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Port Critical Infrastructure Network

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Abstract

The main aim of the article is introduced the Baltic Port Critical Infrastructure Network (BPCIN). It is done according to the Baltic Sea Core Ports. The basic technical parameters and the main cargo handling of particular ports are described. Furthermore, the involvement of the BPCIN in the Trans-European Transport Network is presented.

1. Introduction

The importance of economic activity of the seaports has an international reach. Ports occupy an important place in the integrated sea-land transport chains and in international supply chains. They also have a big impact on the efficiency of economic, technical and technological integration of the maritime and land transport. Thus, they form the efficiency of transport supply and stocks. Therefore they can constitute respectively regional, national, European and world port critical infrastructure networks.

2. Core Ports of Baltic Sea

According to [2] the 21 Baltic seaports are included in the port core network: 2 Danish ports (Aarhus, Copenhagen), 2 German ports (Lübeck, Rostock), 1 Estonian port (Tallinn), 2 Latvian ports (Riga, Ventspils), 1 Lithuanian port (Klaipėda), 4 Polish ports (Gdańsk, Gdynia, Szczecin, Świnoujście), 4 Finnish (Helsinki, Turku, Kotka, Hamina), 5 Swedish ports (Gothenburg, Luleå, Malmö, Stockholm, Trelleborg). However, among these ports, three pairs of ports are under a single port authority, namely Copenhagen-Malmö in Sweden/Denmark, Hamina-Kotka in Finland, and Szczecin-Świnoujście in Poland. These pairs of ports are treated as single ports and this way the number of

Baltic core ports is fixed as 18. These ports distribution at the Baltic Seaside is illustrated in *Figure 1*.



Figure 1. Distribution of core Baltic Sea ports (Baltic Port Critical Infrastructure Network - BPCIN) [2]

The set of those 18 core ports with their facilities we call the Baltic Port Critical Infrastructure Network (BPCIN). The basic facilities and activities of the

BPCIN members (marked in brackets by their initials and by P_i , $i = 1, 2, \dots, 18$) are as follows:

1. The Port of Aarhus (AP, P_1) is an important hub for ports in Northern, Southern and Eastern Europe as well as for the eastern Mediterranean and the Far East, to which they have regular routes. It consists of 6 terminals: Container Terminal, Multi Terminal, Bulk Terminal, Tank Terminal, Ferry Terminal and Cruise ships. The total area of the port is about 2.585.673 sq. m. The maximum water depth is up to 14 m [6].

2. The Copenhagen – Malmö Port (CMP, P_2) is first of all the biggest Nordic port for cars, with hundreds of thousands of vehicles passing through per annum. The four ultra-modern terminals accommodate up to 40,000 cars from all over the world. These terminals are as follows: Copenhagen – terminal, Malmö - Autolink terminal, Toyota Nordic Hub terminal and Malmö - SkandiaTransport terminal. They have total area about 637.000 sq. m and total length of quays equal to 813 m with maximal depth up to 10 m. Furthermore, the four terminals are equipped with 28, 32 m, 45 m (two) wide ro-ro ramps and rail track.

The second important part of the port's activity is container handling. The CMP is biggest container terminal in the Øresund Region. This operates container terminals in Copenhagen (Copenhagen Container Terminal) and Malmö (Malmö Container Terminal). Both terminals are situated in the heart of the Øresund Region. The water depth in terminal is up to 10.0 m. A similar position as in case of the container cargo, the Copenhagen – Malmö port has also in relation to liquid bulk cargo. Import and export of liquid bulk products are oriented towards international and regional markets. The CMP with two terminals (Malmö Oil Terminal and Copenhagen Oil Terminal) achieves the annual turnover of oil close to 7,000,000 tons. Tank capacity is approx. two million m³ connected with pipeline and the most modern and effective equipment. In Malmö oil terminal the maximal water depth his equal to 13.5 m. In case of the Copenhagen Oil Terminal the maximum water depth is up to 12 meters. Furthermore, the tank capacity is equal to about 1 million m³. There is a pipeline to the Copenhagen Airport. The CMP is participated in the project "LNG in Baltic Sea Ports". The last of CMP activity is the handling the dry bulk cargo. The Copenhagen-Malmö Port has the largest dry bulk terminals in Western Sweden and Eastern Denmark. Each terminal in Copenhagen and Malmö has its own profile and specialization. In Malmö there are two terminals Swede Harbour and Södra bulkhamnen. In

the first terminal the water depth is up to 13.5 m and it gives the possibility to handle fully loaded Panamax ships. This terminal's area is about 100000 m² and there is 16000 m² roofed storage. In Swede Harbour, pet coke (petroleum coke) is imported from the USA and distributed in Sweden. Other forms of imported dry bulk include asphalt and road and industrial salt. The export side mostly consists of scrap, which is sent to the USA, Malaysia and India. The Södra bulkhamnen has only 6 meters of water depth. The quay length is equal to 330. In Copenhagen part of the CMP there are four terminals: Prøvestenen with five quays (total length 1204 m), Amagerværket with 5 quays (total length 480 m), Margretholmen with 1 quay (Total length 140 m), Nordhavnen is docs for smaller vessels. In Copenhagen the water depth is between 5.4 meters to 12.0 meters [1].

3. The Lübecker Hafen-Gesellschaft (LHGP, P_3) runs 4 port terminals along the River Trave with modern cargo handling equipment and highly trained staff. RoRo services as well as handling and covered storage and loading of forest products are just as feasible as the handling by gantry cranes of containers, project and heavy lift cargoes. All terminals have excellent links with the hinterland and are accessible by road, rail and inland waterway craft. There are 18 RoRo berths, and total cargo handling/warehousing area is approximately 156 hectares what covered space about 27 hectares. The Skandinavienkai Terminal is the biggest terminal in the Port of Lübeck and one of the largest RoRo and ferry ports in Europe. It is situated directly on the estuary of the River Trave. The total terminal area is equal to 669,000 m². There is 2065 m of quay length. The maximum water depth is at least 9.5 m. In the terminal area are 12000 m of rail track. The main cargoes handled in terminal are: trailers, trucks, containers, new/used vehicles, heavy cargo, general cargo, dangerous cargo. Terminal Nordlandkai is a multifunctional terminal that apart from handling such wheeled cargoes as trucks and trailers is used mainly for handling and storage of forest products, chiefly from Finland. Multifunctional sheds, covered sidings and handling areas ensure loading whatever the weather. The total terminal area is about 484,000 m², what cover the 1550 m length of quay. The water depth is equal to 9.5 m. In the terminal are is about 10000 m of rail tracks. The main cargoes of the terminal are: paper and forest products, trailers, containers, heavy and project cargo. Schlutup Terminal was developed in close consultation with paper manufacturers and is therefore optimally adjusted to meet the requirements of this highly sensitive commodity. The terminal area is around

260,000 m². The total quay length is equal to 230 m. The water depth in the terminal is at least 8.5 m. Furthermore, there is 3300 m of the a raily track. The main cargoes handled in terminal: paper and forest products, trailers, containers, general cargo. Terminal Seelandkai is specially designed for handling ConRo ferries. The water depth in the terminal is set up to 9 m. Total terminal area is 185,000 m². The length of quay is equal to 400 m. The main cargoes handled in terminal are: containers, trailers, new/used vehicles, heavy, project and general cargo. The all 4 terminals of LHG are complement to each other [5].

4. The Port of Rostock (ROP, P_4) is one of the largest German Baltic Sea ports with an area of approx. 750 hectares. It can accommodate ships with a length of up to 300 meters, a width of up to 45 meters and a draught of up to 13 meters. For ships with a length of more than 230 m and/or a width of more than 36 meters and/or a draught of more than 12 m, special permission from the Water and Shipping Authority Stralsund is necessary. Tides do not exist here, however, strong winds from the south may lower the water level by up to 1.5 m, and high winds from the north may raise the water level by up to 1.5 meters. The five terminals operate under Rostock Port Authority: Intermodal Terminal, RoRo Terminal, Ferry Terminal, General Cargo Terminal and Bulk Terminal. The total quay length amounts to over 11,000 m, and there are 47 berths available. 25 of these berths are special berths for ferries (5), roll-on/roll-off vessels (3), coal/building material (2), cement (1), grain (3), fertilizer (1), heavy cargo (3), liquid cargo (6) and chemicals (1). The Intermodal Terminal is the handling terminal for rail, road and seaborne cargo. The ro-ro vessels Finnmerchant and Merchant operate five per week between Rostock and Hanko. Also, the railway operator Kombiverkehr operates a new and very fast connection between the Ruhr and the Baltic Sea coast three times a week. More than 30 intermodal trains operate weekly between the Intermodal Transport Terminal and Verona, Hamburg, Karlsruhe, Brno, Novara, Duisburg, Domodossola and Wels. RoRo terminal supports several liner services to Helsinki, Aarhus, Uusikaupunki, Rauma, Turku, Kotka, Hanko, Lubeck/Travemunde. Ferry terminal is the starting point for ferries to Denmark and Sweden. In general Cargo Terminal three sheds each with a length of 360 m and possessing track and road connections are available for handling and storage. Cranes with a load capacity of up to 100 tonnes guarantee a rapid throughput of general cargo, windmill-powered plants and other project cargo. Pier II is the heart of general cargo handling with 2665 m total length of

quay and the maximal depth from 7.32 – 9.80 m. Bulk Terminal is handling of 7.1 million tonnes in total meant an increase of 18 percent compared to the previous year. Apart from another increase in grain handling to 3.2 million tonnes the 550.000 tonnes of cement pumped over the edge of the quay also made a significant difference, as did the handling of split gravel, which went up by 260,000 tonnes last year to 444,000 tonnes. Now that the railway line has been upgraded, cement handling is back in Rostock. In addition to the handling of coal, building materials, fertiliser and grain are among the most important bulk cargo handled in the Port of Rostock. A daily volume of up to 20,000 tonnes of coal can be discharged at berths 23 and 24. Overhead cranes are used at berth 22 for the unloading of limestone, gravel chippings and sea gravel. The handling of such materials is centred around the coal terminal with a capacity of 240,000 tonnes of hard coal. Conveyor belts supply the neighbouring 500 MW hard coal fired power plant as well as additional recipients. At berth 21, a crane with an hourly output of up to 700 tonnes as well as a preparation plant for sea gravel is available. The fertiliser quay is equipped with a loading facility (hourly output of 1,000 tonnes), railway car unloading station, conveyor belt system and storage depot with a capacity of 55,000 tonnes. The main commodity here is calcium ammonium nitrate (CAN) which is produced the nearby fertiliser plant. The Bulk Terminal has the grain silos with a capacity of 436,000 tonnes as well as facilities for loading and unloading ships, trucks and railway cars ensure skilled handling and fast throughput of goods. A ship loading facility with an hourly output of up to 1,000 tonnes is available for grain export. Vessels are discharged via two unloading facilities with a capacity of up to 350 tonnes per hour. A system of conveyor belts ensures the efficient moving of grain from the silos to the ships. One of the most modern malt houses in Europe is located adjacent to the grain harbour. It has its own silo with a capacity of 10,000 tonnes and is connected with the silo facility at the port thus ensuring the rapid intake of brewer's barley as well as an equally rapid output of goods. With a capacity of 1,600 tonnes of processed canola seed per day the largest oil mill in Germany put into operation in August 2006. The investment cost totalled nearly 14 million Euros. The oil mill comprises the extraction facility, seed storage, seed processing plant, product storage and service department. The port has an open storage capacity of 420,000 m² as well as a covered storage capacity of 55,000 m² available for bulk solids. The oil harbour possesses a tank store with a capacity of 700,000 cubic meters available for the storage and throughput

of mineral oils such as heating oil, diesel and motor fuel. Crude oil, liquid fertiliser and other liquids are handled here as well. The berths at the oil harbour can accommodate 6 tankers with up to 100,000 tonnes and has a handling capacity of up to 6,000 tonnes per hour. The handling of liquids occurs by means of tank car, pipelines (Schwedt, Böhlen) and by tank truck. A neutral service company, Großtanklager Ölhafen Rostock GmbH, is the operator of the oil harbour and provides services for all mineral oil companies using the Port of Rostock. The oil harbour is also the location of a biodiesel plant with an annual capacity of 150,000 tonnes of biodiesel and 18,000 tonnes of glycerine. At three million tonnes the handling of liquid goods showed an increase by 500,000 tonnes or 18 percent compared to 2013. Last year higher amounts of naphtha, crude oil and gas oil were handled in Rostock [14].

5. The Port of Tallinn (TAP, P_5) comprises from 5 harbours: Old City Harbour (Vanasadam), Muuga Harbour, Paljassaare Harbour, Paldiski South Harbour and Saaremaa Harbour. It supports the following activities of Port of Tallinn:

- cargo and activities related to handling it,
- passengers and activities related to serving them,
- real estate development,
- shipping,
- energetic.

The Old City Harbour is one of the biggest and busiest passenger harbours in the Baltic region. It is also the biggest passenger harbour for both Port of Tallinn and Estonia. Tallink, Eckerö Line and Viking Line boats and ferries depart from the Old City Harbour for Helsinki, as well as the Tallink vessels operated on the Tallinn - Stockholm route and St. Peterline vessels on the Tallinn - St. Petersburg route. See the shipping companies. The Old City Harbour has 24 berths with total length equal to 4200 m. Maximal depth is up to 11 m. The harbor takes 52.9 ha of territory. The Muuga Harbour is the biggest cargo harbour in Estonia and specialized on handling transit origin goods. It is the main cargo harbour for Port of Tallinn and locates ca 17 km east of Tallinn. The cargo volume handled accounts for around 80% of the total cargo volume of Port of Tallinn and approximately 90% of the transit cargo volume passing through Estonia. Nearly 3/4 of cargo loaded in Muuga Harbour includes crude oil and oil products, but the harbour also serves dry bulk (mostly fertilizers, grain and coal) and other types of cargo. Muuga Harbour is among the deepest (up to 18 m) and most modern ports in the Baltic Sea region. There are 6 liquid bulk terminals, 2 multipurpose terminals (one of them with a reefer

complex), container terminal and ro-ro terminal, dry bulk terminal, grain terminal, steel terminal and coal terminal. It takes about 524.2 ha of the territory. There are 29 berths with total length equal to 6.4 km. Maximal depth is about 18 m. Paldiski South Harbour, the Port of Tallinn's second cargo harbour, is located 45 km west of Tallinn. The core activity of the harbour is focused on the handling of Estonian export and import cargo and transit cargo. Mainly ro-ro cargo, scrap metal, timber, peat and oil products are handled there. Developing fields of activity include transit of new cars for neighboring markets and pre-sale service. There are following terminals: Passenger Terminal, Petroleum Terminal, 2 Car Terminals, Ro-Ro Terminal, General Cargo Terminal, Timber Terminal, 2 Metal Terminals, Wood Pellets Terminal, Peat Terminal and Biodiesel Terminal. It takes the 141.1 ha of territory. Furthermore, there are 10 berths with total length set up 1.85 km. The maximal depth is equal to 14.5 m. Paljassaare Harbour is situated on Paljassaare Peninsula in Tallinn, approximately 6 kilometres from the centre of the city. With the handling capacity of some 3 million tonnes per year the harbour is considerably smaller than its 2 bigger brothers - Muuga and Old City Harbour. Due to its geographical location Paljassaare Harbour is one of the most sheltered harbours in Estonia in terms of winds and waves. Vessels enter and leave the harbour through a canal (length of canal 800 m, width 90-150m, depth 9.0m). This port is primarily specialises in handling mixed cargo, coal and oil products, as well as timber and perishables. The harbour is also used for cooking oil shipments by the neighbouring refinery. It takes the 43.6 ha and has 11 berths with total length equal to 1.9 km. There operate the following terminals: oil terminal, cooking oil terminal, timber terminal, coal terminal, general cargo terminals (incl. reefer terminal) and dry bulk terminal. Maximal depth is around 14.5 m. Saaremaa Harbour has 2 quays available for vessels accompanied by a quay for auxiliary vessels and a floating berth for small crafts. It is the new harbour with the depth alongside the quay of 10 meters is capable of servicing ships with the length of up to 200 m. The natural depth of the harbour location is sufficient for receiving the biggest cruise ships sailing in the Baltic Sea. The total length of quays is 445 m. There are 13.6 ha of territory [15].

6. The Freeport of Riga (RIP, P_6) lies on both banks of the River Daugava covering 15 kilometers in length. Cargo transshipment capacity at the terminals of the Freeport of Riga accounts for 58,2 million tons per annum. Main types of cargo handled at the Freeport of Riga are containers, various metals,

timber, coal, mineral fertilizers, chemical cargo and oil products. On the FRA functioning the following terminals:

- for general cargo: Baltic Container Terminal, Baltmarine Terminal, Extron Baltic, Freja, Jaunmīlgrāvja ostas kompānija, JP Termināls, KS Terminal, MAN-TESS Tranzīts, MT Osta, Osta Lejasvoleri, P&B Port, Port Magnat, Port Milgravis, Rīgas Centrālais termināls, Rīgas Ostas elevators, Rīgas Pasažieru termināls, Rīgas Universālais termināls, Starts - Rīga, Termināls Vecmīlgrāvis, VEGA Stivisors, WT Terminal;
- for liquid cargo: B.L.B. Baltijas Termināls, Latvijas Propāna gāze, Naftimpeks, NESTE Latvija, OVI, PARS Termināls, Rīgas Universālais termināls, Statoil Fuel & Retail Latvia, VEGA Stivisors, VL Bunkerings, Woodison Terminal;
- for dry cargo: Alpha Osta, Extron Baltic, Freja, Jaunmīlgrāvja ostas kompānija, JP Termināls, KS Terminal, LaCon, MAN-TESS Tranzīts, MT Osta, Osta Lejasvoleri, P&B Port, Port Magnat, Port Milgravis, Rīga Bulk Terminal, Rīga Fertilizer terminal, Rīgas Centrālais termināls, Rīgas Ostas elevators, Rīgas Universālais termināls, Strek, Termināls Vecmīlgrāvis, WT Terminal [3].

7. The Freeport of Ventspils (VP, P_7) is a part of the European TEN-T transport core network. The total area of the port is equal to 2451.39 ha with total length of piers 11012 m. There are 53 piers with maximum depth set up to 17.5 m. The port have a strategic transit connection of export goods for Russia and the CIS countries in freight of chemicals, potassium salt, coal, grain, general cargo, ro-ro and others. The technical indicators of the ice-free port allow us to serve the largest vessels entering the Baltic Sea throughout the whole year. All types of handling of liquid and dry bulk and general cargo as well as vessel services are available at the Freeport of Ventspils. A part of these are provided by the services of Freeport Authority, however, the majority of services are offered by private enterprises operating in the territory of the port: Vars, Ventall Terminals, Ventamonjaks serviss, Ventbunkers, Ventspils Nafta Terminal Ltd (all as liquid cargo terminals), Baltic Coal Terminal, Kalija parks, Ventspils Commercial Port, Ventspils Grain Terminal (dry bulk cargo terminals), Noord Natie Ventspils Terminals, Reefer Cargo Terminal and Ventplac (general cargo terminals). This is the deepest port of the eastern coast of the Baltic Sea [4].

8. The Klaipeda State Seaport (KP, P_8) is the northernmost ice-free port on the Eastern coast of

the Baltic Sea. It is the most important and biggest Lithuanian transport hub, connecting sea, land and railway routes from East to West. Klaipeda is a multipurpose, universal, deep-water port, providing high quality services. The port can accommodate vessels up to 337 m in length, up to 48 m. in width and with a maximum draught of 13.4 m. Under Klaipeda State Seaport is functioning 10 companies for cargo handling services: Klaipeda Container Terminal (JSC), Klaipedos Smelte, JSSC (Joint-Stock Stevedoring Company), Centrinis Klaipėdos terminalas (JSC), Klaipeda Stevedoring Company (KLASCO, AB), Liquefied Natural Gas Terminal (LNG Terminal), Bega, Klaipeda Stevedoring Company (UAB), Birių krovinių terminalas (JSC), Kamineros krovinių terminalas (JSC), Krovinių terminalas (JSC), Malkų įlankos terminalas (JSC) and Klaipedos nafta (SC). The Klaipeda Container Terminal operations at two terminals (designated for containers and Ro-Ro cargo). The company handles container carriers, general cargo vessels and Ro-Ro ferries and provides the following services: cargo warehousing, storage, packaging, sorting, assembling and weighing, re-loading onto other means of transport, handling of non-standard / oversized / overweight cargo, handling of Ro-Ro units. The Klaipedos Smelte provides storage and handling of containers, and oversized and overweight machinery, frozen meat and fish products, and other types of packed and bulk cargo. The company operates specialized warehouses (refrigerators) and open sites for cargo handling. The Centrinis Klaipėdos terminalas operates most advanced Ro-Pax terminal which is equipped with two hydraulic ramps and has a capacity to accommodate three vessels at the time. The company handles Ro-Ro, Ro-Pax, Ro-con, cruise, and other types of vessels. It also provides storage of vehicles on sites and other types of cargo in warehouses. The Klaipeda Stevedoring Company has five specialized terminals (designated for general cargo, dry and liquid fertilizers, grain, and Ro-Ro cargo). The company handles and provides storage of dry, liquid and packed fertilizers, molasses, metal products, ferroalloys, frozen food products, grain crops, and other dry bulk and bulk cargo. The International Ferry Terminal handles Ro-Ro cargo and renders services to passengers. The company also provides towage services. In the Liquefied Natural Gas Terminal FSRU (Floating Storage Regasification Unit) type LNG TERMINAL "INDEPENDENCE" is used for receiving of LNG from gas carriers. The terminal provides the LNG storage and re-gasification; discharging of LNG to gas carriers. The Bega - Klaipeda Stevedoring Company provides storage, handling and packaging of mineral fertilizers, sodium carbonate, mineral and

chemical materials, cement, construction materials, general cargo, etc. at seven specialized terminals (designated for bulk and liquid fertilizers, construction material, liquid chemical products, liquid food products, bulk agricultural products, and other dry bulk cargo). The multipurpose export-import and distribution terminal provides storage and handling of agricultural and food products. The company also offers transportation by railcars and vehicles, cargo forwarding, agency, and logistics services. The Birių krovinių terminalas handles and provides storage of bulk and packed mineral fertilizers, mineral and chemical materials, general and other types of cargo at the specialized terminal, the company handles. It also renders services related to cargo weighing and reloading into other means of transport. The Kamineros krovinių terminalas handles and provides storage of bulk and packed cargo (dry bulk and packed peat, peat briquettes, technological and fuel wood chips, scrap metal, clays, gravel and other dry building materials). It also offers agency-freight and mooring services. The cargo storage services within Klaipėda Port territory and in the customs warehouses which are operated by the company. The Krovinių terminalas handles and provides storage of oil, chemical, and petrochemical products in the specialized terminal the company. The terminal can handle and discharge these products from both rail-tanks and tankers. The company can produce different types of oil products; it offers mooring services, cargo forwarding and transportation by rail within Lithuania, Belarus, and Latvia. The Malkų įlankos terminalas handles and provides storage of bulk agricultural products, round and sawn timber, technological and fuel wood chips, peat briquettes, other types of dry bulk cargo, cement, oversized and overweight cargo at the specialized terminals. The Klaipedos nafta at the specialized oil terminal handles light and dark oil products, crude oil from railway tanks into tankers. Furthermore provides discharge of crude oil and oil products from tankers into railway tanks and provisional storage of crude oil and oil products. Moreover, it provides discharge of petrol and diesel fuel (designated for local market) from tankers to tank-trucks. The company offers mooring services, identifies quality parameters of oil products, collects oily water from vessels, supplies vessels with fuel and water. Klaipėdos Nafta AB is an operator of Liquefied Natural Gas Terminal (LNG Terminal) [12].

9. The Port of Gdańsk (GDAP, P_9) is a major international transportation hub situated in the central part of the southern Baltic coast, which ranks among Europe's fastest growing regions. According to the

strategy of European Union the Port of Gdansk plays a significant role as a key link in the Trans-European Transport Corridor No. 1 connecting the Nordic countries with Southern and Eastern Europe. For years, it has been ranked among the leading Baltic ports in terms of throughput volumes. Thanks to the rapid growth of the Deepwater Container Terminal, it has recently placed second for its container turnovers in the Baltic and attained the position of a hub receiving calls from ocean-going vessels. The total land area of the port is about 661 ha and the total water area is 412.6 ha with the total length of quays 23.2 km. The Port of Gdansk is comprised of two principal sections with naturally diverse operational parameters: the inner port stretched along the Dead Vistula and the port canal, and the outer port affording direct access to the Gulf of Gdansk. The maximal draught of vessels in inner port is 10.2 m and in outer port is 15.0 m. The inner port, which is available for the vessels up to 225 m long, offers a comprehensive range of terminals and facilities designed to handling containerised cargo, passenger ferries and Ro-Ro vessels, passenger cars and citrus fruit, sulphur, phosphorites and other bulk. The other quays fitted with versatile equipment and infrastructure are universal in use and enable the handling of conventional general as well as bulk cargo such as rolled steel products, oversize and heavy lifts, grain, artificial fertilizers, ore and coal. The outer port performs its operations on piers, quays and cargo handling jetties situated immediately on the waters of the Gulf of Gdansk. This section of the port offers state-of-the-art facilities suited to handling energy raw materials such as liquid fuels, coal and liquefied gas. The liquid fuel terminal consists of five berths for handling of crude oil and crude oil derivatives. The handling technology is performed in a closed system, safe for the natural environment. The terminal is equipped with closed handling docks, anti-spill barriers and an anti-fire system. Through a system of pipelines and handling stations of PERN and Gdansk Refinery, fuels can be delivered to refineries and plants home and east lands of Germany. The annual throughput capacity of the terminal amounts to 40 million tones. The terminal is owned by the Liquid Fuel Handling Company "Naftoport" Ltd, the services are rendered by the Cargo Handling and Storage Enterprise "Port Polnocny" Co. Ltd.. Dry Bulk Terminal is comprised of two terminals connected by a conveying system. First of them is coal export pier which accepts vessels up to 280 meters long with draft to 15,0 meters. Two ship loaders allow for loading of 35 thousand tons of coal a day. The second one is an import ore pier with two cranes allowing for unloading of 2600 tons per hour.

This terminal is designed to ensure high throughput capacity of dry bulk cargo, mainly coal and iron ore, and to utilize at the same time the best available technologies in environmental protection. The LPG Terminal, located in the outer port, occupies an area of 11 ha. Its pier can accept vessels up to 190 meters with draft of 9,5 meters. The terminal is suited for the receiving, storing, partial mixing, and distributing - by means of tank cars and trucks - of liquefied gas: propane-butane. It has been designed for an annual throughput capacity of up to 500,000 tones. The terminal also constitutes a storage base for LPG in export relations. The storage base consist of 16 digged-in tanks of a total storage capacity of 13,200 tones. All services are rendered by Gaspol SA - Gdansk LPG Terminal. The outer port also accommodates modern Deepwater Container Terminal. Container handling at the Port of Gdansk is concentrated in the inner port at the Szczecinskie Quay operated by the Gdansk Container Terminal (GTK) and at the Deepwater Container Terminal (DCT) situated in the outer port. The Deepwater Container Terminal became operational on 1 June 2007 with the arrival of the first commercial container ship and it is designed to accommodate the largest vessels that can enter the Baltic Sea i.e. Postpanamax vessels. Terminal area covers 49 hectares, quay length is 650 meters and it's gantry cranes allow for loading/unloading of huge E-type Maersk container vessels. The Port of Gdansk provides services to Ro/Ro vessels at the quays of the Duty Free Zone, furthermore, it is possible at the state-of-the-art Westerplatte Ferry Terminal. A Ro/Ro ramp is also available at the Polferries Terminal operated by the Polish Baltic Shipping Co. offering regular ferry connections to Sweden, and additionally at the Deepwater Container Terminal. Coal is handled in the Outer Port at the dry bulk terminal and in the Inner Port at the Gorniczny Basin wharves. The outer port offers two state-of-the-art terminals designated for handling liquid fuels and liquefied gas. Additionally, fuel and base oils are handled at the Obroncow Poczty Polskiej Quay in the inner port. The Port of Gdansk offers a comprehensive range of specific cargo operations that require highly specialist handling and storage technologies. There is a phosphorites handling base available at the Chemikow Quay which, together with the adjacent Przemyslowe Quay, facilitates the handling of cargoes such as fertilizers, liquid chemicals, minerals and molasses. The Obroncow Poczty Polskiej Quay offers a terminal dedicated to the handling of sulphur as well as other bulk, including molasses and aggregates [8].

10.The Port of Gdynia (GDYP, P_{10}) has very favourable navigation conditions. Roadstead - protected by the Hel Peninsula, which is a natural year-round shield for the anchored vessels, the 2.5 km long outer breakwater and a 150 m wide and 14 meters deep entrance to the port make the port easily accessible from the sea. The Port of Gdynia is a warm water port, where there are no tides. The water level may rise by 60 cm during the strong westerly winds, or fall by about 60 cm during strong easterly winds. The Port of Gdynia is an universal modern port specializing in handling general cargo, mainly unitized cargo transported in containers and in a ro-ro system, based on the well-developed network of multimodal connections including hinterland, regular Short Sea Shipping Lines as well as ferry connections (ferry terminal) . The Port of Gdynia is an important link in the Corridor VI of the Trans-European Transport Network (TEN-T). The quays at the Port of Gdynia are 17,700 meters long, of which over 11,000 are used for handling operations. The maximal draught along the quays is 13.0 m. The total area of the port is 755.4 hectares, including the land area of 508 hectares. Maximum length of the vessel accepted in Port of Gdynia is 340 meters with maximum draught of 13,0 meters. In 2014 total cargo shipped exceeded 19,4 mln tons, which included 0,85 mln TEU (containers). Also over 360 thousands of passengers used Port of Gdynia. Handling of the containerized cargo at the Port of Gdynia is the domain of two modern container terminals located in the Western Port: Baltic Container Terminal Ltd. and Gdynia Container Terminal S.A. Baltic Container Terminal (BCT) is located at Helskie Wharf and has current annual handling capacity of some 750.000 TEUs and potential handling capacity of 1,2 mln. Length of the wharf is 800 m with a depth of 12,7 m. Terminal has 60 hectares area. Containers can be transferred inland by trucks or via railways. Gdynia Container Terminal is located at Bulgarskie Wharf in the Port of Gdynia and covers a total land area of 19.1 hectares with 620 meters of shoreline. GCT owns Bulgarskie Wharf with a length of 450 meters, including 366 meters for container load-on/load-off operations with a depth of 11.0 m alongside. GCT has rail terminal with 4 rail tracks 475 m in length and gatehouse with 4 entrance and 4 exit lanes. There are also - equipped with modern cargo handling equipment - bulk terminals: Baltic Grain Terminal Ltd., Maritime Bulk Terminal Gdynia Ltd., Baltic Bulk Terminal Ltd., Westway Terminal Poland Ltd. and Petrolinvest. Baltic Grain Terminal is a modern port terminal that supports all kinds of loads cereals, such as wheat, barley, rye, rape seed and feed material, such as: meal: soybean, rapeseed and sugar beet pulp. It is situated at two quays: the

Indian and Norwegian in the Port of Gdynia. Grain elevator, built in 1937, in the period before World War II was intended to support export and import of grain and its processing. The elevator at that time was mainly used for exports of Polish grain and as a transit warehouse. Baltic Grain Terminal has a storage area with a capacity of 51,000 tons, which includes: - grain elevator, modernized in 1992. With a capacity of 12,000 tons - steel silos, built in 1996, With a capacity of 14,000 tonnes - a modern flat magazine fodder, opened in 2001. with a capacity of 25,000 tonnes for feed and 32,000 tons of cereals. Maritime Bulk Terminal Gdynia Ltd is located at the main entrance to Port of Gdynia and is directly connected to the railway and road communication systems. Within the structure of the Port of Gdynia, the MBTG has an universal terminal renders the services of reloading, warehousing, big-bagging and sorting all kinds of bulk cargoes. A part of MBTG is a Liquid Fuels Reloading Post - The Terminal renders also operating and technical services for the Liquid Fuels Reloading Post on the breakwater. This post serves the tankers of the length up to 210 m (minimal vessel length - 100 m) and of draught up to 11 m. Baltic Bulk Terminal Ltd. , the joint venture company established by Port of Gdynia and Zakłady Azotowe "PUŁAWY" S.A., operating export of polish chemical products, particularly fertilizers. Two cargo handling and storage terminals were built within a period of 1997-1999, one for liquid another for bulk cargoes Terminals has been exploited since 1999, offering: export of bulk cargoes, import of bulk cargoes, bulk storage including bonded warehouses storage, Processing/Packing of bulk cargoes, export of liquid cargoes, import of liquid cargoes, neutral and 3rd fire safety class liquid cargoes. Baltic General Cargo Terminal Gdynia Ltd. is specialized in handling general cargo. It consists of two terminals - part of BGCT is dedicated to handling ro-ro cargo (within Basin V of the port of Gdynia) and the other part to handling conventional general cargo [9]. One of the most significant investments in Port of Gdynia is the project entitled "Developing the Area of the Bulgarian Quay in the Port of Gdynia", co-funded by the European Union out of the Cohesion Fund as part of the Operational Programme Infrastructure and Environment. The aim of this investment is to increase the port's handling capacity and prepare over twenty hectares of real estate for the purposes of logistics, and thereby to further consolidate the competitive position of the Port of Gdynia in the Baltic Sea region. Located in the Western Port in the immediate vicinity of Gdynia Container Terminal, the investment will allow creating appropriate conditions for handling both general cargo and bulk cargo. Another aim of the

project is to increase the share of alternative transport modes (in relation to road transport) in Pan-European Transport Corridor VI of TEN-T network by increasing maritime shipping (<http://www.port.gdynia.pl/en/Bulgarian>). Another project included in the investment plan of the Port of Gdynia Authority SA, adopted for the years 2014-2017, is entitled "Deepening of the Approach Fairway and Internal Water Reservoirs of the Port of Gdynia – Stage I - Expansion of Turning basin no. 2" and its aim is to open Port of Gdynia for deep sea container vessels. Located in the internal main channel of the Port of Gdynia, Turning basins no. 2 and no.3 currently allow rotating ships of up to 300 m long. According to the shipping operators plans, there is a need to increase these parameters - to allow the Port of Gdynia to accommodate container ships operating between Asian and European ports, with direct calls to the Baltic Sea . This project will allow expanding Turning basin no. 2 to the diameter of 480m, it will be possible to accommodate ships with the length of at least 384 m - 400 m and capacity of at least 14 000 TEU. After completing the investments in infrastructure and technical equipment currently undertaken by the Port Authority together with Baltic Container Terminal and Gdynia Container Terminal, handling capacity in Gdynia will reach approx. 2 million TEU [9].

11.The Szczecin-Swinoujście Port (SSP, P_{11}) can handle vessels of draught up to 13.2 m and a length of up to 270 m. One of the main elements of this port is the largest in Poland terminal for handling dry bulk cargo, mainly coal - both exports and imports, and imported iron ore for the Polish, Czech and Slovak steel companies. Another offer of the port in Swinoujście is ferry terminal equipped with five stations to handle passenger-car ferries and car-railway ferries on the route to/from Sweden. In Swinoujście there is also a new terminal that specializes in handling agro-food products, equipped with a flat storage warehouses with a total capacity of 50,000 tons. The Port of Szczecin is located about 68 km from the sea. The trip by the waterway from Swinoujście to Szczecin takes about 4 hours. The port can handle vessels of draught up to 9.15 m and a length of up to 215 m. Port of Szczecin is universal and handles both general cargo and bulk cargo goods. It specializes in handling and storage of containers, steel products, oversized cargo, paper and cellulose. Port of Szczecin is the largest transshipment center of the granite blocks in Poland. It also handles dry bulk cargo - such as coal, coke, aggregates, grain, fertilizers and liquid cargo, including those requiring special storage conditions and handling, such as tar [19].

12. The Port of Helsinki (HP, P_{12}) is Finland's main port, specialized in unitized cargo services for Finnish companies engaged in foreign trade. The port of Helsinki has frequent regular line traffic, balanced import and export. The specialization of the port is utilizing cargo traffic, containers, trucks and trailers. There are three main areas in the Port of Helsinki: Vuosaari Harbour, West Harbour and South Harbour. The Vuosaari Harbour serves mainly container and roro traffic. There are also great conditions for large-scale train transports: the port railway, which joins the main railway line in Kerava, runs directly to the Vuosaari Harbour quays and terminals. There are 17 RoRo berths with total length of quays equal to 3928 m. The depth of the harbor is from 10.5 to 12.5 m. There operate 4 container cranes (95 t), 4 container cranes (50 t) and 2 container cranes (60 t). The South Harbour and West Harbour serve roro traffic transported by passenger ships. The South Harbor has 6 quays with total length set up to 2190 m. The depth is from 7.5 to 10.3 m. There are 5 roro ramps. The West Harbour dispose 5 quays with total length 2366 m. the depth is from 7.5 to 12.1 m [11].

13. The Port of Turku (TP, P_{13}) is a modern European port that serves efficiently both cargo and passenger transports on the Baltic Sea. It is the leading passenger harbour for Scandinavian traffic and number two in Finland measured by the total number of passengers. Passenger traffic comprises frequent ferry connections between Finland and Sweden as well as cruise traffic in the Baltic Sea. The routes to Sweden are operated by two shipping companies, Tallink Silja and Viking Line, using modern passenger ferries. There are four daily departures from Turku, two in the morning and two in the evening. There is a separate quay at the mouth of the River Aura reserved for cruise liners visiting Turku within a short distance from the sights and services at the heart of the city. The Linnanaukko area serves unitized cargo transports as well as lo-lo and bulk transports. With good road connections, the area also houses the biggest privately owned lorry terminals in the port.

The railway to the Port supports traffic and enables combining sea transports with rail trans-ports. The Linnanaukko area offers the possibility for transfer loading of railway carriages. There are 800 m of quay length with 2 ro-ro berths. It is equipped with one mobile crane (Mantsinen) 20 t. The maximal depth is 7,5-10 m. The West Harbour is designed to serve roro transports and the growing international container transports. The two container terminals and four lightweight halls in the area allow for handling of cargo whatever the weather. Turku Container

Terminal (TCT) utilises state-of-the-art technology and enables the loading and unloading of containers in the Port's facilities instead of the customer's premises. There are quay with total length 1050m and 5 ro-ro berths. The maximal depth is equal to 8.5 – 10 m. The service is done by one 40/48 t gantry crane, one 40/48 t gantry crane, one 35/46 t multi-function crane, one 10/60 t knuckleboom crane and two 8 t knuckleboom crane. The Pansio Harbour is designed for unitised cargo, the ro-ro harbour offers excellent premises for project loads besides the spacious facilities for cargo handling. The area has two 5,000 m² warehouses right next to the berth and more than 140,000 m² of asphalted field space. The large field areas make the Pansio Harbour ideally suited to car imports and exports as well as the needs of the local shipyards and other heavy industry. Logistics warehouses with a total floor area of 50,000 m² are being planned for the area. The berth depth is form 7.5 – 10 m [17].

14. The Port of Hamina-Kotka (HKP, P_{14}) is the largest full-service universal port in Finland, serves all types of cargo: containers, RoRo, liquid bulk, dry bulk, LoLo, gas, project shipments and passenger traffic, and provides versatile value-added services. The location of the Port of HaminaKotka on the Gulf of Finland benefits not only the Finnish imports and exports but also the St Petersburg and Moscow regions in Russia – after all, the port is located only 35 kilometres from the Russian border. The logistics and stevedoring services together with the industrial operations encompassing in total 1,100 hectares within the port render it a unique unit on the Baltic Sea. Transport connections to the foremost economic areas in Finland and Russia and a fairway with a draught of 15 metres enable excellent connections between the Port of HaminaKotka and the rest of the world. There is 9 km of quays with 76 berths. The tank capacity 1.1 million m³. The Port of Hamina-Kotka has 8 main parts: Halla, Hamina, Hietanen, Hietanen South, Kantasatama, Mussalo Terminal and Sunila. The Halla Harbour handles conventional cargoes. The goods handled here comprise exported products of the Finnish wood-processing industry, and imports of raw materials. There are 210 m of quays, 4 berths with maximal depth equal to 7.3 m. The service range available at the Hamina Harbour is more versatile than in any other port area in Finland. This single harbour can handle liquid bulk, dry bulk, containers, RoRo cargoes, gas, project shipments and conventional cargoes. The goods are carried to the harbour area of almost 500 hectares along a fairway 12 metres deep and using excellent road and rail connections. Office centre Haminan Porttitalo located within the gate area houses a customs office

and all logistics services. The Liquid and Gas Terminal at the Hamina Harbour together with its versatile production plants is the foremost hub in Finland for the handling of chemicals. The 15 chemical operators at the terminal can store more than 500,000 cubic metres of chemicals at a time. The Hamina Harbour also has available plots for port-related industries and logistics enterprises. There are 3,000 m of quays, 27 berths with maximal depth equal to 6.5–12.0 m. The Harbour is equipped with 3 container cranes and a mobile crane. The Hietanen Harbour focuses on RoRo cargoes of the wood-processing industry and on motor vehicles. Hietanen has a car terminal of 100 hectares and almost 10 hectares of covered storage space. A customs office and freight forwarders are located within the gate area at Hietanen. The length of quays is set up to 1081 m with 6 berths. There is the maximal draught from 7.9 to 10.0 m. Hietanen South was formerly known by the name Poland Quay, because it was used for unloading coal shipments arriving from Poland. Hietanen South still handles dry bulk cargoes with supporting the 360 m of quays, 4 berths. The draught is around 8.5 m. The oldest harbor in Kotka is Kantasatama. It still has good facilities for shipping, plus warehouses originally built for the needs of the wood-processing industry. In the future, Kantasatama will focus on passenger traffic. For now, this harbor disposes to 962 m of quays with 8 berths. The maximal draught is equal to 7.7–10.0 m. The Mussalo Container Terminal is one of the busiest terminals on the Baltic Sea. It handles a considerable portion of the Finnish exports and transit cargoes. The Dry Bulk Terminal handles a large volume of Finnish imports and transit goods, while the tank capacity of more than 200,000 cubic metres at the Liquid Terminal enables a wide range of storage and value-added services for chemicals. The Mussalo Harbour also has available land areas for the needs of logistics and manufacturing industries for many years to come. More than 4,000 vehicles per day pass through the gate at Mussalo. The Sunila Harbour is primarily used for raw materials imported for the Finnish wood-processing industry, and for exported pulp. There are 400 m of quays (Sunila Oy 200 m), 4 berths (Sunila Oy 2) with maximal draught from 6.0 up to 7.9 m [7].

15. The Port of Gothenburg (GP, P_{15}) is the largest port in Scandinavia. Almost 30 per cent of Swedish foreign trade passes through the port. The Port of Gothenburg can offer a very wide range of routes, with traffic to over 130 destinations throughout the world. There are, for example, direct routes to the USA, Middle East, India and Asia. The Port of Gothenburg is also the only port in Sweden with the

capacity to receive the very largest ocean-going container vessels. Around 25 rail shuttles depart each day, offering companies throughout Sweden and Norway a direct, environmentally wise link to the port and the opportunity to utilise the broad range of routes. At the Port of Gothenburg, there are terminals for containers, ro-ro, cars, passengers and oil and other energy products. Since 2010, the port has been divided into a municipal Port Authority and separate terminal companies that deal with the operational side. Gothenburg Roro Terminal is a vital link in the Swedish export and import chain. The Terminal has around 20 calls per week. The Terminal has an area of 500,000 square metres. Two wide, ice-free fairways guarantee a rapid, safe approach with open water just 1.5 hours away. The terminal has seven quays and can handle trailers, SECUs, containers, chassis, machines, cars and special goods in the form of project loads, as well as stuffing and stripping (reloading) of paper and steel in a weatherproof environment. Logent Ports & Terminals in Gothenburg is by far the largest export port for vehicles in Sweden. There is also a significant import volume. The five companies use Logent Gothenburg Car Terminal. APM Terminals Gothenburg at the Port of Gothenburg is the largest container terminal in the Nordic region and a hub for Swedish foreign trade. Over 50% of all containers to and from Sweden pass through the terminal. There are following shipping lines and routes:

- Atlantic Container Line - Ports of call include Halifax (Canada), Baltimore (USA) and New York (USA),
- CMA CGM - Ports of call include Hamburg (Germany), Århus (Denmark) and Rotterdam (Netherlands),
- Hapag Lloyd - Ports of call include Hamburg and Bremerhaven,
- Hyundai Merchant Marine - Ports of call include St Petersburg (Russia) and Århus (Denmark),
- Green Feeder - Ports of call include Hamburg (Germany) and Fredericia (Denmark),
- K-Line - Ports of call include Lisbon and Leixoes (Portugal) and Felixstowe (England),
- Maersk Line - Ports of call include Hong Kong, Shanghai, Yantian (China) and Kwanyang (South Korea),
- Mediterranean Shipping Company (MSC) - Ports of call include Rotterdam (Netherlands), Antwerp (Belgium),
- Shipping Corporation of India (SCI) - Ports of call include Jeddah (Saudi Arabia), Colombo (Sri Lanka) and Mumbai (India),
- Seago Line - Ports of call include Casablanca and Agadir (Morocco),

- Team Lines - Ports of call include Bilbao (Spain) and Antwerp (Belgium),
- Unifeeder - Ports of call include Hamburg (Germany), Rauma (Finland) and Zeebrugge (Belgium),
- X-Press Container Line - Ports of call include Rotterdam (Netherlands), Antwerp (Belgium) and Bilbao (Spain).

The APM Terminals Gothenburg has 10 berths with water depth down to 14 m. Furthermore, there are 1,8 kilometres of quays, two broad, ice-free fairways guarantee a safe, rapid approach with open water just 1.5 hours away.

Gothenburg Energy Port is the largest energy port for open access in Scandinavia and the site of several refineries and storage companies. Its advantageous geographical location makes the Port of Gothenburg a hub for the whole of the Scandinavian market. Each year, 2,500 tankers put into the Gothenburg Energy Port and half of the crude oil that enters Sweden does so via the Port of Gothenburg. Over 20 million tonnes of oil and other energy products are handled.

The port is also the site of Sweden's largest depot operations, supplying the whole of western Sweden with petrol and diesel and many other products. Some 50 per cent of all refined products remain in Sweden whilst the other 50 per cent go for export to the world market. At the Port of Gothenburg there are three energy ports that handle oil and energy products: Tor Harbour, Skarvik Harbour and Rya Harbour. At Tor Harbour, crude oil is loaded and discharged. The Skarvik Harbour and Rya Harbour load and discharge refined oil products, renewable energy products, chemicals and a small volume of crude oil. There is a total of 24 berths dedicated for tankers in the Port of Gothenburg. [Click here](#) for detailed information about the berths in Tor Harbour. [Click](#) for detailed information about the berths in Skarvik and Rya Harbour. Not just oil The Energy Port handles and produces a wide range of oil and energy products, including petrol, diesel, asphalt, LPG, chemicals, aviation fuel, propane, propylene, fuel oils, heavy oil, petroleum gas, ethanol, tall oil and other bio-oils. Three large refineries are located directly beside the harbour. These are Preem, St1 (which owns the Shell filling stations) and Nynäs. These refineries manufacture a wide range of energy products, including petrol, diesel and asphalt. The finished products are supplied to industry in Sweden and abroad. At the Energy Port there are also three large storage companies: Vopak, Nordic Storage and Scandinavian Tank Storage. The companies offer intermediate storage of thick oil, diesel, petrol,

renewable products such as ethanol and bio-oils, chemicals and other petroleum products [10].

16. The Port of Luleå (LP, P_{16}) is a public harbour which, in spite of its northerly position and thanks to excellent co-operation with modern state-run and locally operated ice-breakers, is open for shipping all the year round. Within the port area there are four harbour sections: the Victoria Harbour where dry goods are handled, Uddebo for liquid products and the industrial quays of LKAB and Cementa, respectively. The old quay for loading iron ore is used for governmental icebreakers and as a cruise port. The Harbour's modern installations make it possible to handle all kinds of bulk goods, as well as general cargo. Around 570 vessels call at Port of Luleå every year, a substantial number of which have a loading capacity (deadweight capacity) of more than 70,000 tons. The annual volume of goods handled exceeds seven million tons, principally bulk goods, which confirms Luleå's position as the largest bulk goods port in Sweden and one of the five largest ports in Sweden. The Port of Luleå contains six different parts. Victoriahamnen handles dry goods and Uddebo handles liquid product and they are the general quays. The Cementa quay is Cementa's facility for unloading cement and LKAB's unloading for ore is at Sandskär and these are industrial quays. Strömören is for serviceboats and the old ore quay at Svartön is used for the governmental ice-breakers and cruise-ships. The annual volume of goods handled at the Victoria Harbour is around 2-3 million tons - mainly coal, limestone, scrap metal and other raw materials for the steel and mining industries. Four cranes, with a radius of action of up to 30 m outside the quay and with a maximum lifting capacity of 20-40 tons when operating with a hook, guarantee fast and efficient handling. Here there is also a fixed 20 m wide ro-ro ramp. The length of the quay is 770 metres. The eastern part, the coal pier, has a length of 250 metres and is mainly used for unloading coal. The inner side of the coal pier is 200 metres long and there is the possibility of direct transloading from vessel to vessel. Uddebo is Luleå's oil harbour, and at its two quay berths about 380,000 tons of liquid products are loaded and unloaded annually. At quay berth 2 it is mainly petroleum products that are unloaded. Quay berth 1 is primarily used for the loading of tar and benzene. Sandskär Oreharbour is LKAB's loading quay for iron ore. The harbour has an efficient equipment what are used to complete the whole handling process, from the unloading of ore trains (the trains are unloaded in motion and it takes about 40 minutes to unload a set of 52 wagons) to the loading of a ship. With a ship loader, whose maximum capacity is 3,000 tons per

hour, more than four million tons of ore are loaded onto ships and barges annually. The length of the quay is 250 m. The Cement Quay is Cementa AB's installation for handling and storing bulk cement. Here an annual volume of about 120,000 tons is unloaded from the company's own self-discharging tankers. Svartön is LKAB's old quay for loading iron ore. The quay is nowadays used for the governmental icebreakers. It is also used as a cruise port [13].

17.The Port of Stockholm (SP, P_{17}) offers quay-berths, facilities and services for ferry, cruise and goods traffic. Ports of Stockholm is also responsible for the development and maintenance of inner-city quays, as well as services for archipelago and other waterborne local traffic. Each year more than 12 million passengers and eight million metric tons of goods pass through Ports of Stockholm simply, efficiently and cost-effectively. The Port of Stockholm have four main areas: Stadsgården and Masthamnen, Frihamnen, Värtahamnen and Loudden. At Frihamnen port are possible practically all types of port operations. From Frihamnen there are ferries to Riga and Saint Petersburg. The container terminal in Stockholm is also located here. Stadsgården and Masthamnen is one of Stockholm's largest ports with extensive ferry traffic to Finland and scheduled cruises to Åland.

Värtahamnen is one of the largest port areas in Stockholm and serves extensive ferry traffic to Turku, Helsinki and Tallinn. It covers a total area of 107,000 square metres and there are three Ro-Ro quay-berths. The terminal also houses the rail tracks for the rolling stock that is transported by train ferry, as well as the tracks used for loading and unloading goods.

Loudden is an energy port, where inflammable products are handled. Special regulations therefore apply to access, and prior notice must be given [18].

18.The Port of Trelleborg (TRP, P_{18}), situated in Skåne region on the southern bank of Sweden, is the largest ro-ro port in Scandinavia and the second-largest within the Baltic Sea region. The port provides port- and warehousing services. It is also the largest ferry port in Scandinavia and an important partner in the four corridors of sea bridges between Scandinavia and the European mainland. One of the major challenges for Scandinavia's largest ro-ro terminal is managing the flow of goods and information in several directions. Particularly when the cargo in the Port of Trelleborg is moved between various modes of transport and shipping lines, haulage companies, train operators and cargo owners all need secure access to up-to-date information.

Port of Trelleborg spans over 700 thou. m², has 1,830 m of quay length, 10 ro-ro berths along with one berth for bulk cargo, two combi terminals and 44 thou. m² of warehousing space, of which 24 thou. m² is connected to railway tracks. A new logistic centre has been launched, offering 17 thou. m² for cross-docking, warehousing (groupage, part loads and intermodal reloading) and other logistics services at the port. Ro-ro cargo and ferry traffic are at the core of the port's business. The cargo flow at the port is attracted by the new intermodal hub with connections to and from northern Sweden and Norway. Three companies serve the ro-ro market at the port – Unity Line, Scandlines and TT-Line, which also carry passengers to and from Germany (ports of Travemünde, Rostock and Sassnitz) and Poland (Port of Świnoujście). Port of Trelleborg is one of the largest ferry ports in Scandinavia, with an annual throughput in excess of two million passengers. There are a total of 42 connections daily between Scandinavia and continental Europe. Trelleborg is an important link with Continental Europe [16].

The Baltic seaports included in the BPCIN network are the biggest Baltic seaports with the densest liner service (container, ro-ro and ferry). Almost all of them are classified in the Top 25 Baltic seaports list (except TP).

3. Baltic Port Critical Infrastructure Network and T-ETN Involvement

Maritime transport has a long tradition and plays a vital role in the BSR. The western, eastern, northern and southern parts of the BSR are separated by the Baltic Sea; maritime transport is essential to facilitate trade exchange and travelling between BSR countries. Furthermore, a number of islands within the BSR are integrated only by sea or air connections. Hence, the connections across the Baltic Sea form a backbone for ensuring connectivity between the different parts of the macro-region.

The cargo volume handled in Baltic Sea region ports is estimated to increase from 757.1 million tonnes in 2010 to 984.8 million tonnes in 2030, which means that 228 million of additional cargo will be handled by Baltic region seaports in 2030 compared to 2010. The greatest share of this additional cargo (72 million tonnes) will be handled by Russian Baltic ports. Russian Baltic ports will be followed by Swedish ports with an increase of 47.0 million tonnes. Ports on the eastern shore of the BSR (Finnish ports, Russian ports, Estonian ports, Latvian ports and Lithuanian ports) will account for 53% (121 million tonnes) of the total increase. In terms of

the cargo throughput growth rate, the leading country will be Poland. It is expected that in 2030 the cargo volume handled in Polish ports will increase by almost 50% in comparison with 2010. A significant percentage volume change in the period 2010-2030 will be also observed for Russian Baltic ports (42%). The lowest growth rate will be observed in Estonian ports (approximately 4%).

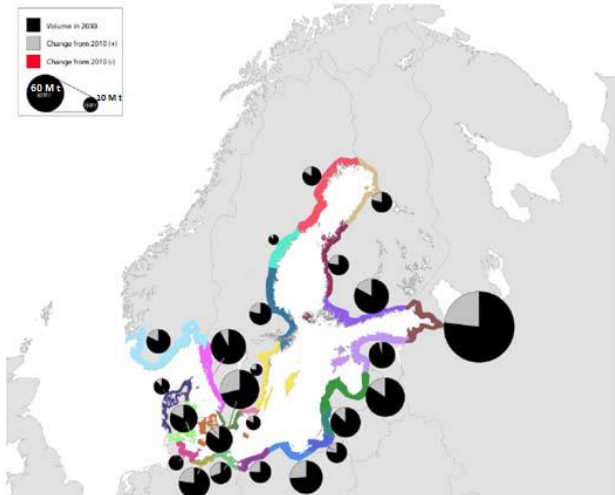


Figure 2. Freight forecast for 24 BSR coastal regions
 Source: Baltic Transport Outlook 2030 [2]

The Figure 2 presents the freight forecast for 24 coastal regions identified in the BTO analysis. It shows the estimated volume handled in ports in particular regions in 2030 and the change from 2010. It can be indicated that among the 24 indicated regions, in 2030 the Leningrad oblast in Russia will handle the largest volume of cargo and simultaneously will be the region with the highest increase in cargo throughput (+66 million tonnes in comparison with 2010). The largest increase is expected for Skåne region in southern Sweden (25 million tonnes). Regions with an increase between 10 and 20 million tonnes include the Gdańsk-Gdynia range, the Kurzeme-Riga region and southern Finland (Uusimaa region). In other regions cargo volume handled in ports is expected to grow by 1-9 million tonnes. It is expected that until 2030 the increase in the freight transport sector will be more than 40%.

The above presented significant and quick development of Baltic Sea Region ports activity cause the high importance of the Baltic Port Critical Infrastructure Network (BPCIN) composed of 18 described in Section 2 core ports and their facilities. Ensuring high safety of this network of port critical infrastructures and its strengthening to climate/weather changes is of great value. The BPCIN high safety and its operations' continuity is

also very important for other critical infrastructures and installations operating in the Baltic Sea Region, especially for other kinds of European transportation infrastructures (Figure 3).

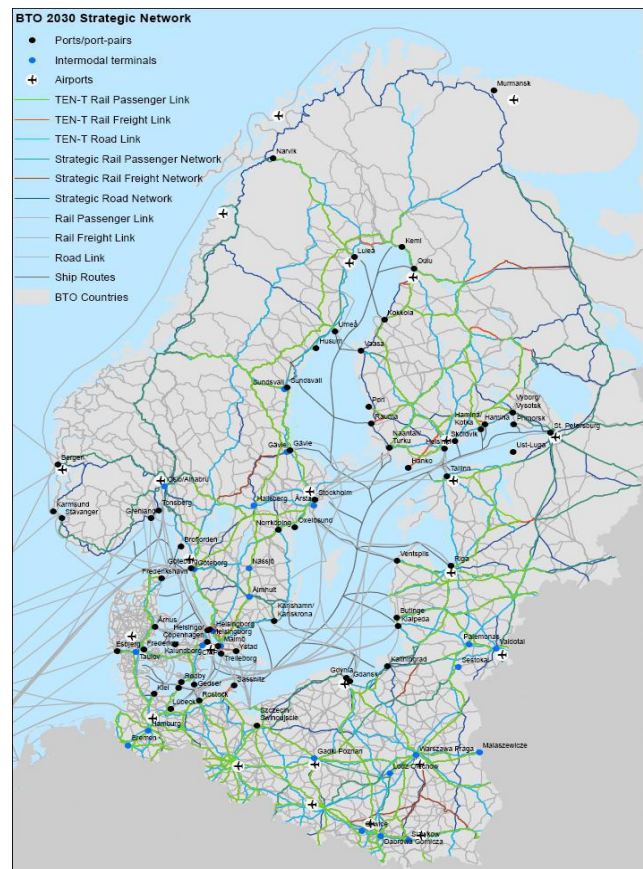


Figure 3. BTO2030 Strategic Network for the BSR [2]

4. Conclusion

The core ports of the Baltic Sea Region have been described. The information about technical parameters and main cargo has been conducted. Furthermore, the Baltic Port Critical Infrastructure Network has been defined. Its involvement in T-ETN has been introduced.

Acknowledgments



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