Baltic LINes

Coherent Linear Infrastructures in Baltic Maritime Spatial Plans

QUO VADIS

Exploring the future of shipping in the Baltic Sea

July 2018

Interreg Baltic Sea Region

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

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1. Introduction

Shipping scenarios for the Baltic Sea

Shipping is one of the main users of the Baltic Sea. There are about 400 sea ports in the region of which 90 are of international importance. Between these ports commercial and passenger traffic is sailing throughout the year. The shipping sector has its own dynamic which is changing over time in its own tempo. This dynamic is largely influenced by the demand for transport, which has a close relationship with the economic growth in the region. But the dynamic also depends on the changing type of products (containers, oil/gas), or even the characteristics and economic lifetime of the ships themselves. Besides this, also other aspects, such as vessel designs, certain port extensions and environmental friendly propulsion systems (e.g. gas instead of oil) can influence the amount and type of traffic between ports and thereby increases or decreases traffic on a certain route.

Shipping determines BSR development and international trade and therefore is one of the most economically important sectors using the Baltic Sea, but it is not the only one. Another 'traditional' sector is fisheries, which is a very dynamic sector changing the location of its activities continuously. Also, in recent years, more space is demanded for developing official nature protected areas and generating electricity using Offshore Wind Farms. And these other uses cannot always coexist with shipping routes. The consequences are that the pressures on the Baltic Sea is growing and the more traditional 'shipping' sector might get influenced by other uses.

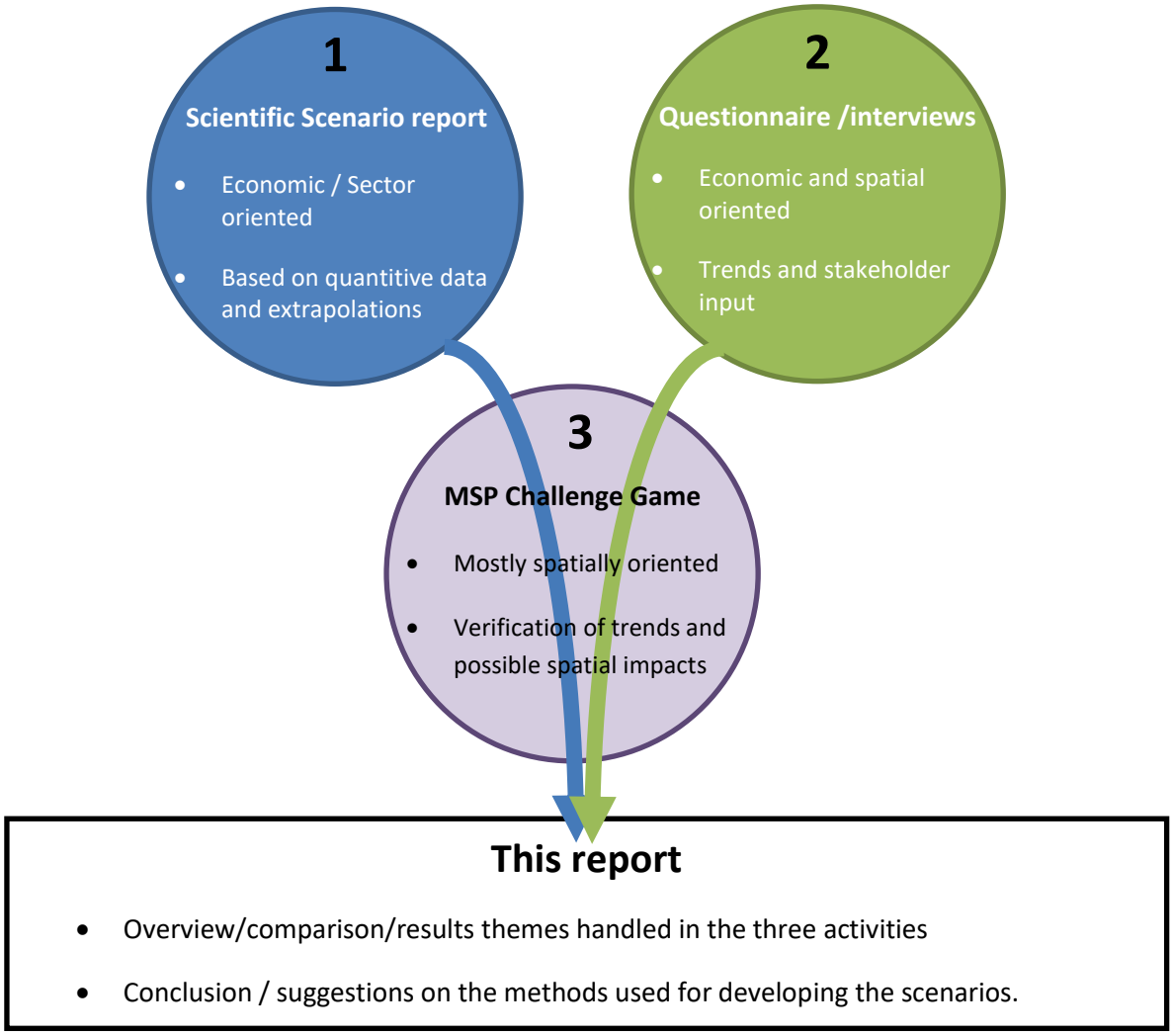
Maritime Spatial Planners need to integrated the spatial demands of the shipping sector in their plans. They can do this by designating specific space in their spatial plans for shipping purposes. This can be non-shipping zones, shipping zones, anchoring zones and more. Most important is that the spatial plan is not only taking into account the current shipping routes but will also look how to include the interest of the shipping sector in the future. This means that planners need to understand how much space potentially is necessary on which location in for example 2030 or 2050. While this is hard to determine easily, planners use forward looking tools to make estimations about this. For example, planners can develop a scenario which trends might happen where in the future. By this, they can integrate the potential outcomes (a future space in the sea) already in their plan.

While these future shipping scenarios are important for all Baltic Sea countries, the transnational Baltic LINes project has been working on spatial shipping scenarios. This report deals with the scenarios building activities done under the project. The goal of this report is to discuss the results of the shipping scenario activities along different themes and thereby provide suggestions for other activities in the project, for example the development of recommendations for MSP.

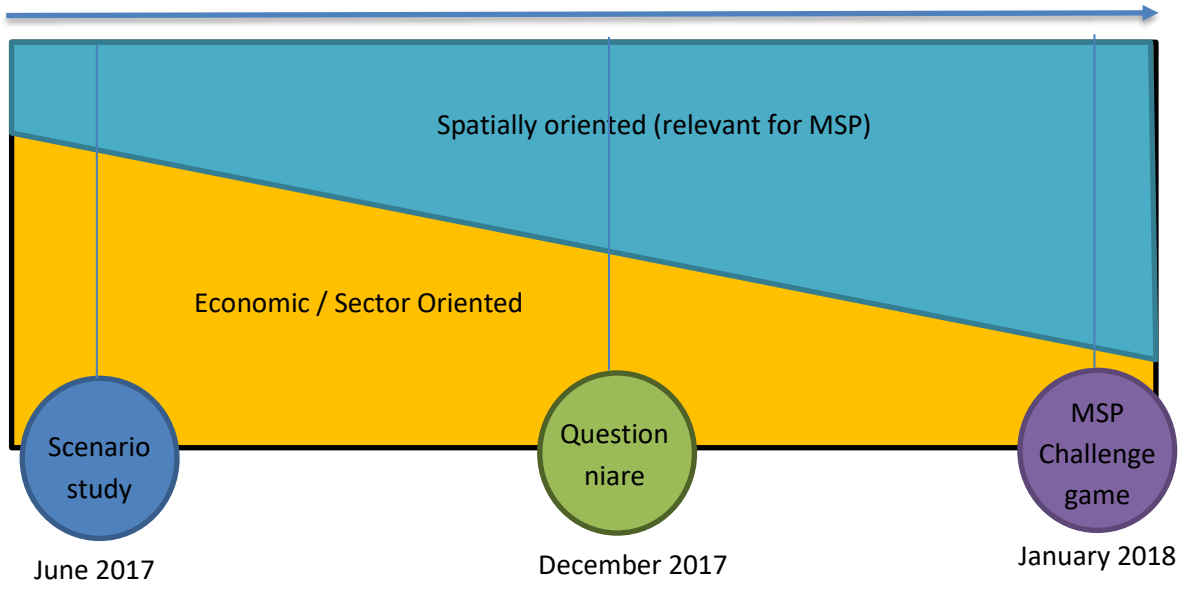
Working towards stakeholder supported spatial scenario's

The scenario developing work of the project consisted of three parts (for a graphical impression please see figure below):

1. Firstly, a scientific sector-oriented study has been done. This study used quantitative data of the existing situation and used extrapolations to predict future trends. Extrapolations have been done by using several variables, based on the different visions: Low economic growth, sustainable economic growth and high economic growth.
2. Secondly, interviews and a questionnaire have been held with a small group of shipping experts. This questionnaire provided a more detailed overview of the sector specific future trends, and also included some spatial issues.
3. The third activity has been a stakeholders' involvement via the interactive game MSP Challenge 2050. This game provided more understanding on the spatial implications of the future shipping trends.



The focus of the three activities differed in the way it concerned the more sector and economic oriented trends, and the spatial component. A sector-oriented approach looks for example at the quantity of ships in total and the number of containers. A spatial oriented approach looks more into where these activities take place in the sea, so which shipping routes are most important and what need is there for space on certain locations in the future. The following timeline provides an overview of when the 3 activities have taken place and what the focus was of these activities.

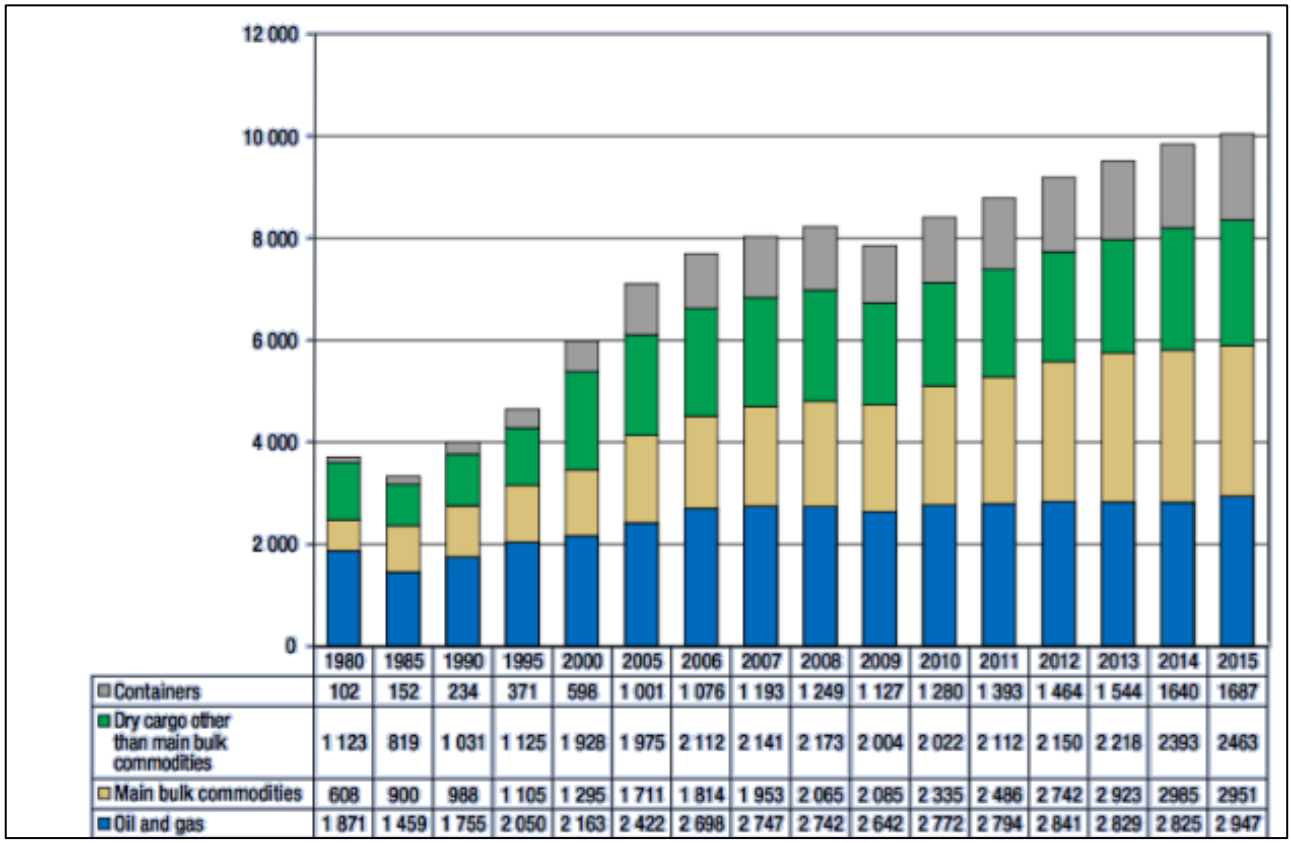


The report will use the three methods to discuss the several findings related to the future of shipping in the Baltic Sea. The themes will be used as the structure of the findings sections, which is chapter 5, of this report. However, before going into depth on the findings, chapter 2 will describe a more elaborated view on the shipping sector in the Baltic Sea. Chapter 3 will elaborate on the 3 the methods used (scenario study, questionnaire and MSP Challenge). Chapter 5 provides the conclusions of the report, both on the content discussed, as well on the methods used.

The report might be updated by the end of the project if subsequent stakeholders' consultations indicate such a necessity.

Introduction to Baltic shipping

According to the UNCTAD more than 80% of global trade in terms of tonnage is transported by sea. In 2016 the total seaborne merchandise reached the level of 10.3 billion tons. In the past 30 years the total amount of cargo transported by ships has almost doubled with an accelerated increase since 2010. Especially the container market has grown considerably (Fig. 1).



	1980	1985	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Containers	102	152	234	371	598	1 001	1 076	1 193	1 249	1 127	1 280	1 393	1 464	1 544	1640	1687
Dry cargo other than main bulk commodities	1 123	819	1 031	1 125	1 928	1 975	2 112	2 141	2 173	2 004	2 022	2 112	2 150	2 218	2393	2463
Main bulk commodities	608	900	988	1 105	1 295	1 711	1 814	1 953	2 065	2 085	2 335	2 486	2 742	2 923	2985	2951
Oil and gas	1 871	1 459	1 755	2 050	2 163	2 422	2 698	2 747	2 742	2 642	2 772	2 794	2 841	2 829	2 825	2 947

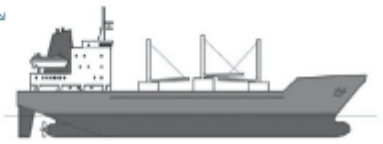
Figure 1. International seaborne trade, selected years (millions of tons)
Source: Review of Maritime Transport 2016, UNCTAD/RMT/2016, New York–Geneva.

Baltic liner shipping consists of three main sectors: ferry (mainly passenger transport, with accompanying unitized cargo – lorries, trucks, cars), cargo (mainly roll-on roll-off unitized cargo) and container shipping (fig.2).

CARGO

Cargo ships move cargo, goods or material from one port to another. Cargo ships can be divided into three sub-categories: general, bulk and other cargo. Cargo ships are the most numerous ships at sea.

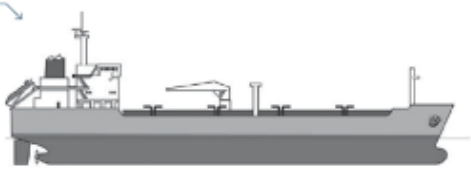
LENGTH: average 134 meters (min 22 – max 292 m)
GROSS TONNAGE: average 6990 GT (min 104 GT – max 94 200 GT)



TANKER

Tanker ships are transporting liquid or gases in bulk. There are different sub-categories such as chemical tanker (carrying hazardous substances), crude oil tanker, gas tanker, oil product tanker and other types of tanker. These ships usually have a double hull to protect the cargo in case of collision or groundings.

LENGTH: average 164 meters (min 25 – max 333 m)
GROSS TONNAGE: average 25 500 GT (min 107 – max 162 000 GT)



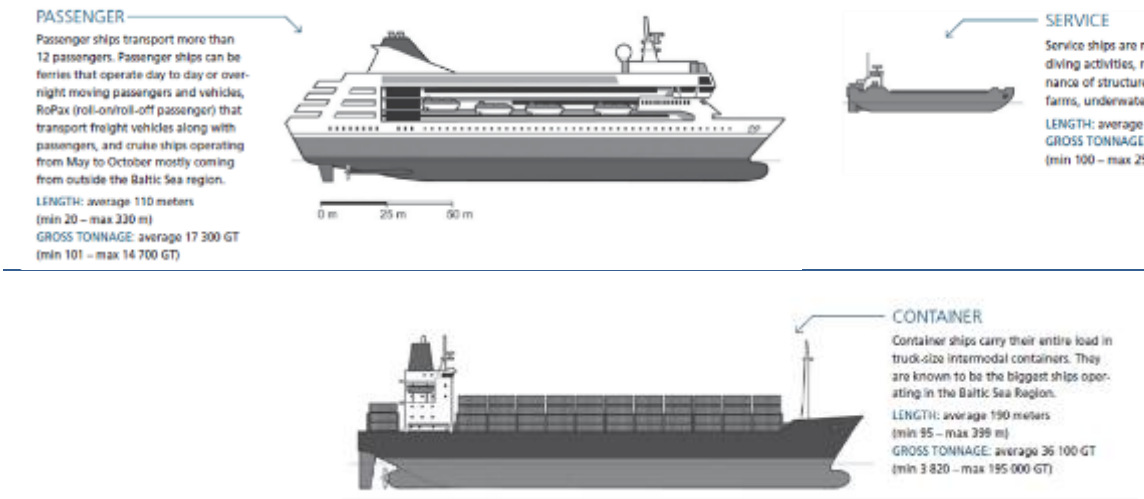


Figure 2. Short description of main ship categories
Source: HELCOM Maritime Assessment 2018.

There are about 2000 ships in the Baltic marine area at any given moment and about 3,500–5,500 ships navigate through the Baltic Sea per month[1]. More than 50% of the ships are general cargo ships. Approximately 20% of the ships in the Baltic Sea are tankers carrying over 200 Mio. tons of oil, about 11% are passenger ships operating about 50 Mio. passengers.

In 2014 all Baltic Sea countries (including Russia) controlled about 7,000 ships with gross tonnage > 1,000, representing 13% of the world fleet and 35% of the EU-controlled fleet (Boteler et al. 2015). The EU-controlled fleet (including Norway) has expanded by more than 70% in the Baltic Sea region in the period 2005 to 2014 (both in GT and DWT). However, the total number of vessels decreased by 31% for the same period indicating a trend towards larger ship sizes, especially for the cargo transport (Fig. 3).

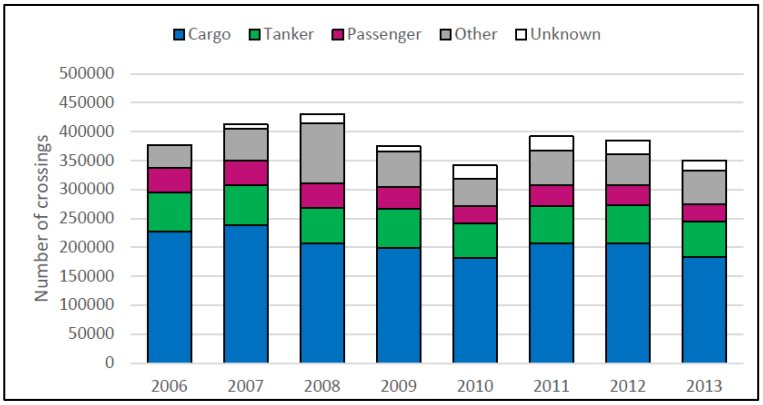


Figure 3. Total annual crossings at fixed AIS lines in the Baltic Sea during 2006-2013 grouped by ship type
Source: Meski and Kaitaranta 2014.

[1] Based on Helcom AIS stats.

2. Methods

The work on the trends and scenarios within the Baltic LINes project has been done in three diverse ways, to get the most complete picture of the future of shipping in the Baltic Sea. We have based our knowledge both on scientific and statistical data as well as on stakeholder opinions which were at the end confronted in the frames of MSP Challenge simulation game.

Some issues have been discussed in all three activities, while other issues have only been included in one for example the MSP Challenge game. The following schedule provides an overview of the themes which are going to be discussed in this report and where they have been dealt at.

	Dealt with in:		
Topic / thematic issue	Scenario Study	Questionnaire /interviews	MSP Challenge game
Shipping numbers (cargo, container, ferries, etc)	X	X	x
Turnover in harbours	X	X	
Shipbuilding	X		
Shipping route patterns	X	X	X
Ports' development	x	X	X
Technology developments	x	X	
Autonomous shipping	x	X	
LNG or other propulsion	x	X	X
Global megatrends	X		x
Legal framework	x		
Environmental standards	x		x
Offshore activities	x		x

The short descriptions of methods used are presented below.

2.1. Scientific economics: Future trends analysis and scenario building

One way to describe the future of Baltic shipping sector was to use the existing statistical data and expert knowledge. Due to the large variety of ports, cargoes and types of vessels, a wide, data-based research was launched to outline and describe the main streams of development for BSR shipping economy. It is significant to show the development and possible future scenarios for particular kind of vessel, cargo groups or even particular countries. Especially considering liner shipping - the deeper researches to secure suitable space for safe shipping, port operations and future development are required.

From the global point of view, influencing factors have been grouped into main megatrends – kind of global stream of influence to the shipping. It was necessary to outline the global economic development and current law framework which has crucial impact on the shipping market. The external factors like changes in trade flows, environmental standards and re-routing of trade

have also been analyzed. Finally, internal factors were outlined similarly divided by particulars scopes of maritime industry – shipyards, offshore, shipping and ports and harbours.

The starting point for discussion on the shipping future and scenarios was the extrapolation of the existing trends. Forecasts for 2030 and 2050 were conducted using historical data provided by EUROSTAT, HELCOM and national port and statistical authorities. The simple method of the linear regression was used. This approach has been applied with regard to three variables that turned out to be very important during the trend analysis namely:

1. "Baltic ports total turnover" in all Baltic countries;
2. "Number of vessel calls in the Baltic Sea Region by ship types";
3. "Number of passengers flows in the Baltic Sea ports by country".

The least squares approach has been used to fit the models for each equation that allows assumption that the errors are independently distributed with a normal distribution.

Predict equation has been following :

$$P_{t+1} = a_t + b * t(+1) + e_t$$

The lower (DGP) and respectively upper (GGP) limit of forecast have been given by:

$$DGP = P_{t+1} - S_e$$

$$GGP = P_{t+1} + S_e$$

Where:

$$S_e = \sqrt{MSE} = \sqrt{\frac{e_t^2}{N-k-1}} = \sqrt{\frac{\sum_{t=0}^{N}(y_t - \hat{y}_t)^2}{N-k-1}}$$

Se – root mean squared error

MSE –mean squared error

e_t – error term,

y_t – dependent variable,

$\hat{y}_t$ – theoretical value of the model,

N – number of observation in model,

k – model parameters number.

The lower and upper limits of forecast have been used in each case for identifying the optimistic (**"**Fast Growth**"** scenario) and pessimistic scenarios (**"**Limited Growth**"** scenario). The reason for the faster or slower growth of the predicted variables were attributed to the changes in the Baltic Sea Region economies.

While preparing the scenarios the absence of the essential turning points have been assumed. One might expect *inter alia* the implementation of numerous legal regulations with the aim of improving safety at sea and environmental protection, resulting in some ship owners and vessels

being banned from the Baltic area and conscious transport policy adopted by the European Commission with the aim of achieving the goals set out in White Papers 2011.

2.2. Asking stakeholders: Interviews and surveys

One week in advance of the MSP Challenge stakeholder workshop in Riga (January 2018) individual invitations to participate in the survey were sent to the registered participants. An internet survey was prepared and consisted of 15 sections with questions and explanatory comments and figures. The survey asked for a number of personal details (i.e. institution and country of work) and was introduced with a short overview of definitions regarding the ship type/ category (taken from the HELCOM Maritime Assessment 2018[2]) to give a common understanding of terms. Respondents were asked to share their opinion on distinct future developments in the shipping sector. For the targeted year 2030 questions about potential developments in maritime transport and potential port developments were raised, hence for the targeted year 2050 questions concerned potential technological developments and potential developments in propulsion systems.[3]

During the MSP Challenge workshop several semi-structured interviews were conducted. Three main question blocks were formulated beforehand by the project partners:

1. *Questions about the respondent's background and present relations to shipping theme/sector.*
2. *Questions about the awareness and knowledge about the MSP in general and the MSP Challenge workshop in particular. Questions about the respondent's expectations and impressions about the MSP Challenge.*
3. *Questions about the main trends/issues/challenges for Baltic Sea and Shipping sector for years and decades ahead.*

First question block was more introductory – to get to know the respondent, while second and third were meant to understand the specific opinion and knowledge. Besides main questions additional and/or clarifying questions were asked during some interviews.[4] In the beginning

[2] Page 20-21 http://www.helcom.fi/Lists/Publications/BSEP152.pdf
[3] *A total of 10 persons participated in the survey.*
[4] In total 8 respondents were interviewed and the interviews lasted from 3 to 15 minutes. Total amount of stakeholders at the MSP Challenge workshop – 18. Represented organisations: Danish Maritime Authority; Estonian Maritime Administration; Estonian Maritime Administration; Finnish Port Association; Shipping Institute Warnemuende; Shipping Institute Warnemuende; BSH (Federal Maritime and Hydrographic Agency); Skulte Port Authority; Maritime Administration of Latvia; Latvian Institute of Aquatic Ecology; Polish Ministry of Maritime Economy and Inland Navigation; University of Gdansk; Morstroytechnology; Admiral Makarov State University of Maritime and Inland Shipping; Swedish Ship-owners Association; European Maritime Safety Agency; Swedish Environmental Research Institute; HELCOM; Finnish Transport Agency (FTA);

respondents were asked if they are willing to answer some questions and if they agree that interviews would be recorded as the working material. It was highlighted that the information from the conducted interviews is an essential part for a) the improvement of the workshop (b) the future actions regarding stakeholder integration on shipping (both Baltic LINes and other MSP projects) and (c) the reporting for the project.

Hence further in text, the stakeholder opinions are highlighted in special boxes.

2.3 Engaging stakeholders: an MSP Challenge workshop

MSP Challenge is a brand, an umbrella, for a suite of board and digital games for higher education, professional training and stakeholder engagement or involvement within the domain of MSP. Like educational games, simulation games or 'serious games' in general, these games are useful in any educational setting where active, (social) constructivist, experiential learning and discovery learning are valued.

MSP Challenge 2050 Baltic Sea Edition is a Baltic Sea specific version of the MSP Challenge digital game that was developed in the course of Baltic LINes. It is thus staged in the Baltic Sea region, offers best-available real-world geographic data on human activities (e.g. locations of wind farms, electricity cables, pipelines, etc.), and connects to validated simulation models for ecology, shipping and energy that calculate and show consequences of planning decisions over time on these three themes.

We used an early version of *MSP Challenge 2050 Baltic Sea Edition* in the workshop designed to engage stakeholders in the topic at hand. Such a game-based workshop greatly helps evoke more creative and simultaneously more considered responses from shipping stakeholders exploring the future of shipping in the Baltic Sea. This is because we essentially recreate the real world to the best of our ability through sophisticated interactive software that stimulates people to develop ideas, implement them, and see the consequences through simulation, all in multiple iterations (i.e. trial-and-error learning). Thanks to MSP Challenge, we can introduce the influences of energy and ecological spatial plans and developments to shipping. Thus, even though the simulation and overall workshop are simplified and condensed, the essence of the marine environment that is the Baltic Sea are nonetheless represented and played out.

In designing the MSP Challenge workshop we used key input from the scientific economic future trend analysis. We essentially used two major components of that analysis:

Latvian Ministry of Environmental Protection and Regional Development; Swedish Agency for Marine and Water Management (SwAM); ERMAK Nord-West

1. Ship traffic within, as well as in and out of, the Baltic Sea region. The shipping simulation used real data provided by HELCOM on the number of ships going from port to port, or coming into or going out of the Baltic Sea. Combined with the spatial areas for shipping (notably IMO shipping routes, and fairways), MSP Challenge's shipping simulation could calculate month-by-month ship movements and visualize them on the Baltic Sea map in the game.
2. Different growth patterns of shipping over a ten-year period. We took the slower and sustained growth scenarios into account in the shipping simulation. The first round of gameplay involved slower (limited, pessimistic) growth, while the second round involved higher (sustained) growth into account, conform the aforementioned scientific economic future trend analyses.

We then created three teams, each consisting of 9 people (of which 6 were the aforementioned carefully selected shipping stakeholders):

- Team South-West: playing from the viewpoint of South-West Baltic:
  - Denmark – Sweden – Germany – Poland – Russia (Kalinigrad) – Lithuania.
- Team Central: playing from the viewpoint of Central Baltic
  - Sweden – Latvia – Estonia – Russia (St.Petersburg) – Southern Finland.
- Team North-East: playing from the viewpoint of North-East Baltic & Bothnian
  - Sweden – Finland – Russia (St.Petersburg) – Northern Estonia.

Each team had the following roles, with appropriate team badge:

- 'Shipping planner' - all the external participants were given this role.
- 'BSR Strategy representative' – additional role for one of the external participants.
- 'Maritime Spatial Planner' - the single MSPlanner, given to project team.
- 'Planner (other activities)' - given to project team, looking particularly at energy and environment. Planners 'non-shipping'/devil's advocates take this role.

Over the course of one afternoon (January 24, 2018) and the following morning (January 25, 2018), the invited stakeholders (Fig. 4) were asked to identify current and future shipping issues or developments within their region, and negotiate within and between regions to explore ideas how to deal with them, and to draw spatial plans for these ideas if relevant.

To help the participants identify issues and develop ideas, we first offered two presentations, covering recent developments and the status quo of shipping in the Baltic Sea. We then asked the participants to play the aforementioned two rounds, which represented two eras in MSP Challenge (2020-2030 and 2030-2040 respectively. By the end of the morning on the second day, we wrapped up the workshop with a debriefing, reflecting on the kinds of issues and ideas that were explored further, as well as their potential consequences (Fig. 4).

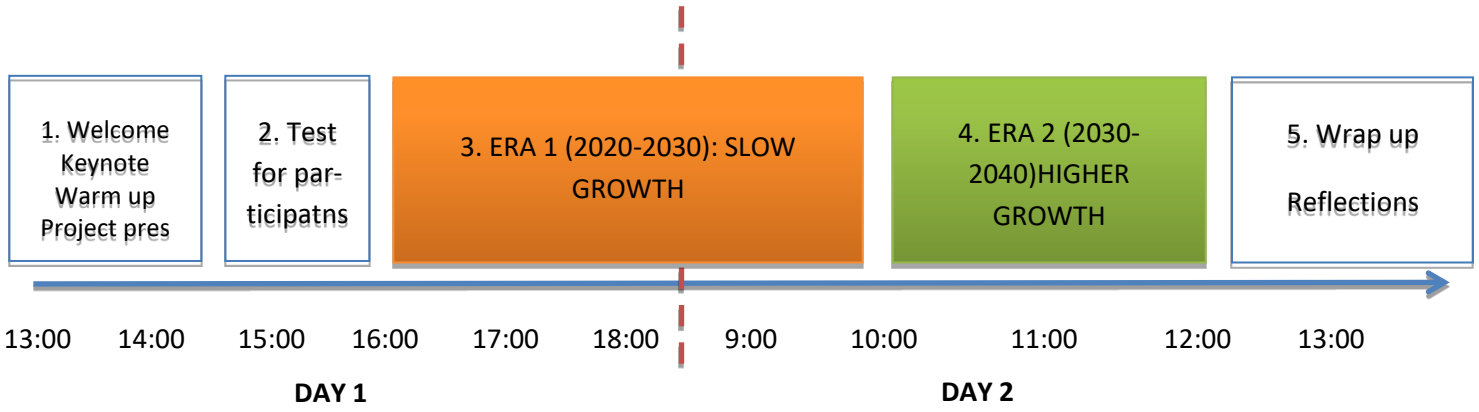


Figure 4. Overall design of the MSP Challenge workshop.
Source: Baltic LInes

Figure 5. The simulation gaming workshop setup in Riga, Latvia, on January 24-25, 2018.
Source: Baltic LInes

3. Future trends and perspectives

3.1. Main development factors

The chapter focuses on the main factors influencing the Baltic shipping. The factors and the Baltic response are described from the one hand by the data-based expertise and by stakeholders.

The Baltic shipping market has a long history of growth and is constantly changing. The region does not have much impact on the global shipping market but it plays an important role as a transport gate towards the Russian market for all EU members and a crucial network for intraregional trade. In recent years there were many factors which influenced the state of shipping, both in terms of quantity as well as quality (technological advances), among them the disintegration of the Central and Eastern Europe, and the change in relations between these countries, further accessions to the EU, global container revolution and the rapid growth and socio-economic promotion of Eastern and Middle Europe. Currently the sea ports are in the eve of important challenges, which will shape their status on the transport market. Introduction of so called Sulphur Directive, political conflicts in Europe or the prolonged uncertainty about the future of European economy, are just selected factors, which will determine the future of sea ports in the Baltic Sea.

There are two major trends that must be underlined. Firstly, the growing domination of the Russian market (containers for the Russian market are also handled by ports in Finland, Estonia, Lithuania and Latvia). Secondly, the rising share of the Polish market (in 2007 it was merely 9%).

There are many external factors which can provide a serious impact on shipping economy worldwide. The most important are changes in the economic development, law framework (especially the environmental standards) and re-routing of trade.

Global economic development

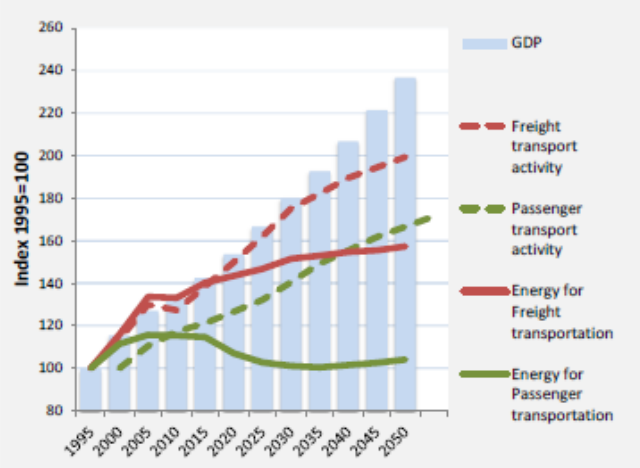


Figure 6. Trends in EU transport activity and energy consumption

Source: Eurostat data.

A large number of sources (IMF 2017, UNCTAD 2017, WTO 2016) expects progressing economic growth for the future but differs in strength of growth prognoses. In general, there is a strong coherence between GDP growth and transport activity and performance (fig. 6). The global shipping sector is highly dependent on the large-scale economic development in the world. Changes in the economic development have a direct effect on the transport demand and, thus, on the well-being of the commercial shipping market. These are coming from both, internal sources, as well as external conditions of the global market:

- diverging global population trends,
- accelerating technological development,
- continuing economic growth,
- globalization and integration,
- increasing international competition for resources, markets and consumers,
- growing pressure on ecosystems,
- increasing consequences of climate change,
- diversifying approaches to governance and
- increasing pollution and environmental impact.

All in all, countries located in Baltic Sea region are involved in most important chains of external trade for United Europe. Most of those countries still need to invest in infra- and suprastructure to be able to handle this traffic both rail and road and become “trade gateway” for Western Europe.

Law framework in the future

The present research shows that are no long-term plans for the legislative change in the 20-40-year period ahead. However, there are documents available, announcing the primary directions of policy change, e.g. in maritime, transport (incl. shipping), environmental (incl. marine), port and fishing policy. The policies adopted by the EU differ, taking the form of communications, resolutions, white, green or blue papers, or regulations. The so-called EU integrated maritime policy is a particular type of strategy, as it is not a single document, but comprises a cohesive system of measures in specific sectors of the maritime economy. The focus of the integrated maritime policy is on issues transcending a single policy area, promoting economic growth in various sectors of the maritime economy, while also coordinating these various sectors and entities operating within them. The directions of change indicated in the various policies adopted by both national and Community legislation extend into the future until 2020, with an outlook to the year 2030. No legislative amendments have been proposed for the year 2050.

The changes planned in the sea shipping industry mainly address the problem of CO_2 emissions reduction. The proposed directions of change will impact the shipbuilding industry. The regulations and guidelines will soon become binding for shipbuilders, forcing them to take

steps to introduce appropriate changes to reduce CO_2 emissions. The main aim of these changes is most of all to improve the energetic efficiency of newly built vessels[5].

Common port policy designed to bring about future legislative change in the Baltic Sea region derives from a number of factors, mainly (as is also the case with shipping) from the need for protecting the natural environment. The Baltic Sea is one of the world's most endangered marine ecosystems. Therefore, the promotion of eco-ports is at present the catalyst for pro-ecological transformations within Europe's port sector. The changes in infrastructural regulations will come as a result of a dynamic increase in ship size, leading to technical problems at ports. Larger ships require wider and deeper waterways, new re-loading facilities and extensive port infrastructure.

Change in global trade flows - re-routing of the international trade

Political relations between EU and Russia, shortage of economic reform, and the low price of oil as well as other commodities does not bode well for the return to the previous trade volumes. Hence BSR ports that are involved in a trade with Russian market should adopt to lower volumes. Nonetheless it's crucial to remember that weaker Rouble is stimulating exports of Russian products (such as chemicals, wood and fertilizers). In some ports, there is a rising trend in those categories of cargo.[6] This may support the traffic from Russia to Europe and other continents. Considering that the most important Russian export gate to the West is the port in St. Petersburg, sooner or later we should expect intensification of this direction. And given the winter months, when the access to this port is limited or impossible, the traffic will have to find other flow corridors, i.e. via Lithuanian or Polish sea ports.

The New Silk Road, also known as "One Belt, One Road" [OBOR] is a 1 trillion US$ plan with an estimated economic multiplier of 2.5 (fig. 7). Since the plan was announced three years ago, only 5% of this budget has been spent. There are as many plans as interested countries and China is talking to all of them. 10,000 articles have been written on the subject, but NDRC has retained only 100. Nothing is decided yet, and may analysts tend to see OBOR as a geopolitical "carrot and stick", something similar to a modern day "Marshall Plan".

[5]The Sixth Governmental Report and the First Biannual Report for the Conference of Parties to the United Nations Framework Convention on Climate Change; Warsaw 2013, p. 78 and 93; Source: https://www.mos.gov.pl/fileadmin/user_upload/srodowisko/szosty_raport_rzadowy.pdf (accessed on 5 June 2017).

[6] K. Liuhto, Maritime cluster in the Baltic Sea region and beyond, University of Turku, Finland, 2016, p. 76. Internet source: https://www.researchgate.net/profile/Kari_Liuhto/publication/303459616_Maritime_cluster_in_the_Baltic_Sea_region_and_beyond/links/574424c708ae298602f0fe73.pdf#page=72.

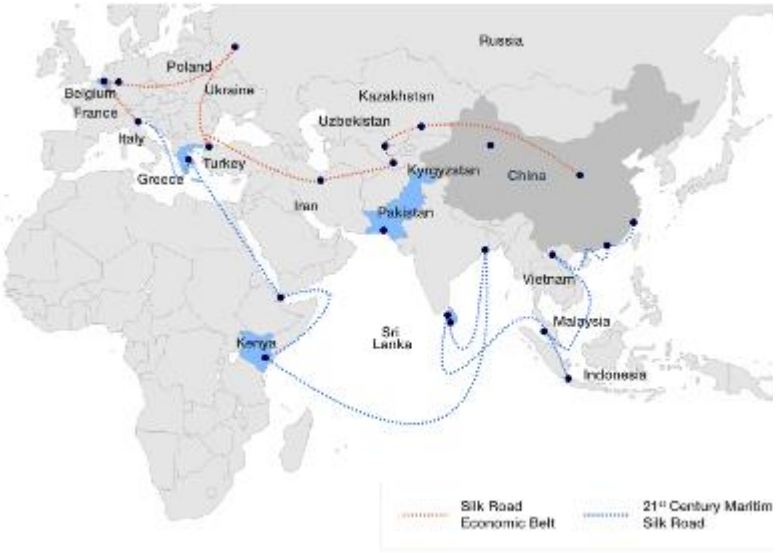


Figure 7. "New Silk Road" proposed routes
Source: https://www.globalinfrastructureinitiative.com

Looking at the European field, the construction of the Rail Baltica railway route is a considerable step towards a better connection between EU border countries and the core Europe (fig.8). It expected to provide an alternative for the north-south transit and might become competitive towards maritime transport in BSR.[7]

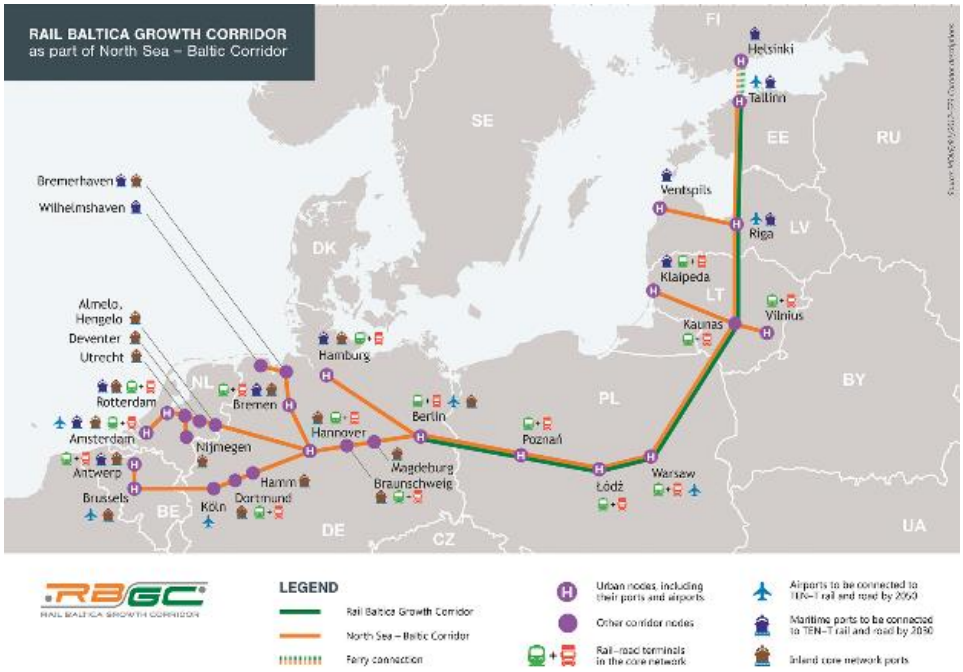


Figure 8. Rail Baltica corridor
Source: https://www.intermodal-logistics.eu

[7] Ibidem, p. 178.

The development of the intermodal corridor connecting the Baltic and Adriatic Seas may also lead to the significant changes in the Baltic liner shipping routing. This corridor is part of the EU's transport corridor network set out in White Book 2011 (fig.9). This may contribute to changes in the transport flow from latitudinal (ro-ro lines from the Mediterranean through the English Channel, the North and Baltic Sea to Sweden, Finland and Russia) to longitudinal (cargo transports bound first for Lubeck, Rostock, Świnoujście, Gdynia/Gdansk and then by ferry for Malmo, Trelleborg, Ystad, Karlskrona and Stockholm have been shifted to rail routes). Looking realistically, this may result only in investments increasing the cargo capacity of these lines, as the added workload is not sufficiently large to justify ships running more frequently along that line, nor will it generate demand for new lines.

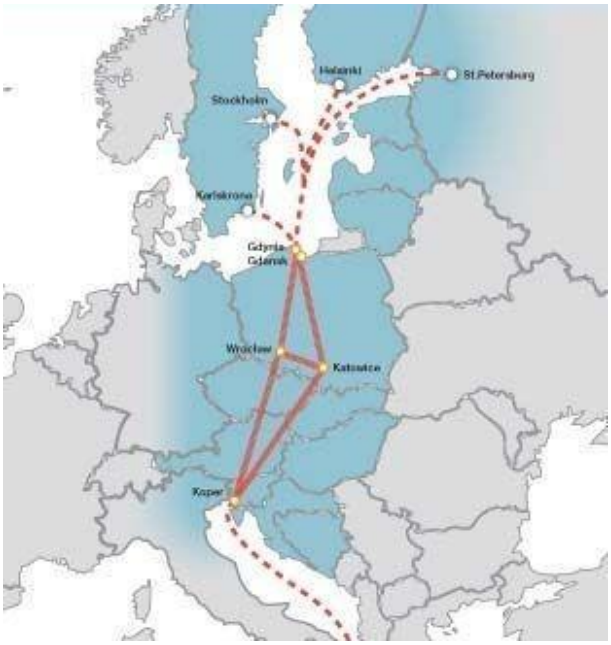


Figure 9. Baltic Adriatic Rail corridor
Source: http://www.balticrail.com/

It have to be underlined here, that some EU initiatives seems to be contradictory as it is also expected that a modal shift of transport from road to sea will take place in Europe. This trend goes back to the White Paper "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system" published by the European Commission in 2011. The superior goal specified in the paper is to reduce greenhouse gas emissions from the transport sector by 20% until 2030 (compared to 2008) and 60% until 2050 (compared to 1990). To achieve this goal, it is aimed to move 30% of road freight over 300 km to other modes (rail and waterborne) by 2030 and more than 50% by 2050.

Change in environmental standards

The Baltic Sea – an ecologically unique world's largest reservoirs of brackish water - during the last 100 years has changed from an oligotrophic clear-water sea into a eutrophic marine environment (Madjidian et al. 2013). The high shipping traffic density is one of the main factors for this negative development by causing air and water pollution. Pollution mainly results from ships using heavy-fuel oil or marine diesel oil and exhausting pollutants such as nitrogen oxide (NO_x), sulphur oxide (SO_x) and particulate matter (PM). The Baltic Sea is designated as an Emission Controlled Area (ECA) and as a Particularly Sensitive Sea Area (PSSA) for which apply much stricter regulations.

In 2011[8], the European Commission set the target of cutting carbon emissions in transport by 60% by 2050, including at least 40% cut in shipping emissions. Also there is the long-term objective of "zero-waste, zero-emission" released by the EU's maritime transport policy. These goals are ambitious as projections show that shipping may increase its annual CO_2 emissions from 800 million tons in 2010 to 2000 million tons by 2050 if no measures are taken (Parsmo et al. 2016).

With regard to future perspectives the EU Marine Strategy Framework Directive (MSFD) is of importance as it has the aim to achieve good environmental status by 2021. Following the MSFD all EU member states are required to develop a marine strategy which includes an initial assessment of the state of environment and a clear description of monitoring programs (Boteler et al. 2015).

On a regional scale HELCOM is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area. With regard to regulations concerning the environment the Baltic Sea Action Plan (BSAP), adopted 2007, is the key instrument for future conservation as it aims to restore good ecological status of the Baltic Sea by 2021. Main goals refer to stop eutrophication, avoid hazardous substances, ensure biodiversity and conduct maritime activities in an environment friendly way (Boteler et al. 2015).

In addition to the aim to achieve good environmental status the Convention of Biological Diversity (CBD) set the target to protect a minimum of 10% of each habitat in the Baltic Sea region. Since 2004 the area of marine protected areas (MPAs) increased threefold. Today about 12% of the Baltic Sea is already covered by the 163 MPAs, either as part of the Natura 2000 network or as HELCOM Baltic Sea protected area (HELCOM 2014). Even though a total of more than 10% of the area is protected already this is not the case for the sub-basins of the Baltic Sea. Therefore HELCOM aims to designate more MPAs in areas where the coverage is rather low. This applies mainly to areas at open sea, implicating that the focus will lay on the protection of areas which are also interesting for the offshore energy sector.

[8] White Paper, EC 2011.

KEY MESSAGES on External factors and trends

- The shipping market is highly dependent on the global and regional economic development. Globally transport overseas has increased over the last decades. The shipping market is expected to grow.
- In the Baltic Sea economic growth of commercial shipping seems to be bipolar. It can be mainly attributed to increasing trade volumes of Russia and the recent increase in the Polish ports performance.
- Both, the MSFD and HELCOM, request Baltic Sea countries to present a marine strategy ensuring a good environmental status of the Baltic Sea by 2020/2021.
- HELCOM aims for additional MPAs, especially in offshore areas that have a lower protection coverage than the rest of the Baltic Sea.
- The European Commissions' ambition to shift transport from road to sea supports this development. On the other hand there are EU initiatives to support rail connections which can be competitive to shipping.
- The European Commissions' rail corridors' plans may support the selected ports infrastructure development.

Trends within the shipping sector

The shipping business is driven by many different internal factors from which the two spatially most important will be further explained. These are the fleet & ship characteristics and the technology developments.

Looking at the **fleet & ship characteristics** some general trends become obvious from the beginning. The first is the general direction of increase of the quantitative and qualitative fleet development. The world's fleet is growing on average by 0.63% year on year in terms of its size and by 4.98 % year on year in terms of its deadweight tonnage. This means that year by year world existing fleet changes into less number of vessel but newly launched vessels are bigger / have larger DWT. Bigger vessels attain better efficiency and lower costs per freighted unit but this trend has also huge impact to worldwide ports. For larger vessels the list of ports which can handle it shrinks considerably. Thus, fleet growth puts pressure on port authorities and terminal operators to fit new requirements and react to their business environment. One should ask here a question of limits of these parameters growth.

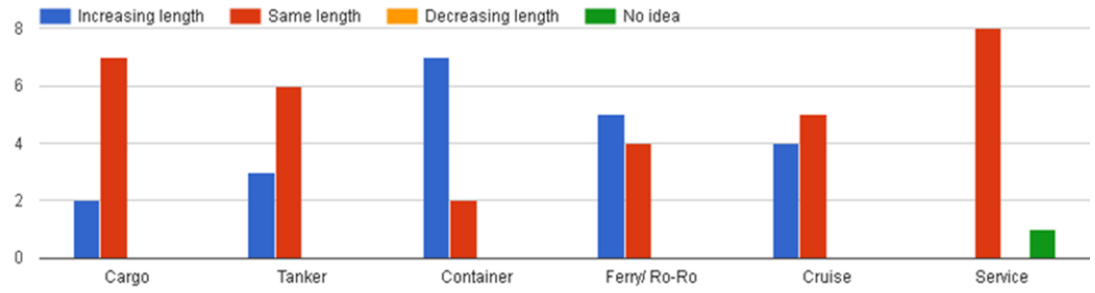
The second trend relates to changes in the type of ships which form the world's maritime fleet. The fastest-growing type is represented by gas carriers, chemical tankers and container ships. At the same time, these vessels are highly specialized and relatively expensive. LNG gas carriers owe their fame to increased usage of natural gas as the purest form renewable energy. These changes extend to the Baltic Sea area, as natural gas is gaining ground in that region. This is exemplified by new liquid natural gas regasification terminals now under construction in Klaipeda and Świnoujście. Chemical tankers thrive due to a shift in freight forwarders' preferences towards specialized cargo requiring dedicated technologies of chemicals transport from Europe's industry leaders. Container ships exemplify the trend of specialization in the transport of unitized (containerized) general mass cargo which is now traded on a large scale. This trend showed its first symptoms as trade links grew between Western Europe and the USA, reaching its peak level in the commercial relations between South-Eastern Asia and Europe or the USA. The vessels operating there feature ever-growing cargo capacities, while their total length is 400 metres and remains basically unchanged. A number of factors combine to make for larger cargo space, including ship width increments, U-shape hulls and separation of bridge and engine room. As can be seen, the main direction of development is specialization.

STAKEHOLDERS VIEW

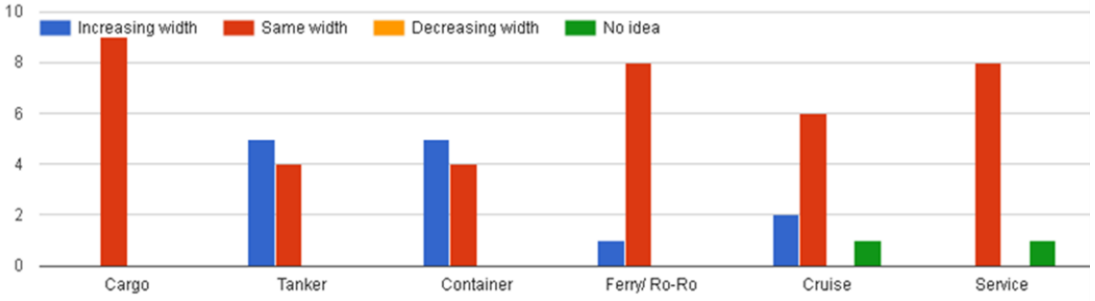
The Baltic shipping stakeholders were asked which trend they do expect regarding fleet parameters. The graph below shows the respondents' expectancies regarding the future dimensions of ships in the Baltic Sea. For most ship types it is expected that the dimensions are about to stay the same or – less strongly pronounced – will have increased by 2030. For none of the types decreasing ship dimensions are foreseen by the respondents. The only exception is for container ships, where a clear tendency is observable towards increasing lengths and drafts.

Which trend do you expect regarding:

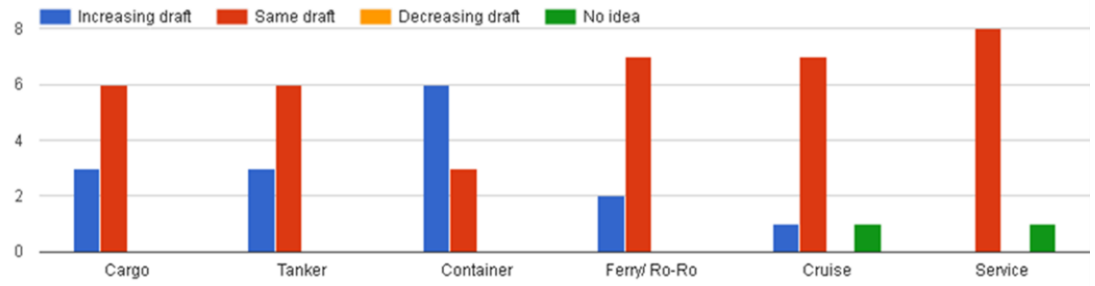
- average length of ships?



- average width of ships?



- average draft of ships?



In terms of **technology**, the main directions of change are as follows:

- ship's propulsion and fuels;
- hull shape;
- optimization of ships operations;
- increasing environmental standards for maritime transport.

Table 1 shows an overview of future shipping technology issues. In this report we will focus mainly on the developments which that ultimately affect the sea space and its use.

Table 1. ***Most influential shipping technology issues***

Ballast Water Treatment System	Smaller engine/de-rating (speed reduction)	Pure gas engine
Low sulphur heavy fuel oil	Reduction of seawater ballast capacity	Air cushion
Liquefied Natural Gas	SCR system	Wind & solar power
System efficiency improvement (Aux)	SO_x scrubber	**Ship Size and advanced ship design**
Hull shape optimisation	Lightweight constructions	**Unmanned vessels (airplane piloting model)**
Waste heat recovery	Dual fuel engine	Vessels interconnectivity (Ship 3.0)
Propulsion efficiency devices	Water emulsification	Cargo and ship integrity monitoring systems
Distillate fuel	Humid air motor/ direct water injection	New materials
EGR system	Hybrid propulsion system	Robotics at the sea
Low NO_x tuning	Counter rotating propulsion	Supply chain perspective (coordination with stakeholders)
Shaft generators	Self-unloading systems	

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

LNG Fleet

One of the answers to comply with environmental regulation is to use LNG fuel. Until March 2015, there were nearly 140 confirmed LNG-fuelled ship projects globally (60 functional LNG-fuelled ships and 78 under refitting/construction). Most of the LNG-fuelled fleet (over 80%) are represented by small ships (passenger/car ferries, offshore platform supply vessels, tugs and petrol vessels) currently sailing in Norwegian waters. However, there are also some larger LNG-powered vessels, such as ro-pax and ro-ro, gas carriers, and general cargo vessels.[9] This trend is

[9] K. Liuhto, Maritime cluster..., op. cit., p. 157.

also getting visible in BSR, where in 2017 a Danish short sea operator launched the first LNG-fuelled container vessel.

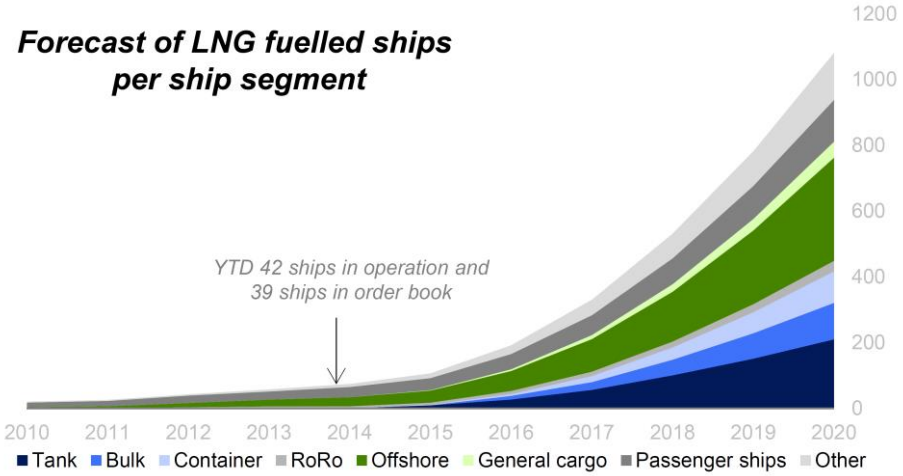


Figure 10. Forecasts of LNG fuelled ships
Source: LNG for Shipping – Current status, Claus Winter Graugaard, 2013

The expansion of the LNG infrastructure in Europe is also influencing the ports development. The new infrastructures will result in ports specialization and enlargements. Figure 11 presents the newest overview of existing and planned LNG infrastructure in Europe including LNG terminals.

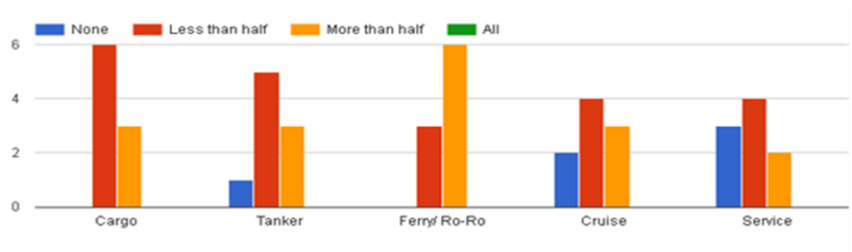
Figure 11. LNG Map 2018 - existing and planned infrastructure
Source: https://www.gie.eu/

STAKEHOLDERS VIEW

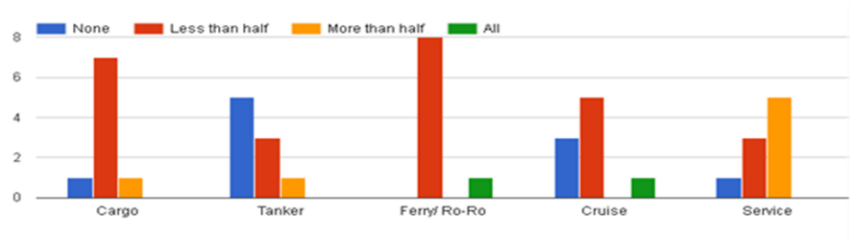
*The stakeholders were asked what portions of vessels they do expect to be used as main propulsion system. The graph below shows the expected shift in **main propulsion systems** by 2050. While electricity is anticipated mainly as propulsion for the short-distance service traffic, are cruise ships likely to have hybrid propulsion systems. It is to conclude that the most severe switch to alternative propulsion is anticipated for the ferry/ ro-ro sector showing counts for all three questioned alternatives, namely LNG, electricity, and hybrid systems. The lowest expectations for a change in propulsion, on the other hand, are given to tankers.*

Which portion of vessels do you expect to use as main propulsion system?

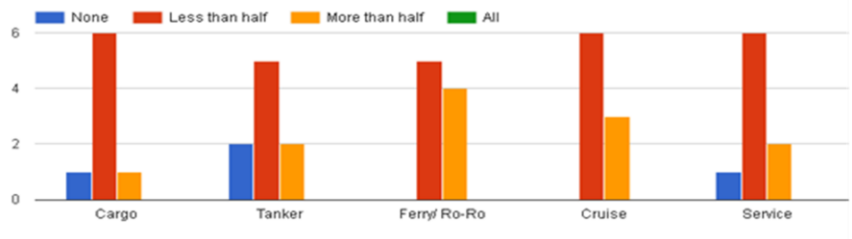
LNG?



Electricity?



Hybryd systems?



This issue was also discussed in the frames of **MSP Challenge game** in Riga 2018. The discussion could be summarized as follows:

- All competitive ports will have LNG facilities in time. Increased intensity coming from bunkering facilities and maybe more densified. Offshore, further at sea bunkering not expected. Without that, there is no further interest for MSP since the spatial impacts are low.
- Potential of a major hub in e.g. Gothenburg or other entry to Baltic Sea for transferring cargo from larger ships onto multiple smaller 'feeder' ships, which would then have the benefit of more environmentally friendly propulsion systems and also change the spatial traffic pattern of larger and smaller ships.

Autonomous shipping

Since a number of years automation is on the agenda for all operative and technical processes of maritime shipping. The unmanned machinery space is already reality on board of many seagoing vessels. In this concept the engine room and its control room is only manned during normal day time working hours, while it is unmanned overnight. Yet, the concept for the navigational bridge of a ship is different. It is still manned at any time when the ship is underway. The manning level, however, has been significantly reduced with often only the watch keeping officer being on the bridge when the ship is in open waters. To facilitate such a reduced manning level several automated navigational systems have been introduced during the past years. Today, an advance voyage planning is carried out on the electronic chart display and information system (ECDIS). Together with an automatic track control, including autonomous course alterations and continuous track monitoring, to avoid undesired deviations from the pre-planned track, a ship could safely pass all known navigational hazards in a reasonable distance without running into danger of grounding on a well charted shoal or colliding with men made installation.

STAKEHOLDERS VIEW

"Future challenge - autonomous shipping – technically already possible, but it will affect safety issues, security issues, and basic legal issues. Not obvious how it will impact marine space – probably first solution would be to separate autonomous shipping from other shipping – to have sort of highways" – Respondent taking part in the MSP Challenge workshop.

A roadmap devoted to the topic of unmanned ships in the Baltic Sea Region has been developed by the ONE SEA project. The plan is to test fully remote-controlled vessels in the next 3 years (2018–2020), and - by 2025 – focus on autonomous commercial traffic (Fig. 12).

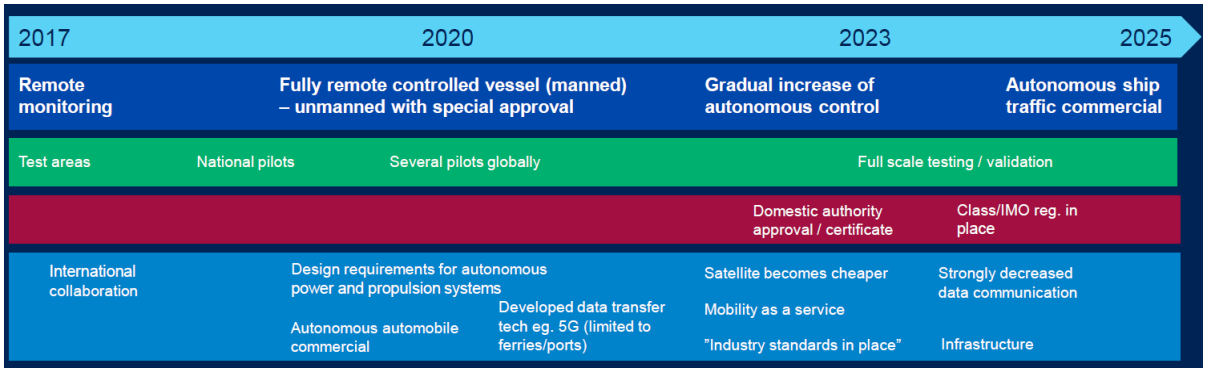


Figure 12. Timeline for autonomous ships
Source: https://www.oneseaecosystem.net

According to last updates from the market, the first autonomic vessel will start its service in 2018. Yara Birkeland will be 120TEU container ship at service between Herøya – Brevik – Larvik in Norway. At the very beginning the vessel will start sailing with small crew on board and become fully autonomous vessel in 2020. The operational field is fully covered by the VTS system which supports the need to keep full control over the unit[10].

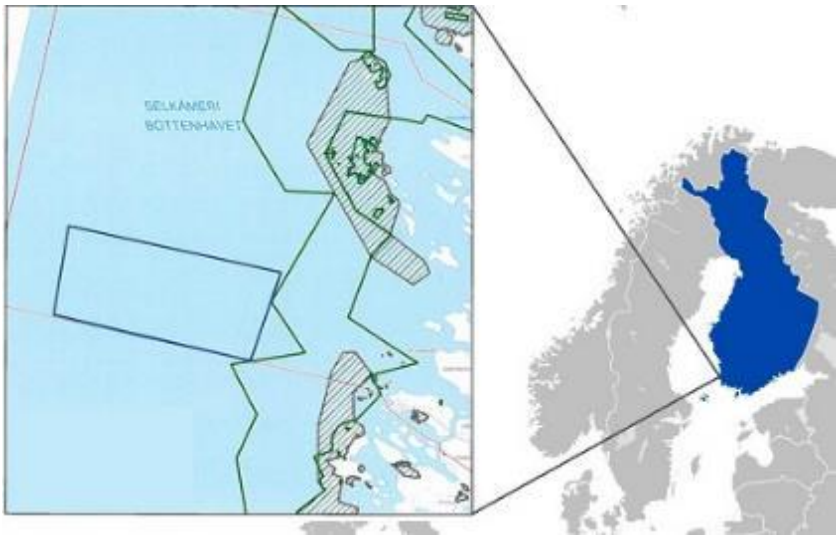


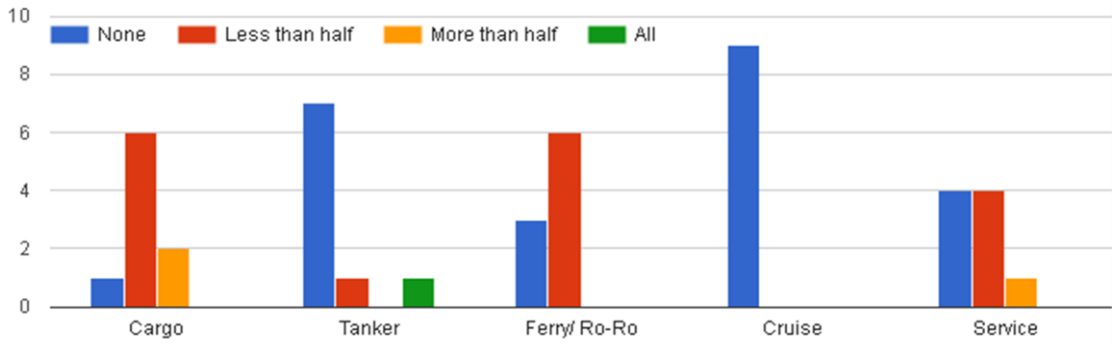
Figure 13. Jaakonmeri Test Area for autonomous vessels
Source:
https://www.oneseaecosystem.net

[10] https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/4B8113B707A50A4FC125811D00407045?OpenDocument; 25.11.2017.

STAKEHOLDERS VIEW

The Baltic shipping stakeholders were asked which portion of completely unmanned vessels they do expect in the Baltic Sea by 2050. The graph below shows the frequency of answers regarding the portion of completely unmanned vessels sailing in the Baltic Sea by 2050. It is to observe that unmanned vessels seem to be rather unlikely for tanker and cruise ships but most likely for cargo/ container and ferry/ ro-ro ships. However, only few of the respondents expect that unmanned sailing will be the dominant transport form by 2050.

Which portion of completely unmanned navigated vessels do you expect in the Baltic Sea by 2050?



The discussion held in the frames of the **MSP Challenge game** in Riga (2018) gave more detailed insight into stakeholder's thoughts. It was stated that small ferry lines could be the first to use autonomous vessels. In general it is expected that full autonomy will most probably only happen to ferries, container ships and in domestic shipping and on certain routes only.

KEY MESSAGES on technology development factors

- The world existing fleet will change its parameters - fewer vessels but newly launched vessels are bigger / have larger DWT.
- Fleet growth puts pressure on port authorities and terminal operators to fit new requirements and react to their business environment.
- Specialization is the main direction of technology developments.
- Short-term development focuses on facilitating the LNG technology to be able to shift to alternative fuels. In the long-term hybrid-propulsion systems are regarded as the most convenient solution. If bunker facilities are not build offshore, there is no major impact on MSP expected.
- Autonomous operation of unmanned ships is still under scientific investigation but represents a real future option for some types of commercial shipping. An according road map for the Baltic Sea Region has been developed by the ONE SEA project.
- The increasing level of automatization may require the designation of fixed shipping routes and consistent safety distances, as well as strict spatial rules for the recreational use of leisure crafts.
- Most probably the autonomous system will be developed in the following types of ships: medium-size bulk carriers, cargo barges, offshore service vessels, tugs.

Summary of main trends

Based on the outlined changes of the global, external and internal factors, **the general trends for the shipping sector in the Baltic Sea Region** can be summarized as follows.

First, shipping is likely to increase on an intra- as well as on an extra-European scale due to global population growth, economic growth and effects of increasing globalization.

Secondly, it is expected that a modal shift of transport from road to sea will take place in Europe. The Baltic Sea favours waterborne transport over shorter distances because of the high density of harbours. Here Short Sea Shipping often reduces the total distances compared to road freight transport. The development towards a raise of road-, bridge-, and tunnel taxes in several EU countries favours this shift from road to sea. However, the shipping industry remarks that also shipping becomes more expensive due to stricter regulations.

Thirdly, it is expected that there will be a greater number of larger vessels to enable more efficient and cost-saving freight transport. However, larger ships are not efficient during times of economic depression as they may be only partly loaded. Shipping companies may account for this risk in having a mixed fleet consisting of ships of different size and react to overcapacity with slow steaming (i.e. going at reduced speed to save fuel costs). Larger ships with deep draught represent a major challenge especially for routes entering the Baltic Sea or crossing its shallow areas as well as for the port development as channels need to be deeper and wider.

GOODS TRANSPORT

In the Baltic Sea Region the transport of cargo increased by around 18% from 2004 to 2013. This growth can be mainly attributed to an increased turnover in ports in the eastern Baltic Sea region, especially Russia. Cargo ships in the Baltic Sea are still often packed with break bulk (e.g. forestry, metal or steel products).

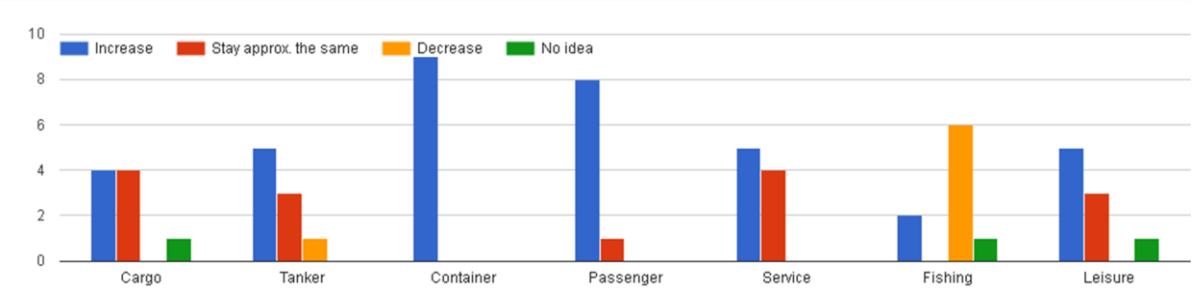
The strongest growth is to observe for the transport of crude oil and fuels after completing the construction of deep-water oil terminals in Primorsk and Ust-Luga as of 2015. In terms of handled cargo mass, the biggest Baltic Sea ports are located in Russia (first two places in 2016).

Container shipping seems to be the most extensive, complex and complicated of all. It is necessary to divide it into two groups: shortsea/feeder and ocean carriers. In the Baltic Sea Region there are 20 carriers operating a total of 130 vessels - mainly feeder ships with an average loading capacity of 1,248 TEU and register tonnage of 1.78 mln RT. Their combined capacity amounts above 160 thousand TEU and is rising (the old vessels are replaced with new and larger ones).

STAKEHOLDERS VIEW

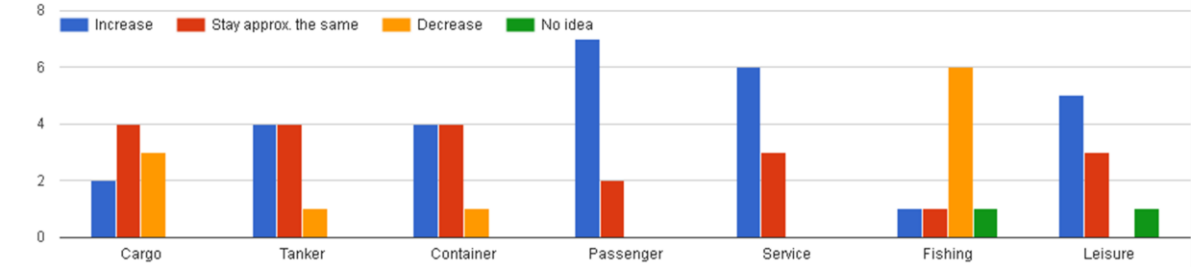
Th Baltic shipping stakeholders have been also asked on future trends regarding the total annual volume of cargo/ passengers and the annual number of ships sailing in the Baltic Sea by 2030. Most significantly is the expected increase in cargo for container ships while their number is less likely to rise. This combination allows the conclusion that the cargo capacity of container ships will probably increase.

Which future trends do you expect for the total annual volume of cargo/passengers transported by ships in the Baltic Sea?



A different observation can be made for passenger ships (include ferries and cruise ships) which are expected to gain both in the annual number of ships as well as an increasing number of passengers. With regard to the development in number of ships it is also to observe that generally more service vessels, less fishing vessels and an increasing number of leisure boats is expected.

Which future trends do you expect for the annual number of ships sailing in the Baltic Sea?



PASSENGERS TRANSPORT

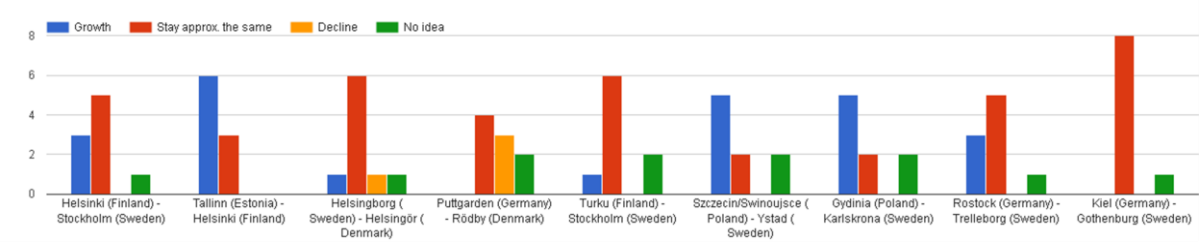
In the past two decades a downwards trend of maritime passenger transport is to observe. This is mainly related to declining ferry services resulting from competition with inexpensive commercial flights and high speed rail links. On the other hand, the cruise ship sector is due to an upwards trend, with Europe as one of the key markets for the global cruise ship industry. Current plans show that between 2015 and 2021 34 of the 36 new cruise ships to be constructed

can be attributed to European yards. Five of the European main destinations are located in the Baltic Sea region, namely St. Petersburg, Copenhagen, Tallinn, Helsinki and Stockholm (Parsmo et al. 2016).

STAKEHOLDERS VIEW

Baltic shipping stakeholders were asked additional, regionally focused question on which trend do they expect for the following international connections. The graph below shows the frequency of answers regarding the expected development of Baltic ferry connections. For almost all ferry connections it is anticipated that they will gain importance or at least stay the same. Only for the ferry connection between Puttgarden and Rødby the respondents could imagine a decreasing trend, which finds its reasoning potentially in the planned tunnel project "Fehmarnbelt" which will then present a direct connection between Germany and the Danish island Sjælland and reduces the time needed to travel from Hamburg to Copenhagen considerably.

Which trend do you expect for the following international ferry connections?



PORTS

There are about 400 sea ports in the entire Baltic Sea Region, 90 of which are of transport significance. Considering the European TEN-T net spatial structure[11], Baltic Sea ports can be divided into two categories - base ports and comprehensive network ports.

HELCOM data suggests that the number of Baltic ports stay the same but existing medium and large ports are likely to grow by more than 50% in the next ten years. Especially northern ports

[11] Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU (Text with EEA relevance 2013 L 348/1).

could benefit from anticipated climate warming and related ice-free conditions during the winter months (WWF 2010).

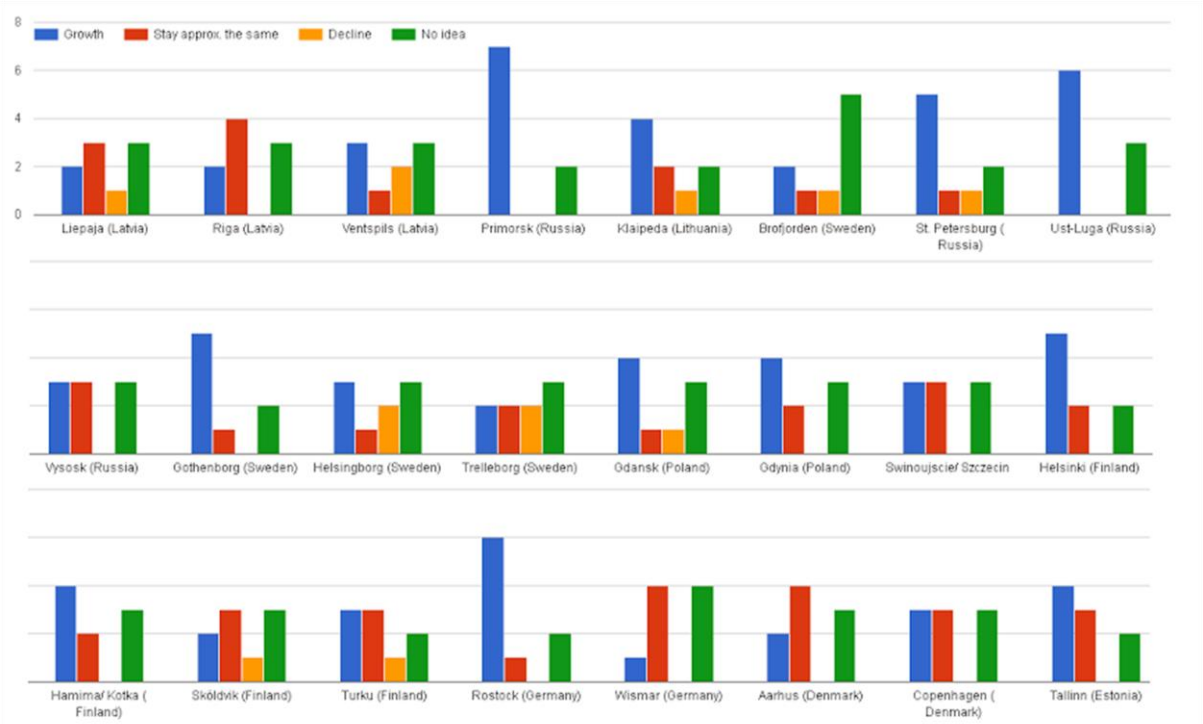
The expected larger portion of bigger vessels might force the concentration of cargo in bigger ports which have better chances of financing the port infrastructure. Small and medium sized ports will not be able to handle larger ships, which in a long term might stimulate the concentration of cargo in bigger ports even further. This may push the medium ports to pursue cooperation with larger ports in order to achieve synergy between them. Making a local or regional alliances as well as mergers of small ship-owners are also plausible scenarios in the future.[12] An important direction in the development of sea ports is represented by the creation of logistical centres and industrial parks in the port hinterlands. This type of initiative is aimed to make port services more attractive through providing comprehensive logistics and, as a result, creating additional load weight, contributing to extra added value from the port. The conclusion is that development understood as creating new infrastructural facilities is just as important as ensuring an efficient transport process and establishing good business relations for ports.

[12] K. Liuhto, Maritime cluster in the Baltic Sea Region and beyond, Internet source: https://www.researchgate.net/profile/Kari_Liuhto/publication/303459616_Maritime_cluster_in_the_Baltic_Sea_region_and_beyond/links/574424c708ae298602f0fe73.pdf#, p. 147 and 159.

The STAKEHOLDERS VIEW

The stakeholders were asked on which trend in port development do they expect for the Baltic ports. The graph shows the frequency of respondents' answers regarding the trend in port development in 24 different medium to large ports in the Baltic Sea. For all Russian ports a clear growth is expected, followed by increasing tendencies for Gothenburg, Helsinki and Rostock. For almost none of the ports a decline in port development is anticipated. Since regional knowledge is needed to answer this survey question a lot of abstentions are recorded.

Which trend in port development do you expect for the following Baltic cargo, tanker and container ports?



The ports developments were also tackled by the **MSP Challenge game** in Riga:

- Expected increase in traffic at specific ports, mostly simply for economic reasons (i.e., the result of a choice to invest by public/private parties, given their future expectations/visions):
  - Ust Luga (all types)
  - Primorsk (oil-related)
  - St. Petersburg (container-related)
  - Helsinki (passenger/ferry)
- Russian ports might become more competitive with climate change (increased availability of oil & gas reserves, , operational port also during winter). Alternative transport paths via

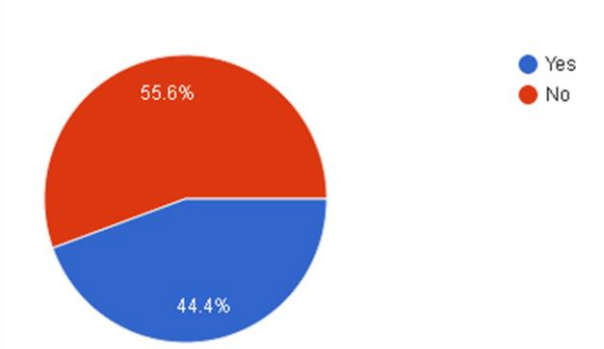
the north-east passage may become important, e.g. by building a railroad from Murmansk to St. Petersburg or Hammerfest to Tornio that would open up the Baltic Sea to shipping over the Northeast Passage.

These observations support the assumption of the growing domination of Russian market and growth tendencies of Russian ports in the Finnish Bay. This trend influences positively the Finnish and Estonian ports handling containers for Russian markets. The visible growth trend is foreseen for other Baltic large ports like Goteborg, Rostock, Gdynia and Gdańsk. These trends will have an direct influence on the shipping density, but will not create changes in the shipping routes distribution. This could be caused by creation of new ports, but it does not seem to be a case in the Baltic Sea Region in near future.

The STAKEHOLDERS VIEW

Baltic shipping stakeholders were asked whether they expect significant changes of the shipping route pattern in the Baltic Sea by 2030. The pie chart clearly indicates that the expectations vary considerably: while 56% do not expect any changes are 44% convinced that the route pattern will change.

Do you think there will be significant changes in the shipping route pattern in the Baltic Sea?



From comments given in a free-text field it turned out that the former group rather expects more traffic on existing routes instead of route changes, while the latter group sees a future where new shipping hubs will have an impact on the traffic pattern.

KEY MESSAGES

- The growth tendencies of Russian ports in the Finnish Bay are expected. This trend influence positively the Finnish and Estonian ports handling containers for Russian markets.
- The visible growth trend is foreseen also for other Baltic large ports like Goteborg, Rostock, Gdynia and Gdańsk.
- Passenger and ro-pax traffic is mostly focused on short distance ports of Finland-Estonia, Finland-Sweden, Germany/Denmark/Świnoujście-Sweden and generate heavy traffic. These numbers are expected to grow.
- The expected increase in leisure traffic will also demand more space which should be possible dedicated to an expansion of safety distances to keep the commercial shipping traffic undisturbed.
- The substantial changes are not reflected in the main shipping routes distribution. These are clearly connected with ports development and the change in the shipping pattern.

3.2 Sectors competing for space– offshore wind energy in short

Based on the experiences in assessing the level of competitiveness of the marine sectors with regards to space, we can conclude that the shipping is mostly competing for space with activities that permanently or on long-term basis occupy the sea space, being at the same time the navigational thread, like oil and gas platforms, aquaculture structures and recently more important – the multiply constructions of offshore wind farms.

The strong impulse for the offshore wind energy development has been given within the last 10 to 15 years with a new focus on renewables in the Baltic Sea Region. The underlying assumptions of European energy policies and policies on the reduction of carbon dioxide emissions as well as the acceleration of planning work related to the sustainable use of natural resources are the main reason for the development of renewable energy at sea. Slowly, offshore wind farms have become a familiar sight in the western Baltic Sea, in Denmark, Sweden and Germany during the last decade.

The favourable areas for offshore wind farms have to meet specific criteria - have an acceptable distance from the coast, good wind conditions as well as suitable geological and subsoil conditions. A limiting factor can be the water depth raising the investment and operation costs. Furthermore, proper port facilities are an important logistical condition for the development of offshore wind farms.

Planning for offshore wind farms needs to consider the intensity of the fishing activities in the area and shipping. The distance to main shipping routes should be sufficient to secure safety of marine traffic and it is recently a highly discussed issue at the pan Baltic level due to national marine spatial plans developments (see also projects like BalticSCOPE and PanBalticScope). The offshore location should also be chosen with a minimum negative impact on protected areas or other valuable natural features like bird migration corridors.

Also, the subsea cables - necessary to transfer the energy produced offshore to land – and their corridors should be routed with a minimum negative impact on other activities and the environment.

The foreseen offshore energy developments in the Baltic Sea Region are shown on the figure 14.

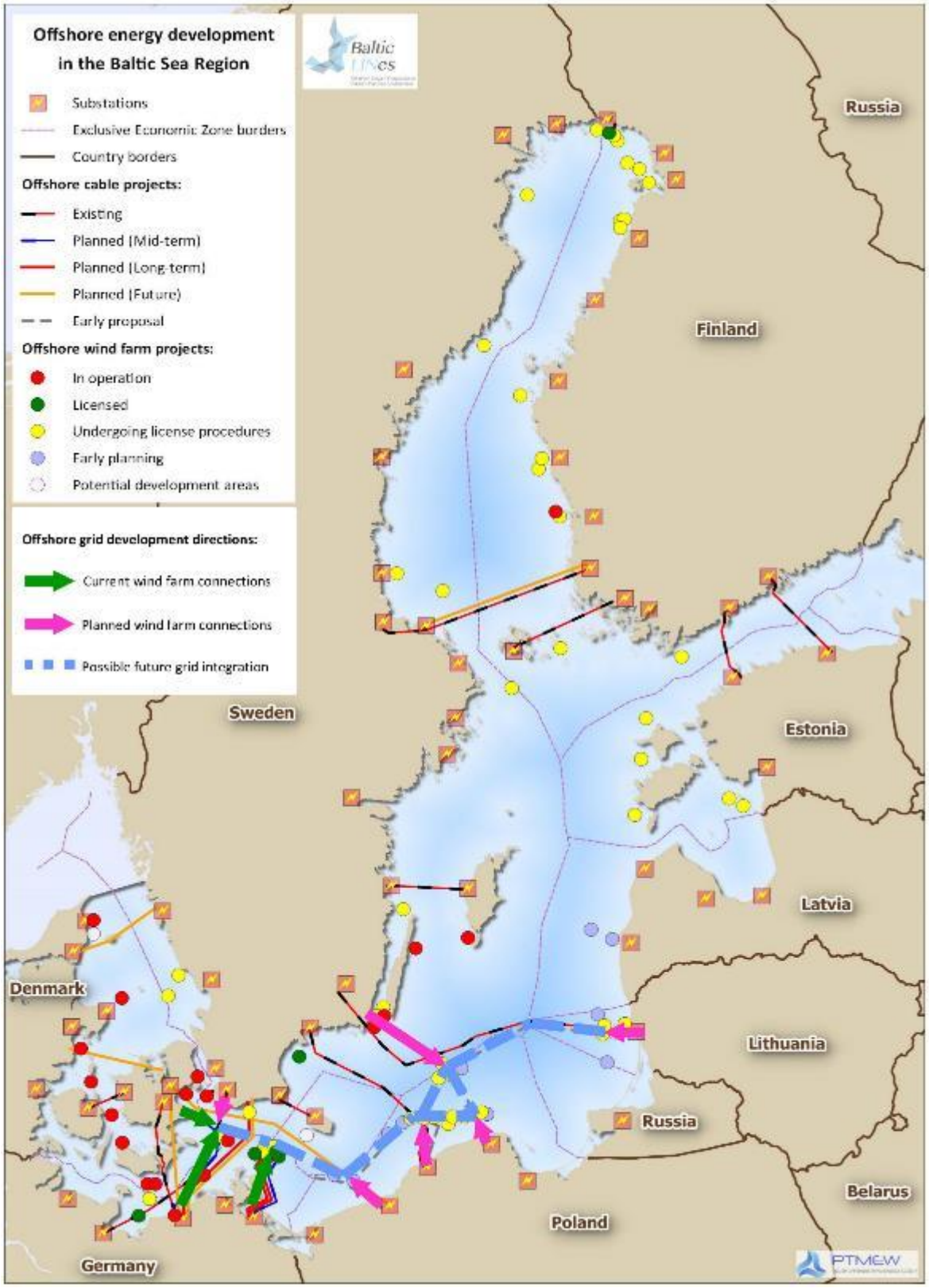


Figure 14. Offshore wind and grid developments in the Baltic Sea Region.
Source: Baltic LINes internal report by PTMEW, 2017

3.3 Baltic shipping scenarios

A scenario is not a prediction of the future as such but rather a story of what the future might look like. With the scenario approach, based on data, scientific expertise and stakeholder knowledge, we aim at spanning likely developments, having potential influence on sea space and its use.

As an approximation of a long term variable inducing faster or slower economic growth one can take the population growth. Thus, the growth narratives in each scenario are slightly different as presented in the table below.

Limited Growth	Sustainable Growth (Extrapolation of the current growth)	Fast Growth
• growth driven mainly by the countries of Central and Eastern Europe and, to a small extent, Russia, • intra-regional exchange between BSR countries sustained but limited in scope, • slow technical / technological advancement in the ship building industry driven by ship owners trying to delay the entry into force of stringent environmental requirements applicable to them, • break-up of the ship building sector into those entities that will pursue technological innovation but remain in the minority due to high investment costs and, as such, will advocate the status quo by trying to keep the quality of services at the same level, • plateauing of tourist traffic, • plateauing of the port service market, few new investments as a result of low cargo turnover growth, • market shrinkage in maritime technology and off-shoring caused by environmental restrictions and low oil prices, leading the wind energy industry to become much less profitable.	• economic growth driven mainly by the Central and Eastern Europe countries, including Russia, as well as Germany and Sweden, • the process of intraregional exchange between BSR countries continued but to a limited extent, • considerable technical / technological advancement in the ship building industry - ship owners try to overtake the competition through better-quality services provided by ecologically and economically efficient ships, • shipping market leadership taken over by innovators investing in new technology and direct customer relations • population growth and increase in the wealth of the society leading to the development of sea tourism as an alternative to travelling on land, • tight competition on the port service market, a large number of new investments due to increases in turnover and customer demands required of ports; direction – 4th generation ports – sets the market position, • development of maritime technology and off-shoring driven by attractive business opportunities and economic growth – however, with environmental restrictions in place, • revival of wind energy thanks to slight hikes in oil prices.	• growth driven by all countries in the region, • intensified intraregional commercial exchange; close macroeconomic cooperation, • strong technical / technological advancement in the ship building industry driven by ship owners trying to secure a competitive edge by offering better services thanks to more ecologically and economically efficient ships, • shipping market leadership taken over by innovators investing in new technology and direct customer relations as a way of securing a competitive edge through low per-unit costs, superior service quality and digitalization, • population growth and enrichment (higher per capita earnings) leading to the development of sea tourism • tight competition on the port service market, a large number of new investments due to increases in turnover and customer demands required of ports; strategy aiming for 4th generation ports dominates, • rapid market expansion in maritime technology and off-shoring driven by economic growth; demand for this technology far outweighs technical requirements imposed by law. • revival of wind farming thanks to oil price jumps.

LIMITED GROWTH

- growth driven mainly by the countries of Central and Eastern Europe and, to a small extent, Russia
- strong regulatory pressure

Baltic Sea Region grows in strength within the EU thanks to moderate population growth, rising commercial activity, innovative technology, know-how and national specialization. The region's economy is undergoing diversification, with national specializations emerging.

The maritime economies there are expanding. A number of new port terminals are under construction, but most importantly the existing ones are being upgraded and improved for efficiency and throughput as a result of intensified commercial traffic carried on by waterways. That traffic is carried on mainly by liners, operating the North / South and East / West connections, carrying mainly finished and semi-finished products. Unitized cargo prevails here. Almost everything is unitized either into semi-trailer or container loads.

Smaller commercial transactions in raw materials also follow this trend. Minerals and fuels, however, are usually carried by tramp shipping. Both these segments are increasingly using larger vessels, having now increased their cargo capacity three-fold compared to 20 years ago.

The vessels are operated by crews reduced to 15 – 20 members as a result of automation seen in many operations, including loading / off-loading. As the amount of cargo carried at one time is very large, extreme caution is exercised in navigating.

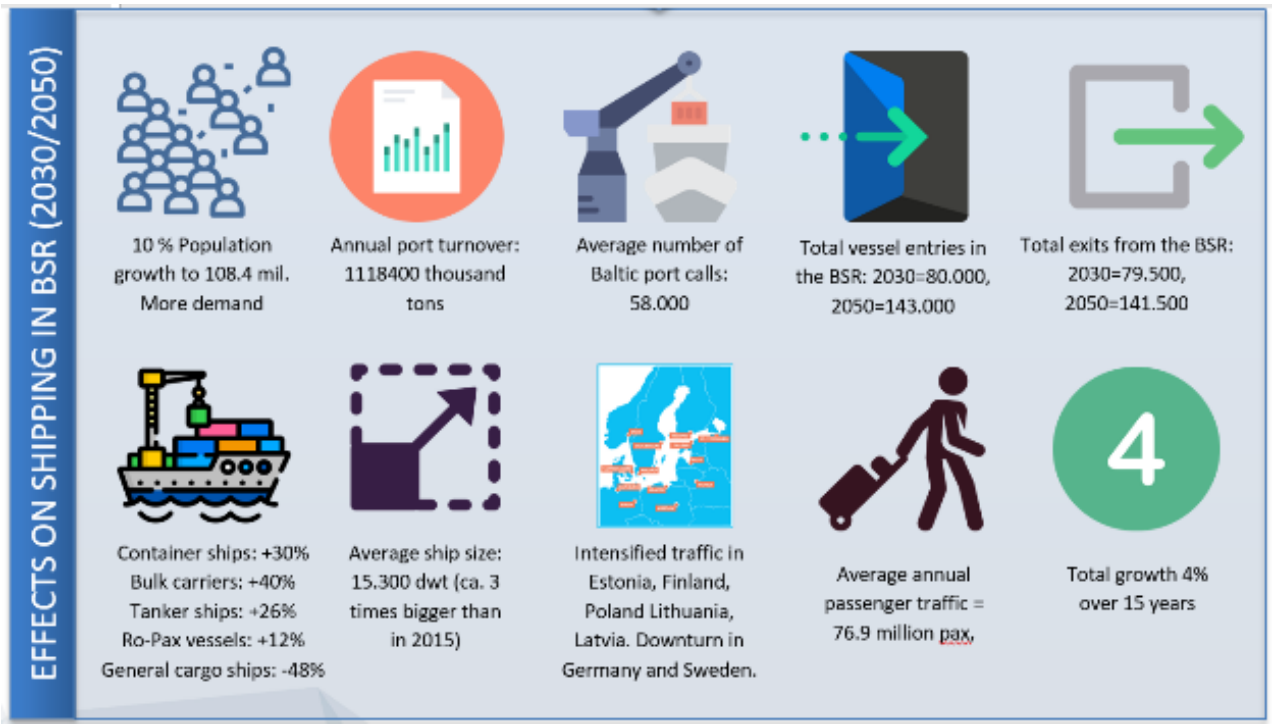
Maritime traffic travels along a few major routes with off-shoots reaching specific ports. No new commercial or shipping connections are established and high entry costs, making it extremely difficult for new ship owners to take the market by storm. The existing ship owners replace their vessels regularly to match the increasingly restrictive standards.

The sea ports themselves are expanding in spatial and economic terms as well as shoring up their position and operating performance, while – at the same time – becoming more aware of environmental protection and the need to inspect the incoming ships. The pollution of the Baltic Sea is being curbed and now there are hopes for improvement as a result of numerous restrictive technical requirements facing ships and ports. This comes as a result of the EU's increasingly stringent transport policies, imposing numerous obligations and limitations on all carrier entities.

New alternative railway links are emerging to lessen the workload of road transport. At the same time, they are taking business away from the sea.

New maritime technologies are emerging alongside sea shipping, which allow obtaining raw materials and energy from the sea. Off-shoring is becoming a regional specialization.

The indexes for Baltic shipping in 2030



Estimation of vessel calls in main ports of the Baltic Sea Region in 2030 and 2050

Vessel Type	Container ship	Cruise ship	Dry bulk carrier	General cargo, non-specialised	Liquid bulk tanker	Passenger ship	Specialised carrier	Total
2010	4 211	761	5 717	60 435	5 948	6 440	354	83 866
2015	4 942	956	5 078	59 907	5 782	6 655	429	83 749
2030	6 810	1 035	7 582	24 492	7 500	7 500	74	58 004
2050	9590	1 326	12 790	20 100	11 320	8 000	100	60 421

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

Estimation of passenger flows in Baltic Sea ports (in thous.) by country

Year	Estonia	Latvia	Lithuania	Poland	Finland	Germany*	Sweden*	Total
2005	8 639	143	166	1 640	17 100	11 735	28 945	68 368
2010	11 186	676	251	2 601	17 825	10 915	25 576	69 030
2015	14 153	602	286	2 421	18 884	11 159	26 246	73 751
2030	23 771	**1 885**	490	2 839	21 639	8 698	17 685	**78 721**
2050	37 726	3 406	762	3 973	26 214	7 015	1 032	89 541

Values for 2030 and 2050 in black mean number of predicted passenger traffic in limited growth scenario.

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

SUSTAINABLE GROWTH

- extrapolation of the current growth
- economic growth driven mainly by the Central and Eastern Europe countries, including Russia, as well as powerful economies of Germany and Sweden

The region gains importance. Population grows in numbers and skills; economic activity grows, especially where it relates to exports. International commercial exchange picks up speed.

A number of new ports emerge to fill the gap in the Baltic transport system, while the existing ones – especially those located along the transport corridors and main cargo routes – become highly modernized to improve their efficiency and throughput. Their hinterland connections strengthen and the range of services widens.

Auxiliary services become more important; the industrial and networking function of ports clearly prevails. The existing fleet is highly modern and replaced regularly but no longer sufficient. New market niches open up to allow for narrow specializations and networking with the newly created transport chains. Unitized cargo prevails, regardless of its type.

Russia establishes normal international relations; its society becomes more sophisticated. This opens up a broad stream of exported goods from Russia, mainly mineral and energy resources. These and other connections are operated by increasingly larger ships driven by improving control devices, which helps to reduce the crew size necessary to operate the systems.

Maritime traffic travels along a few major routes with off-shoots reaching specific ports. Particularly heavy traffic flowing to and from hub ports and key international ports. New commercial ties emerge, enabling shipping lines and ship owning businesses operating them to expand.

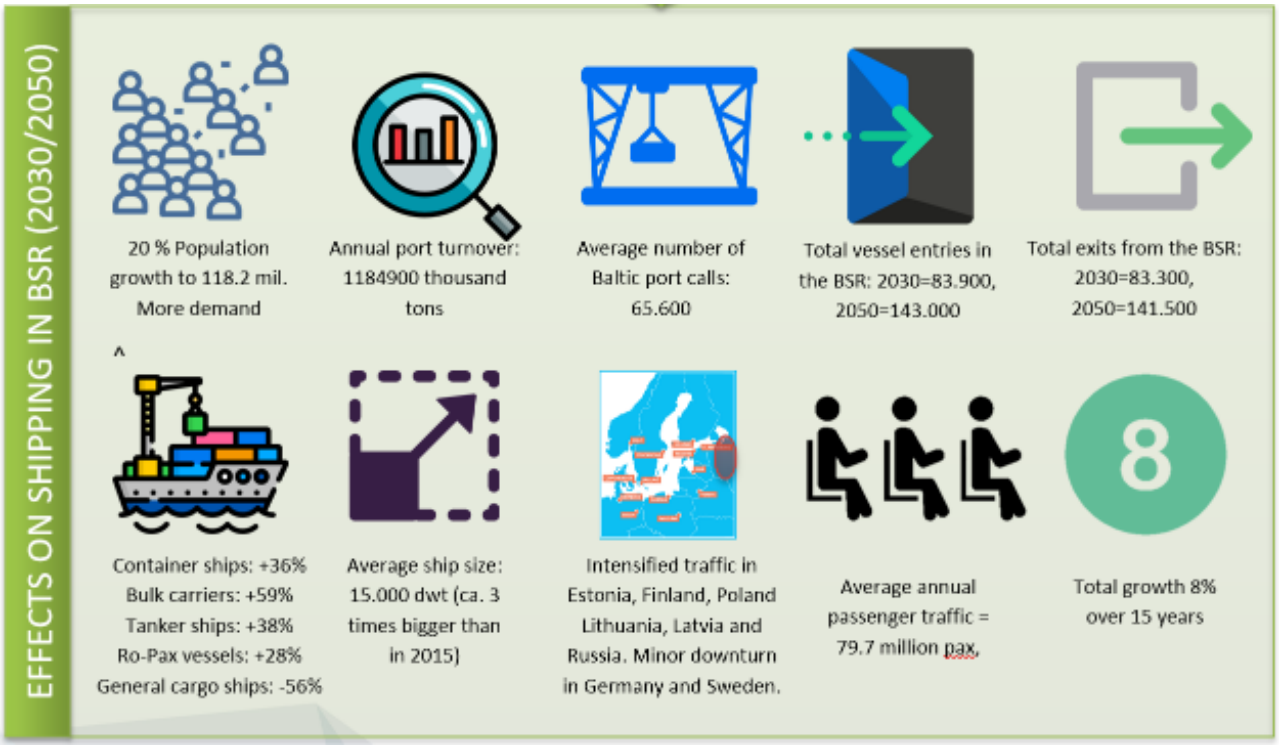
The existing ship owners try to replace vessels within their fleet to better adjust them to future customer demands before such demands actually materialize; a kind of technological race ensues. Cargo space and operating / per-unit cost optimization becomes key goals.

The sea ports themselves expand in spatial and economic terms, as well as streamlining their operations and developing new functions, for example, by building processing plants and heavy industrial facilities in their hinterland. Increasingly more attention is paid to environmental protection and the need to inspect ships calling at ports "Cleaner" and "greener" ships.

The EU's transport policy is essentially restrictive but flexible in its tools thanks to good intraregional relations. This process is supported by innovative shipping and off-shoring. New alternative railway links do not affect sea shipping, as they handle only a part of the annual growth in cargo traffic operated by BSR ports. Transport systems by land and sea cooperate efficiently in more numerous and more narrowly specialized dedicated intermodal transport chains.

New maritime technologies are emerging alongside sea shipping, which allow obtaining raw materials and energy from the sea. Off-shoring and aquaculture become the region's areas of specialization.

The indexes for Baltic shipping in 2030



Estimation of vessels calls in the main ports of Baltic Sea Region in 2030 and 2050

Vessel Type	Container ship	Cruise ship	Dry bulk carrier	General cargo, non-specialised	Liquid bulk tanker	Passenger ship	Specialised carrier	Total
2010	4 211	761	5 717	60 435	5 948	6 440	354	83 866
2015	4 942	956	5 078	59 907	5 782	6 655	429	83 749
2030	**7 140**	**1 110**	**8 563**	**29 015**	**8 250**	**8 500**	**183**	**65 614**
2050	**9 600**	**1 337**	**12 790**	**25 500**	**11 330**	**9 000**	**200**	**66 965**

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

Estimation of passenger flows in Baltic sea ports (in thous.) by country

Year	Estonia	Latvia	Lithuania	Poland	Finland	Germany*	Sweden*	Total
2005	8 639	168	166	1 640	17 100	11 735	28 945	68 393
2010	11 186	720	251	2 601	17 825	10 915	25 576	69 074
2015	14 153	661	286	2 421	18 884	11 159	26 246	73 810
2030	**24 337**	**2 019**	**507**	**3 142**	**21 967**	**9 117**	**18 689**	**79 700**
2050	**37 738**	**3 420**	**774**	**3 985**	**26 226**	**7 027**	**10 384**	**89 550**

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

FAST GROWTH

- growth driven by all countries in the region, population growth and enrichment
- environmental regulations stimulate development of technological innovations

The region stands out on an EU scale. The population growth rate goes from 18% (as recorded in 2010) to 25%; economy as measured by global GDP grows from 33% to 40%. People from that region become famous for their business skills and resourcefulness. As a result, commercial exchange is strong not only intra-regionally but also globally. Thanks to numerous oceanic lines operated by container ships, the Baltic market has a global dimension, leading to the emergence of another commercial connection, namely Asia – Baltic region. Exports are driven by industrial growth, especially in the area of new technology requiring imported raw materials.

Russia becomes one of the key raw materials exporters, while at the same time importing enormous quantities of ready-made products. Exports from other countries of the region include mainly ready-made products delivered by intermodal transport.

Each port is required to have container-handling terminals. Distribution and logistical facilities are located in these port's hinterland. A port's throughput is decided by its hinterland connections or, in other words, the scale of railway and inland waterways networks.

The maritime fleet is among the world's youngest, most modern and economically efficient. At the same time, it complies with environmental requirements. First trial crewless commercial vessels are emerging, supervised strictly by various authorities and security systems. Liner and tramp routes resemble a spider web spun around all the ports of the region.

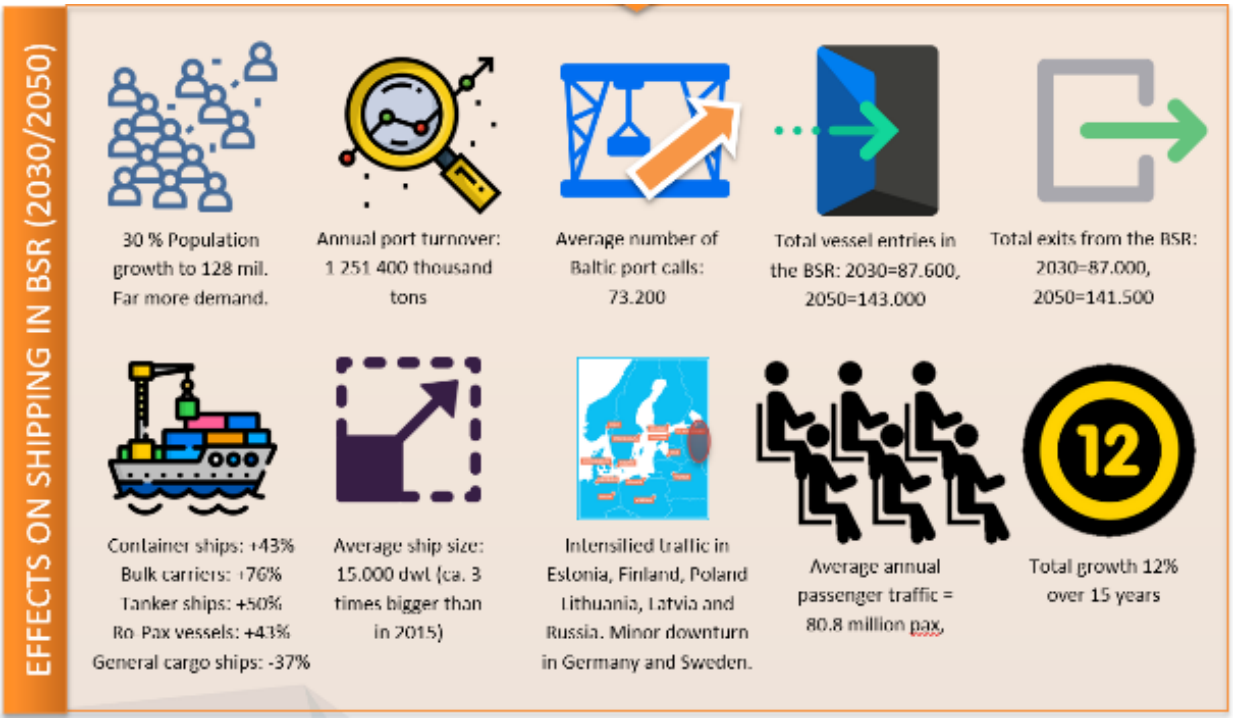
Some of the largest ports of primary importance for BSR national economies stand out because of the numerous maritime trade connections that they operate. A great number of them are new. New market niches open up for innovative ship owning businesses.

Electrical-, hybrid- and hydrogen cell-powered ships are used. Traditional fuels are being phased out. The EU's transport policy meets its main goals and is no longer a stumbling block to businesses. Full digitalization. Customers and carriers have full access to knowledge. Big data solutions are common and used frequently. A shift from seeing the transport industry in terms of branches, in favour of a more holistic view in terms of process with various modalities and entities working together smoothly.

O ff-shoring grows in step with cargo transports. It is no longer used exclusively to mine fossil resources. There are blue technologies in place to allow drawing renewable energy from water and self-clean.

As a result, tourism becomes one of the key economic sectors attracting visitors from all around Europe.

The indexes for Baltic shipping in 2030



Estimation of vessels calls in the main ports of Baltic Sea Region in 2030 and 2050

Vessel Type	Container ship	Cruise ship	Dry bulk carrier	General cargo, non-specialised	Liquid bulk tanker	Passenger ship	Specialised carrier	Total
2010	4 211	761	5 717	60 435	5 948	6 440	354	83 866
2015	4 942	956	5 078	59 907	5 782	6 655	429	83 749
2030	7 467	1 185	9 543	33 358	9 000	9 500	291	73 224
2050	9 620	1 348	12 802	29 800	11 340	10 000	300	72 409

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

Estimation of passenger flows in Baltic sea ports (in thous.)

Year	Estonia	Latvia	Lithuania	Poland	Finland	Germany*	Sweden*	Total
2005	8 639	168	166	1 640	17 100	11 735	28 945	68 393
2010	11 186	720	251	2 601	17 825	10 915	25 576	69 074
2015	14 153	661	286	2 421	18 884	11 159	26 246	73 810
2030	24 904	2 150	523	3 444	22 295	9 535	19 694	80 830
2050	37 750	3430	786	3 997	26 238	7 039	10 396	89 560

Source: Baltic Shipping scenario development, Ernest Czermański, Baltic LINes internal report, 2017

4. From scenarios towards solutions – MSP Challenge (stakeholders view)

In this chapter we offer our analysis of the outcomes of the MSP Challenge session held in Riga, Latvia on 24-25 January 2018. Our analysis is essentially a discussion of the themes identified in the discussions and actions of the stakeholders taking part in the workshop. We have structured our discussion following the three teams: South-West, Central and North-East.

One of the more general comments made was that the shipping status quo in the Baltic Sea is deemed acceptable, if not good. The shipping sector has developed into what it is over a period of centuries, and is bound by key geographical (notably sea depth) and human-made (notably bridges) constraints. It is important to be very careful about changing or making new spatial designations for shipping or that affect shipping. In many of the initiated discussions, the conclusion was often that there were no (clear) indications of any potential spatial implications or considerations. This was generally also the conclusion when it considered key future trends, such as the emergence of autonomous vessels. Those discussions are not reported in this chapter for obvious reasons.

Nevertheless, despite the often uttered statement concerning the shipping sector's power or importance, with increased interest in and importance of offshore energy infrastructure, there simply will be pressure on the shipping sector. This was demonstrated by the fact that on the second day, when a number of wind farms and marine protection measures were considered (thus effecting where ships can go), the overall shipping route efficiency already went down by 0.3%.

4.1 South-West Baltic

Team South-West Baltic ascertained that heavy ship traffic goes through German Marine Protected Areas (Fig. 16). This could create quite some (noise) pollution, or other negative marine-ecological consequences. Either way the team was intrigued and found this worthy of further exploration. The team considered redirecting ferry traffic outside of the MPA through a no-shipping zone on top of the MPA. The additional distance traveled did not seem very high.

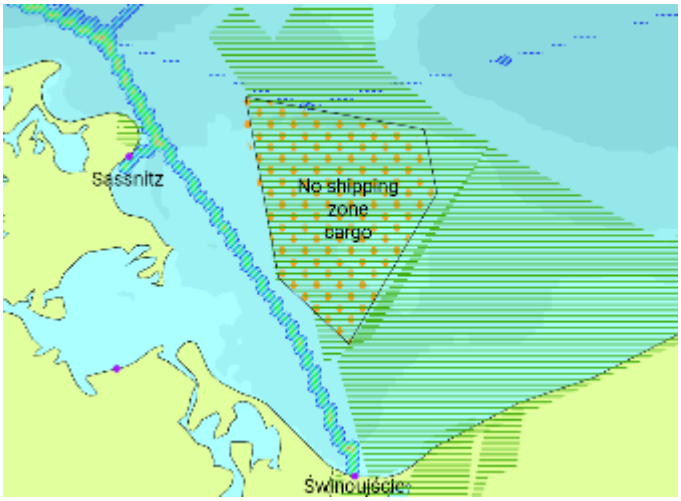


Figure 15. Screenshot of the no-shipping zone for cargo drawn
Source: MSP Challenge session, Riga, 2018.

The team also considered the use of the Great and Little Belts in and out of the Baltic Sea. They had a look at the Great Belt area of Korsør-Nyborg, which would seem to be a 'hotbed' of MPA, Natura 2000, an IMO-grade traffic separation scheme, and high traffic as it is the deep water route in and out of the Baltic Sea. This is a crucial shipping route. The IMO status of the traffic separation scheme is legally strong, which protects the shipping interest. Yet, as a result nature conservation has significantly lower chances here, despite the MPA and Natura 2000 designations in place. The team explored what else could be done in the area, if only as compensation for all the shipping that will need to continue through the Great Belt. The team looked into a compensatory measure, i.e., limiting international shipping traffic passing through the Little Belt, forcing them to use only the Great Belt or Øresund. Thus the team chose to add a no-shipping zone for tankers in the northern part of the Little Belt (Fig. 17 and 18).

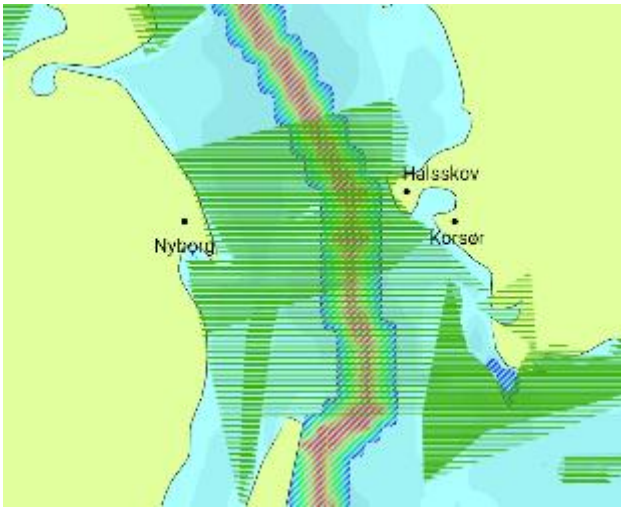


Figure 16. Screenshot of the status quo in the Great Belt
Source: MSP Challenge session, Riga, 2018

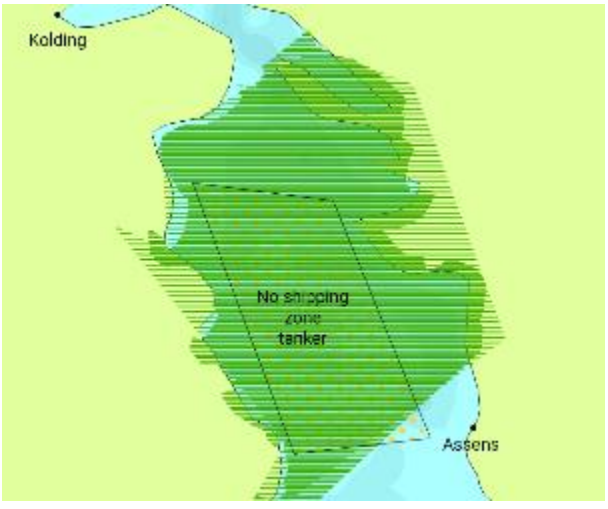


Figure 17. Screenshot of the no-shipping zone for tankers drawn in the Little Belt
Source: MSP Challenge session, Riga, 2018

As a way of considering the potential impacts of other sectors on shipping, Team South-West explored potential implementations of a Blue Growth strategy involving fishing that would probably hardly impact the shipping status quo or its future. They looked into fish farming development. The team explored if fish farming could be possible in combination with offshore wind farms. In efforts to find economically interesting areas with limited shipping impacts, they looked for finfish farming spots located in current offshore wind farms that were relatively close to shore and ports, further away from shipping traffic and lanes, and outside of any MPAs. This led to the identification of some opportunities in Germany and Denmark (Fig. 19).

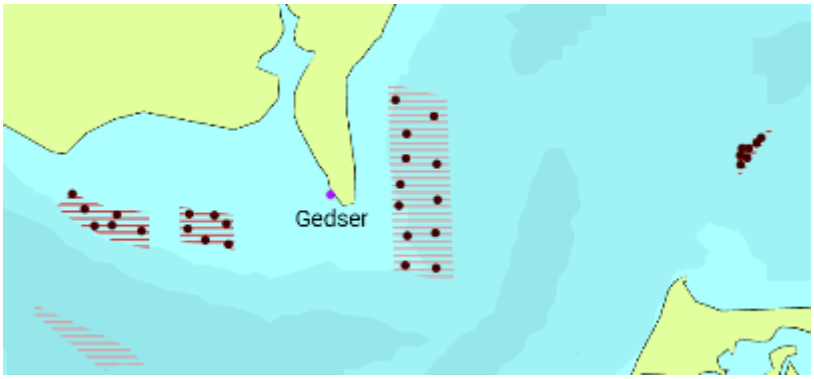
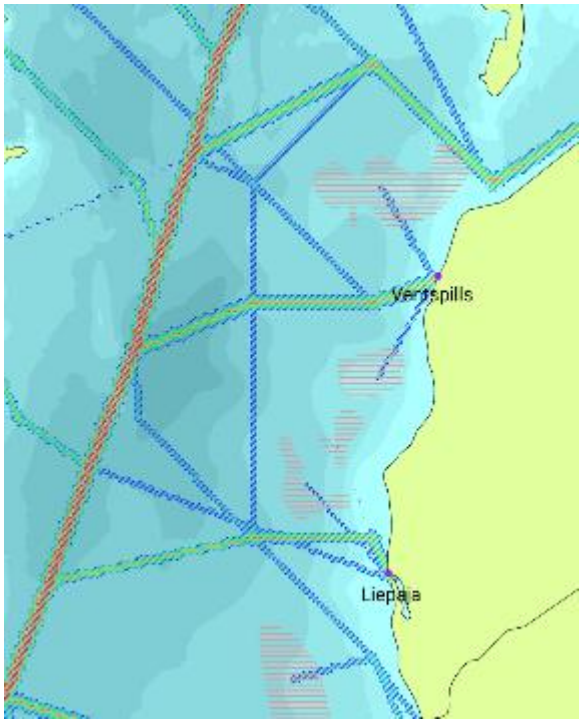


Figure 18. Screenshot of the four wind farms in which finfish farms were drawn
source: MSP Challenge session, Riga, 2018

4.2 Central Baltic

Team Central examined ship traffic along the coast of Latvia. There are several plans for offshore wind farms in the area. The social-geographic specificity of the entire coastal area (Fig 20) raises the question of how diverse shipping routes out of several ports - notably Ventspils - can effectively and efficiently combine with wind farms, or other physical infrastructure limiting shipping for that matter.



Team Central looked into Ventpils in particular. From this port, harbor ships are directed in highly diverging directions. The Team considered developing multiple smaller offshore wind farm areas so that ships can pass between them in several key directions.

Later on in the workshop, the Team concerns for ship traffic proved valuable. The shipping simulation indeed had trouble finding proper routes out of Ventspils port with the new wind farms that the Team had planned.

Figure 19. Screenshot of west coast of Latvia at the start of the game, with much shipping traffic traversing shallow waters
Source: MSP Challenge session, Riga, 2018

Ecological concerns

Team Central also considered marine mammals, harbour porpoises and seals, as a sensitive species in the area affected by shipping, living mostly in this central Baltic area, as far as they knew. Seals travel from the coastal zones to the ice zones to give birth, as far as the team knew. Both species are sensitive to the noise of heavy ship traffic. Possible reduction of noise from shipping, or other protection measures, were explored. Slow steaming was one of the consideration, but quickly contested. In the end, the team did not implement any spatial plans related to this topic (Fig. 21).

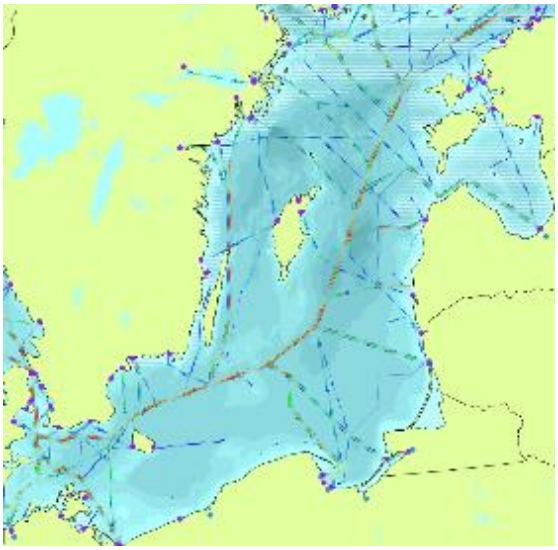


Figure 20. Screenshot of west coast of Latvia at the start of the game, with much shipping traffic traversing shallow waters
Source: MSP Challenge session, Riga, 2018

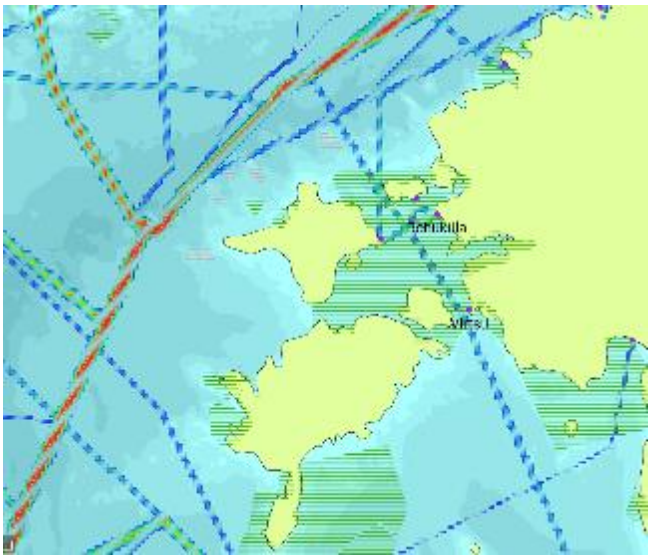


Figure 21. Screenshot of Hiiumaa, Saaremaa and other Estonian
Source: MSP Challenge session, Riga, 2018

The Team also considered the large energy demands of key Estonian Islands, e.g. Hiuumaa and Saaremaa (Fig. 22). The team realized that renewable energy policy as well as the offshore energy sector could lead to a preference for offshore wind farm areas in the neighborhood. The team felt it important to organize shipping in the area in such a way that it does not influence potential energy spots. The current arrangement of (planned) wind farms and ship traffic around the Estonia islands was reviewed. In the end, the team did not implement any spatial plans related to this topic.

4.2 North-East Baltic

Team North-East explored the area surrounding ferry traffic between Helsinki and Tallinn. This team noted that ferry operators are concerned about crossing existing traffic between Helsinki and Tallinn. In simple terms, the problem is that heavy cargo traffic goes on the East-West axis, while ferry traffic goes on the North-South axis (Fig. 23). Thus, they have to cross each other. Since cargo traffic by default gets right of way, ferry traffic will have to wait and/or coordinate their crossing carefully. Either way, this is a pressure on ferry traffic, influenced by a changing market for passenger transport, e.g. as a result of new alcohol tax policy in Estonia.

Adding to the issue is that some ferries or cruises and some cargo ships in the area take (a section of) the same shipping lane. Given the heavy traffic in the area, this could have a negative impact for either. Cargo was considered more here, probably because of the higher economic value it tends to represent. The question was raised whether there was a need for separate lanes – one for cargo traffic, another for ferry or cruise traffic. The team also considered that much cruise traffic in the area occurs during nights, while much cargo occurs during the day. In the end, the team did not implement any spatial plans related to this topic.

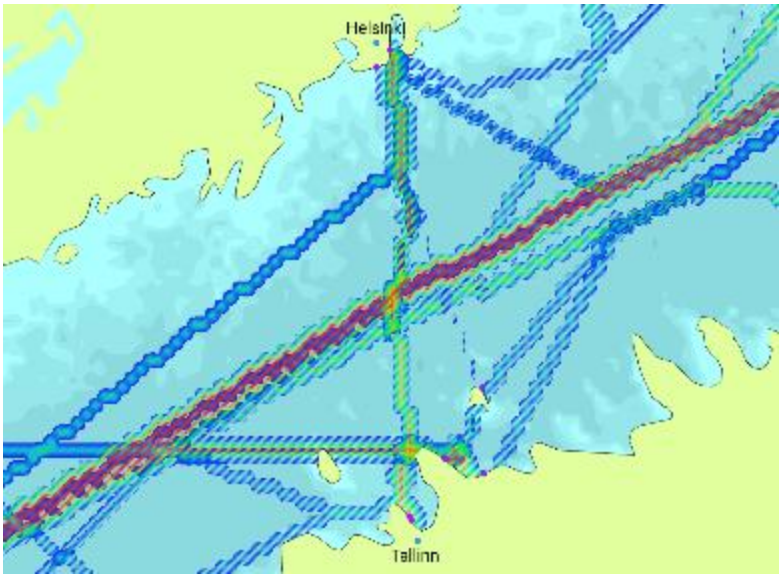


Figure 22. screenshot of Helsinki-Tallinn area showing modeled shipping traffic.
Source: MSP Challenge session, Riga, 2018

The team also considered the importance of fairways to the shipping sector, particularly those that need to be properly, regularly dredged to allow for heavy cargo or tanker traffic into a specific port. The team noted that there are MPAs in the vicinity of certain fairways (Fig. 24). They pointed out that fairway dredging should not be done when the fairway was also in an MPA. In the end, the team did not implement any spatial plans related to this topic.

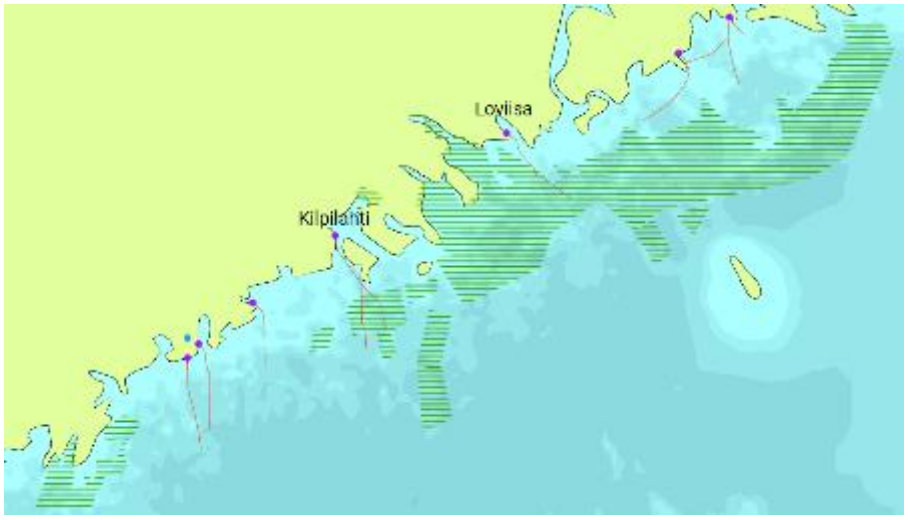


Figure 23. Screenshot of south-east Finland, showing examples of fairways potentially traversing marine protected areas

Source: MSP Challenge session, Riga, 2018

Team North-East also discussed the introduction of new fairways with speed limits and ship size limits through the Finnish south-western archipelago, since not all vessel can always use the

current fairway through the area (Fig 25). This is a complex issue. In the end, the team did not implement any spatial plans related to this topic.

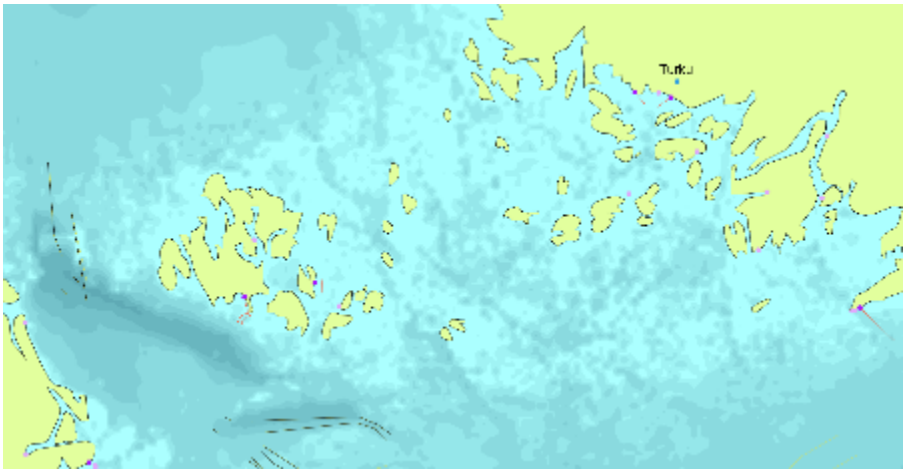


Figure 24. Screenshot of south-west Finland, the Finnish archipelago, with IMO shipping lanes.

Source: MSP Challenge session, Riga, 2018

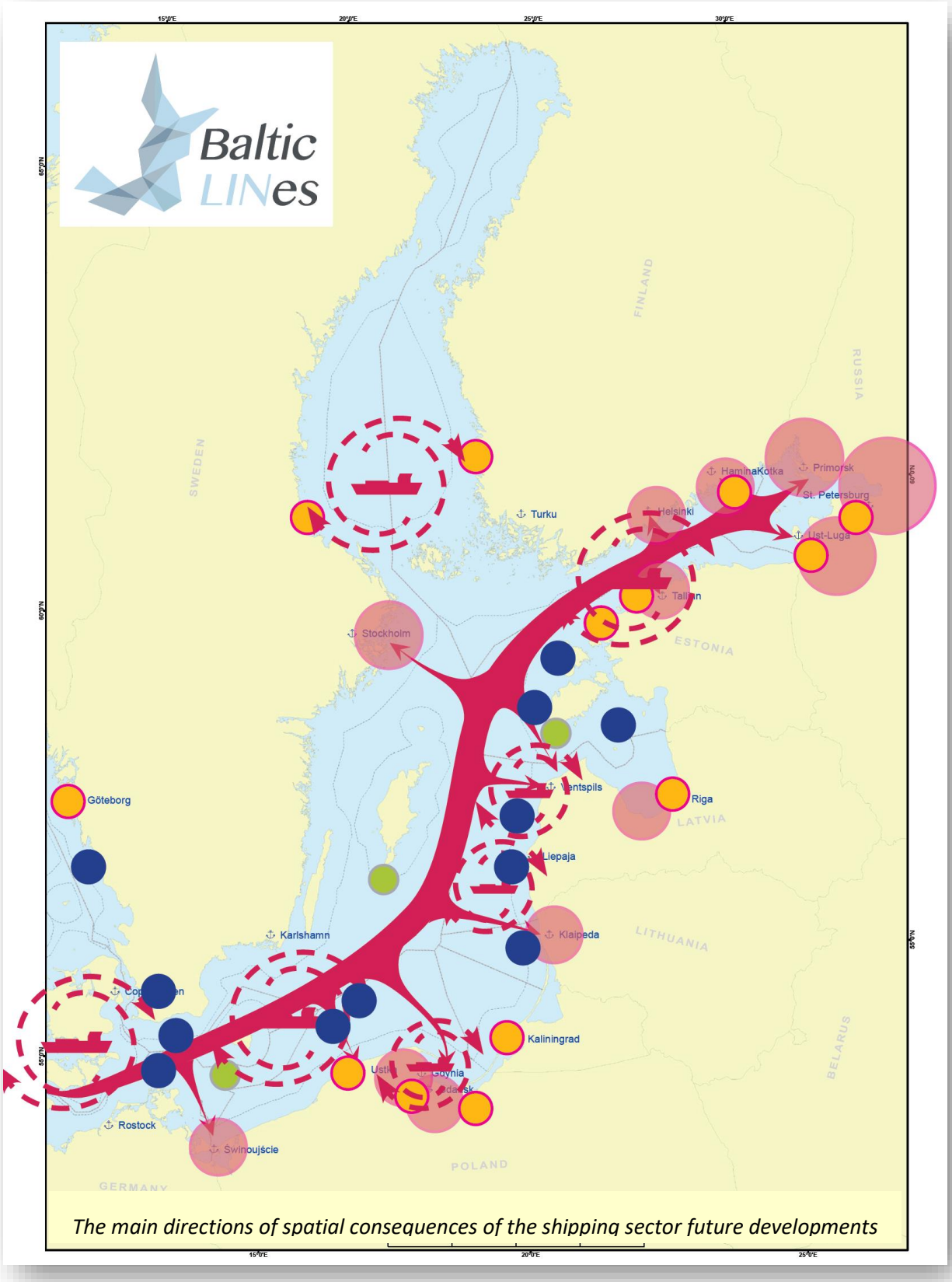
5. Challenges for MSP and recommendations

5.1 Challenges for MSP

As described earlier, the shipping market is highly dependent on the global and regional economic development. The Sustainable and Fast Growth scenarios indicated the growing importance of the Baltic Sea Region in terms of economic growth, especially where it relates to export, with Russia establishing stronger international connections. International commercial exchange picks up speed. The growth is expected in most of the shipping types, especially in containers. The most important Baltic trends foreseen by both the scientist and stakeholders are as following:

1. The increase of trade volume, especially increasing export from Russia
2. The larger portion of bigger ships
3. The strong growth of larger and specialized ports
4. The automatization of vessels
5. The climate change
6. The growth of the offshore industry

For Maritime Spatial Planning the most crucial are spatial consequences of these scenarios - the MSP challenges addressed in medium (till 2030) and long term (till 2050) perspective. In this chapter we have attempted to pre-describe these phenomena.

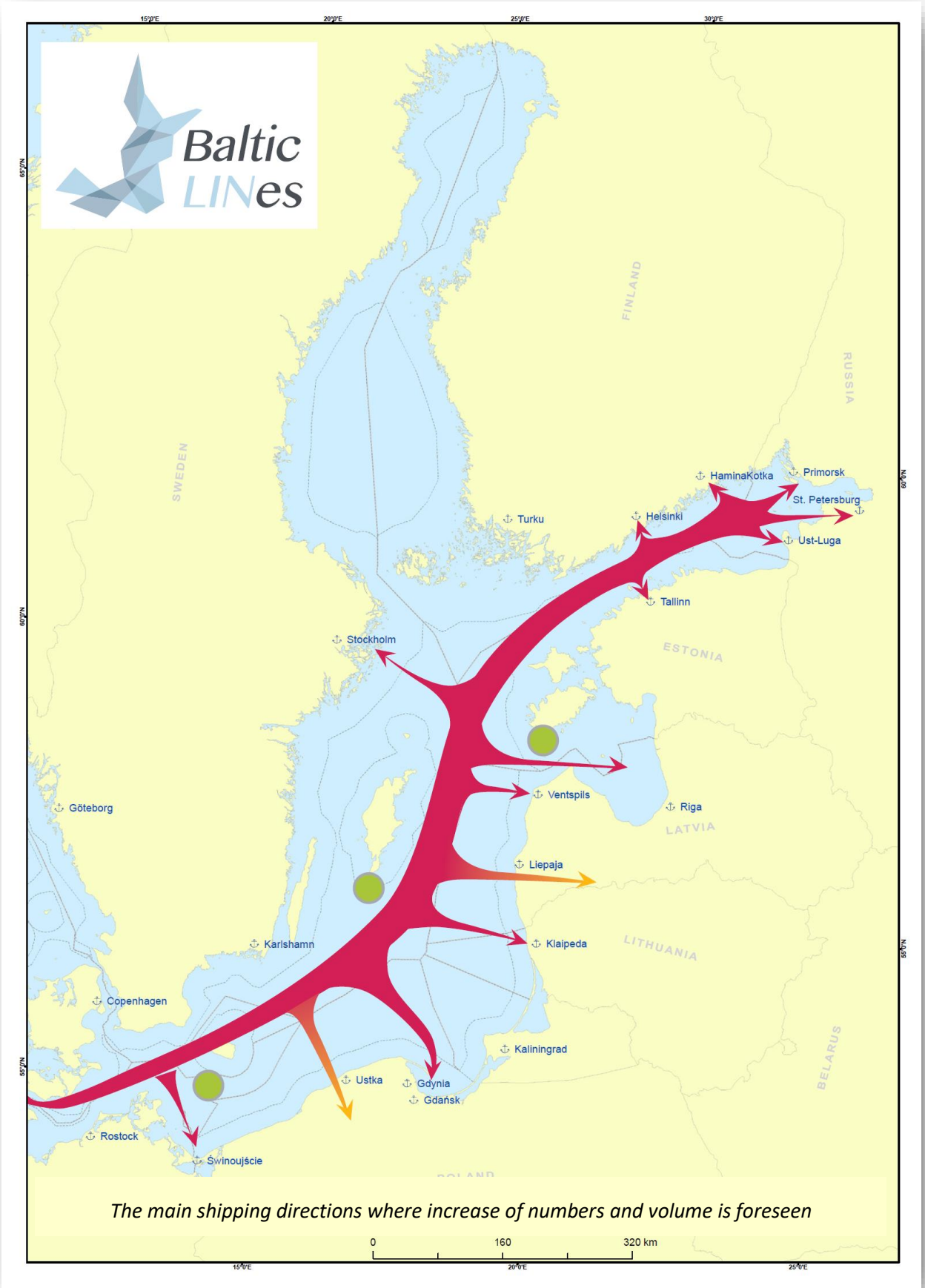


The main directions of spatial consequences of the shipping sector future developments

Challenge I – shipping pattern changes

The increase in annual shipping turnover generally will not have a significant influence on the Baltic shipping pattern. It is foreseen that particularly heavy traffic will concentrate on handling the hub ports and key international ports.

The challenge for MSP is to minimize the different types of risks related to this intensity and traffic concentration. Collision risks will increase calling for better spatial organization of ship traffic including also local shipping and leisure traffic. This is in particular difficult requiring a lot of organizational work due to freedom of navigation in the EEZ and limited possibilities of MSP to achieve necessary results alone. Also environmental risks (i.e. avoiding stronger impact of shipping on ecologically valuable areas (increased underwater noise, birds disturbance, etc.) will require from MSP new type of knowledge and know-how and orchestration of different policies in order to properly address them. A clear agreement on responsibilities related to this issue between MSP and other sea governance regimes would be desirable although very challenging.

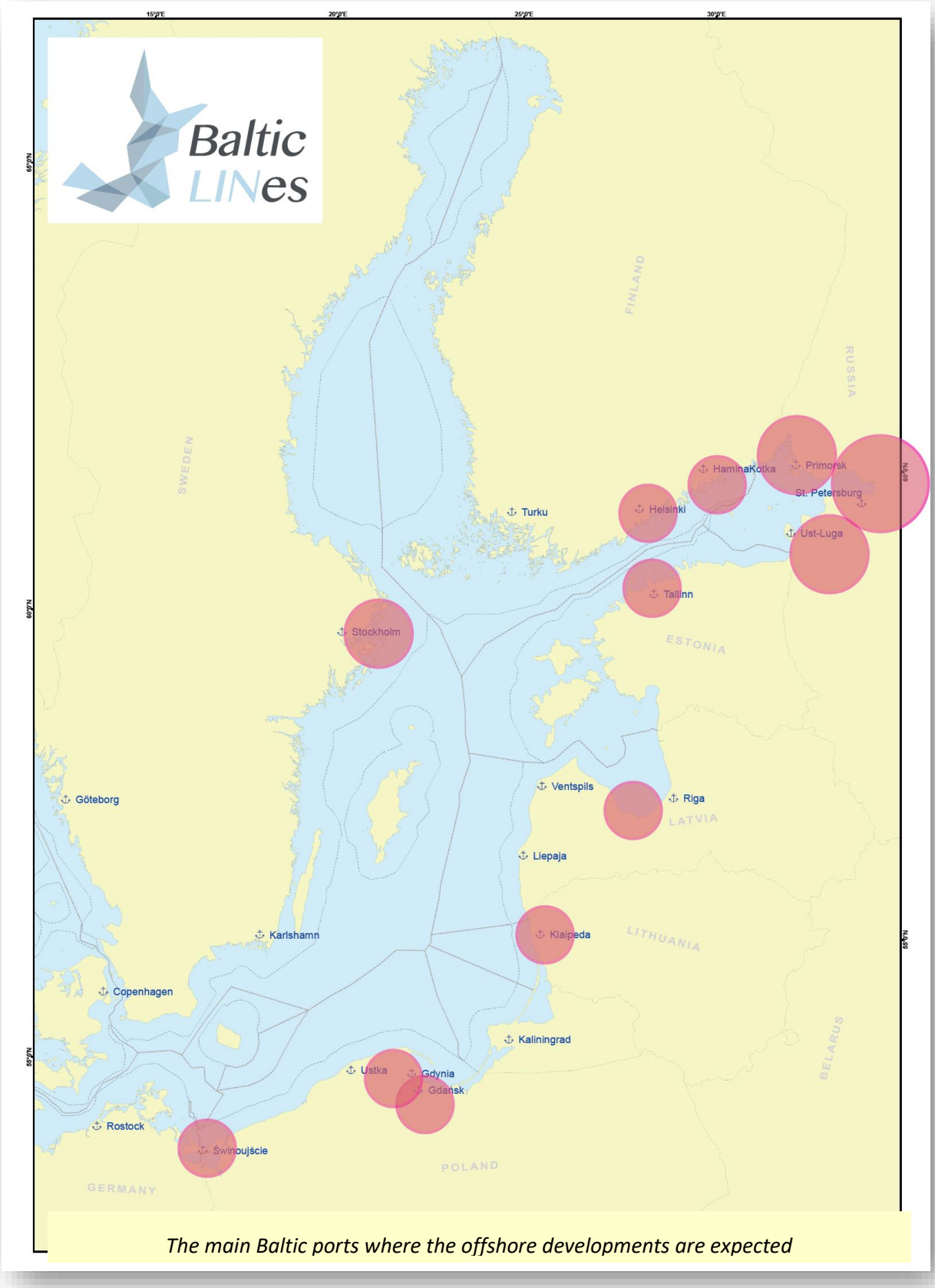


The main shipping directions where increase of numbers and volume is foreseen

Challenge II – ports offshore development

The general rise in annual shipping turnover will locally result in intensified port growth, especially for the largest ports in the Baltic Sea. According to the Fast Growth Scenario each port is required to have container-handling terminals. Some of the largest ports of primary importance for BSR national economies stand out because of the numerous maritime trade connections that they operate. It is to expected that the main ports in Estonia, Finland, Poland, Lithuania, Latvia and especially Russia will grow stronger than ports in Germany, Denmark and Sweden. In the face of limited spatial resources in the hinterland, some ports may have to expand offshore, influencing the marine space use, intensifying the spatial and recourse conflicts as well as increasing pressure on the natural environment.

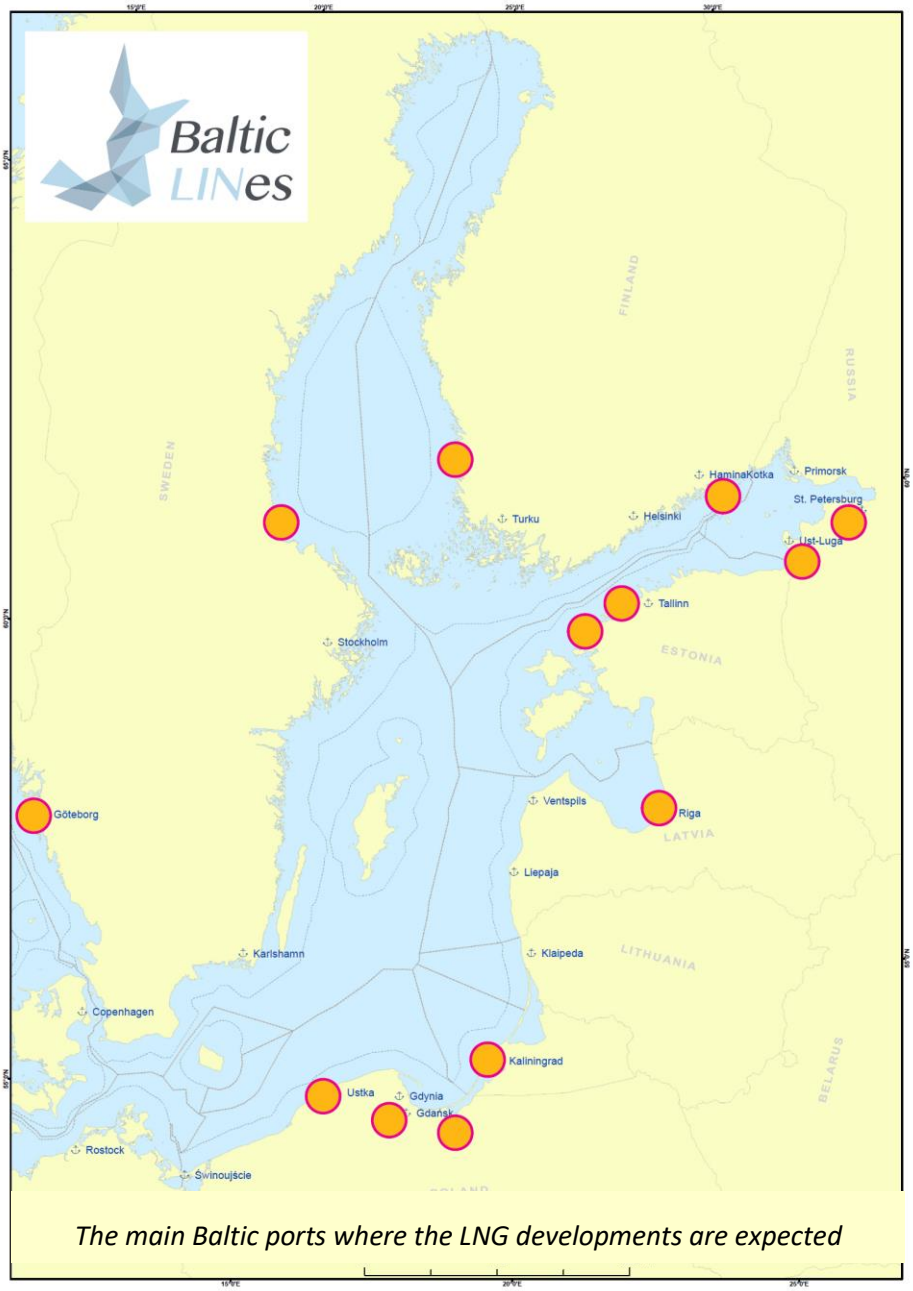
The challenge for MSP is to reserve the adequate space for port development in line with eco-system based approach. Key problem is high level of uncertainty that concerns both the new port technologies (e.g. ports unmanned located outside urban areas, connection of ports with land infrastructure etc.) and consequences of port development for the dynamism of the coast. Also increased environmental pressures must be addressed by MSP (ports are located in the land-sea interface which as a rule are ecologically productive e.g. photic zone etc.). The challenges require foresight type of approach under MSP, better understanding of coastal dynamics and functioning of regulating and supporting ecosystem services. Due to intensity of conflicts related to port development the MSP ability to identify different tradeoffs and put them at public choice agenda as a part of the planning process might be a decisive factor for a success of MSP. The challenge is that port creates benefits for entire economy whereas costs are concentrated locally.



The main Baltic ports where the offshore developments are expected

Another impact influencing the ports development is the expansion of the LNG infrastructure in Europe is The new infrastructures will result in ports specialization and enlargements. Figure 26 presents the newest overview of existing and planned LNG infrastructure in Europe including LNG terminals.

The specific challenge related to that is increased density of the transmission infrastructure. For MSP the most important and troublesome are pipelines that will continue through sea areas. They need space around ports that is usually scarce, valuable and under different types of conflicts even without additional linear infrastructure. Planning challenges will be related to such conflicts intensity and enlarged scope. MSP must take care of conflicts with UCH, shipping, coastal protection to name the most important ones. All these would require additional resources and close co-operation with various professional bodies and NGOs and innovative solutions and planning approaches.



The main Baltic ports where the LNG developments are expected

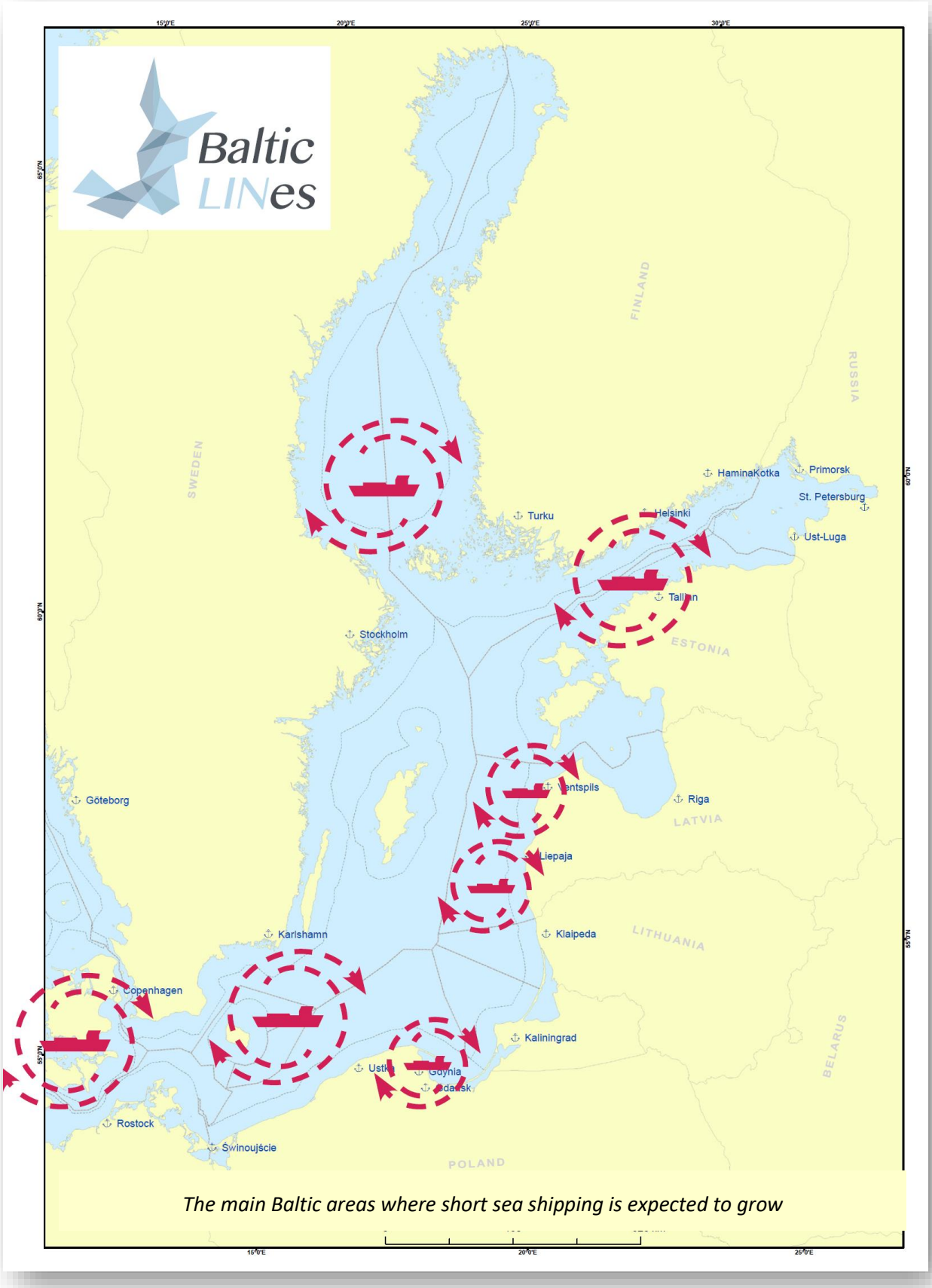
Challenge III – short sea shipping intensification

The smaller, neighbouring ports will become supporting, creating bipolar relations with main ports, intensifying the coastal, short sea shipping traffic. According to the Sustainable Growth Scenario a number of new ports emerge/get stronger to fill the gap in the Baltic transport system, while the existing ones – especially those located along the transport corridors and main cargo routes – become highly modernized to improve their efficiency and throughput.

The biggest intensification is foreseen in the Finnish Bay, due to the development of Russian ports and the ro-ro connection between Estonia and Finland, the Gdańsk and Pomeranian Bay (main national ports development and planned increase in Elbląg port operations due to Vistula Split channel) and Latvian and Lithuanian coast.

Also the foreseen economic growth might translate into the increase of coastal tourism, especially in the sense of yachting and leisure boats traffic. The same is true for off-shore new industries. For instance port of Ustka in Poland might develop as a service port for off-shore wind energy in Polish EEZ. Port of Wladyslawowo has already serves as an oild and gas extraction hub.

This will increase the intensity of spatial conflicts in the indicated coastal waters, demanding more attention from the MSP process. To ensure the navigational safety and the access to ports, the careful planning of any multiply constructions (e.g. offshore wind farms) have to short sea shippingbe in place. So the problems for MSP are similar to the ones listed under challenge no. 1.However here specific challenge is related to typical coastal conflicts between various types of short sea shipping themselves and with other coastal depended sectors like tourism national defense and artisanal fishery. MSP must find a way how to make priorities among various sectors and coastal uses respecting their (market power is not the best method in each case) and how to civilize pressure from additional technical infrastructure on coastal defense. New planning tools are necessary in order to properly frame planning process and avoid dominance of the vested interests.



The main Baltic areas where short sea shipping is expected to grow

Challenge IV – more space for manuvering

Both scenarios and the stakeholders interviews indicates that the shipping future means larger portion of bigger ships with higher DWT. Of course one have to remember that due to the Danish Straits natural conditions this increase is limited for the Baltic Sea. However, is rise is still expected. Bigger ships – require more space for maneuvering not only in the ports area (anchorage, ect) but on the routes as well, especially close to multiplied constructions like windfarms. as well as the growing recreational traffic will need additional space alongside of the IMO schemes.

MSP challenges is mainly related to securing such additional space. Here space should be carefully estimated. The problem is lack of commonly agreed standards and uncertainty related to technology development. The national planners alone will be unable to address this challenge. Trying to do that might result in incompatible solutions in different countries diminishing the BSR connectivity.

Challenge V- Autonomous shipping

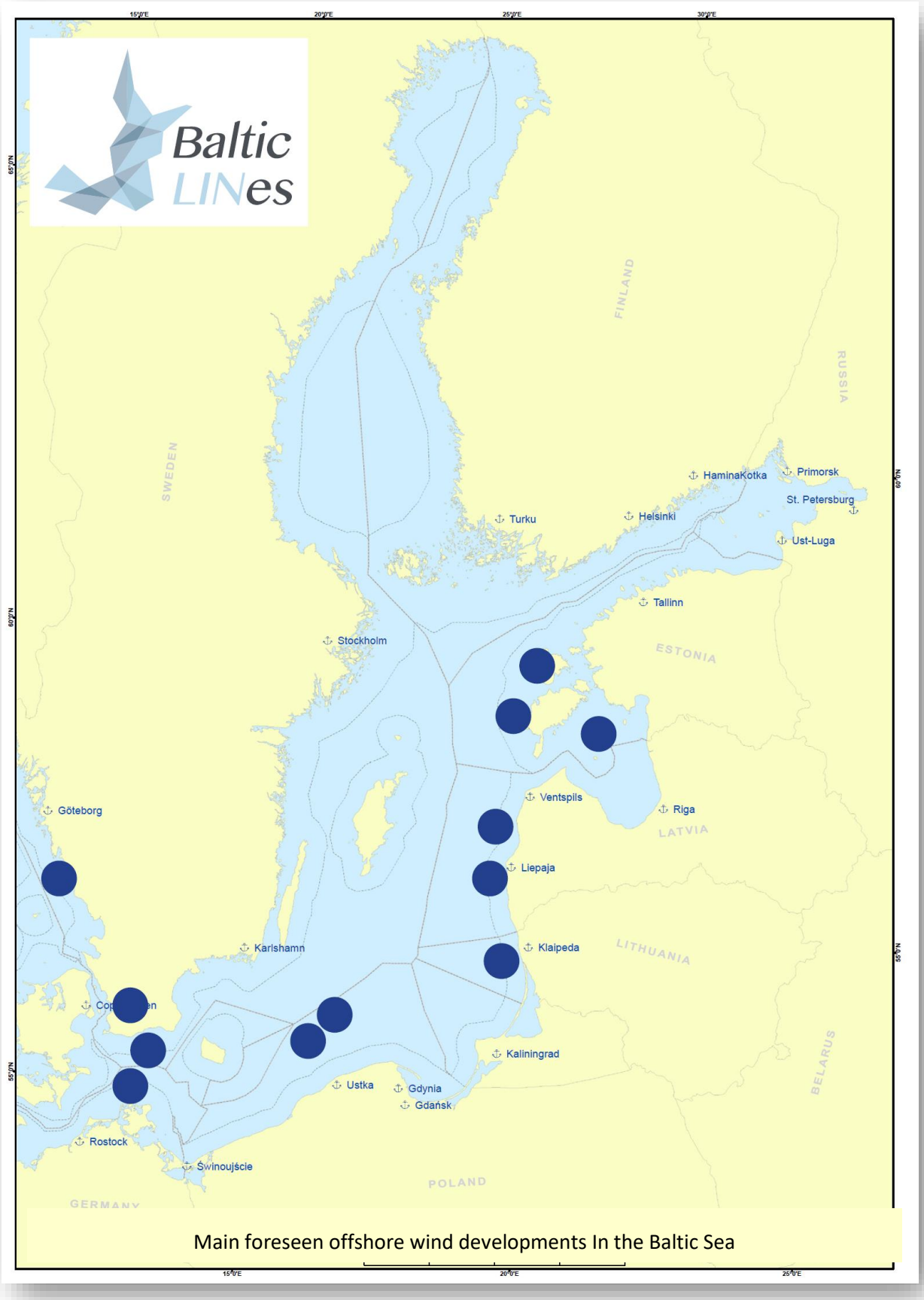
If the concept of unmanned ships is to become reality the fixed corridors to be used mandatorily by such ships, as for aircraft in aviation, could become a prerequisite for the concept of autonomous shipping together with reasonable safety distances to other spaces dedicated to e.g. fishery, military operations or deep sea mining.

Even if this is the far future reality MSP should now the minimum is to ensure the planned areas for transport are wide enough to safe the space for future So the challenge in principle is very similar to the previous one. Specific problem here is related to the possibility of hijacking the autonomous ships by the remote hackers. MSP must ensure space for emergency actions in this case i.e. must assess and estimate space demand for such needs. This is an entirely novel problem for MSP that would require new type of knowledge and tools for stimulation of emergency situations

Challenge VI - Growing offshore services

The planned developments in offshore industry (energy production, mineral extraction, aquaculture, etc.) will increase and introduce new traffic on the routes connecting constructions with the service centres. It will have mainly local but strong influence on shipping patters as being predominantly perpendicular to traditional shipping routes.

MSP challenges are very similar to the already described and are related to increased intensity of spatial conflicts and necessity to prioritize among sectors and ability to understand the environmental consequences of the spatial decisions. Specific challenge for MSP here is related to properly addressing socio-economic impacts of development of various off-shore industries on terrestrial communities and cumulative environmental impacts of blue growth. Understanding impacts is important for assigning space to different type of uses in a conflict situation and allow to run MSP consistently with national and regional priorities.



Main foreseen offshore wind developments In the Baltic Sea

5.2 Recommendations

for MSP authorities

The trends and challenges described in the report should be taken by MSP authorities into consideration when designing and running MSP process. The following recommendations seem the most important:

- Stakeholder dialogue is one of the most promising vehicles of addressing wicked multifaceted problems related to navigation and navigation infrastructure development
  - While securing the sea areas free of navigation obstacles, MSP authorities should pay attention to economic factors (costs of shipping, intensity of shipping, growth of shipping intensity in the future, demand for shipping), navigation safety (distance to natural and artificial navigation obstacles, existence of ports of refuge, existence of navy training grounds) and environmental pressures from shipping intensification (e.g. noise pollution, oil spills, air pollution, disturbance of birds and sea mammals, the most probable direction of migration of dangerous substances in case of accident). Final decision should keep the balance between those concerns established as an outcome of genuine stakeholder process.
  - Similar multi-criterion approach should be applied to seaward development of ports. However, in this case there are some other important decisive factors that should be taken into consideration such as impact on coastal erosion or impact on land hinterland such as traffic congestion, environmental and social impacts on coastal population. MSP process as a minimum should result in identification of all these factors and those affected by tem.
  - When planning coastal areas the authorities should take into consideration the expected development of short-sea and leisure. This might induce a new types of trade-offs with other sectors such as artisanal fishing UCH or nature protection (photic zone). MSP should strive towards multi-use. If infeasible alternative can be a stakeholder dialogue revealing intensity of conflicts and compensation needs.
- There are also some rules of thumb that might facilitate the MSP process, at least should not be forgotten:
  - There is a need to ensure connectivity over the national borders of sea areas/ sea corridors free of navigation obstacles in order to secure safety of navigation when the number of such obstacles is expected to increase rapidly.
  - Also international (Baltic) standards should be agreed among MSP authorities with regard to such sea areas in terms of minimum safety requirements for ships with normal and dangerous cargo separately (taking into account shipping intensity type

of cargo, and number of autonomous ships, type of navigation obstacles nearby – i.e. their safety buffers etc.).

- Permanent ferry lines should be kept free from navigation obstacles and MSP should take into consideration new ferry connections that will be developed in the future.
- When planning sea areas free of navigation and development of ports seaward the MSP authorities should take into consideration the new demand and shipping connections resulting from development of off-shore industry.
- MSP authorities should promote smart positioning of OWF and aquaculture areas in order to secure navigation among key Baltic destinations (even located in other countries), calculation of the financial burden for the shipping sector related to the location of permanent navigation obstacles.
- Passages through OWFs and aquaculture areas should be developed to facilitate access to ports and secure safety of navigation (easy access to ports of refuge).
- MSP should try to bundle and protect technical infrastructure in order not to compromise navigation safety when both shipping intensity and size of the ships is expected to increase.

- MSP authorities might also try to keep track with the dynamic future oriented issues related to navigation
  - MSP authorities should consider facilitation of development of autonomous shipping through increasing transnational cooperation on innovative zones in the MSPs and close contact with operators on this issue.
  - MSP authorities should study and creatively co-develop the concept of multi-use with active participation of the shipping sector.
- Since MSP is a social process, MSP authorities must understand the market and political power of the shipping industry and other sea users affected by the shipping in order to device a fair and comprehensive MSP process and not to give automatic preferences to the concerns of the most organised stakeholders.

for SHIPPING stakeholders

Shipping stakeholders might also adjust their way of functioning to the new circumstances of the crowded sees. The following might be recommended:

- Create a better representation of shipping stakeholders for Baltic affairs by teaming up and showing the key issues and development possibilities. Acquiring skills how to express all these concerns in spatial terms.

- Understand that although shipping belongs to traditional and privileged by international law sea use, in many countries other sea uses might also be prioritised on expense of shipping freedom. In practical terms MSP means the end of the era of the shipping freedom. Therefore shipping sector should become more pro-active in the development process of the different Baltic MSPs.
- Maintain regular contacts with MSP authorities (not only during the period of preparation of the plans) in particular in terms of knowledge and tacit knowledge sharing (in particular to the future trends, costs of overcoming the distance etc.), Remaining open even without direct benefit for the shipping industry.
- Remain in dialogue with other sea users. Trying to understand their concerns and development plans in order to assess their impact on the shipping sector. Inform other sectors on developments in shipping and future plans for the same reason.
- Organise itself in line with spatial specificities of the branches of the shipping industry (e.g. the cruise sector need to organise itself in a way to represent their spatial interest regarding harbour and harbour development and launching of innovative concepts with regard to environmental concerns of the harbours and port cities).
- Work in parallel on the technical concept of autonomous shipping and spatial implications of its development and consult the outcomes regularly with the different authorities.

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