BOTTLENECKS IN INTERMODAL TRANSPORTATION – THE CASE OF THE BALTIC REGION

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ABSTRACT

Due to trends in globalisation and outsourcing, container traffic is increasing at rapid speed. Reflecting this development, several new ports and container terminals are built around the Baltic Sea. However, as many ports have previously been serving liquid materials from pipelines, port hinterlands currently lack the connectivity for the further transportation of solid materials to and from the ports. Rail connections between ports and major cities in the region are virtually non-existent, and many roads in the Baltic States are not built for the truck sizes and weights required for intermodal container traffic. The situation of the transportation infrastructure in the region is improving very slowly, therefore shippers need alternative solutions to ensure the movement of their freight in and out of these ports. This paper examines and assesses the bottlenecks for freight movement in the Baltic States from the perspective of intermodal transportation. A framework for conducting the examination of the perceived bottlenecks on different levels is proposed. Bottlenecks for intermodal transportation are found on organisational, regional, but also international levels.

Keywords: Baltic States, intermodal transportation, bottleneck analysis

1. INTRODUCTION

The Baltic States (Estonia, Latvia and Lithuania) have faced dramatic geopolitical changes in recent years, breaking away from the Soviet Union in the early 1990s and recently joining the European Union (EU). The European integration is a challenge bringing about new opportunities of economic growth and for the transport sector. Recently, new ports and container terminals have been built around the Baltic Sea and old harbours have been rehabilitated in order to reflect the positive economic growth. All three Baltic Republics in addition to Russia itself are natural competitors for East-West cargo shipment; however, compared to other Baltic ports, the Port of Klaipeda has the best hinterland road with a four lane European standard motorway to Vilnius and rail connection to the East and Moscow (Rytkönen *et al.*, 2002). Nevertheless, today the infrastructure of most accession countries is unable to cope with the new transport needs and is hindering the development of sustainable transport networks (Grimaldi, 2003).

The political history of the Baltic States as well as their geographic proximity to countries of the Former Soviet Union (FSU) explains some special problems related to these countries transport infrastructure. Current road and rail networks still emphasise an East-West connection to major Russian cities (Economist, 2003b; Jauernig and Roe, 2001), while the

North-South connections – that would serve as a link between the three Baltic capitals, Tallinn, Riga and Vilnius – are largely neglected. Freight volumes are increasing rapidly, though in new directions and forms. For one, a trend away from East-West trade towards more intra-Baltic and other North-South trade is evident. Secondly, the structure of items transported is changing, away from mainly oil and gas transport through pipelines to ports (Economist, 2003b; Laurila, 2003) to more service products, unitised goods, and container traffic (comp. Banister and Berechman, 2001). Ultimately, this affects the modal split of freight transport in the region (Arnold *et al.*, 2004). Consequently, several new seaports are constructed in the Baltic States to accommodate for container traffic (Ojala *et al.*, 2004). This introduces an interest in intermodal transportation. However, given that the transitions in transport infrastructure don't follow the speed of increase in freight volumes, the actual transportation of this freight is challenged. This paper thus aims at identifying bottlenecks for intermodal transportation in this context, in order to visualise the most necessary points of improvement to facilitate intermodal transportation. This will help to develop freight transport in the Baltic States, which is argued to facilitate the economic growth of a region.

The paper is structured as follows: First, a conceptual framework is developed to identify different levels for bottlenecks in intermodal transportation. This framework is then used for discussing these bottlenecks in more detail. A discussion of the future challenges concludes the paper.

2. A FRAMEWORK FOR INVESTIGATING BOTTLENECKS IN INTERMODAL TRANSPORTATION

Intermodal transportation can be defined as the movement of goods by two or more modes of transportation in the same loading unit without handling the goods themselves when changing transportation modes (ECMT, 1997). But while intermodal transportation is typically discussed in Europe as a policy issue (Bontekoning *et al.*, 2004) to counteract traffic congestion on European roads (Groothedde *et al.*, 2005) or due to environmental considerations (Arnold *et al.*, 2004), the Baltic States face unique dilemmas. Road transport accounts for 75% of freight movements in the EU (Gentry *et al.*, 1995) and is heavily increasing also in the Baltic States, but a range of managerial problems in economies in transition (Peng and Vellenga, 1993) pair infrastructural issues. Also, while intermodality is mainly discussed between road and rail transport (Arnold *et al.*, 2004; Bontekoning *et al.*, 2004; Groothedde *et al.*, 2005), sea transportation dominates in freight transport in the Baltic States (Ojala *et al.*, 2004). Thus, the focus of intermodal transportation in this geographical region is on the interconnectivity of seaports. At the same time, air transport in the Baltic States is neglectable (Ojala *et al.*, 2004). Therefore the focus of this paper is on the three dominating transportation modes (which haven't been challenged in their importance since their discussion in Buchhofer, 1995), namely maritime, rail, and road transport.

For the purpose of examining and assessing the bottlenecks or challenges in intermodal transportation in the Baltic Sea region, a conceptual framework is proposed. The framework takes it starting point in the organisational and supply chain level and from there continues to the national/regional level to the international level (see Figure 1). Thus it moves from micro-organisational issues to interorganisational, and ultimately, macro-economic levels of analysis. A distinction between bottlenecks on these levels is followed throughout the paper.

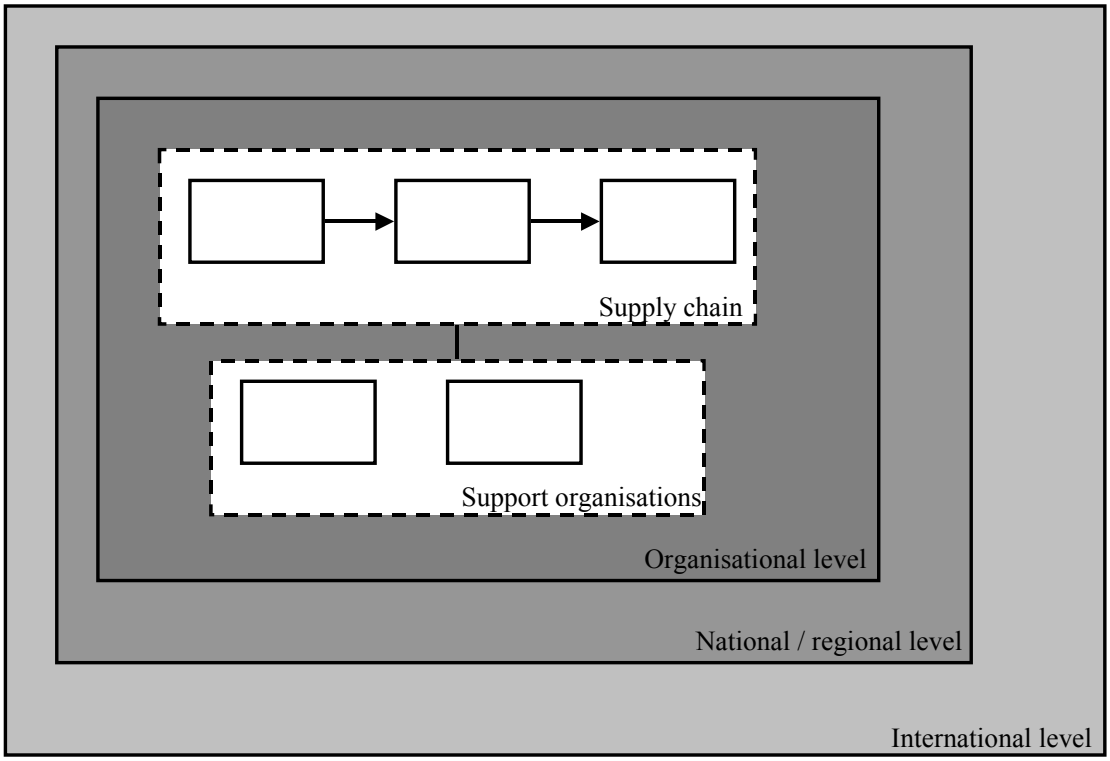


Figure 1: A conceptual framework for investigating bottlenecks in intermodal transportation

2.1. Organisational and supply chain level

Structural changes in the demand for goods affect the entire logistics chain. Different products require new equipment and handling capabilities from transportation companies. The Baltic States have recently undergone a major economic transition from planned to market economies. Hand in hand with this development, manufacturing companies needed to reorientate themselves from industrial mass production to offering more customised and service products (Banister and Berechman, 2001; Buchhofer, 1995). The configuration of these products has a strong impact on the freight to be transported, i.e. the number of shipments is increasing while the freight volumes per shipment decrease (Hesse and Rodrigue, 2004). The assumption is that the unit cost of transportation varies between different modes. The steepness of cost curves reflects volume movements, freight handling charges, the speed of transportation, and costs of switching modes in intermodal transportation (Banomyong and Beresford, 2001). Customisation and manufacturing in batches also leads to more frequent but smaller shipments, and ultimately affect the requirements placed on transportation companies, i.e. the support organisations in the supply chain. However, poor handling capabilities currently lead to many organisations favouring seaports outside the Baltic States for international transportation in the region (Laurila, 2003). Thus, organisational adaptation in especially operational but also leadership skills proves to be necessary for Baltic transportation companies to compete in an international environment.

Other developments concern the management of transport providers. In a free market economy, manufacturers, wholesalers and retailers are supposed to provide goods, which are demanded (Peng and Vellenga, 1993). Restructuring trucking services in economies of transition struggle with the following points: the difficult financial situation of domestic companies, limited experience of management (see also Goh and Ang, 2000; Persson and Bäckman, 1993), the unsettled legal status of stationary property, and a sharp decline in state-owned enterprises (Rydzkowski, 1993). At the same time, vehicle maintenance and operation

costs have increased (Jauernig and Roe, 2001; Queiroz, 2003). This paved the way for other states, e.g. Sweden and Denmark, in the Baltic Sea region to claim dominant roles as a logistics centres (Vigede, 2003; Matthiessen, 2004). In order to regain regional competitiveness, the Baltic States would need to invest significantly into their transport infrastructure (comp. Goh and Ang, 2000).

Although the economic development and prosperity of the Baltic States does not solely depend on the development of their transport infrastructure, its importance in terms of providing opportunities for future logistical developments should not be underestimated. Business relationships can develop in isolation from transport infrastructure, but a functioning logistics solution is necessary to fulfil business promises and contracts. The rise and fall of many dot.com companies has illustrated how missing logistics solutions can determine the success of a company. Similarly, an underdeveloped transport infrastructure is a major impediment to the economic development of a region.

Intermodal transportation in essence calls for the management of multi-actor logistics chains (Bontekoning *et al.*, 2004). This mode of transportation is favoured over e.g. combined transportation in the Baltic Sea Region, because of differences in truck lengths in different countries, e.g. Sweden and Germany. Therefore, vessels carry containers rather than trucks across the Baltic Sea, which are then loaded onto different types of trucks for final delivery. It is thus surprising, how little interest the management of business relationships has gained in the Baltic States. According to a survey by Deloitte and Touche (2000), over 90% of global manufacturers (which are there defined as those in Western Europe, North America and Asia) felt that building and managing an efficient and effective supply chain will be critical for survival. At the same time, D&T's more recent survey (2002) of firms in the Baltics and the CEE states portray quite a different picture. Only 4% of Latvian firms, 12% of Lithuanian firms and 14% of Estonian firms thought that an emphasis on SCM is essential for survival (Deloitte and Touche, 2002). Similarly low was the usage of e.g. electronic market places in purchasing – a mere 12% of Estonian, 4% of Latvian and 7% of Lithuanian firms used this technology, compared to 71-84% from global players (Deloitte and Touche, 2002). If such attitudes continue Baltic firms could be at a serious disadvantage in the EU. In the short run, companies in the Baltic States have the comparative advantage of relatively low labour costs vis-à-vis other EU countries, but even just in intermodal transportation, they are outweighed by relatively high operational costs, and long transhipment times between different transportation modes. Therefore, it will be necessary for Baltic firms to become more competitive in their manufacturing processes and to form linkages with partners throughout the EU. One way to accomplish this is through SCM in which suppliers, producers and customers form alliances.

A supply chain is defined as "a set of three or more entities (organizations or individuals) directly involved in the upstream (suppliers) and downstream (customers) flow of products, services and/or information from a source to a customer" (Mentzer *et al.*, 2001). Effective supply chain management requires a supply chain orientation, i.e. a management philosophy of co-ordinating the entire supply chain from an overall systems perspective (Mentzer *et al.*, 2001). Co-operation with supply chain partners usually involves the formation of long-term alliances with suppliers and customers. Some Baltic manufacturers, especially in the dairy industry have been able to do this as about 80% of supplies come from about 23% of the suppliers (Deloitte and Touche, 2002). There are more opportunities to gain these partnering efficiencies in other industries. Other performance indicators related to suppliers are the quality and on-time delivery of inbound materials. Survey results show that 83% of the Baltic participants regularly received shipments on time, compared to 99% for the top global

companies (Deloitte and Touche, 2002). The indicator of the quality of inbound materials is often expressed as the number of defective parts per million (PPM) received. The figures for the Baltic survey respondents were about 23,000 PPM, while only being 4,000 PPM for top international firms (Deloitte and Touche, 2002). The opposite side of the SC is the ability of a manufacturer to provide on-time deliveries to its customers. The average for the Baltic survey participants was approximately 90% vis-à-vis 99% for top quartile performers (Deloitte and Touche, 2000). The bottom line is that supply chains will be a source of competitive advantage for first movers and the downfall of those who hesitate (Deloitte and Touche, 2000). Investing in information technology and the development of e.g. strategic alliances with suppliers are key drivers for developing a competitive advantage as the global market moves towards a co-operative supply chain structure. Today, too few Baltic manufacturers embrace the concept of SCM and thus this area represents an area of opportunity to increase performance, not only company performance, but the performance of the extended supply chain.

2.2. National and regional level

Significant differences between developed and developing countries can be seen in the quality and productivity of materials handling operations, the quality of transport infrastructure, the modal split as well as the problems and challenges confronted (Pedersen, 2001; Persson and Bäckman, 1993; Ülengin and Uray, 1999). However, many so-called "developed" countries struggle with similar problems related to their transport infrastructure (Bookbinder and Tan, 2003). One of the main issues being that transport infrastructure is always lagging behind in terms of how quickly issues related to infrastructural problems can be resolved. In terms of development of the transport infrastructure and in order to sustain the growth potential of the Baltic Sea, regional issues should be given preference to national issues (Baltic Development Forum, 2003). It can also be argued that today, in the emerging global competitive landscape, regions are the key to economic success (Bjørn Serba *et al.*, 2004).

A decade ago Buchhofer (1995) stated that the Baltic rail networks were in hopeless condition and that the Baltic States, with their particular infrastructural heritage, would be forced to accept an emphasis in favour of road transport, even if this was not desired in the European Union. This projection was correct in that road transport has in fact increased and is predicted to further increase significantly in the Baltics (European Commission, 2001; de Jong *et al.*, 2004). Unfortunately, the current state of the road network is still a significant impediment to freight traffic on roads in the Baltics (Ojala *et al.*, 2004). However, for successful intermodal transportation, all linkages between maritime, rail and road transportation have to be facilitated by a functioning transport infrastructure.

The importance of *maritime transport* in the Baltics originates in Hanseatic times (Buchhofer, 1995). Port development and maritime safety are important issues in the Baltic States (Ojala *et al.*, 2004). Different types of seaports exist to serve liquid materials, RO-RO and container traffic. Liquid goods dominate the capacity usage at the ports (Buchhofer, 1995; Ojala *et al.*, 2004), as Russian oil pipelines are directed to end there. More goods are loaded than unloaded in Baltic ports, indicating the important transit function of the Baltics for natural resources from Russia (Buchhofer, 1995; European Commission, 2003). Currently, about 40% of Russian exports to non-Baltic EU member states are transported through the Baltic States (Laurila, 2003). Of the total cargo carried in the Baltic Sea serving the East-West corridor, Estonian ports take care of 12%, Latvian ports of 28% and Lithuanian ports of 9% (Laurila, 2003). The high share of Latvian maritime transport is explained by the central location of Latvia. Latvia lies on the Southeast coast of the Baltic Sea and has land borders with Lithuania, Estonia, Belarus and Russia. It has a long tradition of trading with its

neighbours in Northern Europe and offers a natural transit hub for trade with Russia and the EU, especially Scandinavia. Latvia is therefore often said to be the new transit hub of the Baltics (Bruce-Jones, 1999). Still in 1995, seaport capacities in the Baltics were devoted 80-95% to Russian transit traffic (Buchhofer, 1995), but a decrease in transit freight is evident (UNECE, 2004b), especially considering gas and oil transit (Economist, 2003b). A good example is the port of Klaipėda where in 2000 Russian cargo, without petrochemicals, constituted 31% of the turnover while in 2003 it amounted to only 2% (Borteliene, 2004; comp. also UNECE, 2004b). Consequently, Buchhofer (1995) suggests that Baltic ports should not compete with each other for the same transit freight but rather differentiate themselves in handling capabilities, i.e. ensuring minimal spatial spillovers (Haynes *et al.*, 2004).

Maritime transport in the Baltics is however, undergoing major changes. Port construction needs a refocus from handling liquid materials to container and RO-RO traffic due to a focus shift away from Russian gas and oil (Laurila, 2003) towards the demand of more service products (Banister and Berechman, 2001). This change in the type of freight moving through Baltic ports also calls for the development of port hinterlands (Hesse and Rodrigue, 2004; Lewis *et al.*, 2001). Port hinterlands and connections, i.e. the possibilities for intermodal transportation thus affect the competitiveness of ports.

Intermodal transportation always involves multiple actors (Bontekoning *et al.*, 2004) and transhipment points. Thus it must be kept in mind that each mode of transport plays a key role in the logistics chain and only through close co-operation can competitive transport services be offered to meet the needs of the clientele. One of the major problems facing many of the Baltic seaports is that these ports have previously been serving liquid materials from pipelines, and therefore port hinterlands currently lack the connectivity for the further transportation of solid materials to and from the ports. The situation of the transportation infrastructure in the region is improving very slowly, and therefore shippers need alternative solutions to ensure the movement of their freight in and out of these ports.

An obvious bottleneck for intermodal transportation is the lack of *rail connections* between ports and major cities in the region. Rail transport is the dominating transportation mode in the Baltic States (Ojala *et al.*, 2004). As a legacy of the main interest in rail transport during Soviet times, there is a relatively high density of rail tracks in the Baltic States (already in 1995 accounting for 31 km per 1 000 km^2; Buchhofer, 1995). Nonetheless, these tracks have low technical standards, minimal electrification, are rarely multiple tracks (European Commission, 2003) – and, as is true for all other transport infrastructure in the Baltic States, are not well maintained (Buchhofer, 1995). There are many hurdles to overcome the institutional and technical fragmentations of rail transport in the EU (Priemus and Zonneweld, 2003). Harmonising standards and requirements for rolling stock, locomotives, signalling, information systems (Lewis *et al.*, 2001) and track gauges (Ojala *et al.*, 2004; Sankaran, 2000) serves the interoperability and interconnectivity of EU rail transport (Banister and Berechman, 2001; Haynes *et al.*, 2004). As the Baltic States have different track gauges from their next-door EU member Poland (the Baltic States follow the FSU gauge of 1 524 mm while their next-door EU neighbour Poland follows the standard gauge of 1 435 mm), they can be seen as an island when it comes to rail transportation. This is an important bottleneck for the interconnectivity of the Baltic States with the EU.

However, another bottleneck is still prevailing in rail transport. Another legacy of Soviet times is the East-West orientation of rail tracks, while no direct rail connection exists between the three capitals of the Baltic States, i.e. between Tallinn, Riga and Vilnius. Buchhofer (1995) in fact even predicted the continuing decay of the existing rail network. On the other

hand, since the EU decided to encourage a modal shift from road to rail (Arnold *et al.*, 2004; Lewis *et al.*, 2001) rail networks in the Baltics have received increased interest and funding with the flagship Rail Baltica as the main construction project (see Figure 2). Nevertheless, the current situation is such that the infrastructure of most accession countries is still unable to cope with the new transport needs and is hindering the development of sustainable transport networks (Grimaldi, 2003). Unfortunately, Rail Baltica does not enjoy high priority in terms of receiving funding from the EU (Barnard, 2003; Ojala *et al.*, 2004).

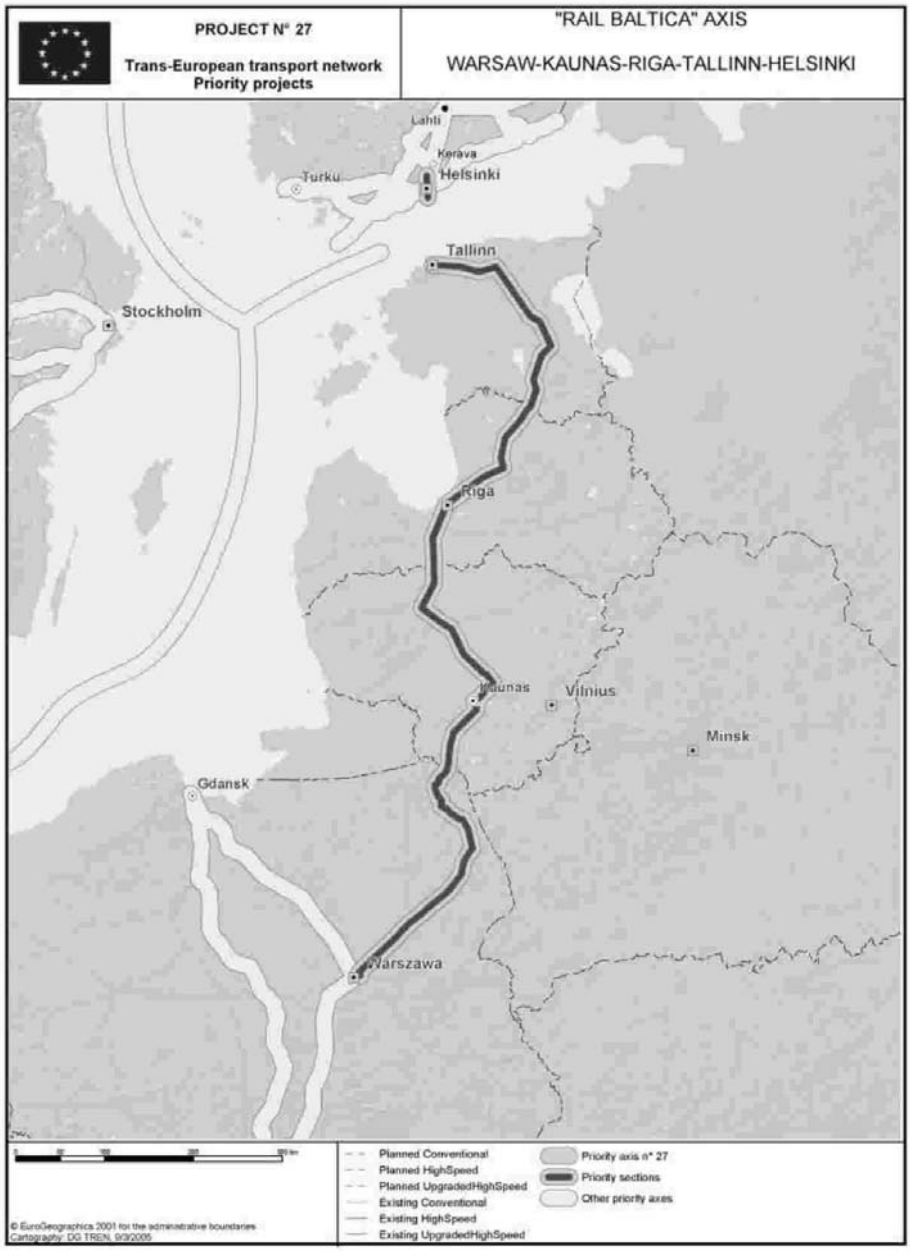


Figure 2: Rail Baltica (European Commission, 2005b)

Road transport can adapt more readily than other modes of transportation to new demand, especially in economies in transition (Persson and Bäckman, 1993). It is more flexible than rail transport not only in the chosen routes but also in the timing of a shipment. Keeping this in mind, a sound strategy seems to be the heavy investments and priority that Lithuania has

given to modernisation and development of its road transport infrastructure (Sea International Business Magazine, 2004).

Road constructions are necessary to overcome a similar bottleneck to rail transport – that there is no North-South connection between the three Baltic capitals. Following a similar route to Rail Baltica, a Via Baltica is constructed simultaneously. Its construction is under way, though suffers from a lack of co-ordination between the three Baltic States. Thus, parts of Via Baltica are still just a mud road, e.g. at Banska in Latvia. Unfortunately, even the Via Baltica is not able to respond to the increases in freight transport in the Baltic States, as it is not being planned as a highway. Other problem in road transport is the lack of paved roads and highways except around major cities (Ojala *et al.*, 2004). Some local bottlenecks that existed in 1995 such as at the border to Poland and around major cities (see Buchhofer, 1995), have been taken care of through EU accession, and the construction of urban bypasses (Ojala *et al.*, 2004). But other major challenges in road transport remain untouched, e.g. changes in sizes and weights of vehicles operated on the current road network. Even though this road network is constructed for the 50 ton military weight class (Buchhofer, 1995), the change from <30 ton vehicles that operated on them in Soviet times to >40 ton vehicles entering roads from the EU results in a heavier usage of the roads and increased maintenance requirements. The increase in road transport outweighs any increase in rail transport (Ojala *et al.*, 2004), however, with alarming effects on road safety (UNECE, 2004a). Latvia and Lithuania rank among the countries with highest number of fatalities in road accidents (Economist, 2003a; European Commission, 2003).

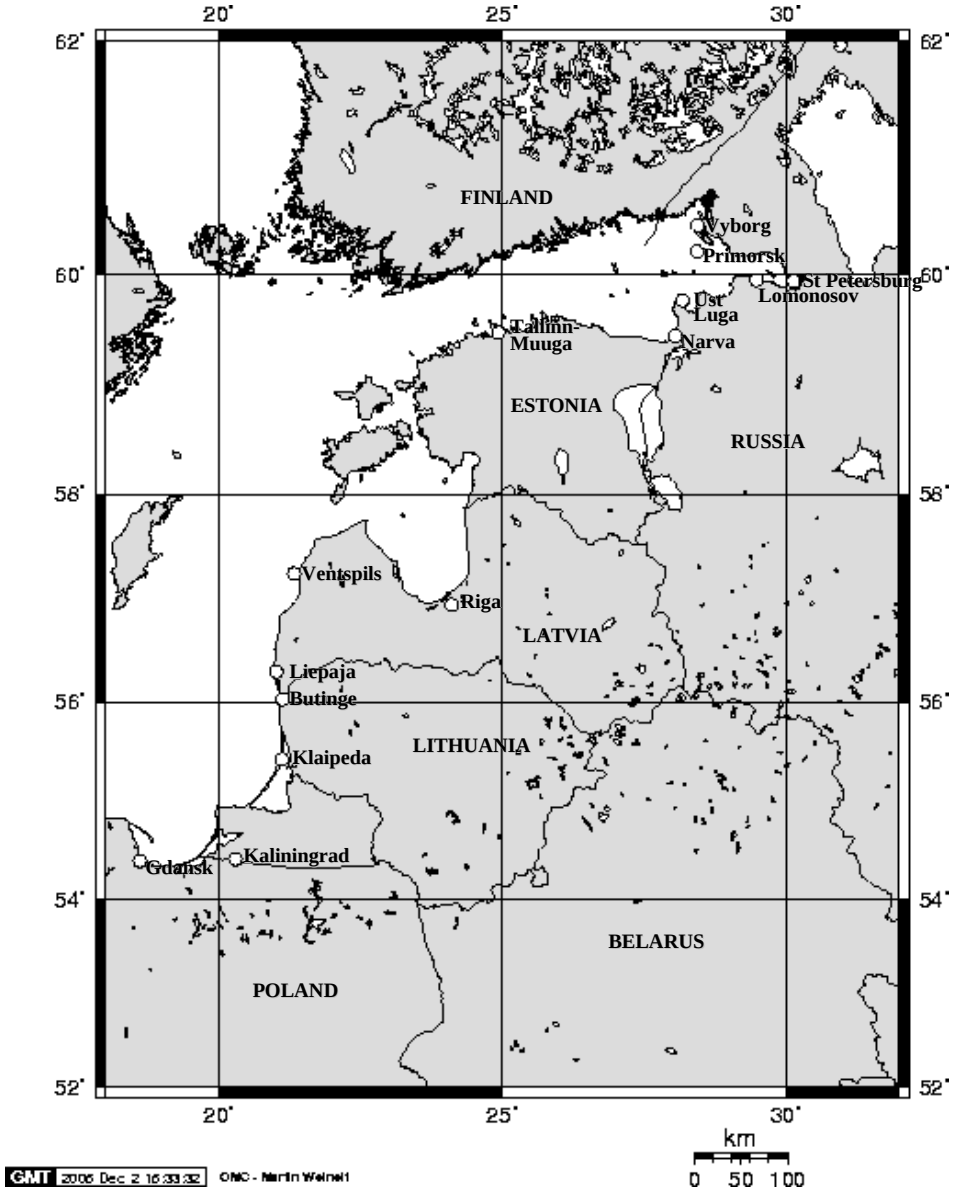
2.3. International level

Taking the analysis one step further, international trends and bottlenecks also affect intermodal transportation in the Baltic States. A supra-national view is thus needed to assess the effectiveness of intermodal transportation. In fact, both the trend towards supra-national transport investments and regional enhancements of transport infrastructure (Docherty *et al.*, 2004) come together in the efforts of the EU to increase the transport interconnectivity to the Baltic States.

As for maritime transportation, nationalistic tendencies in the Baltic States lead to the curious situation that similar ports (e.g. container terminals) are constructed at many points simultaneously, competing for international cargo (see **Figure 3**). At the same time, Russia is investing heavily in own port development in the Baltic Sea Region, and is rerouting current pipeline connections from the Baltic States to its own new ports, e.g. to the port of Primorsk (Economist, 2003b; Ojala *et al.*, 2004). Therefore, Buchhofer (1995) suggests a better co-operation among the Baltic countries instead of nationalistic tendencies in transport competition.

In terms of the international environment, other challenges also take place that influence the future development of the Baltic Sea Region. For example, the Northern Maritime Corridor (NMC) is an interregional project with 20 regions and 9 countries participating, covering the Northern Periphery and North Sea areas with associated partners in Northwest Russia (Fiva and Eiterjord, 2005). The project promotes sea based and intermodal transportation and pursues the idea of the Northern Maritime Corridor as the “motorway of the Northern Seas”. The transhipment market in the NMC area is around 150 million tonnes. Transhipment is the fastest growing sector in the container port market, and it is estimated that this figure will rise to approximately 300 tonnes in the near future. Fiva and Eiterjord (2005) also emphasise that to complete the TEN-T axes to neighbouring countries and axis representing the NMC is needed. Two projects that are of interest are presented, the first one

indicating that Arctic Russia can develop into an alternative to Baltic Sea ports when serving as a major gateway for containers to and from Russia (Fiva and Eiterjord, 2005). This could be achieved through the use of a port in the Barents Sea Region, as until now, the Barents transportation option has been largely ignored. It is however expected that it would offer a competitive and complementary link compared to ports in the Baltic Sea region.



Russian ports: Vyborg, Primorsk, Ust Luga, St Petersburg, Lomonosov (St Petersburg 2), Kaliningrad
Baltic ports: Tallinn-Muuga, Riga, Ventspils, Liepāja, Butinge, Klaipėda
Polish port: Gdansk

Figure 3: Maritime ports (drawn with OMC)

Another project presented by Fiva and Eiterjord (2005) is the development of Scapa Flow international container transhipment terminal in the Orkney Islands. Scapa Flow is considered to be vital to help counteract bottlenecks at the major EU container ports. The Scapa Flow hub would primarily serve the transhipment markets of Northern Europe and the Baltic States

and Scandinavia. It is argued that this hub would enable shipping lines to reduce megaship deviation in time by two-thirds and shorten the average feeder distances by 20%, thereby offering major savings.

The utmost challenge for international interconnectivity of the Baltic States stems from the current state of rail and road connections in Poland. Given this situation, the Baltic States can be regarded as an island for freight movements to and from other EU member states. While rail and road transport infrastructure in the Polish bottleneck is to be improved, the Baltic States can respond to the increasing demand for transportation by shifting their focus to maritime transport in the short term.

Differences in track gauges between the Baltic States and Poland also affect the interconnectivity of the Baltic States. Currently, only one transhipment point exists where wagons can be changed from one gauge system to the other. Only freight wagons equipped for both gauge systems can use a gauge change facility in Mockava, Lithuania, while other rail transport incurs high transhipment costs (Schramm and Hofmann, 2003). Therefore, EU-gauge tracks should be extended to a logistics centre in Kaunas to overcome current bottlenecks at the border to Poland (Buchhofer, 1995; Jauernig and Roe, 2001). This plan though, is estimated to be carried out by 2010 only (European Commission, 2005a).

A further problem of Baltic-Polish rail connections is the routing through Kaliningrad (being an enclave of the Russian Federation without any overland connection to Russia; Vinokurov, 2005) that involves the crossing of non-EU borders. Connected to the status of Kaliningrad is also the question of Russian freight (and passenger) transit through Lithuania. Special documents have been issued for Russian passenger and freight transit (the so-called Facilitated Rail Transit Document – a similar one existing for road transit – European Commission, 2004; Vinokurov, 2005), but problems remain even for freight entering the EU without paying tariffs or duties (Borteliene, 2004). Another legacy of Soviet times is the emphasis of East-West connections, while there is no railroad connecting even the three capitals of the Baltic States (Economist, 2003b; Ojala *et al.*, 2004).

3. CONCLUSION

May 2004 marked a historical era for Europe, with ten new countries from Central and Eastern Europe and the Mediterranean joining the European Union. Among these were the Baltic States of Estonia, Latvia and Lithuania. New trading partners, increases in trade volumes and changes in demand structures affect the way companies operate in this region. Intermodal transportation is in particular predicted to increase in the Baltic States. This paper therefore set out to identify major bottlenecks for intermodal transportation in this region. Bottlenecks were identified on an organisational/supply chain, national/regional, and international level for three transportation modes affecting intermodal transportation: maritime, rail, and road transport. Overcoming these bottlenecks will be essential to make intermodal transportation in the Baltics more effective.

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