

**MARITIME TRANSPORTATION IN THE GULF OF FINLAND IN 2007  
AND THREE ALTERNATIVE SCENARIOS FOR 2015**

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This paper presents cargo flows in maritime transportation in the Gulf of Finland in 2007 and gives three scenarios for cargo flows in 2015. The Gulf of Finland is surrounded by three different national economies with different maritime transportation structures. There are approximately 30 ports in the area, but in 2007 87% of tonnes were handled in the seven biggest ports. In 2007 total 263 million tonnes of cargoes were transported in the Gulf of Finland. 56% of the cargoes were oil transports. Approximately 53 600 ship calls were made to the ports in the Gulf of Finland in 2007.

The following factors were studied when formulating the future scenarios: maritime transportation in the Gulf of Finland 2007, economic development, development of key industries, and development of maritime transportation trends. Scenarios were based on previously made transportation scenarios and other forecasts on the future development.

As a result, a range for the total tonnes in 2015 of each three alternative scenario was formulated and they are as follows:

- the slow growth scenario: 280.8 – 363 M tonnes (expectation value 322.4 M tonnes)

- the average growth scenario: 404.1 – 465.1 M tonnes (expectation value 431.6 M tonnes)
- the strong growth scenario: 445.4 – 575.4 M tonnes (expectation value 507.2 M tonnes)

These figures were divided further by country to import, export and domestic traffic, and to oil transports and other cargoes, and to the number of ship calls (tankers/other ships).

The development of maritime transportation in the Gulf of Finland in future is mainly dependent on the development of Russian economy and transportation sector. If the current economic decline leads to a longer lasting recession, the growth of the transported tonnes will slow down. But if the decline does not last long, it can be expected that the economic growth will continue and along with it also the growth of transported tonnes.

**Keywords:** maritime transportation, future scenarios, The Gulf of Finland

# MARITIME TRANSPORTATION IN THE GULF OF FINLAND IN 2007 AND THREE ALTERNATIVE SCENARIOS FOR 2015

## 1 INTRODUCTION

The worldwide growth of maritime transportation has been outstanding during last decades. Reason for the growth is mainly the globalization of trade. Also in the Gulf of Finland maritime traffic has increased strongly in the past years due to the good economic development in the area and especially increasing oil export activities of Russia. It is widely assumed that in the long-run the growth of maritime transportation will continue although the current decline of global economy has slowed down the growth in the Gulf of Finland as well.

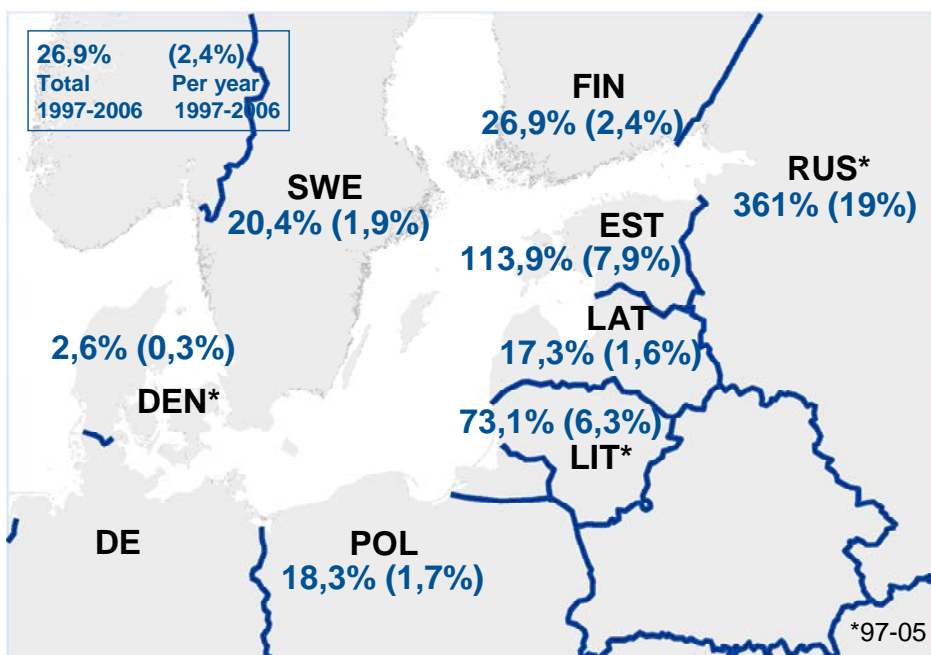


Figure 1. The development of cargo tonnes in maritime transportation in the Baltic Sea area, 1997-2006 (Saurama 2007)

The Gulf of Finland is a shallow and ecologically vulnerable sea area. There is a dense passenger and cargo traffic of which oil transports have a share of over 50 %. The increasing maritime traffic increases the environmental risks both through direct environmental effects and by increasing the accident risk. By knowing the structure and the amount of maritime transportation now and estimating it in future the risks of maritime transportation can be better analyzed. Besides risk analysis, future scenarios give valuable information for the companies and for the other actors in the field by tracing the factors, which affect the amount of maritime transportation, and by giving alternative development paths to the future. This kind of information can be used e.g. to formulation of effective social policies to minimize risks and to making of strategic decisions of different kinds.

This paper describes 1) the structure and amount of maritime transportation in the Gulf of Finland in 2007, 2) what are the main factors and trends affecting the amount of maritime transportation in future, 3) three alternative future scenarios for the maritime

transportation in the GoF in 2015, and the results of the probability distribution simulation of these three scenarios.<sup>1</sup>

## 2 MARITIME TRANSPORTATION IN THE GULF OF FINLAND IN 2007

The Gulf of Finland is a part of the world's largest area of brackish water, the Baltic Sea. The Gulf of Finland is 400 km long and its width varies between 60 and 135 km. Three countries surround the Gulf of Finland: Finland, Russia and Estonia. The Gulf of Finland is very shallow: the maximum depth is 60 metres and the average depth 37 metres. (For comparison: the average depth of the Mediterranean Sea is 1550 metres.) The Gulf of Finland is partly ice-covered, approximately from December to April. The ice-cover is the heaviest on the Russian side of the gulf.



Figure 2. Major ports in the Gulf of Finland and transit routes to/from Russia in the Gulf of Finland in 2007

Maritime transportation in the Gulf of Finland is characterised by the majority of oil products in transports and by the dense passenger traffic line between the ports of Helsinki and Tallinn. Cargoes are transported to/from the Baltic Sea/Gulf of Finland mainly in feeder traffic from/to European hub ports. Maritime traffic in the Baltic Sea area is also marked by the high frequency of Ro-Ro and Ro-Pax services, which serve e.g. forest and steel industry products of Finland, and transports of containers, trailers and other conveyors.

The Gulf of Finland is surrounded by three very different national economies with different maritime transportation structures. Finland is a country of high GDP/per capita with a diversified economic structure. The number of ports is large, although many of the ports are small and five biggest ports (Hanko, Helsinki, Sköldvik, Kotka and Hamina) handled 85 % of cargoes in Finnish ports in the GoF in 2007. The maritime transportation consists of many types of cargoes: raw materials, industrial products, consumer goods,

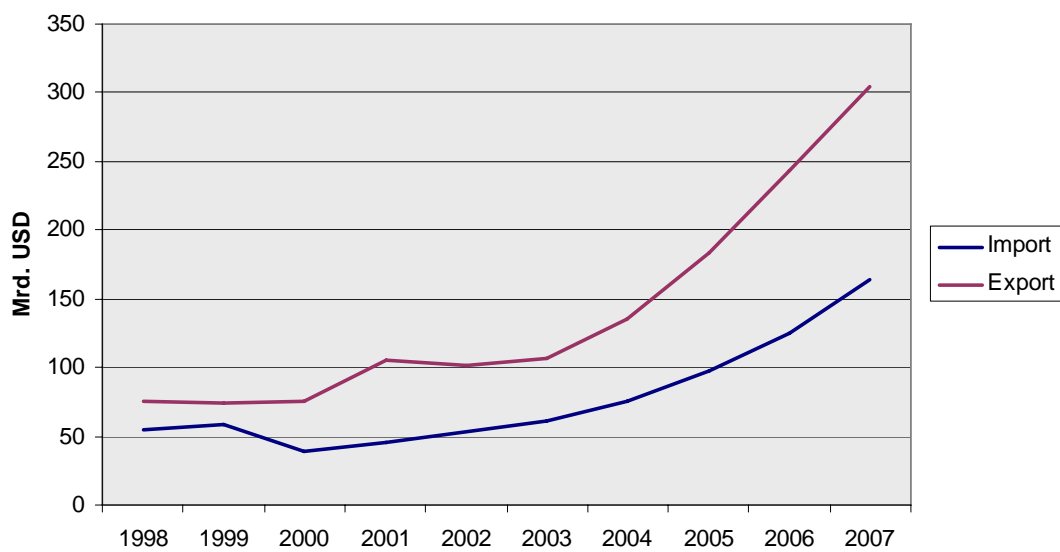
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<sup>1</sup> This research has been done as part of the cross-disciplinary research project “SAFGOF - Evaluation of the traffic increase in the Gulf of Finland during the years 2007-2015 and the effect of the increase on the environment and traffic chain activities” of Kotka Maritime Research Centre (<http://www.merikotka.fi/uk/SAFGOF.php>).

coal and oil products, and the Russian transit traffic of e.g. new cars and consumer goods, which are transported further to Russia mainly by road.

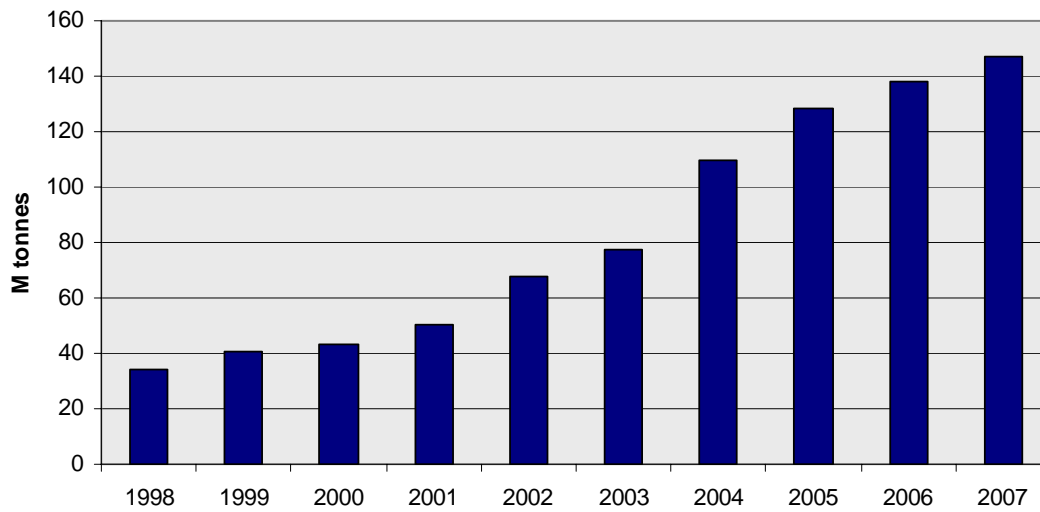
Russia is a large country with huge growth potential. In recent years, the expansion of oil exports has led to a strong economic growth, which is also apparent in the growth of maritime transports. Russia has been expanding its port activities in the Gulf of Finland and it is officially aiming to transport its own imports and exports through the Russian ports in the future; now they are being transported to great extent through the Finnish, Estonian and other Baltic ports. Russia has five ports in the Gulf of Finland and their share totalled about 35 % of all cargoes handled in the Russian ports.

**The development of import and export in Russia, 1998-2007**



*Figure 3. The development of import and export in Russia, 1998-2007 (BOFIT 2009; Spiridovitch 2009; Customs Russia 2009)*

**The development of oil transportation in the Gulf of Finland,  
1998-2007**



*Figure 4. The development of oil transportation in the Gulf of Finland, 1998-2007 (Finland's environmental administration 2008a)*

Estonia has also experienced fast economic growth, but the growth has been slowing down already during the past couples of years. The size of its economy is small compared to Russia, which means the transported tonnes cannot be very massive. However, relatively large amounts of the Russian transit cargoes have been transported through the Estonian ports. In 2007 73 % of all goods transported through Estonian ports were transit cargoes, and of the transit cargoes 76 % were oil products. The rest were mainly coal and fertilizers. Estonia's own import and export consist of forestry products, metals or other raw materials and consumer goods. Estonia has many ports on the shores of the Gulf of Finland, but the port of Tallinn dominates the cargo volumes.

In 2007, 263 M tonnes of cargoes were transported in the maritime traffic in the Gulf of Finland, of which the share of oil products was 56 %. 23 % of the cargoes were loaded or unloaded in the Finnish ports, 60 % in the Russian ports and 17 % in the Estonian ports<sup>2</sup>. The largest ports were Primorsk (74.2 M tonnes) St. Petersburg (59.5 M tonnes), Tallinn (35.9 M tonnes), Sköldvik (19.8 M tonnes), Vysotsk (16.5 M tonnes), Helsinki (13.4 M tonnes) and Kotka (10.7 M tonnes).

<sup>2</sup> Statistics are based on the following sources: EUROSTAT, Finnish Maritime Administration, Statistics Estonia, Morcentr-TEK (Russia), ports, and news services.

### Maritime transportation in the ports of the Gulf of Finland, 2007

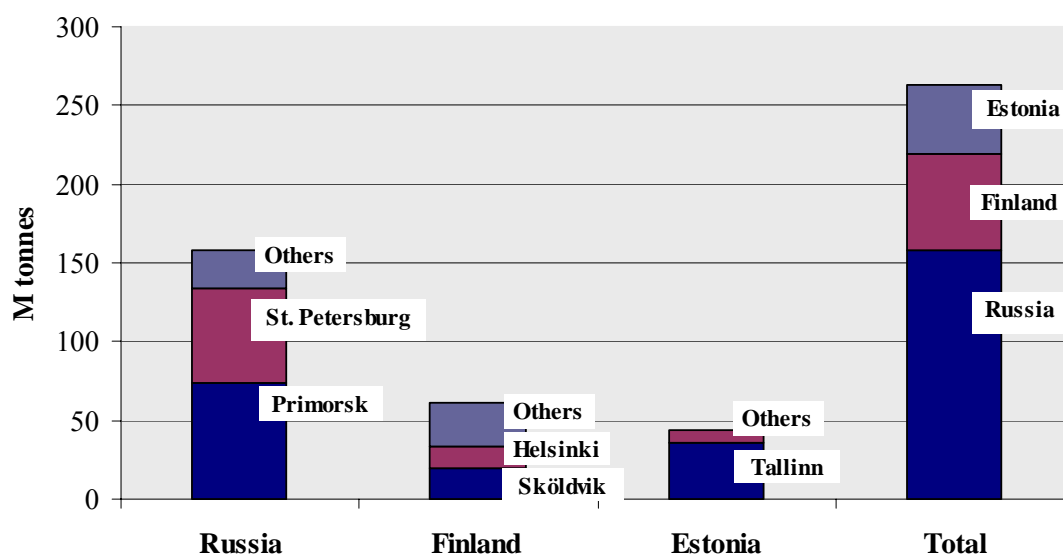


Figure 5. Maritime transportation in the ports of the Gulf of Finland, 2007

Approximately 53 600 ship calls were made in the ports of the Gulf of Finland in 2007. The densest traffic was found in the ports of St. Petersburg (14 651 ship calls), Helsinki (11 727 ship calls) and Tallinn (10 614 ship calls).

The average ship sizes in the Gulf of Finland are rather small due to the geographical conditions of the area - maximum waterway depth being 15 m, and due to the relative thinness of cargo flows in comparison with the number of ports.

Table 1. The average ship size of the most common ship types in the Gulf of Finland, 2007<sup>3</sup>

	GT	DWT	Length	Breadth	Draught
General cargo ship	3 588	4 684	97	14	5
Bulk ship	20 298	33 895	179	26	10
Container ship	14 165	16 128	158	23	9
Ro-Ro ship	13 247	8 587	148	21	7
Ro-Pax ship	12 447	2 896	108	18	4
Passenger ship	230	35	32	7	2
Cruiser	31 506	3 971	182	24	6
Tanker, crude oil	32 514	58 739	165	28	10
Tanker, product	12 467	20 605	119	19	7
Tanker, chemicals	12 224	19 190	140	22	9

<sup>3</sup> Based on HELCOM AIS data on ships in the Gulf of Finland. Used data presents 17 days around the year 2007 and the average ship sizes is the average size of the ships, which were in the Gulf of Finland in those 17 days.

### 3 TRANSPORTATION SCENARIOS AND MAIN TRENDS

Scenarios are made in order to trace how certain things might develop in the future. In the scenarios, factors, trends and events are studied in order to combine them for a plausible description of possible, although not always probable, outcomes. Because the world is a complex place and the future is always uncertain, a scenario should be regarded as one possibility, not as an accurate prophecy. A scenario approach often involves two or more alternative scenarios, which can be used to compare and examine alternative futures (e.g. Stead & Banister, 2003).

But why are scenarios made if they are not trustworthy descriptions of the future? Although the future cannot be precisely predicted, the scenarios can still give valuable insights: they can act as planning tools and early warning systems for current realities or work as catalysts for strategic discussion in the society. (Sørensen et al. 2008) A good scenario offers alternative views on the future in order to bring out how different factors might develop and what kind of effect they might have. (Mannermaa 1999)

The future can be traced in numerous ways. In some methods, the past development, e.g. on the basis of time series statistics, is used in order to formulate the future development, or scenarios can be done by outlining alternative futures by different methods such as using expert views or quantitative modelling.

In the construction of a scenario, conceptual framework is needed to capture changes in the external environment of a subject. Conceptual framework can be grouped into the following types of factors and trends:

- Socio-cultural
- Technical
- Economic
- Ecological
- Political or regulatory (Sørensen et al. 2008).

The transportation scenarios are usually based on the assumption that the amount of transports follows the development of the economy, although also other factors influence the development of transportation, e.g. government policy, environmental aspects, technology, land use planning and social and behavioural trends (Shifan et al. 2003). The relationship between the development of transportation and the economy is usually analyzed in terms of the development of GDP and trade. In the long run, the development of transportation has been perceived to follow the development of GDP (Ubbels et al. 2003; Stead and Banister 2003). When the GDP grows to a certain level, especially the international transports increase because countries of high GDP produce, consume and thus transport more. An effective transportation system is a precondition for the economic development. Globalization is one of the keywords in the development of transportation because it affects the volume of consumption and production as well as the place of production (Ubbels et al. 2003).

### 3.1 Major trends in trade and transportation

Trends, which affect the future of transportation globally, can be grouped into megatrends, trade trends and logistic trends. The megatrends have an effect on almost all human activities. Because transportation is closely connected with trade, the trade trends are essential from the point of view of transportation. The logistics trends, on the other hand, are directly connected to the transportation.

Utilization of ICT and the importance of safety (e.g. safety of vessels), security (e.g. prevention of terrorism) and environmental aspects (e.g. climate change) are seen to be worldwide megatrends, which affect also transportation. The most important world trade trends are globalization, outsourcing and the growth of the role of Asia in global economy (e.g. Pålsson and Bengtsson 2008; Venäläinen and Löfgren 2007; Lautso et al. 2005). Global economic growth has been catalysed by the increasing globalization and deepening economic integration (UNCTAD 2007). In logistics, the main trends are e.g. containerisation or unitization of cargo, concentration of cargo flows, enhancement of speed and service level in logistics and transparency of supply chain (Venäläinen and Löfgren 2007).

According to Sala et al. (2008), things which concern most maritime transportation in the long run are seen to be climate change and other environmental risks, the availability and price of energy, the development of transport-related technology, structural changes of trade and industry, and globalization.

Sørensen et al. (2008) see the following drivers as the most important for the transportation sector in the future: economic growth, priority of sustainability in public regulation, investments in infrastructure, liberalisation and harmonisation of the transport and logistics sector, technological development, and energy prices.

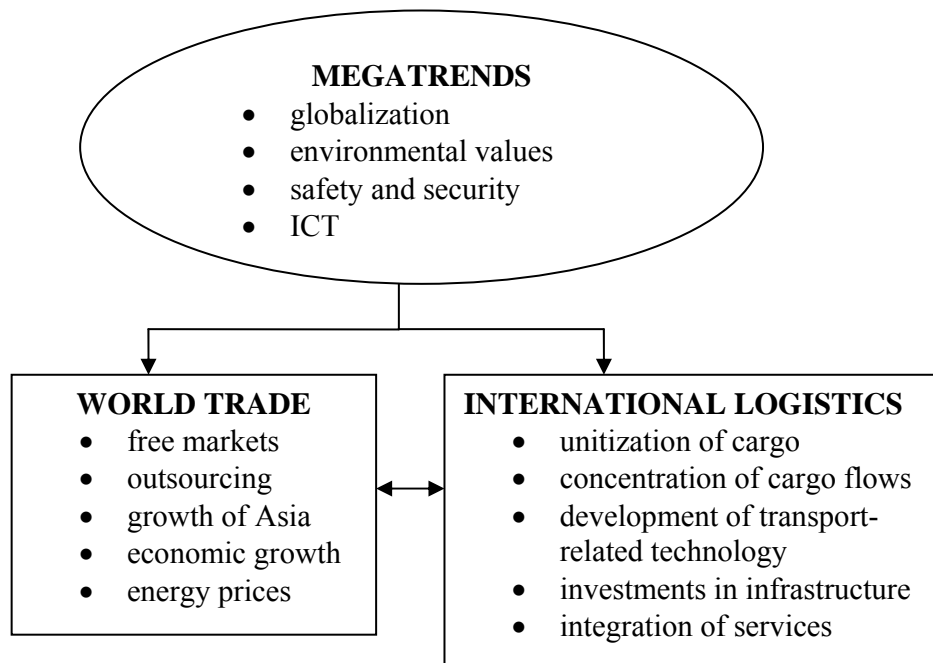


Figure 6. Global factors and trends affecting the maritime transportation (retold of Venäläinen and Löfgren 2007)

### **3.2 Development of maritime transportation in the Gulf of Finland**

Maritime transportation in Finland consists mainly of the transports of industries, energy-related transports (coal, oil products), the transports of consumer goods, and of Russian transit traffic. For the ports of the Gulf of Finland, forest industry related transports have traditionally been the core industrial transports, but recently forest industry has been under major challenges in Finland. (Venäläinen and Löfgren 2007) At the moment the shipments of forest industry products have been decreasing – in maritime transportation exports of forest industry products fell by -10 % in 2008 compared to the year 2007 (Finnish Maritime Administration 2009)

The demand for energy products in Finland is expected to stay quite stable (Lehto et al 2006). The climate policies are putting pressure for the replacement of non-renewable energy sources, but in the short term it is not likely to have deep impact on the energy sector. The transit traffic to/from Russia has a central role in the ports of Hanko, Kotka and Hamina. Finland's transit route has some major advantages compared to other routes, such as good safety level and logistic sector is well developed. (Ruutikainen and Tapaninen 2007)

The maritime transportation of Russia is characterised by export of oil products. Russia also exports other raw materials (e.g. coal and metals) and imports consumer goods. The policy of Russia is to protect the transportation markets against foreign competition. Russia is also aiming to redirect cargo flows which are now going to Russia via the Baltic or Finnish ports straight to the Russian ports. (Lautso et al. 2005) In practise it means that port and other logistic capacity is to be expanded. The ports of Primorsk and Ust-Luga have been the biggest port investments, but other Russian ports in the Gulf of Finland are expanding their capacity as well. Investments concentrate especially on oil export capacity and on container handling capacity (e.g. Portnews 7.7.2008; Transport Russia 2008). At the moment the economic decline is slowing down planned investments, for example in the port of Ust-Luga.

The maritime transportation in Estonian ports is characterised by a large amount of Russian transit traffic. The future of the Russian transit traffic in Estonia looks nevertheless uncertain because of economic and political reasons. The transit cargoes already declined in Estonia in 2007, mainly due to the dispute over the removal of a statue related to the Second World War in Tallinn. (Hilmola et al. 2007) It remains to be seen how transit traffic will develop and if Estonia is able to find replacing cargoes if the Russian transit traffic will come to an end in the Estonian ports. Otherwise, no major changes in e.g. Estonia's own production structure are expected to happen, which would radically change the maritime transportation patterns in future. In Estonia's own import and export, the main commodity groups are minerals, raw wood and consumer goods.

Worldwide container transport markets have been growing strongly and more and more cargoes are transported in containers. Also in the Baltic Sea area, the growth in container transports is expected. In 2007 3.1 M TEU container goods were transported in the Gulf of Finland. The largest container ports were St. Petersburg (1.7 M TEU), Kotka (0.7 M TEU) and Helsinki (0.4 M TEU). Container traffic in the Baltic Sea area is forecasted to become threefold or even quadruple until 2020 (Lloyd's Register Fairplay 2007,

Venäläinen 2008). Russia dominates the growth: in 2000-2005 more than 40 % of total growth of container traffic in the Baltic Sea was related to Russia. Container trade in Russia has grown by an average of 25-30 % per year. (Lloyd's Register Fairplay 2007)

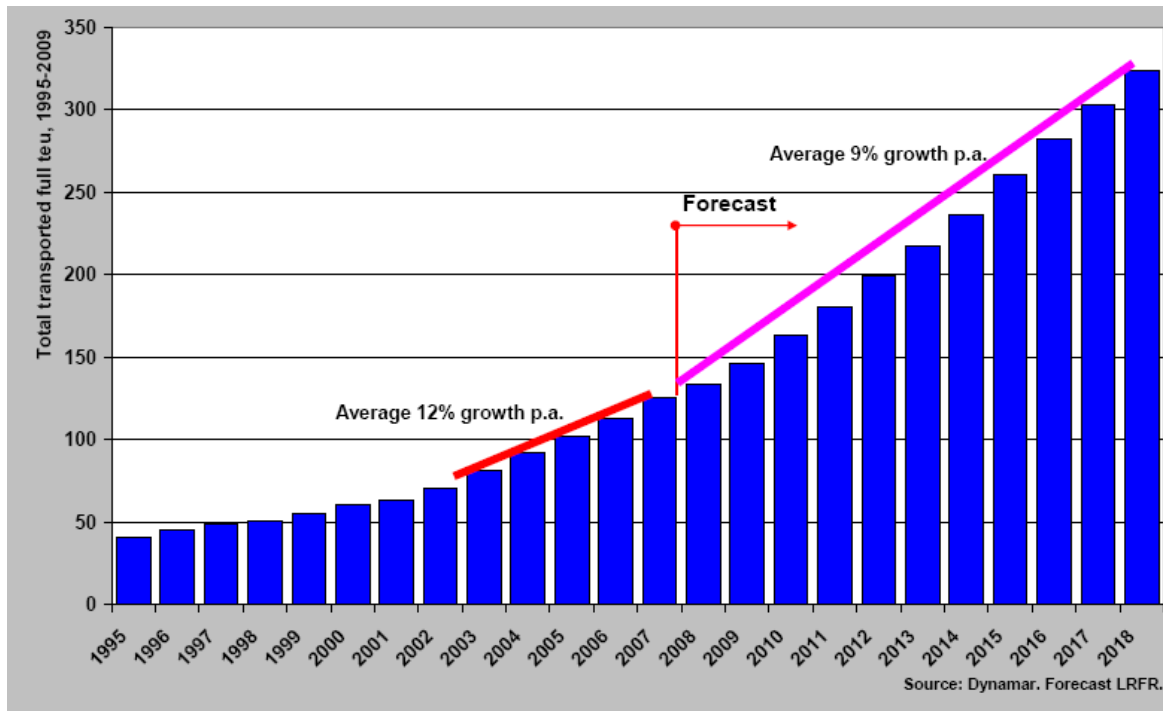


Figure 7. The development of global containerised trade (Pålsson and Bengtsson 2008)

It is questionable if there is going to be enough terminal capacity to handle the container volumes in the Gulf of Finland. Although private companies would be willing to invest in the new capacity it can be that environmental requirements or other reasons (such as port legislation or other governmental actions) are blocking the investments. One central question in container traffic is the balance between import and export transportations. Often in the ports cargo in containers is transported only to one direction and empty containers have to be transhipped from one port to another. St. Petersburg is an example of such port, and empty containers are often carried to Hamina and Kotka where containers are loaded before a ship heads back to the hub port. (Lloyd's Register Fairplay 2007) Finnish export industries have also benefitted from import containers in transit traffic to Russia because the same containers have been used in Finnish export transports. (Posti et al. 2009)

### 3.3 Development of economy in the Gulf of Finland

Due to the decline of global economy all three countries surrounding the Gulf of Finland are also witnessing decline at the moment. When demand for export products decreases, unemployment figures raise and domestic consumption slows down. Forecasts for economic growth are continuously decreased. Bank of Finland forecasts the amount of GDP to be reduced by 0.5 % in Finland in 2009 (Bank of Finland 2008). For Russia International Monetary Fund forecasts the development of GDP -0.7 % in 2009 (IMF 2009a), and for Estonia the development of GDP +0.5 % in 2009 (IMF 2009b).

From the national point of view the major challenges in Finland in the long-run are e.g. ageing of population and a high cost level. The economic growth is forecasted to slow down permanently. Russia has witnessed strong economic growth in past years. Now the production is slowing down in the key sectors, the production capacity of the industry is expiring, there are bottlenecks in the transportation infrastructure, and institutional and structural reforms are slowly progressing. There is also a lack of skilled workers in Russia. In the long-run, the biggest threat to the Russian economy is the dependence on prices of raw materials. A stable growth would require versatility in the production structure. (Spiridovitch 2008) In Estonia, the regression of economic growth has been a consequence of high inflation and rapidly decreased domestic demand (Ministry of Economic Affairs and Communications and Ministry of Finance 2008).

#### **4 THE GULF OF FINLAND IN 2015: THREE ALTERNATIVE SCENARIOS**

In this study, the scenarios were created based on the previous maritime transportation scenarios. By using different scenarios from various sources, three alternative distributions for maritime transportation in the Gulf of Finland in year 2015 were formulated. Main sources for the scenarios were: “Baltic Maritime Outlook 2006” (The Institute of Shipping Analysis et al. 2006), “Scenario on seaborne traffic between Finland and other countries up to 2030” (Lehto et al. 2006), maritime transportation visions and forecasts for Russian ports (e.g. Ministry of Transportation of Russian Federation 2008), “Oil transit in Estonia and in Finland” (Hilmola et al. 2007), and forecast of Finland’s environmental administration and VTT Technical Research Centre of Finland (Finland’s environmental administration 2008b). The chosen scenarios and forecasts are all based on the assumption that the amount of transportation follows the development of the economy. They also have similar ideas about factors and trends affecting the amount transportation in future as it was presented in the previous chapter.

Three scenarios built in this project were called “the slow growth scenario”, “the average growth scenario” and “the strong growth scenario”. First, the underlying assumptions on the development of economy in general and per country, of oil industry and of sea transportation were written for each scenario. On the basis of these underlying assumptions the cargo tonnes were calculated for each scenario following the scenarios and forecasts mentioned in the previous paragraph. The total tonnes of these three scenarios were further divided into oil products and other cargoes, import, export and domestic traffic by country by following the figures of 2007. If necessary, some changes were introduced, e.g. the effect of the construction of Ust-Luga port. Tonnes were transformed to ship calls by calculating the relationship between the long-term development of transported tonnes and the average ship sizes in the Gulf of Finland.

The basic starting points for the three alternative scenarios were:

- the slow growth scenario: economic recession
- the average growth scenario: economy will recover quickly from current instability
- the strong growth scenario: the most optimistic views on development will realize.

According to the slow growth scenario, the total tonnes for the maritime transportation in the Gulf of Finland would be 322.4 M tonnes in 2015, which would mean a growth of 23 % compared to 2007. In the average growth scenario, the total tonnes were estimated to

be 431.6 M tonnes – a growth of 64 %, and in the strong growth scenario 507.2 M tonnes – a growth of 93%.

**Three scenarios by country for the Gulf of Finland in 2015**

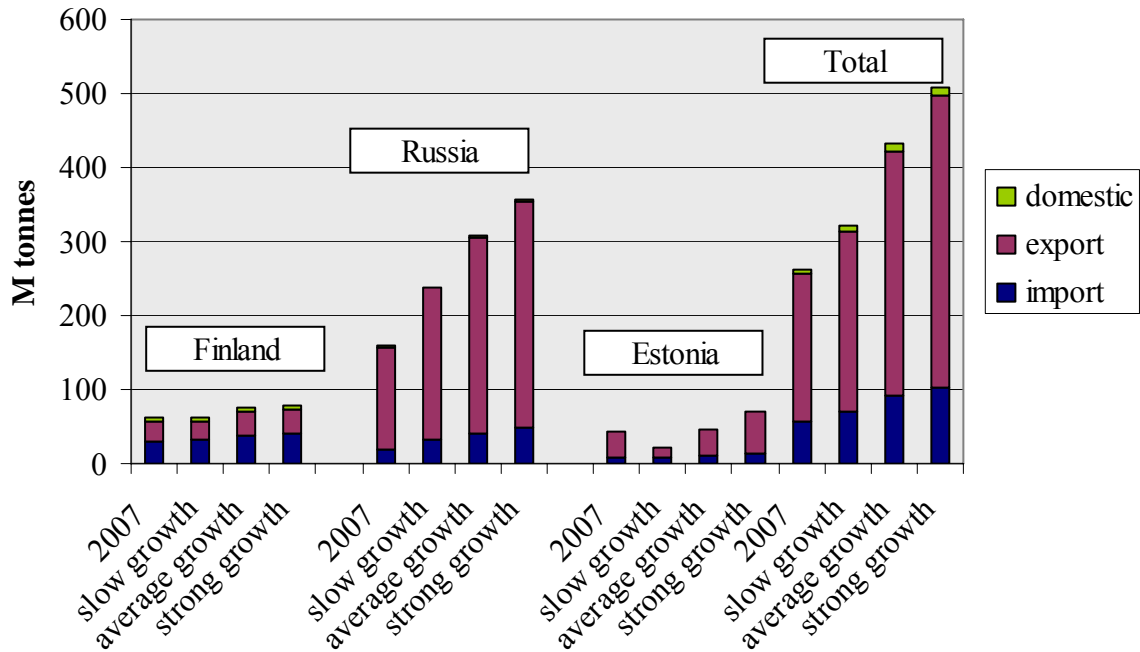


Figure 8. Three scenarios for the Gulf of Finland in 2015, divided by country to export, import and domestic traffic

However, the future development of maritime transportation in the GoF is dependent on so many societal and economic variables that it is not realistic to predict one exact point estimate value for the cargo tonnes for a certain scenario. Plenty of uncertainty is related both to the degree in which the scenario will come true as well as to the cause-effect relations between the different variables. For these reasons, probability distributions for each scenario were formulated by an expert group of Kotka Maritime Research Centre (see footnote 1 on page 4).

Uncertainty consists of two distinct components (see e.g. O’Hagan et al. 2006). Aleatory uncertainty is randomness included in almost all the processes (stochasticity – something we cannot control or know). Epistemic uncertainty, in turn, rises from imperfect knowledge of the things that, in principle, are knowable. In this case, the epistemic uncertainty is related to i.e. lack of data what comes to the events in future (we can not know something that have not happened yet).

Frequentistic statistical approach can be applied only for the aleatory questions, while epistemic ones typically are unrepeatable, creating a need for some other way to define our uncertainty concerning them. The answer is to use personal probability that is someone’s “degree of belief”, which applies to both types of uncertainty. The purpose of expert elicitation is to construct a distribution that properly represents the expert’s knowledge and related uncertainty. Personal probability is always dependent on the

knowledge that person have, thus being different from other experts' probabilities (O'Hagan et al. 2006).

The selection of the experts should thus be considered carefully. In addition, well planned elicitation process is necessity to assist the expert in rational and thoughtful evaluation of her / his knowledge and experience thus ensuring that they are answering the actual questions we wanted. In this study, the expert group of three persons consisted of front row researchers of the topic in Finland. We provided group the ready sketched expectation values and rationale behind them. First, the group evaluated these draft values – this time somewhat agreeing with them. After that, they discussed their views concerning the factors that would likely have impact on the realization of these future expectation values. On the grounds of conversation, standard deviations were constructed with the help of facilitator. In the end we asked the group to evaluate their relative believes (on scale 0 – 1, summing to 1) in the realization of each future scenario.

On the basis of the point estimates or expectation values for the three scenarios the experts defined their subjective degrees of belief on these values by together evaluating realistic ranges for the values to illustrate the uncertainty they saw to be dealt with. These ranges for the tonne values are as follows:

- the slow growth scenario: 280.8 – 363 M tonnes (expectation value 322.4 M tonnes)
- the average growth scenario: 404.1 – 465.1 M tonnes (expectation value 431.6 M tonnes)
- the strong growth scenario: 445.4 – 575.4 M tonnes (expectation value 507.2 M tonnes)

In overall, the expert group estimated the distributions to be wider in the case of Russia because the transported tonnes in Russia are to a large extent greater than in Finland and Estonia. With Russia, the range varies between 10 and 25 M tonnes while the range varies only between 0.1-9 M tonnes in Finland and in Estonia.

The amount of oil transports in Finland in all the scenarios was thought to have quite a narrow distribution because the demand for oil in Finland is expected to be relatively stable. Russia had wider distribution in all the scenarios, especially in the strong growth scenario where the expectation value was thought to be the most uncertain. The oil transports in Estonia were seen to have more uncertainty because of the instability of the development of the Russian transit transports in Estonia. If Estonia maintains its position as a transit country for the Russian oil products exports, the amount of the transit oil transports will have more growth potential. The other cargoes were seen to have a relatively even distribution in all the three scenarios. In the slow growth scenario, Finland was thought to have more uncertainty below the expectation value, which means that the economic recession can hit harder to Finland than to Russia and Estonia, which have had stronger growth and still have more growth potential in their national economies.

The spread and skewness of the distributions were largely conditional to the scenario and to the group of products. The more confident are the experts, the narrower and more peaked are the distributions. In the case of larger amount of uncertainty the distribution becomes skewed, having a longer tail on the side. The figure below shows that the expert group estimated that the average growth scenario has the narrowest distribution in terms

of the distribution of transported tonnes, the strong growth scenario had the widest range and the slow growth scenario was in between these two.

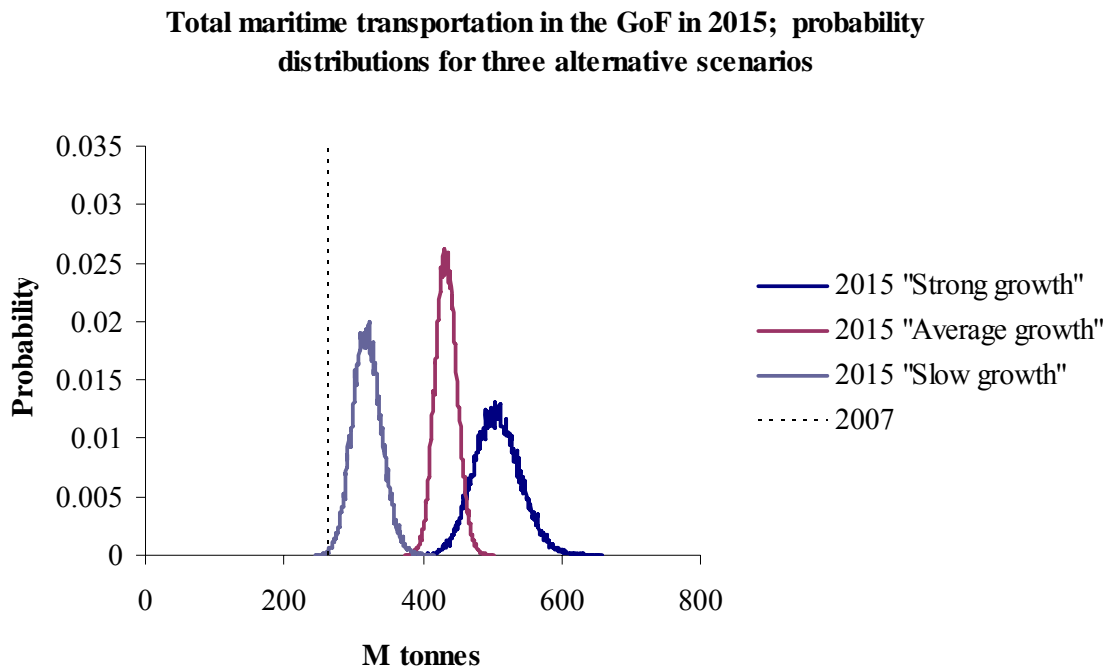


Figure 9. Probability distribution for three alternative scenarios on maritime transportation in the Gulf of Finland in 2015

In the table below (Table 2.) the tonnes have been transformed into ship calls in the ports of the Gulf of Finland. *Ship calls* is the number of ships arriving at a port per year. Number of ship calls has been calculated as follows:

- tanker calls: the slow growth scenario – average ship size is assumed to stay the same as in 2007 (relationship between number of ship calls and transported tonnes of petroleum products); the average and the strong growth scenario - factor 1.34 has been used to calculate the number of tanker calls. The factor is based on time series statistics of Finnish Maritime Administration from years 1980-2007. The factor was calculated so that from years 1980-2007 number of ship calls and the total net tonnage of ship calls for each year were divided = the average net tonnage per ship call. After that the average growth factor (1.34) for the time series of the average net tonnage per ship call was calculated.
- other ship calls: the slow growth scenario - average ship size is assumed to stay the same as in 2007 (relationship between number of ship calls and transported tonnes of cargoes excl. petroleum); the average and the strong growth scenario – factor 1.17 has been used to calculate the number of ship calls. The factor is based on time series statistics of Finnish Maritime Administration from years 1980-2007 and it has been calculated same way as the factor for tanker calls but including other ship types. Figures contain also passenger and Ro-Ro-passenger ships.

In the slow growth scenario it was assumed that if the cargo tonnes don't grow much there is no pressure to put larger vessels into the traffic and that is why the same relationship between transported tonnes and ship calls in 2007 were used. In the average and the strong growth scenario cargo tonnes are increasing so it is profitable to put larger

vessels into the traffic. However, this doesn't mean that the maximum ship sizes in the Gulf of Finland grow – that is not possible due to the geographical limitations, when maximum depth of fairways in the Gulf of Finland is 15 metres – but the existing distribution of ship sizes changes so that the average ship sizes grow. The same factor for the average and the strong growth scenario has been used because usually no rapid changes happen in the ship stock due to the long operating life of a ship and to a slow process of building new ones, and so there is no reason to believe that there would be any major difference in this matter between the average and the strong growth scenarios.

*Table 2. Number of ship calls in the ports of the Gulf of Finland in 2007 and in 2015 according to three alternative scenarios*

	<b>tanker calls</b>	<b>other ship calls</b>	<b>total ship calls</b>	<i>growth %</i>
2007	6 269	47 327	53 596	
The slow growth scenario 2015	6 670	61 232	67 902	27
The average growth scenario 2015	6 819	68 390	75 209	40
The strong growth scenario 2015	8 083	79 493	87 576	63

In sum, it can be stated that the future development of maritime transportation in the Gulf of Finland is dominated by the development of Russia. Maritime transportation in Finland is expected to be more stable and, in any case, such a growth potential cannot be seen in Finland. The development of maritime transportation in Estonia is rather challenging to forecast at the moment but, on the other hand, the transported tonnes in the Estonian ports are relatively small. The shares of export and import of the maritime transportation are not expected to change radically in the reference period.

Oil will dominate the transports also in the future and the share of oil products will probably increase compared to the share of crude oil. In regard to the other cargoes, the transports of raw materials and bulk goods will probably be replaced to some extent by cargoes of high-value, which adds especially to the container transports. But in overall, substantial changes are not expected in the commodity groups transported by sea.

The growth potential of the ports concentrates on the Russian ports, especially Primorsk and Ust-Luga, if investments will come true as planned. It is likely that the larger ports do better in the competition than the small ones due to the economies of scale and to the concentration of cargo flows.

In the near future, the development of the maritime transportation in the Gulf of Finland is mainly dependent on the current economic decline. If it will lead to a longer lasting recession, the growth of the transported tonnes will slow down and the situation in 2015 is most likely to be close to the slow growth scenario. But if the instability does not last long, it can be expected that the economic growth will continue and along with it also the growth of transported tonnes. Much is dependent on the prices of oil - if oil prices are going to be high and, it will bring a strong economic growth to Russia, which in turn adds to the other transports in the Gulf of Finland as well.

## 5 CONCLUSIONS

In this study, by combining statistics from multiple sources, it was found out that in 2007 263 M tonnes of cargoes were transported by sea in the Gulf of Finland with approximately 53 600 ship calls to the ports in the area. Share of oil transports was 56 %. The largest ports were Primorsk, St. Petersburg, Tallinn, Sköldvik, Vysotsk and Helsinki.

The amount of transportation follows the development of economy. The relationship between the development of transportation and economy is usually analyzed in terms of the development of GDP and trade. In this study also the structure of maritime transportation in 2007 in the GoF, development of key industries, and development of maritime transportation related trends were studied when formulating future scenarios.

Three alternative scenarios for the year 2015 were formulated with the probability distributions. Scenarios were based on the previous transportation scenarios. The slow growth scenario presented the situation of hard economic recession (+ 23 % compared to the year 2007), the average growth scenario presented the situation of quick recovery of economy (+ 64 %), and the strong growth scenario (+ 93 %) the most optimistic views on the future development. Total tonnes of the three scenarios were divided further by country to import, export and domestic traffic and to oil transports and to other cargoes. Also the number of ship calls (tankers/other ships) was calculated for each scenario.

It can be stated that the development of maritime transportation in the Gulf of Finland is dominated by the development of Russia. Oil products will dominate the transports also in future. In regard to the other cargoes, the transports of raw materials and bulk goods will probably be replaced to some extent by cargoes of high-value, which adds especially to the container transports. But in overall, substantial changes are not expected in the commodity groups transported by sea.

In the near future, the development of the maritime transportation in the Gulf of Finland is mainly dependent on the current economic decline. If it will lead to a longer lasting recession, the growth of the transported tonnes will slow down and the situation in 2015 is most likely to be close to the slow growth scenario. But if the decline does not last long, it can be expected that the economic growth will continue and along with it also the growth of transported tonnes.

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## REFERENCES

- Bank of Finland (2008) Euro & Talous 4/2008, Bank of Finland, viewed 11 February 2009,  
<[http://www.suomenpankki.fi/NR/rdonlyres/F21FCC1C-E078-4E71-9738-09FAABC26269/0/et\\_4\\_2008.pdf](http://www.suomenpankki.fi/NR/rdonlyres/F21FCC1C-E078-4E71-9738-09FAABC26269/0/et_4_2008.pdf)>
- BOFIT (2009), BOFIT Russia Statistics, The Bank of Finland Institute for Economies in Transition Suomen, viewed 23 January 2009,  
<<http://www.suomenpankki.fi/bofit/seuranta/venajatilastot/>>
- Customs Russia (2009), Экспорт-импорт России важнейших товаров за 2008 год [Export and import of major products in Russia in 2008], Customs Russia - Statistics, viewed 9 February 2009,  
<<http://www.customs.ru/ru/stats/ekspress/detail.php?id286=5449&i286=1>>
- Finland's environmental administration (2008a) Öljykuljetustietoja [Oil transport information], e-mail from Meri Hietala, Finland's environmental administration, to Jenni Kuronen, Centre for Maritime Studies, 2.10.2008.
- Finland's environmental administration (2008b) Neljännes Venäjän öljyntuotannosta kuljetetaan Suomenlahden kautta [Quarter of Russian oil production is transported through the Gulf of Finland], Finland's environmental administration, viewed 10 February 2009,  
<http://www.ymparisto.fi/default.asp?contentid=303401&lan=fi>
- Finnish Maritime Administration (2009) Monthly statistics on shipping between Finland and other countries – December 2008, Finnish Maritime Administration, viewed 13 February 2009,  
<[http://veps.fma.fi/portal/page/portal/fma\\_fi/tietopalvelut/tilastot/tilastotaulukot/ulkomaan\\_meriliikenne/kktilasto/mlt\\_kk\\_0812.pdf](http://veps.fma.fi/portal/page/portal/fma_fi/tietopalvelut/tilastot/tilastotaulukot/ulkomaan_meriliikenne/kktilasto/mlt_kk_0812.pdf)>
- Hilmola, O-P., Hunt, T., Jõgisoo, M., Lorenz, H., Murulauk, A., Ruutikainen, P., Savolainen, V-V., Szekely, B., Terk. E., Xu, D. (2007) *Oil transit in Estonia and Finland – Current status, future demand, and implications on infrastructure investments in transportation chain*, 1<sup>st</sup> edition, Estonian Maritime Academy, Tallinn, Estonia.
- IMF (2009a) Russian Federation and the IMF, International Monetary Fund, viewed 11 February,  
<<http://www.imf.org/external/country/RUS/index.htm>>
- IMF (2009b) Republic of Estonia and the IMF, International Monetary Fund, viewed 11 February,  
<<http://www.imf.org/external/country/EST/index.htm>>
- The Institute of Shipping Analysis, BMT Transport Solutions GmbH, Centre for Maritime Studies (2006) *Baltic Maritime Outlook 2006 – Goods flows and maritime infrastructure in the Baltic Sea Region*, 1<sup>st</sup> edition, Risbergs Information och Media AB, Uddevalla, Sweden.

Kuronen, J., Helminen, R., Lehikoinen, A. and Tapaninen, U. (2008) *Maritime transportation in the Gulf of Finland in 2007 and in 2015*, 1<sup>st</sup> edition, Centre for Maritime Studies, Turku, Finland.

Lautso, K., Venäläinen, P., Lehto, H., Hietala, K., Jaakkola, E., Miettinen, M., Segercrantz, W. (2005) Current status and development outlook for transport connections between the EU and Russia [abstract in English], Ministry of Transport and Communications Finland, viewed 9 February 2009, <<http://www.lvm.fi/web/fi/julkaisu/view/12791>>

Lehto, H., Venäläinen, P., Hietala, K. (2006) Growth outlook of seaborne transport between Finland and foreign countries up to 2030 [abstract in English], Finnish Maritime Administration, viewed 10 February 2009, <[http://veps.fma.fi/portal/page/portal/fma\\_fi/tietopalvelut/julkaisut/julkaisusarjat/2006/ML\\_ennuste\\_2030.pdf](http://veps.fma.fi/portal/page/portal/fma_fi/tietopalvelut/julkaisut/julkaisusarjat/2006/ML_ennuste_2030.pdf)>

Lloyd's Register Fairplay (2007) North Sea Baltic Hub – Market analysis, scenario and port action points, viewed 11 February 2009, <<http://www.westsweden.se/fileadmin/mediabank/www.westsweden.se/resources/Rapporter/North%20Sea%20Baltic%20Hub.pdf>>

Mannermaa, M. (1999) *Tulevaisuuden hallinta – Skenaariot strategiatyöskentelyssä* [Control of future – scenarios in strategy working], 1st edition, WSOY, Porvoo, Finland.

Ministry of Economic Affairs and Communications and Ministry of Finance (2008) Economic survey of Estonia 2007, Ministry of Economic Affairs and Communications, viewed 11 February 2009 <[http://www.mkm.ee/failid/2Economic\\_Survey\\_of\\_Estonia\\_2007.pdf](http://www.mkm.ee/failid/2Economic_Survey_of_Estonia_2007.pdf)>

Ministry of Transportation of Russian Federation (2008) Транспортная стратегия Российской Федерации на период до 2030 года [Transportation Strategy of Russian Federation until 2030], Ministry of Transportation of Russian Federation, viewed 10 February, <[http://www.mintrans.ru/prensa/TransStrateg\\_VV.htm](http://www.mintrans.ru/prensa/TransStrateg_VV.htm)>

O'Hagan, A., Buck, C.E., Daneshkhah, A., Eiser, J.R., Garthwaite, P.H., Jenkinson, D.J., Oakley, J.E., Rakow, T. (2006) Uncertain judgements: eliciting experts' probabilities. 1<sup>st</sup> edition, John Wiley & Sons, London, UK.

Portnews (7.7.2008), Портовая независимость [Autarchy of the ports], Portnews news service, viewed 13 February 2009, <http://portnews.ru/digest/3772/?print=1>

Posti, A., Ruutikainen, P., Haapakangas E-L., Tapaninen, U. (2009) TRALIA – Transitoliikenteen lisäarvopalvelut [TRALIA – Value-added services of transit traffic in Finland], Centre for Maritime Studies, viewed 6 May 2009. [http://www.merikotka.fi/tiedotteet/TRALIA\\_Transitoliikenteen\\_lisaarvopalvelut.pdf](http://www.merikotka.fi/tiedotteet/TRALIA_Transitoliikenteen_lisaarvopalvelut.pdf)

Pålsson, C. and Bengtsson, N. (2008) OPTIMAR – Benchmarking strategic options for European shipping and for the European maritime transport system in the horizon 2008-2018 - Final Report, European Commission, viewed 12 February 2009, <[http://ec.europa.eu/transport/maritime/studies/maritime\\_en.htm](http://ec.europa.eu/transport/maritime/studies/maritime_en.htm)>

Ruutikainen, P. and Tapaninen, U. (2007) Elintarvikkeiden vienti, autojen ja arvotavaroiden transito Venäjälle – nykytila ja tulevaisuus [Export of food products, transit of cars and high-value goods to Russia – current state and the future], Centre for Maritime Studies, viewed 13 February 2009, <<http://mkk.utu.fi/dok/pub/07-venajatransito.pdf>>

Sala, E., Viren, R., Puntanen, S. (2008) Future operating environment in the transport sector [abstract in English], Ministry of Transport and Communications Finland, viewed 10 February 2009, <[http://www.lvm.fi/c/document\\_library/get\\_file?folderId=57092&name=DLFE-4074.pdf&title=Tulevaisuuden%20toimintaymp%C3%A4rist%C3%B6%20liikennesektorilla%20\(LVM45/2008\)>](http://www.lvm.fi/c/document_library/get_file?folderId=57092&name=DLFE-4074.pdf&title=Tulevaisuuden%20toimintaymp%C3%A4rist%C3%B6%20liikennesektorilla%20(LVM45/2008)>)

Saurama, A. (2007) Itämeren meriliikenne ja kehitysnäkymät [Maritime traffic in the Baltic Sea and future sights], The Baltic Sea Portal, viewed 12 February 2009, <[www.fimr.fi/fi/ajankohtaista/seminaarit/fi\\_FI/ihmisen-tarpeisiin/\\_files/12076504320035484/default/merenkulku.ppt](http://www.fimr.fi/fi/ajankohtaista/seminaarit/fi_FI/ihmisen-tarpeisiin/_files/12076504320035484/default/merenkulku.ppt)>

Shiftan, Y., Kaplan, S., Hakkert, S. (2003), Scenario building as a tool for planning a sustainable transportation system, *Transportation Research Part D* 8 (2003): 323-342.

Spiridovitsh S. (2008) Maaraportti Venäjä syyskuu 2008 [Country report Russia September 2008], Finpro, viewed 11 February 2009, <<http://www.finpro.fi/NR/rdoonlyres/7472069F-27E0-4044-BB0C-32631EDDE64D/11686/FinproRussiacountryreport090117sspfl.pdf>>

Spiridovitsh, S. (2009) Maaraportti Venäjä tammikuu 2009 [Country report Russia January 2009], Finpro, viewed 23 January 2009, <<http://www.finpro.fi/NR/rdoonlyres/7472069F-27E0-4044-BB0C-32631EDDE64D/11686/FinproRussiacountryreport090117sspfl.pdf>>

Stead, D. and Banister D. (2003), Transport policy scenario-building, *Transportation planning and technology* 26 (6): 513-536.

Sørensen, S. Y., Moltesen, J., Haahr, J. H. (2008) Trends and drivers of change in the EU transport and logistics sector: scenarios, European Foundation for the Improvement of Living and Working Conditions, viewed 9 February 2009, <<http://www.eurofound.europa.eu/pubdocs/2008/40/en/1/ef0840en.pdf>>

Transport Russia (2008) Контейнерный бум нам не грозит? [We are not threatened by the container boom?], Transport Russia News service, viewed 14 November 2008, <<http://www.transportrussia.ru/2007-09-20/econom/bum.html>>

Ubbels, B., Rodenburg, C., Nijkamp, P. (2003), A multi-layer scenario analysis for sustainable international transport, *Transportation planning and technology* 26 (1): 69-103.

UNCTAD (2007) Review of Maritime Transport 2007, United Nations Conference on Trade and Development, viewed on 9 February, <[http://www.unctad.org/en/docs/rmt2007\\_en.pdf](http://www.unctad.org/en/docs/rmt2007_en.pdf)>

Venäläinen, P. and Löfgren, P. (2007) Valittujen asiakassegmenttien kehitysnäkymät [Future sights of selected customer segments], Finnish Maritime Administration, viewed 9 February 2009, <[http://veps.fma.fi/portal/page/portal/fma\\_fi/tietopalvelut/julkaisut/julkaisusarjat/2007/MKL\\_Asiakassegmentti\\_Loppuraportti.pdf](http://veps.fma.fi/portal/page/portal/fma_fi/tietopalvelut/julkaisut/julkaisusarjat/2007/MKL_Asiakassegmentti_Loppuraportti.pdf)>

Venäläinen, P. (2008) Seaborne container transports in Finland [abstract in English], Finnish Maritime Administration, viewed 11 February 2009, <[http://veps.fma.fi/portal/page/portal/fma\\_fi/tietopalvelut/julkaisut/julkaisusarjat/2008/Suomen\\_konttikuljetukset.pdf](http://veps.fma.fi/portal/page/portal/fma_fi/tietopalvelut/julkaisut/julkaisusarjat/2008/Suomen_konttikuljetukset.pdf)>