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CONTAINER TRANSIT IN FINLAND AND ESTONIA

– CURRENT STATUS, FUTURE DEMAND AND IMPLICATIONS ON INFRASTRUCTURE INVESTMENTS IN TRANSPORTATION CHAIN

Olli-Pekka Hilmola, Ulla Tapaninen,
Erik Terk & Ville-Veikko Savolainen (eds.)

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Turku 2007

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Foreword

The Russian economy has grown steadily since the economic crisis of 1998; from year 1999 onwards GDP has grown over 6% per year. There are no reasons to believe that this growth will slow down. Today Finnish and Estonian ports handle a major share of the Russian transit traffic. While Finnish ports have mainly concentrated on container import to Russia, Estonian ports take a major share of the oil export from Russia. This business has a big effect for both countries' infrastructure, number of working places and even tax income. To be able to hold and even increase the competitiveness in this transit business, the needed infrastructure has to be studied carefully.

This report is the one of two final reports made in the project OKT-infra. The aim of OKT-infra project was to collect information of present ports, border crossing and warehousing infrastructure both in Finland and Estonia and carry out computer simulations based on estimated traffic growth. The computer simulations showed the needed capacity to sustain and increase the competitiveness of Finnish and Estonian routes for transit traffic.

It was found out that some of the inevitable continuous investments, like warehousing and border crossing capacity have been neglected during the years of Russian transit growth, and based on simulation study best capacity situation exist in the harbors (lifting). Even though Russia is building its own container ports, there will be millions of TEU for ports in Finland and Estonia as well.

This project was funded by European Union and several private partners (City of Kouvola, Port of Kotka, Cursor Oy). It was completed by a group of researchers from Kouvola Unit of Lappeenranta University of Technology, University of Turku, Kotka Unit and Estonian Maritime Academy.

Centre for Maritime studies in University of Turku expresses its gratitude to all the researchers and other parties who have contributed in collection of data, analyzing it and writing the results.

Turku 4th December, 2007

Juhani Vainio
Director
Centre for Maritime Studies

Abstract

Since 1999 Russian GDP has grown steadily over 6% per year and no signs of slowing down have occured. Economic growth can be seen in increase of wages and consumption. This will in turn increase both the import and export of goods and raw materials. Today Finnish and Estonian ports handle a major share of the Russian transit traffic. While Finnish ports have mainly concentrated on container import to Russia, Estonian ports take a major share of the oil export from Russia.

The increase in the Russian consumer demand is so strong, however, that the country's own ports will not be able to deal with the increasing imports. Finland will maintain its position in Russian transit transports. The relative share may decrease, but the absolute one will grow. Also Estonia would like to have its share of the container transit traffic, in addition to its oil transit flows.

The goods transported in containers via Finland to Russia arrive mainly from Far Eastern ports mostly to the ports of Kotka and Hamina. From here, the majority of goods are after intermediate storage transported by trucks to Russia, cities of Moscow and St. Petersburg. In Estonia there is currently available for container transports only one terminal: Muuga Container Terminal in port of Tallinn.

In Finland the most important border crossing point is Vaalimaa, which has been suffering increasingly from traffic congestion, and this causes long queues outside of the actual border crossing area. In the worst cases the length of this queue has been over 50 kilometers.

In Estonia, the most important road border crossing point, through which the major proportion of transit freight passes in containers to Russia, is Narva (although not so concentrated as in Finnish Vaalimaa situation), and it is located in the North-East side of Estonia (two other options also exist in the South-East towns of Koidula and Luhamaa). In this research we concentrated on Narva border crossing point from Estonian side.

System dynamics simulation models were built to describe the possible future need of infrastructure, which transit transports is using (harbour lifting, warehousing and border crossing capacity). The results show that considerable capacity investments are needed in Vaalimaa and Narva border crossing stations, as well as in warehousing of transit containers in Estonia (also with some time delay in Finland). On the other hand, basically no new capacity (or very limited amounts) is needed for container lifting in Finnish or Estonian ports.

Inevitably container transit transports to Russia will grow also in the future, and enlargement investments should be completed proactively in Estonia, as well as in Finland, instead of following demand increase with several years of time lag. Even though Russia is building its own container ports, in the forthcoming decade there will be millions of containers free for competition to be transported through alternative ports located in Estonia and Finland.

Keywords: Containers, Transit Transports, Investments, Infrastructure, Finland, Estonia

Tiivistelmä

Venäjän bruttokansantuote on kasvanut yli 6 prosentin vuosivauhtia vuodesta 1999 lähtien ja mitään merkkejä talouskasvun hidastumisesta ei ole näköpiirissä. Talouskasvu näkyy myös palkkojen ja kulutuksen nousuna. Nämä taas lisäävät kulutustavaroiden tuontia ja raaka-aineiden vientiä. Tällä hetkellä suurin osa Venäjän transitosta kulkee Suomen ja Viron satamien kautta. Suomalaiset satamat ovat pääasiassa keskittyneet konttien kauttakulkuun Venäjälle ja Viron satamien kautta kulkee vieläkin merkittävä osa Venäjän viemästä öljystä.

Venäjän kuluttajamarkkinoiden kysyntä on kuitenkin niin vahvaa, etteivät sen omat satamat kykene hoitamaan yhä kasvavia tuontitavaravirtoja. Suomi tulee säilyttämään asemansa Venäjän transitoliikenteen suhteen. Suhteellinen osuus voi laskea, mutta kuljetusmäärät tulevat kasvamaan. Myös Viro haluaisi entistä suuremman osan konttitransitosta, nykyisen öljytransitonsa rinnalle.

Suomen kautta Venäjälle konteissa kuljetettavat tavarat saapuvat pääasiassa Kaukoidän satamista, Kotkaan ja Haminaan. Tästä eteenpäin suurin osa tavarasta kuljetetaan välivarastoinnin jälkeen rekoilla määränpäähänsä Venäjälle, Moskovaan tai Pietariin. Virossa on tällä hetkellä ainoastaan yksi varsinainen konttiterminaali: Muuga Container Terminal Tallinnan satamassa.

Suomessa tärkein rajanylityspaikka on Vaalimaa, joka on kärsinyt lisääntyvässä määrin liikenteen ruuhkautumisesta, aiheuttaen pitkiä jonoja varsinaisen rajanylitysalueen ulkopuolelle. Pahimmissa tapauksissa jonot ovat olleet yli 50 kilometrin pituisia.

Virossa tärkeimmät rajanylityspaikat teitse ovat Narva (sijaitsee Viron koillisosassa), jonka läpi suurin osa konteista kulkee (joskaan ei niin keskitetysti kuin Suomen Vaalimaan tapauksessa), sekä Koidula ja Luhamaa maan kaakkoisosassa. Tässä tutkimuksessa keskityimme tutkimaan Viron osalta Narvan rajanylitysaseman tilannetta.

Systeemidynaamisen simuloinnin avulla arvioitiin transitovirtojen käyttämän infrastruktuurin riittävyyttä seuraavan vuosikymmenen aikana (satamien nosto-, yleinen varastointi ja rajanylityskapasiteetti). Tulokset osoittavat, että merkittäviä investointeja tarvitaan raja-asemilla Vaalimaalla ja Narvassa, sekä Viron osalta myös transitokonttien varastointiin (muutaman vuoden aikaviiveellä myös Suomessa). Mielenkiintoinen tulos tutkimuksessa oli se, että satamien nostokapasiteetti todettiin riittäväksi myös tulevaisuudessa; joskin pienin varauksin.

Konteissa transitona kuljetetun tavaran määrä tulee väistämättä kasvamaan myös tulevaisuudessa. Investoinnit infrastruktuuriin Suomessa sekä Virossa tulisikin tehdä ennakoiden etukäteen, eikä kuten aikaisemmin, jolloin kysyntää on seurattu muutaman vuoden aikaviiveellä. Vaikka Venäjä kasvattaa omia konttisatamiaan, tulee seuraavan vuosikymmenen aikana olemaan miljoonia kontteja kilpailtavaksi Viron ja Suomen satamille.

Avainsanat: kontit, transito, investoinnit, infrastruktuuri, Suomi, Viro

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1 INTRODUCTION

Container revolution started from transports between east-coast of US and main West-European harbours. However, as Asian economies started to take-off in terms of manufacturing, weight of container market shifted into route of Asia-US and Asia-Europe (e.g. Nazery 2005, United Nations 2005a & 2005b, Knowles 2006). Now, as one of the last resorts of container market, also Baltic Sea and especially its Bay of Finland ports have experienced from significant increase of container transports. Also other transportation modes, like road transports and railways in this region have started to get used of this intermodality favouring transportation mode (e.g. US has already used intermodal solutions in larger scale for more than two decades, especially in port-railway connections, e.g. Vassallo 2005). In terms of distribution advancement and adoption of containerized cargo, Central and Eastern European Countries (CEEC) could be described as following decade or so behind of logistical solutions applied in “the west”. For example, such concepts as “key account distribution channels”, demand visibility in a supply chain, and level of containerization are still in the starting ground in CEEC (e.g. in Lorentz & Hilmola 2007, Babakin 2007). Also retail market, e.g. in Russia, could be characterized as lacking significant international retailing presence, where local chains dominate the market (Lorentz et al. 2006; Lorentz & Hilmola 2008). Therefore, research is needed to be completed from the enabling factors for these advanced logistics concepts, which are often related into logistics infrastructure investments. This study draws picture on this topic concerning Finland and Estonia, and especially into high growth containerized cargo going through these regions, and ending into east, like Russia. Mostly we are interested in this research work on the rough capacity of transportation chain in these two markets with respect of container transports. A priori we know that e.g. in case of Baltic States transportation growth has been having factor of four (Kovacs & Spens 2006) as compared to GDP growth, which is well above world average of 2.5 (United Nations 2005b).

However, it should be noted that container market in Europe is significantly concentrated only on several hubs, like Rotterdam, Hamburg and Antwerp: Based on European Union (2006) statistics ten largest container ports take from total volume of 40 largest container ports up to 70 %. Although, St. Petersburg harbour is nowadays handling more than 1.5 million TEU per year (similar amount with all of the harbours in Finland operating in container market), Baltic Sea harbours (especially harbours in the Bay of Finland) will remain as feeding spokes in the European container transportation system, and therefore more emphasis should be given on how these harbours are connected into overall transportation chain, and what is the capacity of nearby critical points.

1.1 Background

The Russian economy has grown steadily since economic crisis in 1998 (e.g. dealt within Chiodo & Owyang 2002). The Russian economy has grown steadily since economic crisis in 1998. Since 1999 Russian GDP has grown steadily over 6% per

year. There are no reasons to believe that this growth will slow down. Economic growth can be seen in increase of wages and consumption. This will in turn increase both the import and export of goods and raw materials. Figure 1 shows this development during 2000-2006 and it can be seen that they have been growth rates have been rather similar. Still exports are dominating Russian trade; e.g. the export surplus in 2006 was 150 billion USD.

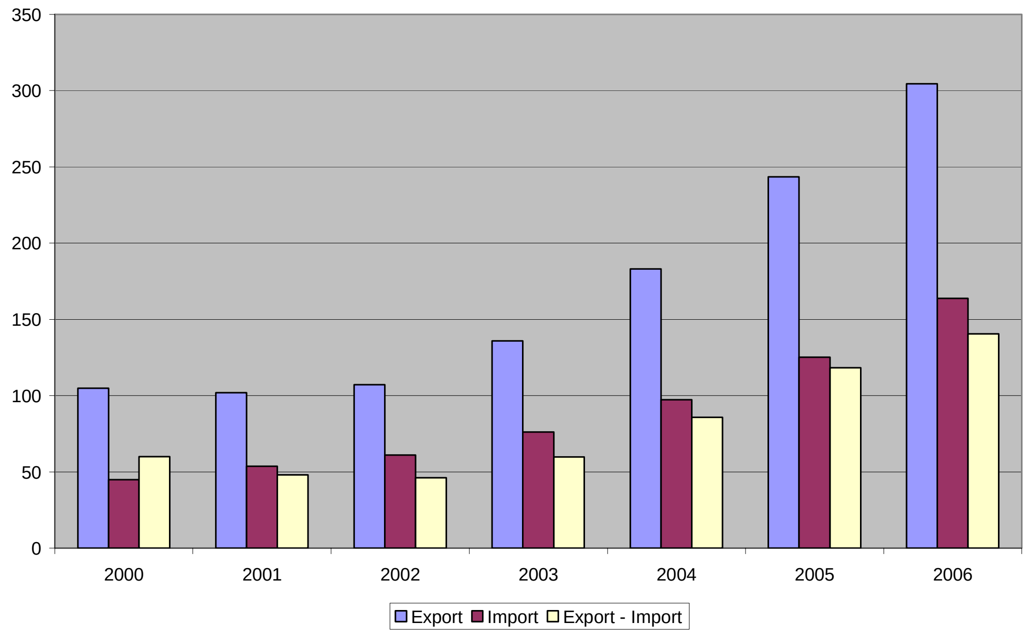

Figure 1. *The development of imports and exports in Russia (USD) 2000–2006 (Source: BOF 2007a).*

For decades Russia – and previously Soviet Union – carried out a major part of its import and export via Baltic Sea. Today Finnish and Estonian ports handle a major share of the Russian transit traffic. While Finnish ports have mainly concentrated on container import to Russia, Estonian ports take a major share of the oil export from Russia. This business has a fundamental effect for both countries' infrastructure, number of working places and even tax income. To be able to hold and even increase the competitiveness in this transit business, the needed infrastructure has to be studied carefully.

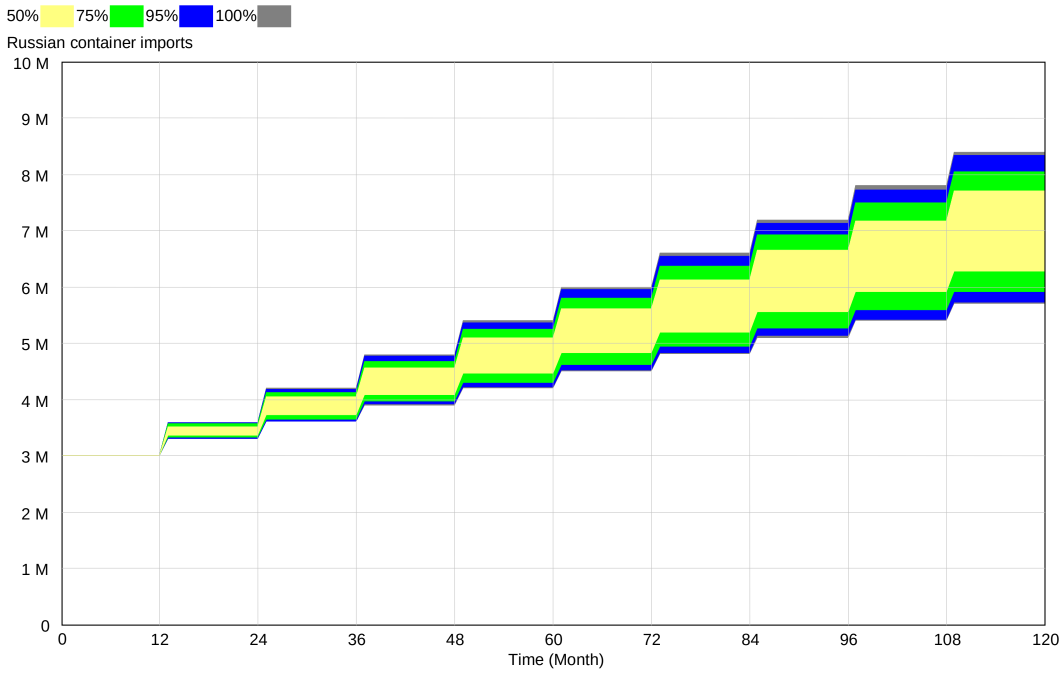

Figure 2. *Stochastic demand increase of Russian container imports in the decade perspective of this study (time period of 2007-2016).*

Throughout this report we have assumed that Russian container imports is currently reaching level of 3 million – based on literature analysis of Russian container market presented in Chapter 3, this estimate is currently most often mentioned in different macro-economic reports. As Figure 2 shows, we have included some uncertainty in the growth percentage of container import growth, which is estimated to be stochastic variable with uniform distribution variation from 10 % to 20 % (calculated from base volume, 3 million TEU). As Figure 2 shows that in ten years time (year 2016) container volume should reach the level of 6-8 million TEU, and in the next five years (year 2011) it should be around 4.5-5 million TEU.

1.2 Aims of the Project

This report is the other one of two final reports made in the project OKT-infra. The aim of OKT-infra project was to collect information of present port, border crossing and warehousing infrastructure both in Finland and Estonia and carry out computer simulations based on estimated traffic growth. The computer simulations showed the needed capacity to sustain and increase the competitiveness of Finnish and Estonian routes for transit traffic.

OKT-infra project has received its funding from Interreg IIIA –program, effective in Southern Finland and Estonia, which is funded and directed by European Union.

1.3 Methods and Project Partners

The study was carried out in three steps. First, the needed data of handling capacity of container and oil in ports, capacity of railways and border crossing stations was collected as well as estimates of increase of Russian transit volumes. The data was either available in public or it was collected by interviews. Second, simulation model was created to take into account the present situation, bottlenecks and possibly needed investments. Finally, the results were studied and this research report was written.

Project partners have been:

- Coordinating partner: Lappeenranta University of Technology, Kouvola Unit.
- Main Partners: Estonian Maritime Academy and Centre for Maritime Studies (University of Turku) in Kotka.
- Cooperating organizations: City of Kouvola, Port of Kotka, Cursor Ltd. Merikotka (Kotka Maritime Research Centre) and Estonian Association of Port Operators.

Two workgroups were established: one for the container traffic and the other for oil traffic. This report is based on the work of the container traffic group. The other report is published in Proceedings of Estonian Maritime Academy No 4, 2007.

1.4 Geographical Coverage

The geographical coverage of this project is presented in Figure 3. In Finland ports of Kotka, Hamina, Hanko and Helsinki are marked into the map. Additionally there are in Finland the border crossing station of Vaalimaa, and cities of Kouvola and Lappeenranta marked. On the Estonian side there are port of Tallinn and its harbour Muuga presented. Additionally city of Paldiski, which has two harbours, is presented. From North-Eastern part of Estonia port of Sillamäe and border crossing station of Narva are also presented. The other Estonian border crossing stations in Koidula and Luhamaa are not presented in this map as they are located more south of Estonia.

Figure 3. *Gulf of Finland (Source: Jeppesen 2007).*

1.5 Structure of the Report

In Chapter 2 we shall give an overview of literature concerning container transportation issues in global scale and in Chapter 3 we will present the findings of literature concerning container transportation issues in Russia. Chapter 4 presents present status of container transit traffic in Finnish and Estonian ports, while Chapter 5 presents the status of border crossing and Chapter 6 the status of warehousing in Finland and Estonia.

In Chapters 7 and 8 we show the simulations of container traffic and its effects on border crossing and warehousing investments. This discussion is continued in Chapter 9 where capacity estimations are lifted and new simulation run. Chapter 10 presents the sources of data collected in the project. Chapter 11 clarifies the results by discussion. The conclusions of research concerning container transit completed during the project are given in Chapter 12.

2 LITERATURE REVIEW: CONTAINER TRANSPORTATION ISSUES IN GLOBAL SCALE

Globalization is today one of the central trends in the world economy. The phenomenon makes itself visible also in transportation flows. Multinational companies are getting a dominant position and cost versus quality considerations are becoming number one factors for them in accomplishing their strategies. In relation to container transportation there are certain elements that play central role in decision making: time to market, price considerations, service quality, safety regulations and stability. (Deshpande et al. 2007; Shintaini et al. 2007; Ivanova 2007). Governments try to emphasize sustainability aspects that are often in contradiction with the objectives of multinational corporations. In order to find the optimal measures for transport infrastructure, tools offered by system approach are a viable option.

The underlying idea is to exploit the present available resources in a way (with help of advanced technologies and investment in an institutional setting) that the future generations could meet their own needs without constrains created by the present. Tao and Hung (2003) define sustainable transportation as follows: "*The achievement of continued transportation activities supported by environmental, economic and social objectives at various space-based scales of operation*." With this regard system approach is a tool to specify the interactions between economic, social and environmental factors in order to be able to show how these subsystems work together for the mutual advantage or disadvantages. To be able to do this, various scenarios are determined including static and flow variables. In describing intrinsic dynamics, usually mathematical functions are employed. In the case of transportation systems the most often used optimization model is linear programming (Tao & Hung 2003). Since there is no generally accepted set of methodologies in evaluating transportation investments, the only possibility to set out processes that are of different emphasis or value in a model of a country (Quinet & Vickermann 2004). In practice, there are many additional problems to be faced: how to analyze risk, what is the ideal balance between technical and economic aspects, the effect of delay, asymmetric information available to parties included, etc. As transport infrastructure investments have a multiple role in an economy their implications depend on the context in which they are implemented. To find the optimal solution the tools offered by the system approach are an effective set of measures striving toward sustainability.

Table 1. *Article analysis related to international container transportation.*

Author & Title	Major arguments	Other information
Shintani, Koichi, Akio Imai & Etsuko Nishimura & Stratos Papadimitriou (2007): *The container shipping network design problem with empty container repositioning*	Empty containers rise handling time in ports that in turn results in excessive fuel costs for forwarding companies. However, in practice there is no load rejection among shipping companies due to the fierce competition on the markets.	It can be claimed that so far there was no research available that would have taken into account in an integrated manner the optimal fleet composition with specified routing characteristics covering empty container repositioning.
Deshpande, Pranav J., Ali Yalcin, Jose Zayas-Castro, Luis E. Herrera (2007): *Simulating less-than-truckload terminal operations*	Via simulation based intelligent assignments resources can be reduced while increasing quality of service levels in less than truckload terminals. These techniques are still rarely used in practice in the US.	Despite the increasing need for improving supply chain response time, reliability and flexibility nowadays 75 percent of transportation firms still rely on manual procedures for decision making.
Nazery, Khalid (2005): *The impact of cargo trends on terminal developments in Asia*	As a result of growing international trade and globalization, ports in Asia will become inter-modal transport hubs focusing on transit flows. This will mean ever increasing trade offs in decision making.	China ordered lately vessels with 8100 TEU capacity. Most forecast for containerships demand envisages 8-9 percent of growth. By 2020 maritime transport is estimated to be tripled from the level of 2005.
Kwan Clarence & Kris Knutsen (2006): *Inter-modal Revolution: Investments in the Yangzi River transport corridor will make access to China's interior easier*	In China currently rail transport constitutes the main barrier for the improvement of containerization. Rail has a reputation of being slow and unreliable. Huge scale investments are needed.	Logistics costs in China represent 21 percent out of GDP that is more than double to that of the United States or Japan. Between 2001 and 2005 there was 25000 km added to the road network in China.
Tsuji, Hisako (2005): *International Container Transport on the Trans-Siberian Railway Continued to Increase in 2004*	Empty containers, the competitiveness of TCR and the chronic problem of lack of rail wagons at Vostochny Port are the biggest threat for the future of TSR. The future of TSR is under great uncertainty.	Transport time is shorter and costs are lower using TSR compared to sea voyage from Asia to Europe.
Liliopoulou, Anastasia; Michael Roe & Irma Pasukeviciute (2005) Trans Siberian Railway: from inception to transition	The main reason for the detrimental development of TSR originates in the political views between the Baltic States and Russia. The potential of TSR linking Europe and Asia has been confirmed long ago.	By the means of regular express block train services the TSR was more competitive in the 80's compared to sea transport. Each train had 52-55 wagons and able to carry up to 110 TEU.

The primary message arising from the articles gathered to Table 1 is that focus of transit transport trade flows is about to move to China and South-East Asia, and that the current state of productivity pertinent to container transport is at a low level compared to what it could be. The inherent inefficiencies are mostly due the different structures of economies of the regions in Europe, Eurasia and in America and the different scale transportation contributes to the increasing level of Gross

Domestic Product (GDP). This growth of GDP leads to even bigger increase of transport as transportation itself is both of derived nature generating positive externalities and it is also a basic input element into the production process of goods (Quinet & Vickermann et al. 2004). Lautso et al. (2005) focused on giving a general perspective on the differences of growth rates of GDP during the forthcoming decades in regions of the globe relevant to this research.

The forecast is in line with the outcome of the article analysis above: until 2010 China demonstrates by far the most dynamic rates with regard to growth in GDP reaching 7.5 percent while in the old EU countries the rise of GDP will hardly reach 2.2 percent. The outcome reveals that the speed of economic development will slow down significantly by the year of 2030, but still China will stay at the peak position during all the periods of estimation. According to the same study by Lautso et al. 2005, freight flows between these three regions will increase in the following manner: Export from the EU-25 (excluding energy products) to China and Russia will become threefold by the year of 2030. Import from these regions by 2030 will rise by 2-3 times compared to the level of 2004.

As a consequence of increased competition and profit orientation of multinational enterprises this trend will lead to unbalanced situation where investments in transport infrastructure will not serve the needs of a society. Because public authorities will contribute to the allocation of investment capital (this being desirable or not), information asymmetries between partners of transport infrastructure financing will widen. The amount of empty containers in transport might still grow and without correcting measures the sustainability objectives of governments will not be achievable.

It can be seen that the emerging social marginal costs coming from transport network investments are significant, but in a way out of control (Clarence 2006). In practice, everything is dependent on the behavior of the parties involved in the construction investment. However, the long duration of the project and the level of uncertainty involved in the decision making processes, the profitability calculations of the investments are sometimes not even sensible to be created.

The rate of fatal accidents and congestion percentage might be in certain cases better measurement tools for transport infrastructure investments. One might even claim that from certain point of view negotiation skills outweigh rational decision making procedures. Key success factors thus may correlate with the way of constructing the method of measuring success: Some governments prefer to include substantial amount of non-monetary factors over cost reduction ones whereas others may do it vice versa. Some country may set a very low level of discount rate with long project life for calculations, while others may determine high discount rate with shorter project duration. Some policy makers may see it important to evaluate the rise of value of human life as a result of these investments. In general, the core problems of measuring the outcome of transport infrastructure investments are in relation to the fact that there are no generally worldwide approved standard procedures for these issues.

It has been widely supported that maritime transportation will dominate the scene within the near future due to increasing containerization while the role of road will decrease (Khalid 2005). Since sea captures already now about 90 percent share out of international transit container transportation and still it has some decisive factors limiting its chances of further growth (Ivanova 2007; Tsuji

2005).). As a consequence the relative share of maritime transport will most probably diminish out of the estimated future growth of container transport that will reach 15 percent until 2010 (Scherbanin J., 2003). On the other hand, experts of the field agree that due to its expensiveness air transport will not be so attractive from the viewpoint of increase in volume in the future. Rail container transport has clearly a chance here to overtake some of the volumes from all sea routes. With regard to the trade between EU and China especially two lines are in the focus of attention: Trans China Railway (TCR) and Trans-Siberian Railway (TSR).

Chinese government is doing its best to attract as much volume to its own territory as it is possible. The results are already visible: Already now the volume of freight traffic going via the TCR is 1.5 times in size to that of the volumes transported through Russia (Filina 2006). Despite the fact that Russian authorities have reacted to correct the situation, the future of TSR does not look bright: The Chinese Ministry of Railways has recently signed a 5-year-contract with Burlington Northern Railway Santa Fe (BNSF) to improve the inter-modal dimension of railroads. The value of contract is several billions of USD. With the help of this project, the ministry will be able to build 18 mega rail terminals out of which 7 would be placed at seaports (Vickerman 2006).

The aim is clearly to establish efficient port railway hub centers to facilitate reliable, frequent connections between Asia and Europe. This is the most urgent problem with regard to the usability of TSR as a transit route between these two continents: Very recently Russian Railways (RZD) purchased shares in ports controlled by private owners in Russia and nearby the border of North Korea (in the city of Rajin) to be able to open the route to waterway in South-East Asia (Hilletofth et al. 2007). The main challenge in this setting is to create sufficient contractual platform, which it would be possible to minimize risk for private participants and motivate all the contributing parties to finish the construction projects as soon as possible. Another factor that affects the prospects of future growth of volumes on the TSR is the condition of infrastructure and fleet size. TSR is one step behind its competitor also in this respect: On the Trans Chinese Railroad the utilization of German technical knowledge in updating the lines is forecasted to attract over 60 percent increase in volumes in the near future between Shanghai and Paris (Filina 2006).

Nevertheless, transportation infrastructure investments bear fruit only after a long period of time. Theproductivity problems related to empty container repositioning cannot be solved in the short run. This is especially true for rail traffic where cost incurred by empty container handing might outweigh the profits obtained from cargo movements (See Shintaini 2007). One of the reasons for low productivity in the US is the inappropriate level of utilization of available technology and a great amount of manual processes (Deshpande et al. 2007). It can be argued that the same problem exists also in Russia. It can be concluded that the growth of container traffic of rail and ports in Russia and China can be laid down only by immediate governmental financial aid package within a suitable framework of public-private partnership configuration. In China the main issue seems to be the low quality image of rail being slow and unreliable (Clarence et al. 2006), and one can argue that even massive investments are of no use. The shipping industry has gained a competitive advantage that might be difficult if not

impossible to offset in the near future. The concept to build containers emerged through maritime transport and this gives an advantage to this industry (Khalid 2005). In addition it has been pointed out that the duration and variation of time spent at the nodes is significantly higher than that of the time spent between the nodes (Deshpande et al. 2007). This fact favors all water transit options to inter-modal solutions. These facts might indicate that in the case of TSR the chance for increasing the level of transit traffic would require to make Ural region mines facilities so efficient and productive that they would gain a central position as a strategic node between China and the EU. The inception of TSR started off with the utilization of Ural mines and could be a potential focus of attention in the future too (Liliopoulou 2005 et al.). The pressure is high to shorten the length of time for implementing an infrastructure suitable for modern block container trains to operate on long distances.

3 LITERATURE REVIEW: CONTAINER TRANSPORTATION ISSUES IN RUSSIA

All of the articles analyzed in Table 2 are more or less stating that the container transport is still increasing, and especially in Russia. The platform for growth is inevitable: World-wide container market itself increases 7-8 % per year and the level of containerization in Russia is still at relatively low levels. World Bank's experts estimated that in the year 2001 whole world container transports reached level of 73 million TEU, in 2006 this reached 90 million TEU, and four years after the same figure should already be at the level of 140 million TEU annually (Babakin 2007). Therefore, it is quite understandable why numerous countries are developing their ports and try to make a business and support local employment from this continuous increase.

Poland for example is developing the ports Szczecin, Svinoustie, Gdansk, Gdynia (capacity is 460,000 TEU) and especially Gratsika, because the last mentioned port is situated on the transit route between Germany and Russia. German company Scandlines who is servicing shipping lines between Sweden, Denmark and Germany is now affiliated with the Baltic ports of Ventspils and Klaipeda. Germany is interested to enlarge this transport corridor (Babakin 2007).

Table 2. Analyzed articles concerning container transportation issues in Russia.

Author & title	Major arguments	Other information
Babakin, Aleksandr (2007): *Zone of active search.*	Poland established Bureau of Maritime Administration and is developing the ports Szczecin, Svinoustie, Gdansk, Gdynia and Gratsika. Especially the last one, as it is situated on the transit way between Germany and Russia. Port Gdynia handling capacity is currently at level of 460000 TEU per year. German company Scandlines servicing shipping lines between Sweden, Denmark and Germany is nowadays affiliated with Baltic ports Ventspils and Klaipeda. Germany is interested to enlarge this transport corridor. Baltic countries are offering "Highways of the sea" - unification of the documents and the legislation satisfying all parts, to establish solid contacts between transport system with logistic centres, intermodal terminals, railway stations and crossing places of transport corridors.	World bank experts predicted yearly increase 7-8% of container transport. The level of containerization in Russia is 5 times lower than in Europe. In 2005 the St. Petersburg port's different terminals handled 42% of the container flow to Russia, in 2006 into Russia was transported 3.2 million TEU, and 50% went through the port of St. Petersburg.
Delovoi Peterburg (2007): *Terminal will be added for containers.*	"St. Petersburg sea port" will construct the new container terminal with capacity of 1.4 million TEU per year. The project organization is Royal Haskoning, which has worldwide experience in container terminal projects. It will be situated on the territory of "Fourth Stividor company". In 2008 they will order the equipment and start the construction project. The total cost of the project is est. to be $364 million. The first phase of the terminal will start working in 2009, but the full scale of use will start 3 years later.	The lack of handling capacity at the St. Petersburg port was identified by experts long time ago. In the beginning of October "First Container Terminal" sold the only container building factory in the western side of Russia, because container business is more profitable than manufacturing containers. The additional condition was that factory will be removed from the port area.
Poljakova, Irina (2007): *Does the container boom threat us.*	Long time ago it was obvious that containerization will appear in the Russian transport business as well. During Soviet Union era two different containers were used, MPC and Morflot. These were produced in Abakanvagonmaš and bought from India. Morflot containers were used in import/export lines and in good conditions, while MPC containers were used inland and as a result they were not maintained. Today's situation is quite difficult and the government is not supporting the activities enough. Up to 2005 Transsib had continuous container transportation growth, but from 2006 the business disappeared due to the increase of tariffs. The lowering of these and even setting up special low taxes could not bring back the lost volumes. Generally in Russia there is also lack of container terminals – in the system of OAO RZD there is only 44 container terminals.	Containers could be also used on the rivers. In the West transport via rivers is widely used. In a case of Russia there exists number of potential rivers for container transportation as well. Russia should carefully examine the development of the port of Hamburg: The TEU turnover in the first half of year 2007 was 4.8 million TEU, 14.3% more than in 2006. In the same period the China-Hamburg including Hong Kong container flow was 1.5 million TEU, to the Baltic region 639,510 TEU (+32%), Hamburg and Russian ports on Baltic-360,000 TEU (+42%).
Gudok (2007): *New container line started between Liepaja-Moscow.*	Container transport is increasing in the Baltic region. Director of the Special economic zone in Liepaja informed that the new railway connection between Liepaja and Moscow will guarantee the delivery of goods in exact time. This line is very useful for the Liepaja port as well. The train with 45 feet containers leaves Liepaja once in week, in the future up to five times per week. Project was realized in cooperation with Eimskip, Samskip and LDZ Cargo.	New line provides some help to solve the problems of several kilometers long queue of road transport on the Latvia-Russia border. The starting point of containerized cargo is Germany, England, Ireland, Belgium and France.
RBK (2007): *In the near future the development of the Russian ports will be determined by container business companies.*	In the near future development of the ports will be determined by companies handling containers. The volume of the container transport could increase several times, as the level of containerization is low. Turnover of the Russian container transport market increased last year on 24.9% from 1.92 million to 2.40 million TEU (if account all flows this number is 3.88 million TEU). Within five years it will achieve level of 5 million TEU.	Specialization is trend in sea ports; not long time ago the companies dealing with metal built their own sea ports. Nowadays the companies dealing with oil and coal develop own specialized ports. According to the researchers the throughput of the Russian ports in oil products will increase from 225 million tons of today to 300 million tons in year 2010. This will be achieved using new terminals in Kaliningrad, on the Black sea and in Primorsk.

The Baltic region will also be affected by this growth mentioned above. Baltic countries are offering the so called Highways of the sea concept: Unification of the documents and the legislation satisfying all parties, to establish solid contacts between transport system with logistics centers, intermodal terminals, railway stations and crossing points of transport corridors (Babakin 2007). The director of the Special economic zone in Liepaja, Latvia announced that the new established container train line Liepaja-Moscow is very useful. The train with 45 feet containers leaves once in a week and in future up to five times a week, which guarantees the delivery of goods just in time. This line is very useful for the development of Liepaja port as well (Gudok 2007).

Already several years ago it was obvious that Russian business companies will start the containerization. In 2005 St Petersburg terminals handled 42% of container flow to Russia and in 2006 roughly 50% of 3 million TEUs are going to through St Petersburg. Despite of these great amounts, the level of containerization in Russia is considerably lower than in Europe. Today the level of containerization is 5-7%, compared to the 50-60% in Europe. Turnover of the Russian container transport market increased a lot last year: when accounting all flows to Russia as well as internal railway container transport it makes 3.88 million TEU. It is predicted that after five years it will be 5 million TEU. Now there are 3 companies on the container transport market which control more than one terminal: OOO NKK, GK “Severstaltrans” and IK “TPS” (RBK 2007).

A very strong signal about the growth of container transportation is given also by St. Petersburg sea port. Royal Haskoning is leading the project to build a new container terminal with total costs of 364 million dollars, and this terminal should partly start working in 2009. By the year 2012 the terminal should offer already a full scale of operation with handling capacity of 1.4 million TEU annually. This investment should reduce the lack of handling capacities in St. Petersburg, which was identified by Russian experts a long time ago (Delovoi Peterburg 2007).

Lastly, Irina Poljakova has warned about the growth of container transit. She has been discussing over the the lack of container terminals. The 44 terminals existing in the system of OAO RZD are obviously not enough for increasing container business, as the figures show the increase of container flow to the Baltic region, Hamburg and Russian ports (Poljakova 2007). Therefore she has suggested the active use of river transport to reduce the problem.

4 CONTAINER TRANSIT TRAFFIC IN FINNISH AND ESTONIAN PORTS

4.1 Container Transit Traffic and Finnish Ports

The goods transported in containers via Finland to Russia arrive from Far Eastern ports mainly to the ports of Helsinki, Kotka and Hamina. From here, the majority of goods are after intermediate storage transported by trucks to Russia, Moscow and St. Petersburg. The ports also handle a great volume of Finnish import and export transportations.

In 2006, the number of containers handled in Helsinki, Kotka and Hamina totalled 1,045,836 TEU (20-foot containers). This is 74% of the total of 1,410,682 containers handled by Finnish ports. The numbers handled by the ports of Kotka and Hamina have been increasing throughout the beginning of the 21st century, whereas the number handled containers by the Port of Helsinki has declined (see Figure 4). In fact, Kotka surpassed Helsinki in 2006 with its 461,876 TEU, while this amount for Helsinki was 416,527 TEU. The total number for the Port of Hamina was 166,983. The number of containers in the Port of Hanko has remained low compared to the other three, being 47,840 TEU in 2006. (FPA 2007)

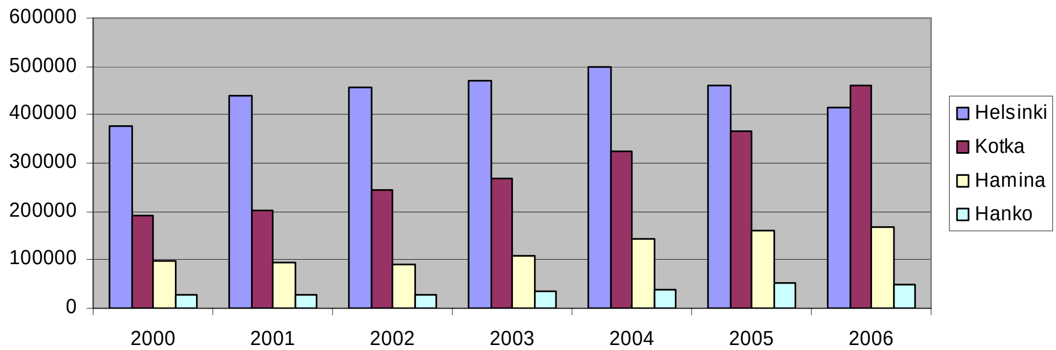

Figure 4. *Number of handled containers (TEU) in the ports of Helsinki, Kotka, Hamina and Hanko during 2000-2006 (FPA 2007)*

When looking at transit transports in all Finnish ports, Kokkola is the dominant one. Iron pellets from Kostamus are transported to the west through this port. Transit transports in Hanko consist of cars. The number of transit containers in this port is low, only 8,585 TEU in 2006.

East-bound transportations via the ports of Helsinki, Kotka and Hamina include valuables and transits of cars, which have increased dramatically in Kotka in the last three years. A certain number of cars is also transported to the east via Hamina. In addition, west-bound liquid bulk from Russia is carried via Kotka and Hamina.

The share in tons of Helsinki in transit transports has gone down from over one million in 2001 to slightly over 200,000 in 2006 (see Figure 5). The same

trend is reflected in the number of transit containers. The share of Helsinki has declined from over 120,000 TEU in 2003 to slightly over 19,000 TEU in 2006, while Kotka and Hamina have increased their shares (see Figure 6). Helsinki will have its new Vuosaari harbour investment ready for operation in 2008, but this will not change its position in transit transport. Most probably Vuosaari harbour will serve domestic market imports as well as export operations of Finnish companies.

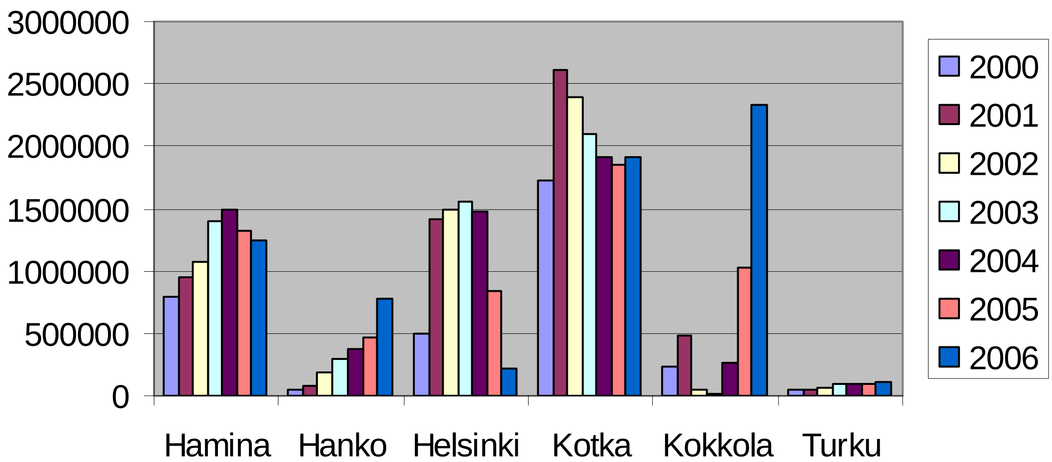

Figure 5. *Transit transports in certain ports during 2000-2006 (tons). (FPA 2007)*

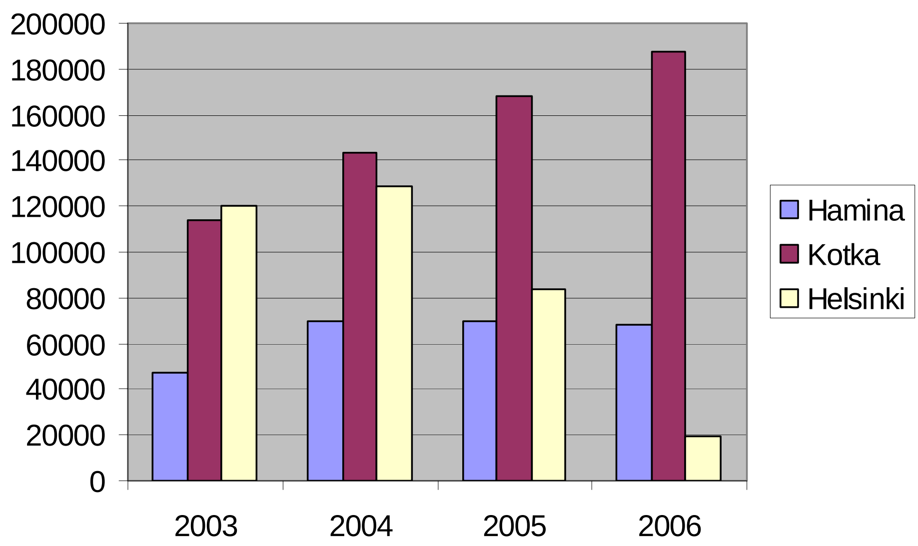

Figure 6. *Number of transit containers during 2003-2006 (FPA 2007).*

The transit transports of Helsinki, Kotka and Hamina totalled over 3.3 million tons in 2006, which was some 50% of the total transits in Finland (6.7 million tons). The ports of Kotka and Hamina have also been significant transit ports for liquid bulk. On the other hand, with Russia concentrating its exports to its own ports in line with the country's transport strategy, the volume of liquid bulk has gone down. In 2006, 486,000 tons of Russian liquid bulk products were transported to the west via Kotka and 862,000 tons via Hamina. (Figure 7)

Figure 7. *Liquid bulk transits in Kotka and Hamina between 2000-2006 (FPA 2007)*

4.1.1 Transit Transports by Road

The National Board of Customs compiles statistics on the east-bound transits in Finland. In 2006, more than 2.9 million tons of goods with a total value exceeding EUR 24 billion were transported to the east by road. The most important point of origin was Kotka with a 41% share. Hanko, Hamina and Helsinki (see Figure 8).

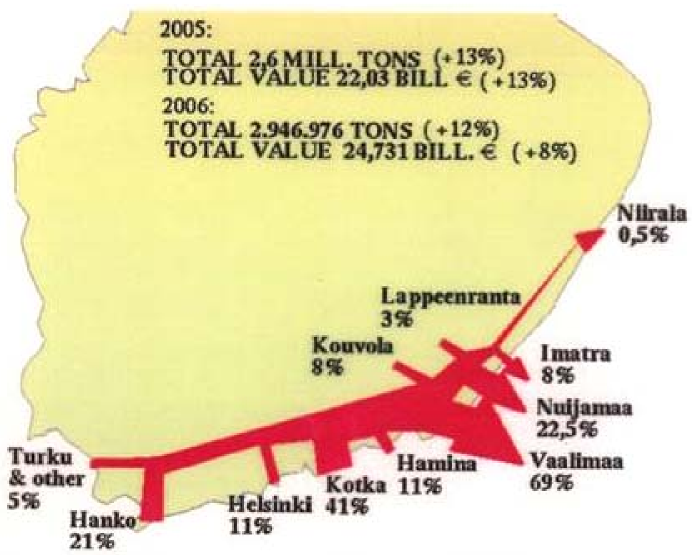

Figure 8. *Points of origin for transit transports by road 2005-2006 (Source: National Board of Customs).*

The majority, 69%, of road transits in 2006 went through Vaalimaa. Waiting lines of trucks have become a common phenomenon, especially on the main artery to

Vaalimaa. These are a nuisance to the local inhabitants and other traffic. The truck parking area built adjoining Vaalimaa border crossing has not alleviated the situation. Extending the parking area and also building a similar area in the vicinity of Nuijamaa border crossing is in the plans.

The east-bound goods were transported in over 312,000 truck loads. The share of Russian trucks was 87% and that of Finnish ones 6%. The share of vehicles registered in other countries was 7% (see Table 3).

Table 3. *Volume of east-bound truck transports in 1990-2006, and forecast on 30th of July 2007 (SKAL 2007, National Board of Customs).*

	FIN /EXPORT	RUS	OTHERS		FIN	RUS	OTHERS	
1990	4 789	4 243	2 152	11 184	43 %	38 %	19 %	
1991	6 051	5 692	2 321	14 064	43 %	40 %	17 %	25,80 %
1992	11 583	8 538	6 869	26 990	43 %	32 %	25 %	91,90 %
1993	32 409	21 381	10 485	64 275	50 %	33 %	16 %	138,10 %
1994	53 184	38 381	21 253	112 818	47 %	34 %	19 %	75,50 %
1995	51 864	60 691	19 908	132 463	39 %	46 %	15 %	17,40 %
1996	59 871	81 493	18 084	159 448	38 %	51 %	11 %	20,40 %
1997	68 933	115 597	16 958	201 488	34 %	57 %	8 %	26,40 %
1998	52 439	94 439	13 538	160 416	33 %	59 %	8 %	-20,40 %
1999	24 724	81 063	8 273	114 060	22 %	71 %	7 %	-28,90 %
2000	28 961	98 355	8 503	135 819	21 %	72 %	6 %	19,10 %
2001	29 601	102 119	9 889	141 609	21 %	72 %	7 %	4,30 %
2002	27 898	126 036	8 880	162 814	17 %	77 %	5 %	15,00 %
2003	25 682	162 366	11 264	199 312	13 %	81 %	6 %	22,40 %
2004	22 097	200 613	15 422	238 132	9 %	84 %	6 %	19,50 %
2005	16 753	242 244	17 434	276 431	6 %	88 %	6 %	16,10 %
2006	18 218	271 186	23 273	312 677	6 %	87 %	7 %	13,10 %
+ or -	1 465	28 942	5 839	36 246				
2007-3	5 336	69 675	5 466	80 477				
estimate	21 344	278 700	21 864	321 908	7 %	87 %	7 %	

The number of loads transported across the eastern border from Finland to Russia by Finnish vehicles increased by 9 % (1,465 in Table 2), and respectively Russian vehicles increased by 12 % (28,942) in 2006. As to import loads, the share of Finnish trucks went down by 16 % (-11 545) and that of Russian ones went up by 11 % (7,370). The total volume of traffic increased by 9 percent. The Russians increased their share by 12 % equalling 36 520, while the share of Finnish carriers went down by 11 percent equalling 10 080 trucks. This is due to the decrease (-11,545) in the number of vehicles in import traffic. (see Table 4)

Table 4. *Truckloads in traffic between Finland and Russia in 2005-2006. (SKAL 2007, National Board of Customs 2007, Statistics Finland 2007)*

TOTAL TRAFFIC / EXPORT + IMPORT					**%**	**%**	**%**	
	FIN	**RUS**	**OTHERS**		**FIN**	**RUS**	**OTHERS**	**Change-%**
2005	89 444	309 865	26 771	426 080	21 %	73 %	6 %	15 %
2006	79 364	346 177	37 049	462 590	17 %	75 %	8 %	9 %
change	-10 080	36 312	10 278	36 510				
change-%	-11 %	12 %	38 %	9 %				
EASTBOUND TRAFFIC / EXPORT				**EXPORT**	**FIN**	**RUS**	**OTHERS**	**Change-%**
2005	16 753	242 244	17 434	276 431	6 %	88 %	6 %	16 %
2006	18 218	271 186	23 273	312 677	6 %	87 %	7 %	13 %
change	1 465	28 942	5 839	36 246				
change-%	9 %	12 %	33 %	13 %				
WESTBOUND TRAFFIC / IMPORT				**IMPORT**	**FIN**	**RUS**	**OTHERS**	**Change-%**
2005	72 691	67 621	9 337	149 649	49 %	45 %	6 %	13 %
2006	61 146	74 991	13 776	149 913	41 %	50 %	9 %	0 %
change	-11 545	7 370	4 439	264				
change-%	-16 %	11 %	48 %	0 %				

According to Customs statistics from Kotka and Hamina (National Board of Customs 2007a), the use of TIR carnets has increased. In 2005-2006, their numbers were as presented in the following Table 5.

Table 5. *Number of TIR Carnets in Kotka and Hamina (National Board of Customs 2007a)*

	2005	**2006**	**2007** [1,2]	
Kotka	26795	24538	6781	[1] 1.1.-1.3.2007 (+30%)
Hamina	69479	96304	48641	[2] 1.1-31.5.2007

As a rule, there are no significant queues in the TIR customs office, and the queuing time was estimated to be 10-20 minutes. According to representatives of the customs, this work has got slower since June, as EU exports need to be saved first before the TIR document is opened. The saving of the export lot takes 3 minutes/document, after which opening the TIR carnet including the sealing takes some 20 minutes. If the exports and number of TIR carnets keep increasing at the current rate, queues will occur, unless progress can be made in simplifying the document.

4.1.2 Transit Transports by Rail

The Trans-Siberian railway from the Russian Far East to Finland was previously a significant transport route for containers with valuables. In 2003-2005, the number of containers exceeded 100,000 TEU per year. From the beginning of 2006, Russia increased the transport charges, as a result of which the number of containers collapsed to less than 10,000 TEU. Suppliers shifted their transports to the sea. The Russian Railways has set up a joint venture titled Container Trans Scandinavia Oy with the Finnish rail operator VR. The target is to develop rail

transports between Finland and Russia, including transits by regular, scheduled container trains to Moscow. VR Cargo estimates the transport volume for 2007 at 30,000 TEU. (see Figure 9) This, however, would require the acceptance of customs transits at the Moscow goods station to the customs service point selected by the customer, which is not possible at least at the moment. A regular container train would at least partly alleviate the congestion of trucks at border crossings.

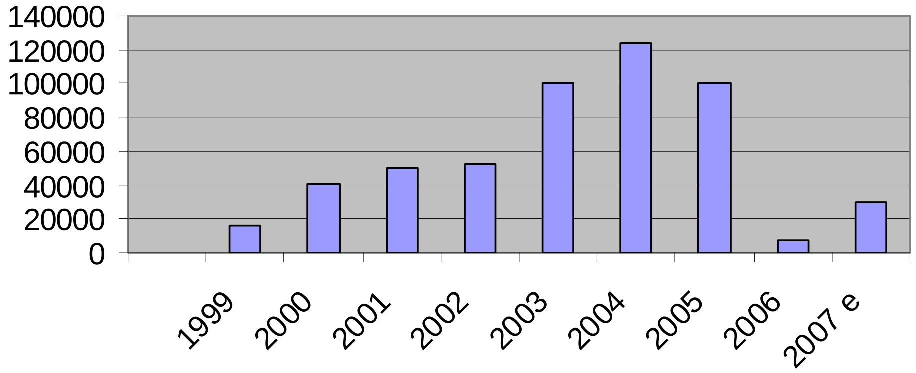

Figure 9. *Development of container traffic to the Far East in 1999-2006, estimate 30 July 2007(VR 2007).*

The planned increase in the transit transports of cars by rail could also help shorten the queues. The Russian Railways have announced that they will procure car-transporter wagons and build reception terminals in Moscow and Yekaterinburg.

In 2006, only 5%, or over 100,000 tons, of east-bound transits were carried by rail. In the Russia-Finland direction, some 4.1 million tons of transits were transported, 95% of which by rail. The largest item was iron pellets from Kostamus via the Port of Kokkola (see Figure 10)

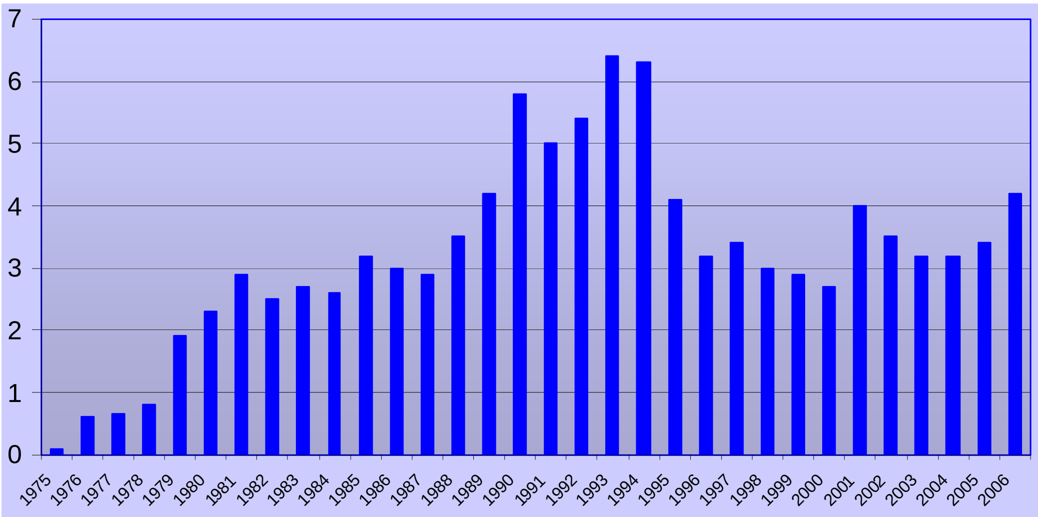

Figure 10. *Development of transit transports by rail in 1975-2006 (million tons) (Andersson 2007)*

4.1.3 Future Development of the East-Bound Traffic

The Russian GDP has seen a dramatic increase since the financial crisis of 1998. In 2006, it went up by 6.9%. At the same time, the standard of living of the population has improved. This has resulted in an increase of consumer demand and imports of consumer goods. In the first half of 2007, it is estimated that the Russian economy grew by 7.8%. The growth is speeded up by the increase in consumer demand. During the first six months of the year, retailing increased by 14% compared to this period the year before. Russian imports increased by 39% and exports 8% from the situation of the year before. (BOF 2007c)

It is estimated that the value of exports via Finland to Russia is 25-30% of the total value of Russian imports. Hernesniemi et al. (2005) estimate that the annual economic growth of 6% in Russia will result in a 10% increase in export transportations (incl. east-bound transits) and 5% in import transportations (incl. west-bound transits).

Russia is strongly developing its infrastructure along the lines of the Government-approved transport strategy. The oil ports of Primorsk and Vysotsk are already in operation on the Gulf of Finland, and the multi-purpose port of Ust Luga is under construction and partly operational. The objective of Russia is to shift as much of its transportation volumes as possible to its own ports. The construction of new ports and development of the existing ones will also transfer containerised transports of consumer goods and cars from the route via Finnish ports directly to Russia.

The other aspects of logistics in Russia will also develop. Logistics centres are being built, and western distribution centres are beginning to develop. This will be reflected as an increase in containers being transported directly to Russia without being unloaded in Finnish warehouses. At the same time, large logistics companies will establish themselves in Russia to set up their own warehouses.

On the other hand, the number of storage facilities in Russia remains inadequate, and their services are not advanced enough. They also are expensive compared to the rents of Finnish warehouses. The bureaucracy of the Russian Customs and other authorities is another obstacle for development.

The increase in the Russian consumer demand is so strong, however, that the country's own ports will not be able to deal with the increasing imports. Finland will maintain its position in Russian transit transports. The relative share may decrease, but the absolute one will grow.

4.2 Technical Information of Finnish Ports

4.2.1 Port of Helsinki

The Port of Helsinki consists of four harbour sections: West Harbour, North Harbour, South Harbour and Laajasalo Oil Harbour. In addition, the Port of Helsinki comprises the bulk harbour of Kantvik in Kirkkonummi. In 2006, the Port of Helsinki handled 11.7 million tons of goods.

West Harbour and North Harbour handle containers. In 2008, these functions will move to the new Vuosaari Port.

West Harbour

West Harbour specialises in container traffic but also serves ro-ro cargos. The West Harbour has a 42-ha container terminal with 450 reefer places and a warehouse for dangerous goods. The container terminal also has a bonded warehouse offering the same benefits as a freeport. The area also features containerisation and container repair services and three container depots. The operators of the harbour are Finnsteve Oy and Multilink Terminals Oy.

Technical data:

Depth of channels	11, 9.1 and 8.9 m
Total land area	83.4 ha
Container terminal	42.0 ha
Length of quays	4,083 m
Ferry berths 8	
Universal crane	1/ 30-40 t
Container cranes	7/30-50 t

Warehouses:

Port of Helsinki	76,300 sq.m
Private companies	22,240 sq.m

General customs Warehouse:

Sheds	5,028 sq.m

Railway yard:

Sorting

Track	Length	
009	382	not in use after 01.09.2007
010	400	arrival track
011	415	turning track for locomotives
012	315	
013	260	
014	275	
016	200	container depot track
017	260	container depot track

Port owned

Track	Length
006	350
007	154

North Harbour

The harbour has a 35-ha full-service container terminal. It offers multimodal storage services for the container, truck and trailer traffic. There are 58 reefer places in the harbour. A containerisation service, container depot and repair services are available for the customers. The Free Zone offers long-term storage.

Technical data:

Depth of channels	5.0, 8.0 and 9.0 m
Total land area	74.0 ha
Container terminal	35.0 ha
Length of quays	2,269 m
Ferry berths	7
Quay crane	1/150 t
Universal crane/ container hook	1/30,5/40,0 t
Mobile crane	1/100/35 t

Warehouses:

Port of Helsinki	14,033 sq.m
Private companies	55,650 sq.m
Free zone open storage	11 ha
Free zone covered sheds	2,419 sq.m

Railway yard:
yard for arrivals

track	length
015	720
016	720
017	720
018	680

Sorting

Track	length
008	350
009	336
010	330
011	185

To the warehouse
number 7

006	370
007	375
040	105 inside
041	210 side track

Port owned

Track length

020	200 arrival to the port
021	123
023	145 to Finnsteve 1
024	124 to Finnsteve 2
025	157 S 3 warehouse
026	178 S 3 side track
027	145
031	110

Price list

Handling of container	€23.05
minimum/ hour	€156.15

Warehousing container €/TEU/24 h

1-7 days	0.00
1-14	1.90
1-45	2.73
over 45	4.05 each over 45 days

Empty containers €/sq.m/month	1.42

Cargo charges €/1000 kg

General charge	
General cargo	2.86
Forest industry products and metals	1.68

Bulk	
Sand and gravel	0.10
Other goods	3.62

Vuosaari (in 2008)

Land area	150 ha
Depth of channels	12.5 m (minimum)
Quays	3.6 km
Berths	15 ro-ro, 2 container
Operators	Finnsteve, Multilink Terminals, Steveco
Cranes	no information yet
Logistical area	50 ha
Reserved for terminals	160 000 sq.m

Railway yard	
Yard for arrivals	2 tracks 780 m,
	1 860 m

	1	980 m
	1	770 m
	1	810 m
	1	725 m
	1	670 m
	1	57 m

Eastern tracks
6 tracks 212- 465 m

Middle tracks
7 tracks from 517-571 m, possibly plus 2 tracks of 517 m and 571 m

Western tracks
8 tracks from 226-699 m, possibly 1 with 1065 m

4.2.2 Kotka

The Port of Kotka consists of six harbour sections: The City Terminal, Hietanen, the Polish Quay (Hietanen South), Mussalo, Sunila and Halla. In 2006, a total of 9 576 815 tons of goods were carried through the Port of Kotka.

Mussalo
The container, liquid and bulk terminals are located in Mussalo. The logistics area of Mussalo covers 300 ha, and it will be expanded by 150 ha in 2008-2009. It will be possible to build a branch railway line to the new logistics area. The annual capacity of the current container terminal is 1 million TEU.

Mussalo has 235,988 square meters of heated and unheated warehouses for the containerisation, handling and storage of export/transit goods, and many of these areas are linked to the rail network.

The operators of the container terminal are Steveco Oy, Finnsteve Oy and Multilink Terminals Oy. They have at their disposal seven container cranes with a capacity of 40-50 tons and one mobile crane. In 2006, Mussalo became the largest container port in Finland with its 461,879 TEU. The port handles dry and liquid specialised containers including IMDG and reefer containers.

Technical data

Total land area	300 ha
Depth of channels	10.0 m and 12.0 m
Quays	1,436 m
Ferry berths	8
Cranes	7 container 40-50 t, 1 mobile

Warehouses

Heated and unheated warehouses for containerisation, handling and intermediate storage	235,988 sq.m

All warehouses privately owned

Mussalo bulk terminal

Quays	600 m
Ferry berths	2
Depth of channels	13.5-15.3 m
Cranes	3/40 t, 1/8 t

Mussalo liquid terminal

Berths	2
Depth of channels	13.5-15.3 m
Storage tanks	241,500 cubic meters

Railway yard

16 tracks	length 571- 1,055 m

Connections from the main yard to terminals

There has been a shortage of railway lines in Mussalo. The expansion of the railway yard of Kotolahti during year 2009 will ease the situation. In addition to the main track, it will feature 10 tracks in the railway yard, the lengths of which will be 870-1,220 m, and a connecting line to Palaslahti.

Hietanen

The terminal of Hietanen has become a significant transit terminal of cars. In 2006, 205,490 cars were carried to Russia through Hietanen, which is 38.8% of the cars transported to Russia through Finnish ports.

Two terminals

Car terminal	90 ha
Ro-Ro terminal	83 ha

Cranes	1/40 t
Quays	1,033 m
Berths	6
Depth of channels	7.9-10.0 m

Warehouses

Covered storage	103,000 sq.m
SECU unit	8,000 sq.m

Railway yard in Hovinsaari

Upper yard	8 tracks from 586-895m for arrivals
Lower yard	17 tracks from 207- 775 m for sorting

Railway yard in the port (includes Hietanen south)
7 tracks from 250-350 m
5 tracks from 125-495 m

Hietanen south (Polish quay)
- used for bulk and from 2007 for cars

total area	18 ha
Quays	360 m
Berths	3
Depth of channels	8.5 m
Covered storages	11,175 sq.m

Kantasatama (City terminal)

Traditional ro-ro, lo-lo and storo- port with total area of 26 ha.

Quays	962 m
Berths	8
Depth of channels	7.7-10.0 m
Cranes	1/60 t, numerous mobile cranes
Warehouses	
Covered storages	60,000 sq.m
Railway yard	8 tracks from 303-674 m

Private quays

Sunila quay 400 m with four berths (2 owned by Kotka)

Depth of channels	6.0-7.9 m
Halla Quay, UPM Kymmene (lo-lo)	quays 210 m with 2 berths
depth of channels	7.3 m
cranes	2/8 t

Mussalo Pohjolan Voima Oy (bulk)

Quays	200m plus oil quay
Berths	2
Depth of channels	8.0-9.0 m

Pricelist of the port of Kotka

Container cranes	€22.70/container hoisting
Warehousing	
Containers €/TEU/24 h	
1-7 days	0.00

8-14 days	1.20
15-30 days	2.20
over 30 days	4.40 each

Dues on goods	
Goods with no specially mentioned unit price	€/ton 2.12
Liquid bulk, other products of chemical industry(carried with tankers)	1.68
Oil products, methanol	1.13
Wood pulp and building boards	1.26
Dry bulk(except scrap metal)	0.99
Wood	0.48/ cubic meter
Cars	€4.35 each
Other vehicles	5,000 kg €58.50 each
Other vehicles	over 5,000 kg €11.00 each

4.2.3 Hamina

The Port of Hamina handles itemised goods, large units, liquids and gas. The port consists of seven harbour sections, which are Hillo, Lakulahti, Kiirenkari, Palokangas, the container terminal, Paksuniemi, liquid harbour and gas terminal. In 2006, the port handled a total of 5,181,311 million tons of goods.

The operators in the port are Hamina Multimodal Terminals Ky and Steveco Oy. The fairway leading to the Port of Hamina will be deepened from the current 10 m to 12 m in 2008. This will enable an increase of up to 50% in the cargo capacity. In Paksuniemi, an area of 50 ha will be built up for added storage fields and new industrial properties. The container terminal will be expanded by 33 ha, while 400 m of new berths will be completed. These expansions will bring the container capacity of the port up to 1 million TEU annually.

Technical data:

Depth of fairway	10 m (in 2008 12 m)
Land area	315 ha
Reserve area at the port	110 ha
Industrial area	100 ha
Warehouses	300,500 sq.m
of which heated	61,000 sq.m
Open storage	200,000 sq.m
China clay depot	86,000 cubic meters
Urea depot	17,900 cubic meters
Liquid bulk cisterns	500,000 cubic meters
Container terminal	50 ha, in 2010 additionally 33 ha and 400 m for berths
Cranes	3 container cranes, 6 other cranes

Hillo (bulk and general cargo)

Quay	
Length	345 m
depth of channels	6.5 m
Berths	4

Lakulahti

Quays	
Length	807 m
Depth of channels	7.9-8.6 m
Berths	8

Hiirenkari

Quays	
Length	468 m
Depth of channels	7.9-8.4 m
Berths	6

Palokangas

Quays	
Length	200m
Depth of channels	10 m

Liquid terminal

Quays	
Length	187 m
Depth of channels	9.0-10.0 m
Berths	3

LPG	
Quay length	170 m
Berth	1

Railway yard

Poitsila yard	
8 tracks	from 585-880 m
Middle yard	
13 tracks	from 438-1,101 m
Lakulahti yard (port owned)	
6 tracks	from 202-489 m

Oil yard (port owned)	
9 tracks	from 175-385 m
Middle yard (port owned)	
4 tracks	from 362-520 m
Puoteli yard (port owned)	
4 tracks	from 342-403 m
Summa yard	
three tracks	from 551-629 m

Price list

goods with no specification	€2.06/t
Dry bulk	€0.95/t
Wood pulp and building boards,	
Metals	€1.22 /t
Paper products	€1.24/t
Chemicals	€1.61/ t
Wood products	€0.44/ cubic meter
Containers and trailers	€32.41 each
Cars max 1,500 kg	€2.56 each
1,500-3,500 kg	€5.18 each
Open field dues	
Containers and trailers	
1-15 days	€0.76/day
16-30 days	€1.55/day
over 30 days	to be agreed separately

4.2.4 Hanko

Hanko is the southernmost port in Finland. It specialises in the exports of paper and imports of cars. The share of fresh products is also increasing. Hanko is the largest transit port for cars in Finland. 313,000 cars were transported to Russia via Hanko in 2006. The port also is ideally positioned for winter navigation. The port consists of the Western Harbour and Outer Harbour/Freeport.

Western Harbour

Cranes: one/45 tons
Berths:

	Length	Depth
No 1: Ro-ro	245 m	13.0 m
No 2 Ro-ro	220 m	7.3 m

No 4 Ro-ro	165 m	9.0 m
No 5 Ro-ro	300 m	7.8 m
Other berths:	120 m	6.8 m

Covered storages:	55,300 sq.m
Open storage:	128,000 sq.m

Outer Harbour and Freeport

Berths
2 Ro-ro, 170m and 180 m, depth 7.2 m

Covered storage:	21,000 sq.m
Open storage:	600,000 sq.m

Cargo rates	Import €/t	Export €/t
General fee	2.77	2.77
Exceptions to the general fee		
Transit cars	4.71	4.71
Iron, steel, stone, non precious metals	1.83	1.83
Timber	0.73/ cubic	0.73/ cubic
Cellulose, wood pulp, paper, card board, plywood, other raw material boards	1.11	1.11
Vehicles (max 18,45 €/ one)	9.59	9.59
Bulk	0.91	0.91

Craneage charges

under 6 tons	€68.58/h	
6-10 tons		€121.83/h
10-20 tons		€159.41/h
30-40 tons		€342.92/h
over 40 tons	€420.17/h	

Storage charges:
Field and container charges:

Cold storage	€0.10/sg.m/week €0.88/sg.m/month €8.14 sq.m/ year
Containers	€0.20/month/TEU

Short term warehouse hire

1-3 days	free
4-7 days	€0.23/100 kg/ day
8-15 days	€0.44/100 kg/day

over 15 days	€0.71/100 kg/day
Outdoors	
1-3 days	free
More than 3 days	€0.15/100 kg/day
Terminal fee for imports/ exports min 16,90	€3.99/100 kg

Railway yard

arrival tracks	6	149 m- 696 m
sorting tracks	9	380 m-980 m
loading tracks	7	139 m-139 m
Other tracks to terminals and free Port	8	200 m- 395 m

According to the representative of one operator, "exact craneage charges are difficult to specify, as they vary greatly from one customer to the other. If I had to give an estimate of a price, it would be something like EUR 35-40 in Helsinki and EUR 30-35 in Kotka. If you look at the price lists of the ports, you can get the exact list price of craneage. You must note, however, that the craneage charge given by the port includes precisely the craneage and nothing else. The container is hoisted from the ship to the quay, but it will move no further. Our prices include transport to the field and other measures. The ports charge EUR 20-25 for hoisting, and the remainder of our price is for other jobs that we do for the customer. On the whole, the paradox of it is that there is no generally applicable charge, but the price depends on the customer and of course their volumes."

4.2.5 Performance of Container Cranes in Helsinki, Kotka and Hamina

The numbers of the next three figures (Figure 11, Figure 12 and Figure 13) were calculated by dividing the vessels' length of port call by the total number of containers unloaded and loaded. Data was collected from the PortNet database (FMA 2007). The best performances seem to be achieved by a company that manages the whole logistics chain, the vessel, cranes, stevedoring, containers, container terminal and land transports.

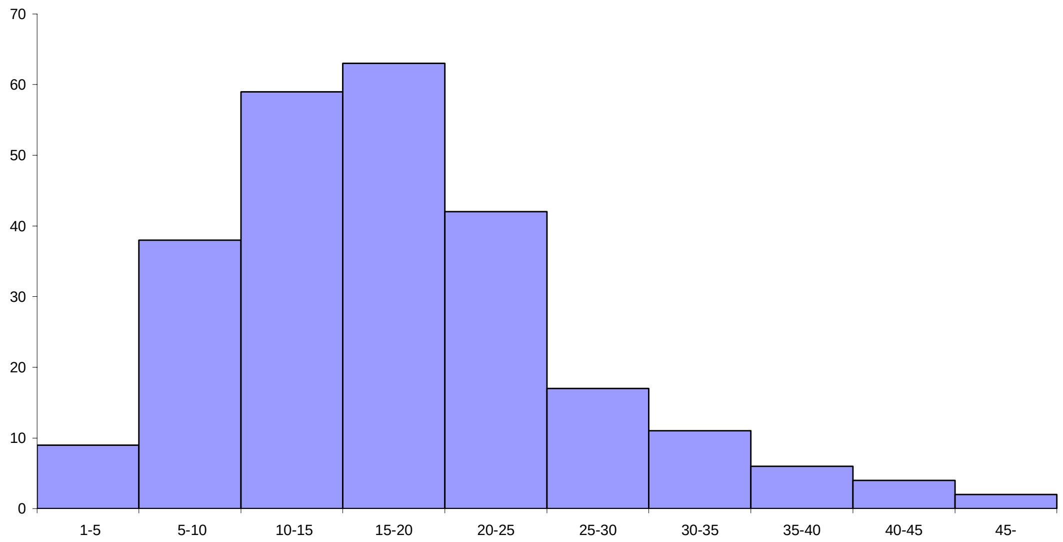

Figure 11. *Container hoisting per hour 1.Jan - 31.Mar 2007 at Port of Helsinki, n = 251 (mean = 17.56, where stdev = 8.77).*

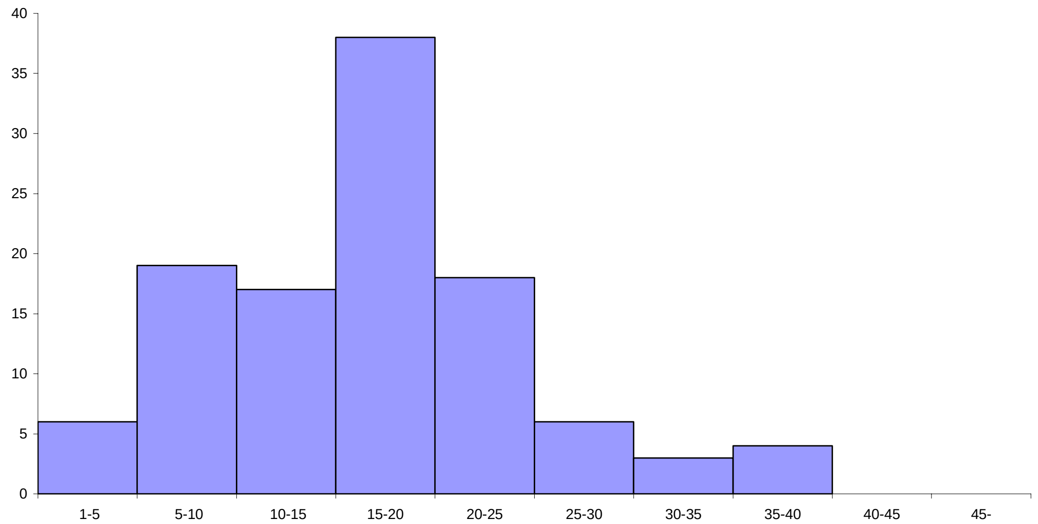

Figure 12. *Container hoisting per hour 1.Jan - 31.Mar 2007 at Port of Kotka, n = 111 (mean = 16.69, where stdev = 7.94).*

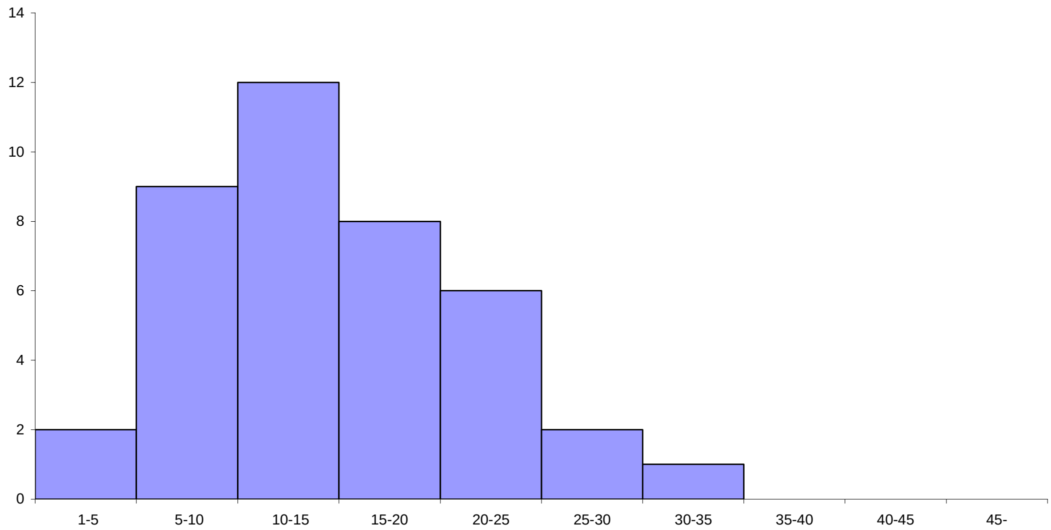

Figure 13. *Container hoisting per hour 1.Jan-31.Mar 2007 at Port of Hamina, n = 40 (mean = 14.63, where stdev = 6.97*)

One thing affecting the performance is the distance of the container field from the loading quay and the loading speed of cranes (the hoisting speeds of cranes vary). Most cranes would be able to hoist more than the reachstackers and towing vehicles are able to feed them. However, notable is the fact that performance differences between these three harbours are nearly insignificant. As highest frequency is observed in Helsinki and Kotka within class of 15-20 container lifts per hour, the same class could be found from Hamina step lower from 10-15 lifts per hour. This result reveals that 500 TEU container ship will wait in the port for unloading from 25 to 33 hours in the case of Helsinki and Kotka, while in Hamina this takes from 33 to 50 hours (if the highest frequency class is used as efficiency estimate).

4.3 Container Transit Traffic and Estonian Ports

Container traffic has been growing tremendeously all over the world. Situation is the same, when we examine container traffic through the ports of Russia, Finland and Baltic States (see Figure 14).

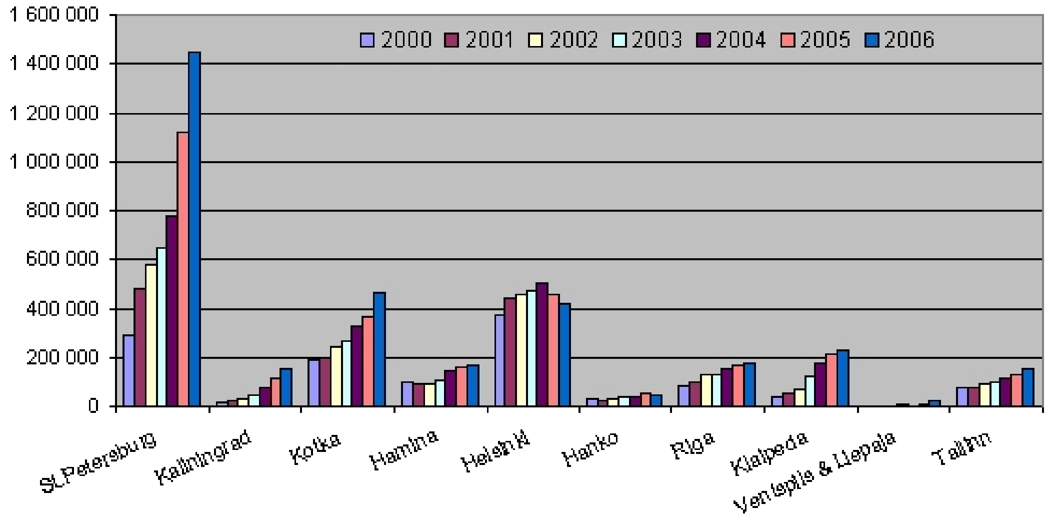

Figure 14. *Container traffic in Russia, Finland and Baltic States 2000-2006 (FPA 2007, Port of Tallinn, Muuga CT)*

Adding up the port throughputs on the Figure 14 we see container traffic growing to nearly three fold between 2000 and 2006. Only in Port of Helsinki container traffic has shown some decrease during 2000-2006, but when comparing years 2000 and 2006 the number of containers handled has risen. Reasons why container transport is booming is among others trends in logistics, growing popularity of container as transporting unit and in our region economic growth of Finland, Russia and Baltic States.

Currently there is only one specialised container terminal in Estonia, Muuga Container Terminal (CT) and it is situated in the Muuga Harbour. As Table 6 shows, 99% of all containers are handled by Muuga CT. Other ports and terminals handle containers only occasionally. Some ports, other than Port of Tallinn, have tried to establish container lines but unsuccessfully for now. Currently Paldiski Northern Port is developing container corridor Gävle-Paldiski-Moscow.

Table 6. *Container throughput Estonian ports, Port of Tallinn and Muuga CT 1996-2006, TEU (Statistics Estonia, Port of Tallinn, Muuga CT)*

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Containers total		54 585	55 472	65 535	76 692	78 072	88 984	100 875	141 157	128 634	153 004
Port of Tallinn	45 578	54 585	55 471	65 535	76 692	78 072	87 912	99 629	113 081	127 585	152 399
Muuga CT	22 211	24 840	25 980	39 248	51 184	66 410	87 051	94 822	111 599	126 933	152 063

Table 7 shows that the amount of transit containers through Estonia has varied much during last seven years.

Table 7. *Handled containers and transit containers through Estonia (Statistics of Estonia).*

	2000	2001	2002	2003	2004	2005	2006
Total	76 692	78 072	88 984	100 875	141 157	128 634	155 004
Transit	10 453	7 218	7 606	4 856	5 152	36 401	34 046
Tr-%	14 %	9 %	9 %	5 %	4 %	28 %	22 %

4.3.1 Technical Information of Muuga Container Terminal (CT)

Currently there is only one specialized container terminal in Estonia, Muuga CT. It operates in Muuga harbour and has yard area of 4,000 m^2 covered and 13+5 ha open yard (3,500 TEU, 300 trailers, 500 cars). In covered area there is a separate branch for 6 railway cars. In open yard there is a railway branch for 25 container cars. For loading and unloading three different quays are used. Their characteristics are shown in Table 8.

Table 8. *Specification of quays of container terminal.*

Cargo	Quay nr	Length (m)	Depth (m)
CONT	14	219	12,4
CONT	15	200	12,4
CONT	16	198	12,4

Biggest ships which visited Muuga CT were with container capacity of 1,438 TEU. Muuga CT is servicing seven container lines presented in Table 9.

Table 9. *Container lines visiting Muuga CT.*

Operator	Route
TECO Line - Germany	Muuga - Bremerhaven – Hamburg - Muuga
TECO Line - Finbest	Muuga - Helsinki - Antwerpen - Rotterdam - Helsinki – Muuga
TECO Line - Finbest	Muuga - Aarhus - Antwerpen - Felixstowe - Rotterdam - Helsinki - Muuga
Unifeeder Container Service	Muuga - Bremerhaven – Hamburg - Helsinki - Muuga
MSC	Muuga - Antwerpen - Riga - Helsinki - Kotka - Muuga
Team Lines	Muuga - Bremerhaven – Hamburg - Muuga
CMA CGM	Muuga - Hamburg - Helsinki - Muuga

Muuga CT is handling containers with the equipment listed below:

- Two Ship-to-Shore gantry cranes by Konecranes. The cranes have an outreach of 36 m. and lifting capacity of 40 ton, a hoisting speed of 60/120 m/min and the trolley speed is 150 m/min;
- Harbour mobile cranes produced by Liebherr;
- LHM-250- lifting power 66 tons, productivity up to 30 containers per hour;
- LHM-40- lifting power 104 tons, productivity up to 40 containers per hour;
- Two Rubber Tyred Gantry Cranes (RTG) by Kalmar;
- Two Shuttle Carriers by Kalmar
- 6 Reach Stackers with 41 ton lifting capacity by Valmet, Kalmar and SMV
- 2 container handler with 12 and 25 t lifting capacity by Kalmar
- 5 forklift trucks with lifting capacity 1.5-3.5 t by Toyota, Still, Nissan and Linde
- 7 terminal trucks by SISU;
- 7 Buiscar multitrailers and 20 Mafi trailers for container transport within the terminal;
- Depot for linking up freezer-containers (144 units);
- Railway tracks for 30 railway cars;

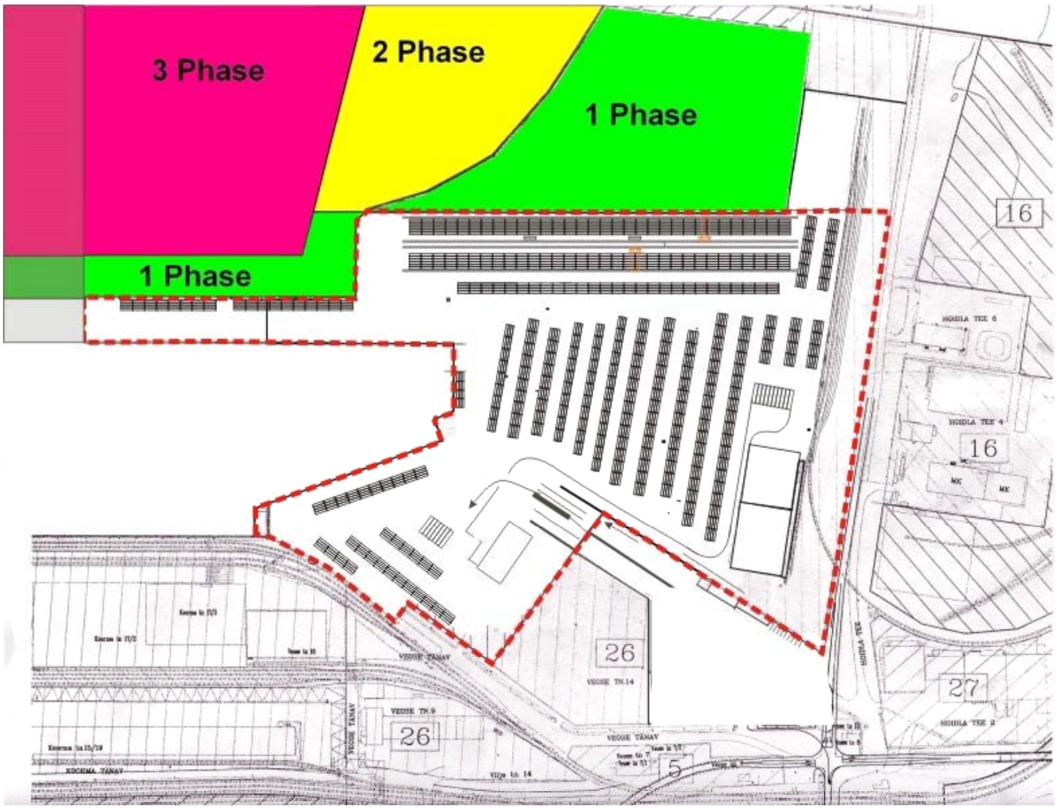

Figure 15. *Muuga CT expansion plan (Zimin 2007).*

Comparing container traffic of Muuga Harbour/Muuga CT to other ports, container volumes were not so big compared to competitors of Finland and Russia. One of the reasons was that it had some work efficiency problems in the past. In the second half of 2006 Muuga CT introduced new technology containing RTG and shuttle carrier. With reorganising technology terminals productivity rose over 16% (gross productivity 18.15% from 15.87 to 18.75, net productivity 16.83% from 20.33 to 23.75) (Zimin 2007). Though new technology has been introduced, the handling volumes have risen so fast that there is need for expansion. Port of Tallinn has already started project for expansion of Muuga Harbour's eastern part (Figure 15). In addition to new terminals and quays, industrial park (75 ha) will be built.

Containers are taken to and from the port mainly with road transport. Small amount of containers are transported by rail. According to the Statistics Estonia only 8,645 TEUs were transported by rail to and from the ports of Estonia (transit containers in amount of 14,914 TEUs were transported by rail in 2006). The reasons why this number is so low is that there is not enough container platforms and trains are transporting mainly liquid (in 2006 26,1 million tons of oil and oil products out of total 45 million tons) and dry bulk (9,8 million tons of solid mineral fuels and over 2,4 million tons of fertilizers) coal cargoes.

4.3.2 Performance of Container Cranes at Muuga CT

The container lifting capacity at Muuga CT was also examined. Compared to figures from the Finnish ports, the figures from Estonia are more unreliable as they were calculated from the total tonnage and total number of TEUs. They also differ from the Finnish in a way that in Finland the calculations were made based on the whole stay at port, while in Estonia only actual loading/unloading time was taken into consideration. So, these figures are not directly comparable to each other. As Figure 16 shows the average number of hoisting per hour is 12.77 and the standard deviation is 5.66. Although, it can be said that it seems that productivity in Finland is higher, as the productivity numbers are higher, even the difference between calculation methods should give Muuga CT advantage (Figure 11, Figure 12, Figure 13 and Figure 16).

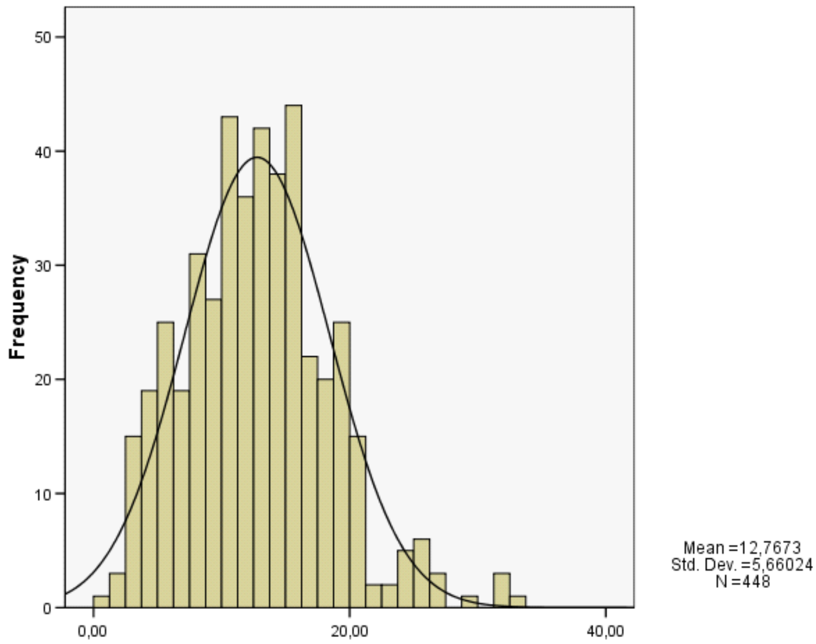

Figure 16. *Container hoisting efficiency at Muuga CT (hoisting per hour), n = 448.*

4.4 Dues and Charges of Containerships in Baltic Ports

Current research aim was to compare dues and charges paid by container ships in port of Tallinn, Helsinki, Hamina, Kotka, St Petersburg, Riga and Klaipeda. As container ships sail usually on regular basis, calculations were made for 1, 25 and 60 port calls. Possible rebates were taken into account, exept the rebate on vessel due in the port of Hamina, because the rebate is applied company wise not ship wise.

Ports included in this research and their collected dues and charges as presented in Appendix 1. Ports where pilotage due is levied, ports total dues and charges can differ from the tables shown below because pilotage due depends from the distance. At the same time the differences from pilotage dues are not so

big that they would change the general picture. Pilotage dues are collected in all the researched ports except ports of Riga and Klaipeda.

In terms of port dues and charges most favorable ports for container vessels are Tallinn and Riga. Other ports are considerably more expensive. But there must be taken into account that as the ports are only one chain in the supply chain, also port dues and charges form only one part of the total (transport) costs.

In Table 10 total port dues and charges per call of containership OOCL Narva is shown in Euros. In Figure 17 costs are presented graphically.

Table 10. *Comparison of port dues and charges per call of OOCL Narva in Euros.*

# of calls	Tallinn	St. Petersburg	Riga	Klaipeda	Helsinki	Hamina	Kotka
1	7923	9009	10036	10792	23763	25306	25412
25	6530	9241	7467	9565	12857	14399	14506
60	5232	9241	5520	8917	8577	10158	10265

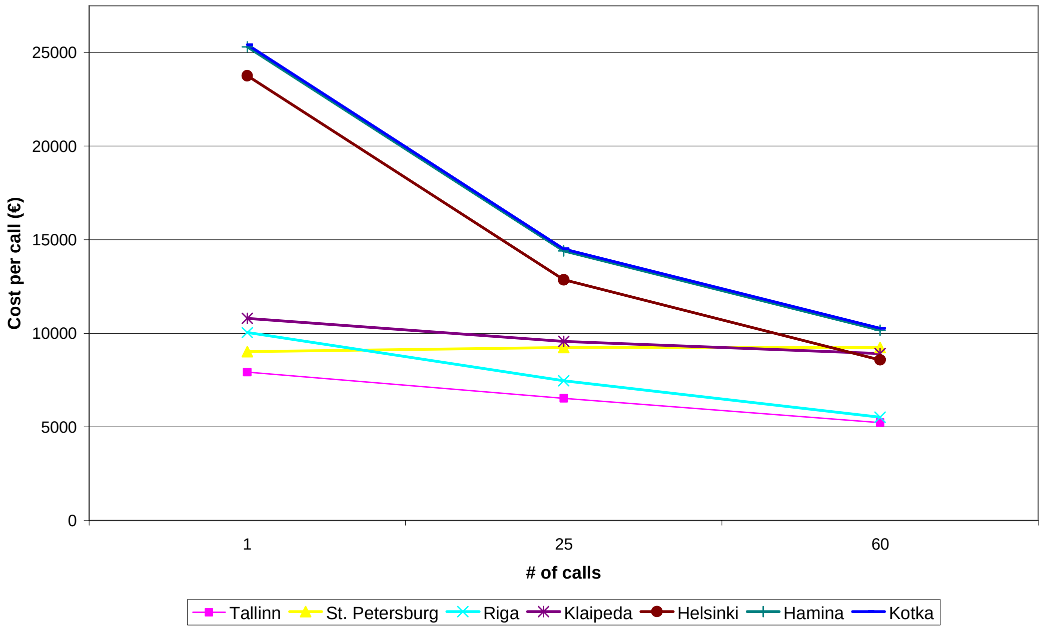

Figure 17. *Comparison of port dues and charges per call of OOCL Narva in Euros.*

In Table 11 are shown port dues and charges in total per call of containership Arctic Fox in Euros. Figure 18 shows it graphically.

Table 11. *Comparison of port dues and charges per call of Arctic Fox in Euros.*

# of calls	Tallinn	St. Petersburg	Riga	Klaipeda	Helsinki	Hamina	Kotka
1	4709	5630	6361	8724	14291	15410	15475
25	3995	5787	4733	7946	8112	9232	9297
60	3173	5787	3499	7535	5709	6829	6894

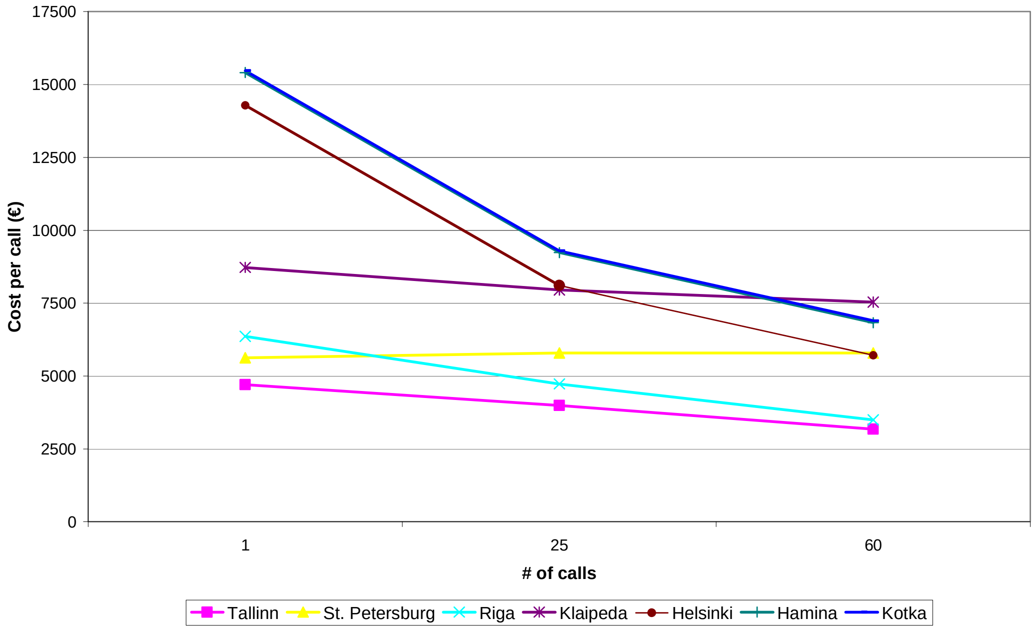

Figure 18. *Comparison of port dues and charges per call of Arctic Fox in Euros.*

In Table 12 total port dues and charges per call of containership Pavo are shown in Euros. Figure 19 presents costs graphically.

Table 12. *Comparison of port dues and charges per call of Pavo in Euros.*

# of calls	Tallinn	St. Petersburg	Riga	Klaipeda	Helsinki	Hamina	Kotka
1	3369	3135	3318	4611	12590	9679	9730
25	2652	3215	2469	4205	6678	6086	6138
60	2282	3215	1825	3991	4379	4689	4741

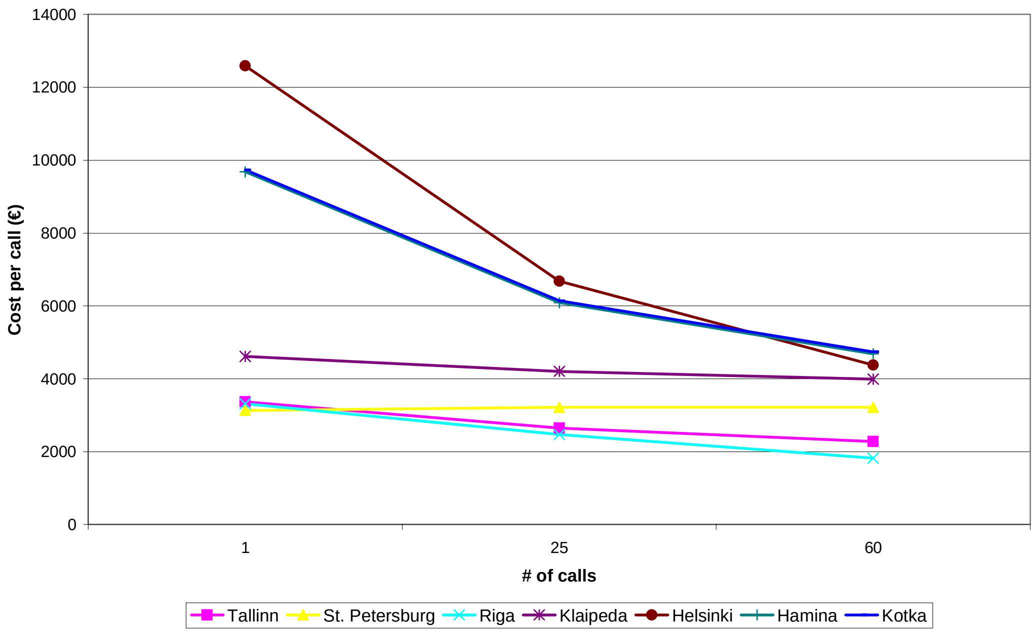

Figure 19. *Comparison of port dues and charges in total per call of Pavo in Euros.*

As a conclusions about container vessel call costs to Estonian and Finnish ports, we can argue that price competitiveness of Estonian ports is in the infrequent seasonal / project based containerized cargos. However, as volumes grow, and the frequency of vessels' port calls increases as well, the cost difference is becoming lower. Therefore, on cost side Finland could still offer somewhat appropriate level for containerized cargo. However, as input prices will increase in Estonia into the same level with Finland, the productivity difference between unloading/loading of cargo will keep the rates in Finland more sustainable (either distributed for customers, owners or used in internal development).

5 BORDER CROSSING IN FINLAND AND ESTONIA

5.1 Border Crossing from Finland to Russia

In Finland transit transports are polarized: eastbound transit traffic is transported by road and westbound transit is transported by railways. One reason for this is the lack of suitable stock and carriers on railways to transport containerized cargo; the stock is more or less suitable for carrying bulk goods. So, it is natural that transit coming from Russia is transported on railways and in practice all the transit traffic heading through Finland to Russian consumer markets is transported on roads.

Main border crossing points from Finland to Russia by rail are:
- Vainikkala
- Imatrankoski
- Vartius
- Niirala.

Main border crossing points from Finland to Russia by road are:
- Vaalimaa
- Nuijamaa
- Imatrankoski.

In this chapter we are focusing on the Finnish eastbound traffic which is mostly going through Vaalimaa border crossing point. The OKT-Infra project is focusing on trasit oil and container flows through Finland and Estonia, and the only transit flows through Finland at the moment are containers. Vaalimaa alone accounts for about two thirds of transit tons from Finland to Russia. All in all, transit traffic to Russia has been growing, and the growth has been especially impressive concerning transit transportation of passenger cars. For example, in 2005 over 330 000 cars were transported through Finland, and already in 2006 very same figure was about 530 000 (National board of customs 2007b, 2007c). Based on the figures of the first quarter of the 2007 the growth is stronger than ever; if the growth remains at the same level for the remainder of the year, the amount of transported cars through Finland to Russia grows to one-and-half-fold (National board of customs 2007d). In total 774 000 passenger cars were imported to Russia in 2005 and in 2006 the amount was already over 1 million cars (UN 2007); in other words over half of all imported passenger cars to Russia came through Finland. Märkälä and Jumpponen (2007, p. 47) found out that port of St. Petersburg is another, almost as important as the Finnish, route in transporting cars to Russia. Russian markets, and accordingly the imports, for passenger cars are going to be growing strongly, as only two families of ten have a car presently in Russian; in their transportation strategy Russian government has set a goal of 80 percent of families having a car by the year 2020 (Märkälä & Jumpponen 2007, p. 27).

The oldest and most important border crossing point at Vaalimaa was established in 1958, and it has been open 24 hours a day since 1993. At the moment it is the most active border crossing point on the eastern border of Finland, and e.g. Finnish customs employs there 125 employees. In 2006 about 1.2 million vehicles crossed the border at Vaalimaa, 440,000 of which were trucks. Finnish customs has also facilities to X-ray vehicles at the border, and about 12,000 vehicles get transilluminised every year. (National board of customs 2007e)

The amounts of goods crossing border at Vaalimaa eastbound have been growing since they were at their low in 1999 during the financial crisis of Russia (National board of customs 2007e). Clear trends in eastbound transit show that the transported amounts have been growing for the last two years annually over 15 percent (National board of customs 2007a, 2007b; MINTC 2006). Growth seems to be anything but slowing down: the figures of the first three months of 2007 show growth of nearly 25 percent (National board of customs 2007d, see figure 1). Statistics also clearly point out that amount of traffic at the border is increasing towards end of the year (National board of customs 2007f). Traffic in tons from Vaalimaa is presented in more detail in Appendix 2. Although when looking at traffic amounts in number of trucks at Vaalimaa the growth is not as dramatic as in tons (Table 13).

Table 13. *Trucks crossing border eastbound at Vaalimaa 2006-2007 (National Board of Customs 2007).*

2006													
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**	**ch. % 05-06**
12604	14151	15794	16059	17080	18394	18251	17759	17428	20154	19278	18596	205548	16,0 %

2007													
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**	**ch. % 06-07***
14973	16223	17965	18947	18620								86728	14,6 %

* first five months

The duration of border crossing and factors affecting it have been studied in a project launched by the Finnish Ministry of Transport and Communication. Project was a a case study (Sirkiä et al. 2005), and it concluded that the first and foremost goal should be developing the border crossing process as a whole towards more efficient activities. To achieve this goal, Finnish and Russian Customs have to develop their activities and do infrastructure investment planning in cooperation. Other identified development targets were Russian departure customs clearing and clearing at the destination. Also in Finland, especially in heavily encumbered customs offices, there is a lack of resources in departure customs clearing. (Sirkiä et al. 2005)

Total eastbound capacity in 2006 of the three main border crossing points was estimated to be 1130 trucks per day; respectively Vaalimaa had 610, Nuijamaa 380 and Imatrankoski 140 trucks per day (MINTC 2006). The capacities mentioned before are annual averages, and some of the busy months at Vaalimaa have average capacities of 800 trucks per day eastbound (National board of customs 2007e). Finnish and Russian customs have set a target capacity of 1600 trucks per day through these three border crossing points. Interestingly in Imatrankoski and Nuijamaa the transports have been about half transit and half

export, but in Vaalimaa 88 percent of the transports were transit transports. (MINTC 2006)

Vaalimaa has been suffering increasingly from traffic congestion, which causes long queues outside of the actual border crossing area. In the worst cases length of this queue has been up to 50 kilometers (Finnish road administration 2007). The bottleneck of the border crossing is on Russian side of the border, problems are present in both the bureaucracy (e.g. nine different service points in several buildings) and in the level of infrastructure (Sirkiä et al. 2005, National board of customs 2007d). This has led to situation where the latest and forthcoming investments have been/will be focusing on minimizing the negative side-effects of growing transit traffic (e.g. widening of the side of the road in 2006-2007 and building parking areas for trucks in 2008). There has been plans to make an investment to separate passenger and freight traffic in their own lanes in 2009has been in planned (National board of customs 2007d, MINTC 2006). The already completed actions regarding other border crossing points include opening also Imatrankoski for 24 hours per day (estimated to add capacity by 100 trucks per day) border crossing from the beginning of 2007 and separation of freight and passenger traffic in Nuijamaa. (MINTC 2006, National board of customs 2007e).

Variability of arrivals was examined using the only available data, which in this case was the data of queue length. Variability was calculated from addition of trucks and average monthly handling capacity. Incoming trucks equals the total of addition of the queue together with average of handled cars per day. The data is from time period from November 2006 to June of 2007. These calculations resulted in variability of 45 percent which was multiplied 1.1 equaling variability of 50 percent. This correcting measure was performed, because the used calculation method uses averages and has therefore has leveling effect on variability.

5.2 Border Crossing in Estonia

5.2.1 Border Crossing by Road

Estonia has a significant part in serving Russian transit cargo flows. Transit through Estonia has enabled to establish successful enterprises and many jobs to both sides of the border. To retain the position it is rather important to research the needs of logistical chains that pass through Estonia.

The number of trucks crossing the border has increased every year. The growth seems to continue, and therefore investments in infrastructure will soon be necessary. As developing infrastructure is rather expensive and takes a huge amount of time, it is extremely important to examine the situation in main border crossing points in Estonia.

The most important road border crossing points, through which the transit goods pass in containers to Russia, are Narva in North-East side of Estonia, and correspondingly in South-East towns of Koidula and Luhamaa are the crossing points.

Narva

Narva border crossing point's truck terminal was built in 1997 and the planned capacity was 150 trucks altogether (in and out) per 24 hours. Now the figure is 300-400 trucks per day, which makes it more than 2 times greater than planned 10 years ago. Nevertheless, it is thought that 500 trucks is the maximum number, because the infrastructure is not capable to create new workplaces for custom officers.

Russia has the biggest influence on the capacity: It all depends on how many trucks can the Russian side can take. As the border crossing point director said, "nothing else affects working on full capacity, because on our side the process management works very well".

But the growth of capacity is surely interfered with infrastructure. The latter's potentiality has been exhausted due to the border crossing points location in the middle of the town and enlarging the area is not possible.

Narva border crossing point receives information about the number of trucks in the queue from municipal enterprise Transservice-N. The enterprise offers a waiting platform for the trucks which are waiting for the border crossing. When calculating waiting time, the number of trucks crossing the border in 3 days is used. It considers only the outgoing route, because incoming direction nearly does not have a queue. That is because of the fact that majority of outgoing trucks are loaded, but every second of incoming ones is empty. All the trucks waiting for the border crossing are standing in one and the same queue, except some with perishable goods. Amounts of trucks passing the Narva border crossing station is presented in Table 14.

Table 14. *Trucks crossing border at Narva during 2004-May.2007 (Estonian National Tax and Customs Board 2007).*

2004	1	2	3	4	5	6	7	8	9	10	11	12	SUM
IN	1425	2278	2598	2791	2289	2602	2862	2698	3003	3155	2946	3633	32280
OUT	1607	2136	2626	2587	2360	2529	2779	2847	3108	3336	3048	3359	32322
SUM	3032	4414	5224	5378	4649	5131	5641	5545	6111	6491	5994	6992	64602

2005	1	2	3	4	5	6	7	8	9	10	11	12	SUM
IN	2461	3498	4088	4130	3923	4098	4262	4235	4370	4318	4517	4748	48648
OUT	3168	3702	4426	4798	4515	4513	5093	5141	4868	4976	4964	4590	54754
SUM :	5629	7200	8514	8928	8438	8611	9355	9376	9238	9294	9481	9338	103402

2006	1	2	3	4	5	6	7	8	9	10	11	12	SUM
IN	2728	3938	4550	4499	4465	4513	3971	4066	4460	4556	4026	4745	50517
OUT	3472	4503	4755	4948	4950	4764	3638	3533	4442	4623	3992	4238	51858
SUM :	6200	8441	9305	9447	9415	9277	7609	7599	8902	9179	8018	8983	102375

2007	1	2	3	4	5	6	7	8	9	10	11	12	SUM
IN	3109	3852	4781	4739	3882								20363
OUT	3495	3833	4486	4829	4531								21174
SUM	6604	7685	9267	9568	8413								41537

The average of the three first months of the year 2007 shows that queue length is approximately 2.83 km (see Appendix 3). It must be mentioned that the average is so low because of the zeros in the beginning of January. Usually the length reaches up to 4 km.

In usual circumstances border forming takes up to 15-20 minutes. This time can be affected negatively by incorrect documents, different electronic applications among them internet using problems.

There is no reason to doubt in custom officers' competence or flexibility, because most of the problems are solved by them on the border. The future predictions see growth of the waiting time at the border in outgoing direction, because the goods flow to Russia increases continuously.

(Information and figures: Aleksei Ponomarjov, the director of Narva border crossing point; the webpage of Estonian Tax And Customs Board: www.emta.ee)

Luhamaa and Koidula

Similarly with Narva, the number of trucks crossing the border has been increasing also in Luhamaa and Koidula. Comparing the figures from the year 2003 and 2006 in Luhamaa the growth has been 1.9 fold and in Koidula 2.8 fold (see Table 15 and Table 16). During the last two years this figure has stabilized: comparing 2005 and 2006 the growth is accordingly 2% and 1%. This year approximately 1306 crossed the border in Luhamaa in a week, in Koidula 1,065 trucks.

Table 15. *Trucks crossing border at Koidula during 2003-2006 (Estonian National Tax and Customs Board 2007).*

	1	2	3	4	5	6	7	8	9	10	11	12	SUM
2003	1143	1474	1601	1775	1958	2003	1883	1955	2096	2025	2059	2072	22044
2004	1520	1520	2455	2854	2409	2515	2656	2744	2805	2566	3469	4631	32144
2005	3286	3854	4090	4668	5101	5238	5680	5727	6552	7034	5650	5179	62059
2006	3617	4771	5503	5132	5668	5293	5401	5967	5502	5082	5054	5807	62797

Table 16. *Trucks crossing border at Koidula during 2003-2006 (Estonian National Tax and Customs Board 2007).*

	1	2	3	4	5	6	7	8	9	10	11	12	SUM
2003	2007	2891	3122	3379	3330	3117	3529	3504	3573	3815	3836	3596	39699
2004	2857	2857	4077	4523	2269	3474	2678	3375	3365	3564	3627	4213	40879
2005	3162	5158	7011	7067	6498	6045	5700	5783	6336	7188	6428	7152	73528
2006	4664	6424	6959	6620	6533	5854	5939	6197	6379	6444	6197	6834	75044

Trucks with cargo and also the empty ones stay in the same queue when they are going out of Estonia. The reason for this is that road has a limited width which does not allow organizing more than one queue. In the opposite direction the situation in general is different. Incoming trucks have two separate lines: one is for trucks with cargo and the other is for the ones that are empty. When considering the queue length, the average of this year for the 3 first months shows 0,75 km in Luhamaa and 0,7 km in Koidula. From the Appendices 4 and 5, it can be seen that the length of queue rarely goes over 2 km.

The biggest problem is once and again the unstable work of the Russian side, which causes long queues from time to time in outgoing direction and waiting time rises up to several days. The queue is longer when public holidays are coming. Time spent on documents forming depends on the incoming cargo, documents being in order and necessity of control.

A large part of border crossing trucks in these two border crossing points are the ones which carry out transport between third countries and pass Estonia only as transit. Additionally to Russian and Estonian car transport trucks Latvian, Lithuanian and Dutch trucks are also often seen.

(Information and figures: Jüri Haamer, the director of South Tax and Border Center; www.emta.ee)

5.2.2 Border Crossing by Rail

Approximately 45 million tons of goods are transported by rail in Estonia. That is almost 36 train pairs per 24 hours, where 25 come through Narva and circa 10 pairs through Orava. Very few, just 3 to 4 come through Valga. Accordingly, there are 2 border crossing points/stations, which are truly important when oil transit is taken into the consideration Narva in the North-East of Estonia and Koidula, in the South-East of Estonia (though the actual border crossing is much further inland- Orava station). In Narva, there are 9 station rails and 7 of these are used for shunting, but in Orava there are 6 station rails and only 5 are in use.

Narva and Koidula

Unlike road transport, there are no queues, because railway traffic works by the schedule. Nevertheless there is no reason to believe that Estonian railway works as precisely as Swiss clock. Estonian Railway has relatively low tariffs and good capacity, but on negative side the infrastructure is in moderate/poor condition, equipment is old and the security level is low.

In May 2007, the amount of trains passing Narva was only two thirds of the capacity (see Table 17). Comparing with the previous period, today the goods traffic capacity is the same as it was in 2001. In June 2007 there was also only 16 goods train pairs. Occurred low level of traffic is due to the repair works of the section VF's Gatšina-Kingisepp and also the St. Petersburg junction is being electrified. It must be mentioned that Estonian Railway is also doing repairing works on its whole spread.

Table 17. *Amount of trains crossing at Narva border crossing station, during 2002-2006 and first five months of 2007.*

	2002	2003	2004	2005	2006
Import trains	5525	6554	6477	6351	6738
Export trains	6169	6186	6180	5657	6258
Sum	11694	12740	12657	12008	12996
Avg # of trains per month	975	1062	1055	1001	1083

2007	1	2	3	4	5
Import trains	675	564	626	584	384
Export trains	593	529	608	543	393
Sum	1268	1093	1234	1127	777
Avg # of trains per day	41	39	40	38	25

International railway traffic considers Orava station as a limiting point for the capacity, because its capacity is 16 train pairs a day. At the same time Narva does not slow the traffic: on Narva railway section Karina-Tapa stage lets through 34

pairs a day. At this very moment it is quite difficult to say the accurate capacity of Narva station, because it has been rebuilt and extended recently.

So, it is rather difficult to say that stations are the bottlenecks. It could be stated that there are certain sections, which have proven to be problematical from time to time. For example Tallinn-Ülemiste, Ülemiste-Tapa, Valga-Piusa can not be considered as bottle-necks. The real bottle-necks would be sections where the cargo traffic holds big quantities, such as Lagedi-Maardu, Tapa-Narva and Tartu-Orava

The capacity in border-stations depends more on train traffic and its frequency and on the work of neighbour railway. Stopping times there depend on carriages' technical condition, amounts of shunting works and locomotive changes, and also time for document handling. Accepting and handing over the trains in border stations is being completed according to the timetable. For transit trains it is said that 45 minutes can be spent on drawing up the border documents, for route trains the time is 30 minutes. Mostly there are no problematical documents, just 5-7%, and these do not hold the infrastructure anyway.

The border officers are able to watch all the goods trains that are going out of the country by the carriages-watching-system. The information about incoming trains is sent 2 hours earlier with preliminary weight report. All the data will be inserted by the Estonian Railway after trains have arrived.

When examining all the average indicators, it could be possible to accept more trains. But again Russia is the unpredictable factor: what is on the situation there and how many trains are they sending here per 24 hours.

Estonian border stations can not work at full capacity, if the trains arrive irregularly, and do not follow traffic schedules. That is why the number of trains and the pressure on the capacity of infrastructure is varying. If we leave out the capacity problems in Orava just for a second, the main obstacle reaching efficiency is the trains' unstable arriving times to border stations from Russia. There are plenty of examples that sometimes a lot of trains arrive at the same time and the infrastructure is the constraining factor. Respectively there are also times, when the number of trains is lower than usually.

When leaving out all the reasons which are somehow related to Russia, we find out that Estonian side has also its problems. The main issue is hidden into the contracts related to the goods arriving to Estonia. These contracts state who will carry the goods, and which terminal will deal with the goods. That is the reason why some terminals are overloaded, while the other may stay empty.

The economical success would be protected and guaranteed by developing infrastructure, IT and facilitate in time and secured deliveries. All that could be accomplished through systematical co-operation, preventing accidents, good customer service, research and continuous analyses. According to Railway Inspection the Koidula border crossing point is building new station away from city of Tartu, where the customs procedures are currently performed. For 2008-2010 Estonian Railway has planned some important major repairs, which should speed up the traffic and increase the capacity in the bottlenecks.

(Information and figures: Jaak Simon, Railway Inspection; K.Roos, the director of Narva border station; www.evr.ee, www.rinsp.ee)

6 WAREHOUSING IN FINLAND AND ESTONIA

6.1 Warehousing in Finland

In this chapter we are giving an outlook on warehousing capacities of the most important Finnish cities regarding eastbound transit traffic. We identified Kotka, Hamina, Kouvola and Lappeenranta as these cities. In addition, we examined briefly the warehousing capacities of Helsinki and Hanko. Hanko differs from the other cities by in way that its eastbound transit traffic consists almost solely of car transportation; e.g. 254,000 cars were imported to Russia via port of Hanko in 2005 (Märkälä & Jumpponen 2007), and the figure in 2006 was approximately 300 000 (authors' own calculations based total figures of Port of Hanko 2007a). Also considering Helsinki an important city in terms of transit is somewhat contradictory, as port of Helsinki and the activities around it have been concentrating on serving the Finnish consumer markets, instead of Russian consumer markets. Kotka and Hamina have more favourable location for transit transports near Russian border and they have also invested in transit business. Additionally they have already strong exports, so they have general cargo flows in both directions. Also Kouvola has taken its share of the transit flows, mainly due to its location as central railway city in South-Eastern Finland. Lappeenranta is having favourable location in South-Eastern Finland near of all main border crossing points.

Figure 20 depicts the development of warehousing capacity Kotka, Hamina, Kouvola, Lappeenranta and Hanko; Helsinki is not presented in the figure, as it has rather steadily had warehousing capacity of about 1.2 million m^2 during 1997-2006. Figure 20 illustrates the effect of increasing traffic on warehousing capacities; there have been some clear increase surges in warehousing capacity, especially in Hamina in 2002 (159 %) and in Kotka during 2002 (109 %) and 2005 (55%). Also Kouvola there has been increase in warehousing capacity, but the surges have not been as steep (e.g. in Kouvola capacity grew by 24 % in 2002 and 39 % in 2005). Lappeenranta has had rather some, even conservative, growth compared e.g to Kotka and Hamina. Also Hanko has more than doubled its warehousing capacity, granted that the absolute figure is still rather small.

At the moment Kotka has about 580,000 m^2, or in volume 4.4 million m^3, of warehousing capacity (City of Kotka 2007). According to city of Hamina (2007) warehousing capacity there is at the moment about 354,000 m^2 and volume about 3 million m^3. At the moment in Kouvola there is reported to be 225,000 m^2, or alternatively 1.6 million m^3 in volume, of warehousing capacity. In Kouvola there is still plenty of area reserved in city planning for new warehouses, but at the moment there are no new investments of bigger magnitude in sight (City of Kouvola 2007). Lappeenranta has roughly the same amount of warehousing capacity as Kouvola. These findings together with count of warehouse buildings and percentage of warehouses with installed heating are summarized in Table 18. Figures of volumes are indicative as there were missing values for some of the buildings in the registries.

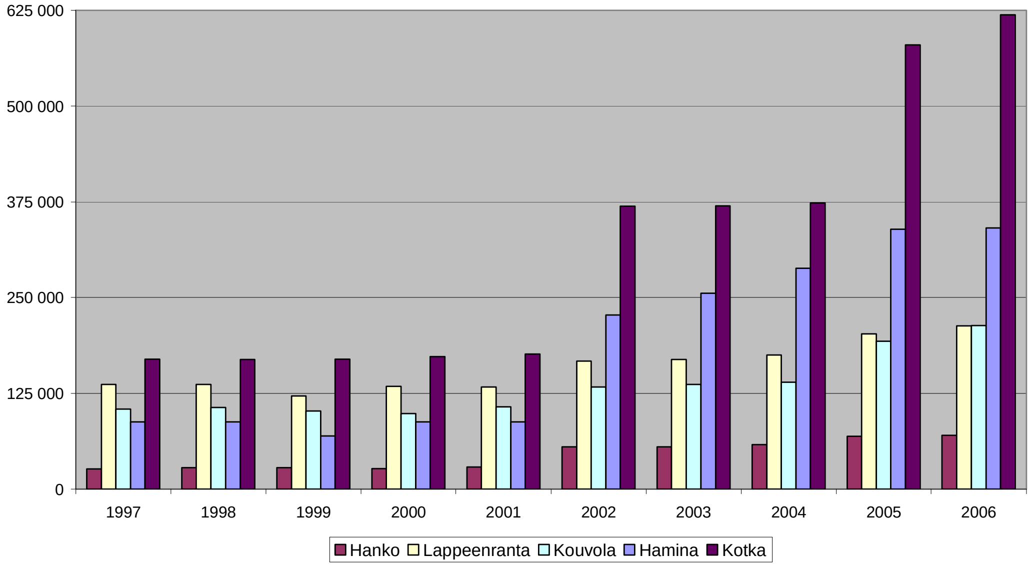

Figure 20. *Total warehousing capacity in certain Finnish cities in square meters between 1997-2006 (Source: Statistics Finland 2007).*

Table 18. *Current warehousing capacity in the three most important Finnish eastbound transit cities (Lappeenranta 2007, Kouvola 2007, Hamina 2007 and Kotka 2007).*

	Lappeenranta	Kouvola	Hamina	Kotka
Capacity (m^3)	1 853 608	1 607 955	2 998 584	4 363 330
Capacity (m^2)	218 974	225 208	353 935	582 937
Amount	226	132	204	311
% w/ installed heating	n/a	75 %	39 %	37 %

At the port of Hanko there exists numerous companies concentrating on importing cars and export of paper products is balancing flows out of the port. As mentioned before, Hanko has over doubled its warehousing capacity in less than 10 years (Statistics Finland 2007b). Lately, the port of Hanko has been investing annually 3-4 million euros. In future they are planning an investment of 7-10 million euros on a pier and it will, together with budget pressures from the city, have diminishing effect on other investments for the next couple years.

Port of Helsinki is at the moment going through restructuring of its operations. This is why the development of current West harbour and North harbour at port of Helsinki has been minimal in recent years and volumes have been moving to e.g. port of Kotka. All cargo operations are going to be centralized in the new Vuosaari harbour, which is according to plans going to be opened for traffic in end of 2008 (Port of Helsinki 2007). Port is going benefit city e.g. by reducing heavy traffic in the city centre (Port of Helsinki 2007b).

Area of warehouse buildings inside the area ports in respective cities are presented in Figure 21. The amount of Kotka port was 468,000 m^2 in 2006 (Finnish Port Association 2007), which accounts for 80 percent of the city's total warehousing capacity. In the area of Kotka port there is 200 hectares of unused land and further enlargements have to be made towards the sea (Niemi 2006). Finnish Ports Association (2007) reports that alone inside the Hamina port area there is almost 310,000 m^2 of warehouse buildings and it represents about 87

percent of city's total warehousing capacity. In the end of 2006 Hanko is reported having 56,800 m^2 of warehouses in its port area, which is about 81 percent of total warehousing capacity in Hanko (Finnish Port Association 2007, Statistics Finland 2007). Also port of Hanko is already using almost all of its area, so any bigger expansions have to be made towards the sea (Järvinen 2007). Helsinki is a clear exception in this group as it has only about 15 percent of its warehousing capacity inside the port area. This is quite impending result as the port of Helsinki is serving mostly Finnish consumer markets and the central warehouses of those goods are most often outside port area, and also often outside even Helsinki itself in its neighbouring cities. Cities dealing mostly with transit have their warehouses centralized in the port area.

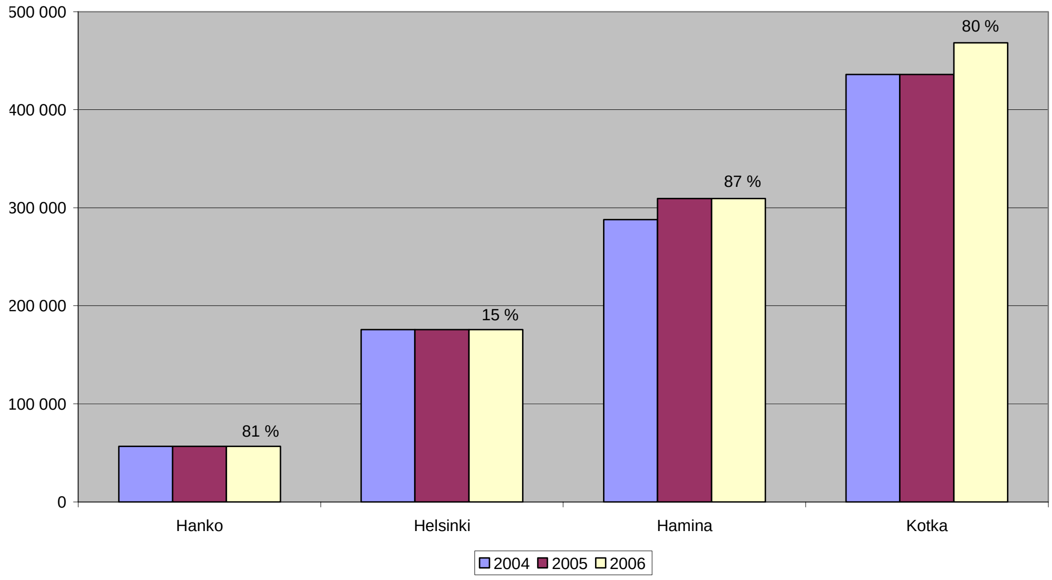

Figure 21. *Total area of warehouses inside port area capacity in square meters in port area between 2004-2006, and its percentage share of total warehousing capacity of respective city in 2006 (Source: Finnish Port Association 2007, Statistics Finland 2007, Cities of Hamina and Kouvola).*

6.2 Warehousing in Estonia

In this part we are giving you an overview about the main warehousing capacities situated in Estonia related to eastbound transit traffic. According to the latest data, three main warehousing territories have been identified: Port of Muuga, Maardu terminal and Paldiski Esteve PVC hall.

We are also adding a remark about transport statistics in Estonia. There is a lack of reliable statistics regarding warehousing capacity in Estonia.

6.2.1 Capacity

As for the containers, there are big Refra PVC halls as under roof warehousing area (no data about their size) in the Port of Muuga and on the whole the port

capacitates 151,000 m^2 of total warehousing area (Port of Tallinn 2007). In Maardu (whose owner is Cargohunters/Freselle) a hall of 8,000 m^2 takes place. In Muuga CT there is one under roof warehouse inside the terminal, and it is 8,000 m^2. About 170,000 m^2 is in use as an open container storage yard.

Regarding the transit containers, Muuga CT does not have exact figures and knowledge what the final destination point of the cargo inside the container is. According to some documents, the final destination of the cargo is some Estonian warehouse, but from this point Muuga CT is not able to see what will happen with the cargo. It could be taken out from the container inside warehouse, and later loaded into tented trailer and transported to Russia. So, it can be transit cargo, but Muuga CT, as a container terminal, are not able to see it from the documents. Therefore, with 80% probability, Muuga CT claims that 40%-45% of import cargo coming to Muuga CT terminal in containers is transit cargo.

There is no strong basis to claim that only transit containers are growing. Muuga CT has local cargo growth as well as transit cargo, and it is more or less the same growth for local and transit cargo. That is also true for the container growth beginning from 2000. We also found out that container volume growth percentage does not depend so much on the transit cargo. Muuga CT comment's with following: *"It was always the same 40%-45% of total import is transit cargo"* (Muuga CT 2007).

There is also an Esteve PVC hall in Paldiski. Its estimated capacity is approximately 20,000 m^2 under roof warehouses provided with necessary equipment (e.g. reach stacker) for handling containers.

Storage of loaded containers under roof is very marginal business and it is only fo certain temperature-sensitive goods. Referring to the member of Estonian Association of Logistics Illimar Paul, it loses the point because majority of sea carriers would not promise to carry cargo on hold only. It means that at sea the container would not be under the roof. The same goes for railways or cars. In consequence we may say that percentage of such goods does not exceed 1% of container flow.

When it comes to the under roof warehouses the situation is different. With under roof warehouses we mean the warehouses with one door, a roof and some vacancy. Such vacancy is available for example in Logistic Park of Tapa and is approximately 40,000 m^2 (left by a military unit since Soviet Union period).[1] There is also a trend in increasing of some area in the ports.

Under roof warehouse area, which is related to container servicing, is marginal in Estonia at the moment. It is caused by the fact that to this day (speaking about containers) Estonia has not been so much into for example repackaging of deliveries. Mostly with containers it has been about carriage type change. In fact, demand for repackaging has not been very remarkable. Due to that, there was no reason of creating advanced logistics centers. In the opinion of experts, if such demand is going to take place and will exceed the critical mass, then the logistics centers are going to be built taking reciprocal demand into consideration. No potential problems to impede that have been found. In fact, there are needed territories and experience in building and using modern

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[1] www.rrk.ee

innovation-intensive warehouse complexes (for example a warehouse complex in Jüri situated near Tallinn-Tartu highway).

As it was mentioned above, present business of Port of Muuga regarding containers in the container terminal does not call need for under roof warehouses as a matter of importance. In addition, enough rapidly increased port area for servicing and storage of turnover is sufficient at present and in the near future. On the other hand, this subject may actualize in case there is going to be built a container terminal with bigger output in the Port of Muuga or other location. However, if there would be need in creating of a distribution centre (regarding the change of the business idea of container business), then the present reserve area would be enough. For example, there is a 35,000 m^2 logistic park of Muuga situated between Maardu Lake and Port of Muuga, which is in the development process[2].

6.2.2 Warehousing Capacity Trends in Tallinn Area

Unfortunately, there is no statistics for warehousing capacity in Tallinn and its surroundings. However, we investigated the trends of its future growth. In the opinion of experts of Schenker Estonia and Ace Logistics Group there has been growing trend in warehouse capacity at least during last 5 years. This trend is going to hold during the forthcoming next years, after what it is going to calm.

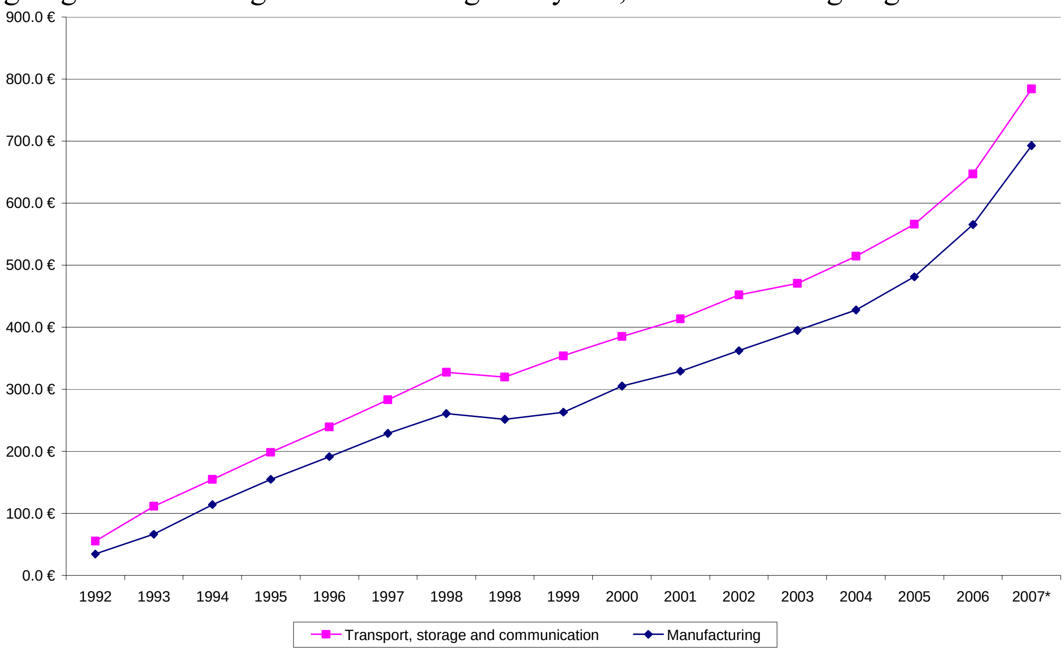

Figure 22. *Average monthly gross salary in Estonia during time period of 1992 to 2007 (two first quarters). Source: Statistics of Estonia*

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2 http://www.rrk.ee/index.php?lang=est&main_id=33&PHPSESSID=3fca0e92bf9ca7a2cf8fca218e282048

This can be explained by a few reasons. Firstly, wage levels in Estonia are growing rapidly. If a few years ago foreign investors built warehouses hoping on the cheap labour force in Estonia, today the situation is different. There is also identified rather significant decrease in labour force for staying in the work in warehouses. On the other hand, consumption growth in Estonia is also increasing. So, there is a definite connection between wage growth and decrease of warehouse amount. In fact, warehouse capacity grows on average 20-30% per year, but it is strictly related to the lack of labour force (Schenker Estonia). Consequently, owners of warehouses decide to move their business to Finland, Poland or Baltic States choosing between better quality or cheaper labour force.

As labour market constraints development of warehousing services, it is easily explained by analyzing monthly salary development in a longer time period. As Figure 22 shows, salaries in logistics as compared to manufacturing have generally been higher in Estonia during long period of time, and salary level has increased significantly in recent years. Therefore, it is rather easy to understand, why e.g. Finland is taking so large proportion from warehousing services of transit cargo; learning time related to value added logistics services is long, and as salary difference to Finland is not remarkably different, then competitive advantage could only be built with huge investments on hard and soft technology.

7 TRANSIT CONTAINER TRAFFIC AND ITS EFFECT ON BORDER CROSSING CAPACITY INVESTMENTS

7.1 Introduction

Most often traffic flows between regions, their respective currency valuations, and in the end economic prosperity is not equally distributed (Ohmae 1985). This leads to the situation where traffic is seldom in balance between major economies, and currency crises affect to the transportation flows enormously. For example, United Nations (1999a) estimated that South-Korean port of Busan has suffered from empty container handling significantly during Asian economic (and currency) crisis occurred in 1997. In case of Russian currency crisis, occurred in year 1998, devaluation resulted in the fall of imports to below half in only one year time (Chiodo & Owyang 2002). Based on Krugman's (2005) findings, world faces every 19th month currency crisis, and eventually traffic flows and logistics systems will pay the price (rapid enlargement of trade unbalance between regions, increasing amounts of empty transports). Even if the world trade has developed favourably during the recent years, the unbalance between continents still exist – as world trade continues to grow, this situation has only enlarged. As US is developing more into service and knowledge economy, and Asia serves their manufacturing power, the traffic is very unbalanced between these two continents (United Nations 2005a & 2005b). Similar situation is reported to be found from Europe as well; Russia exports extensively raw materials to west, using sea and rail, while their imports are mainly driven by road transports via Finland, and Baltic States (Kilpeläinen 2004). So, it could be argued that traffic balance is one factor, and transportation mode selection is another. This mode unbalance is not the minor issue; so far economic growth has favoured sea containers and air transports, but concurrently railways have been unable to respond on international transportation demand (Shu 1997; Lee 2004; Vellenga & Spens 2006). However, railways have been under agenda of several international traffic development projects (United Nations 1999a & 1999b; Molnar & Ojala 2003).

Research problem in this paper concerns the North-European country, Finland, and its role as transit territory for logistical flows of west to Russia and other rapidly growing eastern economies. Our problem is to build up a method with system dynamics simulation in order to estimate capacity addition needs in main border crossing of road transportation (containerized cargo). Problems firstly relates, how much we need to have additional border crossing capacity in total, in how many slots this is needed to be completed, and when these are timed to happen. Built model could be used in anywhere, if needed data for different variables is available. We have used reliable public secondary sources to obtain this – especially border crossing point seemed to be valuable source of needed data. So, some of the data is from instant public sources, while some of the parts were acquired from visits and contacts to the authorities.

7.2 Logistics across the Borders

As Figure 23 shows, world GDP has increased steadily during the last 50 years. However, this means that as the world trade is increasing by a higher magnitude compared to GDP, the amounts of transportation, especially international, also increases. The relationship between world trade and GDP growth was for a long time near of 1.5, meaning that every time the world GDP grows with one percent, trade has increased with 1.5 times. However, as globalization turned real during 1990's, this relationship has only fostered, so nowadays the multiplier is 2.5 (United Nations 2005b). Transit areas to larger markets show larger growth rates – as Baltic States represent important transit area for exports and imports of Russia and Ukraine, it has been found that growth factor of four exist(Kovacs & Spens 2006).

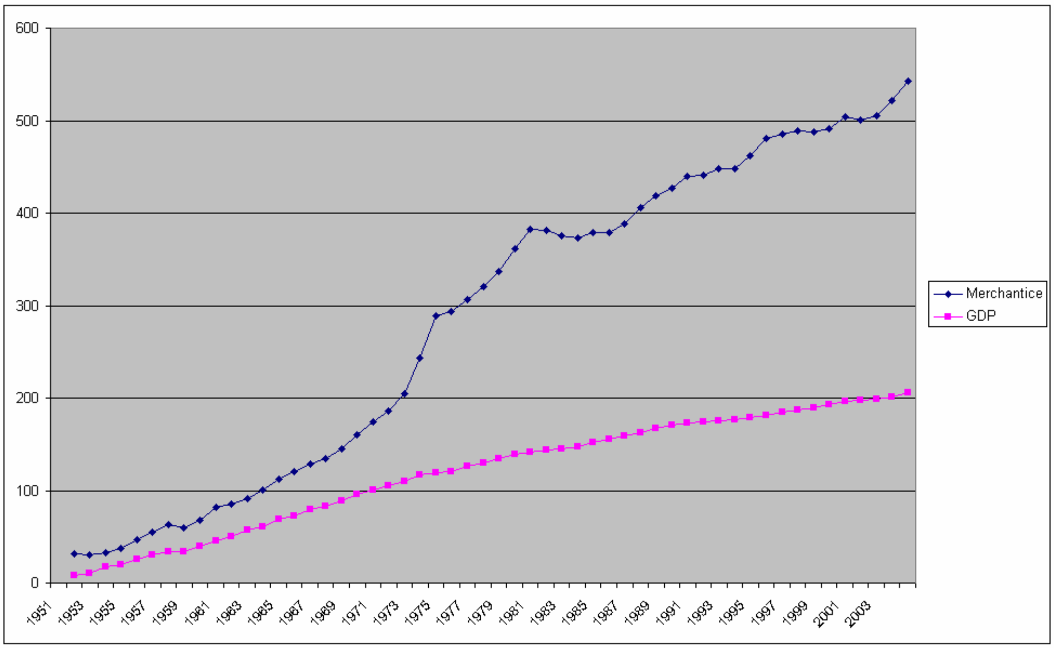

Figure 23. *World trade and GDP development. Source: World Trade Organization*

It is not surprising to find out that all the other three transportation modes, namely road, sea and air freight have increased their total transportation volumes for decades. From these three most popular alternatives, air freight has been predicted to grow annually by 6.2 percent (Boeing 2005), nearly without any limits. Also infrastructure research related to transportation models supports this mode; infrastructure in air freight transportation is constantly increasing, while e.g. road transportation has started to fall (Marchetti 1988), and rail infrastructure has been on the constant decline for several decades. Sea transportation was revolutionized after the 1950's with container transports, and volumes have followed similar rates with air freight (e.g. Platou Report 2006); United Nations (2005b) estimate that the growth was 8.5 % per year during 80's and 90's, while in the forthcoming

years we could expect slightly lower growth rates, 6.6 %. However, it is important to note that in railroad freights, although there exist a demand for increased international transportation, the proportional share and absolute amount of railroad freights have been in constant decline, e.g. in Europe. A number of different authors argue that this decline has been due to the collapse of communism/socialism, and overall changed production structures as European economies have developed via agriculture to industrial and further on to information/service economies. We can not argue against these factors; however, the reason for this declining development in the business side has mostly been the lack of international cross-border scheduled routes (e.g. passenger transports, see Milan 1996) as well as the flexibility to connect railway freights to other transportation modes (Batisse 2001).

Although, the developing nations, like China as well as India are showing remarkable growth rates, our world is still organized in a rather triad manner. Like Ohmae (1985) argued, fifteen original members of EU, USA and Japan rule the world, as we think it through of world's GDP. This is still the story, as *Table 19* illustrates: Total GDP from these countries is still in the range of 65-70 %, while during 80's this figure was five to ten percentage points higher. So, the developing world is getting richer, but with rather slow speed (in absolute terms), and these three regions still make the most important economic decisions in the world, and hold significance in transportation flows. However, within the next five years, we could expect that these rapidly developing economies are taking even larger share from world economy, and also traffic flows. This has already occurred in the sea transportation side; from TOP20 container ports (United Nations 2005a: p. 76), 12 are located in Asia and six in China alone. Correspondingly only seven ports from the economic triad make the list, three from both US as well as Europe, and one from Japan. Interestingly, from new growth economies, China and Russia have shown highest growth rates. India follows more conservative development (*Table 19*).

Table 19. *European Union 15 countries, USA and Japan, and their respective Gross Domestic Products, comparison to world total. Source: Statistics Finland (2007).*

	2000	2001	2002	2003	2004	2005	2006 (est.)
EU-15	8.082.521	8.122.622	8.873.944	10.812.548	12.437.570	12.878.975	13.597.422
USA	9.816.975	10.127.950	10.469.600	10.960.750	11.712.475	12.455.825	13.244.550
Japan	4.668.786	4.097.958	3.925.113	4.234.917	4.608.136	4.557.116	4.367.459
Total	22.568.282	22.348.530	23.268.657	26.008.215	28.758.181	29.891.916	31.209.431
Percent from total	71,30 %	71,18 %	71,34 %	71,12 %	70,15 %	68,06 %	64,73 %
China	1.198.483	1.324.812	1.453.837	1.640.966	1.931.642	2.243.688	2.630.113
India	461.329	473.867	494.848	576.547	667.342	780.784	886.867
Russia	259.702	306.583	345.486	431.429	591.861	763.878	979.048
Total	1.919.514	2.105.262	2.294.171	2.648.942	3.190.845	3.788.350	4.496.028
Percent from total	6,06 %	6,71 %	7,03 %	7,24 %	7,78 %	8,63 %	9,33 %
Whole World	31.654.000	31.398.000	32.616.000	36.572.000	40.998.000	43.920.000	48.212.688

Transportation traffic imbalance has been under interest in the continental perspective, since the starting of Japanese exports to US with significant manner in 60's and 70's. This in the end resulted in the legislation that e.g. Japanese car manufacturers were forced to establish their own factories (could be characterized

as screw-driving assembly places) to US soil to prevent increasing import taxes. However, traffic imbalance has continued in US case with both Asia, but as well with Europe. As Figure 24 illustrates, sea container traffic alone is three times higher from Asia to US than vice versa. However, in year 2004 from Europe sea container traffic was above 50 % more than from US to Europe. It should be remembered that valuation of US currency was in relatively low levels, as compared to Euro and Japanese Yen, and "traffic unbalance" should be at relatively low level then (since it favours US manufacturing units). Thus, until last year Chinese Yuan was having fixed rate with respect of US dollar, and simplistically speaking China and US were the same "common" trade area. Interestingly, European and Asian container traffic is nearest of balance, although, Europe does export more to Asia than other way around. Imbalances in world traffic flows result on the increased transportation costs, since empty transports increase significantly. For example, United Nations (2005) have estimated that during previous years empty container movement has been on the range of 20 to 22 % in the world scale. Anyway, large world-wide corporations hold the key in transport decisions; their internal material movements account majority from foreign trade of US, Japan and Europe (Barros & Hilmola 2007).

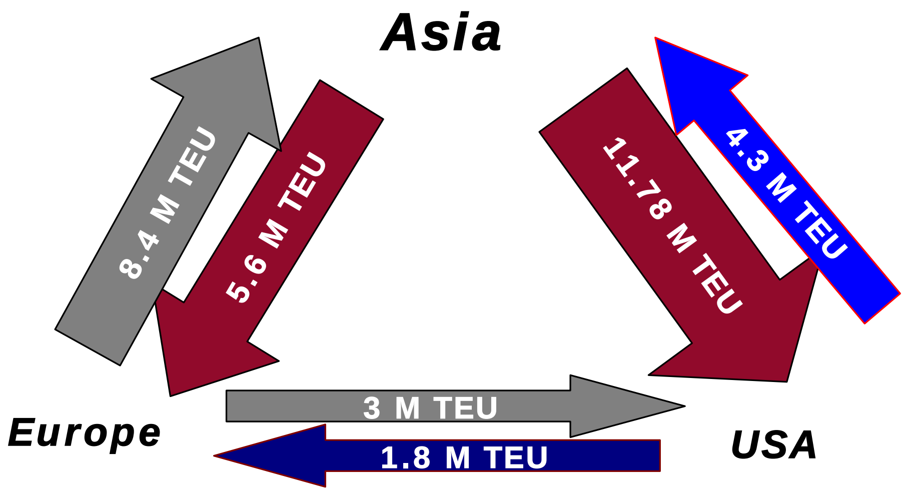

Figure 24. *Trade imbalance between three major continents is great, container transports (Twenty-feet Equivalent Units) in year 2004. Source: United Nations (2005b)*

Among continents, traffic unbalance exists also between countries; for example, Finnish-Russian traffic could be considered as one good example. Kilpeläinen (2004) estimated that road transit traffic from Finland to Russia was 17.5 times larger than vice versa. In the longer observation period, we could identify that this unbalance have persisted over magnitude of ten, except year 1995, and during the most recent years this has only worsened. During year 2005 from Finland to Russia road transportation traffic was above 30 times higher than vice versa. So, basically trucks traveled empty from Russia to Finland (in one out of thirty they have full load to carry), in order to take the load from some harbour (e.g. Hamina, Kotka, Helsinki or Hanko), and continue with full load to Russia. Traffic unbalance problem is created by the structure of Russian national economy and well-developed Northern-Europe; prestigious raw material base favors sea (54 %

from the value of Russian import to Finland) and rail (22 %) as transportation modes, and ignore road transportation (9 %). In contrary Finnish export relies on the road transportation side (86 % from the value of Russian import to Finland), and rail as well as sea has much smaller share (approx. 6-7 % share each). As one solution we could suggest either favouring road transports or railways solely in this situation; traffic would be in perfect balance as *Table 20* shows in its last part. As one step further development of direct railway connections to further in Central-Asia and Asia could be developed through Trans-Siberian Railways (TSR). However, currently this connection has faced a severe demand collapse due to increased transportation costs: during 2005 above 100,000 TEU was transported in this route, and in one year time this collapsed below 10,000 TEU. Currently similar sluggish development continues. Interestingly, in the end of 90's United Nations (1999a) estimated that below 5 % of container transports between Europe and Asia uses railway route through Russia. However, currently this percentage is below 0.1 % (for the situation in 2003 to 2005 see Lee 2004; Vellenga & Spens 2006).

Table 20. *Transportation unbalance in two main modes of transit traffic. Source: Statistics Finland (2007)*

Road Transportation (in tons)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Eastbound	801.886	1.203.895	1.848.106	1.378.648	895.959	1.181.843	1.402.330	1.663.700	2.126.857	2.490.231	2.780.085
Westbound	123.630	99.797	80.707	75.937	60.855	57.112	129.544	127.195	115.869	101.046	85.881
Total	925.516	1.303.692	1.928.813	1.454.585	956.814	1.238.955	1.531.874	1.790.895	2.242.726	2.591.277	2.865.966
Eastbound / Westbound	**6,5**	**12,1**	**22,9**	**18,2**	**14,7**	**20,7**	**10,8**	**13,1**	**18,4**	**24,6**	**32,4**

Railways (in tons)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Eastbound	476.304	629.070	580.717	359.285	229.740	222.515	237.351	210.863	202.188	234.363	196.745
Westbound	3.627.058	2.605.293	2.780.808	2.588.567	2.580.591	2.449.521	3.771.110	3.249.834	2.992.308	2.967.038	3.191.587
Total	4.103.362	3.234.363	3.361.525	2.947.852	2.810.331	2.672.036	4.008.461	3.460.697	3.194.496	3.201.401	3.388.332
Westbound / Eastbound	**7,6**	**4,1**	**4,8**	**7,2**	**11,2**	**11,0**	**15,9**	**15,4**	**14,8**	**12,7**	**16,2**

Total (in tons)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Eastbound	1.278.190	1.832.965	2.428.823	1.737.933	1.125.699	1.404.358	1.639.681	1.874.563	2.329.045	2.724.594	2.976.830
Westbound	3.750.688	2.705.090	2.861.515	2.664.504	2.641.446	2.506.633	3.900.654	3.377.029	3.108.177	3.068.084	3.277.468
Total	5.028.878	4.538.055	5.290.338	4.402.437	3.767.145	3.910.991	5.540.335	5.251.592	5.437.222	5.792.678	6.254.298
Westbound / Eastbound	**2,9**	**1,5**	**1,2**	**1,5**	**2,3**	**1,8**	**2,4**	**1,8**	**1,3**	**1,1**	**1,1**

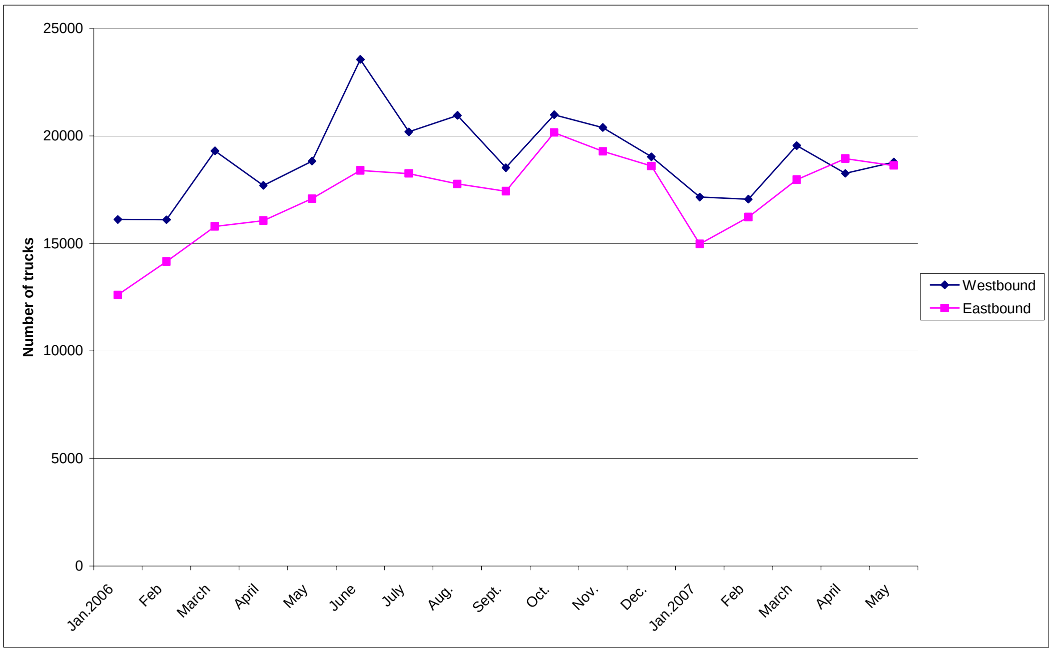

Figure 25. *Border crossing of trucks at Vaalimaa (Finland) border station. Source: Border station statistics*

In some occasions road transportation is able to utilize star structure (instead of two-way traffic, truck goes from A to B and continues to C, and from there goes back to A) to avoid harmful effects of unbalanced traffic. However, as Figure 25 shows from the main border crossing point of Finland (Vaalimaa), amount of trucks coming from Russia and going to Russia are nearly the same. Differences might arise from the fact that waiting lines in the main entry point to Russia are in some occasions extremely long ones, and trucks use two other more northern points to get in the country more quickly (border crossing point of Nuijamaa in Lappeenranta and Imatrankoski in Imatra) or some trucks heading to Central Europe might take direct route via BeloRussia and Poland and enjoy the benefits of cheaper fuel

7.3 Research Environment and Introduction to the Simulation Model

Simulation Model

System dynamics model (presented in *Figure 28*) built for simulating border crossing is trying to describe the possible future situation at Vaalimaa (Finland) border crossing station (main border crossing point in eastern transit traffic). Model could be applied as such to Estonian border crossing of eastern transit traffic (containers with trucks via Narva border crossing point). Similarly with oil transportation model, on the left side there exist Russian container imports, which we currently estimated as being 3 million TEUs per year (through Russia's own harbours it is currently been handled approx. 2 million TEU), and Finland having approx. 10 percent share of these transports. Thus, from traffic going through Baltic Sea and especially Gulf of Finland, Finnish harbours' share from transit traffic is approx. 25-30 percent. Therefore, one could rightly argue that region

competes merely with other importing regions of Russia rather than ports competing against other alternative ports. For Figure 26 future demand forecast could be predicted at least with two models; continuous growth model by linear trend shows that in the next five years time most probably we end up to transit container volumes of 330,000 TEUs (model is having explanation value of 55.15 %, as equation shows). If constrained growth curve is fitted into data, we could rightly argue that volumes stay at current level, and further growth is not going to realize. Thus, alternative for these two forecast models is time series of using data only from year 2000 onwards, which is shown in Figure 27. Regression line predicts rather accurately development of transit traffic (above 90 %), and based on that volumes should be around 420,000 TEU in five year time period. Use of data from 2000 onwards holds two major strengths: (1) containerization of cargo has increased in a world scale considerably within last two decades, and (2) Russian currency crisis, occurred in year 1998, and devaluation resulted in the free fall of imports to below half in only one year time period (Chiodo & Owyang 2002).

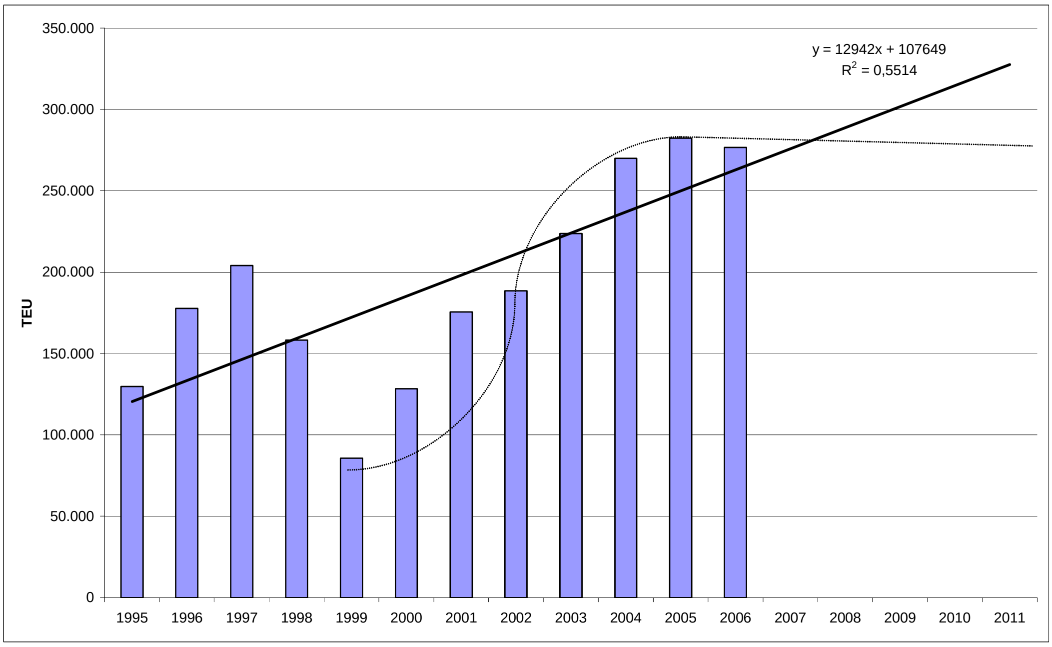

Figure 26. *Transit container transportation traffic transported through Finland time series for period of 1995 to 2006 (data before 2003 is approximation from transported tonnages from Statistics Finland).*

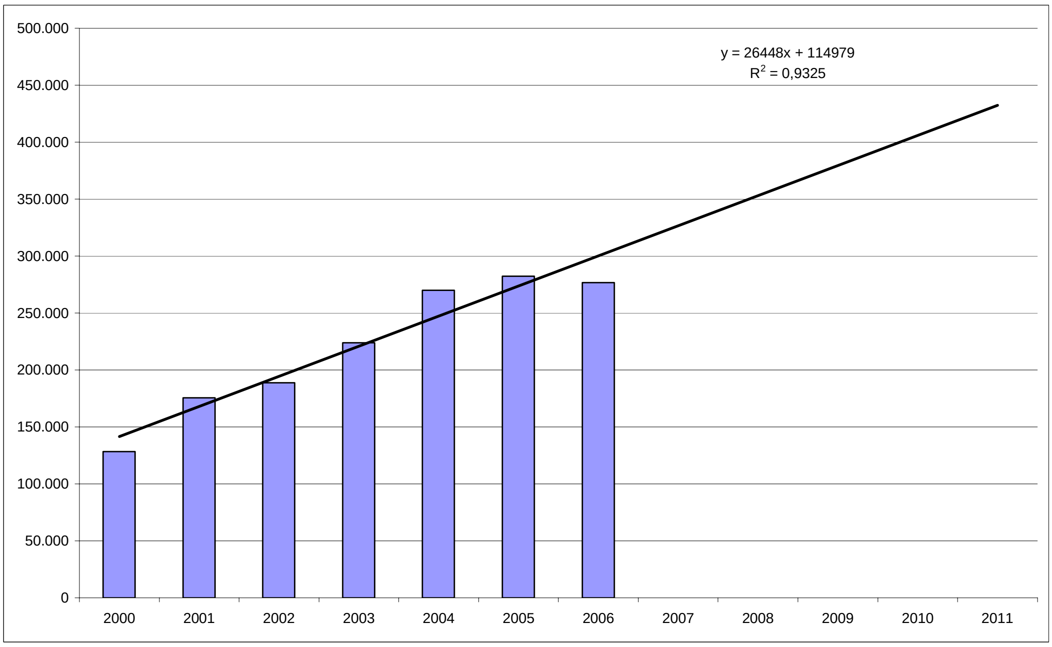

Figure 27. *Transit container transportation traffic transported through Finland time series for period of 2000 to 2006 (data before 2003 is approximation from transported tonnages from Statistics Finland*).

Vaalimaa is currently having approx. 69 percent of the transit transports to Russia (Finnish Board of Customs 2007a), and so we used it as Vaalimaa's share of the Russian container imports.

As Figure 28 shows, we have chosen monthly observation period for simulation run, and have estimated that each truck could carry two 20 feet containers (on the average – cargo is in frequent cases unloaded from containers in Finnish warehouses, and loaded on the conventional carrying platforms of a truck). Border crossing capacity at Vaalimaa is at the moment estimated to reach 670 (although momentarily it has been reported to reach 800, Kuntsi 2007) trucks per day eastbound, and it is open every weekday (30 days per month). Based on the official statistics we have estimated that the level of originally containerized border crossing capacity to reach 89% from total transit freight traffic. Therefore, we could calculate current monthly container handing capacity at Vaalimaa, and argue it to reach roughly 17,900 container trucks per month.

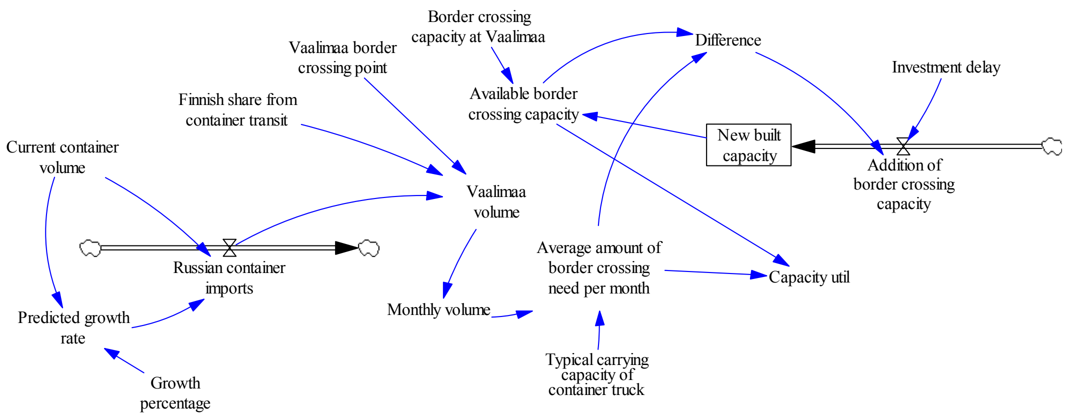

Figure 28. *System dynamics model for imported containers to Russia through Vaalimaa border crossing point.*

Investment delay in border crossing capacity is estimated to be 12 months, and in this first model computer invests each occasion one third from the need (as available border crossing capacity is being deducted from the average amount of border crossing need per month).

7.4 Initial Simulation Results

In order to provide rough approximation of infrastructure needs during the next 10 years, shown model was simulated for period of 120 months. In the following we have estimated following stochastic variables for the model:

- Russian container import percentage growth from the base value: 10 to 20 percent (random uniform distribution) – In Russia import growth rate was around 20 percent in 2007, more than three times of GDP growth (6.7 %). Early months of 2007 have indicated even higher growth rates in imports (up to 50 %, Barents Observer 2007), and forecasts of GDP growth argue Russian economy to remain current level of GDP growth (or moderately decline from it, e.g. BOF 2007b, Economist 2007)
- Finnish share from container transit: 5 to 14 percent (random uniform distribution), at the moment 9.5 percent (285,000 TEU)
- Vaalimaa's share from transit traffic: 60 to 80 percent (random uniform distribution).

With these variable changes model was simulated 200 times, and results are shown in Figure 29 and in Figure 30. As Figure 29 shows, in ten years time Vaalimaa's container volumes will increase at maximum around 750 kTEU, and at worst transportation volumes could decrease 150 kTEU. Based on the selected stochastic variables, most likely handling volume is in ten year time around 260 to 480 kTEU. Although growth rate seems to be impressive, it should be remembered that uncertainty creates increasing variation in estimated demand over the years, and worst-case scenario in simulation experiment does not show

that much change to the current level of activity. Consumer market in Russia might continue its boom for decades, but relative attractiveness of Finnish route and other border crossing points create significant uncertainty in the results.

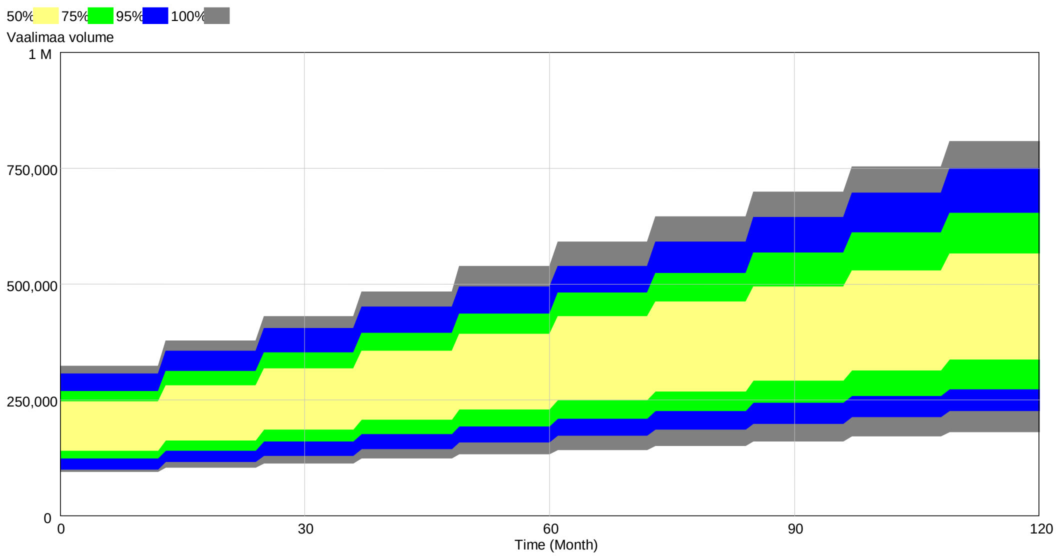

Figure 29. *Simulated annual volumes at Vaalimaa border crossing station (TEU).*

Investment needs in Vaalimaa's border crossing capacity are represented in Figure 30; as could be noticed a maximum of 17,000 additional truck handling capacity per month, if demand is needed to be satisfied (for container traffic alone). This amount would almost double the current capacity. In more conservative growth scenarios also investments of 8,000 units could be enough, most of the runs are requiring much less investments. This increase corresponds to about 50 % capacity increase as compared to the current level. As Figure 30 suggests, in the early part of the first four-year period no handling capacity addition would be needed, but by the end of the simulation period over 50 percent of the simulation runs suggest some amount of investments. Thus, it should be emphasized that these results only concern container transportation and other transportation items in road transportation mode could significantly affect into results (e.g. transit of cars).

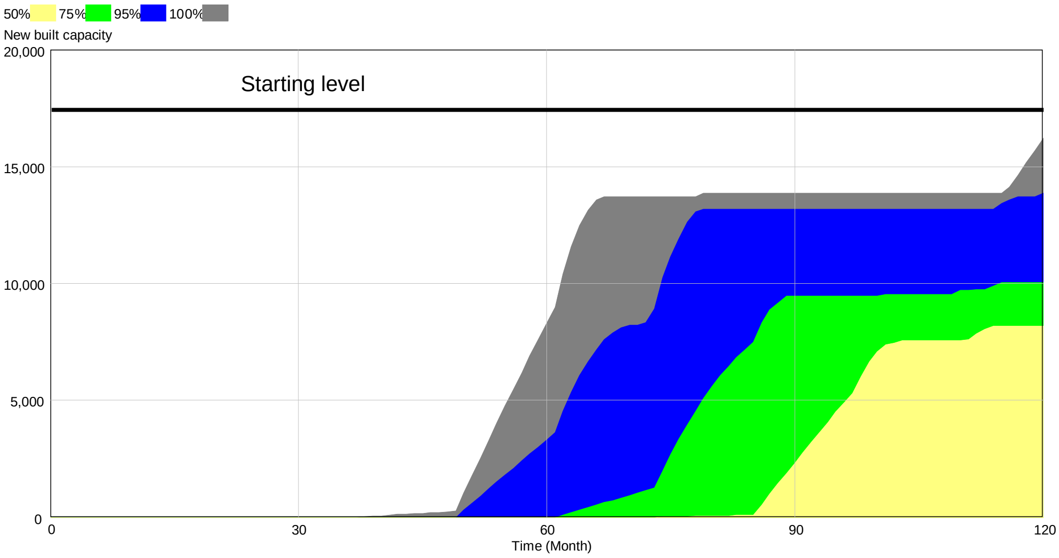

Figure 30. *Simulated new built capacity at Vaalimaa during the next ten years (Starting level of capacity: 17,000 eastbound border crossings per month)*

7.4.1 Additional Simulation Model to Check Investment Policy Proposal

In order to test the stochastic simulation model and operational feasibility of the earlier proposed investment plan, we modified simulation model a bit as Figure 31 shows. Here we have just checked how capacity utilization of border crossing capacity and queues develop at Vaalimaa, if amount of 8,500 truck handling capacity is being added in the beginning of the third year, and another 8,500 truck handling capacity in the beginning of the sixth year. Our lead time estimates at border crossing point relay on the earlier case-study research from border crossing (Sirkiä et al. 2007), where average border crossing time was 5.11 hours (excluding queuing time), and variability in border crossing time (service time in queuing theory) was estimated to be 53.5 %. Variability of arrivals on the queue was calculated from previous data from year 2006 and early 2007, and it showed variation of above 50 percent.

As Figure 32 shows, proposed timing of two large capacity additions is relatively workable one, if capacity utilization is not desired to increase above 100 %. However, as capacity additions are relatively large, utilization of years after capacity addition is on the average 50 %. Thus, due to the general transit market growth to Russia, average capacity utilization increases to the level of 60-70 % in three years time. Although, this level of utilization seems to be low, but even in the most simplest service system (one service phase, and one waiting line, like in small grocery store) utilization should not exceed 80 %, if long queues are not tolerated (e.g. Hilmola 2002).

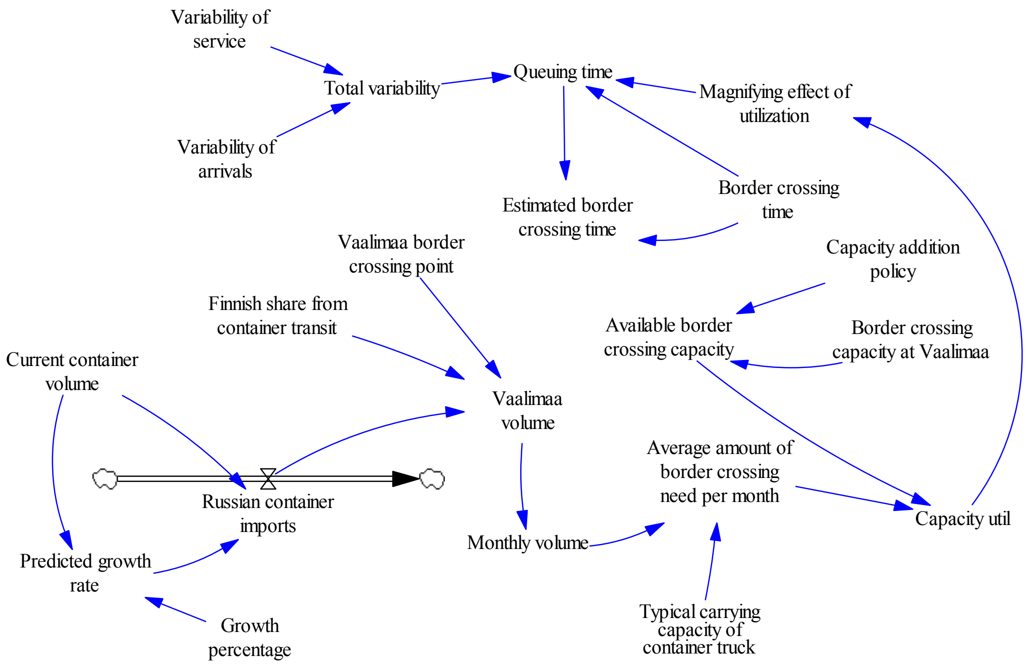

Figure 31. *Simulation model to test transit container traffic via Finland, as capacity is enlarged in two phases, first 7,500 units in the beginning of year 4, and additional 7,000 in the beginning of the year 8.*

As it is currently the case, waiting lines in the border crossing point have increased in Finland up to 50 km (FRA 2007) and in Figure 33 is clearly shown that currently waiting time at the border is around 10 hours, but when capacity is in overuse the waiting times can explode up to 100 hours (and more as waiting times limited to 96 hours to allow better examination of also the lower waiting times). As we can see from the previous two figures waiting times are starting to get significantly longer as capacity utilization is over 0.8

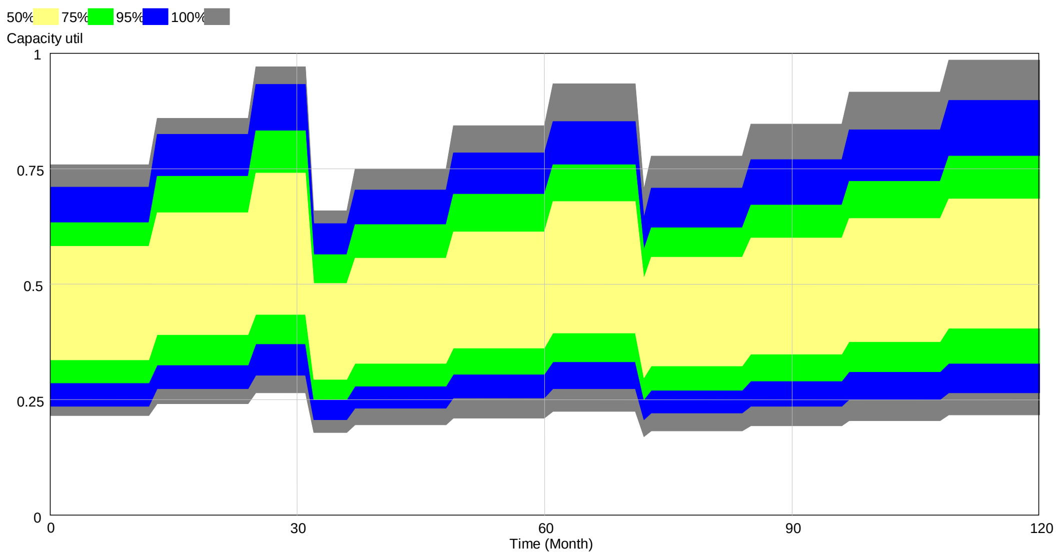

Figure 32. *Estimated capacity utilization as additional investments are made based on the programme.*

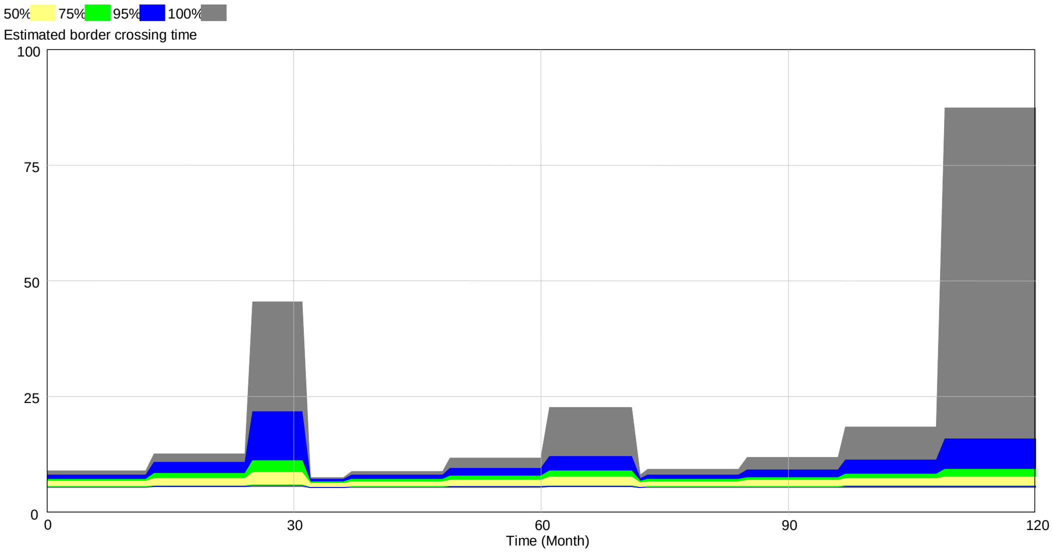

Figure 33. *Estimated border crossing time at Vaalimaa (hours), if capacity additions are made based on the proposed investment programme.*

7.5 Comparison to the Situation in Estonia, Narva Border Crossing Point

In Estonia border crossing is not that concentrated in one point as is the case in Finland. However, Narva is the most important from three main points, and has roughly 43% from total truck traffic between Estonia and Russia (other border crossing points are Luhamaa & Koidula). We assumed that for the transit traffic the percentage would be a little higher, about 50 %, due to its location near ports. It should be emphasized that Narva does not directly gain its importance from truck traffic, but most of the high volume transit oil shipments go through this border crossing point (currently at the level of 90 %). Waiting lines appear in borders similarly in Estonia as is the case with Finland, but waiting line lengths are 7-8 km in maximum in Narva border crossing point (average is a bit under 3 km). To simulate infrastructure needs in largest Estonia we have made following assumptions on stochastic variables:

- Russian container import percentage growth from the base value: 10 to 20 percent (random uniform distribution) – In Russia import growth rate was around 20 percent in 2007, more than three times of GDP growth (6.7 %). Early months of 2007 have indicated even higher growth rates in imports (up to 50 %, Barents Observer 2007), and forecasts of GDP growth argue Russian economy to remain current level of GDP growth (or moderately decline from it, e.g. BOF 2007b, Economist 2007)
- Estonia’s share of container transit: 0.7 to 3 percent (random uniform distribution) – Currently this share is approx. 1 % from total Russian container transports.
- Narva’s share of transit traffic: 40 to 46 percent (random uniform distribution)

Based on the information from Narva border crossing point, we have estimated that handling capacity of 170 trucks per day exist for outgoing container trucks (corresponds to 5100 trucks per month) and 21 percent of the border crossing capacity is in use of transit traffic. Based on our growth scenario we can assume that share transit transports at Narva will increase. For this reason in the model the share of transit transports is also assumed to be growing 3 percent points every year. This results in 48 percent in the start of the ninth year. As road transportation legislation is stricter in Estonia than in Finland for the weight of a truck, we have assumed that truck could carry 1.5 TEU at once (in Finland this is 2 TEU). The investment policy is here different to the previous model in a way that here only one sixth of the difference between capacity need and available amount is invested.

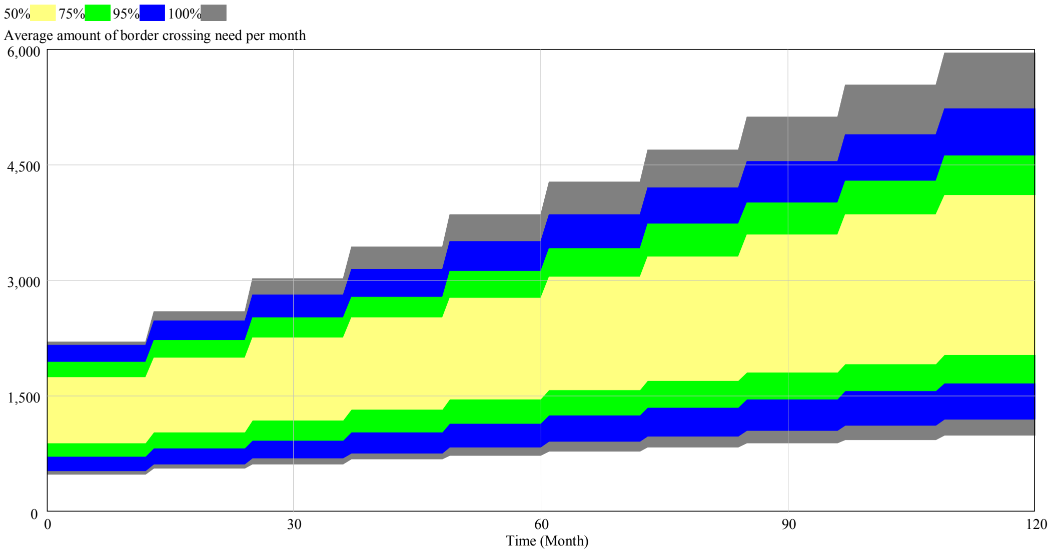

Figure 34. *Estimated need of total border crossing capacity at Narva in trucks per month.*

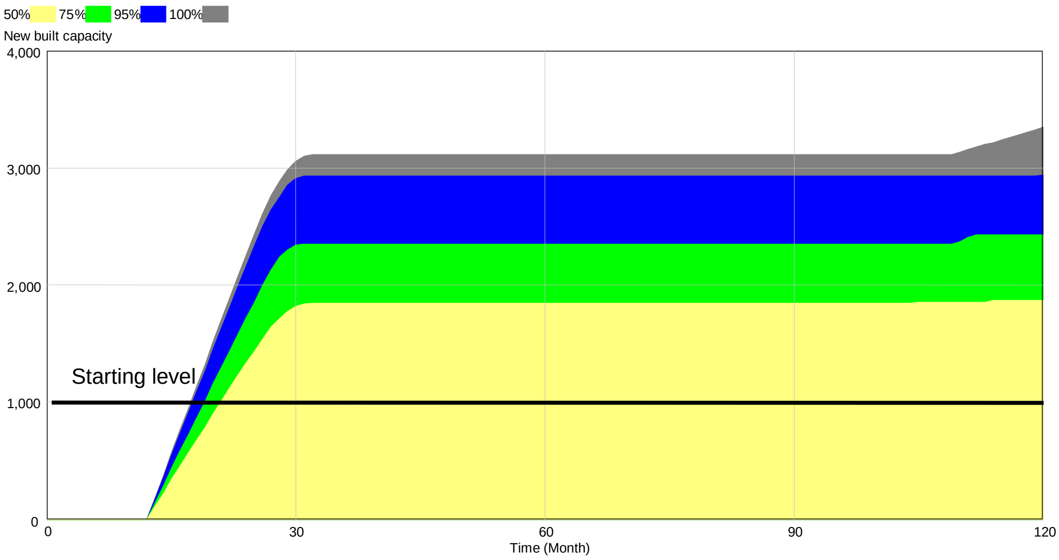

Figure 35 *Estimated amount of needed new capacity at Narva border crossing point for truck handling (Starting level of capacity: about 1000 eastbound border crossings per month).*

Based on the simulation model, in the ten year period Narva's share from eastbound transit containers is at maximum a bit over 100,000 TEU, which accounts for certain level of needed border crossing capacity (presented in Figure 34). Most probably volumes will double in this period, and therefore we could assume a priori that current level of truck handling capacity would not need to be increased that much, as growth scenarios are rather conservative. This assumption was partly verified with simulation model, since as suggested in Figure 35 in a larger scale in the second half of the observation period new capacity is being required.

Investment program for Narva was planned for the second model as follows: (1) Capacity added 1,750 truck handling units at start of the time period and (2) 2,000 handling units at 36th month. From the real data (see Appendix 3) we have estimated that variability of arrivals of the trucks in the system is 36 % and service time variability 27.8 %. In the Narva border crossing station the actual border crossing takes on average six and half hours. As we can see from the Figure 36, after the over utilization at the beginning the investments made in capacity seem to have enough impact to keep the capacity utilization under 1 in every case.

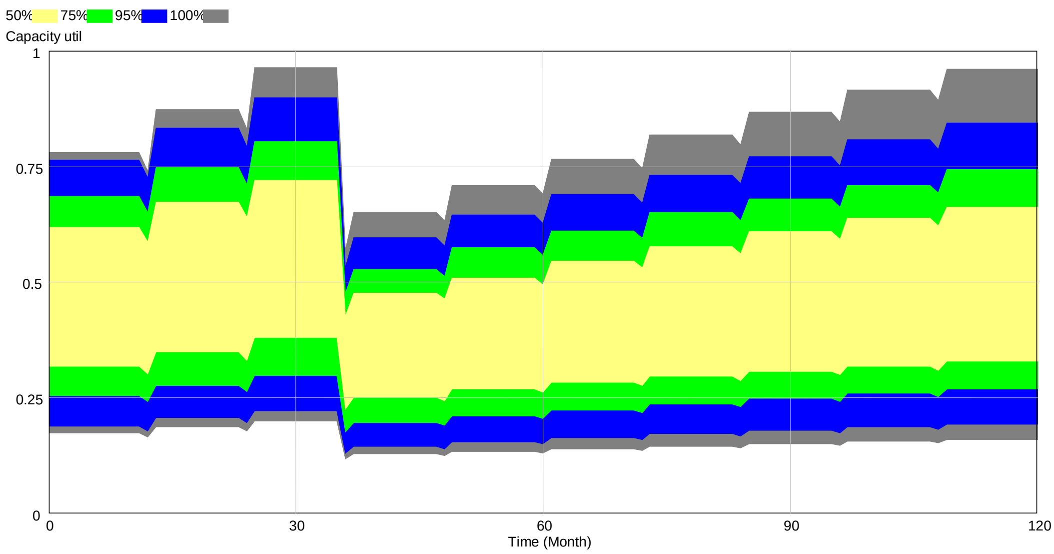

Figure 36. *Capacity utilization at Narva border crossing point during ten year simulation period.*

Figure 37 shows the estimated border crossing time at Narva. By adding the first investment right to the start of the period, we can eliminate queuing times growing without limits. The two peaks in estimated queuing time around 25 hours can be seen, but those affect only less than 5 percent of the simulation runs. Estimated border crossing times explode again near the end of the examination period again for some simulation runs, maybe third wave of investments would be needed around 9 years. Most importantly seems that with this kind of investments

the estimated queuing time stays under 10 hours with over 75 percent of the simulation runs.

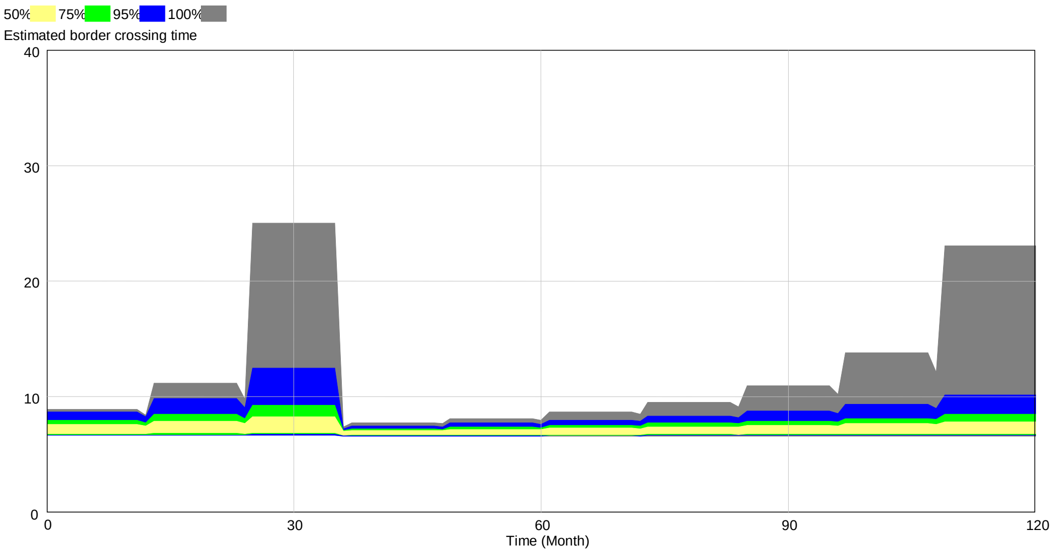

Figure 37. *Estimated border crossing time at Narva in ten year simulation period.*

7.6 Arrivals at Border Stations in Finland and Estonia

We also examined the weekdays of arrivals at the border crossing points. The examination has been completed so that any addition to queue (FRA 2007) will show as greater than zero in the chart, and reduction or staying put will show as zero in the chart. Weekdays are represented by numbers from 1 to 7, so that 1 equals Monday, 2 equals Tuesday and the other weekdays are coded respectively. So, basically weekdays with lowest leftmost column are the busiest.

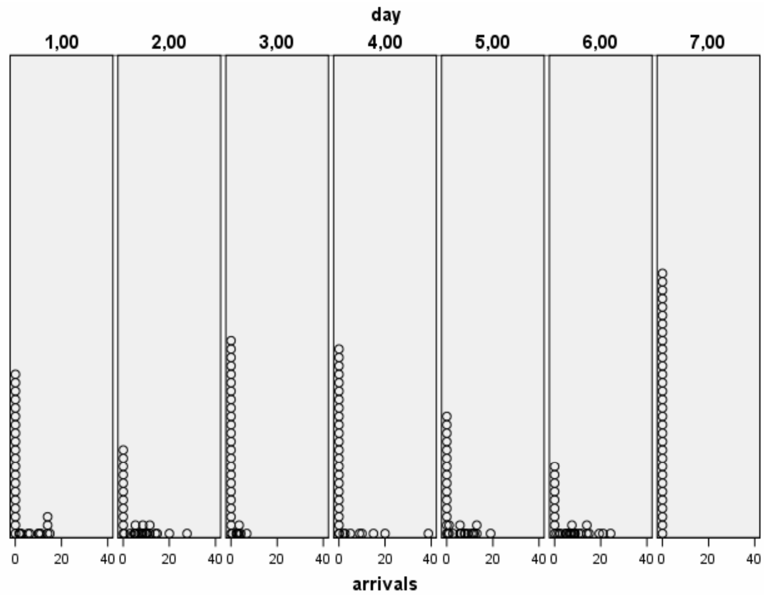

Figure 38. *Development of truck arrivals to the Vaalimaa queue during period of 1.Nov.2006 to 12.June.2007 (one observation per day).*

As we can see from Figure 38 at Vaalimaa the busiest days during the examination period were Tuesday, Friday and Saturday. Also on some Mondays, Wednesdays and Thursdays the queue length was increasing.

Similar consideration was also made for the Narva border crossing station in Estonia. From the results, presented in Figure 39, it can be concluded that in Estonia situation is a bit different: Although the examination period is shorter, the arrivals in Estonia have been divided to several weekdays; Wednesday and Saturday being the busiest.

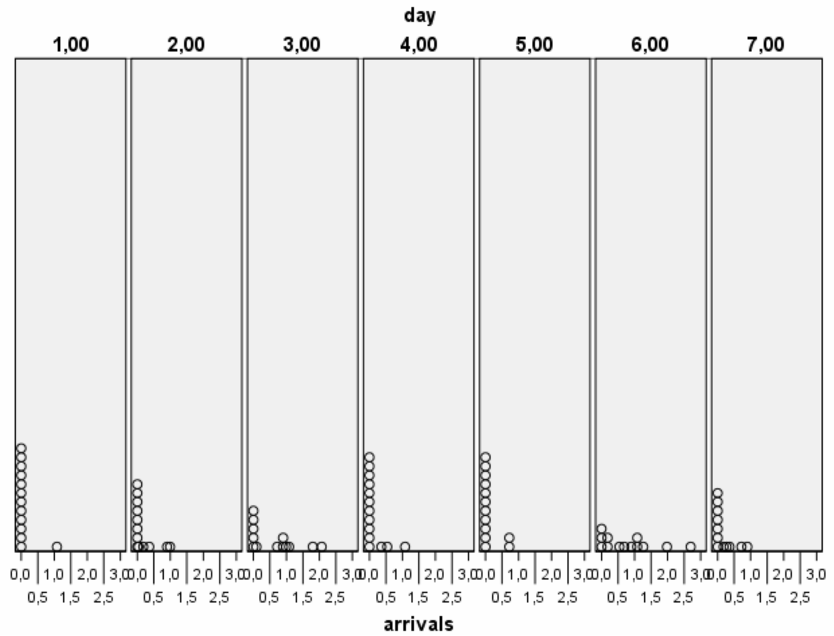

Figure 39. *Development of truck arrivals to the Narva queue during period of 1.Jan.2007 to 31.March.2007 (one observation per day).*

The problem of uneven arrivals, which is most evidently apparent in Finland, adds the queues on certain days. But this problem is difficult to avoid as the Finnish ports are dependent on the feeder lines from bigger ports on certain days (MINTC 2006).

Ministry level report draft concerning border crossing and its smoothing from Finland to Russia (MINTC 2006) presented an example of these days of arrival. There was Monday, Thursday and Friday mentioned as days on which the queue length most likely increases. These days partially differ to ones we found: basically we found that recently on every weekday except Sunday the queues have been increasing at some time period.

8 TRANSIT CONTAINER TRAFFIC AND ITS EFFECT ON WAREHOUSING INFRASTRUCTURE INVESTMENTS

8.1 Finland

In this chapter we are attempting to model the warehousing requirements regarding the ever expanding container transit traffic through Finland to Russia. First we identified the most important cities regarding container transit traffic. These were the port cities Kotka and Hamina, and also railway city Kouvola and Lappeenranta near of all the main border crossing stations. The warehousing capacities of these three cities are presented in Figure 40; all information is from the cities, except for Lappeenranta, which square meters figure is from Statistics Finland, and cubic meters are approximation based on the data from other cities and the square meters.

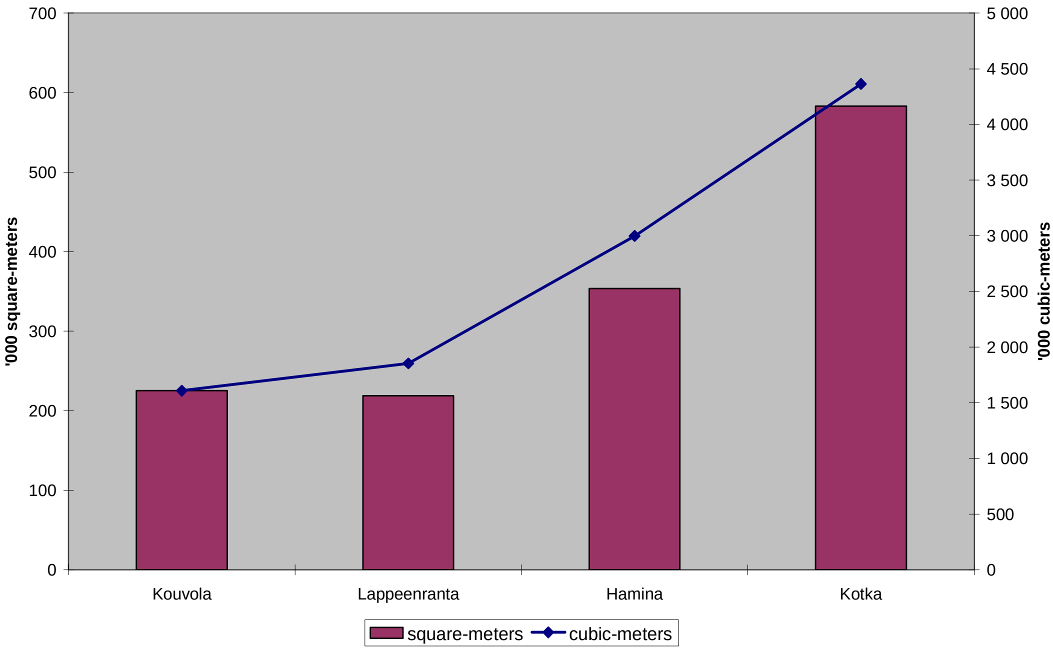

Figure 40. *Warehousing capacities in Lappeenranta, Kouvola, Hamina and Kotka (City of Lappeenranta 2007, City of Kouvola 2007, City of Hamina 2007 and City of Kotka 2007).*

As we can see Kotka has, in both square meters and in cubic meters, about equal amount of warehouses and Kouvola and Hamina together. Altogether four cities have significantly more warehousing capacity in square meters than the biggest city in Finland, Helsinki (Statistics Finland 2007).

To examine the adequacy of the warehousing capacity in the South-Eastern Finland regarding the container transit traffic, we have developed two different system dynamics models. The first model takes square meters of the warehouses

into consideration and the second one looks at the cubic meters. Simulations with each model were run 200 times.

8.1.1 First Model: Square Meters

The model based on square meters assumes that the container import to Russia is 3 million containers per year. One TEU is estimated to take up 15.11 square meters of space in the warehouse (ISO standard 20-feet container). We have corrected the capacity figures by assuming that about 50 % of the capacity is in the use transit traffic and 80 % of the warehousing area can be used efficiently. The model is presented in Figure 41.

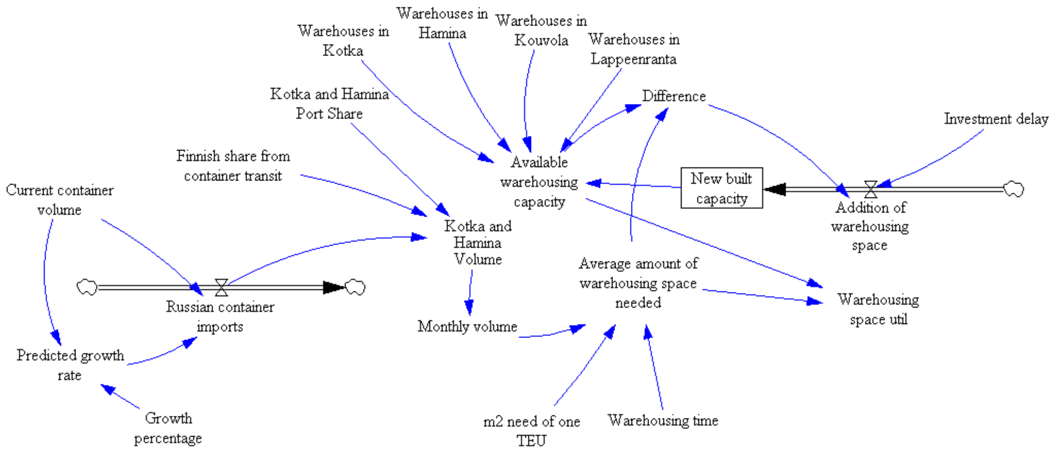

Figure 41. *System dynamics model based on capacities in square meters.*

Investment delay for new warehousing capacity in both models is estimated to be 12 months. Model invests in capacity one sixth of the absolute needed capacity.

The used stochastic parameters in the simulation were the following:

- Growth 10…20% annually
- Finnish share 5…14%
- Kotka and Hamina share 87.5…93.5%
- Warehousing time 0.5…1 months

The average amount of needed warehousing capacity for containerized transit cargo is presented in Figure 42. The figure shows that the maximum amount of needed warehousing space is 1.2 million m^2 and the most probable amount is 600,000 m^2.

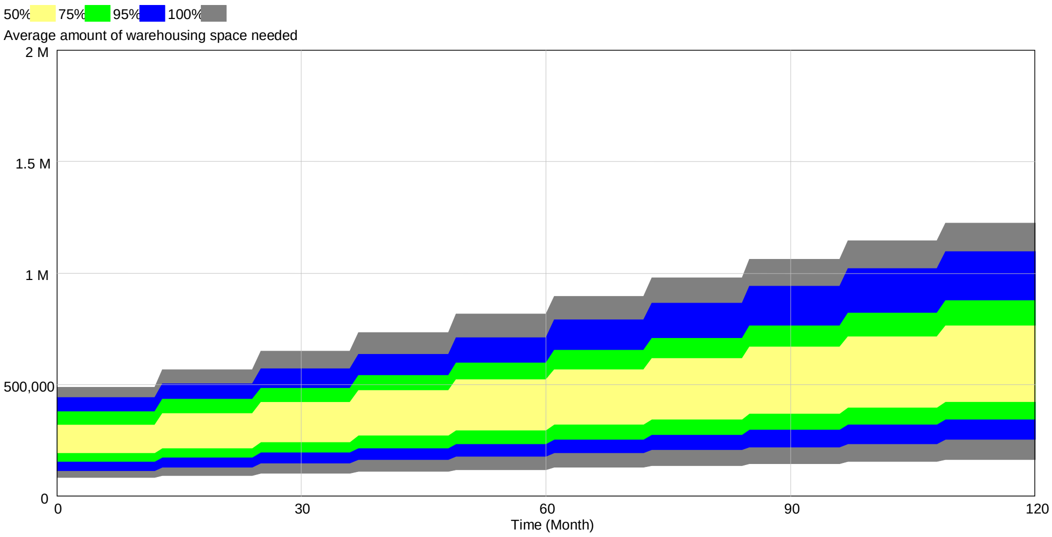

Figure 42. *Average amount of needed capacity in square meters.*

As can be seen in Figure 43 the space utilization is on very high level through out the simulated ten-year period. This, of course, is only a two dimensional consideration, but it clearly favours building specialized and high warehouses, e.g. instead of using old buildings for warehousing purposes.

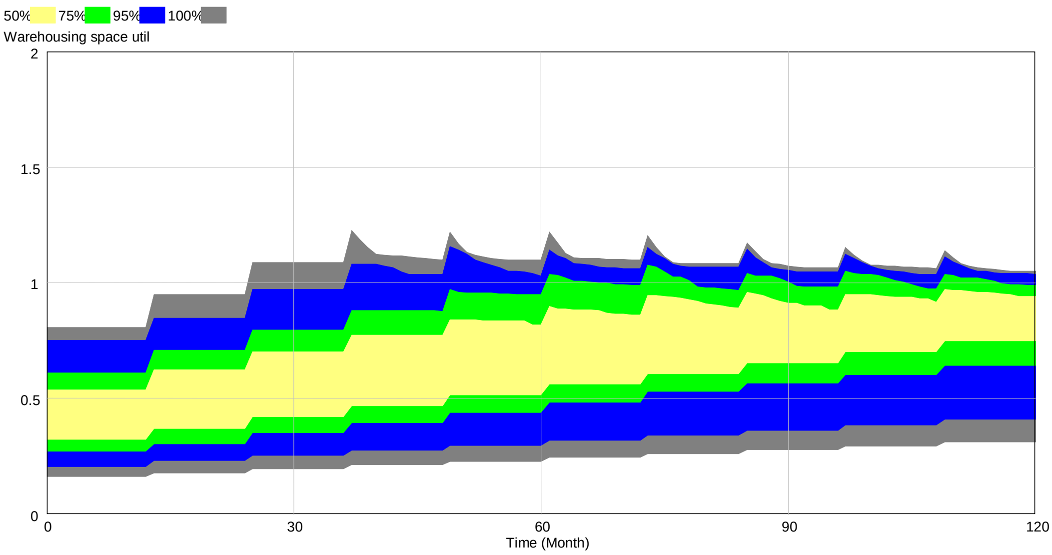

Figure 43. *Warehousing space utilization according to square meters model.*

Figure 44 shows that investments are not likely needed during the first two-year period, but after that there are some investment needs, when considering only from the square meters point of view.

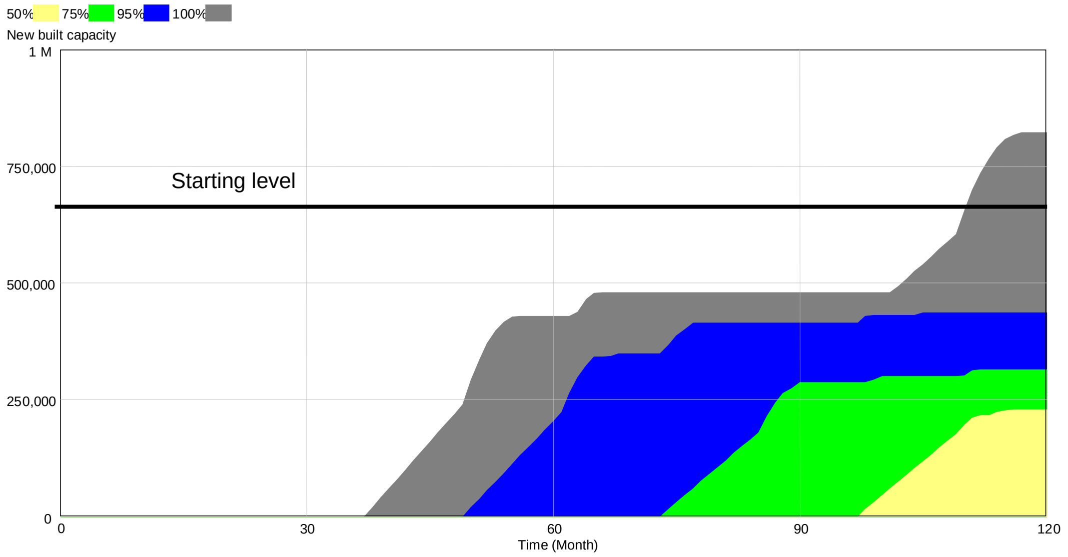

Figure 44. *New built capacity according to square meters mode (Starting level of capacity: 700,000 square meters of warehouses in use of transit).*

8.1.2 Second Model: Cubic Meters

The model based on cubic meters (Figure 45) assumes that the container import to Russia is 3 million containers per year. One TEU is estimated to take up 39.15 cubic meters of space in the warehouse (ISO standard 20-feet container). We have corrected the capacity figures by assuming that about 50 % of the capacity is in the use transit traffic and 70% of the warehousing volume is in efficient use. Otherwise the used parameters are same as presented previously in the square meters model.

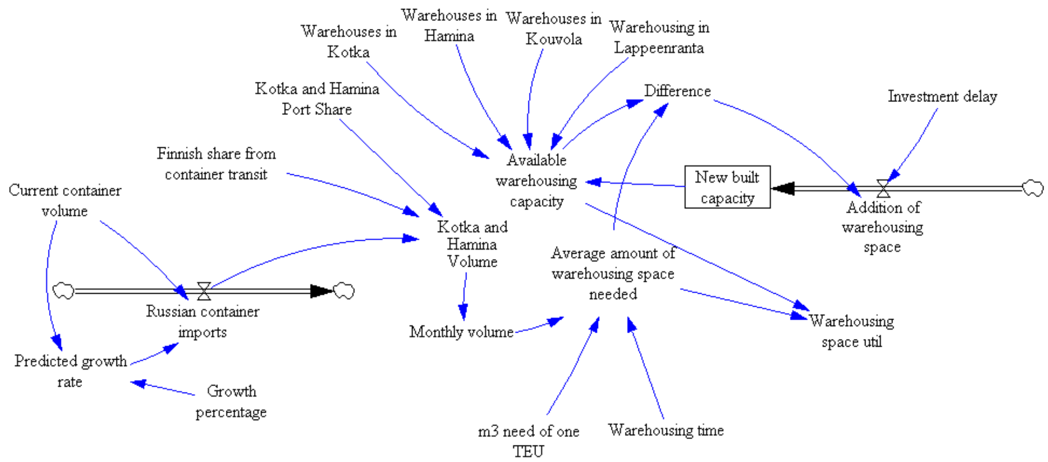

Figure 45. *System dynamics model based on capacities in cubic meters.*

Figure 46 shows the average amount of needed warehousing space according to the cubic meters model. It can be seen that the maximum needed amount of

warehousing space is between 3.2 million cubic meters and 1.6 million cubic meters.

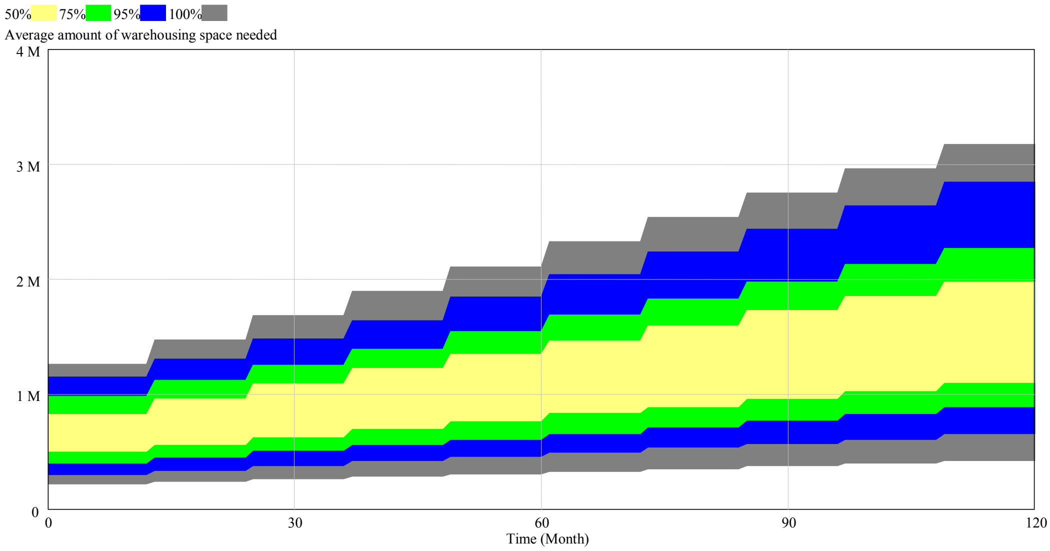

Figure 46. *Average amount of needed capacity in cubic meters.*

The warehousing capacity utilization presented in Figure 47 clearly shows the difference between the developed two models: as the capacity utilization rate stays under 1, the cubic meters model does imply that investments are not needed during the next 10 years. This was also confirmed by the simulation, where none of the simulation runs resulted in new built capacity.

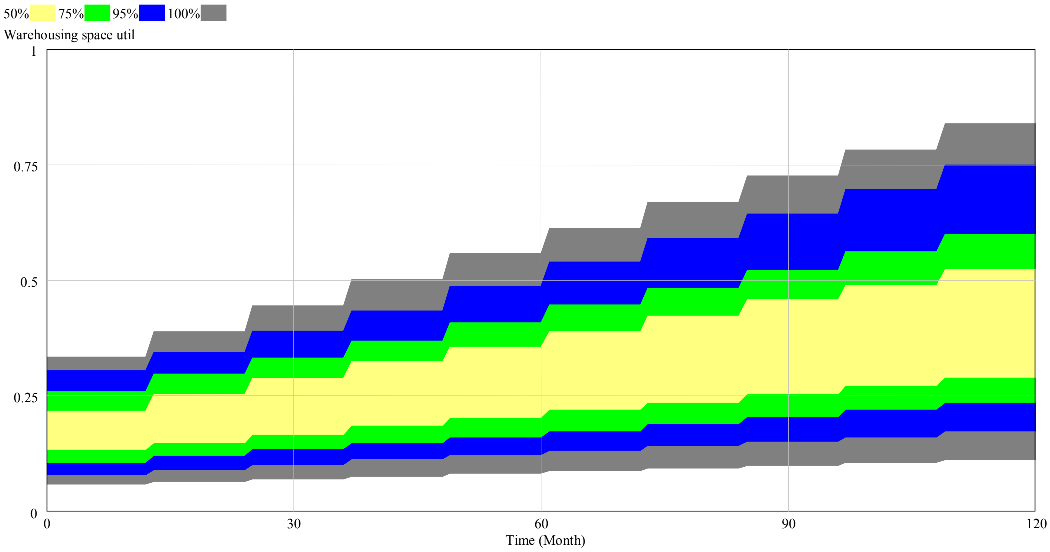

Figure 47. *Warehousing space utilization according to cubic meters model.*

8.2 Comparison to Situation at Muuga CT at Port of Tallinn

Additionally, similar examination of Muuga Container Terminal (CT) at the Port of Tallinn was made. Models are similar to the ones presented before and are based on the growth scenario of Russian container import market. First model is again based on warehousing capacity at port in square meters and the second is based on approximation of available cubic meters.

8.2.1 First Model: Square Meters Model at Muuga

At the only real container terminal, Muuga CT, there have not been very intensive warehousing activities and the containers stored in open container fields, rather than inside warehouses distributed from there onwards. For that reason we have estimated the average warehousing time at Muuga port to be shorter than in Finnish warehouses. The amount of current warehousing capacity was estimated to be 10,000 square meters and respectively 77,000 cubic meters.

The used stochastic parameters in the simulation were the following:

- Growth percentage 10…20 %
- Muuga CT Port Share 95…99 %
- Estonian share from container transit 0.7…3 %
- Warehousing time 0.1…0.4 months

Using these parameters the amount of needed warehousing space during the next ten years is at most 100,000 square meters per month, and most likely somewhere around 40,000 square meters (Figure 48).

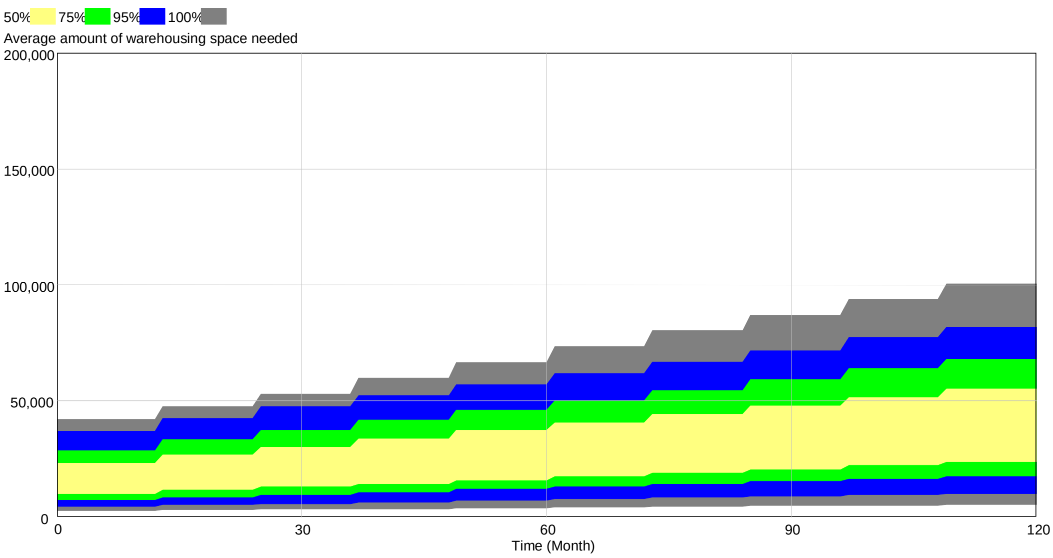

Figure 48. *Average amount of needed warehousing capacity according to square meters model at Muuga.*

Figure 49 presents the capacity utilization which shows that in the beginning huge over utilization and with the investments the utilization gets closer to 1 – this significant change is result of nearly non-existent warehousing capacity at Muuga.

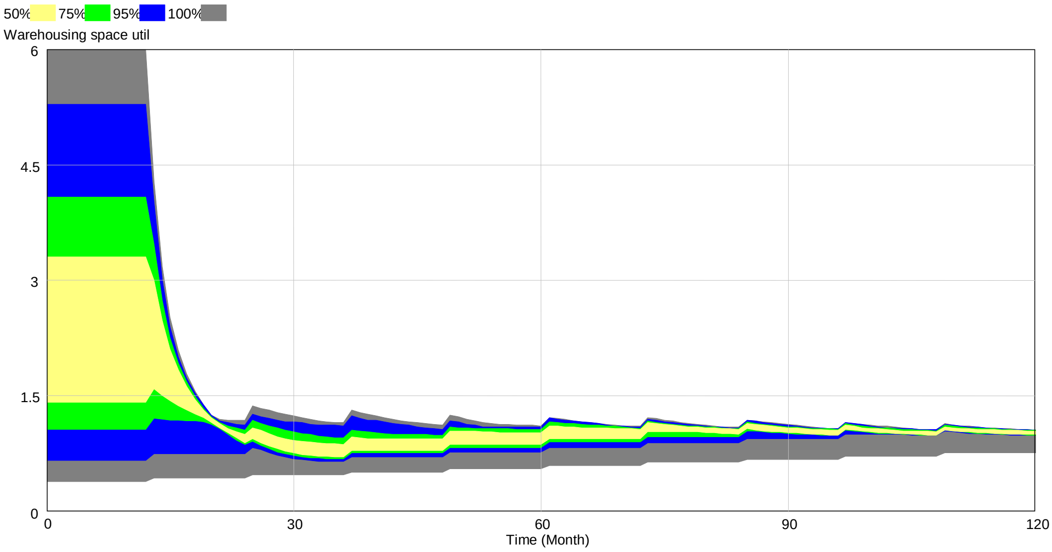

Figure 49. *Warehousing space utilization according to square meters model at Muuga.*

Figure 50 presents the new built capacity during the simulated time period of ten years. It suggests that the needed investments are most likely around 40 000 square meters, but easily they could also be over 60 thousand square meters. In other words, the capacity will be most likely to be at least quadruple during the next ten years.

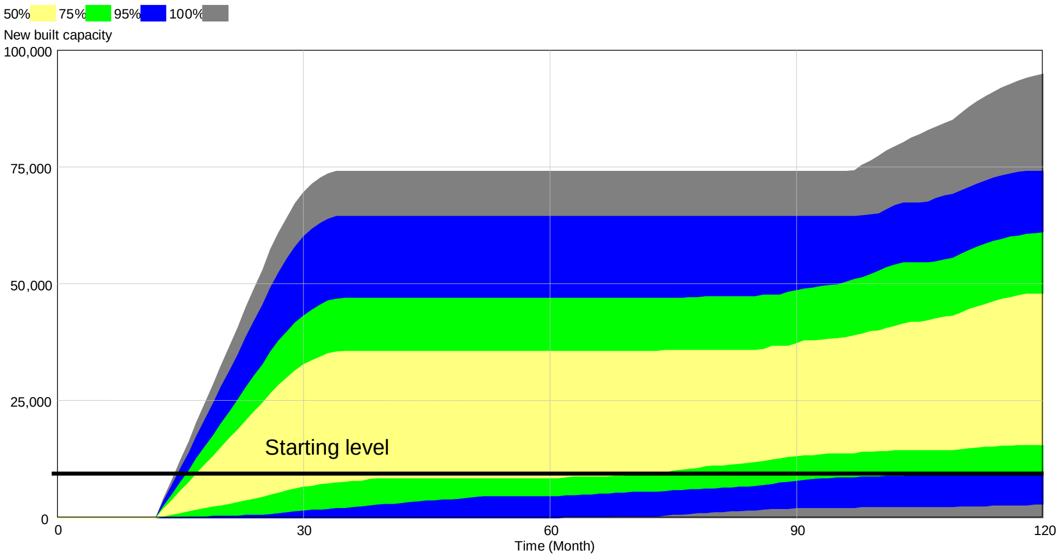

Figure 50. *New built capacity according to square meters model at Muuga(Starting level of capacity: 10,000 square meters of warehouses in use of transit)..*

8.2.2 Second Model: Cubic Meters Model at Muuga

The parameters in this model suggest that the needed capacity in cubic meters model could as high as 260 000 cubic meters, but it will most likely be around 120 000 cubic meters (see Figure 51).

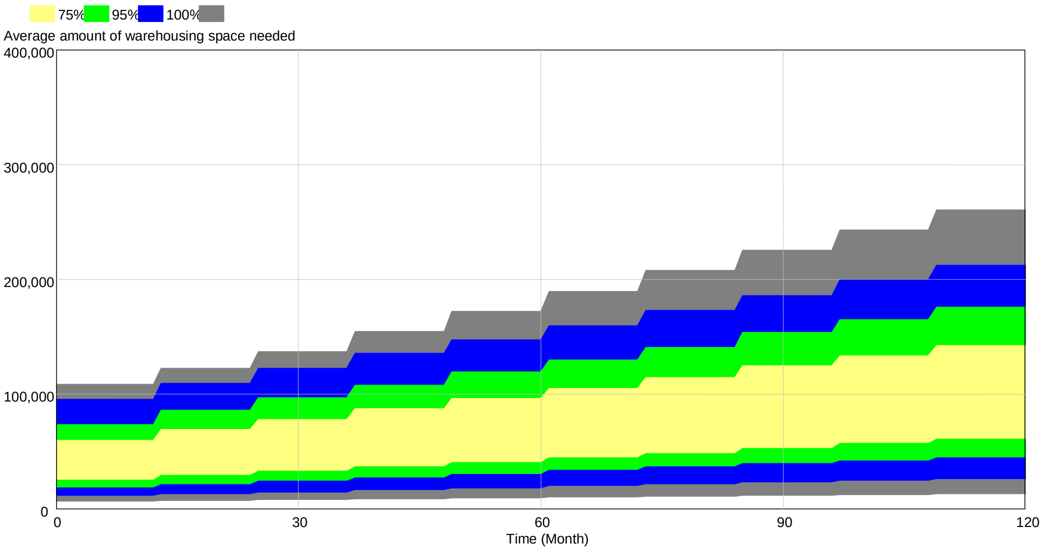

Figure 51. *Amount of needed warehousing capacity according cubic meters at Muuga.*

Again capacity utilization is high, although as high as in the previous model, in the beginning and due to the investments towards the end of the period it gets closer to 1 (see Figure 52).

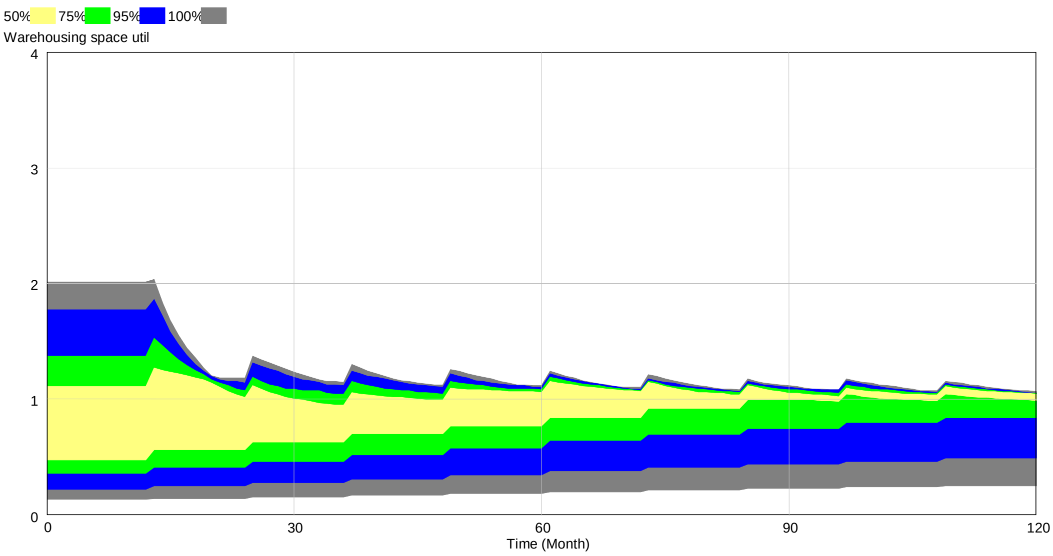

Figure 52. *Warehousing space utilization according to cubic meters model at Muuga.*

Figure 53 presents the made investments, which during the period are peaking at little over 200,000 cubic meters and the most probable amount is around 75,000 cubic meters, which would roughly double the current capacity.

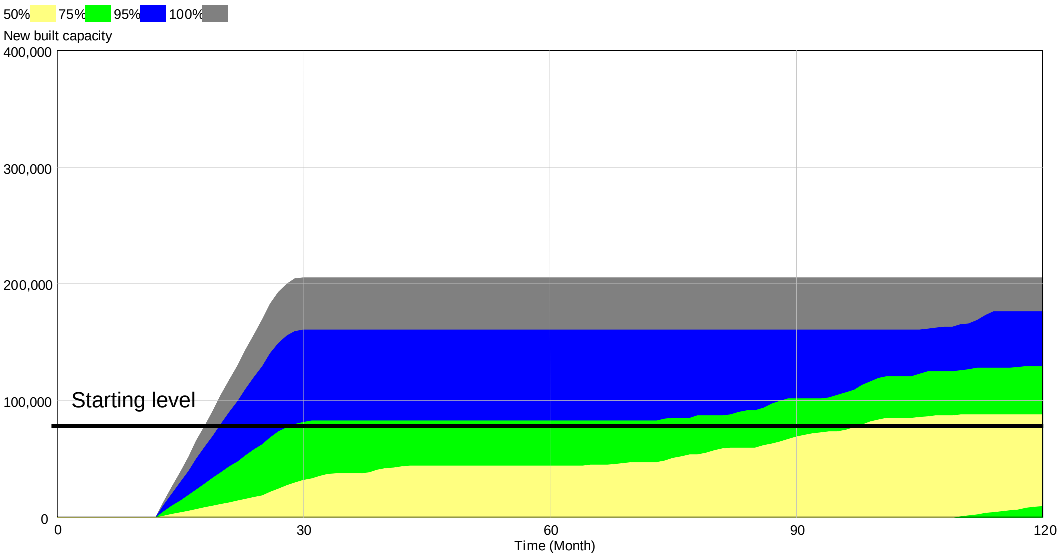

Figure 53. *New built capacity according to cubic meters model at Muuga (Starting level of capacity: 77,000 cubic meters of warehouses in use of transit).*

9 LIFTING CAPACITY ESTIMATION FOR TRANSIT CONTAINER TRAFFIC USING SYSTEM DYNAMICS

This chapter deals with estimation of lifting capacity and its sufficiency regarding the expanding transit traffic. We are examining the unloading/loading speeds at the most important transit ports in Finland, Kotka and Hamina. The basic assumptions are the same as in previous chapters dealing with simulation. Russian container imports are assumed to be 3 million containers and to be growing at rate of 15%. The share of containers going through Finnish ports is 9.5%. Normal work weeks in both ports are assumed based on interviews to be the following: Monday to Friday 16 hours per day and 5 hours on Saturday. This equals on average to 23 work days per month when calculated with 16 hours per day.

The model is presented in Figure 54. The lifting capacities were calculated from the data from PortNet (2007) of port calls of container vessels in both ports. Numbers were calculated from whole staying time at the port, not from the actual active unloading/loading work. For both ports unloading/loading speeds were some what normally distributed. Mean for Kotka was 17.63 hoisting per hour (standard deviation 7.93) and for Hamina 14.63 (standard deviation 6.97). Maximum number of simultaneously loaded container ships was assumed to be 8 in Kotka and 7 in Hamina. As approximation of the lifting capacity in use of transit, we used the share of transit containers from the total containers through the respective port (Kotka = 40.67% and Hamina = 41.04%). Also the amount of TEUs was divided by 1.75 (“TEU per container” in the model), as most of the containers in sea vessels are forty-foot containers. Lifting capacity utilization rate is assumed to be 80 percent.

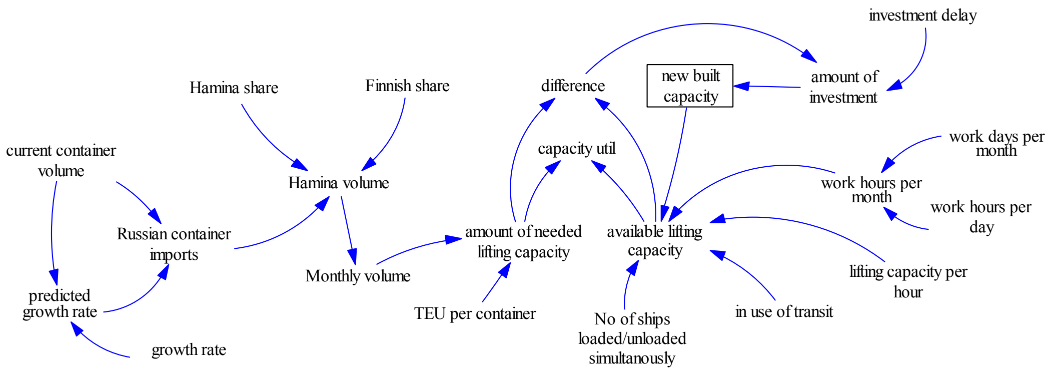

Figure 54. *The simulation model for lifting capacity at Port of Kotka.*

Model adds investments with 12 month delay. The invested amount is one sixth of the difference between needed capacity and available capacity.

Actual stochastic variables for simulating lifting capacity in Kotka are the following:

- Annual growth 10…20 percent (random uniform distribution)
- Finnish share 5…14 percent (random uniform distribution)

- Kotka share from transit containers through Finland to Russia: 55…75 percent (random uniform distribution)
- Lifting capacity per hour on average 17.63 hoisting per hour (random normal distribution: min = 1.5, max = 40, standard deviation = 7.93).

9.1 Simulation Results

9.1.1 Kotka

Figure 55 presents the monthly need of lifting capacity at port of Kotka for transit containers according to our growth model. The maximum amount is around 34 000 units and the most probable amount by ten years from here is around 20 000.

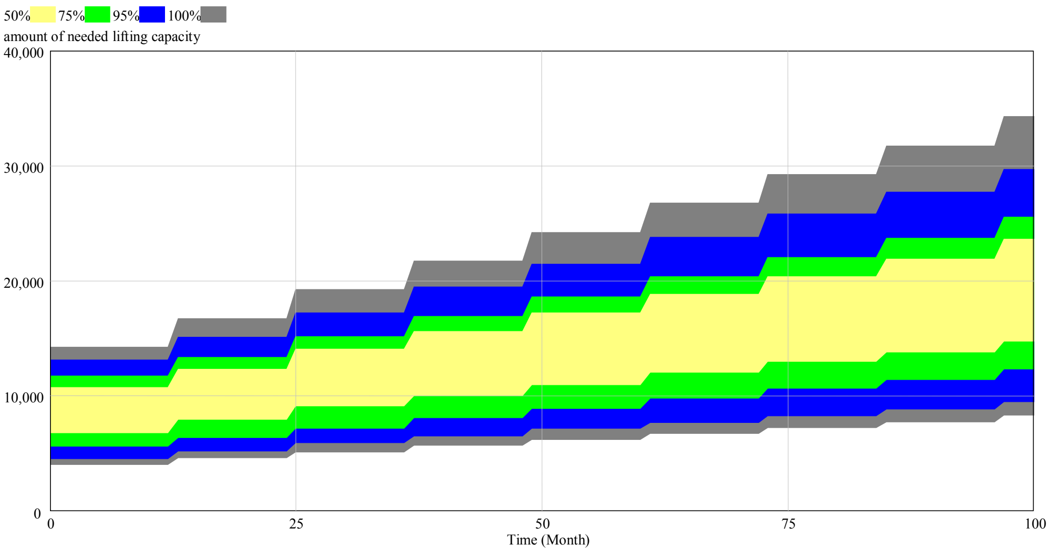

Figure 55. *Amount of needed lifting capacity per month according to simulation model at Port of Kotka.*

In Figure 56 lifting capacity utilization for Kotka port is presented. Some runs suggest right from the start some investments, but those are the runs with lower lifting capacities.

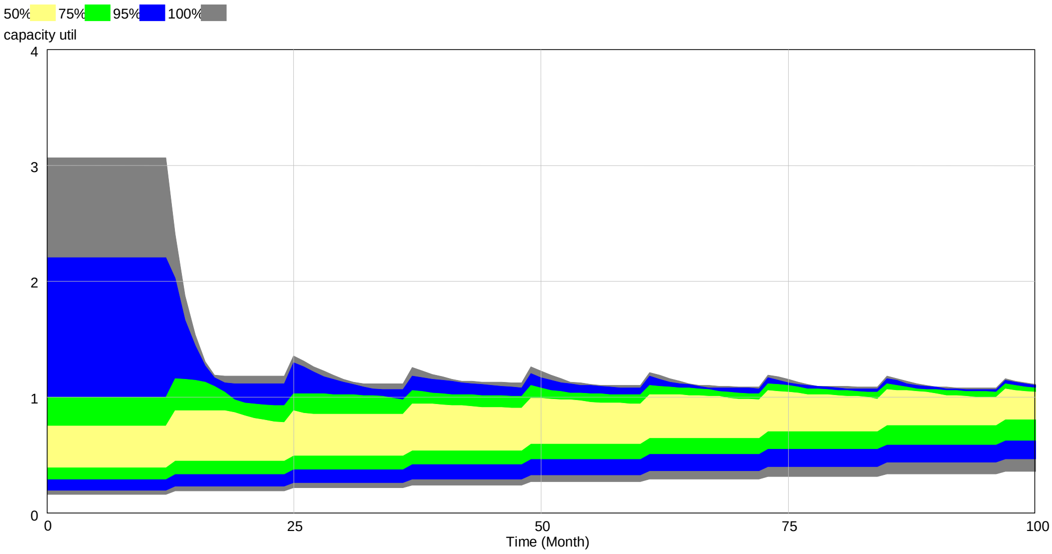

Figure 56. *Capacity utilisation according to lifting capacity simulation at Port of Kotka.*

The new built lifting capacity is presented in Figure 57. About half of the runs suggest some investments which most likely would be under 10 000 units (hoisting per month) of new capacity during the next ten years. Maximum amount of investment is a little under 30,000 units.

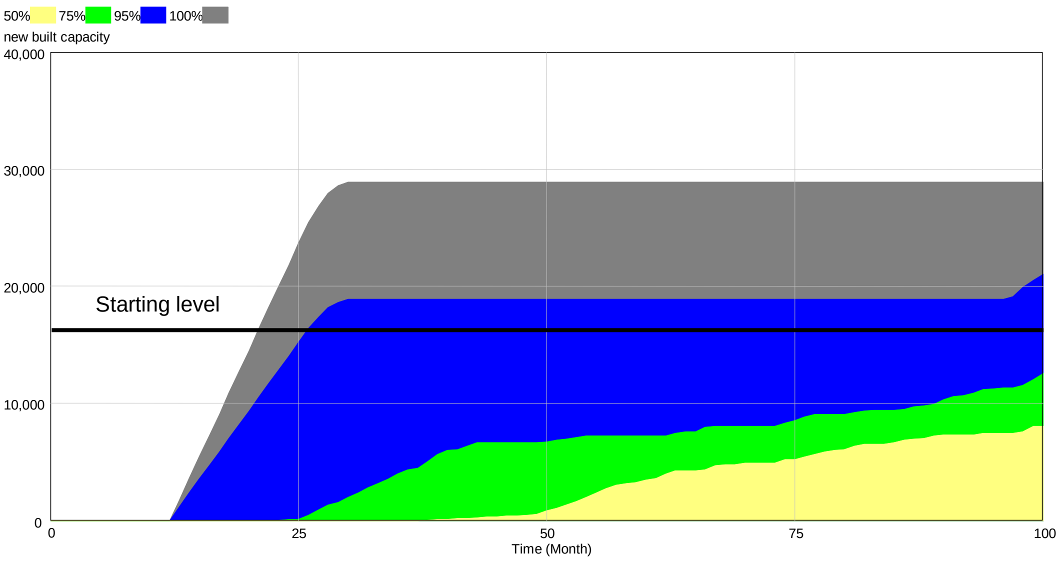

Figure 57. *New built lifting capacity according to simulation at Port of Kotka (Starting level of lifting capacity in use of transit: 17,000 container hoistings per month).*

9.1.2 Hamina

For modeling lifting capacity at port of Hamina the stochastic variables are the following:

- Annual growth 10…20 percent (random uniform distribution)
- Finnish share 5…14 percent (random uniform distribution)

- Hamina share from transit containers through Finland to Russia: 15…35 percent (random uniform distribution)
- Lifting capacity per hour on average 14.63 hoisting per hour (random normal distribution: min = 2.5, max = 32.5, standard deviation = 6.97).

Figure 58 presents the monthly need of lifting capacity at port of Hamina for transit containers according to our growth model. The maximum amount is around 15,000 units and the most probable amount by ten years from here is around 7,500.

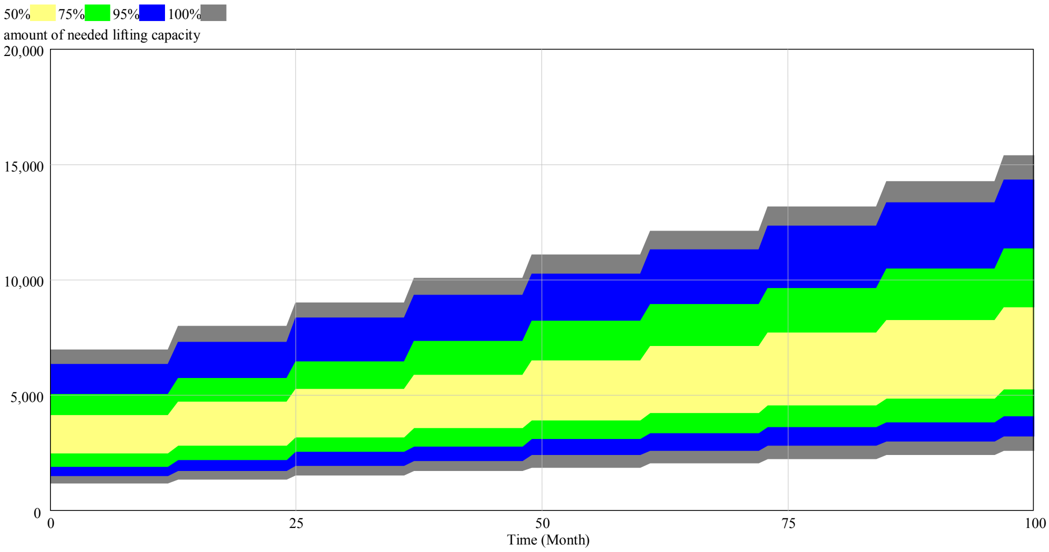

Figure 58. *Amount of needed lifting capacity according to simulation model at Port of Hamina.*

Again similar phenomenon as in Kotka simulations can be seen in when examining the capacity utilization (Figure 59). Minority of the runs need the investments in capacity as their unloading/loading capacity is very low.

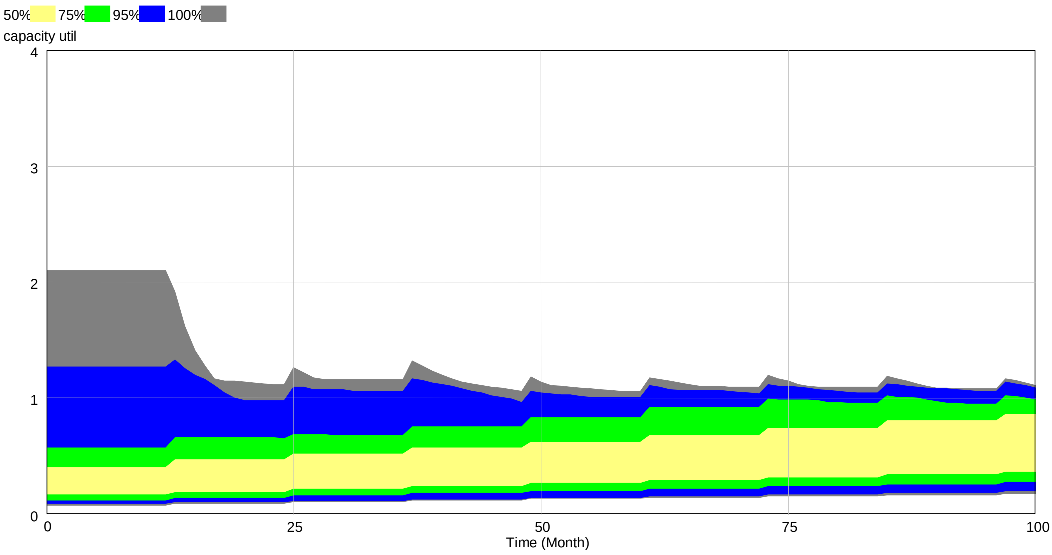

Figure 59. *Capacity utilisation according to lifting capacity simulation at Port of Hamina.*

Only about twelve percent of the simulation runs need any investments. So, it can be concluded that most probably investments in Hamina are not needed in lifting capacity.

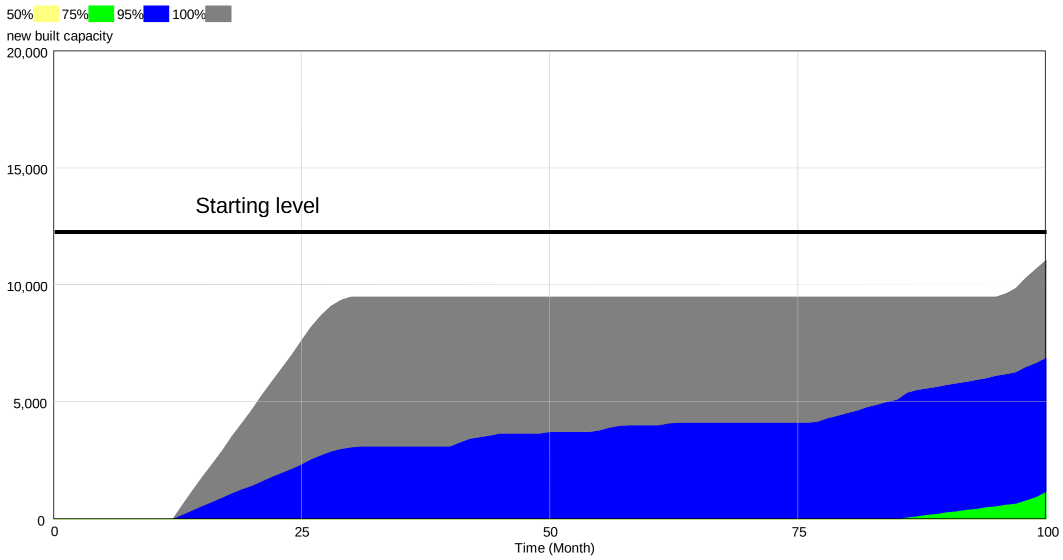

Figure 60. *New built lifting capacity according to simulation at Port of Hamina (Starting level of lifting capacity in use of transit: 12,500 container hoistings per month)..*

9.1.3 Muuga CT

Yet again it is assumed that Russian container imports are annually 3,000,000 TEU and Estonia currently transiting eastbound about 0.7 percent of it and handling in total about 1.2 percent of it. For estimating the container lifting capacity at Muuga CT we have assumed that Estonian ports are operating every day of the week and loading/unloading of ships can take place any time of the day. The number of quays at Muuga CT is three and as the number of cranes or employees does not limit the loading/unloading of the ships, three is also used as the number of ships that can be simultaneously loaded/unloaded. The official statistics show that current amount of transit containers accounts for about 21 percent of total number of containers. This figure is assumed to be growing three percentage points every year, totaling 48 percent by the start of the tenth and last year of the simulation. Distribution for lifting capacity was gained from the port calls of ships. Amount of TEUs had to be approximated using total amount of TEUs and total amount of tons. Loading speeds were corrected by dividing them by 1.75 as most of the containers in the sea shipping are forty-foot containers. Investments are added with 12 months' delay and size of the investment is one sixth of the difference between needed and available capacity. In the next Figure 61 the model for lifting capacity estimations is presented. We have assumed the efficient utilization of the lifting capacity to be 80 percent.

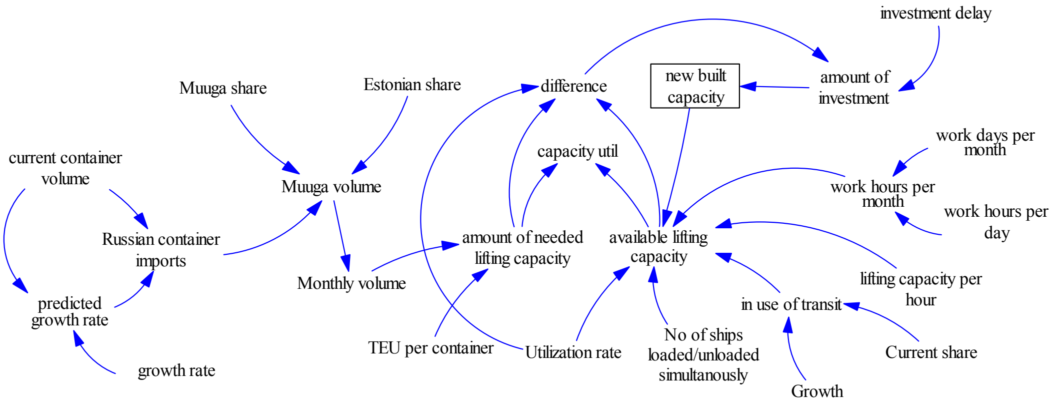

Figure 61. Lifting capacity model for Muuga CT.

The model was simulated 200 times with the following stochastic variables:

- Growth percentage 10…20 % (random uniform distribution)
- Muuga CT Port Share 95…99 % (random uniform distribution)
- Estonian share from container transit 0.7…3 % (random uniform distribution)
- Lifting capacity, mean 12.77 hoisting per hour (random normal distribution, min = 2, max = 34, standard deviation = 5.66).

In the Figure 62 amount of needed lifting capacity according to the assumed growth scenario is presented. As we can see from the figure needed lifting capacity reaches at its most around 10,000 hoisting per month, though most probably it will be around 6,000.

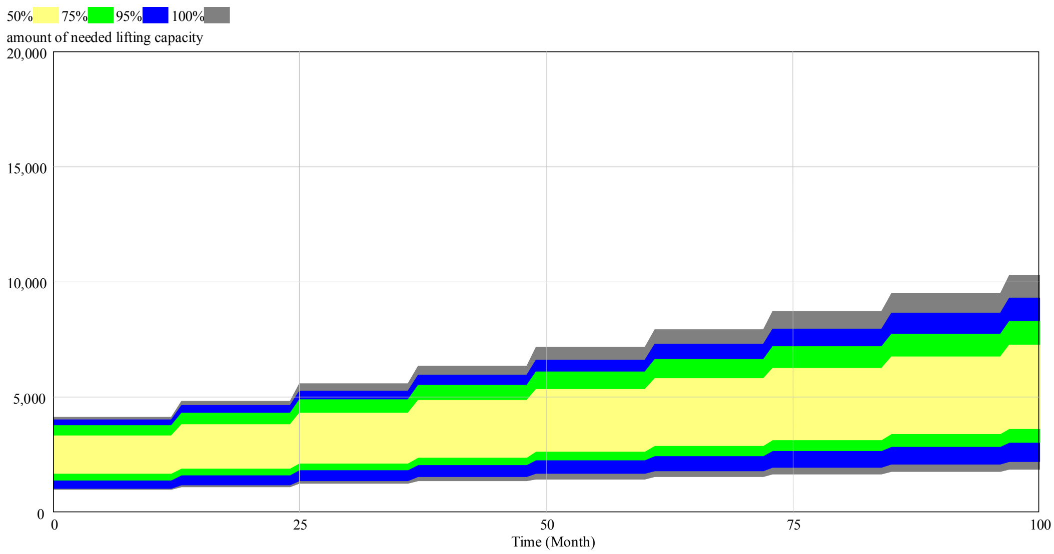

Figure 62. *Amount of needed lifting capacity at Muuga CT.*

In Figure 63 utilization rate of the lifting capacity at Muuga CT is presented. As it can be seen from the figure some of the runs seem to have the infrastructure vastly over utilized.

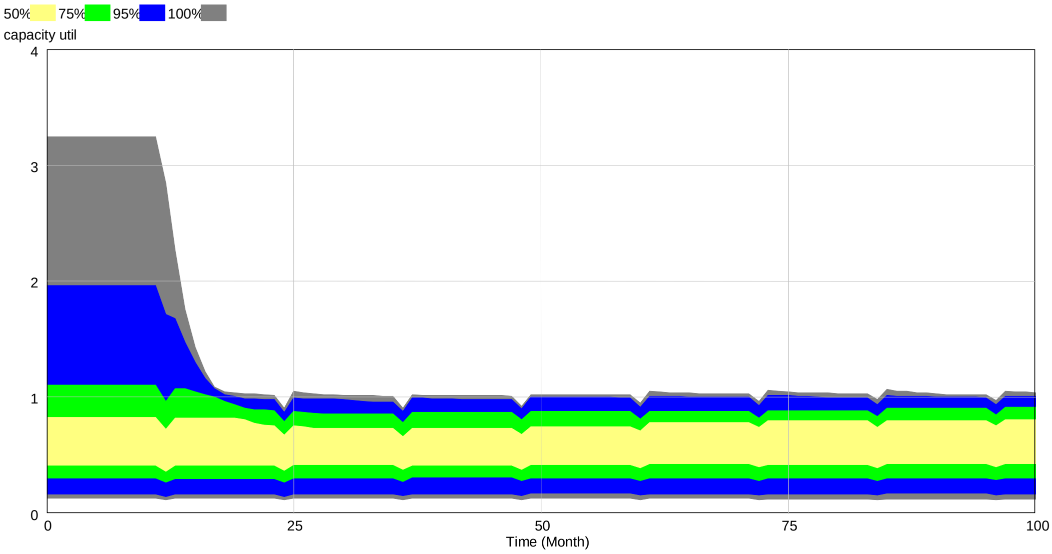

Figure 63. *Lifting capacity utilization rate at Muuga CT*

In Figure 64 new built lifting capacity investments are presented. Total percentage of the runs which need some amount of investments is around 10, and most of these runs have very low loading/unloading speed throughout the simulated time period. If the investments are needed, they would most likely be under 2,000 hoisting per month, but even as high as 9,000 units in some cases.

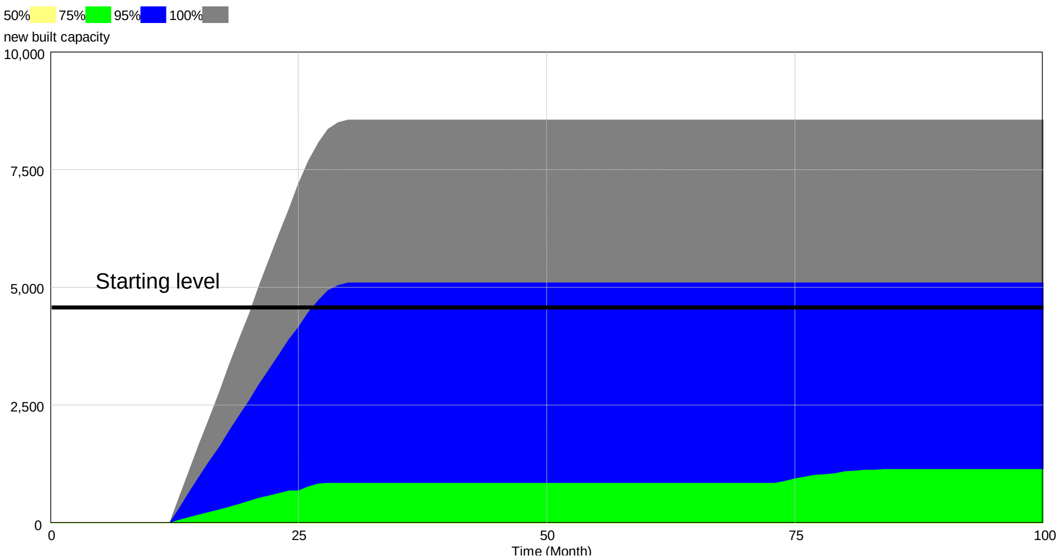

Figure 64. *New built lifting capacity investments at Muuga CT (Starting level of lifting capacity in use of transit: 4,500 container hoistings per month). .*

10 SOURCES OF INFRASTRUCTURE RELATED MACRO DATA IN FINLAND AND ESTONIA

Data for the research process was quite well available in Finland (see Table 21). Regarding ports the basic information is widely publicly available from Finnish Maritime Association and the port authorities. Only more detailed data of port calls of ships from PortNet website requires authorization. Information concerning border crossing there is a little less information available publicly. Information can be collected by contacting interviewing National Board of Customs and their representatives in different offices. Information about warehousing capacity in square meters was found from Statistics Finland and the planning departments of the cities. Information about warehouse buildings and their capacity in cubic meters on the other hand could be only found from cities. Nowadays Finnish Railways (Valtion rautatiet, VR) collects and publishes in its annual report the information of the transit cargo moved on railways. Statistics Finland used to collect all the transit statistics but currently they have moved to be collected by different organizations. Statistics of transit cargo transported on road is collected by National Board of Customs, respectively VR collects the info regarding rail and Finnish Maritime Association collects the transit data from the ports.

Table 21. *Data availability from the Finnish sources.*

	Authority	Availability
Ports		
-infrastructure	Finnish Port Association, Port authorities	Public: www.finnports.com, web-sites of the ports
-port calls	Port authorities, Finnish Maritime Association	Restricted: www.portnet.fi (requires authorisation) Public: Ulkomaan Meriliikenne 2006, FMA-publication
-open hours	Port authorities	Public: websites of the ports
-throughputs / handled containers	Finnish Port Association, Port authorities	Public: www.finnports.com, websites of the ports
Border crossing		
-capacities at border / traffic figures	National Board of Customs, Ministry of Transport and Communications	By request Public: MINTC publications
-queue lengths	National Board of Customs, Finnish Road Administration	By request
-future investments	National Board of Customs, Ministry of Transport and Communications	By request
Warehousing		
-capacities in square meters	Statistics Finland, Planning departments of the cities	Public: StatFin statistics web service By request
-capacities in cubic meters	Planning departments of the cities	By request
Railways		
-transit containers	VR- Oyj	Public: Annual reports, www.vr.fi

Data for the research process was not well available in Estonia as it is seen from the Table 22. Regarding ports the only information that was publicly available was about opening hours. The other topics such as infrastructure, port calls and throughputs needed contacting port authorities. Information concerning border crossing there is rather similar situation: it is possible to get information about the queue lengths and a bit about the future investments from web-sites. For further investigations it is necessary to interview Estonian Tax and Customs Board and their representatives in different centers and offices. Information about warehousing was the most difficult to find. Some information was found by contacting port authorities and the leading Estonian organizer of Logistics Conferences- Sensei OÜ. By contacting Estonian Tax and Customs Board it was possible to get information about transit containers transported by rail. Statistics of transit cargo transported on road is mostly collected by Estonian Tax and Customs Board and major part of the information concerning ports is collected by contacting port authorities.

Table 22. *Data availability from the Estonian sources.*

	Authority	Availability
Ports		
-infrastructure	Port authorities	By request
-port calls	Port authorities	By request
-open hours	Port authorities	Public: websites of the ports
-throughputs / handled containers	Port authorities	By request
Border crossing		
-capacities at border / traffic figures	Estonian Tax and Customs Board	By request
-queue lengths	Estonian Tax and Customs Board	Public:http://www.emta.ee/veokid
-future investments	Estonian Tax and Customs Board Ministry of Economic Affairs and Communications	By request Public: www.mkm.ee
Warehousing		
-capacities in square meters	Port authorities Sensei OÜ	By request
-capacities in cubic meters	Port authorities Sensei OÜ	By request
Railways		
-transit containers	Estonian Tax and Customs Board	By request

As we can see from previous paragraphs and tables in Finland the data is well publicly available compared to situation in Estonia. But in both countries a lot can be done regarding data availability on transit traffic. For example in Finland almost all of the data is available publicly. If this data would be accurate enough,

a kind of user interface (UI) for all this data could programmed rather easily. UI could be located possibly on webpage of a national authority and provide real-time information regarding traffic situation e.g. at border crossing stations, roads and ports. This kind of development would need co-operation from various authorities, such as road administration, customs, port association and researchers.

11 DISCUSSION

During this research process we have found out that some of the inevitable continuous investments, like warehousing and border crossing capacity e.g. in Estonia (latter item also to some extend in Finland) have been neglected during the years of Russian transit growth, and based on our simulation study best capacity situation exist in the harbours (lifting capacity). This is relatively surprising, since harbours represent often the most expensive and riskiest investment in the logistics infrastructure. However, harbours in Finland and Estonia serve also home country export companies as well as consumption, and therefore transit transports "fit" relatively well in capacity investment plans. For example, in Finland home consumption could be low due to some reason, but transit transports compensate the contemporary losses; i.e. transit traffic gives hedge for the completed investments. However, in a case of warehousing and border crossing we cannot find such a synergy, both seems to be dedicated investments, and mostly only for serving transit.

Thus, we stress that container transit transportation seems to Russia is going to grow in the future also, and enlargement investments should be completed proactively in Estonia as well as in Finland – instead of following demand increase with several years of time lag. As raw material, and especially oil, exports from Russia are breaking highest volumes and prices at the moment for more than two decades of time, we cannot find any reason why consumption and import of consumables in Russia would not follow this export income development.

Only major threat for container transit through Finnish and Baltic ports at the moment is the enlargement plan of St. Petersburg container harbour. However, if the growth continues in container volumes, during year 2012, when St. Petersburg terminal extension is planned to be in full-scale operational mode, amount of container transports to Russia is estimated to be roughly 5 million TEU. If St. Petersburg handles approx. 3 million TEU, then alternative routes have volume of 2 million TEU to compete from. Volume is so huge that either Finland or Estonia alone could not take it by themselves. Therefore, we identify that both of these countries should specialize on some sort of consumer items, and build infrastructure around of it. For example, Finland could further utilize its knowledge from production/distribution of electronics and mechanical products, by developing advanced warehousing, information system knowledge and training/degree programs to support transit transports of these items. In Estonia's case more feasible specialist route would be less warehousing intensive containerized items, like components and semi-finished items transported to factories operating in feasible range of Russian territory. Of course Estonia can start to offer also value added warehousing services, but it will need even greater amount of investments than on warehousing infrastructure.

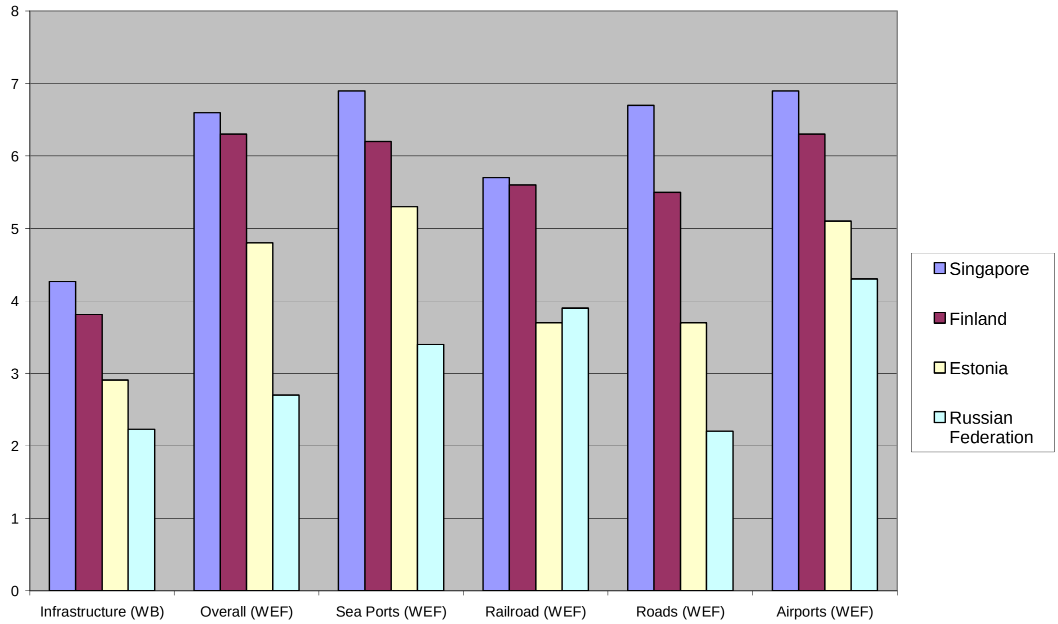

Figure 65. *Comparing state of infrastructure in Singapore, Finland, Estonia and Russia (WB denotes to World Bank measured with 5-point Likert scale, while WEF corresponds to World Economic Forum, and is measured with 7-point Likert scale). Source: World Bank (2007) and World Economic Forum (2007).*

Our research findings share similarities with the outcome of two larger infrastructure studies completed by World Bank (WB) / Turku School of Economics (Finland) and World Economic Forum (WEF). As Figure 65 shows, e.g. differences in sea ports are not that significant between Finland and Estonia, but railroad and roads have relatively high performance gap. Overall, infrastructure shape in Finland is graded as higher in both WB and WEF studies, but without giving real explanation why. In a case of transit transports our research group believes it to be related to value added logistics, and especially in infrastructural capacity at border crossing points and warehouses. Although, sea ports are not having insignificant role either – in a case of the most important container transit ports of Finland, Kotka and Hamina, warehousing areas are located mostly in the larger harbour area, which gives needed operational flexibility for logistical operations. However, origins of this are in the proactive enlargement plans of warehousing operations by city government, harbours and logistical operators. This type of activities we identify that are simply non-existent in a case of Estonia. Another important distinctive factor is a border crossing capacity. For example, in a case of Finland, we could not handle transit transports of more than 0.6-0.8 million TEU at current border crossing capacity (if no other transit transports would not be allowed with road transports, and every day of whole year border crossing points would operate at maximum capacity) – same limit in Estonia, taking only into account Narva border crossing capacity, would be 0.15-0.2 million TEU. However, practical and more feasible limits are roughly 30-50 % below of these numbers, since car transit to Russia is increasing in both of these countries, and seems to also continue to show growth in the future. Interestingly, especially in Estonia, container transit with trains to Russia has been under active development lately (e.g. with regard of tailored railway wagons, see Baltic News Service 2007). This mode of transports hinders some unrealized

potential in border crossing capacity, and could clearly be one point of development in the future.

12 CONCLUSIONS

12.1 Background

Container revolution started roughly five decades ago, and it has brought revolution in logistics operations between continents and regions, mostly in recent two decades perspective. This is also the case within Baltic Sea region, and in most recent years, especially in the ports of the Bay of Finland. For example, during year 2000 roughly 1 million TEU was handled in the Bay of Finland, while six years later this had grown to just below 3 million TEU – this corresponds approx. 10 % annual growth, and means doubling of the handled volume every seventh year. So, based on this logic we could expect that in the Bay of Finland most important ports handle altogether some 5.5-6 million TEU during year 2013. Quite significant proportion of this large container volume is having origin in Russian and eastern consumer market. Therefore, research related to infrastructure needs e.g. in Finland and Estonia is justified now, and also in the forthcoming years.

In this project we have gathered information of present port and border crossing infrastructure and warehousing capacity both in Finland and Estonia. While Finnish ports have mainly concentrated on container import to Russia, Estonian ports take a major share of the oil export from Russia. The objective of Russia is to shift as much of its transportation volumes as possible to its own ports. The construction of new ports and development of the existing ones will also transfer containerised transports of consumer goods and cars from the route via Finnish ports directly to Russia. In addition, logistics centres are being built in Russia, and western distribution centres are beginning to develop. This will be reflected as an increase in containers being transported directly to Russia without being unloaded in Finnish warehouses. At the same time, large logistics companies will establish themselves in Russia to set up their own warehouses.

On the other hand, the number of storage facilities in Russia remains inadequate, and their services are not advanced enough. They are also expensive compared to the rents of Finnish warehouses. The bureaucracy of the Russian Customs and other authorities is another obstacle for development.

The increase in the Russian consumer demand is so strong, however, that the country's own ports will not be able to deal with the increasing imports. Finland will maintain its position in Russian transit transports. The relative share may decrease, but the absolute one will grow.

The goods transported in containers via Finland to Russia arrive from Far Eastern ports mainly to the ports of Helsinki, Kotka and Hamina. From here, the majority of goods are after intermediate storage transported by trucks to Russia, Moscow and St. Petersburg. In Estonia there is currently only one container port, Muuga Container Terminal.

12.2 Results of the study

When studying the port costs it was found that that price competitiveness of Estonian ports is in the infrequent seasonal / project based containerized cargos. However, as volumes grow, and port visiting frequency of vessels increases as well, the cost difference is becoming lower.

In Finland transit transports are polarized: eastbound transit traffic is transported by road and westbound transit cargo is transported by railways. The most important border crossing point is Vaalimaa. Vaalimaa has been suffering increasingly from traffic congestion, which causes long queues outside of the actual border crossing area. In the worst cases length of this queue has been up to 50 kilometers

In Estonia, the most important road border crossing points, through which the transit goods pass in containers to Russia, are Narva in North-East side of Estonia, and correspondingly in South-East towns of Koidula and Luhamaa are the crossing points.

When looking at traffic cargo warehousing in Finland Kotka, Hamina, Kouvola and Lappeenranta are the most important cities. In addition, Helsinki and Hanko were studied. Helsinki has the far most warehousing capacity, while Kotka coming next. In Estonia there is very little under roof warehousing capacity available for transit containers.

System dynamic models were built to describe the possible future situations in border crossing stations. The results show:

- Additional 17,000 trucks per day handling capacity is required to satisfy the needs (for container traffic only) in Vaalimaa. This increase corresponds to about 50 % capacity increase as compared to the current level.
- In Narva, the highest growth scenario the capacity need is roughly 50% compared to current existing one, and most probably realized number will be half of this (if capacity additions are needed in any case).
- Based on square meter model, in Finland the maximum amount of needed warehousing space is 1.2 million m^2 and the most probable amount is 600 000 m^2. Based on cubic meter model no investments are needed.
- In Estonia, there will be needs from doubling to quadrupling the warehousing capacity for container traffic.
- On the other hand, no new capacity is needed for container lifting in Finnish or Estonian ports.

Our research results verified that generally sea ports are in good capacity condition with respect of growing volumes, but in a case of warehousing and border crossing more attention for investments should be given in the forthcoming decade. Warehousing investment need concerns especially Estonia, but in five year timeframe also Finland. Border crossing capacity enlargement should hold priority in both of the countries immediately.

During our research process, we also encountered quite important improvement point in the dissemination of macro logistics data – in case of

Estonia quite small amount of data is freely available in Internet, while in the case of Finland information is fragmented into various different places. Therefore, it would be beneficial for the Baltic Sea region to have one Internet portal, which would gather information from container transports (and possible some other important transported items, such as oil) together, and making whole situation more transparent for decision-makers. With this addition we could avoid unnecessary investments on infrastructure, as the situation as a whole would be known, instead of from the point of view of one country or one actor in that country. Further information dissemination would also clearly benefit economic growth in the area, since scarce assets would be invested more wisely, and leaving room for other competing projects.

During this research process we have found out that some of the inevitable continuous investments, like warehousing and border crossing capacity e.g. in Estonia (latter item also to some extend in Finland) have been neglected during the years of Russian transit growth, and based on our simulation study best capacity situation exist in the harbors (lifting).

Thus, we stress that container transit transportation seems to grow to Russia in the future too, and enlargement investments should be completed proactively in Estonia as well as in Finland – instead of following demand increase with several years of time lag. Even though Russia is building its own container ports, there will be million of TEU for other ports as well.

We suggest that both Finland and Estonia should specialize on some sort of consumer items, and build infrastructure around of it. For example, Finland could further utilize its knowledge from production/distribution of electronics and mechanical products, by developing advanced warehousing, information system knowledge and training/degree programs to support transit transports of these items. In Estonia's case more feasible specialist route would be less warehousing intensive containerized items, like components and semi-finished items transported to factories operating in feasible range of Russian territory.

12.3 Further research

This study has shown clearly the needed infrastructure for container transit traffic in Finland and Estonia. However, before these investments in border crossing stations and warehousing capacity can be realized their location, exact type and investment time schedule has to be carefully planned.

This study was based on linear growth of Russian transit cargo volumes. However, also the effect of exceptional situations should be studies. What would happen if St. Petersburg port is closed for several months, e.g. due to severe ice conditions or accidental destruction of ports. What if Finnish port are on strike? The effect of these situations can be unexpected, but they could quite easily be studied by means of simulation.

For other possible future research avenues within container market, we would be interested to investigate further, how flexibility, lead-time performance and volume handling ability enables different routes to attract more containerized cargo than others. A priori we know that flexibility of logistics operations is the norm to be in business among Finnish logistics industry, since export companies

have needed this during years (e.g. Sandhu (2005) est. that 60 % from the value of exports of Finland and Sweden are projects, which require from logistics operations mostly flexibility, not cost efficiency). On the other hand, Russian and Estonian economies are not that project concentrated in exports, and logistical operations have different advantages. Among Finnish export companies it is quite usual to outsource logistical services widely (e.g. Koskinen & Hilmola 2008), and this might facilitate increase of flexibility as well. It would be interesting to examine, what kind of role: (1) the level of education among actors and quality of programs have on flexibility, (2) what kind of role industrial base of each country holds with this respect, and (3) how outsourcing is supporting enhancement of flexibility.

Finally, the results of this study should be yearly updated with new information of Russian transit cargo volumes

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APPENDIX 1

Collected charges and dues in different ports.

	Port of Tallinn	Port of Helsinki	Port of Kotka	Port of Hamina	Port of Riga	Port of St. Petersburg	Port of Klaipeda
berthing due/fee					X	X	X
canal due/fee					X	X	
due on vessel waste disposal		X	X	X			
mooring charge	X						
dues on mooring and unmooring		X	X	X			
ecology due						X	
fairway due		X	X	X			
icebreaking due						X	
lighthouse due	X				X	X	
navigation due	X					X	X
pilotage due	X	X	X	X		X	
sanitary due/fee					X		X
tonnage due	X						X
waste fee	X						
vessel due		X	X	X		X	X

APPENDIX 2

Transported tons through Vaalimaa border crossing point (Source: National Board of customs 2007f).

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	ch. % 05-06
export *	148 735	162 525	180 201	169 896	188 975	200 860	213 112	210 190	216 982	248 658	237 945	238 722	2 416 801	16,5 %
transit	128 837	143 983	159 986	150 145	168 017	179 049	191 058	189 079	195 069	219 681	209 325	211 878	2 146 107	17,8 %
tr-share	87 %	89 %	89 %	88 %	89 %	89 %	90 %	90 %	90 %	88 %	88 %	89 %	89 %	
import *	67 852	69 639	81 490	102 851	76 349	85 011	64 605	56 334	57 031	53 368	56 418	43 062	814 010	-21,6 %
transit	5 530	5 492	6 183	6 278	7 515	6 248	5 249	5 654	6 543	7 062	6 374	5 141	73 269	13,1 %
tr-share	8 %	8 %	8 %	6 %	10 %	7 %	8 %	10 %	11 %	13 %	11 %	12 %	9 %	

2007	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	h. % 06-07*
export *	178 660	206 377	229 599	233 616	229 926								1 078 178	26,8 %
transit	157 988	178 936	198 978	201 539	199 395								936 836	24,8 %
tr-share	88 %	87 %	87 %	86 %	87 %								87 %	
import *	41 150	45 258	46 735	59 973	51 106								244 222	-38,7 %
transit	6 735	6 839	7 756	7 856	8 670								37 856	22,1 %
tr-share	16 %	15 %	17 %	13 %	17 %								16 %	

* export and import figures include transit

** first five months

APPENDIX 3

Queues at Narva Border Crossing Point

Narva/01.01.07-31.03.07

Date	Trucks in queue to Russia	Queue length in km	Accepted trucks to Russia in last 24 h	Predictable waiting time in h
31.03.2007	**200**	**3,6**	133	**39**
30.03.2007	**230**	**4,14**	121	**47**
29.03.2007	**190**	**3,42**	116	**37**
28.03.2007	**230**	**4,14**	134	**44**
27.03.2007	**190**	**3,42**	121	**35**
26.03.2007	**180**	**3,24**	121	**33**
25.03.2007	**220**	**3,96**	155	**38**
24.03.2007	**180**	**3,24**	121	**33**
23.03.2007	**120**	**2,16**	140	**21**
22.03.2007	**160**	**2,88**	129	**30**
21.03.2007	**220**	**3,96**	140	**40**
20.03.2007	**120**	**2,16**	116	**21**
19.03.2007	**70**	**1,26**	145	**11**
18.03.2007	**135**	**2,43**	160	**23**
17.03.2007	**200**	**3,6**	149	**36**
16.03.2007	**190**	**3,42**	122	**38**
15.03.2007	**220**	**3,96**	126	**45**
14.03.2007	**190**	**3,42**	108	**35**
13.03.2007	**200**	**3,6**	128	**34**
12.03.2007	**220**	**3,96**	161	**38**
11.03.2007	**350**	**6,3**	138	**62**
10.03.2007	**360**	**6,48**	116	**65**
09.03.2007	**250**	**4,5**	152	**46**
08.03.2007	**300**	**5,4**	132	**63**
07.03.2007	**300**	**5,4**	103	**62**
06.03.2007	**300**	**5,4**	107	**56**
05.03.2007	**400**	**7,2**	142	**77**
04.03.2007	**340**	**6,12**	140	**68**
03.03.2007	**400**	**7,2**	90	**80**
02.03.2007	**250**	**4,5**	128	**46**
01.03.2007	**250**	**4,5**	143	**49**
28.02.2007	**190**	**3,42**	119	**38**
27.02.2007	**185**	**3,33**	105	**35**
26.02.2007	**200**	**3,6**	138	**35**
25.02.2007	**250**	**4,5**	139	**49**
24.02.2007	**260**	**4,68**	136	**54**
23.02.2007	**250**	**4,5**	96	**52**
22.02.2007	**210**	**3,78**	114	**43**
21.02.2007	**250**	**4,5**	136	**50**
20.02.2007	**250**	**4,5**	100	**54**
19.02.2007	**290**	**5,22**	125	**55**
18.02.2007	**350**	**6,3**	111	**71**

17.02.2007	**300**	**5,4**	142	**59**
16.02.2007	**250**	**4,5**	104	**55**
15.02.2007	**250**	**4,5**	122	**50**
14.02.2007	**250**	**4,5**	104	**51**
13.02.2007	**200**	**3,6**	135	**38**
12.02.2007	**200**	**3,6**	118	**41**
11.02.2007	**240**	**4,32**	124	**49**
10.02.2007	**230**	**4,14**	109	**47**
09.02.2007	**170**	**3,06**	123	**35**
08.02.2007	**195**	**3,51**	121	**39**
08.02.2007	**195**	**3,51**	121	**39**
07.02.2007	**225**	**4,05**	110	**39**
06.02.2007	**110**	**1,98**	128	**19**
05.02.2007	**120**	**2,16**	144	**24**
04.02.2007	**180**	**3,24**	149	**34**
03.02.2007	**190**	**3,42**	104	**36**
02.02.2007	**120**	**2,16**	128	**21**
01.02.2007	**150**	**2,7**	150	**27**
31.01.2007	**130**	**2,34**	137	**26**
30.01.2007	**70**	**1,26**	108	**14**
29.01.2007	**15**	**0,27**	117	**3**
28.01.2007	**45**	**0,81**	128	**9**
27.01.2007	**85**	**1,53**	118	**18**
26.01.2007	**55**	**0,99**	108	**11**
25.01.2007	**80**	**1,44**	120	**15**
24.01.2007	**100**	**1,8**	143	**19**
23.01.2007	**50**	**0,9**	123	**10**
22.01.2007	**30**	**0,54**	111	**6**
21.01.2007	**60**	**1,08**	134	**11**
20.01.2007	**40**	**0,72**	146	**8**
19.01.2007	**2**	**0,036**	111	**0**
18.01.2007	**50**	**0,9**	125	**9**
17.01.2007	**60**	**1,08**	146	**11**
16.01.2007	**5**	**0,09**	112	**1**
15.01.2007	**3**	**0,054**	114	**1**
14.01.2007	**15**	**0,27**	122	**4**
13.01.2007	**0**	**0**	119	**0**
12.01.2007	**0**	**0**	81	**0**
11.01.2007	**0**	**0**	99	**0**
10.01.2007	**0**	**0**	82	**0**
09.01.2007	**0**	**0**	94	**0**
08.01.2007	**0**	**0**	66	**0**
07.01.2007	**0**	**0**	96	**0**
06.01.2007	**0**	**0**	72	**0**
05.01.2007	**0**	**0**	17	**0**
04.01.2007	**0**	**0**	15	**0**
03.01.2007	**0**	**0**	3	**0**
02.01.2007	**0**	**0**	0	**0**
01.01.2007	**0**	**0**	2	**0**
Average queue length KM		**2,83**		

APPENDIX 4

Queues at Koidula Border Crossing Point

Koidula/01.01.07-31.03.07

Date	Trucks in queue to Russia	Queue length in km	Accepted trucks to Russia in last 24 h	Predictable waiting time in h
31.03.2007	**50**	**0,9**	87	**12**
30.03.2007	**54**	**0,972**	91	**16**
29.03.2007	**76**	**1,368**	78	**25**
28.03.2007	**98**	**1,764**	73	**27**
27.03.2007	**110**	**1,98**	69	**20**
26.03.2007	**98**	**1,764**	91	**26**
25.03.2007	**102**	**1,836**	96	**28**
24.03.2007	**118**	**2,124**	90	**30**
23.03.2007	**144**	**2,592**	101	**36**
22.03.2007	**164**	**2,952**	100	**44**
21.03.2007	**159**	**2,862**	89	**45**
20.03.2007	**130**	**2,34**	68	**32**
19.03.2007	**84**	**1,512**	93	**28**
18.03.2007	**97**	**1,746**	81	**28**
17.03.2007	**60**	**1,08**	109	**15**
16.03.2007	**15**	**0,27**	73	**3**
15.03.2007	**30**	**0,54**	119	**7**
14.03.2007	**72**	**1,296**	89	**18**
13.03.2007	**42**	**0,756**	74	**10**
12.03.2007	**46**	**0,828**	90	**9**
11.03.2007	**55**	**0,99**	103	**11**
10.03.2007	**49**	**0,882**	76	**10**
9.03.2007	**23**	**0,414**	88	**6**
8.03.2007	**42**	**0,756**	89	**10**
7.03.2007	**72**	**1,296**	89	**14**
6.03.2007	**54**	**0,972**	112	**15**
5.03.2007	**78**	**1,404**	95	**15**
4.03.2007	**98**	**1,764**	78	**20**
3.03.2007	**47**	**0,846**	72	**11**
2.03.2007	**0**	**0**	65	**0**
1.03.2007	**16**	**0,288**	87	**4**
28.02.2007	**21**	**0,378**	112	**5**
27.02.2007	**27**	**0,486**	109	**6**
26.02.2007	**36**	**0,648**	80	**7**
25.02.2007	**57**	**1,026**	77	**14**
24.02.2007	**45**	**0,81**	72	**11**
23.02.2007	**33**	**0,594**	98	**8**
22.02.2007	**57**	**1,026**	94	**14**
21.02.2007	**96**	**1,728**	142	**18**
20.02.2007	**95**	**1,71**	100	**19**
19.02.2007	**50**	**0,9**	82	**8**

18.02.2007	**30**	**0,54**	87	**6**
17.02.2007	**20**	**0,36**	80	**4**
16.02.2007	**28**	**0,504**	87	**5**
15.02.2007	**42**	**0,756**	60	**8**
14.02.2007	**28**	**0,504**	102	**6**
13.02.2007	**12**	**0,216**	113	**2**
12.02.2007	**5**	**0,09**	40	**1**
9.02.2007	**0**	**0**	60	**0**
8.02.2007	**7**	**0,126**	88	**1**
7.02.2007	**26**	**0,468**	103	**5**
6.02.2007	**6**	**0,108**	119	**1**
5.02.2007	**0**	**0**	62	**0**
2.02.2007	**0**	**0**	55	**0**
1.02.2007	**6**	**0,108**	99	**0**
31.01.2007	**36**	**0,648**	92	**6**
30.01.2007	**16**	**0,288**	89	**3**
29.01.2007	**6**	**0,108**	72	**0**
26.01.2007	**0**	**0**	62	**0**
25.01.2007	**0**	**0**	71	**0**
24.01.2007	**16**	**0,288**	74	**2**
23.01.2007	**0**	**0**	43	**0**
22.01.2007	**0**	**0**	33	**0**
19.01.2007	**0**	**0**	54	**0**
18.01.2007	**0**	**0**	92	**0**
17.01.2007	**28**	**0,504**	94	**0**
16.01.2007	**10**	**0,18**	53	**0**
15.01.2007	**0**	**0**	61	**0**
12.01.2007	**0**	**0**	43	**0**
11.01.2007	**0**	**0**	45	**0**
10.01.2007	**0**	**0**	38	**0**
9.01.2007	**0**	**0**	58	**0**
8.01.2007	**0**	**0**	29	**0**
7.01.2007	**0**	**0**	55	**0**
6.01.2007	**0**	**0**	15	**0**
5.01.2007	**0**	**0**	11	**0**
4.01.2007	**0**	**0**	3	**0**
3.01.2007	**0**	**0**	1	**0**
2.01.2007	**0**	**0**	0	**0**
1.01.2007	**0**	**0**	0	**0**
Average queue length KM		**0,70**		

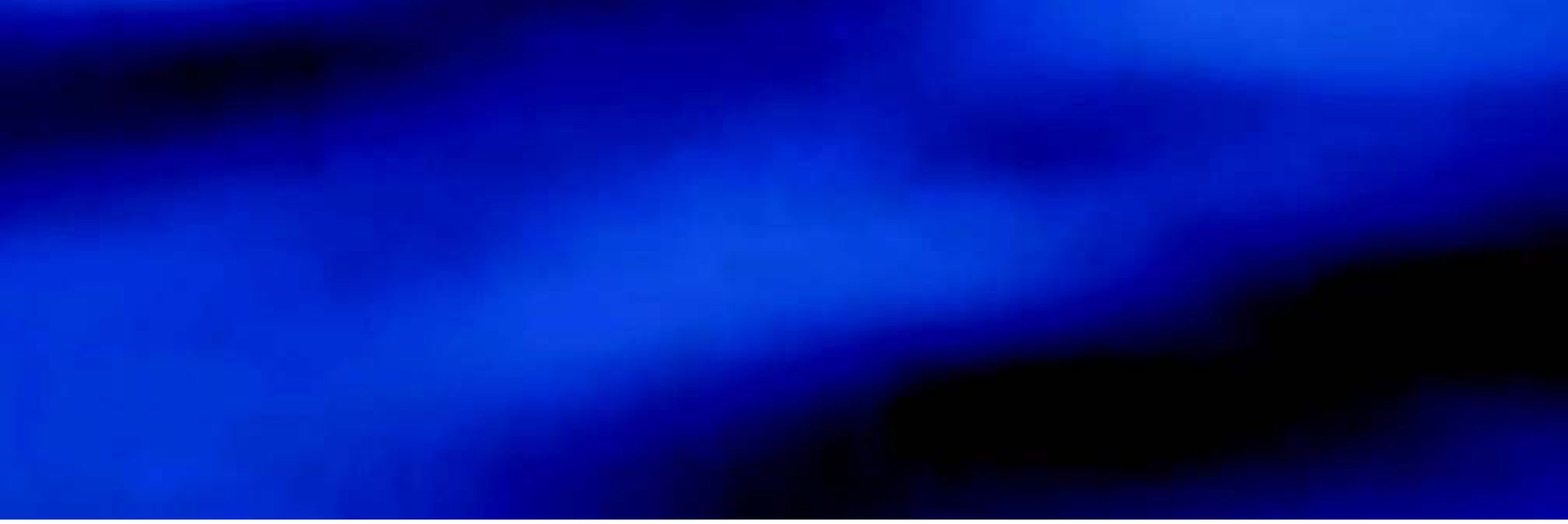
APPENDIX 5

Queues at Luhamaa Border Crossing Point

Luhamaa/01.01.07-31.03.07

Date	Trucks in queue to Russia	Queue length in km	Accepted trucks to Russia in last 24 h	Predictable waiting time in h
31.03.2007	**40**	**0,72**	81	**15**
30.03.2007	**25**	**0,45**	79	**10**
29.03.2007	**55**	**0,99**	70	**20**
28.03.2007	**65**	**1,17**	66	**22**
27.03.2007	**65**	**1,17**	84	**24**
26.03.2007	**80**	**1,44**	71	**28**
25.03.2007	**85**	**1,53**	71	**30**
24.03.2007	**85**	**1,53**	81	**30**
23.03.2007	**95**	**1,71**	76	**40**
22.03.2007	**115**	**2,07**	51	**57**
21.03.2007	**105**	**1,89**	37	**48**
20.03.2007	**73**	**1,314**	56	**24**
19.03.2007	**76**	**1,368**	78	**23**
18.03.2007	**107**	**1,926**	85	**35**
17.03.2007	**112**	**2,016**	71	**43**
16.03.2007	**100**	**1,8**	60	**40**
15.03.2007	**110**	**1,98**	55	**48**
14.03.2007	**115**	**2,07**	60	**48**
13.03.2007	**100**	**1,8**	55	**45**
12.03.2007	**98**	**1,764**	60	**36**
11.03.2007	**91**	**1,638**	65	**32**
10.03.2007	**48**	**0,864**	70	**17**
09.03.2007	**17**	**0,306**	65	**7**
08.03.2007	**25**	**0,45**	68	**12**
07.03.2007	**40**	**0,72**	54	**20**
06.03.2007	**60**	**1,08**	78	**24**
05.03.2007	**80**	**1,44**	64	**25**
04.03.2007	**76**	**1,368**	82	**25**
03.03.2007	**72**	**1,296**	78	**25**
02.03.2007	**66**	**1,188**	64	**25**
01.03.2007	**81**	**1,458**	65	**35**
28.02.2007	**95**	**1,71**	65	**36**
27.02.2007	**100**	**1,8**	34	**48**
26.02.2007	**60**	**1,08**	60	**24**
25.02.2007	**65**	**1,17**	58	**24**
24.02.2007	**59**	**1,062**	70	**20**
23.02.2007	**21**	**0,378**	66	**24**
22.02.2007	**55**	**0,99**	70	**20**
21.02.2007	**92**	**1,656**	59	**35**
20.02.2007	**50**	**0,9**	59	**20**
19.02.2007	**30**	**0,54**	71	**12**
18.02.2007	**60**	**1,08**	69	**20**

17.02.2007	**50**	**0,9**	10	**67**
16.02.2007	**35**	**0,63**	66	**13**
15.02.2007	**60**	**1,08**	73	**25**
14.02.2007	**55**	**0,99**	60	**21**
13.02.2007	**40**	**0,72**	59	**16**
11.02.2007	**40**	**0,72**	53	**16**
11.02.2007	**35**	**0,63**	65	**14**
10.02.2007	**15**	**0,27**	58	**3**
09.02.2007	**8**	**0,144**	61	**2**
08.02.2007	**34**	**0,612**	71	**13**
07.02.2007	**54**	**0,972**	54	**22**
06.02.2007	**26**	**0,468**	57	**15**
05.02.2007	**10**	**0,18**	65	**5**
05.02.2007	**10**	**0,18**	65	**5**
04.02.2007	**26**	**0,468**	83	**10**
03.02.2007	**15**	**0,27**	52	**10**
02.02.2007	**10**	**0,18**	57	**5**
01.02.2007	**10**	**0,18**	63	**5**
31.01.2007	**21**	**0,378**	69	**7**
30.01.2007	**9**	**0,162**	60	**3**
29.01.2007	**28**	**0,504**	72	**10**
28.01.2007	**37**	**0,666**	69	**14**
27.01.2007	**10**	**0,18**	62	**2**
26.01.2007	**0**	**0**	58	**0**
25.01.2007	**15**	**0,27**	69	**8**
24.01.2007	**25**	**0,45**	28	**10**
23.01.2007	**14**	**0,252**	71	**3**
22.01.2007	**0**	**0**	53	**0**
21.01.2007	**8**	**0,144**	78	**2**
19.01.2007	**13**	**0,234**	61	**6**
19.01.2007	**0**	**0**	48	**0**
18.01.2007	**10**	**0,18**	66	**4**
17.01.2007	**30**	**0,54**	64	**12**
16.01.2007	**0**	**0**	63	**0**
15.01.2007	**0**	**0**	50	**0**
14.01.2007	**6**	**0,108**	68	**0**
13.01.2007	**0**	**0**	35	**0**
12.01.2007	**0**	**0**	28	**0**
11.01.2007	**0**	**0**	36	**0**
10.01.2006	**0**	**0**	29	**0**
09.01.2007	**0**	**0**	46	**0**
08.01.2006	**0**	**0**	49	**0**
07.01.2007	**0**	**0**	50	**0**
06.01.2007	**0**	**0**	37	**0**
05.01.2007	**0**	**0**	10	**0**
04.01.2007	**0**	**0**	7	**0**
03.01.2007	**0**	**0**	11	**0**
02.01.2007	**0**	**0**	0	**0**
01.01.2007	**0**	**0**	1	**0**
Average queue length KM		**0,75**		



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