes the feeder market China to North-Europe. Firstly, the market characteristics are discussed. Subsequently, the dominant trade-lane configurations in this market and the commonly used Incoterms are reviewed. Finally, a comparison between feedering and short sea shipping is made for this market.

3.3.1 MARKET CHARACTERISTICS

A large amount of goods are imported by Norway and stuffed into containers. The value of all these imports was $ 89,169,976,778 in 2014, which covers 380,000 TEU (The World Bank Group, 2014). 33.6% of these imports is coming from Sweden, Germany or China – see figure 1 (Global Edge, 2014).

Top 10 Import Partners	Import Volume ($)
Sweden	$10,960,217,816
Germany	$10,569,280,616
China	$8,448,964,287
United Kingdom	$5,767,594,472
United States	$5,533,601,086
Denmark	$5,447,081,573
Netherlands	$3,318,785,806
France	$3,073,537,533
Poland	$2,879,239,986
Italy	$2,731,716,810

Percentage Distribution

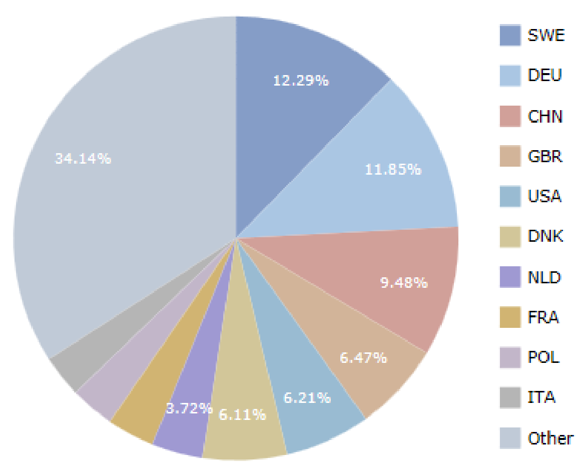

Figure 15 **Top 10 import partners of Norway (Source: Adapted from Global Edge 2014)**

If only the imports from intercontinental regions (in total 220,493 TEU) are taken into account, 103,018 TEU, which is 47% of the intercontinental imports, came from China in 2015 (Seabury, 2016). Due to the fact that the focus of this research is on containerized consumer goods with an origin in China, it is interesting to know how these goods will be transported to Norway and what the supply chain looks like.

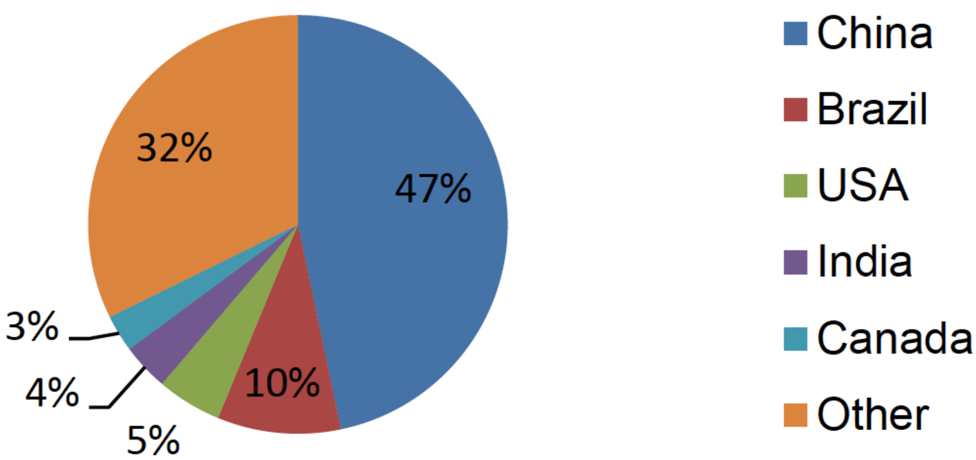

Figure 16 **Norwegian non-European trade partners of containerized cargo, imports (Seabury, 2016)**

For the transport of containers from China to Norway different modes could be used (Port of Rotterdam, 2015; Vries, 2016; Duursma, 2016). No direct sea services are available between China and Norway, which means that there is a stop in between. In most cases this stop is in North-West Europe, where the major part of the containers is cross-docked. Containers going from China to a hub in North-West Europe are part of the deep sea legs from the ocean carriers. From North-West Europe to for example Norway, the containers are transported with feeder services, via short sea shipping or by road. Due to the hub and spoke system, complex configurations occur. In figure 3 the most important transshipment ports in North-West Europe are depicted. These hubs are all part of the schedules of ocean carriers from China to North-West Europe.

Figure 17 **Container hubs in North-West Europe**
(1=Southampton, 2=Felixstowe, 3=Antwerp, 4=Rotterdam, 5=Bremerhaven, 6=Hamburg, 7=Gothenburg)
(Source: Portopia 2014, amended by TNO)

Within the feeder market two business models exist; dedicated feedering and common feedering. Dedicated feedering is basically an extension of deep sea liners, operated by the ocean carrier. In common feedering, the service is operated by an operator without a substantial equity interest of ocean carriers, who is specialized in organizing feeder transport. The trend in 2015 has been that overseas lines increasingly handle their own feeder transport. This implies that deep sea operators, such as Maersk, Hapag Lloyd, MSC, etc., want to have more control (Zomer & Rijn, 2016a; Shortsea Shipping Norway, 2016; Zomer & Rijn, 2016d). As a result, deep sea operators established new feeder routes in 2015, meaning that dedicated feedering becomes more important for China-Norway containerized imports. This has resulted in an increase in shipping capacity to Norway and affected the feeder volumes of the common feeder operators, such as FO-

NL1[7]. As a result, the common feeder operators increasingly concentrate on European cargo (Shortsea Shipping Norway, 2016). Due to the changes in the feeder and short sea market, there are opportunities for common feeder operators to combine transshipment containers with short sea continental containers. According to LSP-NL4, combining deep sea containers with short sea containers already occurs. FO-NL1, as a common feeder operator, focuses more and more on short sea containers, because of the increasing part of dedicated feedering. Before, FO-NL1 volume was composed of 90% feeder containers and 10% short sea containers. Now the proportions are different; 65% feeder and 35% short sea (Zomer & Rijn, 2016e; Zomer & Rijn, 2016c). This implies that FO-NL1 has changed their operations due to the increased importance of short sea containers on their services.

An important characteristic of the Norwegian incoming and outgoing flows is the imbalance. The amount of TEU exported from Norway to all continents except Europe is 141,619 TEU. For the import this amount is 220,493 TEU. A lot of reefers are needed in Norway to export their goods. 29% of all the goods exported from Norway to other continents than Europe, are fish related products (Zomer & Rijn, 2016c). This imbalance creates opportunities for operators with a good repositioning strategy. They have a competitive edge (Zomer & Rijn, 2016c).

3.3.2 DOMINANT TRADELANE CONFIGURATIONS

Creazza, Dallari & Melacini (2010) mapped five containerized sea-based supply chain configurations from Asian factories to European retailers, which are adopted and extended by Lin et al. (2016). The five configurations of Creazza, Dalari & Melacini (2010) are as follows: (1) direct deliveries with FCL from individual suppliers to retailer's regional warehouses (RW); (2) direct deliveries with LCL from individual suppliers to retailer's RWs; (3) a one echelon supply chain with consolidation hub in the Far East; (4) a one echelon supply chain with consolidation hub in Europe; and (5) a two echelon supply chain with consolidation hubs in both the Far East and Europe.

[7] FO-NL1 is a feeder operator.

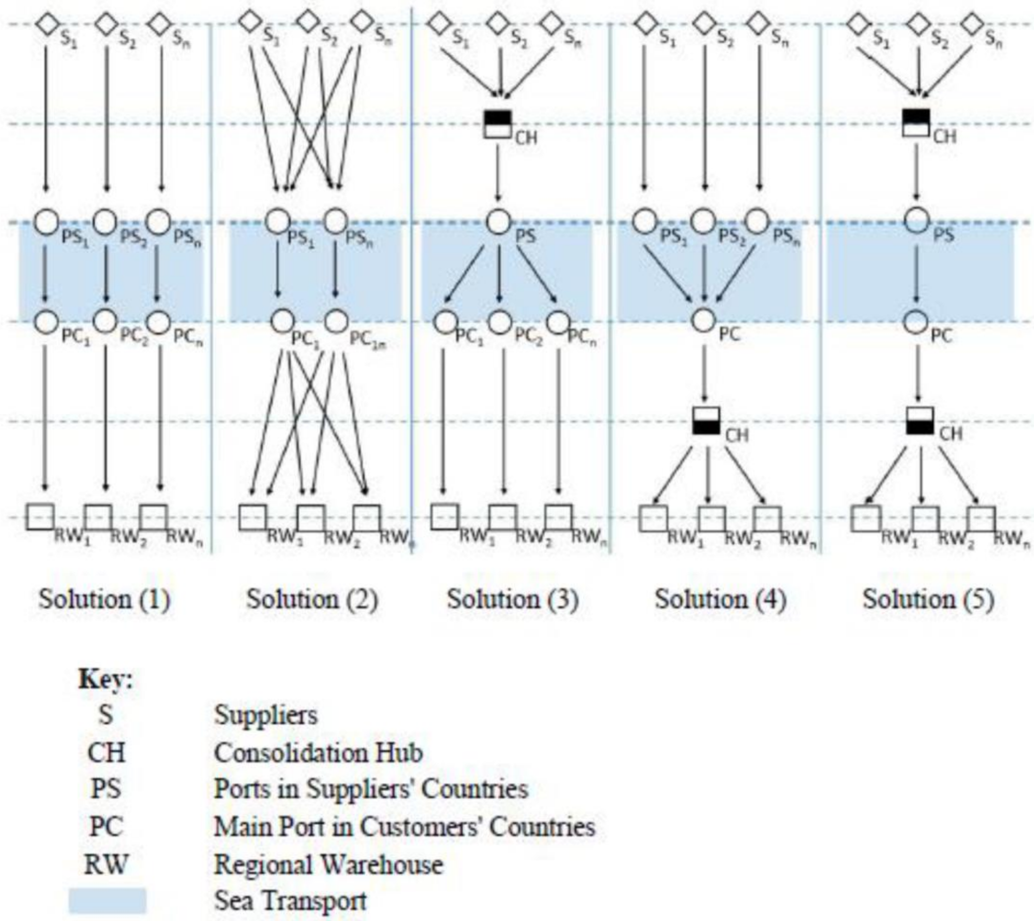

Figure 18 **Five Asia-Europe container supply chain solutions (Creazza et al. 2010)**

The research conducted by Creazza et al. (2010) only considered supply chains from suppliers to retailers RWs, ignoring the final leg from RWs to retail stores. In addition, because of the typical location of RWs in Europe, road haulage is usually employed in the last segment of these supply chains, which is more environmentally damaging than short sea shipping (SSS) (Hjelle, 2014). In order to analyse the European hubs, the perspective of the transshipment hub in hub-spoke networks is missing. Therefore, Lin et al. (2016) adopted and extended these five containerized sea-based supply chain configurations.

According to Lin et al. (2016), concept (a) and (b) are similar to solution (4) and solution (5) in figure 4 respectively. Concept (c), (d), and (e) are to be considered as new findings/concepts. The Asian-Europe sea container supply chain solutions of Lin et al. (2016) are as follows: (a) consolidation in customer country; (b) upstream consolidation for one buyer; (c) upstream consolidation for a group of buyers; (d) upstream and downstream buyer consolidation; and (e) upstream and downstream buyer consolidation with hybrid solution in Europe.
The supply chain configurations mentioned above are taken from the perspective of a retailer's individual supply chain design, and focus on FCL-shipments. But, it is also possible that the main hubs will be used to deconsolidate several containers with shipments from several suppliers (allowing for efficient building of LCL-shipments with destination Rotterdam, Hamburg, Bremerhaven, Southampton, Felixstowe, Gothenburg or Antwerp and reconsolidate 'Norwegian' shipments in for example 45 ft. containers). An overview of the different possible configurations,

taken from the perspective of the trans-shipment hub in hub-spoke networks, is depicted in Figure 20.

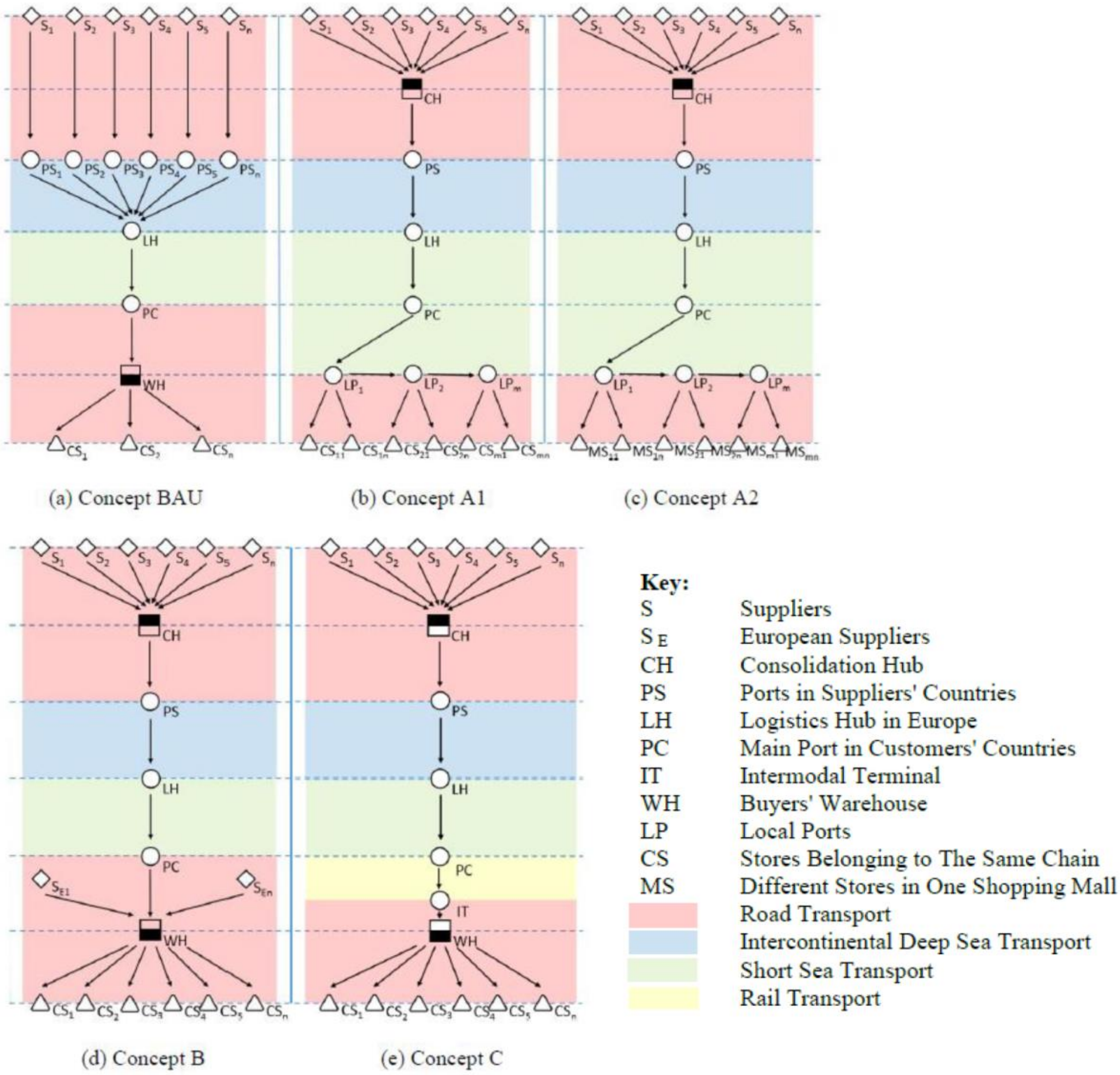

Figure 19 **Asian-Europe sea container supply chain solutions (Lin et al. 2016)**

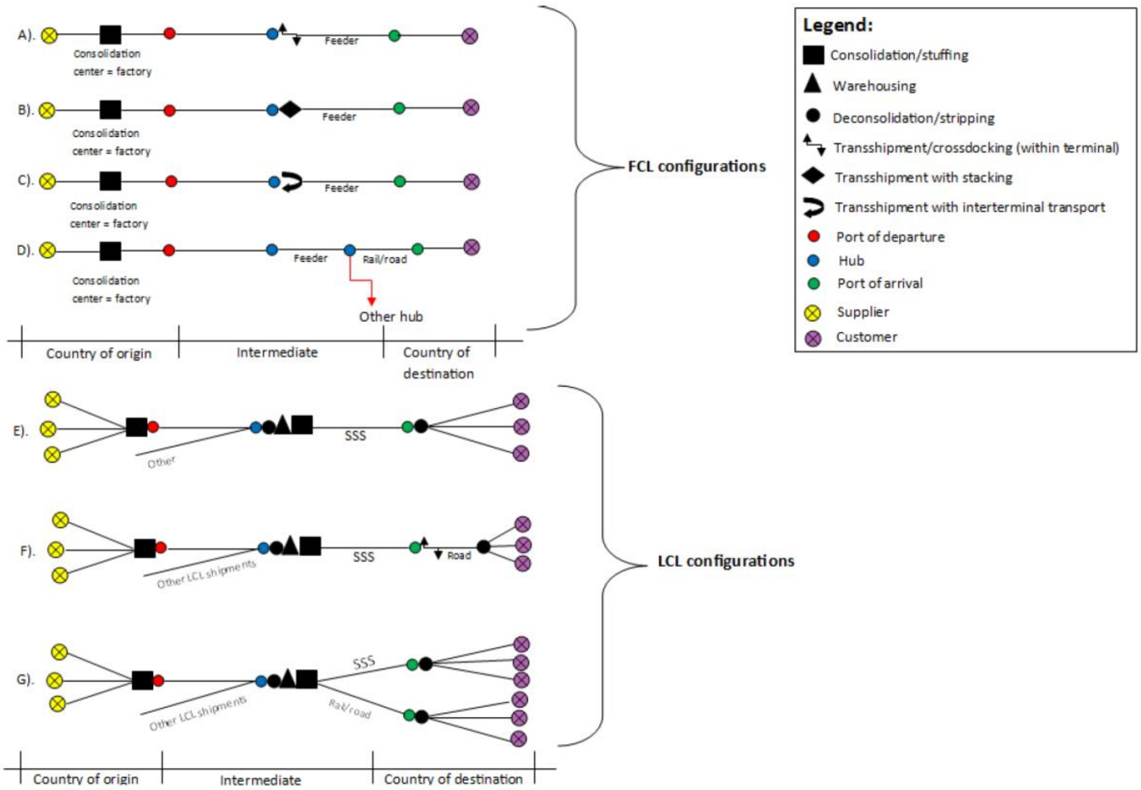

Figure 20 **Seven Asia-Europe container trade-lane configurations**

Based on the output of the interviews and data provided by the Customs Administration of The Netherlands, it can be concluded that the FCL-configurations (A till D) are the most common ones. LCL configurations do not often occur in the market China – Europe, however some parties especially focus on LCL shipments, offering services based on configuration E. With Less-than container Load (LCL) shipments, the retailer only pays for the cargo that needs to be shipped in a container with other cargo from other customers of the freight transport provider. This requires a separate consolidation process increasing costs and lead time. If the retailer knows that the ordered cargo cannot fill a 20-foot container, he normally accepts a mark-up for consolidation and the shipment is treated as a LCL shipment. The extra costs for deconsolidation, consolidation and the extra complexity do not make the FCL configurations attractive for the major part of the trade between China and Europe. What happens is that at the origin goods from different vendors are consolidated for one customer. It is supplied and stuffed in the container. At that moment the container is a FCL, but there are LCL shipments inside. Thus, a FCL could have more than one interpretation. It is important to notice that some manufacturers refuse ordering of LCL shipments by (small) importers and retailers. They state that the clearance charges are huge and they cannot incur it (China Importal, 2013). This suggests that many manufacturers only accept FCL shipments.

The low sea shipping rates also influence consolidation rationality. Because of the low sea rates for FCL shipments at the moment, more retailers and shippers order a full container load transport and accept the inefficiency of a lower occupancy rate of the container. In return, they benefit from the advantages of a FCL, such as faster processing and a lower risk of inspections (if only cargo for one customer is inside the container).

A general remark has to be made about the SeaConAZ concept. There are some restrictions with regard to the SeaConAZ concept. For Europeans, product certification regulations put a lot of restrictions on the type of products that can be purchased off shelf in China. While some of these products reach a decent quality standard and are already sold in Europe, they are not in compliance with EU product certification regulations. This includes, but is not limited to the following: toys, children's products, furniture, cosmetics, and electronics (China Importal, 2014). Products with such restrictions result in higher risks and in higher chances that such a shipment will be inspected. In case of LCL shipments this could cause problems, because there is a higher probability that such products are part of the container with LCL shipments. However, no indications exist for this.

Some logistics service providers are active in freight forwarding and consolidation, deconsolidation and warehousing of cargo and offer their clients (e.g. non-European companies) a central warehouse facility in Europe. The volumes of each individual client company do not justify an own European Distribution Centre (EDC, whereas these foreign companies/non-European companies are forced to keep stock in Europe in order to comply to the lead time requirements of their customers.

So called non-vessel operating common carriers (NVOCCs) offer similar services, but the difference is in the asset ownership, they do not operate own warehouses. As a result such NVOCCs without own warehouse facilities tend to consolidate LCL shipments in the beginning of the chain, for example in China, thus applying the concept of destination based stuffing. In contrast, logistics service providers use their warehouses to reconsolidate LCL shipments from different destinations.

3.3.3 TYPE OF INCOTERMS

Incoterms are intended primarily to clearly communicate the tasks, costs and risks associated with the transportation and delivery of goods. Eleven three letter Acronyms specify the respective duties and obligations of buyer and seller, who arranges the formalities, who organizes the transportation (until what point) and it specifies where costs and risks are transferred from seller to buyer. This transfer point is often specified as location in combination with the 3-letter acronym. So 'FOB Shanghai', the contract of carriage is in accordance with the conditions for Free-On-Board, whereas Shanghai is the loading port (and transfer point). Based on the selected Incoterm, the retailer can let the supplier handle the shipping of products to a nearby port in China or all the way to the front door. A price quoted by a Chinese supplier is always based on an Incoterm. It is not possible to compare prices of different Chinese suppliers if the Incoterm belonging to the price is unknown (China Importal, 2013).

Very little information is available about the use and frequency of the different Incoterms in the Chinese-Europe market. From expert opinions it is known that FOB and CIF are the most commonly used Incoterms, but statistics which can support this do not exist. From China Importal (2015), it can be concluded that the Incoterm mostly used for Chinese imports is FOB. The agreed Incoterms is a commercial arrangement and is not reported in standard trade or customs statistics (Zomer & Rijn, 2016c). More important is where the shift of responsibility and risk is being made. In China, in the main European hub or in Norway (Zomer & Rijn, 2016c). Expert opinions indicate that transfer of responsibility is the most common in Oslo. In case of the BAU solution transfer of responsibility is in Oslo if the Incoterm is CIF Oslo. For other solutions the transfer of responsibility depends on the type of Incoterm that is used.

In case of LCL shipments which will be stored in The Netherlands, the commonly used Incoterm is FOB. So a Norwegian retailer has an LCL shipment from China with Incoterm FOB Shanghai. From Shanghai the retailer organizes the transport with a specific party. If it is a LCL shipment, the transport will be booked with an LSP provider in Norway. This company takes care for the transport to Norway or to Gothenburg. For all customers of LSP-NL4 who keep inventory at the warehouse of LSP-NL4, LSP-NL4 requires that the delivery condition is DDP if they are the fiscal representative. The reason for this is that, for example LSP-NL4, can demonstrate to the tax authorities that those goods are actually delivered from their warehouse to the customers and that the VAT is reverse charged correctly. This model is used for Sweden and Finland. In the case of Norway, the goods remain a customs good (which means that the good will not cleared) due to the fact that Norway is not a member of the EU. If a Norwegian retailer buys something from a customer of LSP-NL4, the Incoterm is often EXW (Zomer & Rijn, 2016e). In conclusion, the carriage is divided into two parts; the first part is from China to the warehouse in The Netherlands and the second part is from the warehouse in The Netherlands to an European destination. For the first part the Incoterm is FOB Shanghai and for the second part the Incoterm is for example DDP Stockholm. The Incoterm DDP is required due to the fiscal representation. In case of Norway, the Incoterm for the second part is for example EXW Kristiansund.

However, the Incoterm EXW is not actually used for shipments from China to Europe. The reason for this is the transport between the factory in China and the port of departure in China. Managing the transport for this part in the supply chain is not recommended due to the complexity. Companies in China could organize this transport much more efficient. Thus, the export compliance would be arranged by the seller.

The structure of Incoterms for LCL shipments also applies to the concept of Amazon FBA (Fulfillment by Amazon). Amazon FBA enables e-commerce companies to completely outsource storage and delivery of goods, domestically. In order to ship to an Amazon fulfilment centre, acceptance of the DDP terms of sale (Incoterm) is needed. That means that the shipper must arrange all freight, payment of duties and customs clearance (China Importal, 2016).

In conclusion, there exists a link between chain responsibility and the choice of an Incoterm. When one party has more integrated chain responsibility, the higher the probability that the Incoterm DDP, DAP or EXW is used. This means that the responsibility of the supplier and the retailer will change, but this is dependent of the location where the responsibility of the supplier is transferred to the retailer (the second component of the Incoterm). If the location is Shanghai, the ocean leg and the feeder leg will be considered integrally. If the location is Rotterdam, the transport will be arranged by two different parties, which means that the ocean leg and the feeder leg will be considered separately.

The agreed Incoterm is part of the contract of carriage. The contract of carriage contains conditions of carriage that spell out the obligations and rights of a carrier and a shipper. This contract addresses issues associated specifically with what is being carried, and how the liability and compensation for damage or injury to (or loss of) the goods is assessed, apportioned, and paid

(Business Dictionary, n.d.). An important part of the contract of carriage are the demurrage and detentions terms, which are also determined in negotiations between supply chain partners (Zomer & Rijn, 2016a; Zomer & Rijn, 2016b; Zomer & Rijn, 2016d). The demurrage and detention conditions are negotiable. A longer than standard period to return the empty container to an empty depot allows feeder or shortsea operators to apply repositioning strategies in the ports of call during a scheduled line. The additional costs to be paid for stretching these demurrage conditions pay off the benefits of applying repositioning strategies. The feeder or shortsea operator and the buyer can collaborate to share these benefits in the service offer (Zomer & Rijn, 2016a; Zomer & Rijn, 2016b).

3.3.4 SUSTAINABILITY OF FEEDERING VS. SHORT SEA SHIPPING

Where feedering is always intercontinental, short sea shipping is always European, continental or intra EU. The short sea market of Norway consisted of 150.3 million tonnes transported in 2014 of which 112.9 million tonnes was going via the North Sea region (Eurostat, 2016). Only 6 million tonnes of this amount could be counted as container (Eurostat, 2016), which is equivalent to 704,000 TEU. Not all these containers were filled with shipments; 215,000 TEU were empty (Eurostat, 2016).

Intercontinental containers with cargo destined for Swedish, UK/Irish and Norwegian retailers are in a lot of cases forwarded from the European hub-port by maritime feeder links. In case of Rotterdam, these containers are for almost 100% forwarded by maritime feeder links to their final destination. This makes this solution more sustainable than hinterland transport via road. For other hubs, such as Hamburg and Gothenburg, this can be different, but this is not known.

According to expert opinions which were revealed during the interviews, the potential in sustainability in the market of European, continental transport from the perspective of Norwegian imports is considerable. Rotterdam could have a role in the preservation of European, continental flows to Norway. Thus, the challenge is to explore whether complementarity exists in deep sea and short sea in order to combine deep sea containers with short sea containers. In the next chapter, this is further explained.

3.4 HUB FUNCTION ROTTERDAM

This chapter describes the container market of Rotterdam and the hub function of Rotterdam. It is organised around three unique selling points (USPs) of Rotterdam. The first USP is the connectivity of Rotterdam. The second USP is the fiscal representation and the last USP is the powerful short sea hub.

3.4.1 THE CONTAINER MARKET

The total container volume of Rotterdam is 12.2 million TEU. The overwhelming part, 8 million TEU, is deep sea and feeder. The other 2.2 million TEU is short sea. In Figure 21 the division of short sea, deep sea and feedering is depicted.

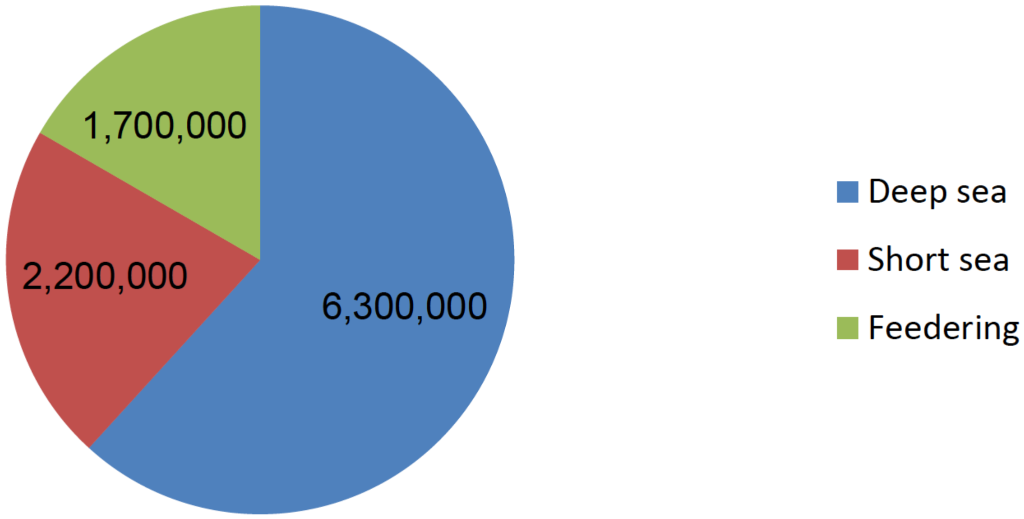

Figure 21 **Split of total container volumes in the Port of Rotterdam in 2015**

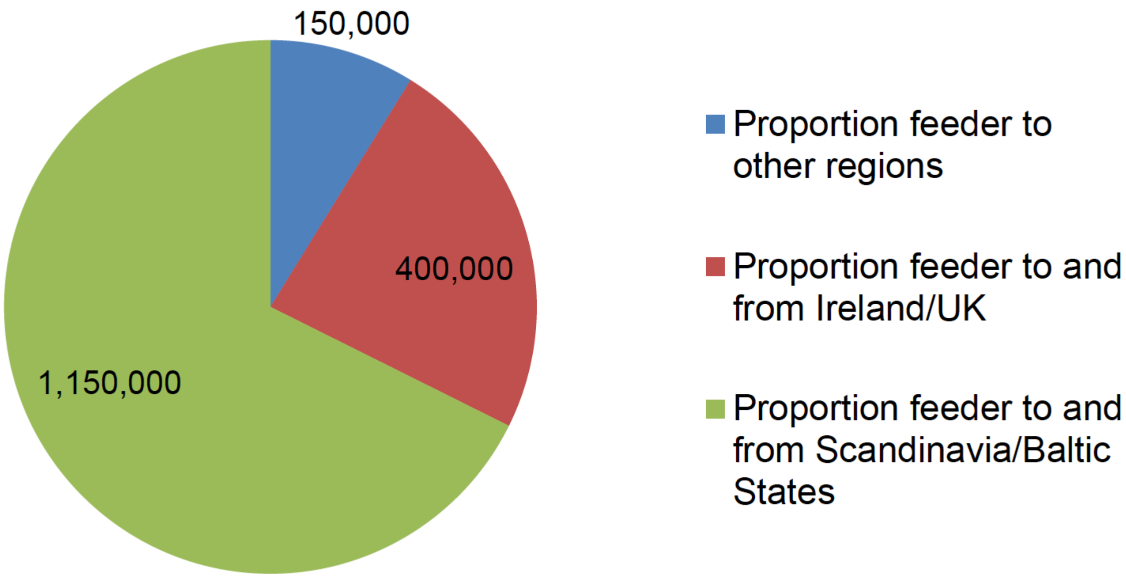

Figure 22 **Total feeder market Port of Rotterdam in 2015, and proportion destined for peripheral European regions**

The proportion of feeder transport in the market Rotterdam-Scandinavia/Baltic States was 1,150,000 TEU in 2015, of which 560,000 TEU was from Rotterdam to Scandinavia/Baltic States and 590,000 TEU was from Scandinavia/Baltic States to Rotterdam. Also empty containers are included in these amounts The proportion of feeder transport to Scandinavia/Baltic States is 80% of the total Rotterdam feeder market (1,700,000 TEU). Ireland/UK forms another substantial feeder market with 400,000 TEU (import and export) (Zomer & Rijn, 2016c). See Figure 22 for an overview of the total feeder market of Rotterdam in 2015.

To get a better understanding of the feeder market Rotterdam-Norway, the Customs Administration of the Netherlands has provided data with regard to the number of shipments in the first six months of 2016 from China to Norway via Rotterdam. In total, 17,558 shipments from China to Norway via Rotterdam are shipped. Each shipment contains at least one container, but most often more than 1 container is included in the shipment. It can be concluded that the amount of containers is at least double the amount of the shipments (Customs Administration of The Netherlands, 2016).

3.4.2 CONNECTIVITY

Rotterdam has a very good position in the feeder market, because of the high-frequency feeder services to a lot of destinations such as the United Kingdom, Ireland, Scandinavia and the Baltic States (Port of Rotterdam, n.d.). From Rotterdam to Norway there are 17 direct connections to the following ports: Oslo, Moss, Brevik, Larvik, Frederikstad, Kristiansand, Rorik, Maloy, Havik, Svelgen, Straumen, Orkanger, Tananger, Husnes, Flora, Hoyanger and Bergen (Customs Administration of The Netherlands, 2016). In Figure 23, the services of Samskip to Norway are depicted. Samskip is one of the shippings companies who offer services to Norway.

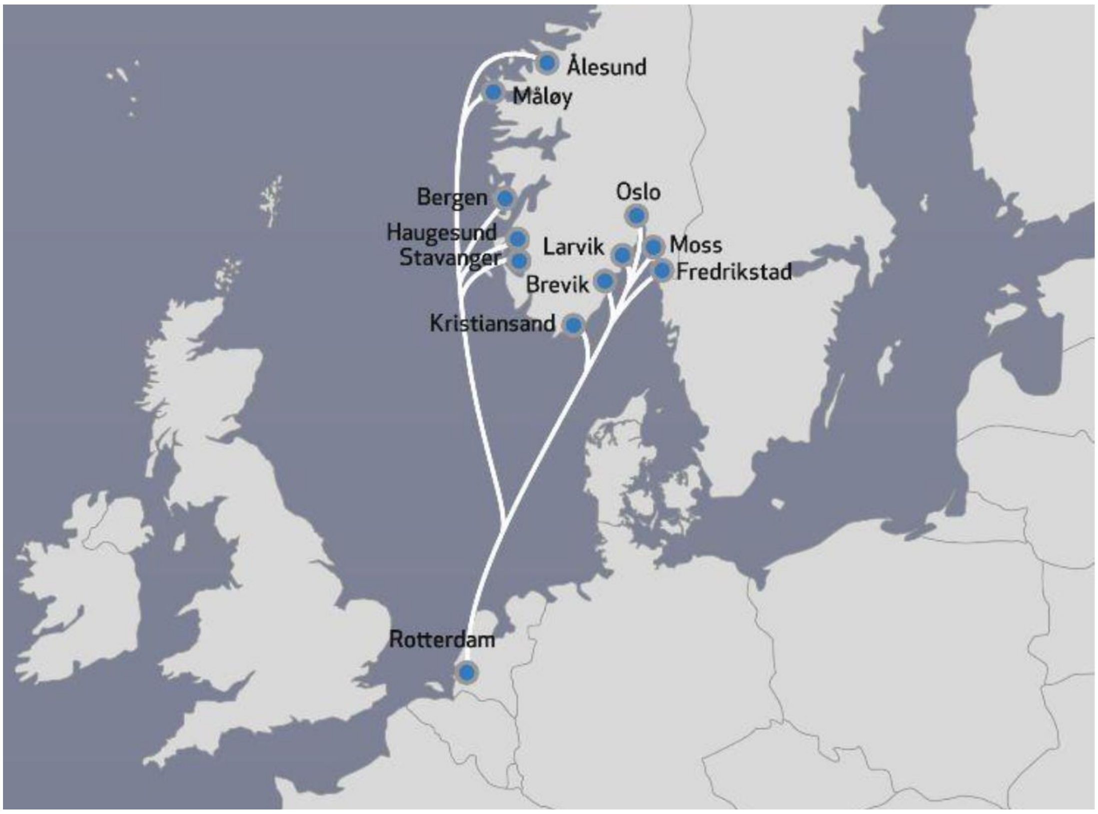

Figure 23 **The services of Samskip to Norway (Source: Adapted from World Maritime News 2012)**

To understand the feeder market of Rotterdam, it is necessary to know the size of this market. During the interview with the Port of Rotterdam it became clear that Rotterdam is the dominant market for Norway, because of the number of services and the geographical location. Rotterdam has the most calls in the market Asia-Europe compared to Hamburg and Antwerp, and is more often the first port of call in North-West Europe. One of the reasons for this is that a ship from Asia cannot sail fully loaded into the port of Hamburg or Antwerp. What you see happening is that the ship first goes to Rotterdam and then the ship carriers on to Hamburg. Hamburg is closer to Norway, but the extra transit time makes it less appealing, safeguarding Rotterdam's position. Furthermore, Rotterdam is the dominant market for the east coast of England and Iceland, but Rotterdam also has a powerful position in the Scan-Baltic market (Zomer & Rijn, 2016c).

Being the first port of call in Europe for many deep sea liner services gives Rotterdam a great advantage. The connection by feeder vessel to the port of Rotterdam is often faster than transportation through ports that appear later in the same deep sea service. Since the container is loaded from the deep sea vessel onto the feeder vessel directly at the terminal, the feeder vessel has already resumed its journey before the deep sea vessel is ready to leave for the next port of call in Europe. This results in an interesting time saving. Here too, the container feeder service provides a fast connection (Port of Rotterdam, n.d.).

Containers going from China to Norway via Rotterdam are mainly transshipment containers which will not be consolidated or reconsolidated in the port of Rotterdam. Most of the time these containers are only dropped at the quay of a terminal. In Norway the container will be stripped and the products will be shipped to the customers. This does not mean that consolidation, reconsolidation and warehousing does not take place, but most of the cargo volume going from China to Norway via Rotterdam are FCL shipments (Zomer & Rijn, 2016e). LCL does not often occur in flows from China to Rotterdam. Due to the high costs of consolidation and reconsolidation, shipments are often booked as ''one' container'' (FCL). Either if the container is full or if it is partially empty: it goes on the ship as is. If consolidation would occur the logic place to do this would be in China and not in Rotterdam. This is due to the low costs for labor in China compared to labor costs in Rotterdam (Zomer & Rijn, 2016c). Due to the low shipping rates, it is currently attractive to ship LCL shipments as a FCL shipment. When the shipping rates will increase, combining LCL shipments will become more important.

3.4.3 FISCAL REPRESENTATION

The Netherlands has a very strong position in terms of fiscal aspects, because The Netherlands offers a highly competitive fiscal climate. The limited fiscal representation that is offered by The Netherlands is quite unique, because of the possibility of VAT reverse charge. How does it work? For instance, a German commercial firm imports thousands of containers from the Far East for various purchasers in Germany, other EU member states, and Switzerland. The goods entered the EU through Hamburg, where "Einfuhrumsatzsteuer" (import VAT) had to be paid. It took the German VAT tax authorities a month or two to return this VAT. By importing the goods through Rotterdam and clearing them in the Netherlands with Limited Fiscal Representation, a liquidity advantage of a few million Euros was created. The Netherlands is the only country that applies this VAT reverse charge on a large scale. This results in the presence of parties such as LSP-NL4 exploiting the EDC for their customers (the non-European companies) in The Netherlands, but also the presence of EDC's of a lot of multinationals in The Netherlands. Customers of LSP-NL4 do not need to invest in working capital for VAT reclaims (Zomer & Rijn, 2016e). As a consequence, the routing of the cargo goes via The Netherlands.

For Norway, the fiscal representation is not interesting because Norway is not included in the EU and therefore the VAT reverse charge is not applicable for Norway. However, many companies applying this model, use The Netherlands as their EDC location and ship goods from China via The

Netherlands to the rest of Europe, also shipments destined for the Norwegian market (Zomer & Rijn, 2016e).

3.4.4 COMPLEMENTARITY WITH SHORT SEA

Rotterdam wants to be the leading European hub for global and Intra-European cargo flows in 2030. Rotterdam will form an integrated network with its hinterland and it will be a frontrunner in creating and maintaining efficient and sustainable chains. At the moment, Rotterdam is an attractive hub for all cargo flows, but Rotterdam wants to accelerate their success in combining short sea shipments with deep sea shipments in the coming years.

During the interviews with the Port of Rotterdam and LSP-NL4 it became clear that there are a lot of opportunities for short sea shipping from Rotterdam to Norway. The proportion short sea in the market Rotterdam-Scandinavia/Baltic States was 730,000 TEU in 2015. The proportion feeder in the market Rotterdam-Scandinavia/Baltic States was 1,150,000 TEU, which is 80% of the total feeder market (Zomer & Rijn, 2016c).

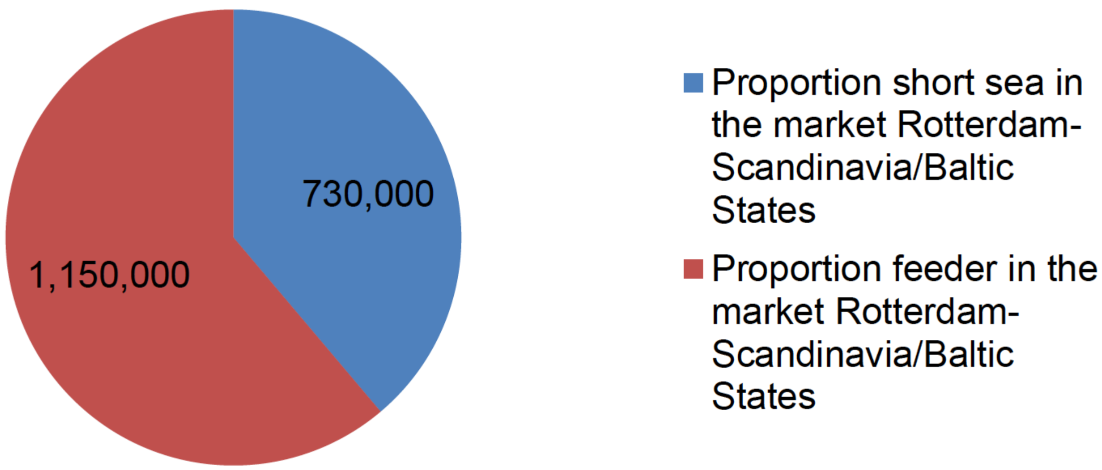

Figure 24 Total short sea and feeder in the market Rotterdam-Scandinavia/Baltic States in 2015

Thus, there is more potential in the short sea market. The feeder market is already very successful. A lot of intra-European flows are going to Norway by truck. Consequently, when the focus is on sustainability it is advisable to look at the intra-European flows instead of the Chinese flows. Containers from China are not going to Norway by truck. This might be different for Gothenburg or Hamburg (Zomer & Rijn, 2016c; Zomer & Rijn, 2016e).

In vessel operations the strict distinction between feeder services and shortsea services is getting vaguer (feeder operators also ship continental containers), combining deep-sea shipments with continental shipments is not so obvious. Deep sea container are often 20 ft (1 TEU) or 40 ft (2TEU) long and short sea are containers usually measure 45 ft. It is quite expensive to reconsolidate the containers. Furthermore, the whole logistic operations of short sea shipping are different from the deep sea operations (Zomer & Rijn, 2016c). If Rotterdam could combine short sea shipping with feedering, they have an advantage over their competitors.

3.5 CONCLUSIONS, LIMITATIONS & FURTHER RESEARCH

3.5.1 CONCLUSIONS

The aim of this research was to examine the role of European hubs for sea containers being transported from China to periphery countries in North-West Europe such as Norway. The research questions that are answered by means of existing literature and conducted research interviews are:

To what extent are intercontinental containers with cargo destined for Swedish, UK/Irish and Norwegian retailers forwarded from the European hub-port by maritime feeder links today?

1. Where are the containers with cargo destined for Swedish, UK/Irish and Norwegian retailers stripped and cross-docked today?
2. To what extent is such cargo, after cross-docking in Europe, forwarded through maritime transport alternatives?
3. Could the degree of dominance of the BAU-solution be linked to the Incoterms applied in relevant markets?
4. Could trends with respect to the typical Incoterms applied in these trades be identified?

To answer the first and the third research question, several interviews have been conducted with the Port of Rotterdam, but also other LSPs in related markets. Based on existing literature and conducted interviews, it can be concluded that a major part of the intercontinental containers with cargo destined for Norwegian retailers is forwarded from the European hub-port by maritime feeder links today. There are two options to ship goods to Norway or other countries, such as Sweden and the UK, namely feedering or short sea shipping. Dedicated feedering becomes more important for China-Norway containerized imports. As a result, common feedering loses market share and the focus of the common feeder operators changes into a combination between feedering and short sea shipping. Thus, it can be concluded that all the intercontinental containers with cargo destined for Swedish, UK/Irish and Norwegian retailers are forwarded from Rotterdam by maritime feeder links today. For other European hubs, such as Hamburg, this can be different, because of their geographical location relative to for example Norway and Sweden.

For the second research question the most important transshipment hubs must be identified. Inspecting schedules and conducting research interviews give an answer to this question. The results of the interviews prove that Antwerp, Rotterdam, Bremerhaven, Hamburg and Gothenburg are the most important transshipment hubs for cargo destined for Norway and Sweden. These hubs are also integrated in the schedules of the ocean carriers. Other important transshipments hubs in this research are Felixstowe and Southampton, especially for the UK/Ireland market. This research focused on the hub function of Rotterdam. Rotterdam is an attractive hub for all cargo flows at the moment, but Rotterdam is expected to be the leading European hub for global and intra-European cargo flows. This means that Rotterdam wants to combine short sea shipping with feedering in order to have an advantage over their competitors.

For research question four and five it can be concluded that there is a link between chain ownership and the Incoterms applied. The probability of using the Incoterm DDP, DAP or EXW is higher when one party has more integrated chain responsibility. The responsibility of the supplier and the retailer is dependent of the location where the responsibility of the supplier is transferred to the retailer. This will be determined by the second part of the Incoterm. The first part of the Incoterm specifies the conditions and the second part specifies the location where the responsibility of the supplier is transferred to the importer. FOB and CIF are the most commonly used Incoterms in the Chinese-Europe market. In case of the BAU-solution transfer or responsibility is in Oslo if the Incoterm is for instance CIF Oslo. This is the most obvious. For LCL shipments the contract of carriage is split into carriage from China to the EDC warehouse facility, commonly used Incoterm is FOB Shanghai; and a carriage section from the EDC to the customer, using DDP Stockholm for example. So, from Shanghai the transport is in most cases organized by logistic service providers which have a warehouse function in Europe, especially in The Netherlands because of the fiscal representation. From this warehouse function in Europe to the final destination Sweden for example, the delivery condition is DDP. In case of Norway, the Incoterm for the latter is often EXW, because Norway is not a member of the EU. As a result, the VAT could not reverse charged and the goods remain a customs good.

Associated with the Incoterms are the demurrage and detentions terms, which are part of the contract of carriage. If a logistic service provider could negotiate good demurrage and detention conditions with the ocean carrier, the carrier will charge some additional costs, but feeder/shortsea operator and buyers can jointly operate a model resulting in higher efficiency gains through integrating repositioning strategies in their feeder/shortsea schedules.

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4 EUROPEAN HUB ANALYSIS PART 2[8]

4.1 SUMMARY OF EUROPEAN HUB ANALYSIS PART 2

This section provides a follow up on the analysis of the role of the European hubs in the feeder market China to North-Europe provided in section 3. We are focusing on common supply chain designs of European retailers. Moreover the container flows, lead times and costs from China to peripheral areas (Sweden, Ireland and Norway) are examined. The method of analysis is desk research, validation by central actors and research interviews.

The feasibility of the SeaConAZ solution has been explored in supply chains of two segments: fashion and electronics. The results show that the fashion industry offers more potential for the SeaConAZ solution than the electronics sector. In the electronics sector, the concept of a European Distribution Center and some satellite DC's in the peripheral areas is often applied in the case when inventory is always needed. The SeaConAZ solution is not applicable on this type of supply chain designs. In the fashion industry, China is a major production country, which is one of the reasons that there is huge potential to bundle. Also, the fragmented retail distribution channels in Europe make the SeaConAZ solution attractive. The concept of bundling at source creates possibilities to take advantage of this fragmentation by organizing scale in procurement which increase the buying power of SMEs (small and medium enterprises). Parties that organize this bundling by consolidation across shippers, so-called bundling service providers, are needed in these kind of branches.

The analysis also identified the container flows, lead times and costs to ship a container from China to peripheral areas. The data analysis of container flows shows that China is the dominant non-EU import country for both Sweden, Ireland and Norway. This may indicate that bundling has potential on these trade lanes. The analysis of transshipment (lead) times from China to peripheral areas in North-West Europe shows that the lead time is approximately 35 days including the dwell time in transshipment ports such as Rotterdam.

The lead time can be shorter if priority handling is applied. The cost analysis highlights substantial cost differences depending on the shipment size (Full Container Loads – FCL versus Less than Container Loads – LCL), and also depending on the standard loading unit (e.g. 20ft FCL versus 40ft FCL). The difference in costs between a 20ft FCL and a 40ft FCL is a factor 1.3-1.6.

A cost comparison model has been developed for different consolidation concepts. When applying it to China-Norway containerized maritime transport, the SeaConAZ type of solution is the cheapest solution, closely followed by re-consolidation in Rotterdam. Feasibility of the consolidation concepts also depend on available volume of LCL shipments in the tradelane. The Norwegian market is relatively small. In fashion, fragmented distribution channels allow for

[8] This section is based on a restricted project report written by TNO. Information that could be linked to the informants is deleted or re-written in an anonymized form. The data collection for this analysis was conducted in 2017.

substantial volumes of LCL shipments. The mainport function of Rotterdam offers potential to combine reconsolidation of deepsea LCL shipments of all oversea origins and possibly also continental LTL shipments. The results of this analysis are used as input for further analysis in the SeaConAZ project.

4.2 INTRODUCTION

4.2.1 BACKGROUND

In 2016, an analysis of the role of the European hubs in the container feeder market China to North-Europe was performed by TNO. The results of this analysis are used as input for the second part of the European Hub Analysis, of which the results are described in this report.

4.2.2 RESEARCH SUBJECTS

The following subjects are further elaborated:

- Supply chain structure of European retailers with a European Distribution Centre (EDC) in the Netherlands
- The size of the container flows from China to peripheral areas, such as Sweden and Ireland
- The current existing transshipment (lead) times and costs for shipping a container from China to peripheral areas, such as Sweden, Norway and Ireland.
- To what degree different service levels (e.g. priority handling) are offered in the port.
- Comparison between the cost of SeaConAZ type of solution and the cost of the traditional solution.

These subjects need different methodological approaches. In the next section this will be discussed.

4.2.3 METHODOLOGY

In order to elaborate on the subjects mentioned above, the methodology will be explained. Most of the methods are of an explorative nature. Many of the outcomes are therefore of a qualitative nature, but quantitative analysis plays an important role in elaborating some of the subjects.

The first subject is analyzed through research interviews with central actors in the fashion and electronics supply chain. For the second subject, data from the Port of Rotterdam was used. For the third, fourth and fifth subject desk research was done and the figures were validated by central actors.

4.3 COMMON SUPPLY CHAIN DESIGNS FOR EUROPEAN RETAILERS

An analysis of the design of common supply chains for European retailers is intended to get an idea of the consolidation concepts that are typically used by European retailers. The research performed in 2016 showed that different trade-line configurations exist. It also shows that Rotterdam has the most calls in the market Asia-Europe when compared to Hamburg and Antwerp, and is more often the first port of call in North-West Europe. This is, along with the attractive geographical location of Rotterdam, the reason why a lot of EDCs are located in the Netherlands. Therefore, it is interesting to have a look at the strategies of these European retailers for serving more peripheral regions in Europe (Sweden, Norway, and Ireland) with cargo of Chinese origin.

In order to know when SeaConAZ type of solutions are attractive, interviews have been conducted with EL-MANU[9] and LSP-FASHION. These parties are active in the fashion and electronics sector. Both supply chains are described below.

4.3.1 FASHION

At the moment, LSP-FASHION is offering a concept ''bundling at source location'' in the fashion industry, which is the same as the SeaConAZ concept. Bundling at source location is applied in the fashion and lifestyle branches. In those branches much of the flow of goods of the suppliers is very similar in the sense that they are often produced in the same production countries, delivered to the same shops and shopping streets, in the same delivery window, etc.

This is the reason that there is huge potential to bundle. LSP-FASHION has succeeded in initiating this bundling of goods. By working as a branch with a lot of retailers together, buying power can be organized in order to carry out the procurement for a number of retailers centralized. As a result, bundling is created 'automatically', because of the high amount of goods that is shipped to the same shops. By bundling at the source, transshipment and handling in Europe are prevented. The consolidation activities are moved to the production countries, such as China, in order to bundle the shipments at store level or shopping street level. As a result, the handling costs are shifted upstream to China against lower labor costs. The net benefit of this logistic concept is interesting for European retailers. About 90% of the total volume in fashion and sports distribution is towards SMEs (small and medium enterprises). In addition, the concept of bundling at source creates possibilities to organize scale in procurement, increasing the buying power of SMEs.

The concept bundling at source location is applied in two countries, namely the Netherlands and Sweden. In the near future, LSP-FASHION wants to expand the concept to many other countries. The Netherlands was the first country where this concept was applied, specifically the consolidation of shipments in China destined for the distribution centers of central European actors in the fashion retailing business.

From the consolidation center, shipments from different suppliers are combined for individual shops. Sweden was the second country where this concept was applied. The concept in the Netherlands and Sweden often involves the same brand owners, but there are other shops behind the brand owners.

Bundling at source location means that the handling of the goods is performed upstream in the chain. Bundling at source locations is only possible if the following conditions are met:

[9] The real identity of the case companies i concealed through the use of constructed names. EL-MANU is a major manufacturer of electronics, LSP-FASHION is a major LSP providing services for the fashion industry.

1. Products that are produced in the same manufacturing regions
2. Products that are bought on pre-order
3. Products that have similar delivery time windows

The concept of bundling at the source is very successful, but there are some remarks. One of the reasons why bundling at source location is complicated is that purchasers determine where to produce and they do not often take into account the logistics aspect. Another reason is that some products require such a short lead time that order-driven production in China is not feasible which means that near shoring, for example East-Europe, is the only possibility in make-to-order environments. In case of e-commerce, make-to-stock and local inventory keeping is always needed, because consumers demand that their products are delivered as soon as possible. In that case, the concept of a European Distribution Center and some satellite DC's in the peripheral areas is commonly used.

For a major actor in the fashion retailing business, a difference in logistic activities exists between private labels and premium brands. The goods of the private labels enter Europe via Rotterdam. Private labels first go to a central DC in a European country and from there go to the European market. For the Scandinavian market, the goods of the private labels (of which the majority of the shipments is LCL) are going via this DC to Scandinavia. The premium brands are distributed via a central location to the rest of the Netherlands. Most (not-Norwegian) premium brands have their European Distribution Center in North-West Europe (Netherlands, Belgium, Germany). In addition, relatively many Scandinavian brands deliver to Norway from Sweden, Denmark and Finland. In some cases, goods for the Scandinavian market are delivered to central warehouses of retailers. However, in most cases, the package services or pallet carriers delivers the goods directly to the store. Due to the fact that a central supplier is changing their strategy towards transport to national DC's instead of transport to retailers, the retail distribution will be removed and supply chain structures will also change. This supplier is increasing the minimum order quantity for each order in order to achieve their goal. The expectation is that other premium brands will follow.

The impact of supply chain disruptions on the bundling at source concept is rather limited. When disruptions take place in West-Europe, lots of alternatives such as other entry ports or alternative modes are available in order that the products are always on time. The consolidation center in China is run by a LSP-CHN. A lot of time and coordination in communication is spent by LSP-CHN, because LSP-CHN takes care of the bundling of orders from different parties of different sectors. The concept of bundling at source location could be more vulnerable than ''the old process'', because shipments for one special retailer are not divided over the containers. In case of disruptions, the retailer of the products in that specific container will have a problem. In case of ''the old process'', there is always some inventory available.

Theoretically, the vulnerability in case of bundling at source location is increased. However, in practice this is not the experience.

4.3.2 ELECTRONICS

As mentioned above, the concept of a European Distribution Center and some satellite DC's in the peripheral areas is commonly used in the case when inventory is always needed. EL-MANU, which is a multinational imaging and electronics company, applies this concept (Echelon Inventory Management). They have a European Distribution Center, satellite DC's and they hold some strategic stock in the individual countries. All products are categorized in 'ABC items'. The EDC holds all items in stock, satellites only A&B items and A-items also in the national centers. The products are grouped into Finished Goods, Boxed Products, Configured Products and Service Parts, each with their own lead time requirements. The majority of the products are produced and manufactured in the East Asia, mainly China. More than 800,000 big electronics units, more than 3 million supplies and almost 5 million service parts are shipped from the East Asia to Europe to serve the European customers. The European DC is located in The Netherlands. EL-MANU has satellite DCs in Spain, Italy, Sweden and Turkey and also covers the distribution to South Africa. The Swedish satellite is located in Stockholm and serves the Scandinavian countries, including Norway.

In principle, all incoming containerized goods are first shipped to the EDC, mainly via Rotterdam. About 90% is transported from the port via inland shipping to the a Container Terminal and further by road to EL-MANU's EDC location next door. Around 10% (urgent) shipments use road transport.

Customer orders are fulfilled and delivered from satellite DCs, creating replenishment orders from the European DC. Depending on the destination, all European customers can be delivered within 48 or 72 hours. The replenishment orders from satellites are consolidated into weekly shipments from EDC to satellite DCs.

For finished goods – the majority in terms of volume – the logistics for goods produced in China with final destination Norway is as follows. For replenishing the Swedish satellite location, road transport is used. EL-MANU has different service providers for FTL-shipments, LTL/pallet shipments and groupage shipments. From the satellite DC in Stockholm, customer orders in Scandinavia are being delivered. This is all being done by road transport. The UK and Irish market is being served directly from the EDC in The Netherlands, except for Service Parts which are being kept on stock in a UK location.

There are some exceptions to this standard pattern. Complete production printers are being cross-docked in the port of Rotterdam directly to the satellite DCs, not first going to the EDC in The Netherlands. Backorders also require urgency and are being delivered directly from the EDC using trucking or airfreight solutions.

Summarizing the analysis above, the SeaConAZ solution – e.g. stuffing dedicated containers destined for Norwegian or Scandinavian customers – does not serve the supply chain design and echelon management of EL-MANU. The size of its European Supply Chain allows for optimization approaches focusing on its own supply chain.

Major disruptions in the fulfilment hardly take place. Inbound logistics to the EDC can easily be shifted from Rotterdam to Antwerp in case of disruptions and customers can always be delivered directly from the EDC in case of disruptions in one of the satellites.

4.4 DATA ANALYSIS OF CONTAINER FLOWS FROM CHINA TO SWEDEN, IRELAND AND NORWAY

In the analysis of 2016 the container flows from China to Norway was included. A summary of the results is as follows: 47% of the intercontinental imports (103.018 TEU) came from China in 2015. For Sweden and Ireland this percentage is, respectively, 46% (140.819 TEU) and 39% (51.848 TEU) in 2016 (Seabury, 2017). Table 1 gives the top three of intercontinental import countries for Norway, Sweden and Ireland including the product categories.

Table 9 Intercontinental import countries including the amount of TEU and product categories (Seabury, 2017)

Country	Import from	Product categories (based on G3 commodity list)
Norway	1. China (103,018 TEU) 2. Brazil (20,955 TEU) 3. USA (11,035 TEU) Total: 220,493 TEU	1. Other products of the food-processing industry (18,725 TEU) 2. Stone and cements for building & construction (14,873 TEU) 3. Household furniture (12,930 TEU)
Sweden	1. China (140,819 TEU) 2. USA (35,735 TEU) 3. India (13,482 TEU) Total: 307,485 TEU	1. Household furniture (22,563 TEU) 2. Fruits, Fresh: Tropical Fruits (11,872 TEU) 3. Miscellaneous chemical products NES (10,620 TEU)
Ireland	1. China (51,848 TEU) 2. USA (24,437 TEU) 3. India (10,180 TEU) Total: 131,543 TEU	1. Containers & packaging for transport of goods (13,693 TEU) 2. Household furniture (7,628 TEU) 3. Stone and cements for building & construction (6,630 TEU)

Data about the export to intercontinental countries from Norway, Sweden and Ireland including product categories is given in

Table 10.

Table 10 **Intercontinental export countries including the amount of TEU and product categories (Seabury, 2017)**

Country	Export to	Product categories (based on G3 commodity list)
Norway	1. China (30,776 TEU) 2. USA (22,479 TEU) 3. India (11,610 TEU) Total: 141,619 TEU	1. Fish, frozen (31,606 TEU) 2. Crude mineral products for industry (23,858 TEU) 3. Crude crop and forestry products for industry (11,207 TEU)
Sweden	1. USA (63,012 TEU) 2. China (56,841 TEU) 3. Japan (56,612 TEU) Total: 449,453 TEU	1. Crude crop and forestry products of industry (118,049 TEU) 2. Paper products, semi-finished (95,515 TEU) 3. Iron & steel products, semi-finished (35,123 TEU)
Ireland	1. USA (49,444 TEU) 2. China (37,418 TEU) 3. Nigeria (6,019 TEU) Total: 164,473 TEU	1. Beverages (36,835 TEU) 2. Crude crop and forestry products of industry (24,620 TEU) 3. Other products of the food-processing industry (17,685 TEU)

It can be concluded that the size of the Norwegian imports from intercontinental countries is much bigger than the size of the Norwegian exports to intercontinental countries. This is not the case for Sweden and Ireland. There are also some similarities. China is the dominant non-EU import country for all the three countries. Furthermore, all the three countries have the product category ''household furniture'' in the top 3 of import from intercontinental countries. This also applies to the product category ''crude crop and forestry products of industry'' for the export to intercontinental countries.

4.5 ANALYSIS OF TRANSSHIPMENT LEAD TIMES FOR SHIPPING A CONTAINER FROM CHINA TO PERIPHERAL AREAS IN NORTH-WEST EUROPE

In order to analyse the transshipment lead times from China to peripheral areas in North-West Europe, the scope of a transshipment lead time is determined. The transshipment lead time means the time from the port of origin to the port of destination. The transshipment lead times are based on the service of different operators and are split up in three sections: 1). Typical lead times from China to Rotterdam; 2). Typical lead times in the port of Rotterdam; 3). Typical lead times from Rotterdam to the port of destination in Norway, Sweden and Ireland. Table 3 gives an overview of the lead times for shipping a container from China to peripheral areas in North-West Europe.

Table 11 **Lead times between port in China and port in peripheral areas in North-West Europe**

Origin	Destination	Transit time (in days)
China	Rotterdam	20-38
Rotterdam	Rotterdam	2-6
Rotterdam	Norway	2-4.5
Rotterdam	Sweden	3-4.5
Rotterdam	Ireland	2-3

The lead times for each part of the supply chain are further elaborated in the subsequent paragraphs

4.5.1 TYPICAL LEAD TIMES FROM CHINA TO ROTTERDAM

The lead time from China to Rotterdam is approximately one month (SeaRates.com, 2017), depending on the origin port and the sequence of the loop in North-West Europe. In table 4 an overview of the different origin ports and the destination ports with corresponding transit times is depicted. This information is based on the information of different carriers. Note that the numbers are days between ports. It can vary between different carriers.

Table 12 **Transit times between port in China and port in North-West Europe (Cargo from China, sd)**

	Le Havre	Felixstowe	Antwerp	Rotterdam	Bremerhaven	Hamburg
Dalian	34	34	41	32	36	34
Tianjin	33	35	41	33	37	37
Qingdao	28	30	39	31	31	29
Shanghai	26	26	32	27	28	30
Ningbo	32	26	30	28	30	28
Xiamen	26	30	29	28	26	27
Guangzhou	26	29	28	26	29	28
Shenzhen	22	22	26	22	24	24

It can be concluded that the transit times from the port in China to Le Havre are in some cases shorter than those of Rotterdam. However, in total, the transit time of Le Havre is equal to the total transit time of Rotterdam. For Felixstowe, Antwerp, Bremerhaven and Hamburg, the total transit time is, respectively, 5 days, 39 days, 14 days and 10 days longer than Rotterdam. To verify these lead times, the Navigate tool of the Port of Rotterdam has been used. Table 13 gives an overview of the transit times.

Table 13Lead times between port in China and Rotterdam (Port of Rotterdam, 2017)

Origin port	Destinati on port	Transit time	Carrier
Shanghai	Rotterdam	23,5 – 37 days	1 United Arab Shipping Company (UASC) Hapag-Lloyd 2 CMA-CGM APL
Shenzhen	Rotterdam	21,5 – 36,5 days	1 COSCO SHIPPING Lines OOCL Evergreen Line 2 CMA-CGM CNC Line
Dalian	Rotterdam	32 – 36,5 days	1 COSCO SHIPPING Lines APL 2 United Arab Shipping Company (UASC) MOL K-Line Yang Ming NYK Line Hapag-Lloyd
Hong Kong	Rotterdam	20 – 38 days	1 Mediterranean Shipping Company (MSC) 2 Evergreen Line COSCO Shipping Lines OOCL Pacific International Lines (PIL)

1 Carrier(s) with shortest transit time

2 Carrier(s) with longest transit time

It can be concluded that the lead time from China to Rotterdam varies from 20 days till 38 days.

4.5.2 TYPICAL LEAD TIMES IN THE PORT OF ROTTERDAM

In order to know the lead time in the port of Rotterdam, the dwell time in port is important. The definition of the Pacific Merchant Shipping Association (2016) on dwell time in the port is used and is given: ''the amount of time a container waits to get picked up at a marine terminal after being unloaded from a vessel".

The dwell time of a feeder container is dependent on various factors, including:

- Date of arrival ship of origin
- Date of departure of the feeder vessel (for shipment to port of destination), in other words availability of connecting services
- Inventory strategies
- Date of desired delivery date final recipient, in other words lead time requirements
- Demurrage conditions (Lu, 2016)

As mentioned above, the average dwell time depends on the demurrage conditions. Demurrage and/or detention cost will be charged by the shipping company (usually after approximately 5 days, depending on shipping company/mutual agreement).

The fact that costs will arise after a number of days does not mean by definition that the average dwell time would be shorter than 5 days. In addition, other unforeseen factors can play a role, such as:

- Customs (physical check, scan, document check);
- Waiting for Customs clearance due to lack of information on import or transit;
- Blockage due to the owner of the goods (holder of the B/L), in expectation of payment from the buyer (carrier release)

The dwell time in the port of Rotterdam is determined by using different sources. In 2007, the average dwell time of containers in port was 6.3 days (+40% in comparison with 2006). A difference exists between the dwell time of empty containers and full containers. The average dwell time of empty containers was 9.8 days in 2007 (+67% in comparison with 2006) and the average dwell time of full containers was 5.5 days in 2007 (+28%) (Ruijgrok & Verweij, 2007).

The Europe Container Terminal (2011) claimed that the average dwell time of containers on deep-sea terminals in Rotterdam could increase to 6 days in 2011. In the hinterland, there may still be up to 12 days at an inland terminal before a recipient calls the container to his warehouse or production site. Nowadays, the transit time in the port of Rotterdam for a feeder container is 2-6 days. The feeder operators go to peripherical areas approximately once a week. A typical carrier ship their own containers to Norway, so they take the cargo out of the container and load the cargo in their own container in Rotterdam. This means that if a container from China arrives 2 days before departure of the feeder ship, it is only possible to take the next feeder ship as it is not possible to take the cargo out and load it into another container within 2 days. In that case, the transit time is 6 days. If cargo from intercontinental regions is bundled with European cargo, the transit time in the port is often shorter. The goods are stocked in a distribution center and are offered at the port just a short time in advance.

From these different sources it can be concluded that the range is 2-6 days depending on the (unforeseen) factors mentioned above.

4.5.3 TYPICAL LEAD TIMES FROM ROTTERDAM TO NORWAY, SWEDEN AND IRELAND

The different transshipment (lead) times from Rotterdam to peripheral areas are given per country.

Norway

It depends on the destination in Norway, but on average the lead time from Rotterdam to Norway is 2 to 4.5 days if we look at the destinations Oslo, Moss and Alesund. In Table 14 the existing transshipment (lead) times per operator from Rotterdam to Norwegian ports are depicted.

Table 14 **Existing transshipment (lead) times in days per operator from Rotterdam to Norwegian ports (Port of Rotterdam, 2017)**

Operator	Lead time Rotterdam – Oslo	Lead time Rotterdam - Moss	Lead time Rotterdam - Alesund
Samskip	2	4	3-4
Cargow	x	x	2
DFDS	2	3	x
Euro Nordic Logistics	x	x	2-4
CMA CGM (FAS Norway Feeder)	2-3	3-4	x
Unifeeder	2-3	2-4	x
Mediterranean Shipping Company (MSC)	1	x	x
ANL Container Line	2	x	x
OPDR Shipping	3	3	x
Evergreen Line	3	3-4	x
Hapag-Lloyd	3	4	1.5-4.5
Tschudi Lines Baltic Sea AS	x	3-4	x
Euro Container Line AS	x	x	1.5-4.5
North Sea Container Line	x	x	3
Koppelmann P	x	x	3
Briese Schiffahrts GmbH & Co	x	x	3-3.5
Mann Lines	3	4	x

Looking at the schedules of the different operators, we observe that the lead time from Rotterdam to Oslo is on average 2-3 days, the lead time from Rotterdam to Moss is on average 3-4 days and the lead time from Rotterdam to Alesund is on average 3 days. In some cases, the lead time depends on the sequence of the roundtrip.

Sweden

It depends on the destination in Sweden, but on average the lead time from Rotterdam to Sweden is 3 to 4.5 days if we look at the destinations Stockholm and Gothenburg. In Table 15 the existing transshipment (lead) times per operator from Rotterdam to Swedish ports are depicted. Direct connectivity from China to Sweden exists, but the frequency is limited.

Table 15 Existing transshipment (lead) times in days per operator from Rotterdam to Swedish ports (Port of Rotterdam, 2017)

Operator	Lead time Rotterdam – Stockholm	Lead time Rotterdam - Gothenburg
Samskip	x	3
SCA Logistics	4	x
K-Line	x	3
Unifeeder	x	2
Mediterranean Shipping Company (MSC)	4.5	1.5-2.5
ANL Container Line	x	3
Evergreen Line	x	4-5
Hapag-Lloyd		4
Tschudi Lines Baltic Sea AS	x	3-4
OOCL	x	3
X-Press Feeders	x	4
COSCO Shipping Lines	x	5
CMA-CGM	x	4

Looking at the schedules of the different operators, we observe that the lead time from Rotterdam to Stockholm is on average 4-4.5 days and the lead time from Rotterdam to Gothenburg is on average 3-4 days. In some cases, the lead time depends on the sequence of the roundtrip.

It is interesting to notice that for example Samskip indicates that the transshipment (lead) time from Rotterdam to Sweden is approximately 7 days. Samskip defined the lead time as the transit time from terminal to terminal. This includes the dwell time in the port. It can be concluded that 3-4 days dwell time in port is customary and this amount is exactly in the middle of the range of 2-6 days.

Ireland

It depends on the destination in Ireland, but on average the lead time from Rotterdam to Ireland is 2.5 days if we look at the destinations Cork, Dublin and Limerick. In

Table 16 the existing transshipment (lead) times per operator from Rotterdam to Irish ports are depicted.

Table 16 **Existing transshipment (lead) times in days per operator from Rotterdam to Irish ports (Port of Rotterdam, 2017)**

Operator	Lead time Rotterdam – Cork	Lead time Rotterdam - Dublin	Lead time Rotterdam - Limerick
Samskip	2	x	2
Unifeeder	3	x	3
ANL Container Line	2	2	2
Evergreen Line	x	2	
Hapag-Lloyd	1.5-3	0.5-4	1.5-3
X-Press Feeders	2	2-3	2
CMA-CGM	2-4	1-3	2-4
Sea Consortium Pte Ltd	1.5-2	4	1.5-2
Eucon Shipping & Transport	2-3	x	2-3
BG Freight Line	2-4	2-3.5	2-4
DFDS Logistics	4	x	x
Crowley Liner Services Inc.	x	0.5	x
Maersk Line	x	1-2	x
Yang Ming	x	3	x
USC Barnkrug GmbH & Co KG	x	3	x
Jungerhans Maritime Services	x	4	x
MacAndrews	x	9	x

Looking at the schedules of the different operators, we observe that the lead time from Rotterdam to Cork is on average 3 days, the lead time from Rotterdam to Dublin is on average 2-3 days and the lead time from Rotterdam to Limerick is on average 2-3 days. In some cases, the lead time depends on the sequence of the roundtrip.

It is interesting to notice that for example Samskip indicates that the transshipment (lead) time from Rotterdam to Cork is approximately 5 days. If we look at the data from the Navigate tool of the Port of Rotterdam, we can conclude that the dwell time in port is approximately 3 days, which matches with the range of 2-6 days.

4.5.4 PRIORITY HANDLING

In some cases priority treatment in terminal handling is being offered. European Gateway Services has a comprehensive and continually growing network of inland terminals spread across the European market. Some of these also function as an extended gate, meaning a direct extension of the deepsea terminals in Rotterdam and other seaports. Here you do not have regulate customs formalities, lead times are even shorter.

Another way to provide priority handling in port is in green lane treatment by customs for compliant and trusted economic operators (Authorised Economic Operator or similar schemes). For consolidated containers, the risk of customs interventions is higher, because the chance that one of the traders is not compliant is higher. A solution for this is that consolidators could apply service concepts where they consolidate only shipments from trusted traders together in a container.

However, the order in which the containers are loaded of the ship has a big influence on this. For example, if a container is on the last to get unloaded, this takes up a lot of extra time. Priority handling can be interesting in this case.

Maersk tried to design the Daily Maersk service to offer customers a premium product. This product gives customers guaranteed delivery times in return for higher freight rates. However, Maersk has effectively dropped this service. It was not a commercial success. Daily Maersk was launched in September 2011 to have a differentiated product for customers. There has not been a big enough demand to pay the premium it takes to run the service (Lloyd's Loading List, 2015).

4.6 COST ANALYSIS

A cost comparison between the cost of the SeaConAZ type of solution and the cost of the traditional solution for shipping a container from China to peripheral areas in North-West Europe is made in this chapter.

4.6.1 FREIGHT RATES

To get more insights in the current rates for shipping a container from China to peripheral areas, different sources are consulted. It depends on the origin port and destination port, the type of cargo and the volume of the cargo what the rates are.

To give an indication of the rate to ship a container, a difference between FCL (Full Container Load) and LCL (Less than Container Load) has to be made. In case of FCL, a difference between a 20ft container, a 40 ft container, and a 40ft High Cube (HQ) exist. The difference is the size of the container. It is interesting to notice that the rates for a FCL and LCL are rather volatile and subject to available capacity on the market and market power and negotiating power on the demand side.

First, the rates for a FCL are defined. To ship a container from China to Rotterdam two rates are compared (Zeevracht Calculator, 2017; SeaRates.com, 2017). The first rate is € 1,772 for a FCL 20ft and the second rate is € 1,318 for a FCL 20ft. A mark up of 30-60% is charged for a FCL 40ft container, depending on the size of the container (40ft or 40ft HQ). The first rate for a FCL 40ft is **€ 2,303 and the second rate is € 2,125 for a FCL 40ft. The first rate for a FCL 40ft HQ is € 2,418 and the second rate is € 2,125 for a FCL 40ft HQ. Overall, 63-77% of the rate of a 40ft FCL is the rate for a 20ft FCL. See**

Table 17 for the average rates.

Table 17 Average rates of FCL 20ft, FCL 40ft, FCL 40ft HQ from China to Rotterdam

Capacity	Average rate
FCL 20ft	€ 1,545
FCL 40ft	€ 2,214
FCL 40ft HQ	€ 2,272

Based on

Table 17, it can be concluded that a FCL 40ft is cheaper per weight/volume/shipment size than a FCL 20ft. The capacity of a FCL 40ft is twice the capacity of a FCL 20ft. The cost mark-up is 30-60%. If the average rates of a FCL 40ft and a FCL 40ft HQ are compared, a FCL 40ft HQ is still interesting. The capacity of a FCL 40ft HQ is 15% more than the capacity of a FCL 40ft, the rates are only 3% higher. Summarizing, the average transport rates do not increase proportional with the capacity in m^3.

The rate for shipping a container depends on the destination. The rate for shipping a container from China to Rotterdam is cheaper compared to the rates for shipping a container from China to peripheral areas, such as Ireland, Sweden and Norway. The rate for shipping a container from China to Felixstowe will probably be the same or a bit more expensive than the rate for shipping a container to Rotterdam. If the rate for shipping a container from China to Rotterdam changes, the rate for shipping a container from China to Felixstowe also changes. For other destinations, such as Belfast and Dublin a mark-up will be charged. This conclusion is based on the rates of Shenzhen CQ Cargo Logistics (reference day: 5 May 2017). Shenzhen CQ Cargo Logistics charges 1,350 USD (40ft) and 750 USD (20ft) for a container from China to Felixstowe. A mark up for Belfast and Dublin of 300-400 USD (40ft) and 100-150 USD (20ft) is charged. The rates are subject to extreme fluctuations. In Table 18 the rates for shipping a container from Rotterdam to Scandinavia via short sea by a central actor are shown.

Table 18 **Rates of FCL 45ft**

Origin port	Destination port	Rate per 45ft FCL
Rotterdam	Bergen	€ 1,650
Rotterdam	Gothenburg	€ 1,245
Rotterdam	Oslo	€ 1,825
Rotterdam	Stockholm	€ 1,860

The costs for preparing export documentation, Norwegian customs clearance costs and the costs for the first and last mile are excluded (reference day: 28 June 2017).

4.6.2 CONSOLIDATION OPTIONS

The business case for consolidation can be positive if bundling can be realized. It is interesting consolidate LCL shipments instead of shipping a LCL shipment in a FCL if the cost of bundling in a consolidation centre is lower than the additional transport cost for a FCL. The shipment order quantity is important to decide if consolidation is an interesting option. When ordering full container shipment sizes, the rate is relative lower, for LCL, a substantial mark-up is being calculated to compensate for consolidation activities and risk of low container occupancy rates.

However, there are a few factors to consider in case of LCL and FCL.

First, the benefits of LCL are mentioned:

- Low level of inventory in case of LCL: In case of having no money or space to accommodate a full container in a warehouse. Using LCL ensures shipping in smaller volumes in order to keep a steady flow of inventory.
- More free time to make delivery appointments in case of LCL: A delivery appointment is required for many final destinations. With an LCL shipment, the timeframe to pick up, deliver and return the container to the port is somewhat longer – usually about 5 days at the port, and then about 7 days at the deconsolidation center. This makes it more likely to get a delivery appointment before demurrage and/or detention fees will be charged.
- Splitting shipments is easier in case of LCL: Splitting shipments in case of delivery to for example multiple 3PLs is easier in case of LCL, because LCL allows to split the shipment, rather than sending multiple full containers.

Second, the disadvantage of LCL is mentioned:

- The delivery of LCL takes place slower than FCL: For a LCL shipment it is more complicated and requires some steps: consolidation of different shipments, processing multiple documents per container, and sorting the goods for each customer. The potential delay exists at each step.

Third, the benefit of FCL is mentioned:

- The delivery of FCL takes place faster than LCL: When a FCL shipment arrives at the port, it will be unloaded from the vessel and delivered to the buyer.

Fourth, the disadvantages of FCL are mentioned:

- High level of inventory, because a FCL shipment exists of a high volume.
- Less free time to make delivery appointments in case of FCL. In case of a FCL shipment the container have to be picked up, delivered, and returned to the port within about 8 days before demurrage and/or detention fees will be charged. In case of LCL this timeframe is longer.
- FCL does not allow for splitting the shipment.

Another important assumption is the break-even point at which the price of a large LCL load equals the price of a 20ft FCL container. This varies depending on the destination and the current state of the ocean freight market.

Based on two different sources, we assume that an average LCL shipment larger than 12.5 cubic meters costs more than a 20 ft container. The first source is Cargo From China (2016) which states that a LCL shipment larger than 15 cubic meters costs more than a 20ft container. The second source is an expert in the global freight forwarding market who states that a LCL shipment larger than 10 cubic meters costs more than a 20ft container. The break-even point for LTL is different. FTL makes sense when a LTL shipment consists of more than 10 pallets (where a FTL can carry up to 30 standard pallets safely) (Freightquote, 2015; Freightquote, n.d.). Also relevant in the transport ordering decision is the consequences for the lead time. Groupage or consolidation results in longer order-to-fulfilment time, this can add up several days.

4.6.3 BASIC ASSUMPTIONS

Based on the cost for shipping a container from China to peripheral areas in North-West Europe, a cost comparison between the cost of SeaConAZ type of solution and the cost of the traditional solution can be made. In the following tables the assumptions for these calculations are shown.

Table 19 Capacity assumptions for the calculations

	FCL 20ft	FCL 40ft	FCL 40ft HQ	FCL 45ft	FTL
Capacity (in m³)	33	68	76	74	88
Capacity used if the load rate is 85% (in m³)	28	58	65	63	75
Difference in capacity relative to a FCL 40ft	-51%		+12%	+9%	X

Table 20 Cost assumptions for the calculations

	FCL 20ft	FCL 40ft	FCL 40ft HQ	FCL 45ft	FTL
Rate China-Rotterdam	€ 1,550	€ 2,215	€ 2,275	X	X
Rate Rotterdam – Bergen	€ 1,120	€ 1,600	€ 1,650	€ 1,650	€ 2,235
Rate Rotterdam-Oslo	€ 1,240	€ 1,770	€ 1,825	€ 1,825	€ 1,650
Total rate China - Oslo	€ 2,790	€ 3,985	€ 4,100	€ 1,825	€ 1,650
Difference in rate relative to a FCL 40ft	-30%		+3%	X	X

Two other important assumptions which are mentioned above is that an average LCL shipment larger than 12.5 cubic meters costs more than a 20ft container and that a FTL makes sense when a LTL shipment consists of more than 10 pallets. Based on these assumptions the cost for a LCL and LTL shipment per m³ have been calculated. The rate for shipping a FCL 20ft from China to Oslo is € 2,790. The rate for a LCL shipment per m³ from China to Oslo has been calculated as follows: € 2,790 / 12.5 = € 223.20. The FCL 20ft rate is used, because the assumption is that an average LCL shipment larger than 12.5 cubic meters costs more than a 20ft container (FCL). The rate for shipping a FTL from China to Oslo is € 1,650. The rate for a LTL shipment per m³ has been calculated as follows: € 1,650 / 24.93 (24.93 is the capacity of 10 standard pallets with goods) = € 66.19. The FTL rate is used, because FTL makes sense when a LTL shipment consists of more than 10 pallets. The rates for Rotterdam – Bergen are calculated based on the rate for Rotterdam – Oslo. The reason for choosing Oslo and Bergen as destination is because it is assumed that in case of the SeaConAZ solution, bundling will take place on region (for example region Bergen). In case of the BAU solution, bundling will take place on country which means that all the shipments are shipped to Oslo. From Oslo hinterland transport is needed to for example Bergen. The trucking distance is much higher in case of the BAU solution compared to the SeaConAZ solution. For an overview of the cost per m³ LCL and m³ LTL, see Table 21.

Table 21 **Rates for each type of shipment Rotterdam - Oslo**

Type of shipment	Rates
LCL 1 m³	€ 223.20
LTL 1 m³	€ 66.19

4.6.4 OUTCOME COST ANALYSIS

Based on the assumptions mentioned above, the cost of the traditional solution (shipping in 20ft container, crossdocking in Rotterdam, feedering to Oslo and trucking to Bergen) can be calculated. The traditional solution means shipping a LCL shipment of 6 m³ in a FCL 20ft. The cost for shipping 1 m³ LCL has been calculated above. The costs for shipping a LCL shipment of different size is not linear. The distribution of the costs is according to an expert judgement as follows: +10% for shipping a LCL shipment of 9 m³ and +15% for shipping a LCL shipment of 6 m³ (see Figure 25). The costs for a LCL shipment of 9 and 6 m³ are based on the cost for an average LCL shipment of 12.5, which is the same as a FCL 20ft container (Table 22). The hinterland transport costs from Oslo to Bergen are calculated via a rate per kilometer.

Figure 25 **Rate for LCL shipment**

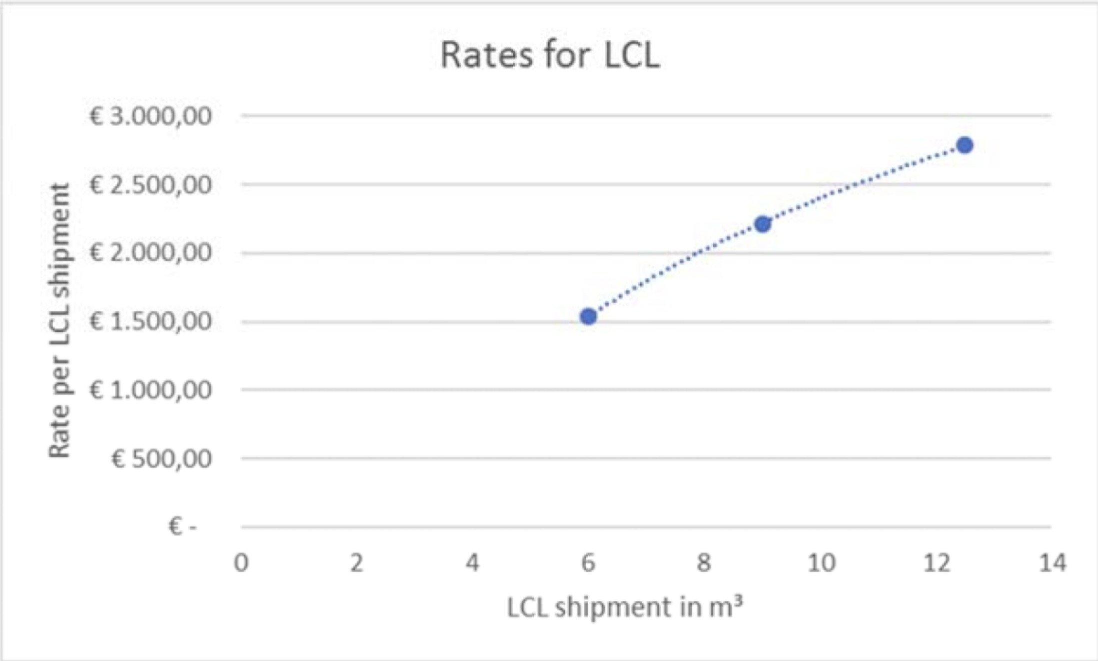

Table 22 **Rates of FCL 45ft**

LCL shipment in m³	Rate LCL shipment	Comments
6	€ 1,540	+15% on the cubic meter price
9	€ 2,209	+ 10% on the cubic meter price
12.5	€ 2,790	The FCL 20ft rate is used, because the assumption is that an average LCL shipment larger than 12.5 cubic meters costs more than a 20ft container (FCL)

Another traditional solution to ship a LCL shipment is shipping a 6 m^3 LCL shipment in a 20ft container to Rotterdam, then re-consolidation in Rotterdam and via road to Bergen. The costs for shipping a LCL shipment of different size from China to Rotterdam is not linear. The distribution of the costs is as follow: +10% for shipping a LCL shipment of 9 m^3 and +15% for shipping a LCL shipment of 6 m^3 (see Figure 25). Also the costs for shipping a LTL shipment of different size from Rotterdam to Oslo is not linear.

The distribution of the costs is as follow: +10% for shipping a LTL shipment of 12 m^3 and +15% for shipping a LTL shipment of 6 m^3. The rate for a LCL+LTL shipment of 6 m^3 will be € 1,359.20. The rate of the SeaConAZ type of solution if the LCL shipment of 6 m³ is shipped in a FCL 20ft will be € 571.12. If the LCL shipment of 6 m³ is shipped in a FCL 40ft via the SeaConAZ type of solution, the rate will be € 396.02.

Another cost efficient solution is shipping a LCL shipment of 6 m³ in a FCL 40ft to Rotterdam. The LCL shipment is stuffed with other LCL shipments in for example China. Subsequently, re-consolidation takes place in Rotterdam and from Rotterdam the LCL shipment will be shipped with other shipments with destination Bergen in a FCL 45ft. The rate for this solution will be € 428.85. An overview of the rates of the different solutions can be found in Table 23.

Table 23 Costs for each solution

Type of solution	Rates
BAU solution A	€ 1,587.00
BAU solution B	€ 1.359.20
SeaConAZ solution 20ft FCL	€ 571.12
SeaConAZ solution 40ft FCL	€ 396.02
Re-consolidation in Rotterdam	€ 428.85

Looking at the rate for each solution, it can be concluded that the SeaConAZ type of solution is an interesting solution if there is enough market volume to allow for delivery address consolidation (bundling at source). The Norwegian market is relatively small. Re-consolidation in Rotterdam is the second best solution.

The mainport function of Rotterdam offers potential to combine re-consolidation of deepsea LCL shipments of all oversea origins and possibly also continental LTL shipments. A note has to be made about the BAU solution. The BAU solution (LCL) requires an additional consolidation process in a warehouse which means extra handling costs. This is not the case with the other solutions. For the extra handling costs we do a rough estimate of 400 euros which is already included in the costs.

This analysis implicates that the solution with re-consolidation in Rotterdam and the SeaConAZ type of solution are cost efficient solutions. A note has to be made about the SeaConAZ type of solution, because the costs of this solution will be slightly higher due to the extra consolidation costs on the Chinese side. Despite these extra costs, the SeaConAZ type of solution remains a cost efficient solution.

4.7 CONCLUSIONS

The aim of this research was to further elaborate on the following topics:

- Supply chain structure of European retailers with a European Distribution Centre (EDC) in the Netherlands;
- The size of the container flows from China to peripheral areas, such as Sweden and Ireland;

- The current existing transshipment (lead) times and costs for shipping a container from China to peripheral areas, such as Sweden, Norway and Ireland.
- To what degree different service levels (e.g. priority handling) are offered in the port.
- Comparison between the cost of SeaConAZ type of solution and the cost of the traditional solution.

Concerning the common supply chain designs for European retailers the following can be concluded:

- The SeaConAZ concept seems to offer an alternative solution for several international fashion supply chains delivering to peripheral regions in Europe. China is a major production country, which is one of the reasons that there is huge potential to bundle. Another reason why the SeaConAZ solution is attractive for this branch is the fragmented retail distribution channels in Europe. In this branch about 90% of the total volume is towards SMEs. This type of enterprises orders small order quantities on pre-order Therefore, the concept of bundling at source creates possibilities to organize scale in procurement, increasing the buying power of SMEs. Branches, like the fashion branch, need to have parties, such as LSP-FASHION, that consolidate across shippers. They are so-called bundling service providers.
- In the electronics sector, the concept of a European Distribution Center and some satellite DC's in the peripheral areas is commonly used in the case when inventory is needed. In that case echelon inventory management is often applied. EL-MANU also applies this concept. Flows of products are bundled in order to have FCLs. The SeaConAZ solution is not applicable on this type of supply chain designs. EL-MANU is optimizing their current supply chain design, at which they deviate from the echelon inventory management. An example of this is sending directs shipments to the satellite DCs instead of sending it first to the European Distribution Center. There are potential opportunities in cooperating horizontally.

The data analysis of container flows from China to Sweden, Ireland and Norway shows that the size of the Norwegian imports from intercontinental countries is higher than the size of the Norwegian exports to intercontinental countries. The opposite is true for Sweden and Ireland. The analysis also shows some similarities. The first similarity is that China is the dominant non-EU import country for both Sweden, Ireland and Norway. The second similarity is that the product category ''household furniture'' is in the top 3 of import from intercontinental countries for both Sweden, Ireland and Norway. This also applies to the product category ''crude crop and forestry products of industry'' for the export to intercontinental countries from Sweden, Ireland and Norway.

With regards to the analysis of transshipment (lead) times from China to peripheral areas in North-West Europe, it can be concluded that the lead time from China to Norway is 35 days on average, the lead time from China to Sweden is 35.5 days on average, and the lead time from China to Ireland is 34.5 days on average. This includes the dwell time in transshipment ports such as Rotterdam. In case of priority handling, the lead time can be shorter.

The total costs associated with shipping a container from China to peripheral areas are subjected to extreme fluctuations due to market power and negotiating power. A distinction in costs has to be made between a FCL and LCL, and between a 20ft FCL and a 40ft FCL. The difference in costs between a 20ft FCL and a 40ft FCL is a factor 1.3-1.6. Overall, 63-77% of the price of a 40ft FCL is the price for a 20ft FCL. The mark up between a FCL and LCL is unknown, because in case of LCL there are a few factors to consider, such as the inventory level, the delivery time and splitting the shipments. However, the cost for an average LCL shipment larger than 12.5 cubic meters is higher than a 20 ft container. In case of a LTL shipment, FTL makes sense when a LTL shipment consists of more than 10 pallets. Based on some rates including these assumptions, the calculations show that the SeaConAZ type of solution is the cheapest solution, closely followed by re-consolidation in Rotterdam.

The SeaConAZ type of solution is interesting in case of enough market volume, because bundling is required for this solution. Another potential benefit of the SeaConAZ type of the solution is that the amount of transport kilometers via road is much lower compared to the BAU solution. The reason for that is the SeaConAZ type of solution bundles on region instead of on country. For the solution with re-consolidation in Rotterdam there is also enough market volume needed. However, this market volume exists because of the mainport function of Rotterdam, which offers potential to combine re-consolidation of deep sea LCL shipments of all oversea origins and possibly also continental LTL shipments.

It is recommended to elaborate the cost analysis in a more sophisticated model, because of the number of expert judgements. Verification of the numbers is recommended. There are a lot of sources which can used for verification.

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5 CASE IRELAND[10]

5.1 BACKGROUND

Newcastle University joined the SeaConAZ consortium in mid-2018 with a mandate to examine the China – Ireland container trades in the context of the key foci of the project i.e. can cost and environmental savings / benefits be realized through greater upstream (i.e. near to source) consolidation in the logistics chain. A particular focus too is to examine the potential for greater modal shift from road to sea on the final transport legs in Europe. The Newcastle team bring significant case specific expertise to the project. Professor Mangan spent the early part of his career working in Ireland (in both transport policy and in the commercial transport sector) and he is a Visiting Professor at the School of Business, Trinity College Dublin (the #1 ranked university in Ireland). He has an in-depth knowledge of the Irish transport and logistics sectors and the country's transport linkages. Mr. Sven Romijn is the Research Associate working on the project and recently completed a masters degree in marine transport at Newcastle (with first class honours). He gained some very valuable transport related work experience prior to commencing his postgraduate studies. Ireland represents a novel and interesting case in the context of the project's focus and aims, and should yield some interesting insights:

- The country has an import led, relatively affluent and high tech economy. Key exports include products such as pharmaceuticals and technology related products and services, while the domestic retail sector is heavily reliant on imported goods.
- Geographically Ireland (the Republic of Ireland – see the textbox below for a detailed description of the accepted terminology) is part of an island shared to the north with Northern Ireland (part of the United Kingdom). A land border exists on the island between both jurisdictions (currently a subject of much discussion in the context of Brexit negotiations and associated commentary), at present there is free movement of goods and people across this border as both countries are currently members of the EU (until March 2019 when the UK leaves the EU). There are no land links between the island of Ireland to Great Britain and Continental Europe (unlike for example the channel tunnel linking England and France). Geographically Ireland is at some distance from the economic center of gravity of the EU. At the time of writing the issue of Brexit is the single, largest factor that will have a major influence on future container flows to and from Ireland (both in terms of what is transported and how it is routed).
- The United Kingdom (a much larger economy by a factor of 8 – 10 depending upon the measure used) is Ireland's nearest neighbor and a key trading partner. Some non UK originating imports to Ireland and exports from Ireland to countries other than the UK traverse the UK 'landbridge' enroute to their destination. A key consideration for many exporters, importers and logistics companies given Ireland's smaller scale is whether to consider Ireland as (i) an import / export destination in its own right or (ii) combine product

[10] This section is based on a restricted project report written by The University of Newcastle. Information that could be linked to the informants is deleted or re-written in an anonymized form. The data collection for this analysis was conducted in 2018.

flows with those to / from the UK (because of the proximity of both countries) or (iii) combine product flows with those to / from certain Continental European countries (typically Belgium and the Netherlands) due to shared currency (Ireland is in the Euro Zone, as are Belgium and the Netherlands, while the UK uses Sterling).

- Due to both commercial (not sufficient volumes) and physical (depth and berth capacity) constraints the largest container vessels that call to Irish ports are typically three to four thousand TEUs, accordingly the deepsea container lines typically call to the larger UK and Continental European container ports with feeder services linking Irish ports with these deep sea services.

A Note on Terminology

The following are the commonly accepted geopolitical terms which are used in this report: Ireland (IRL) is the term generally used for the Republic of Ireland (ROI), the United Kingdom (UK) comprises Northern Ireland (NI) and Great Britain (GB) (with the latter comprising England, Scotland and Wales), and the British Isles is commonly used (usually in meteorology and geography) to refer to Great Britain and the entire island of Ireland. Note too that the UK comprises other dependencies (such as the Isle of Man, Gibraltar, Falkland Islands etc.) however these are not particularly relevant in the context of the focus of this report. Interestingly the Isle of Man lies between the island of Ireland and GB however its (largely service based) economy doesn't lead to any particularly significant trade flows between the proximate countries and thus it will not be considered further in this report. The term 'Irish' is generally used in an economic context to refer to 'of the Republic of Ireland' - hence 'Irish ports' are those located in ROI (but not NI) and that is the usage we will adopt in this report (culturally and socially however the term 'Irish' is sometimes used to include ROI and NI actors e.g. the 'Irish rugby team' comprises both ROI and UK citizens). There are many nuances and complexities around all of this terminology – these are obviously outside the scope of this report – this section usefully serves just to clarify the accepted terminology that should be used.

Note that LoLo refers to Lift-on/Lift-off container vessels and RoRo refers to Roll-on/Roll-off vessels (on RoRo vessels sometimes the tractor unit will accompany the RoRo trailer unit, hence the terms accompanied and unaccompanied RoRo).

Transhipping involves a loading unit moving from one ship to another while transloading involves unpacking the container and loading the goods into a different container or other loading unit.

Buyer consolidation involves the consignee (i.e. the buyer) bringing together different shipments into the one container which is delivered to the consignee. Commercial consolidation (also known as Groupage) involves mixing different shipments for different consignees in the same container.

Figure 26 Terminology applied in this chapter

All of the aforementioned issues will be detailed and discussed further in this report which is structured as follows: Section 5.2 outlines the methodology employed and data sources used; Section 5.3 gives an overview of the Irish economy while Section 5.4 describes both Republic of Ireland and Northern Ireland ports and transport linkages; Section 5.5 details the core statistical analysis around (mostly inbound) container flows and Section 5.6 details the qualitative analysis and adjudicates on the application of upstream consolidation, cost and environmental savings / benefits, and greater use of short sea shipping, in the Irish context.

5.2 METHODOLOGY AND DATA SOURCES

The project progressed primarily via two empirical phases viz. analysis of statistical and other secondary data, and interviews with key stakeholders. A literature search was also conducted to identify any articles of relevance to the subject matter. The statistical analysis was based largely on the available public / Government data sources. In the Irish context then these are the Irish Central Statistics Office (CSO)[11] , cross referenced against individual port reported statistics (as per their websites) and augmented too by (very useful and comprehensive) data reported in the quarterly publication The Irish Maritime Transport Economist published by the Irish Maritime Development Office (IMDO)[12]. Statistics on Northern Ireland ports were sourced from the UK's statistics of port traffic[13]. In addition AIS data showing LoLo vessels calling at Irish ports was sampled across a number of time periods to build up a picture of both the size of vessels typically calling to Irish ports and their origin / destination ports in the UK and Continental Europe. The insights from the secondary research were then explored via interviews and follow up telephone conversations / emails[14] with three key actors all of whom are especially familiar with container flows in and out of Ireland:

- The managing director of one of the leading feeder container lines operating in and out of Ireland.
- The managing director of a large importer and distributor of retail goods with multiple stores across the ROI.
- The senior buyer in the above large importer and distributor of retail goods with multiple stores across the ROI.

5.3 THE ECONOMY OF IRELAND[15]

Ireland (i.e. the Republic of Ireland) has been a member of the EU since 1973. The country has a population of 4.63 million with a higher concentration located along the Eastern seaboard of the country. Living standards are comparatively good – in fact Ireland has one of the highest scores in the EU for GDP per capita in purchasing power standard. There is (at present – i.e. prior to Brexit) a common travel area between Ireland and the UK however (as is the case too with the UK) Ireland has negotiated an opt-out from the Schengen area.

The most important sectors of Ireland's economy in 2016 were industry (38.9 %), wholesale and retail trade, transport, accommodation and food service activities (12.9 %) and public

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[11] https://www.cso.ie/en/statistics/transport/statisticsofporttraffic/
[12] https://www.imdo.ie/Home/site-area/statistics/maritime-transport-economist/irish-maritime-transport-economist
[13] https://www.gov.uk/government/statistics/port-freight-statistics-2017-final-figures
[14] To respect the confidentiality of the interviewees their names / companies are not detailed here but are known to the project leader.
[15] Sources: https://europa.eu/european-union/about-eu/countries/member-countries/ireland_en and https://www.imdo.ie/Home/site-area/statistics/maritime-transport-economist/irish-maritime-transport-economist

administration, defense, education, human health and social work activities (12.3%). The 1990s and 2000s saw the emergence of a strong and vibrant, but ultimately overheating, economy (aka 'the Celtic Tiger') which crashed in 2008 necessitating bail out assistance from the EU and the IMF. The economy has recovered strongly since with annual expansion of GDP for each of the past 6 years. GDP in 2017 was €296 billion and GNP €241 billion (GNP is lower in Ireland due to net outflows to foreign owned companies etc.). Ireland has a trade surplus of €45 billion with exports valued at €122 billion and imports at €77bn.

Table 24 illustrates the key import and export regions for Irish merchandise trade in 2017 (note that in this report our focus is merchandise trade only as opposed to all trade which would also include services). In volume terms however – given both domestic consumption and the value adding nature of production activity in the economy – there are more imports (40 million tonnes) than exports (18 million tonnes). Table 24 illustrates the top export and import commodities (in value and volume terms) in 2017.

Table 24 Origin / Destination of Irish Merchandise Trade (by value)
Source: Irish Maritime Economist, Vol 15, April 2018

Country / Region	Exports	Imports
EU	€63 billion	€45 billion
… of which UK	€16 billion	€18 billion
Non EU	€59 billion	€31 billion
… of which China	€4 billion	€1 billion

Table 25 Top export and import commodities (% shares by value and volume) in 2017
Source: Irish Maritime Economist, Vol 15 Pages 14-15 , April 2018

	Exports (Value)	Exports (Volume)	Imports (Value)	Imports (Volume)
1	Chemicals & Pharmaceuticals (55)	Crude Materials (25)	Machinery & Transport Equipment (39)	Mineral Fuel & Lubricants (34)
2	Machinery & Transport Equip (17)	Food & Live Animals (23)	Chemicals & Pharmaceuticals (23)	Food & Live Animals (21)
3	Misc Manufactured Articles (12)	Manufactured Goods (21)	Misc Manufactured Articles (11)	Crude Materials (20)
4	Food & Live Animals (9)	Mineral Fuel & Lubricants (14)	Food & Live Animals (9)	Chemicals & Pharmaceuticals (9)
5	Manufactured Goods (2)	Chemicals & Pharmaceuticals (7)	Manufactured Goods (7)	Manufactured Goods (8)
6	Crude Materials (1)	Beverages and Tobacco (4)	Mineral Fuel & Lubricants (5)	Machinery & Transport Equipment (2)
7	Beverages and Tobacco (1)	Machinery & Transport Equipment (2)	Other Commodities (3)	Miscellaneous Manufactured Articles (2)
8	Other Commodities (1)	Misc Manufactured Articles (2)	Beverages and Tobacco (1)	Beverages and Tobacco (2)
9	Mineral Fuel & Lubricants (1)	Animal & Vegetable Oils (1)	Crude Materials (1)	Animal & Vegetable Oils (1)
10	Animal & Vegetable Oils (1)	Other Commodities (1)	Animal & Vegetable Oils (1)	Other Commodities (1)

5.4 PORTS AND TRANSPORT LINKAGES

A list of the major ports and shipping operators in Ireland can be found at: https://www.imdo.ie/Home/site-area/statistics/ports-operators/ports-operators . Figure 27 illustrates the key ports in both the ROI and in NI viz:

- In NI: Larne (RoRo), Belfast (RoRo and LoLo) and Warrenpoint (RoRo and LoLo)
- In the ROI: Dublin (RoRo and LoLo), Rosslare (RoRo), Waterford (LoLo) and Cork (RoRo and LoLo).

A relatively strong and competitive logistics sector (hauliers, freight forwarding companies, 3PLs etc.) exists in both NI and the ROI with companies in both jurisdictions regularly handling freight flows in both jurisdictions. In the global Logistics Performance Index (LPI)[16] - which ranks country logistics performance across 160+ countries – Ireland was ranked #29 in 2018, although this is relatively good it is an actual decline since a high of #11 as recently as 2014.

Figure 27 **Key Ports in NI and the ROI**

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[16] https://lpi.worldbank.org/

We sampled AIS data on SeaNet to get an insight into the size and routing patterns of LoLo vessels calling at NI and ROI ports (Table 26). The largest vessel was (just) 1216 TEUs. It can be observed too that some vessels called to more than one port in NI / ROI; the previous port of call for most of the vessels was a UK, Dutch or Belgian port, with the exception of one vessel which was inbound from Spain (Bilbao).

Table 26 LoLo vessels calling at ROI and NI Ports. Source: SeaNet

Date	Time	Name Ship	Size	Current Port	Last Port	2nd Last Port
04/10/2018	14:00	BG Diamond	1004 TE	Belfast	Rotterdam	Cork
04/10/2018	14:00	Anna G	508 TEU	Belfast	Liverpool	Dublin
04/10/2018	14:00	Helga	822 TEU	Dublin	Southampton	Le Havre
04/10/2018	14:00	BG Emerald	1004 TE	Cork	Cork	Rotterdam
04/10/2018	14:00	Atlantic Comet	508 TEU	Cork	Rotterdam	Cork
06/10/2018	14:00	Samskip Express	803 TEU	Cork	Dublin	Rotterdam
06/10/2018	14:00	Elbtrader	972 TEU	Dublin	Dublin	Rotterdam
06/10/2018	14:00	BG Diamond	1004 TE	Dublin	Belfast	Rotterdam
06/10/2018	14:00	Elbfeeder	974 TEU	Dublin	Antwerp	Dublin
06/10/2018	14:00	Elbstrand	868 TEU	Dublin	Antwerp	Dublin
08/10/2018	09:00	Nordic Bremen	1036 TE	Belfast	Southhampton	Le Havre
08/10/2018	09:00	JSP Rider	804 TEU	Belfast	Rotterdam	Belfast
08/10/2018	09:00	Elbcarrier	974 TEU	Dublin	Rotterdam	Dublin
08/10/2018	09:00	Samskip Endeavou	803 TEU	Dublin	Rotterdam	Dublin
08/10/2018	09:00	Victoria	508 TEU	Dublin	Antwerp	Belfast
08/10/2018	09:00	Ruth Borchard	1216 TEU	Dublin	Liverpool	Leixous (Portugal)
08/10/2018	09:00	Endeavor	750 TEU	Dublin	Bilbao	Liverpool
08/10/2018	09:00	Arx	750 TEU	Dublin	Rotterdam	Dublin
08/10/2018	09:00	Anna G	508 TEU	Cork	Liverpool	Greenock
10/10/2018	14:00	BG Jade	1004 TE	Cork	Rotterdam	Liverpool
10/10/2018	14:00	Helga	822 TEU	Dublin	Southamption	Le Havre
10/10/2018	14:00	Jork	868 TEU	Dublin	Rotterdam	Dublin
10/10/2018	14:00	Mirror	803 TEU	Dublin	Rotterdam	Antwerp
10/10/2018	14:00	Victoria	508 TEU	Belfast	Dublin	Antwerp
12/10/2018	14:00	Endurance	750 TEU	Belfast	Antwerp	Belfast
12/10/2018	14:00	Anna G	508 TEU	Belfast	Liverpool	Dublin
12/10/2018	14:00	Elbtrader	972 TEU	Dublin	Rotterdam	Dublin
12/10/2018	14:00	Lisa	822 TEU	Dublin	Rotterdam	Dublin
12/10/2018	14:00	ARA Atlantis	868 TEU	Dublin	Rotterdam	Southampton
12/10/2018	14:00	Francop	822 TEU	Dublin	Southampton	Rotterdam
12/10/2018	14:00	Helga	822 TEU	Cork	Dublin	Southampton

Figure 28 shows the country destinations for liner (LoLo) services departing Irish ports in 2017 (only 5% of vessels have a first port of call outside of the following top 4 countries: Belgium, the UK, the Netherlands and Spain); Figure 29 is a similar representation but includes both origin (last port of call) and destination (next port of call) and uses CSO data. Figure 30 - also using CSO data - illustrates the region of port origin / destination for RoRo vessels calling at Irish ports. Finally, Figure 31 shows the spread of arriving LoLo vessels by ship size.

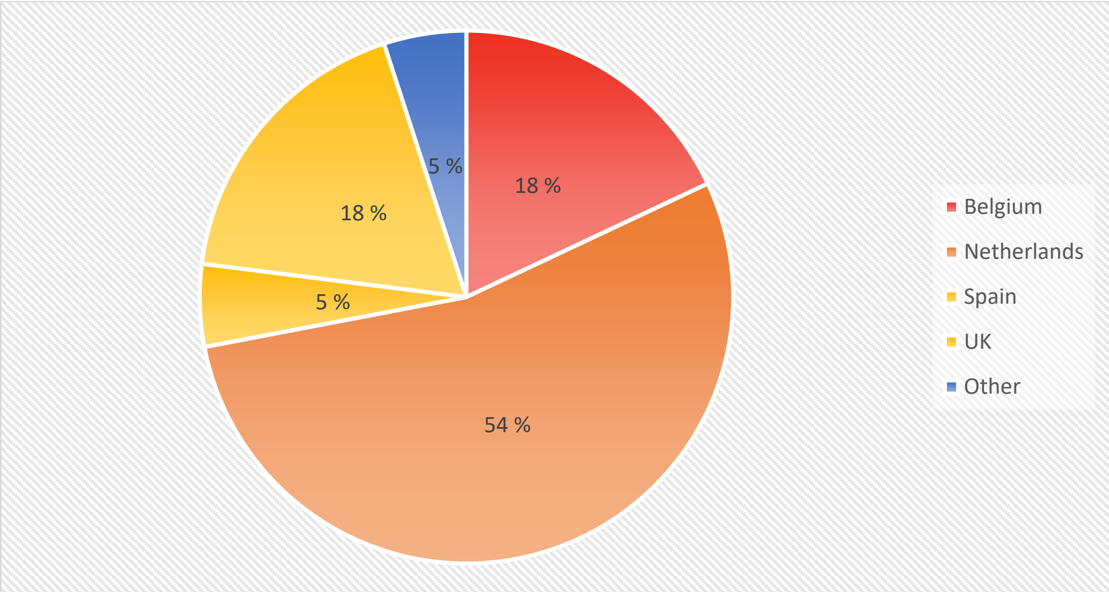

Figure 28 **Liner Service Destinations in 2017**
Source: Irish Maritime Economist, Vol 15, April 2018

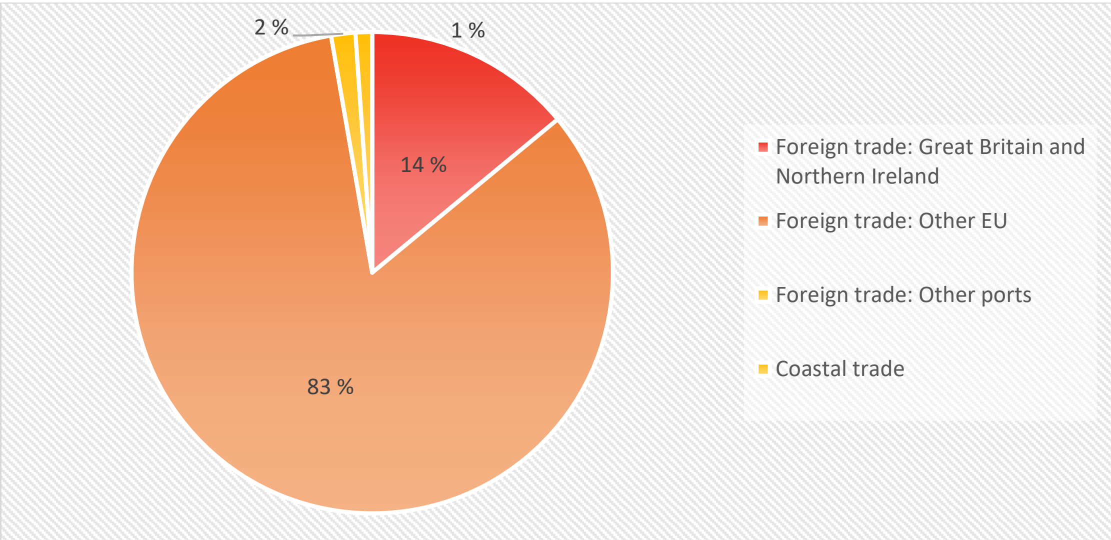

Figure 29 **LoLo Traffic (tonnes) both directions 2017. Source: CSO Statistics of Port Traffic 2017**

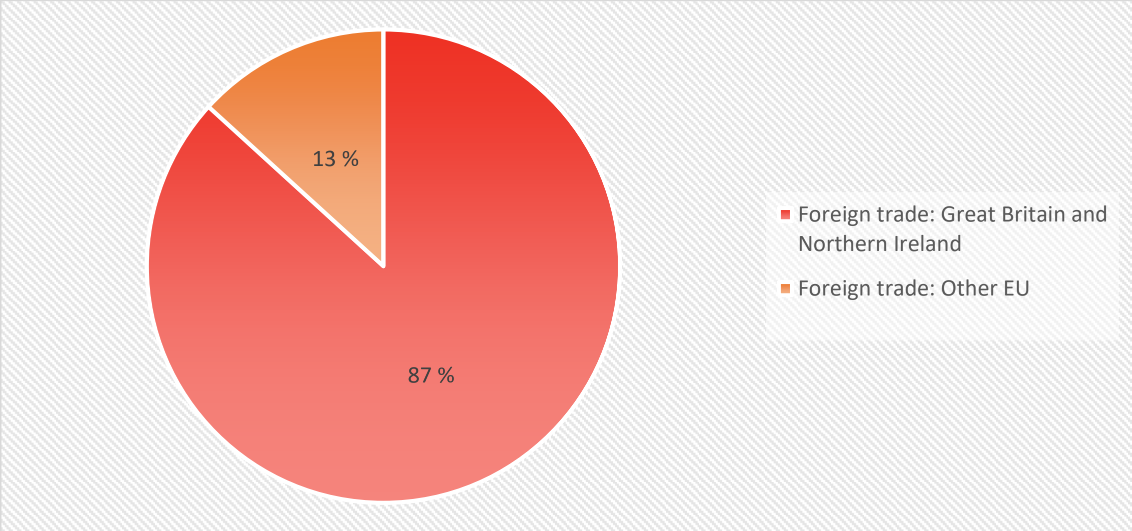

Figure 30 **RoRo Traffic (tonnes) both directions 2017. Source: CSO Statistics of Port Traffic 2017**

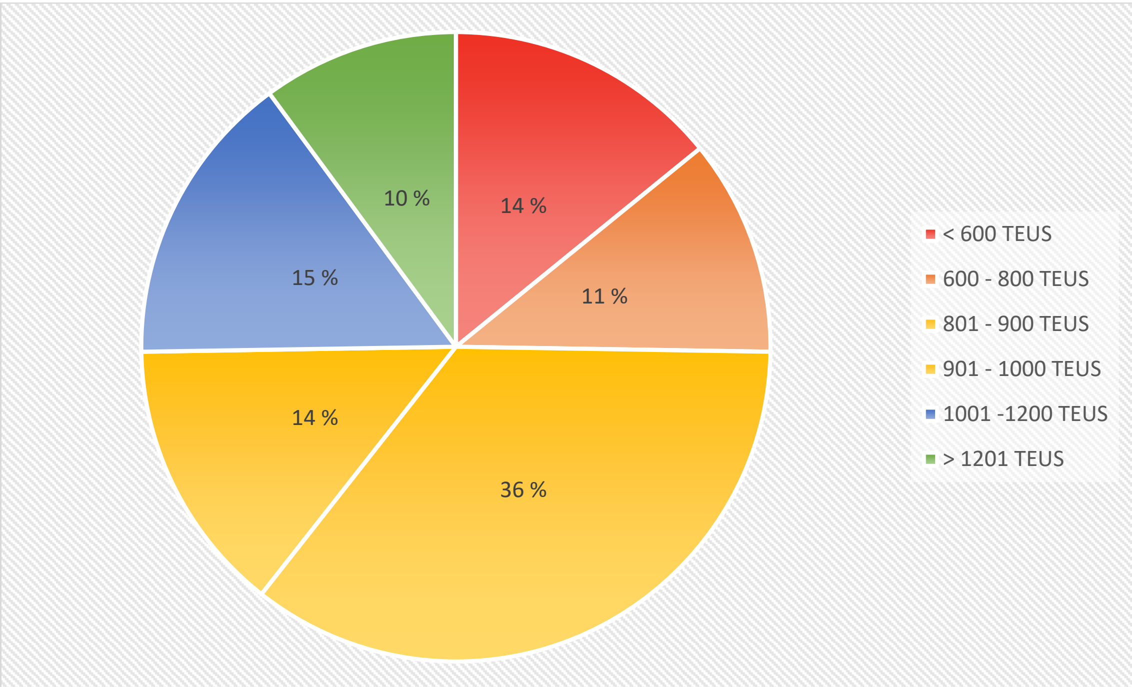

Figure 31 **LoLo Vessel Arrivals by Ship Size in 2017**
Source: Irish Maritime Economist, Vol 15, April 2018

Figure 29 and Figure 30 represent the origin / destination of LoLo and RoRo vessels – note this data represents the last / next port of call of the vessel and the country in which this port is located may not represent the actual country of origin / destination of the goods contained within the unit. For LoLo then the greatest share (83%) are to / from other EU ports (i.e. excluding the UK) – we can assume this includes both deep sea transshipped units plus units originating within /

destined to the EU. For RoRo the greatest share (87%) is to / from UK ports, these then will be a mix of UK originating / destined goods plus goods 'landbridging' across the UK enroute to / from other European ports. Note too that a very small LoLo coastal trade - true short sea shipping - also exists in the ROI (the road distance between Dublin and Cork ports is only approximately 160 miles).

5.5 STATISTICAL ANALYSIS

Figure 32 illustrates the shares of the different categories of maritime traffic in 2017. The containerized (LoLo) share is relatively small when measured by weight – this is to be expected as when measuring maritime freight activity by weight invariably heavier goods such as oil and coal dominate. Of more relevance are the relative shares of LoLo and RoRo, we will return to this point later. Figure 33 repeats the data illustrated in Figure 32 but also includes the total volume of cargo handled at all Irish ports.

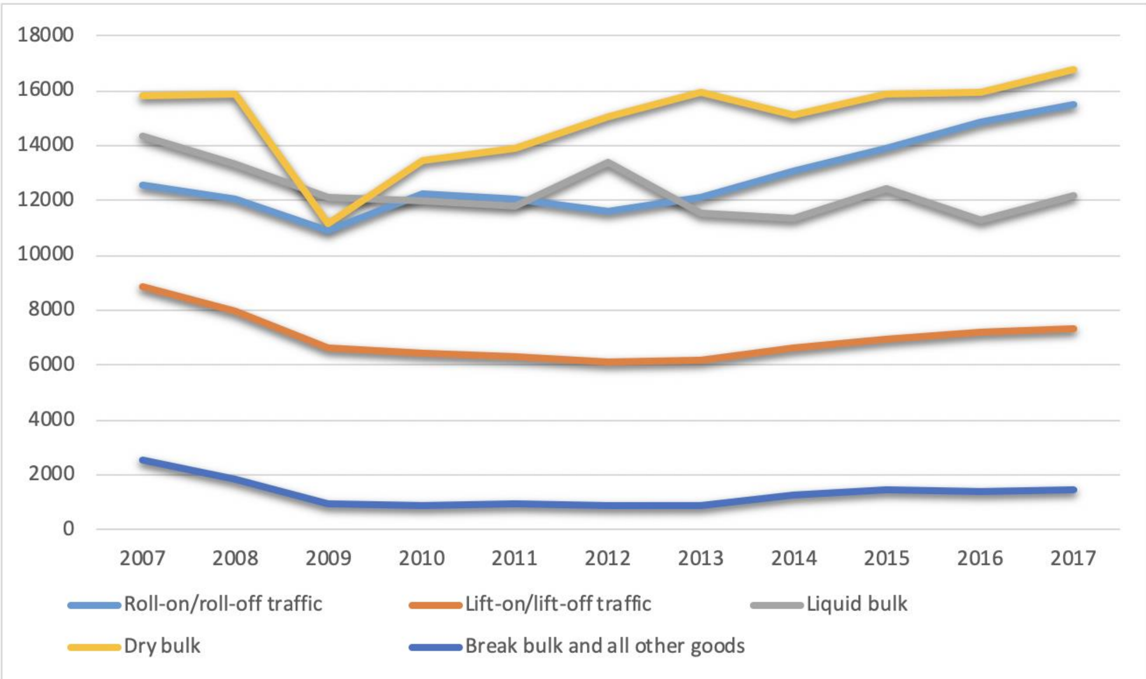

Figure 32 **Tonnage of goods handled by type of cargo and year**
Source: CSO Statistics of Port Traffic, various years

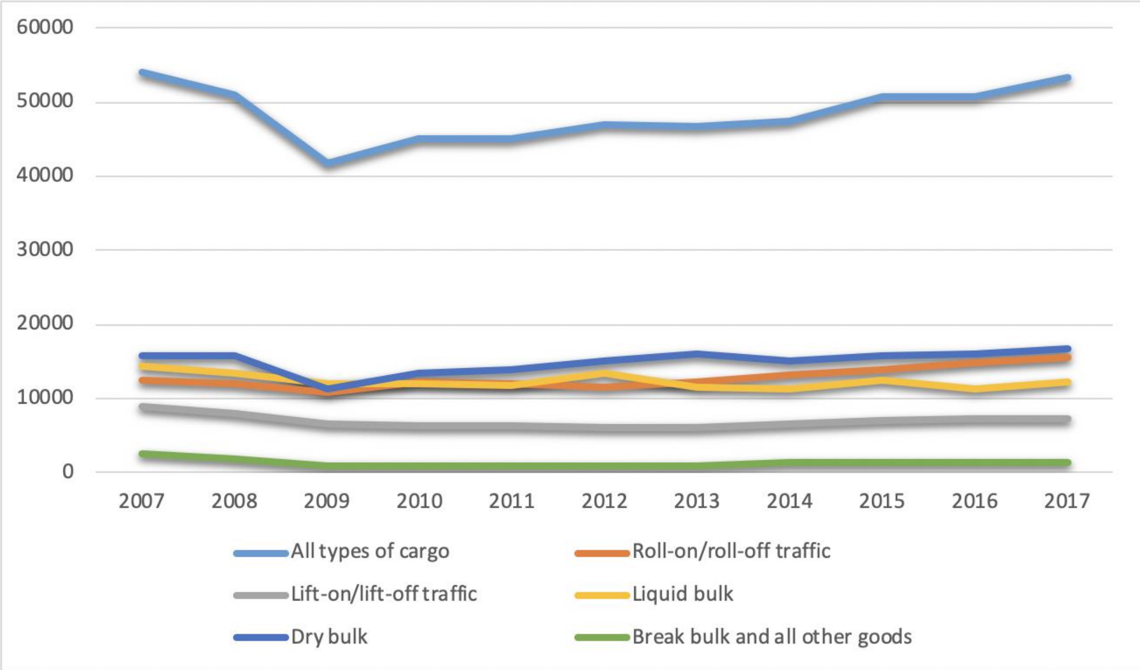

Figure 33 Tonnage of goods handled by type of cargo and year, and including ROI total volume
Source: CSO Statistics of Port Traffic, various years

Figure 34 illustrates the total tonnage of containerized (LoLo) goods handled at Irish ports since 1995. Volumes peaked in 2007 at the height of the economic boom and then declined suddenly and significantly with the onset of economic recession. Since 2013 volumes have started to recover, however they have yet to reach the peak enjoyed in 2007. A directional imbalance exists (54% imports as against 46% exports) – the differential however was much greater at the height of the economic boom in 2007.

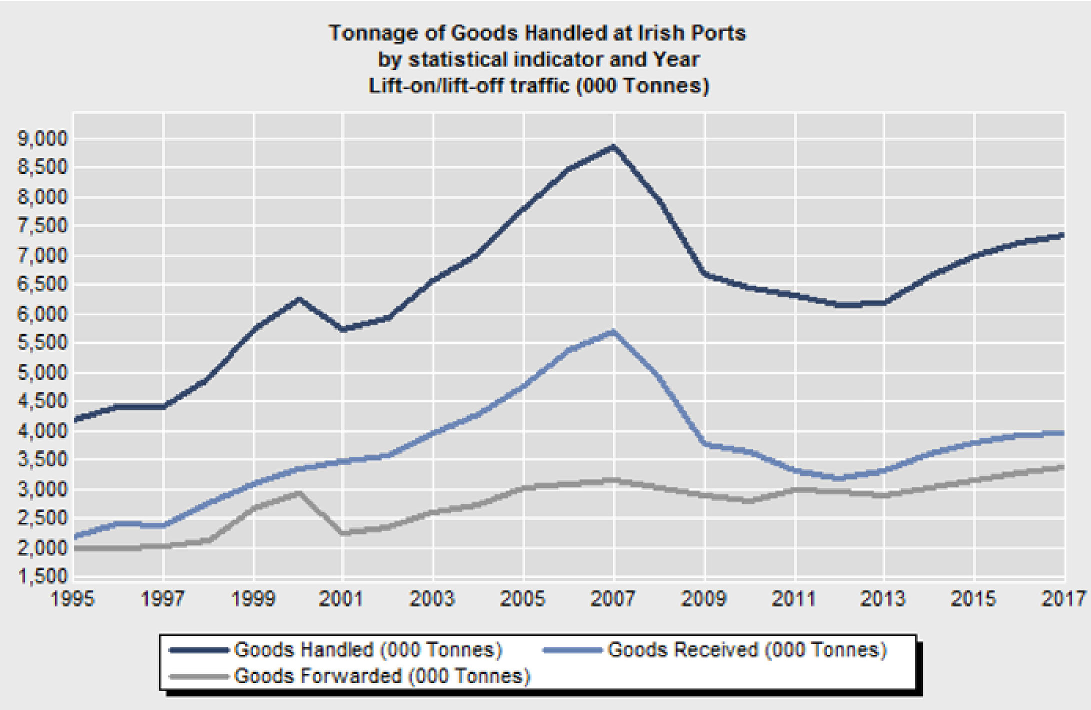

Figure 34 ROI LoLo Volumes. Source: CSO Statistics of Port Traffic, various years

Figure 35 illustrates container numbers since 2000. Again the 2007 peak, and subsequent decline and (partial) recovery, is evident. The total absolute number of units is significantly less than the number of TEUs which suggests that larger units (i.e. 40 foot FEU units) dominate. In fact the average number of TEUs per unit in 2017 was 1.79. Some 76% of units when measured in TEUs were loaded / partially loaded while 24% were empty (i.e. repositioning containers). The majority of the empty units were however on the outbound / export leg from Ireland (34% of export units were empty as opposed to only 13% of import units).

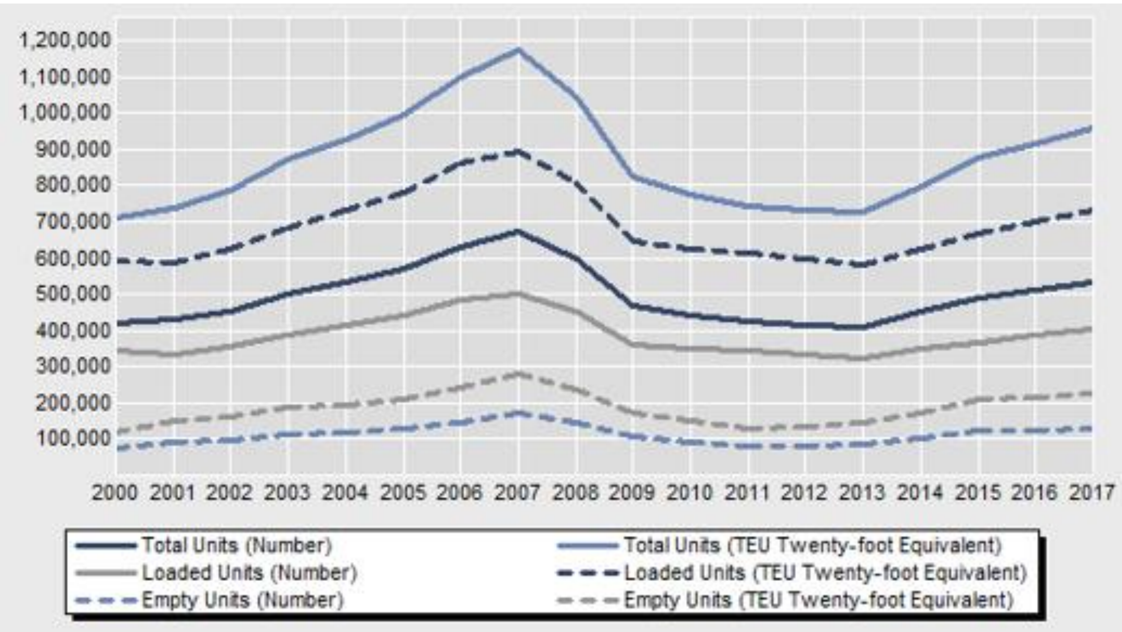

Figure 35 ROI LoLo Numbers. Source: CSO Statistics of Port Traffic, various years

Figure 36 illustrates how the average weight per TEU has changed since 2000. Overall this has declined across the time period to 7.7 tonnes per TEU (15.4 tonnes per FEU). Interestingly when the economic recession hit in 2008 the average weight per container increased suggesting greater efficiency / fewer empties etc.

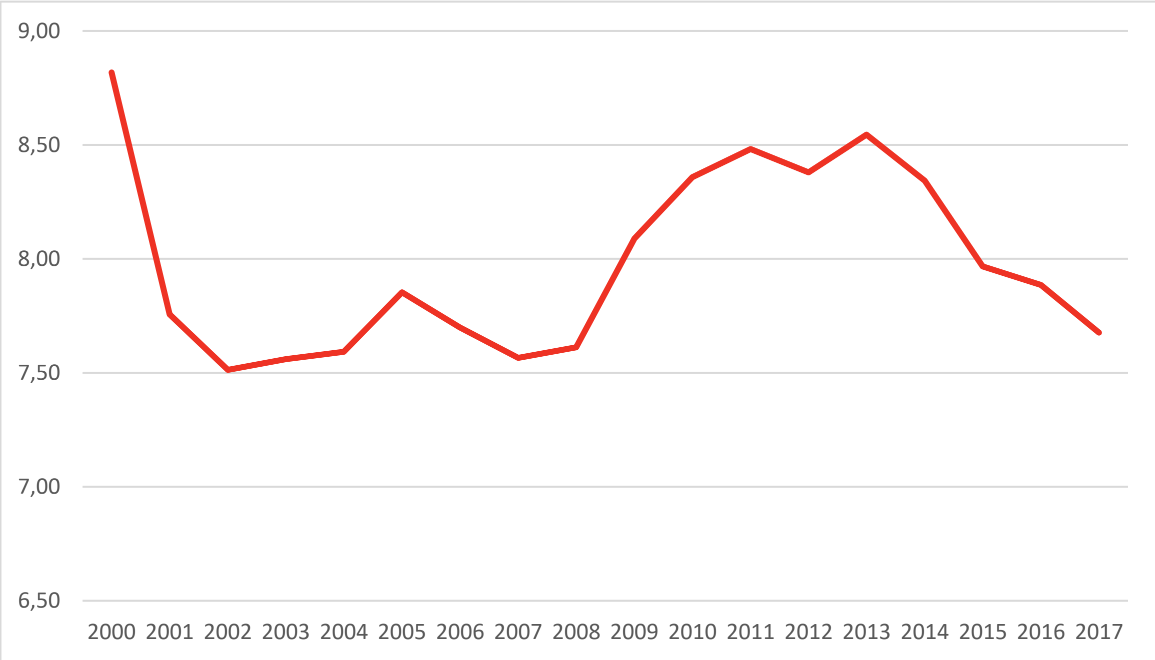

Figure 36 **Average number of tonnes per TEU**
Source: CSO Statistics of Port Traffic, various years

Some 15.5 million tonnes of freight were moved by Roll-on/Roll-off in 2017 in comparison to 7.3 million tonnes by LoLo. As with LoLo a marginal directional imbalance exists with 54% RoRo imports / 46% RoRo exports when measured by weight (in fact then the import / export splits for both modes (RoRo and LoLo) are approximately the same). Figure 37 shows the total tonnage of RoRo traffic handled at Irish ports since 1995. In 2017 approximately 1.12 million RoRo freight units passed through Irish ports.

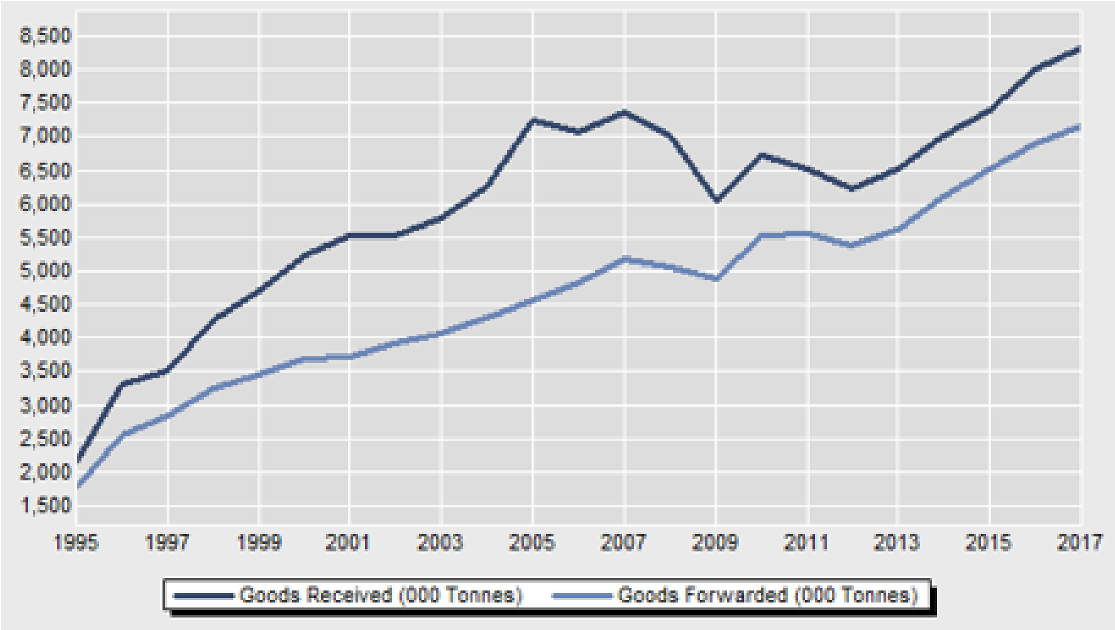

Figure 37 **ROI RoRo Volumes. Source: CSO Statistics of Port Traffic, various years**

Ports in Northern Ireland have traditionally played a significant role in facilitating inbound and outbound freight flows to / from the Republic of Ireland (especially for RoRo and to a lesser extent LoLo). It is not possible however from the available statistics to accurately measure the share of ROI traffic handled by NI ports. Three factors in particular have led to the disproportionate share of ROI traffic handled by NI ports:

- NI ports have traditionally been served by many competitive shipping services to GB. While the differential is less evident today, some two decades ago NI ports had more RoRo capacity than ROI ports.
- Of note is the fact that the sea crossing between NI and GB is shorter than that between GB and the ROI. This allows logistics companies to have more control over their transport chains – they can vary the landside road haulage leg (e.g. divert a truck to another port if a ferry is delayed) whereas they have no control over the sea crossing leg.
- A vibrant haulier base has traditionally existed in NI and it serves many customers both south and north of the ROI/NI border.

Figure 38 illustrates the total NI container trade since 2000. Two ports handle such traffic – Belfast and Warrenpoint – with the former (Belfast, 87%) handling the bulk of such traffic. With regard to RoRo, NI ports handled 846,000 units in 2017.

The split of LoLo activity at ROI (79%) vs NI (21%) ports broadly reflects the size of both economies however NI ports appear to have a disproportionate share of RoRo traffic – NI (44%) vs ROI (56%).

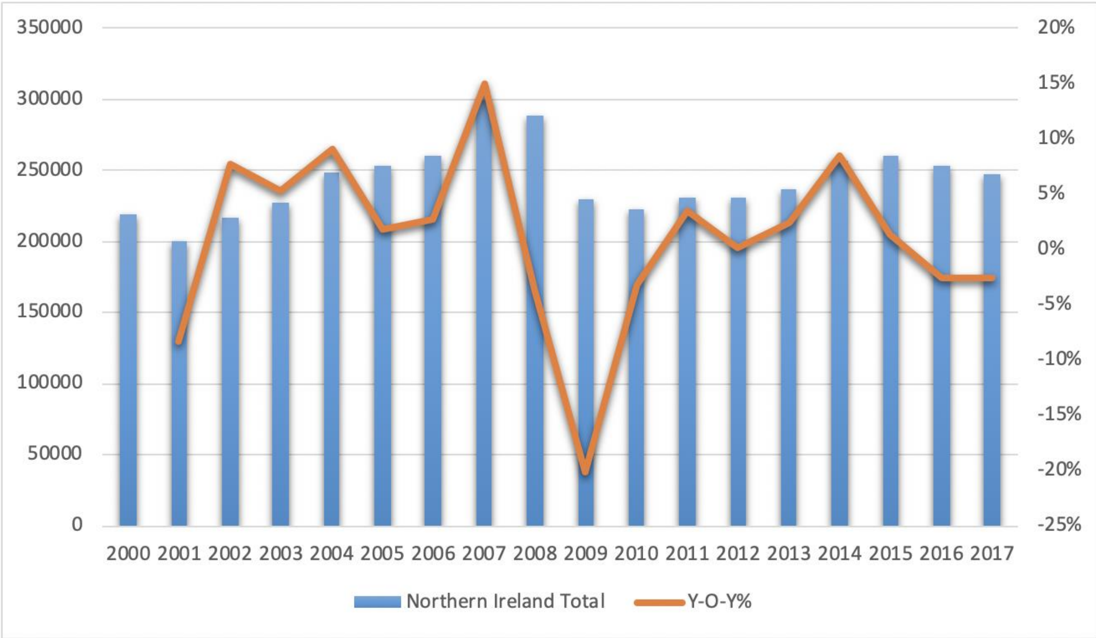

Figure 38 **Northern Ireland Container Traffic (TEUs, import and export combined)**
Source: Department for Transport UK Port Freight Statistics, various years

The particular focus of this study is goods coming from China to Ireland. Based on the preceding analyses we can assume that the bulk of these goods arrive into Ireland via LoLo feeder services having transshipped from deepsea liner services at Continental European ports. A smaller share of units will transship to Ireland via UK deepsea ports. Any goods that originate in China and enter Ireland via (the mostly ex UK) RoRo services are likely to have arrived into the UK or Continental Europe in LoLo units and were then transloaded into RoRo units for onforwarding to Ireland. Finally, a small volume of goods that originate in China will travel to Ireland via air freight. Figure 39 and Figure 40 illustrate the top export and import product groups by value to / from China. In both cases higher value, less bulky goods dominate and are suited to transportation via container.

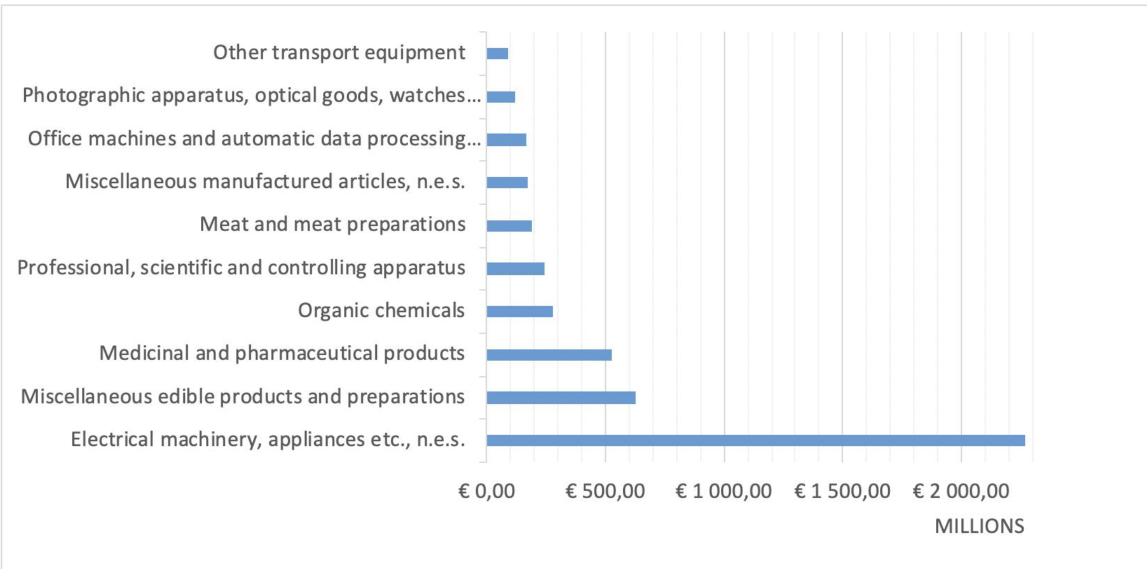

Figure 39 **Top 10 Exports from Ireland to China by Value. Source: CSO External Trade Statistics**

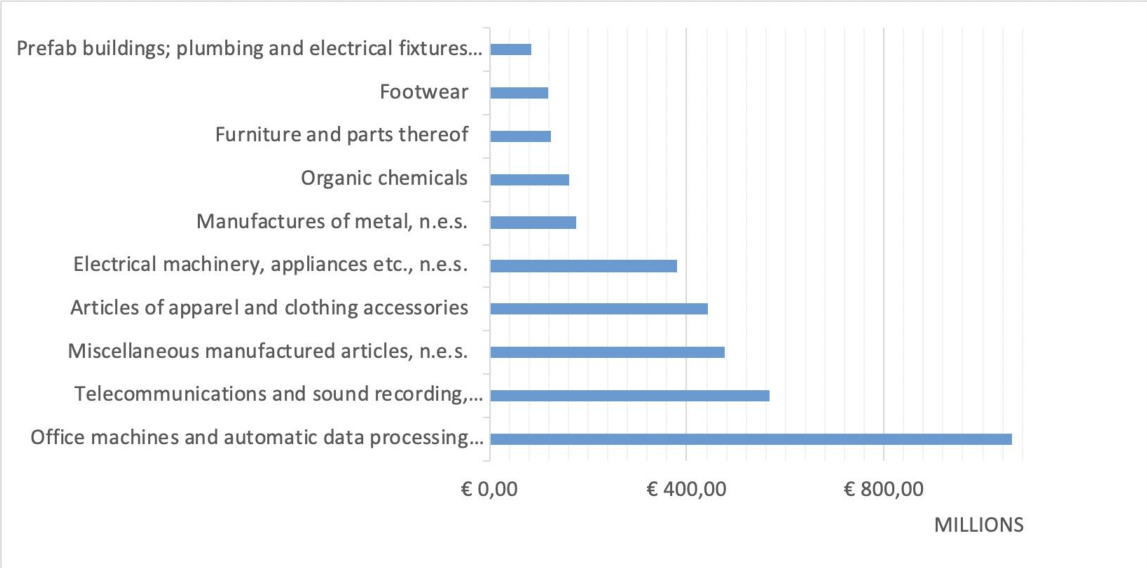

Figure 40 **Top 10 Imports from China to Ireland by Value. Source: CSO External Trade Statistics**

Bringing together the various strands of the preceding analysis we can conclude as follows:

- The bulk of imports from China to Ireland arrive into Ireland via LoLo feeder services having transshipped from deepsea liner services at Continental European ports (and a smaller share transshipping via the UK). While transshipment necessarily incurs a monetary and environmental cost it is not realistic to suggest – given how the global deepsea container sector is structured and operates – that there could or should be calls by deepsea vessels travelling from China at Irish ports. Typically such vessels operate a 'string' of calls at the major ports (e.g. China – Le Havre – Rotterdam – Hamburg – Southampton – China) and can have a capacity of over 20,000 TEUs. Our AIS analysis showed that the largest vessels calling to Irish ports are c.1200 TEUs. Note too that lower vessel capacity can allow higher frequency of calls. Similarly China cannot be considered as a single origin point – there are multiple origin ports in China which are quite a distance apart. Thus a direct service from one such port would not necessarily be of benefit to goods coming from a port serving another region. The deep sea trades are predicated on a model of hub and spoke shipping networks with shortsea feeder vessels servicing the deep sea vessels that call at hub ports in a string like network, and that model is likely to continue into the foreseeable future.

- Any goods that originate in China and enter Ireland via (mostly ex UK) RoRo services are likely to have arrived into the UK or Continental Europe in LoLo units and were then transloaded into RoRo units for onforwarding to Ireland. It is this category of traffic – which from the available statistics it is not possible to estimate - that we should look to converting from RoRo (which costs more and is more damaging to the environment due to the use of road transport) to LoLo.

- The split of LoLo activity at ROI (79%) vs NI (21%) ports broadly reflects the size of both economies, however NI ports appear to have a disproportionately higher share of RoRo traffic – NI (44%) vs ROI (56%).

- In 2017 approximately 1.12 million RoRo freight units carrying 15.5 million tonnes of freight, and 0.54 million LoLo units carrying 7.3 million tonnes of freight, passed through Irish ports.

- With regard to backhauls / directional imbalances in the case of both RoRo and LoLo, volumes of imports (54% share) are marginally greater than exports (46% share) however it is notable that over one third of export containers were empty.

Given these various insights the next section reports on our qualitative (interviews) analysis to gain insights into how (1) China – Ireland freight trades operate in practice and (2) highlight any opportunities that might exist to increase both upstream consolidation and to divert any downstream flows from RoRo to LoLo. As noted already it is not realistic to suggest that there could or should be direct China – Ireland (i.e. without any transshipment) LoLo flows (i.e. deep sea vessels calling at Irish ports) and this point was supported strongly by all of the interviewees; it will thus not be elaborated further.

5.6 QUALITATIVE ANALYSIS AND CONCLUSION

The interviewees identified two categories of unitized freight traffic flowing from China to Ireland:

- Containers transshipping via Dutch, Belgian and (less so) UK deep sea ports.
- Containers transloaded in the UK or Continental Europe from deep sea LoLo to a different loading unit (either another LoLo unit or a RoRo unit and typically via a distribution center). These include goods that are managed by multi region distributors outside of Ireland and will typically add destination country specific value to the product (e.g. labels and instruction manuals for the Irish customer) and also so called 'hotboxes' – units that originally travelled deep sea to a Dutch / Belgian / UK deep sea port which were then deemed urgent and travelled onwards to Ireland either on a RoRo Mafi trailer unit or the goods were transloaded into a RoRo trailer unit for onwards shipping to Ireland. The cost for shipping such a hotbox via RoRo just from the Dutch / Belgian / UK deep sea ports to Ireland can be €2,000 - €3,000 as against an end-to-end (China – Ireland) LoLo cost of c.€1,800 (plus THCs etc.).

It is not possible to calculate the % of Chinese originating traffic that is subsequently sent RoRo to Ireland, although the interviewees did reckon it was small (0 to 10% of all boxes).

Hotboxes arise because of

- the variability that can exist with transit times from China (typically 4 weeks but +/- X weeks)
- changing consumer demands (e.g. fashion trends), and

- errors that may have arisen (an example given was chairs shipped in containers but without cushions some of which then had to be air freighted)

As we saw via the analysis reported above the largest unitized freight flow into Ireland is RoRo units from the UK (which includes units landbridging the UK from Continental Europe). The interviewees were of the view that for UK originating / destined units it was unlikely given market structures that many such units could be converted to LoLo (due to various reasons including lack of rail freight in Ireland and JIT demand patterns necessitating fast RoRo freight flows to retailers in Ireland and other consignees). The category of RoRo units though that could be converted to LoLo are those from further afield i.e. Continental Europe. This would include the aforementioned China originating 'hotboxes', China originating freight that is managed at a Continental European distribution centre, and other Continental Europe originating freight. At present many Irish consignees (e.g. distributors of car parts, white goods etc.) receive inventory via RoRo from UK distribution centres – with Brexit some of these inventories are likely to relocate to Continental Europe with Ireland increasingly serviced from Continental European hubs via RoRo or (preferably) LoLo.

With regard to box sizes most goods travelling from China have a preference for high cube 40 foot boxes – in practice very few 20 foot boxes are used with them 'going out of fashion' according to one of the respondents. Such 'high cube' boxes cannot travel on Irish rail lines but given the small volumes of Irish rail freight this is not deemed to be a hindrance. The shipping line respondent noted that most China – Ireland freight is not palletized due to issues around the necessity to fumigate the wooden pallets upon arrival. The retailer supported this and showed us pictures of a typical container loaded in China with individual products (in this case domestic heaters) stacked individually (but not on a pallet). This would then lend itself to the container not being transloaded (i.e. unpacked and goods transferred to a different (possibly RoRo) loading unit) but instead the single sealed container flowing all the way (via transshipment) to the consignee in Ireland.

The respondents noted that minimum order quantities (MOQs) from Chinese manufacturers are such that for most consignees in Ireland their goods are packed into dedicated containers (or multiples of such containers) – less than full and full containers are thus the norm. Two points are worth noting here:

1. There appears to be little demand among Irish importers and their logistics service providers for use of commercial consolidation / groupage for China originating imports; the importers appear to prefer having their own dedicated full and less than full (if necessary) containers. Mixing in goods for other consignees in the same container appears not to be the norm.
2. Most China – Ireland container flows appear to be single origin consignor – single destination customer. If there are different goods / SKUs within the container they will typically be from the same manufacturer. The Irish based importers do not appear to have the interest in and / or on the ground capability in China to mix products from different manufacturers / consignors in the same container (i.e. buyer consolidation).

Most transactions are executed on an FOB (free onboard) Incoterm basis. Typically the container and the goods inside are inspected by an agent on behalf of the consignee and then sealed into the single (or multiple) consignee specific container(s). It would appear to be the case that - given consignee's demands for ensuring product quality and integrity, the long lead time from ordering to receiving goods, and their risk exposure if things go wrong – consignees have a preference for single load containers that are sealed at origin and transit unhindered to the consignee's premises.

The respondents noted that a wide variety of product types are now suited to containerized transportation from China including for example perishable (and relatively low value) chicken. It was noted too the ‘Belt and Road Initiative’ / One Belt - One Road initiative’ of the Chinese government may lead in time to more efficient containerized freight flows from China. It was noted too that with a growth in slow steaming (driven in part by environmental concerns but likely more so by the potential for fuel cost savings) end to end transit times lengthen – but this in turn leads consignees to demand more end to end containers rather than transloading contents via a distribution center.

6 APPENDIX

6.1 RESEARCH INTERVIEWS

We have conducted a series of research interviews with industry actors in several countries. The full transcripts of interviews are kept confidential to protect the integrity of informants and the companies they represent. In addition to interviews, case companies have contributed with a lot of detailed information informing the case analyses related to costs, lead times and environmental performance. This information is mainly contained in the PhD thesis related to the project.

Table 27 Research interviews conducted under the SeaConAZ Project

#	**First Round of Interviews Conducted in 2015**	
	Interviewers	*Interviewee anonymized*
#1	MFM	Norwegian port
#2	ENU	Scottish freight forwarder
#3	GU	European LSP and retailer
#4	LJMU	UK retailer
#5	MUC	Scandinavian LSP
#6	TNO	Scandinavian LSP-branch of manufacturer
#7	TNO	Scandinavian LSP
#8	TØI	Logistics branch of Norwegian retailer
#9	WUT	Chinese cargo manufacturer
#10	WUT	Major Chinese/International LSP
	Second Round of Interviews Conducted in 2016	
	Interviewers	*Interviewee anonymized*
#11	MUC	Major Chinese/International LSP
#12	MUC	Chinese Maritime LSP
#13	MUC	Chinese Maritime LSP
#14	MUC	Major Chinese/International LSP
#15	MUC	Scandinavian LSP, Chinese branch
#16	MUC	European LSP, Chinese branch
#17	MUC	European LSP, Chinese branch
#18	MUC	Scandinavian LSP
#19	TØI	Norwegian retailer
#20	LJMU	UK retailer
#21	TNO	A series of interviews with Dutch LSPs and cargo owners, feeding into European Hub analysis no 1
#22	TNO	Interview with the Port of Rotterdam

#23	TNO	Interview with Dutch Customs authorities

Third Round of Interviews Conducted in 2017

	Interviewers	*Interviewee anonymized*
#24	TNO	Interview with European Wholesale retailer within apparel industry
#25	TNO	Interview with International Electronics Manufacturer and Retailer
#26	MFM	Scandinavian LSP
#27	MUC	Scandianavian LSP, Chinese branch

Fourth Round of Interviews Conducted in 2018

	Interviewers	*Interviewee anonymized*
#28	TØI	Norwegian retailer
#29	TØI	Norwegian retailer
#30	TØI	Norwegian retailer
#31	TØI	International manufacturer, Norwegian branch
#32	N UNI	Major Irish retailer
#33	N UNI	Major Irish LSP
#34	MFM	Norwegian retailer

6.2 PRESENTATIONS HELD AT THE INDUSTRY SEMINAR "SMART SOLUTIONS IN THE CHINA-SCANDINAVIA LOGISTICS – WHAT COULD BE ACHIEVED WITH RESPECT TO COST- AND ENVIRONMENTAL SAVINGS" (AT THE CONFERENCE "TRANSPORT OG LOGISTIKK 2018", GARDERMOEN OCT 22ND)

The seminar was partly conducted in Norwegian. Chaired by project leader Harald M. Hjelle.

6.2.1 ANDREW SOUCH, GREENCARRIER FREIGHT SERVICES SWEDEN AB: THE RAIL SILKROAD ALTERNATIVE – A SMART AND EFFECTIVE SOLUTION

Short agenda

- Short Introduction Greencarrier
- Brief history of the silk road
- Some current facts and figures
- The products environmental impact
- Development for the Norwegian market

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Introduction – who are we?

- Greencarrier Freight Services is one of the Nordic regions largest privately owned and independant forwarders.
  - Coverage in 12 countries
  - Approx 650 employees
  - Ocean, Air, Rail and Road products and projects.
  - Fokus markets, Nordics and China
  - Norway – 7 offices / approx 140 employees
    - Offering all products, terminal and port logistics, energy and project cargoes
  - China - 7 offices / approx 100 employees

- Sustainability
- Greencarrier Spirit – CRM Corporate Social Responsiblity
- Environment

- Professional handling of all types of cargo in partnership with our customers

- Sister companies - Greencarrier Liner Agency; Nordic Consolidators; MTA.

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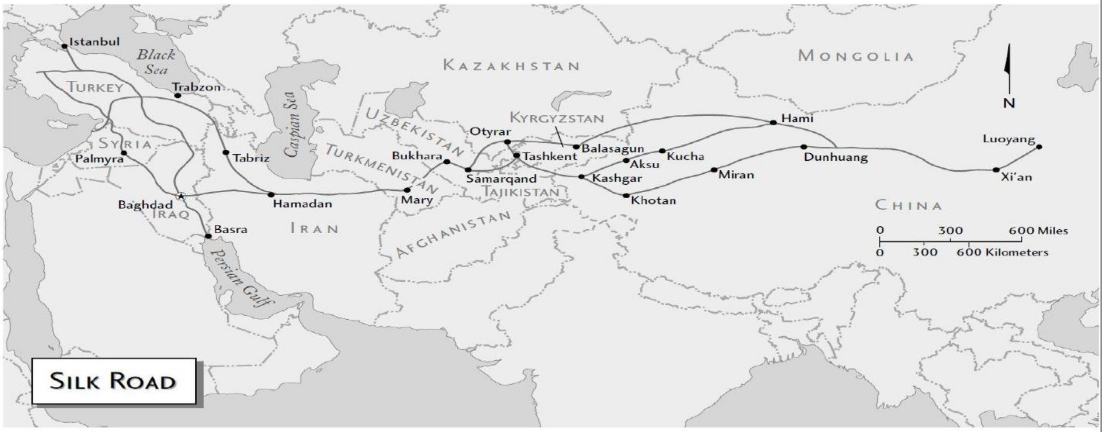
Silk Road 200 BC – early beginnings



How the original silk road started, with trade betweens countries and cultures driving development forward.

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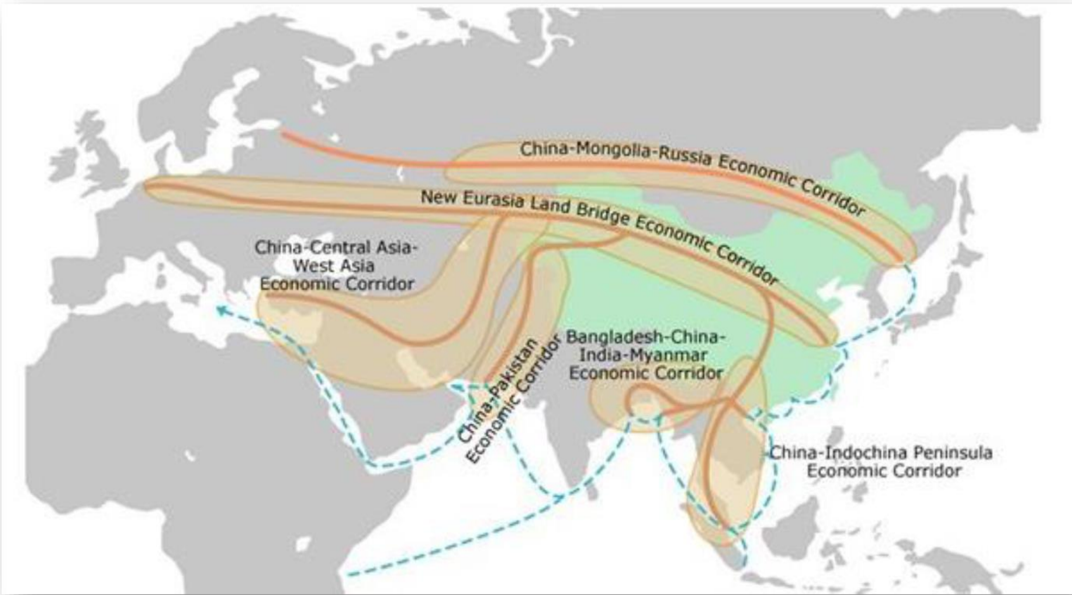
Silk Road 2018 AD – current status



This page is illustrating the 7 key routes of the belt and road initiative. China has planned 1 trillion USD of investments by providing loans at a low cost to the countries involved.

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EEU – Eurasian Economic Union 2015

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Organisational chain of Eurasian rail cargo transport

Organization of Eurasian rail cargo transports – train set-up and container shipment

Set up of trains

Chinese regional governments
↓ Own and finance local logistics platforms
Logistics platforms
↓ Tender the organization of trains from Chinese border (west- and eastbound)
Operators
↓ Organize trains through subcontracting
Carriers

Shipping of containers

Shippers
↓ Task forwarders with transportation of containers door to door
Forwarders/Operators
↓ Choose transport modes and get offered/find terminal to terminal trains by logistics platforms
Logistics platforms
↓ Use the trains previously set up
Operators
↓ Use the trains previously organized
Carriers
↓ Transport the goods through respective countries
Forwarders/Operators
If required: Perform terminal to door transportation

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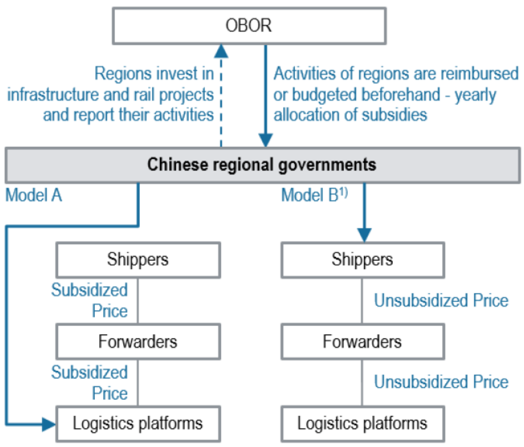
Subsidies are most often used by logistics platforms– First signs of consolidation visible

Deep Dive: Rail freight subsidies in China



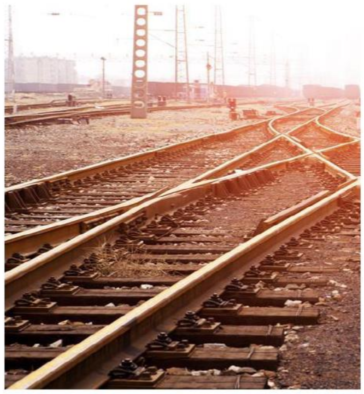
1. Subsidies are part of OBOR program
   - Amounts differ among regions in the range of USD 1.000–2.500/TEU
   - Examples for independent regional governments offering subsidies: Chongqing, Chengdu, Wuhan, Yiwu, Zhengzhou, Suzhou, Hefei
2. Subsidies are expected to decrease in the next years: While no official information is provided yet, some subsidies are currently planned until 2020 (e.g. Wuhan)
3. Moreover China's central government takes more control over the emerging complex network of Eurasian trains
   - Creation of the "China Railway Express" brand with thousands of new shipping containers bearing its new logo to replace the many individual brands in June 2016
   - Announcement of the creation of three main Eurasian routes with transshipment hubs for further distribution as part of the new five-year plan to improve the China-Europe rail network, in October 2016[2)]

GREENCARRIER

A few facts and figures - 2018

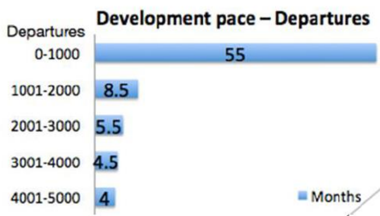
The trains:

- Capacity: 41-60 blocks
- China only accepts up to 41 blocks
- CIS countries up to 60 blocks
- 1 block: 1*40' or 2*20' containers



Development:

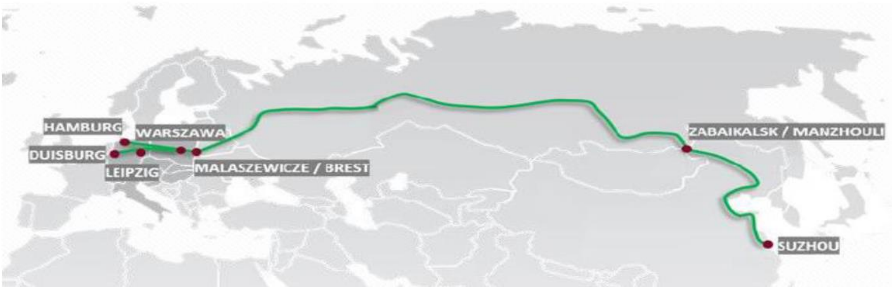
- Currently approx 45 hubs used
- 35 hubs → 2 main routes
  - Trans Siberian Railway (northern route)
  - New Eurasian Land Bridge (southern route)
- Pace of the development
  - 6235 departures
  - 2018: 4000 departures
- Target given on the Silk Road is 5000 FFE in 2020
  - 5% of total CN/EU volumes



Trans-Siberian railway

China → Russia → Belarus

- Transit times
- Faster trains
- Russian investments



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New Eurasian Lane Bridge - NELB

China → Kazakhstan → Russia → Belarus

- Stands for approxinmately 60 % of all rail freight to and from Europe

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Comparison

Shanghai – Hamburg	Sea freight	Air freight	Rail freight - current	Rail freight - future
Route distance	20.000 km	8.500 km	11.000 km	11.000 km
Transit time	30 days	2 days	17 days	**11 days**
Price	Low	High	Medium	Medium
Environmental impact	2.1 ton CO2	139 ton CO2	5 ton CO2	5 ton CO2

Dalian – Hamburg	Sea freight	Air freight	Rail freight - current	Rail freight - future
Route distance	21.500 km	9.000 km	10.000 km	10.000 km
Transit time	40 days	2 days	17 days	**11 days**
Price	Low	High	Medium	Medium
Environmental impact	2.1 ton CO2	139 ton CO2	5 ton CO2	5 ton CO2

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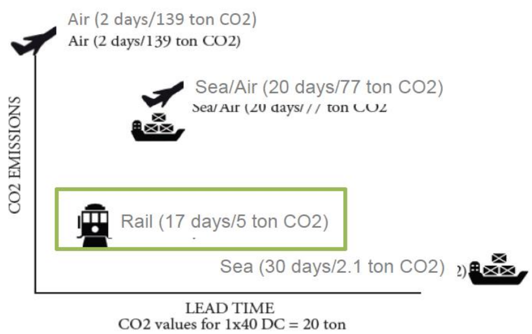
How much is CO_2?

- It takes the life time of 6 trees to convert 1 ton CO_2 into O_2
- An average North European tree converts 7 kg of CO_2 a year into O_2

O_2 = Oxygen = Air



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What are the benefits of using this for Norwegian companies?

- The rail freight product generates lower emissions compared to pure airfreight and any sea/airfreight combinations.
- The rail freight product has a door-door lower cost compared to pure airfreight and any sea/airfreight combinations.
- The rail freight product has a shorter lead time compared to seafreight regardless of pick-up point in China or in Norway.
- Quarterly rating provides a stable cost structure for customers to follow.
- Similar closing process as for seafreight.
- There is a lesser impact of bad weather than by seafreight.

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What are the current solutions for Norwegian companies to look for?

There are a number of different ways of importing products via rail into Norway today through various hubs in the Baltics, northern Europé (Warsaw, Hamburg, Duisburg etc) but two solutions which are probably the best from a lead time, pricing and quality perspective are the following:

China - Norway				
Solution via Finland				
Type	**Routing**	**No. of days**	**Terms**	**Comments**
Hub-Hub	Hefei - Helsinki - Oslo	21 days	FOR - Free On Rail	Bi-weekly import and export solution
Door - door	Hefei - Helsinki - Oslo	26-27 days	FOT - Free On Truck	Including pick-up and local handling in China and destuffing and distribution in Norway

China - Norway				
Solution via Denmark				
Type	**Routing**	**No. of days**	**Terms**	**Comments**
Hub - Hub	Hefei - Hamburg - Arhus - Oslo	18 days	FOR - Free On Rail	2 times a week from China
Door - door	Hefei - Hamburg - Arhus - Oslo	24-26 days	FOT - Free On Truck	Including pick-up and local handling in China and destuffing and distribution in Denmark/Norway

GREENCARRIER


Yes it´s Possible!
Think Rail, think Greencarrier
GREENCARRIER

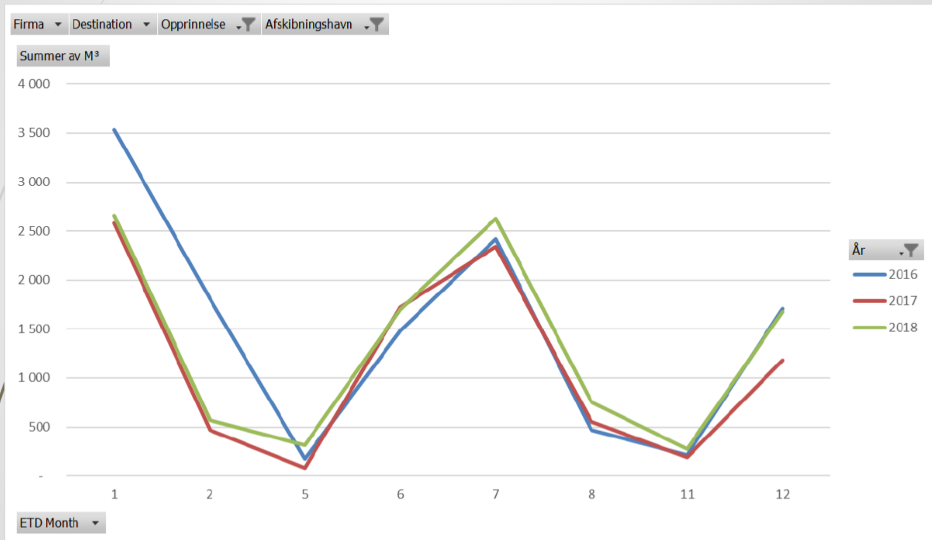
6.2.2 GEIR BROGÅRD-OLSEN, EUROSKO NORGE AS: DETTE OPPNÅR VI VED BRUK AV OPPSTRØMS KUNDEKONSOLIDERINGS-TJENESTER I KINA-SKANDINAVIA-HANDELEN

Crossdocking Historie

- **Pilot prosjekt i Shanghai Høst-2013 sesongen**
  - Startet med 6 ulike destinasjonshavner i Norge + 1 i Sverige
  - 3 ulike firmaer – Eurosko Norge, ESG SE & Økonomisko
  - Utviklet crossdocking software (AS400 basert) i samarbeid med Electronic Commerce Partners
- **Utvidet med Xiamen and Shenzhen Høst-2014 sesongen**
  - Reduserte destinasjoner til OSL + MSS i Norge og GOT i Sverige
- **Bonded warehouse**
  - Skiper hver artikkel iht leveringsplan i butikk
  - ColliCare oppretter nye dokumentsett iht containerinnhold

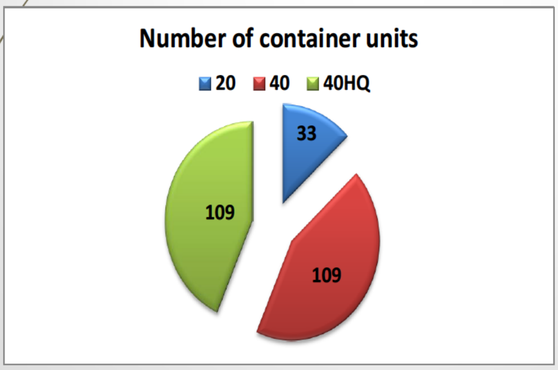
Crossdock volumer - 2018

Peak seasons



Fordeler Shipping

- **Økt fyllingsgrad i container** – fra 23 til 28 m3 pr TEU (TEU = 20 ft = ca 30 m3 kapasitet)
  - *Økt fyllingsgrad tilsvarer reduksjon av 84 TEU's (20ft cont.) pr år (2015)*
- **Eliminert LCL sendinger** fra Kina i peak season
- **Redusert 20ft containere** til et minimum



TEU = 20 ft container

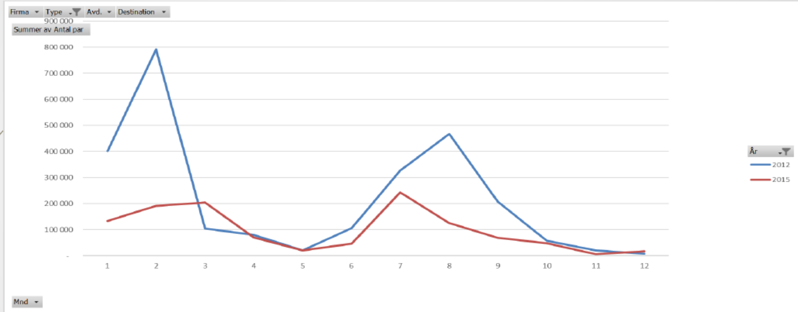
2015 = 469 TEU's

Total pairs from crossdock = 1 797 906

Average = 3 833 pairs per TEU

Målbare fordeler

- **Eliminert volumtopper i høysesong ved lager i Norge**
  - ***53 % av totalt importert volum går direkte til distribusjonsterminal***



- **Ekstra handling cost Kina går ca opp i opp med redusert sjøfrakt og redusert handling v/destinasjon**
- **Redusert arealbehov ved lager** (=reduserte kostnader)
- **Bedre forutsetning for flytting av lager til mer skalerbar løsning i 2017**

Ikke-målbare fordeler

- **Just-In-Time** reduserer lagring i butikk
- **Datafangst** på et langt tidligere tidspunkt
  - *Bedre planlegging på terminal/lager ved destinasjon*
  - *Bedre kontroll på etikettkvalitet og innhold i containere*
  - *Mer nøyaktige leveringsdatoer for butikkene og hovedkontor (automatiske oppdateringer til Eurosko ERP system)*
- **Automatisering** av operasjoner på hovedkontor
- **Kvalitetskontrol** av produktene
  - Mindre reising, mer sko på samme lokasjon

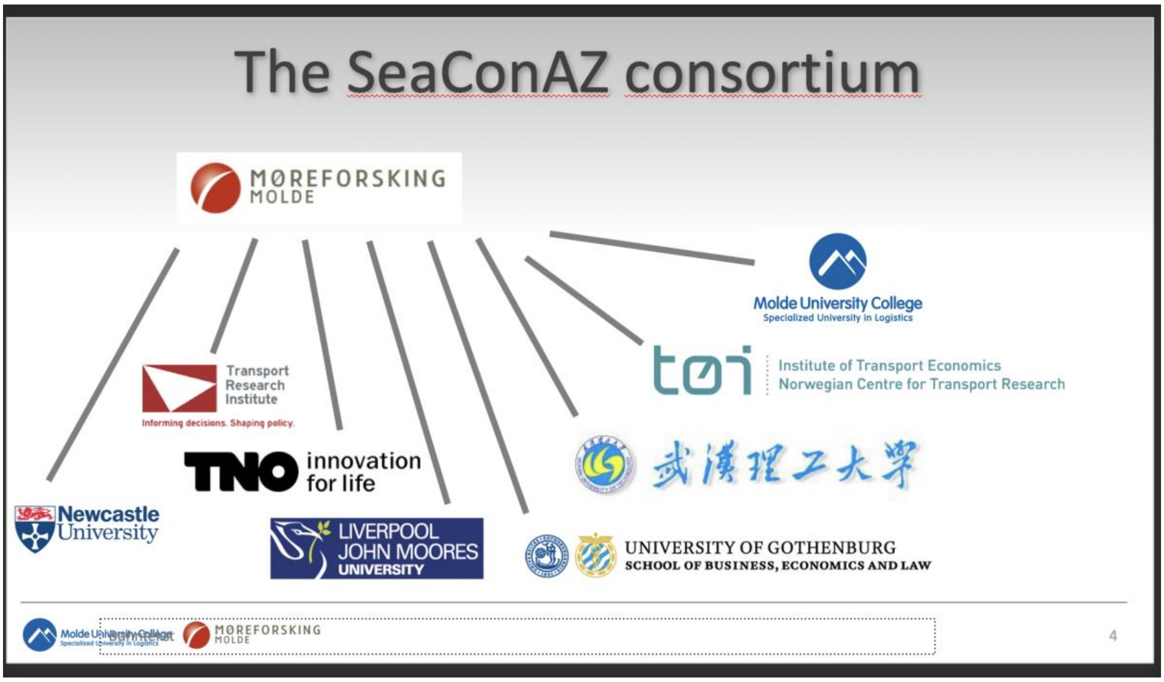
Utfordringer

- **Transittid**
  - Mister første avgang fra Kina Vs direct shipment
- **Uvant løsning for leverandører**
  - Enkelte forsøker å legge på prisen
- **Valutasvingninger** USD vs NOK (handtering faktureres i USD)
- Opprettholde **nødvendige volumer** for en effektiv vareflyt. Konkurranse fra;
  - Sports-/tekstilbransjen
  - Netthandel
  - Økt reiselyst
  - Vridning fra Private labels til etablerte merkevarer

Suksess faktorer

- **Kontroll på egen software**
  - Rask tilgang på utviklingsressurser/feilsøking
- **Direkte kommunikasjon**
  - Være tilstede, vise ansikt
- **Ikke endre på kulturen**
  - La de ta med elementer av sin måte å løse oppgaver på

6.2.3 HARALD M. HJELLE, MØREFORSKING MOLDE AS: KOSTNADS- OG MILJØGEVINSTER VED SMARTE LOGISTIKKLØSNINGER I KINA-SKANDINAVIA-LOGISTIKKEN



PhD Logistics student Ning Lin

- Doktorstudent tilknyttet prosjektet – har nylig levert sin avhandling til bedømmelse
- Vant prisen for beste masteroppgave i logistikk her på Gardermoen for noen år siden – da på temaet effektivitet i container-havner
- Det meste av det som presenteres her er hans analyser
- Han har gjennomført mye datainnsamling og intervjuer på kinesisk og europeisk side av verdikjeden

EU28's imports from China

Source: Eurostat (2018)

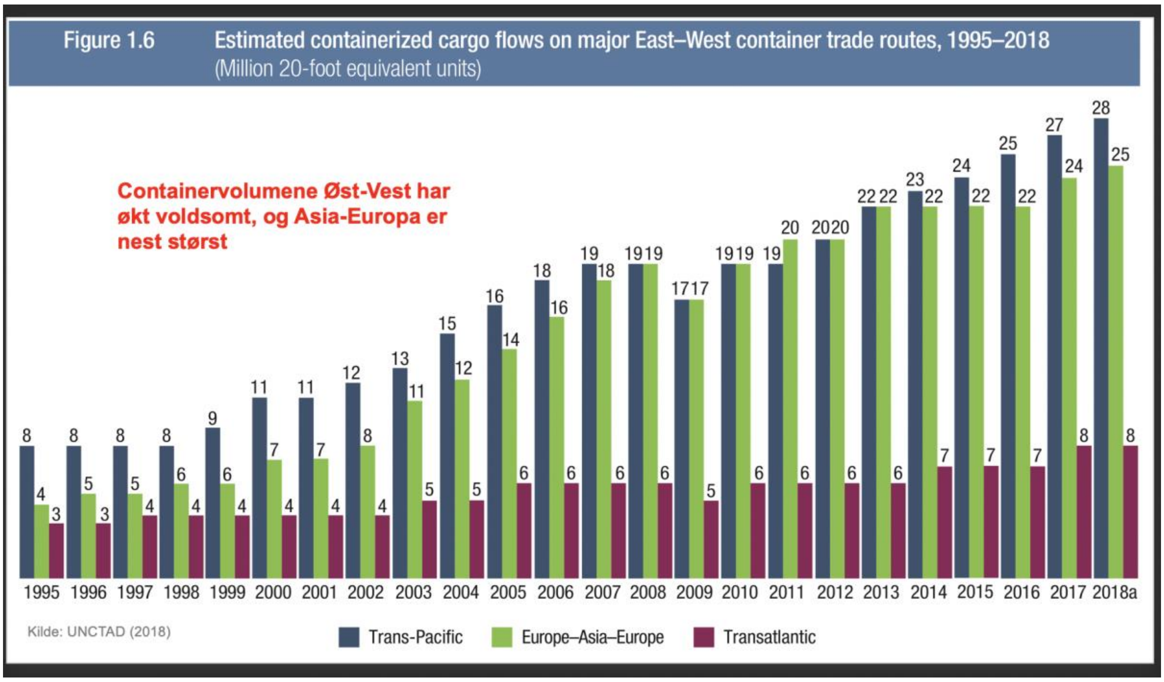
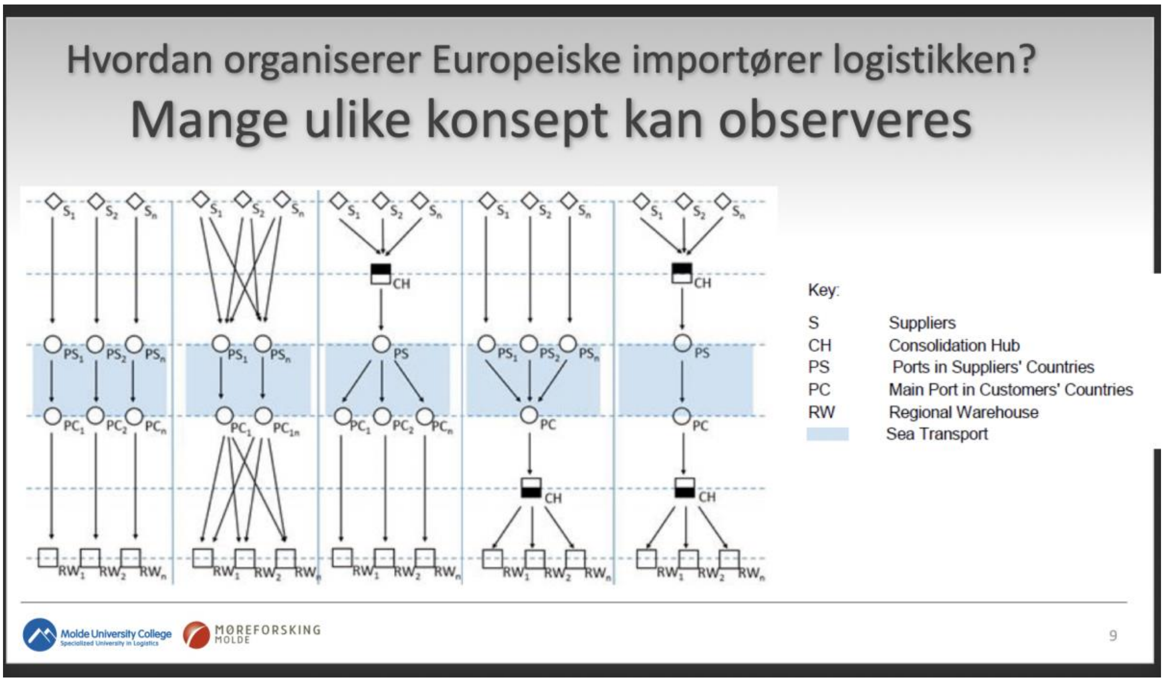


Figure 1.6
Estimated containerized cargo flows on major East–West container trade routes, 1995–2018
(Million 20-foot equivalent units)
Containervolumene Øst-Vest har økt voldsomt, og Asia-Europa er nest størst
Kilde: UNCTAD (2018)
Trans-Pacific
Europe–Asia–Europe
Transatlantic


Hvordan organiserer Europeiske importører logistikken?
Mange ulike konsept kan observeres
Key:
S Suppliers
CH Consolidation Hub
PS Ports in Suppliers' Countries
PC Main Port in Customers' Countries
RW Regional Warehouse
Sea Transport
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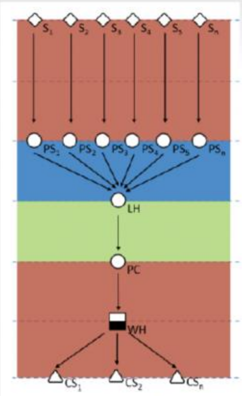
Den mest typiske løsningen



(a) Concept BAU

BAU-løsningen

- Mange leverandører på kinesisk side (S_n)
- Leverer til hver sin havneterminal i Kina (PS_n)
- Deep Sea transport til Europa - leverer til en hub (LH) på Europeisk side
- Short Sea transport til en nasjonal havn (PC)
- Bil til kundens sentrallager
- Bil til butikk (CS_n)

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Source: Lin & Hjelle (2018): Supply Chain Solutions to Upstream Buyer Consolidation with green and resilient supply chain designs in the China-Europe Containerized Cargo Flows.

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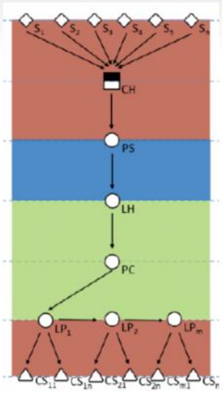
Alternative løsninger (1)



(b) Concept A1

A1: Oppstrøms kundekonsolidering for en kunde

- Mange leverandører på kinesisk side (S_n)
- Leverer til en konsoliderings-hub i Kina (CH) som sender til en havneterminal i Kina (PS)
- Deep Sea transport til Europa - leverer til en hub (LH) på Europeisk side
- Short Sea transport til en nasjonal havn (PC)
- Kysttransport til lokale havner (LP_n)
- Bil til butikker (CS_n)

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Source: Lin & Hjelle (2018): Supply Chain Solutions to Upstream Buyer Consolidation with green and resilient supply chain designs in the China-Europe Containerized Cargo Flows.

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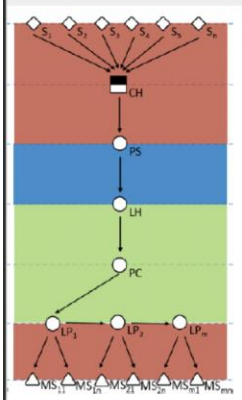
Alternative løsninger (2)

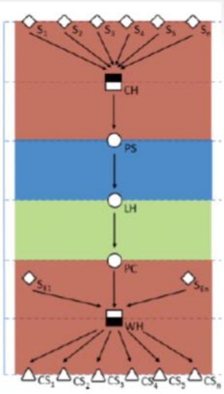


(c) Concept A2

A2: Oppstrøms kundekonsolidering for en gruppe samlokaliserte kunder

- Mange leverandører på kinesisk side (S_n)
- Leverer til en konsoliderings-hub i Kina (CH) som sender til en havneterminal i Kina (PS)
- Deep Sea transport til Europa - leverer til en hub (LH) på Europeisk side
- Short Sea transport til en nasjonal havn (PC)
- Kysttransport til lokale havner (LP_n)
- Bil til kjøpesentre/lokasjoner (MS_n)

Alternative løsninger (3)

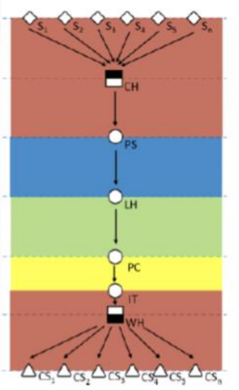


(d) Concept B

B: Oppstrøms og nedstrøms kundekonsolidering

- Mange leverandører på kinesisk side (S_n)
- Leverer til en konsoliderings-hub i Kina (CH) som sender til en havneterminal i Kina (PS)
- Deep Sea transport til Europa - leverer til en hub (LH) på Europeisk side
- Short Sea transport til en nasjonal havn (PC)
- Konsolidering med europeiske leverandører (S_{En}) i kundens nasjonale lager (WH)
- Bil til butikker (CS_n)

Alternative løsninger (4)



(e) Concept C

- **C: Oppstrøms kundekonsolidering med europeisk intermodal løsning**
  - Mange leverandører på kinesisk side (S_n)
  - Leverer til en konsoliderings-hub i Kina (CH) som sender til en havneterminal i Kina (PS)
  - Deep Sea transport til Europa - leverer til en hub (LH) på Europeisk side
  - Short Sea transport til en nasjonal havn (PC)
  - Jernbanetransport til intermodal hub (IT)
  - Bil til kundens nasjonale lager (WH)
  - Bil til butikker (CS_n)

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Source: Lin & Hjelle (2018): Supply Chain Solutions to Upstream Buyer Consolidation with green and resilient supply chain designs in the China-Europe Containerized Cargo Flows.

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Kostnadsanalyse

Oppstrøms kundekonsolidering og nedstrøms multimodal løsning

- Basert på et konkret bedrifts-case hvor man har tatt i bruk slike løsninger
- Sammenligner med en tradisjonell kommersiell spedisjonsløsning på kinesisk side
- Godsstrøm fra mange kinesiske produsenter til mange skandinaviske omsetnings-steder («butikker»)
- Kostnadsfaktorer basert på informasjon fra involverte LSP-aktører og handelsbedriften

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Source: Lin, Hjelle & Bergqvist (2018): The Positive Impact of and Upstream Buyer Consolidation and Downstream Intermodal Rail-Based Solution on Logistics Cost in the China-Europe Container Trade

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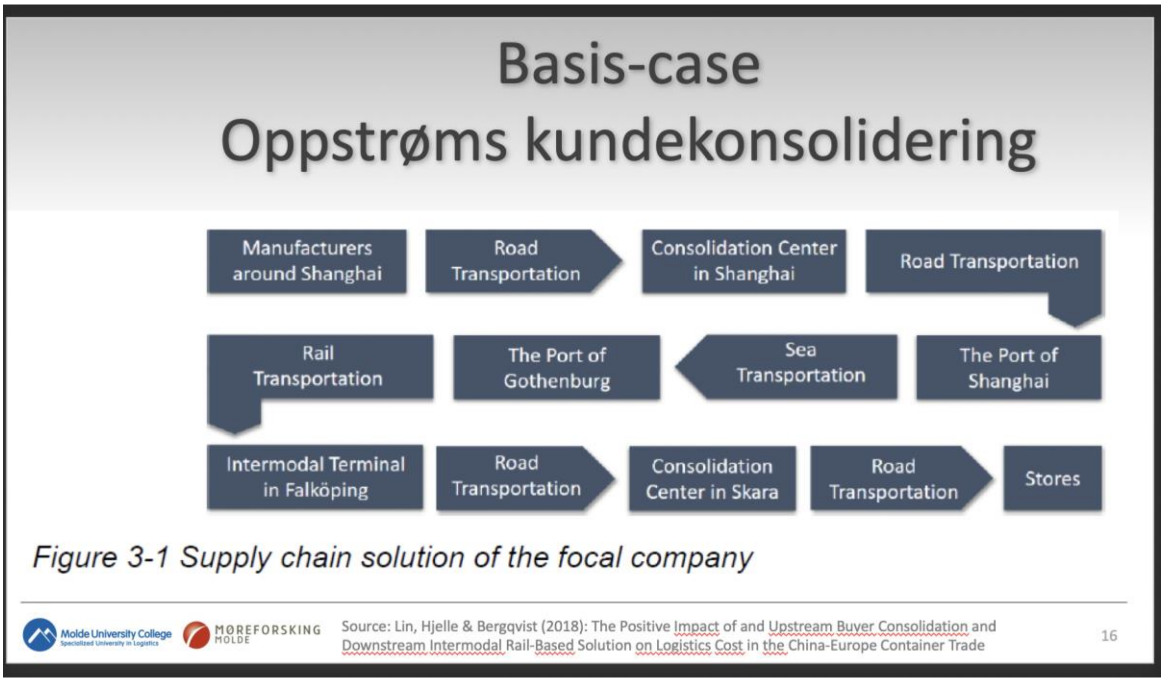
Basis-case
Oppstrøms kundekonsolidering
Manufacturers around Shanghai
Road Transportation
Consolidation Center in Shanghai
Road Transportation
The Port of Shanghai
Sea Transportation
The Port of Gothenburg
Rail Transportation
Intermodal Terminal in Falköping
Road Transportation
Consolidation Center in Skara
Road Transportation
Stores
Figure 3-1 Supply chain solution of the focal company
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Source: Lin, Hjelle & Bergqvist (2018): The Positive Impact of and Upstream Buyer Consolidation and Downstream Intermodal Rail-Based Solution on Logistics Cost in the China-Europe Container Trade
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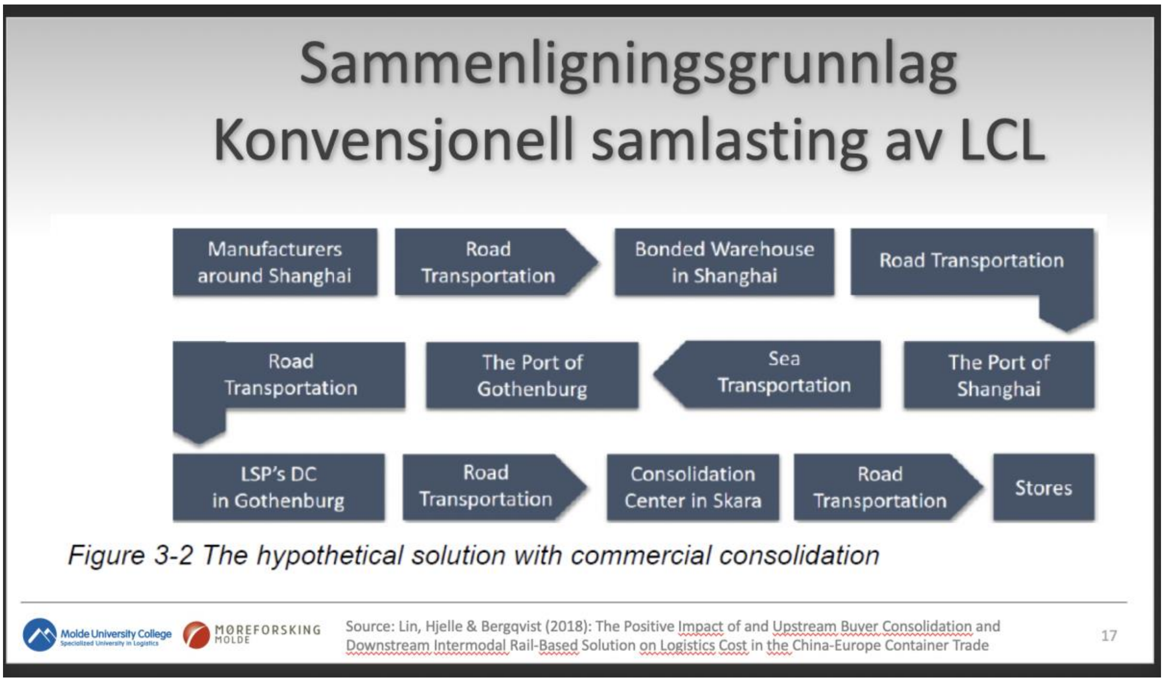
Sammenligningsgrunnlag
Konvensjonell samlasting av LCL
Manufacturers around Shanghai
Road Transportation
Bonded Warehouse in Shanghai
Road Transportation
The Port of Shanghai
Sea Transportation
The Port of Gothenburg
Road Transportation
LSP's DC in Gothenburg
Road Transportation
Consolidation Center in Skara
Road Transportation
Stores
Figure 3-2 The hypothetical solution with commercial consolidation
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Source: Lin, Hjelle & Bergqvist (2018): The Positive Impact of and Upstream Buyer Consolidation and Downstream Intermodal Rail-Based Solution on Logistics Cost in the China-Europe Container Trade
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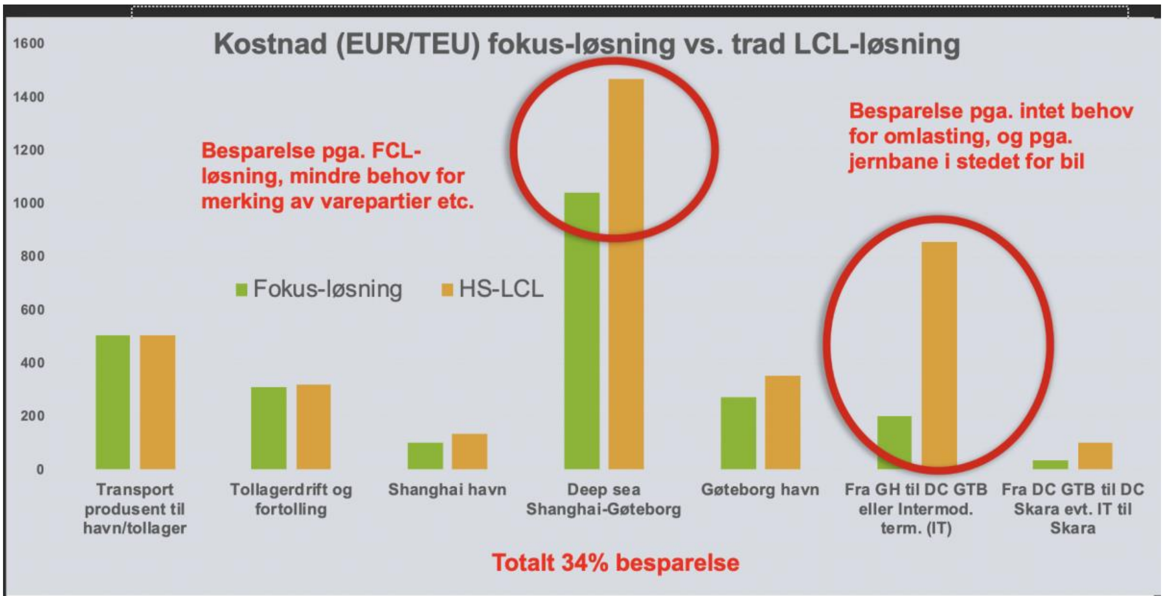

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Source: Lin, Hjelle & Bergqvist (2018): The Positive Impact of and Upstream Buyer Consolidation and Downstream Intermodal Rail-Based Solution on Logistics Cost in the China-Europe Container Trade

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Miljøanalyse

Oppstrøms kundekonsolidering og nedstrøms multimodal løsning

- Basert på et konkret bedrifts-case hvor man har tatt i bruk slike løsninger
- Sammenligner med en tradisjonell kommersiell spedisjonsløsning på kinesisk side
- Godsstrøm fra mange kinesiske produsenter til mange skandinaviske omsetnings-steder («butikker»)
- Energibrukstall delvis basert på informasjon fra involverte LSP-aktører og handelsbedriften. Utslippsfaktorer fra ulike kilder i Kina og Europa.
- Ingen komplett miljøanalyse, kun beregnet CO_2

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Source: Lin (2018): CO_2-Emissions Mitigation Potential of Buyer Consolidation and Rail-Based Intermodal Transport in the China-Europe Container Supply Chains

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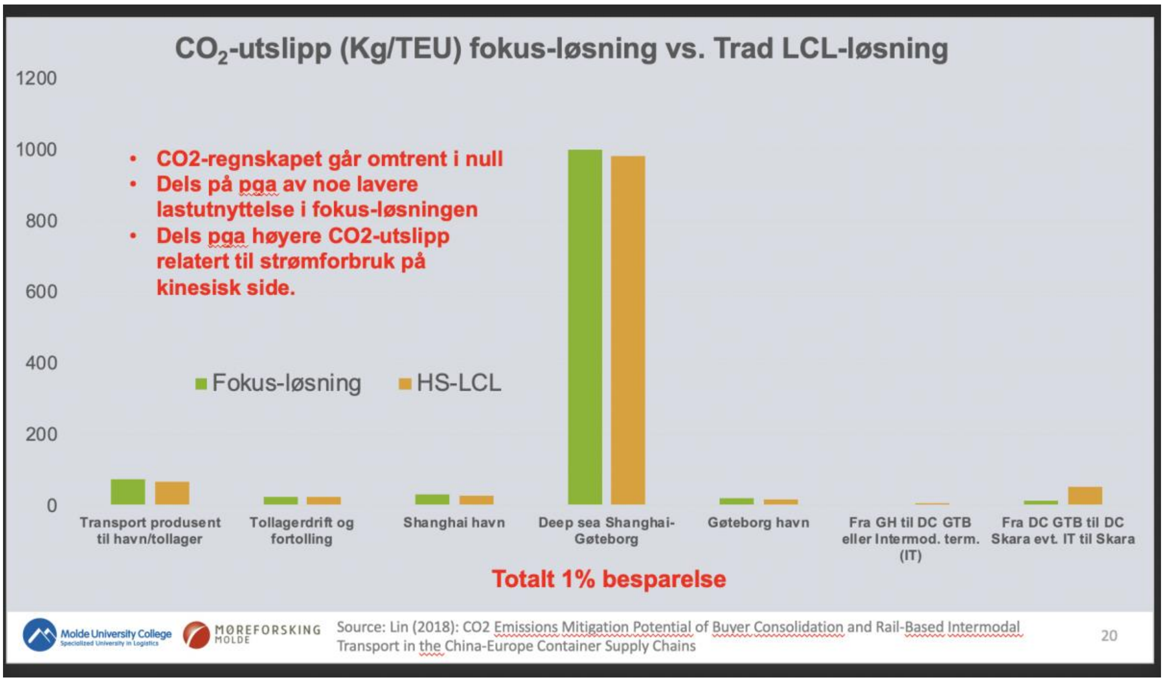
CO2-utslipp (Kg/TEU) fokus-løsning vs. Trad LCL-løsning
1200
1000
800
600
400
200
0
CO2-regnskapet går omtrent i null
Dels på pga av noe lavere lastutnyttelse i fokus-løsningen
Dels pga høyere CO2-utslipp relatert til strømforbruk på kinesisk side.
Fokus-løsning
HS-LCL
Transport produsent til havn/tollager
Tollagerdrift og fortolling
Shanghai havn
Deep sea Shanghai-Gøteborg
Gøteborg havn
Fra GH til DC GTB eller Intermod. term. (IT)
Fra DC GTB til DC Skara evt. IT til Skara
Totalt 1% besparelse
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Source: Lin (2018): CO2 Emissions Mitigation Potential of Buyer Consolidation and Rail-Based Intermodal Transport in the China-Europe Container Supply Chains
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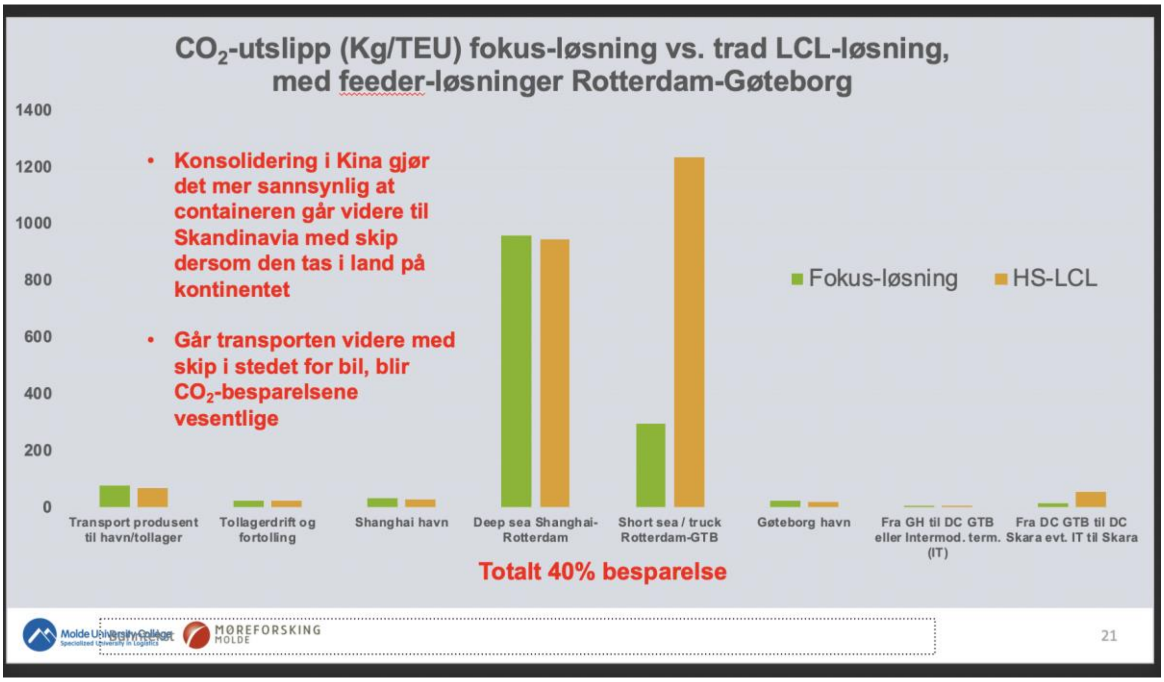
CO2-utslipp (Kg/TEU) fokus-løsning vs. trad LCL-løsning, med feeder-løsninger Rotterdam-Gøteborg
1400
1200
1000
800
600
400
200
0
Konsolidering i Kina gjør det mer sannsynlig at containeren går videre til Skandinavia med skip dersom den tas i land på kontinentet
Går transporten videre med skip i stedet for bil, blir CO2-besparelsene vesentlige
Fokus-løsning
HS-LCL
Transport produsent til havn/tollager
Tollagerdrift og fortolling
Shanghai havn
Deep sea Shanghai-Rotterdam
Short sea / truck Rotterdam-GTB
Gøteborg havn
Fra GH til DC GTB eller Intermod. term. (IT)
Fra DC GTB til DC Skara evt. IT til Skara
Totalt 40% besparelse
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Hvem passer oppstrøms lastkonsolidering i Kina for? (1)

- **Vi har intervjuet en god del bedrifter**
  - Logistikk-aktører og handelsbedrifter
  - I Skandinavia, Nederland, UK og Irland
- **Vi har spurt om deres vurdering av potensialet til oppstrøms kunde-konsolideringsløsninger**
  - Noen bruker slike løsninger
  - Noen har brukt dem men forlatt dem
  - Noen har aldri brukt dem

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Hvem passer oppstrøms kundeorientert lastkonsolidering i Kina for? (1)

- **Basert på tilbakemeldingene vi har fått passer dette hvor en har:**
  - **Små ordrevolumer fra hver leverandør** – for små til å benytte standard FCL-tjenester
  - **Mange ulike leverandører**, men hvor disse likevel er innenfor en **begrenset geografisk region** i Kina
  - **Store nok totale ordrevolumer** fra en region i Kina til at en kan få god nok fyllingsgrad på konsoliderte containere
  - Gods som er pakket i **små enheter som ikke er palletert** (gjør ompakking i Europa kostbart)

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Hvem passer oppstrøms kundeorientert lastkonsolidering i Kina for? (2)

- Basert på tilbakemeldingene vi har fått passer dette hvor en har:
  - **Omsetningspunktene ligger langt fra sentral-Europeiske logistikk-knutepunkter** (Skandinavia, Irland)
  - Hele / **En stor del av varespekteret kommer fra Kina** – med lite behov for å integrere med Europeiske varer
  - Produkter hvor **behovet for lagerhold på Europeisk side er begrenset**
    - Små behov for etterfylling av varer (sesongvarer)
    - Ikke behov for reservedeler/erstatningsprodukter med kort ledetid

Hvilke faktorer er kritiske for økonomien i slike løsninger? (1)

- Ratenivået på Asia-Europa deep sea
  - Lave rater gjør det lite lønnsomt å drive med lastkonsolidering
  - En god del velger å sende halvfulle containere som FCL heller enn å benytte LCL-løsninger
  - Høye rater vil normalt gjøre oppstrøms lastkonsolidering mer lønnsomt

Hvilke faktorer er kritiske for økonomien i slike løsninger? (2)

Valutakurser og relative lønninger

- Dette konseptet flytter aktivitet fra Europa til Kina
- Noe av motivasjonen har vært lavere lønns-kostnader i Kina
- Høyere lønnsvekst i Kina og ugunstige valutakurser kan ta bort potensialet

Hvilke faktorer er kritiske for økonomien i slike løsninger? (3)

Sesongsvingninger eller stabile volumer

- Løsningen passer best om man har stabile volumer
- Blir man låst til en slik løsning med store volumsvingninger, kan det resultere i dårlig utnyttelse av containerne i perioder med små volumer

Hvilke faktorer er kritiske for miljøregnestykket?

- Oppstrøms konsolidering kan legge bedre til rette for at **skip/tog også benyttes på den intra-Europeiske delen** av verdikjeden – det gir miljøgevinster
- Flytting av aktivitet fra Europa til Kina gir ofte økt CO_2-utslipp på grunn av energimixen
- Oppnådd fyllingsgrad til containerne er en viktig faktor også for miljøregnestykket

Noen interessante observasjoner knyttet til nye utviklingstrekk (1)

- Irland og Brexit
  - BREXIT kan gjøre slike løsninger mer aktuelle – fordi det blir mindre gunstig for irske importører å benytte britiske logistikk-knutepunkter
  - Muligens vil en da finne det mer lønnsomt å gjøre markedstilpasninger i Kina i stedet

Noen interessante observasjoner knyttet til nye utviklingstrekk (2)

- **Vil handelen med Kina fortsatt øke?**
  - Produksjon hentes til en viss grad tilbake til Europa – men ikke på grunn av lavere transportkostnader (de øker gjerne) – på grunn av **kortere ledetider og mulighet for mindre ordrevolumer**
  - Kanskje vil dette bli møtt med nye og mer effektive transportløsninger?
    - Belt and road initiative?
    - Mer effektive jernbaneøsninger?
    - Nordøstpassasjen?

Altså: Potensialet er der

- Det finnes **mange mulige løsninger for ulike verdikjeder**
- **Ikke slik at «one size fits all»**
  - Gode løsninger vil avhenge av varetyper, volumer og andre karakteristika for verdikjeden
- Det finnes **rom for innovative, kostnadseffektive og miljømessig gode løsninger** i Kina-Skandinavia handelen

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