
Management of the Ferry Shipping and Ferry Ports in Regional Transport Systems Between Continental Europe and the Nordic Countries

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Abstract:

Purpose: The purpose of the article is to research and assess the position of ferry industry in the transport chains between continental European countries and the Nordic states, as well as evaluate the activities of ferry and port operators to improve the efficiency of the land-sea transportation in North – South corridors.

Design/Methodology/Approach: Several research methods were applied: literature review, data exploration method, desk research and comparative analysis.

Findings: Research revealed lack of publications on ferry business activity in context of its functions in regional supply chains. Research has shown that the proper organization and coordination of services in ferry terminals is the key element to the efficiency of the sea – land transport chains.

Practical Implications: The article emphasizes that the activities undertaken by the ferry and port operators allows to improve the efficiency of the regional transport chains in Baltic Sea Region. The study also indicates the examples of given ports and ferry operators where implementations of the intermodal solutions are undertaken.

Originality/Value: The review of literature revealed lack of publications concerning regional transport systems in BSR. The studies discussing ferry shipping primarily focus on the research into the ferry markets, supply and demand developments, as well as the role of ferries in short sea shipping. So far not study has been conducted on the activities undertaken by both ferry and ports in intermodal systems, so there is a research gap in this area. The paper is the first study on this subject and represents a contribution to the further detailed research.

Keywords: Baltic Sea Region, ferry shipping, ferry terminals, intermodal transport.

JEL classification: M21, L99, L83, C38.

Paper Type: Research article.

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1. Introduction

The development of international trade and the demand for transport services are determined by a number of factors, including the increase in production and consumption, the dynamics of trade development as well as commodity and geographical structure. Transport conditions determining the ability to handle trade flows between the countries are the next prime factors (Grzelakowski, 2010).

In the Baltic Sea Region states trade with neighbouring as well as countries located relatively close. We observed dynamic growth of trade between the continental and Scandinavian countries within last two decades, in average by 10% year to year, in spite of the economic shocks like crisis in 2009 when the decline by 25% occurred.

Trade relations and the size of exchange between the continental Europe and the Nordic states influence the cargo flows in the region. The demand for carriage and patterns of transport chains are complementary to the mutual trade turnover. Goods between the Nordic and continental countries are carried primarily by vessels.

Serry states that ferries and cargo ro-ro ships transport about 80% of the total internal trade volumes in BSR (Serry, 2014). Part of the German and West European countries trade is transported to Sweden and Norway and vice versa by road via Denmark and fixed links in the Danish Straits. However, ferries and pure ro-ros transport the majority of the mutual turnover in the North-South axis.

The land – maritime transport chains between continental Europe and the Nordic states include several components. The most important are shipping and sea terminals. The former one is based on the ro-ro technology being the prime mode for transporting wheeled cargo units which include trucks, trailers, semitrailers and cargo stow on roll-trailers and cassettes. The ships are equipped with car decks and ramps, that means the ro-ro system is used for loading and unloading.

Ferry shipping is a type of liner trade, where passengers and cargo form one market. Both segments are carried by one ship and ferries operate the regular routes. Stopford states that ferries transport people, goods and vehicles over short distances by sea (Stopford, 2009). Similarly Kotowska highlights these two segments – passengers' traffic and cargo transportation (Kotowska, 2014). Pure ro-ro ships transport only cargo, however some are equipped with accommodation up to 12 drivers. In regional Baltic transport chains ferry transport predominate.

The specific feature of ferry shipping is its integration with land transport. Ferry and ro-ro connections are the elements of road-sea transport system to and from mainland Europe, as well as ferry services are regarded as the components of the intermodal transport chains (Musso *et al.*, 2010; Paixao Casaca and Marlow, 2009; Daduna *et al.*, 2012; Urbanyi-Popiolek, 2018). Ferry and ro-ro shipping is also

considered an alternative for the land transportation in the context of sustainable transport development (Castels *et al.*, 2012; Kotowska, 2015; Chen *et al.*, 2014).

Ro-ro terminals are the nodes being the gates between land (road and rail) and sea transport (Musso *et al.*, 2010). The prime function of the terminals is to handle wheeled cargo and ferries. Terminal infrastructure include berths, ramps, storage areas for trucks and semitrailers, rail terminals and gates. The handling equipment primarily consists of tractors and forklift trucks, as the ro-ro technology do not required STS cranes. Occasionally RMG gantries are used in intermodal terminals. Handling organization is the next chief factor.

The terminals require the efficient access to port areas from the land side. The hinterland infrastructure comprises road and rail connections. The easy accessibility is the crucial to port operations. The access to the port area bypassing the cities is one of the critical factors reducing congestion as well as influence on efficiency of transport chains.

2. Research Methodology

The research concerns the operations of the ferry carriers and ferry ports in the regional transport systems. As it was stated in the previous section, ferry shipping dominates in transport of value commodities in cargo flows between European continent and the Nordic countries. The study focuses on organization of the ferry shipping, the port activity and solution in land transportation in pre-carriage and on-carriage to the mainland.

The paper presents the overview of the solutions implemented in ferry industry to meet the requirements of the customers – hauliers, forwarders and traders. The paper is the first study on this subject and represents a contribution to the further detailed research on the sea-land intermodal transport system in BSR.

The aim of the study is to research the position of ferry industry in the transport chains between continental European countries and the Nordic states, as well as to evaluate the activities of ferry and port operators to improve the efficiency of the land-sea transportation in North – Sea corridors. The following research questions have been raised:

RQ1: What is the frame of the regional transport chains in the South and West Baltic between continental Europe and the Nordic countries?

RQ2: What activities are undertaken by ferry and terminal operators to improve the efficiency of the land- sea transport operations?

For the purpose of the paper the analysis of the original data of ferry connections including the number of ferries, number of calls and services was performed. Next the analysis of the cargo volumes handled in selected Baltic ports is conducted, as

well as the analysis of the port infrastructure and service solutions. The data was collected from the ShipPax Information, known as a reliable publisher and provider of consulting services for the ferry shipping industry. The data concerning the infrastructure and the implemented solutions is based on the official information collected from the ferry terminals and ferry operators.

3. Data Analysis

3.1 Ferry Shipping

The total volumes of trucks and semitrailers transported by ferries in 2020 in the Baltic Sea Region amounted to 37 million units. The numbers cover the whole market and comprise all international services and local routes. On the international links being the components of the regional transport systems around 3 million wheeled units were carried. A steady increase in traffic since the beginning of the decade has been observed (Shippax Market 21, 2021).

Ferry business in the BSR includes three prime ferry areas (ShippaxMarket19, 2019):

- West Baltic - comprises services from Denmark to Sweden, Norway and Germany, from Sweden to Norway and Germany and Germany – Norway connection; the west market accounts to 62% of freight traffic.
- East Baltic - includes services from Sweden to Finland and Estonia, and from Estonia to Finland; the east market accounts to 19% of freight turnover.
- South Baltic - comprises lines between Sweden and Poland, Sweden and Latvia and Lithuania and the via Baltic connections between Germany and Lithuania, Latvia and Finland; the market constitutes 19% of freight.

Links in the West and South Baltic are the prime in the land-sea transport systems between continental Europe and Scandinavia. The services on the East Baltic Sea transport mainly goods of mutual exchange, e.g., Finland – Sweden, Estonia - Sweden. In the former markets the traffic covers the mutual exchange of the BSR states as well as transit trade flows from other continental states.

The Baltic ferry business is highly concentrated. According to Shippax data, in January 2020, 16 major carriers operated on the international routes. In terms of the transport capacity and market share the leaders are Finnlines, Stena Line, Tallink Group, TT-Line, DFDS Seaways and Unity Line. The network of the ferry connections included 60 services (some are parallel) with 116 active ferries of different types - ro-pax, cruise-oro and high-speed.

The highest volumes are observed on short cut line Puttgarden – Rodby and on Travemunde – Trelleborg service (Table 1). The next is the central corridor

comprising 5 services between Polish Świnoujście and Swedish ports in Scania. The former routes between Germany, Denmark and Sweden handle primarily trade between those countries as well as from other western and southern continental states as the Netherlands, Belgium, Austria, France, Spain, Italy. The latter is the prime axis for Polish – Scandinavian turnover and transit from central and south Europe. The connection between Lithuania-Sweden handle mainly mutual trade and as well as little transit, chiefly from central and Eastern area like Slovakia, Ukraine.

Table 1. Summary of basic data on selected ferry operators.

Market	Service	Operator	No. of ferries	No. of daily departures	No. of cargo units in 2020
Germany-Denmark	Puttgarden - Rodby	Scandlines	5	Up to 48	499 394
	Rostok - Gedser	Scandlines	2	8-10	146 004
Germany-Sweden	Travemunde - Trelleborg	TT-Line	5	3-4	338 248
	Rostok - Trelleborg	TT-Line	5	3-5	298 310*
	Rostok - Trelleborg	Stena Line	2	3-5	
	Kiel - Gothenburg	Stena Line	2	2	85 045
Poland - Sweden	Świnoujście - Ystad	Unity Line	3	2-3	486 505**
	Świnoujście - Ystad	Polferries	3	2-3	
	Świnoujście - Trelleborg	Unity Line	5	4	
	Świnoujście - Trellebor	TT-Line	2	1-2	
	Gdynia – Karlskrona	Stena Line	3	2-3	263 590
Lithuania-	Kłajpeda - Karlshamn	DFDS	3	1 -2	198 020

Note: *Data comprises TT-Line and Stena Line services, **Data comprises all services from Świnoujście to Ystad and Trelleborg.

Source: Own elaboration based on Shippax Market 21.

3.2 Ferry Ports

The ports selected for analysis are the basic intermodal nodes in the regional supply chains between continental Europe and the Nordic countries. Trelleborg and Travemunde are harbours with the highest level of turnover, where more than 636 248 and 755 632 units were handled respectively in 2020. The volumes for Świnoujście and Rostock amounted to more than 450 000 trucks and trailers (Shippax Market 21, 2021).

In Travemunde ro-ro traffic is performed in four terminals. Unlike others, Skandinavienkai is the biggest and handles ferry traffic only. The services are performed by TT-Line to Trelleborg, Finnlines to Helsinki, Stena Line to Liepaja and Nordo Link to Malmoe. Skandinavienkai is the largest Baltic ferry port in terms of the land area and infrastructure for ferries with nine ro-ro berths (four with the upper deck ramp, two pontoons, one for rail ferry services).

Table 2. Data from selected ferry port of the west and south Baltic Sea.

Port	No. of calls	No. of cargo units	No. berths	No. of services	No of operators
Trelleborg	4 899	636 248	8	7	3
Travemunde	4 400	755 632	9	4	4
Rostock	5 672	463 828	5	3	3
Karlskrona	---	186 590	1	1	1
Kiel	---	189 368	3	3	3
Gdynia	---	263 590	2	2	2
Świnoujście	3 495	486 505	5	4	3
Ystad	3 589	226 813	5	3	3

Source: Own elaboration based on the port information and Shippax Market 21.

Trelleborg is ranked second among the ro-ro ports and is the biggest in Sweden. The prime customer of the port is German TT-Line plying the lines to Travemunde, Rostock, Świnoujście and Klaipeda. The others are Unity Line (Trelleborg - Świnoujście) and Stena Line (Trelleborg - Rostock). The infrastructure includes eight piers for regular ferry traffic. Seven berths are fitted with double ro-ro ramps. Moreover, three are directly linked with railways. The port infrastructure includes also the dedicated intermodal terminal.

The port of Ystad is located in the south coast of the Swedish region Scania, near Trelleborg. The port infrastructure includes five ro-ro piers, one of them adopted to handle rail wagons. The regular ferry services are provided by Unity Line and Polferries to Świnoujście and Mols Line to Roenne in Bornholm.

Świnoujście is the next analysed port. The terminal is sited on the right bank of the Świna River near the estuary. The port infrastructure is composed of five berths. Two piers are fitted with double ro-ro ramps and are adopted to handle rail traffic. From the terminal three carriers operate: to Trelleborg (Unity Line and TT-Line) and Ystad (Unity Line and Polferries).

The ferry terminal in Rostock is sited in the Warnemunde area, a northern district of the city. It is located close to the Warnow River estuary. The infrastructure comprises five piers. The terminal serves three carriers: TT-Line and Stena Line operate to Trelleborg, while Scandlines to Gedser.

4. Discussion

The exchange between mainland Europe and Nordic countries comprises primarily high value products, as automotive, electronic appliances, machinery, construction equipment, medical equipment, textiles, furniture, household appliance and medicines. The other segments are foodstuff and agriculture commodities, wood and paper products, as well as steel and semi-finished products (Urbanyi, 2020). The majority of these products requires fast delivery.

Cargo flows in the analysed area determine the demand for transport services. Ferry links can be regarded as floating bridges between the land transport infrastructure in relation to the carriage of goods. The two-port services are operated in the pendulum model and ships ply the routes according to sailing lists with given number of calls daily. The available capacity of the service is calculated by the number of ferries, the length of load line and number of sailings.

For the customers the access to the service is one of the most important factor when choosing the line. Most carriers maintain day and night cruises, which results in greater flexibility and convenience for hauliers, as well as the accessibility to shipping opportunity. In practice the standard is signing service contracts between carriers and shippers, which gives the latter a guarantee of booking and available space on the ship.

In Baltic regional supply chains the growing demand for transport of the wheeled cargo is observed. The operators have been ordered new vessels with bigger load line as well as has converted the operating ships. Currently the load line of the largest ro-paxes operating in the Baltic Sea amounts to 3500 metres. The newbuildings are much larger with the capacity up to 5100 metres of line (ordered by Finnlines), 4600 metres (TT-Line) or 4500 metres (DFDS). The others plan to introduce within next two years bigger vessels, second hand and converted (e.g. Stena Line for Gdynia – Karlskrona). It is estimated that these activities will increase the capacity of each service by 30% on average.

The technology and organization of ferry shipping require dedicated terminals with efficient handling. The terminals are equipped with facilities for ro-ro technology – berths with ramps and internal roads for cargo drive in and drive out the ship. The services operate upon schedules and the ferries usually lay in ports 2 - 4 hours, or less in short cuts with high frequency. In this duration the ships have to be unloaded and loaded again. Promptness is required by traders, hauliers, forwarders as well as ferry operators, as delays create congestions in terminals and affect the logistics chains.

The number of daily calls oscillates around 14-16 sailings in Trelleborg and Rostock while 10-12 in Travemunde, Ystad, Świnoujście. The mean number of trucks transported by the large ro-pax ferries amounts to 200-240 units discharged and loaded per single trip. The smaller ro-pax ships carry 100-150 road units on average. The mean number of handled trucks in Trelleborg, assuming the use of ferries lanes in 80%, amounts to more 1600. In the other ports the numbers of daily handled units are high as well, e.g., in Rostock – 1200, Świnoujście – 1300.

The movement of the large numbers of trucks passing through terminals require organisation of the traffic within port area. The internal roads in terminals for arriving and waiting vehicles and departing trucks are separated. Before loading, the trucks must enter the terminal for check in at least two hours before departure of the

ship while waiting for loading in parks areas. After drive out, the vehicles leave the port immediately or are loaded on the rail cars.

Increasing ship length and ramp width are the challengers for the port operators. Terminals where the new ships will be introduced are investing in new facilities. In Travemunde Skandinavienkai terminal was expanded for 39 million EUR and new ramps were installed for the new generation of TT-Line newbuildings. In port of Trelleborg the new investments include the construction of two new quays (No. 11 and 12), which are located in the new part of the port, south-east of the city. Quay 10 is equipped with a new ramp dedicated to the new TT-Line ferries.

The investment is to be completed at the turn of 2021/2022. The Polish port of Świnoujście also invest in new facilities. Two existing berth (No. 5 and 6) were demolished and new one was create with 294 metres of line and new ramp. Moreover the intermodal terminal and new parking for trucks is under construction. The terminal in Ystad has also been modernized with two new ro-ro quays dedicated to the new generation of ro-paxes, which are to serve the connection to Świnoujście.

The efficiency transport chains also depends on the land access infrastructure comprising roads and rails. The majority of the analysed ferry ports are well connected to the hinterlands. Selected ports are shown below.

Travemunde terminal is easily accessible from the hinterland by road and rail. The port is directly connected via the own spur road with A1 motorway linking port of Lubeck with the main economic centres of Europe. The railway line from the terminal is also linked with the network in Germany and other western European countries. The terminal in Rostock like the former one is accessible from the hinterland by the road and rail connections. The motorway A19 and the road B105 link the port directly bypassing the urban areas.

The railway line from the intermodal terminal in the port area is linked with the main AGCT network in Germany. Świnoujście is the next analysed port. The hinterland access comprises both the road and rail connections. The expressway S3 (international road E65), begins at the terminal and passing the industry zones runs south connecting with the main network (expressway S6 and motorway A2). The most significant section of 60 kilometres from Świnoujście to Szczecin is under construction and is a bottle-neck. The E59 railway line is a part of the international transport corridor from Malmoe - Ystad to Vienna, Budapest and Prague. As a part of the AGCT network currently the line is undergoing upgrading to the standards of the agreement.

The accessibility infrastructure from the ferry port in Trelleborg to the hinterland is highly developed. The railway line provides the connection from the port area to the rail network in the country. The road traffic is directly linked with public roads (motorway E22 to Malmoe and R9 to east) bypassing the urban area. Ystad is

located close to the former analysed port. The terminal is linked with the hinterland both by road and rail. The heavy traffic from the port is directed through the industry zones straight to the road E65 that begins at the port and connects Ystad with Malmoe and the main road network. Additionally, Ystad is a part of the railway line Malmoe-Simrishamn and is connected by rail with Copenhagen via the Oresund Bridge.

One of the important organizational aspects of hinterland connections with ferry ports are rail -road intermodal transport. Intermodal solutions are developed in three harbours: Trelleborg, Rostock and Travemunde.

In Trelleborg the intermodal infrastructure comprises two intermodal terminals located in the port area alongside the berth with the rail access. The unaccompanied semitrailers are transhipped directly from a ferry to piggyback cars. The intermodal traffic is handled by two reach stackers, with a lifting capacity of 45 tons each.

The Trelleborg terminals cooperate with the Eskilstuna Intermodal Terminal located 600 kilometres north of the Stockholm and Malardal regions. Four operators operate transport in the piggyback system offering daily connections in both directions. The second destination is Hallsberg sited 500 kilometres north from Trelleborg with three round trips weekly operated by TT-Line.

Alike the Swedish port, advanced intermodal services are performed in the port of Rostock. The terminal is located in the southern part of the port. The proximity of the terminal to the ferry berths provides short transit times through the port. The intermodal terminal covers approximately 70 000 m² with three full-train-length tracks. The superstructure includes two gantry cranes for loading units on rail cars, as well as tractors transporting semitrailers between piers and the rail terminal. The network of regular intermodal connections comprises eight destinations, among others: Verona (15 trains weekly), Treviso (2), Brno (3), Wuppertal (3). Currently 30 intermodal trains weekly are scheduled.

Travemunde is the third ferry port with the intermodal connections. The terminal is located within the Skandinavienkai area and is operated by the Baltic Rail Gate. The technical equipment is similar to Rostock and comprises two gantry cranes and tractors. The terminal area covers 25 340 m² with 6 train trucks. The rail network includes connections with Duisburg (6 round trips weekly), Hamburg (5), Ludwigshafen (12), Karlsruhe, Novara (1) and Verona (6).

In the German ports the intermodal transport is performed by numerous operators offering services, e.g., Kombiverkehr, Hupac, TX Logistik. Among others, T-Line and Stena Line in cooperation with the intermodal operators and railways carriers provide their own services, too.

In the other analysed ports the intermodal solutions are not performed. In Świnoujście the ferry terminal will be adopted to handle units under the European project “Sustainable Świnoujście-Trelleborg MoS based on upgrading the port infrastructure, developing intermodal transport and integrating hinterland corridors”. However, the key determinant for intermodal services is the reconstruction of the railway line connecting Świnoujście with the Polish rail network and the adjustment trucks to the AGCT requirements.

5. Conclusions

Commercial intercourse between Continental Europe and Scandinavia is showing an upward trend. The growth in trade volumes largely determines the demand for cargo transport in North – South corridors. Ferries are prime modes of servicing cargo flows in the BSR. Moreover the described ferry ports are the main nodes in the regional supply chains.

Paper examined the ferry transport and terminals in west and south Baltic where more than 80% of cargo traffic is handled.

The data demonstrates an increase in the cargo traffic. Ferry carriers as well as port operators are adapting to the increased demand for transport and handling operations. To increase the efficiency of services the shipowners are introducing vessels with bigger load capacity, adjust schedules to the needs of shippers, as well as increase the frequency of departures. The terminal authorities and operators invest in infrastructure and equipment. Three of analysed ports developed the intermodal rail-road services. The new observed phenomenon is offering by ferry carriers comprehensive services including not only sea transport, but also intermodal services, storage and land haulage e.g., TT-Line, Stena Line and DFDS.

The paper represents a contribution to the further detailed research on the development of regional transport chains and the role of ferry transport and terminals in transport corridors in BSR.

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