



Olli-Pekka Hilmola (editor)

## CONTEMPORARY RESEARCH ISSUES IN INTERNATIONAL RAILWAY LOGISTICS



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# **Contemporary Research Issues in International Railway Logistics**

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## **Foreword**

Several years ago I was having interesting discussion with one well-published technology management researcher, who argued that logistics and supply chain management is needless research topic, since people are able to move boxes and containers forward with only small amount of education. This greatly reminds the situation within logistics development curriculum several decades ago: Distribution was then identified as cost issue alone, and we needed to minimize it with respect of several other factors, like inventory holdings and service levels. Improvement opportunities then lied mostly in the own sphere of influence. However, globalization and outsourcing of operations changed it all, and as regions and companies increasingly specialize in our “global village”, the amount of trade increases 2.5 % as world GDP grows with one percentage. Suddenly transportation issues dealt among the actors became as transnational as well as cross-border, and improvement opportunities appeared in the supply chains and value networks, instead of internal operations. Logistics changed its focus to supply chains and information systems, and these together are increasingly identified as a major value improvement burden in companies, and the main source of competitive advantage.

Rapid change has not been fair, or even sustainable, if we think about changes occurred in the demand for infrastructure, and market share change of transportation modes. For example, in the EU countries road transports have taken in a significant manner the market share from rail in the long-term perspective – short transportation distances, flexibility, small transportation lot sizes and large amount of sea harbors have been listed as top reasons for this. Recently accepted new member countries (and current applicants) experienced also great modal shift, as they got their independence and market economy started during 90’s – rail freight transportation market share declined (or even collapsed) in CEE countries by 60 % (freight tonne-kms) in a time period of 1988 to 1992.

This book is a collection of research papers regarding to logistics and supply chain management, with an emphasis on railways. It gives valuable insights for a reader regarding to international railway operations (between EU and Russia as well as Asia), distribution issues in fast growing markets, restructuring need in European railways, modern outsourcing models and supply chain management practices, and border control infrastructure issues of railways. We do hope that this book is useful

not only for academics and students, but should also represent valuable source of information for directors and managers in companies as well as governmental decision making units dealing with logistical decisions.

Finally we would like to express our gratitude for the city of Kouvola giving us an opportunity to arrange this first international research meeting concurrently with the annual Innorail Seminar. We do hope that in the forthcoming future seminars research viewpoint becomes alongside with business, governmental and trade issues, and these streams together may foster the further development of international railway corridor between Europe, Russia and Asia.

In Kouvola, Finland June 2006,

Olli-Pekka Hilmola

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## From Road to Rail: Polish Perspective

Joanicjusz Nazarko, Maciej Dobrzyński & Urszula Ryciuk

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### Abstract

In the past few decades the world has seen significant economic growth. It is mainly due to the availability of new technologies and international trade opportunities. But this economic growth is also the reason for serious environmental problems. The important aim is to strike a balance between three aspects of development – the economy, social affairs and the environment (sustainable development). Progress towards more sustainable transport system has become imperative in many parts of the world. Many of the European countries, in order to reduce the negative environmental and social impacts of road transport, set as their national target for rail freight to grow (tonne kilometres). There are many initiatives taken in order to encourage rail transport as being one of the most environmentally friendly means of transport. This paper describes actual situation of freight transport in Poland and possibilities of shifting freight from road to rail.

**Keywords:** freight transport, modal shift, sustainable development, Polish State Railways

### 1. Introduction

The dramatic increase in quantity of goods being transported in the last decades is a consequence of the globalisation of trade and the economic growth. Nowadays, goods are transported not only locally or nationally but also internationally. In Europe, for example, the last EU enlargement increased the internal market of new member countries from Central and Eastern Europe. As the result, the increase in mobility causing air pollution, climate change, degradation of landscapes and ecosystems, more energy consumption and accidents can be observed.

Most freight is transported by road but rail transport is recognised as being more environmentally friendly. Commission for Integrated Transport (Incentives for rail freight growth, April 2001) reports that moving freight by rail produces the benefits in the following areas:

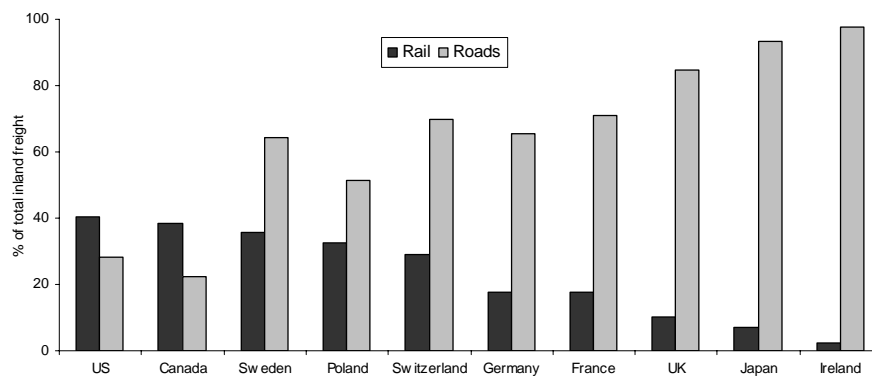
- energy consumption: at least 50% lower than road transport,
- emissions: between 10% and 20% the level of road transport,
- accidents: less than 0.5% the equivalent rate for road transport,
- congestion: one train can carry the payload of up to 100 HGVs.



Many countries, in order to reduce the negative environmental and social impacts of transport, set as their national target for rail freight to grow. There are many initiatives taken in order to encourage shifting road transport to rail. Modal shift (to shift transport from roads to more environmentally friendly means of transport) should be used as an integral part of sustainable economic development strategies. The objective of sustainable development is to strike a balance between three aspects of development – economy, environment and social conditions. Accordingly, sustainable freight transport means efficient, environmentally and socially friendly transport.

## 2. Comparison Between Rail and Road Transport Development

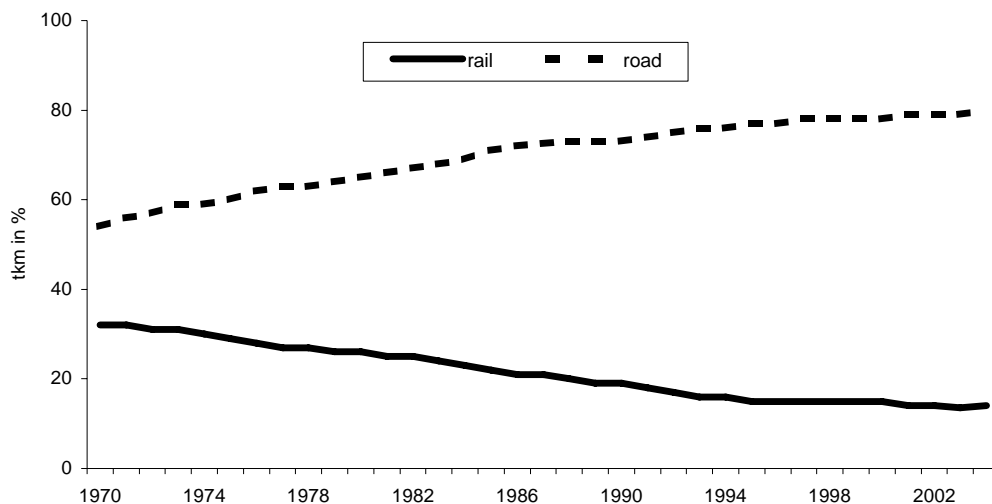
Shifting freight from road to rail is considered as a key part of strategies for developing more sustainable systems of transport. However, for the last twenty years, rail transport has seen a worrying decline, especially in the area of freight transport. The share of freight transport by rail for the all land transport modes (road, rail and inland waterways) is high in United States, Canada and Austria (Figure 1). In the US rail transport is dominant mode, because it is not a state monopoly and it is not subsidised. Rail companies are competing on the market and the result is that rail's share of the freight market has been steadily around 40% (in tonne-kilometres) for the last 30 years.



**Figure 1.** Freight transport in 2003 (% of total inland freight) (OECD 2006)

In the European Union, the modal share of rail freight declined from 32% in 1970 to 14% in 2004 (Figure 2). In the same time road freight transport has almost tripled.

The increase in road transport has been particularly high in the 1990s. In addition, the average distances for one transported tonne also increased and nowadays is about 100 kilometres by road and more than 300 kilometres by rail. The lowest increase in road freight transport was registered in Ireland, Sweden and Austria. The highest in Germany, France, Spain and Switzerland.



**Figure 2.** Inland modal split in EU 15, 1970-2004 (tkm in %) (Eurostat 2006)

In the last years in some European countries (Belgium, Austria, Denmark) freight volumes grew moderately. In Central and Eastern Europe, both freight and passenger rail transport continued with their downward trend (an increase was recorded only in Bosnia and Herzegovina and Slovenia) but, on average, it is still higher than in Western Europe. Increasing the share of freight transport by rail in UE requires investments in railways, improvements in the quality and productivity of rail and liberalization in freight transport markets and regulatory frameworks encouraging to use railway rather than road infrastructure.

### 3. Initiatives Towards Shifting Freight from Road to Rail

The aim of the European Union is to ensure sustainable mobility by encouraging the development of efficient and environment-friendly transport systems that are safe, socially acceptable, and make less demand on non-renewable resources. The promotion of rail transport is an important part of the policy and it is focused through

the integration in the inter-modal and combined transport promotion strategies, and the “revitalisation of rail and other environmentally friendly modes”.

European transport policy was defined in White Paper: “European transport policy for 2010: time to decide”. In this document the European Commission predicts a 38% growth (between 1998 and 2010) in demand for goods transportation and proposed to take measures which should make the market shares of the modes of transport return, by 2010, to their 1998 levels (market share of passenger traffic from 6% to 15% and of goods traffic from 8% to 15%). One of the key objectives of the paper is to shift the balance of transport in Europe (especially freight transport) from road and air towards rail and shipping. In Chapter 1: “Shifting the balance between modes of transport” it could be read: “The growth in road and air traffic must therefore be brought under control, and rail and other environmentally friendly modes given the means to become competitive alternatives”. However, in the middle of project realization time, the following flaws are observed (International Road Federation 2005):

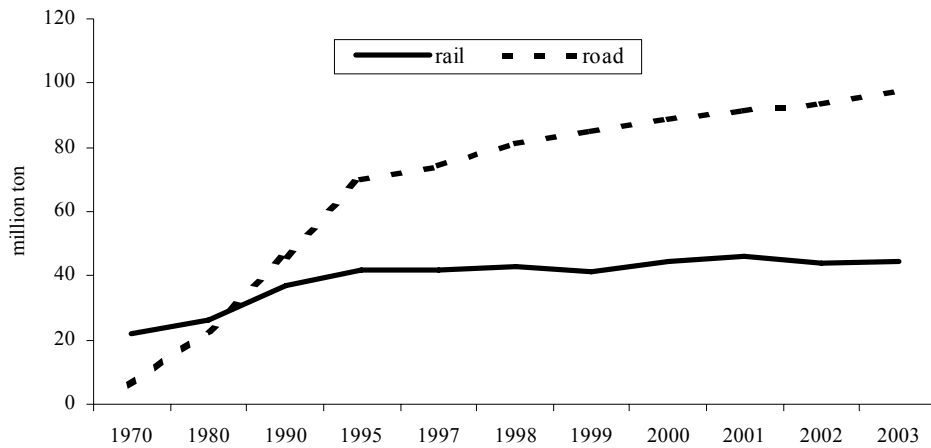
- Modal shift from road to rail is impossible and even attempting it will undermine Europe's prosperity. Road transport accounts for more than 85% and rail transport for a 4%. Even doubling rail transport - through massive subsidies to rail - would reduce road transport by only about 5%.
- Decoupling transport growth from economic growth is a well-meaning but wrong target (negative consequences of traffic should be decoupled but not traffic itself, so long as it is sustainable).
- Many environmental effects of the roads are "threatened by extinction" through tougher standards.
- Roads generate radically more tax revenue than they receive in investments. The very opposite is true for railways. This process is discriminating against roads, regardless of their higher social benefits.

### **3.1. Examples of National Policies Towards Shifting Freight from Road to Rail**

#### *Switzerland*

Freight transport is growing rapidly all over Europe as well as in Switzerland, especially in Swiss Alps Region (for example Gotthard Tunnel). The rapid growth in

freight transport on roads has almost reached their limits (figure 3). There is hardly more space available to construct additional road infrastructure. On the other hand, there is the legitimate need to protect the environment and the people from noise and air pollution.



**Figure 3.** Development of traffic in Switzerland, 1970-2003 (million ton) (Litra 2004)

Transfer freight from road to rail is a central pillar of Swiss transport policy. Switzerland has neither any access to the sea nor any significant water system within its boundaries. The transfer of freight traffic from road to rail is to be achieved by a combination of different measures, including a kilometre tax on heavy goods vehicles and promoting combined transport. Swiss policy to transfer freight from road to rail relies on three fundamentals (Werder 2005):

- the introduction of a new, performance related, Fee for Heavy Vehicle; this fee aims at attributing costs of freight transport according to the polluter pay principle and establishes necessary terms for an adequate competition between road and rail freight transport;
- modernization of the railway infrastructure (financed in half by revenues from the HVF);
- railway reform, which main objectives are raising the productivity and improving the competition of the railway companies.

Heavy Vehicle Fee was introduced on the 1st of January 2001 and replaced former flat charge. The rate of fee depends on three factors: the distance driven, the weight of the vehicle and the pollution emitted by the vehicle. The fee impacts on the transport sector are:

- adjustment of the fleet composition,
- concentration in the hauler business,
- significant brake of former growth trends in traffic volume,
- transfer of freight from road to rail.

However the transfer of freight from road to rail did not happen in the expected scale. This is not surprising and was never expected within such a short time, for the following reasons:

- the share of freight transports in rail in Switzerland is already very high, especially in transalpine traffic, where it amounts to two thirds;
- the competitive advantage which the rail gained due to the fact that the new fee changed prices in favour of the rail, were outbalanced by the productivity gain of the road sector as a result of the higher weight limit.

A transfer of freight from road to rail is therefore not possible without strong additional efforts in the rail sector. Two factors are crucial: the railway sector must realize substantial gains in productivity and has to improve its reliability. The framework for the necessary changes is being established by the rail reform. The Swiss railway enterprises are now urgently requested to improve the quality of their services for transnational transports in order to better meet the demands of the market.

### *Austria*

Austria has adopted a Transport Master Plan which forms the basis of Austria's strategy for the long-term development of the country's infrastructure (roads, railways and inland waterways). Projects under the Transport Master Plan are implemented in accordance with the construction programme of ASFINAG (the Austrian toll motorway network operator) and the Framework Plan for the Railways (Rahmenplan Schienen). Through connecting railways and various forms of combined transport, it has been possible, against the European trend, to keep the proportion of total freight

carried by rail at the comparatively high level of about 35% – several times higher than the EU average. Particularly Austria's transport describes (Austrian Federal Ministry of Transport, Innovation and Technology 2006):

- expanding and improving in quality road and rail networks,
- socially and environmentally friendly proportion of rail transport,
- steadily falling traffic fatalities,
- innovative technologies in both public transport and the volume of private car traffic.

### *The United Kingdom*

Freight on Rail is a partnership between the transport trade unions, the Rail Freight Group, Railtrack, Transport 2000 and the rail freight operating companies. Freight on Rail's aim is to promote the economic, social and environmental benefits of rail freight both nationally and locally. Freight on Rail helps local and regional authorities to promote the shift to rail freight and integrating land use planning and transport (planning a rail-freight strategy, accessing grants, understanding technical issues and engaging with terminal operators, local business and the logistics industry). (Freight on Rail 2006)

### *Germany*

In order to improve the environmental situation, Germany developed the political strategy of sustainable mobility. One of the goals is to reduce transport intensity in 2020 by 5% from 1999 levels. This should be achieved by further development of combined transport systems and a stronger shift from road freight transport to rail and ship. In order to increase rail transport the government introduced: in 1999 ecological tax reform influencing fuel prices and in 2001 Road User Charges. The ecological tax reform has been quite successful in promoting fuel efficiency and in reducing road transportation (road transportation declined and fuel consumption has been reduced by 4% in the year 2000 in comparison to 1999) (German Federal Ministry for the Environment 2003).

### *New Zealand*

Freight volumes in New Zealand are expected to expand at a faster rate than overall economic growth. Efficient and effective rail system is considered as of critical importance to New Zealand's economic development. In 2003 total freight movement in New Zealand was split into road (64%), coastal shipping (25%) and rail (11%). That is the reason why the government released New Zealand Transport Strategy. It is the first strategy in that country that responds directly to the economic but also environmental needs of the country. It is aimed at achieving an affordable, integrated, safe and sustainable transport system by 2010. The main aim of that strategy is to improve the safety of the rail system, contribute to integration between rail and other networks, ensure transport choices take into account the environmental benefits that rail can provide and encourage more freight to be carried by rail (encourage modal shift within a sustainable development context).

### *Japan*

It is the continuing process in business to behave fairly and responsibly. This encourages corporations to increasingly take responsibility for their actions on a global level. By expressing their Social Responsibility, companies are affirming their role in improving the quality of life of the work force and their families as well as of the local community and society at large.

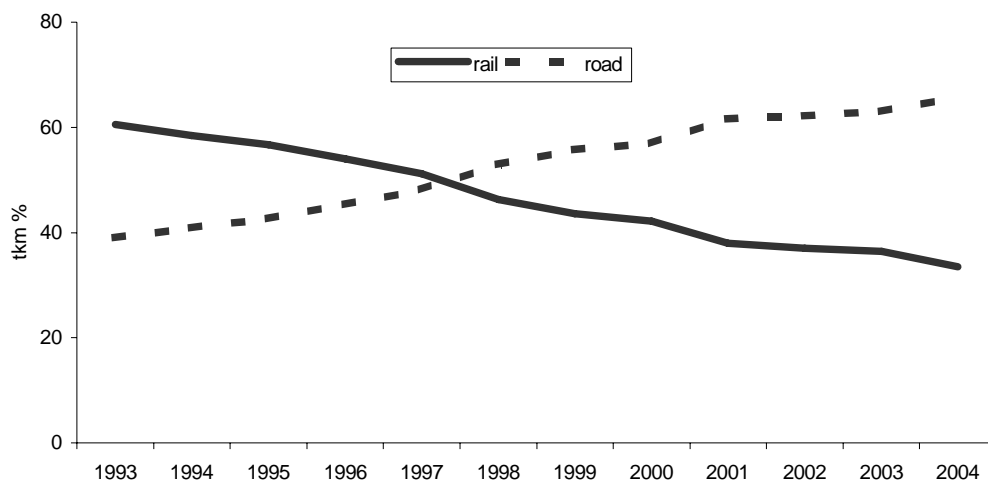
Japanese government launched in April 2005 Eco-Rail Certification Program to Promote Rail Transportation. The aim is to encourage companies to protect the environment by introduction of rail transportation for product distribution rather than using road network. There are two categories of Eco-Rail certification, one for products and the other for companies. A product brand can be Eco-Rail certified if the proportion of rail transport is 30% or more for goods that travel over 500 or more kilometres on land. For a company to be certified, it must use railways for 15% or more of its total product shipments.

Certified companies are allowed to use the Eco-Rail Mark on their products and advertising materials to inform consumers of their environmental initiatives. The Eco-Rail Mark also helps promote environmental awareness among consumers, and provides them with additional information for selecting products. So far sixteen companies and two products have the Eco-Rail Mark certification (Japan for Sustainability). The modal shift ratio (the ratio of rail and ship transportation use) in

the middle and long distance transportation (more than 500 kilometres) is higher than 15% for example in The Ajinomoto Group (45%, which is the highest level among food manufacturers in Japan), Kao Co. (37%), Matsushita Battery Industrial Co. Ltd. (Panasonic) (32.6%) and Canon INC. (more than 20%).

#### 4. Transport in Poland – Actual Situation

The existing system of transport in Poland consists of road, rail, air, inland water and sea transport. Road and rail transport are predominant. In 2004 transport companies transported a total of 1324 million tons of goods, i.e. 6.9% more than in 2003. Growth in transport volume was noted for all transport modes. The share of freight transport by rail for the all land transport modes decreased from 60.5% in 1993 to 33.5% in 2004. It is much lower than road freight transport (39% in 1993 and 65% in 2004) but higher than in many other European countries (figure 4).



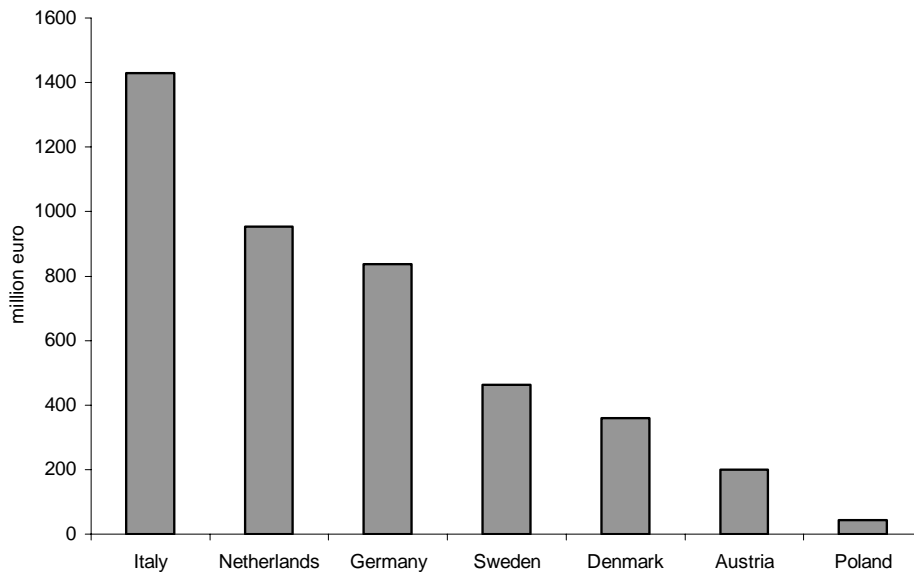
**Figure 4.** Modal split of freight transport in Poland (tkm in %), 1993-2004 (Eurostat 2006)

Main problems that hindered the development of all freight transport in Poland are (United Nations Economic Commission for Europe 2006):



- low level of road transport safety (the fatality of road accidents is 3 times higher in Poland than EU average);
- inefficiency of road administration (in 2005 only 30% of yearly investment plans were carried out);
- obsolete and underdeveloped transport infrastructure (lack of a coherent network of motorways and expressways, low quality of existing roads, only 5% Polish roads can be used in freight transport);
- inefficiency of rail transport (low competitiveness and services quality);
- old transport fleet (might lead to gradual elimination of inland waterway and maritime transport from Polish transport sector);
- low quality of public transport services.

Poland is one of the countries (11 place on the list) with the biggest rail transport network size. The railway length in 2004 was 23500 km but government expenses on rail infrastructure were only 44 million euro (figure 5).



**Figure 5.** The expenses on rail infrastructure development (PKP Group 2004).

## 5. Polish State Railways (JSC)

Polish State Railways JSC (PKP JSC) is a conglomerate founded in 2001 from the former single national rail operator. The purpose of this change was to match European Union directives of dividing transport service from rail system management and founding separate companies able to sell their service outside the rail business. It consists of the following companies, of which PKP SA has the dominant position and holds 100% shares of the other subsidiary companies:

- Polskie Koleje Państwowe S. A. (dominating company),
- PKP Intercity (responsible for long distanced passenger transport),
- PKP Przewozy Regionalne (responsible for regional passenger transport),
- PKP Szybka Kolej Miejska (passenger urban transport)
- PKP Cargo Freight transport (responsible for freight transport),
- PKP Linia Hutnicza Szerokotorowa (responsible for freight transport on wide gauge (1520 mm) line),
- PKP Telekomunikacja Kolejowa (responsible for telecommunications and data transmission for the Polish railways and also serves a number of other companies outside the PKP Group),
- PKP Energetyka (responsible for supplying Polish railroad operators with electric energy),
- PKP Warszawska Kolej Dojazdowa (Warsaw Suburb Railway, WKD, is a suburban railway in Warsaw),
- PKP Informatyka (responsible for supplying Polish railroad operators with IT technology),
- PKP Polskie Linie Kolejowe (responsible for maintenance of rail tracks, conducting the trains across country, scheduling trains timetables and management of rail grounds).

PKP is one of the biggest companies in Poland. It employs 134365 people. Its revenue in 2004 was 17.751.640.600 and net income 100 212.7 (table 1). Actually Polish State Railways (PKP) is in bankrupt. PKP with 7.2 billion PLN of the debt is the third largest debtor of the state budget (Wprost, June 23, 2002).

**Table 1. Results obtained by main companies of PKP Group**

<b>PKP Group</b>	<b>total revenues</b>	<b>net financial result</b>	<b>employees</b>
Polskie Koleje Państwowe S. A.	2.229.833.200 zł	179.497.600 zł	3555
PKP Intercity	791.674.600 zł	- 49.366.100 zł	2130
PKP Przewozy Regionalne	3.200.884.200 zł	- 862.300 zł	19 980
PKP Szybka Kolej Miejska	79 666 000 zł	10 035 000 zł	766
PKP Cargo	6.170.567.800 zł	- 109.776.100 zł	48 265
PKP Linia Hutnicza Szerokotorowa	282.593.800 zł	23.490.400 zł	1176
Telekomunikacja Kolejowa	277.955.900 zł	- 6.477.900 zł	3532
PKP Warszawska Kolej Dojazdowa	21.146.600 zł	80.100 zł	220
PKP Informatyka	75.844.200 zł	-319.400 zł	812
PKP Polskie Linie Kolejowe	3.073.895.800 zł	-176.744.600 zł	45 120
PKP Energetyka	1.547.578.500 zł	20.103.000 zł	8809

Source: PKP Group 2004.

In 2004 PKP CARGO JSC and PKP LHS Ltd companies carried together 163.6 million ton of cargoes, so that by 1.7 million ton (1.2%) more than in 2003. Average distance of carriage for freights amounted to 292.6 km, so that it was by some 0.4 km shorter than in the previous year.

### **5.1. Reform of the Polish Railways**

Reform of the Polish railways has been continued for several years. The most important issue is privatisation of companies. There are various strategies of privatisation for individual companies depending on their position in the market, there are also different preferences concerning time limit of their privatisation. The leading motive of privatisation strategy for the companies specialised in freight service is necessity to cope with competition of strong foreign entities, which will come true after opening of the Polish railway market to EU operators.

Poland's policy priorities have been stated in the government strategy "Infrastructure – a key to development", "Motorways and Other National Roads Construction Program" and the "National Development Plan 2004 – 2006". The development of the system of transport was revised recently by the "Strategy of Transport Infrastructure Development in 2004 - 2006 and the following years". The periods of planning (2004 - 2006 and 2007 – 2013) are in line with the EU planning, what shows the importance of the EU infrastructure plans and financing for Poland's infrastructure development. Although the Strategy concerns all the transport modes,

roads and railways are of supreme importance (M. Krawczyk, K. Siwek, 2003). The main priorities are:

- improvement of connections of Warsaw with European capitals to 2006 and with main country regions to 2013,
- effective transport system for intensified trade turnover within the Single Market and with the Eastern Europe,
- improvement of accessibility of main urban areas in Poland,
- support of the regional development,
- improvement of road traffic safety,
- environmental protection and reduction of costs,
- development of the inter-modal systems.

On 22 February 2005 the Polish government adopted a Strategy on restructuring of Polish State Railways. The strategy aims at increasing railway transport competitiveness and improving the efficiency of PKP S.A. The strategy consists of 3 main elements (United Nations Economic Commission for Europe 2006):

- law on Railway Fund,
- law on Financing of Inland Transport Infrastructure (regulations concerning infrastructure financing, including the law on paid motorways construction),
- new law on Commercialisation, restructuring and privatisation of Polish Railways (PKP).

A new state institution was established – the National Transport Fund, which is composed of two sub-funds: the National Road Fund and the Railway Fund. The main objective of the Railway Fund is to ensure additional financial resources for railway infrastructure investment. The Fund is supplied from the fuel tax. The new law on infrastructure financing guarantees the appropriate level of railway infrastructure investment. The reform aims also at reforming the Polish Railways company. Previous attempts to restructure Polish State Railways have not been successful. The key points of the new strategy are (United Nations Economic Commission for Europe 2006):

- separating PKP into state-owned infrastructure,

- creating regional passenger operating companies between PKP Regional Services and local governments,
- reducing track access charges (15% in 2006),
- reducing the length of the rail network,
- improving infrastructure standards to match those in other European Union countries.

The overall objective of the reform is to retain a significant share of railway transport in the transport structure in Poland. The Government expects that the levels of freight and passenger traffic up to 2007 will not be lower than in 2004.

## **5.2. Strategy for PKP Group**

Strategy for PKP Group in the years to come is connected with liberalization of railway market. Mission of PKP Group is to create conditions contributing to take a place in both domestic and international transport market. In order to achieve this the complete technical and organisational integration with other European railways is needed. PKP JSC has developed program covering actions oriented towards PKP Group and its surroundings. The following are among the most important of them:

- adjustment of legal and organizational standards to the EU requirements,
- implementation of new management systems including the quality management system according to ISO standards,
- restructuring and privatisation of PKP Group companies,
- modernisation of rail infrastructure,
- upgrading standard of services.

It is essential task to the PKP JSC to aspire for strengthening role of railway mode as an operator being friendly to the environment.

## **6. Conclusions**

In Poland the share of freight transport by rail in the all land transport is much lower than road freight transport. As in other countries Polish government tries to encourage

shifting transport from road to rail as the more environmentally friendly means of transport. Nowadays, rail transport is subsidised by government. However, there is need to develop sustainable transport which is not only environmentally and social friendly but also efficient. To combine those three dimensions market opening and fair competition between transport modes is needed. Rail must remain competitive and possible to use as an alternative to road transport, so the government should support the liberalisation and privatisation of Polish railways. Of course, firstly Polish railways and roads need modernisation. After that, road and rail might be used as complementary. The advantages of each can be combined and an effective, environmentally and social friendly solution could be created. In addition, rail freight needs to be considered at international, national, regional and corporation levels.

## References

- Austrian Federal Ministry of Transport, Innovation and Technology (2006). Available at URL: [http://www.bmvit.gv.at/en/eu\\_rat/transport/policy.html](http://www.bmvit.gv.at/en/eu_rat/transport/policy.html). Retrieved: 30.May.2006.
- European Commission (2001). White Paper: European Transport Policy for 2010: Time to Decide. Brussels.
- Eurostat (2006). Your Key to European Statistics. WWW-pages at URL: <http://europa.eu.int/comm/eurostat/>.
- Freight on Rail (2006). WWW-pages at URL: <http://www.freightonrail.org.uk/index.htm>.
- German Federal Ministry for the Environment (2003). Sustainability Impact Assessment of Transport Services Liberalization.
- International Road Federation (2005). IFR Contribution to the Mid-Term Review of the White Paper on European Transport Policy. Available at URL: <http://www.irfnet.org/cms/pages/PagesUp/WP%20consultation.pdf>. Retrieved: 30.May.2006.
- Japan for Sustainability (2006). WWW-pages at URL: <http://www.japanfs.org/index.html>.
- Krawczyk M., Siwek K. (2003). Financing transport infrastructure in Poland - past experiences and future plans. Transport infrastructure development for a wider Europe. Paris.
- LITRA Informationsdienst für den öffentlichen Verkehr (2004). WWW-pages at URL: <http://www.litra.ch>.
- OECD (2006). OECD in Figures – 2005. Available at URL: [http://www.oecd.org/document/34/0,2340,en\\_2649\\_201185\\_2345918\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/34/0,2340,en_2649_201185_2345918_1_1_1_1,00.html). Retrieved: 30.May.2006.
- PKP (2003). A portrait of the PKP Group 2003. Available at URL: [http://www.pkp.pl/english/news/portert\\_grupy\\_pkp\\_en.pdf](http://www.pkp.pl/english/news/portert_grupy_pkp_en.pdf). Retrieved: 30.May.2006.
- PKP (2004). Annual Report of PKP Group. Available at URL: [http://www.pkp.pl/english/news/rr\\_2004.pdf](http://www.pkp.pl/english/news/rr_2004.pdf). Retrieved: 30.May.2006.
- United Nations Economic Commission for Europe (2006). Transport situation in Poland in 2005. Available at URL <http://www.unece.org/trans/doc/transsitdocs/2005poland.pdf>. Retrieved: 30.May.2006
- Werder H. Swiss Federal Department of Environment, Transport, Energy and Communication. Impact of the Heavy Vehicle Fee – Central Pillar of the Swiss Transport Policy. Available at URL: <http://www.are.admin.ch/imperia/md/content/are/gesamtverkehr/verkehrspolitik/28.pdf>. Retrieved: 30.May.2006.

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## The Main Problems of Border Railway Stations

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### **Abstract**

This research concerns one of the main problem of the Russian border railway stations, could be applied in all border crossing points. It is connected with necessity of reduction of time, which a train spends on these stations. This article describes standard schemes of the border railway stations and suggests the decisions at the changing of the construction of the entry areas of these stations, which allowed to reduce the time for the trains, going across the border.

**Keywords:** border, customs, train moving, railway station, arrival, departure

### **1. Introduction**

Border railway stations are intended for the passing through of passenger and cargo trains between Russia and foreign countries whose railways use the same gauge as Russian railways.

The above type of stations can be found where Russia borders with Finland, Mongolia and China as well as on the borders with the C.I.S. and Baltic States. Aside from the operations usually carried out at Russian railway stations, in accordance with requirements of the Rules of Technical Usage of Railways in the Russian Federation Russian Federation (2000), border and custom examinations and other types of checks are carried out. These consist of footbridges with booths for observation and inspection of trains from above, inspection pits for the examination of trains from below, administrative buildings for border and customs workmen, posts for border and military guards, a post for overload, transfer and inspection delayed cargo, zones for frontier guards and custom officials to work from which must be equipped with a signaling system.

### **2. Border Station Traffic by the side of Trans-Siberian Railway**

In connection with the development of transit cargo traffic on Transsib railway lines towards Finland, China, Ukraine and Kazakhstan (for the period 2000 to 2005 the



volume of traffic on the railway lines between these countries increased by 20%) the question of the development and modernization of border railway stations became current. So, for example, at border railway stations Dolbino – Kozachiya and Valuyki – Topoli, the number of trains moving between Russia and Ukraine got up to as many as 80 pairs of trains a day.

In order to admit this number of trains the border stations have to have determined technical and technological parameters (the number of station tracks, the number of teams of people carrying out maintenance on the cars and commercial inspections of the cars, customs and border examinations) which provide stable work without delaying trains approaching these stations.

Apart from this it is necessary to take into account the irregularity of train arrivals at stations which is linked to the differing times it takes to load cars at their departure stations during a month. At present cargo traffic heading towards C.I.S. and Baltic states has its peak period in the second half of the month.

### **3. Station Schemes**

According to the Rules of the Customs Code of the Russian Federation, border terminals must be situated no closer than 4 km from the state border so that at present in Russia the need has appeared for construction and development at border terminals, in order to satisfy this requirement. Border railway stations are placed directly beside borders or at a certain distance (up to 15km) from the border into Russia. If customs operations are executed at a railway station not located at the border, then in this case a border checking post must be situated at the border.

The first standard schemes of the mutual location device of border railway stations and the standard technological process of work at border railway stations and border checking posts were worked out in 1992 (Lengiprotrans 1994; VNIIZT 1992). At this time recommendations about the number of arrival and departure tracks, which were equipped with devices for inspecting trains and used for work with trains and cars sent through the border were prepared.

General recommendations for designing border railway stations, the devices and equipment which it is necessary to provide to them and two principal schemes of

these stations are given in Current Rules and Technical Rates of Station and Junction Design of Russian Railways Regulations (2001).

At border railway stations through which trains with import and export cargo pass, the following main operations are put into practice: arrival and departure of trains, the examination of equipment and the repairing of cars without cutting them, the commercial inspection and elimination of commercial faults, the processing of the trains and cargos documents at the station technological centre, the border and customs examinations, the document and cargo checking, the shunting work for cutting and coupling cars.

The following operations are carried out with passenger trains passing through border posts: the arrival and departure of trains, technical maintenance, the checking of passenger documents by border guards and customs officials, the examination of coupes and other premises in the cars, the internal inspection of post and baggage cars and locomotives.

In order to carry out these operations at border railway stations the following main devices and buildings are provided:

- a yard for arrivals and departures, transit and local passenger trains;
- an arrivals and departures yard for the border and customs examinations of transit cargo trains;
- an arrivals and departures yard for cars arriving at a station for loading or unloading (for “local work”);
- a yard for detained cars;
- shunting tracks;
- tracks for parking train locomotives;
- a customs zone with warehouses and tracks for freight operations and buildings;
- a station building with the electric centralisation of the points and signals;
- passenger platforms;
- footbridges and pits for the examination of trains;
- administrative buildings for border and customs services;
- a building for station workmen;
- a post for border guards;
- a post for military guards;
- a post for the yards foremen.

The analysis of the layout of existing border railway stations has shown that, mostly at these stations arrival and departure yards, tracks for cars which have a long stop at these stations and tracks for local work are situated parallel to each other. This arrangement of the yards is very convenient, since the devices for moving cargo and passenger trains are separate from each other.

The arrangement at these stations is compact and this makes service easier and lessens the charge of shunting units because arrival and departure tracks connected with the shunting tracks and therefore a smaller number of car service staff is required.

At present the technical equipment of existing border stations does not always answer the volume of traffic but the question of their development doesn't have a clear outcome. This links for example to the movement of freight headed to the Baltic States which gets redirected to Russian sea ports because the tariffs are lower there. However when tariff policies change border railway stations will be able to become the restraining factor in the development of travel corridors, so it is necessary to have a theoretical base in order to have the opportunity to make well-founded decisions regarding this case.

For preparation of the appropriate theoretical decisions it is necessary to create a model, which will simulate how a border station works. This model will allow one to substantiate the need for technical equipment.

For this model the statistical data regarding the intervals of train arrivals and their station waiting times in Buslovskaya station were processed.

The analysis of the work on the station has shown that the number of trains passing through the station is changing from 3 to 12 pairs of trains per day each year. The average time that trains spend at Buslovskaya station is 5 hours 12 minutes leaving Russia and 5 hours 25 minutes on their return. A significant part of this time is spent on the processing of documents in the cargo office and in other services, this especially typical for transit trains. During the research period the time spent on checking and preparation of documents changed from 0.7 of an hour to 22 hours 30 minutes (depending on the category of train). First of all this links with the fact that all documents are registered directly at border stations to export goods. As practice shows sometimes it is necessary to cut cars from a train at a border railway station. During the research period about 1100 - 1500 cars were cut from trains at surveyed

stations. The main reasons for delays for such kind of cars are technical and commercial faults, mistakes in the registration of documents and customs and other reasons (necessity of reduction of train length, breach of the plan of shaping, quarantine, etc). If a border station has insufficient track arrangements these factors can result in the delay of trains at other stations near the border. It results in an increase in the period of time that goods spend travelling. At railway stations bordering with Finland terms are stipulated before the transfer of trains, due to the small number of freight and passenger trains passing through, but the same problem can arise too.

In these conditions it is important to make decisions about border railway stations schemes and the number of tracks at border stations, which should provide as short a time as possible between the arrival and departure of trains at these stations. Border stations are designed according to schemes, the location of border checking posts, arrival and departure yards for transit trains and the yard for parking delayed cars differs.

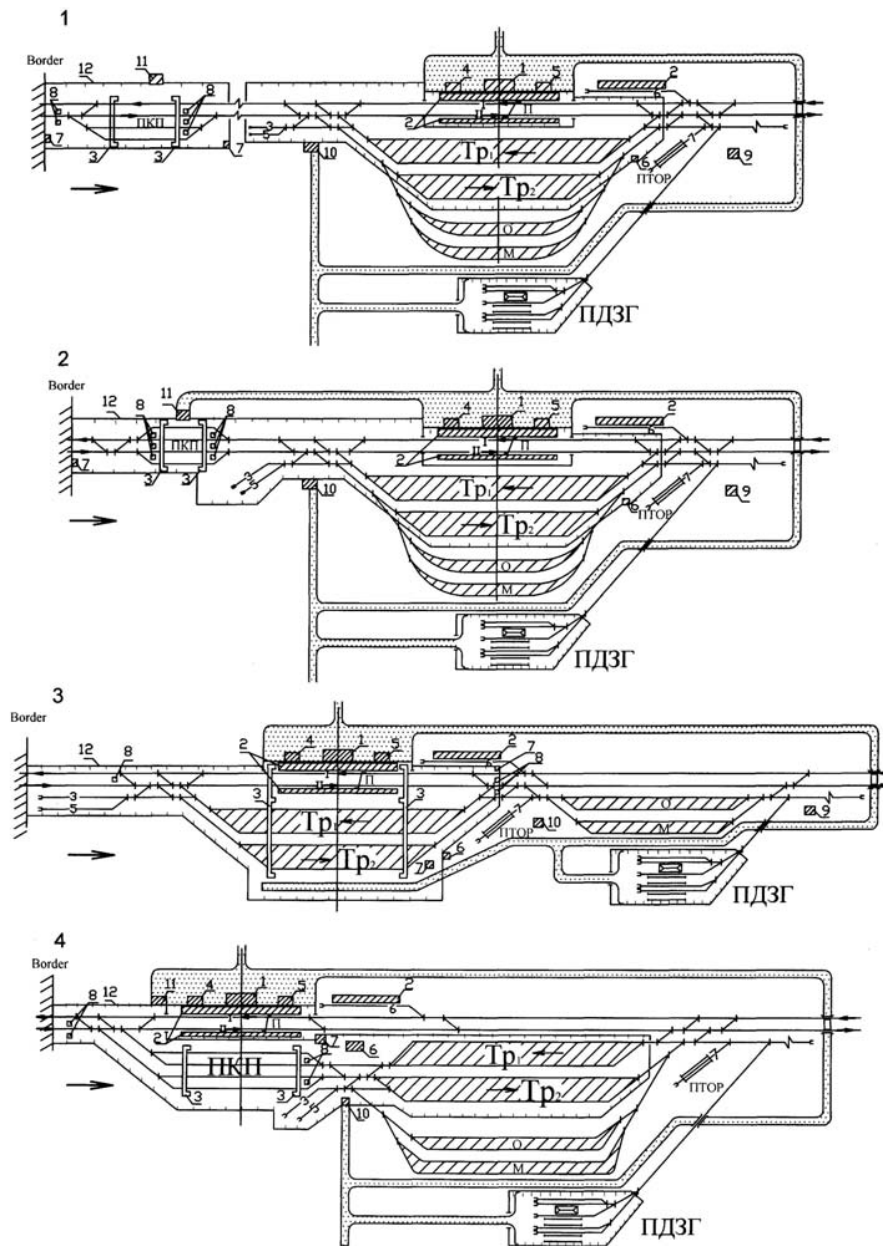
The following are the schemes used by border railway stations (figure 1):

- scheme № 1 – the parallel location of yards and accommodation of the border checking post at the border;
- scheme № 2 – the parallel location of yards and the accommodation of the border checking post and yards for transit cargo trains consecutively;
- scheme № 3 – the parallel location of yards for transit cargo trains and the border checking post and consequent location of yards for local work on part of the down throat of the station;
- scheme № 4 – parallel location of yards for transit trains and local work, accommodation of yards for passenger tracks and the border checking post consecutively, yards for transit trains in the throat of station.

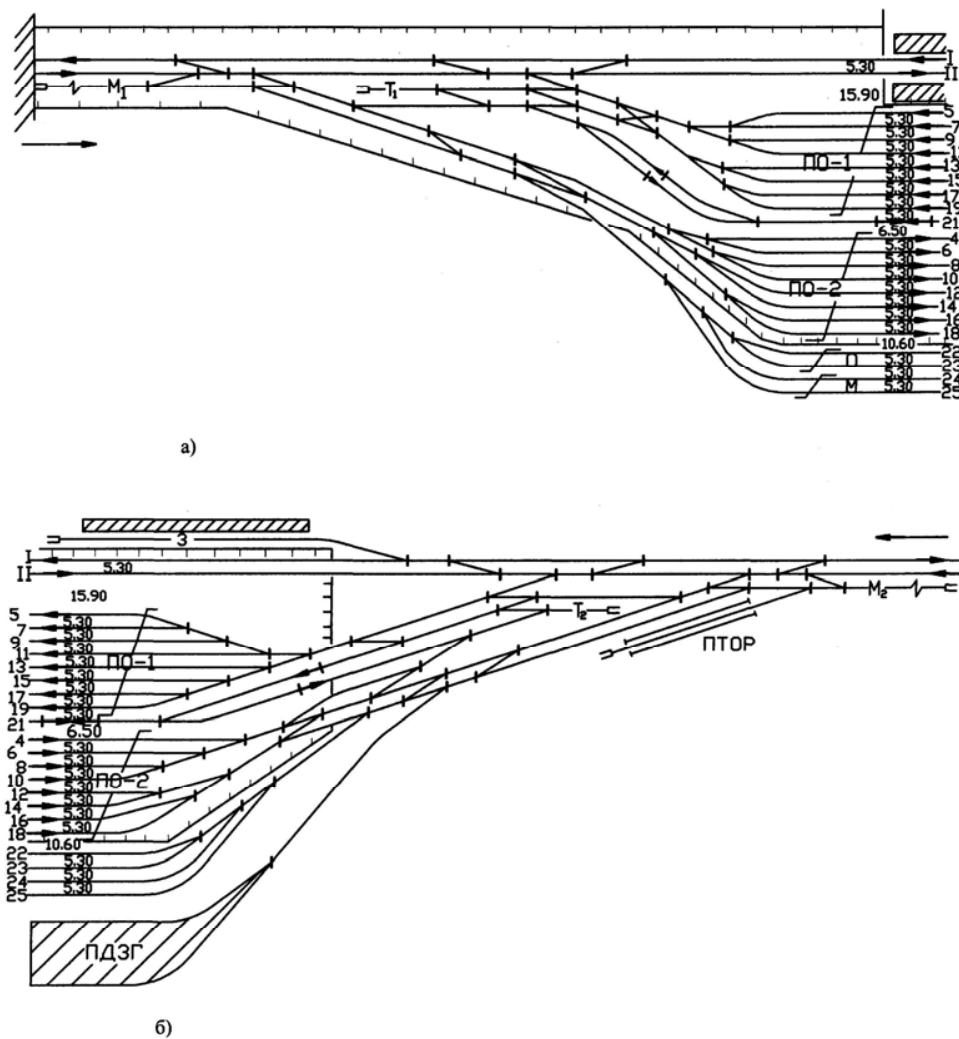
The analysis of these schemes has shown that they can be used only on single lines when the number of trains moving through the border is less than 18 pairs of cargo trains a day.

When the number of cargo trains moving along the single line is more than 18 pairs a day it is necessary to make provision of not less than one side of track for the moving of train locomotives.

This is required to make the essential changes in the design of the throat of border railway stations. In order to minimize the number of intersection routes in the throats of border railway stations, which is located in double lines, the side track for train locomotives must be placed between arrival and departure yards, intended for the preparation of rolling stock, which is sent through the border. Besides it is necessary to provide the tracks for train locomotive parking where they will await cars. In schemes offered earlier, 2 stub tracks were chosen for the parking of locomotives which are located in such a way that the presentation and cleaning of the locomotives leads to a cross roads for arrivals and departures of trains and accordingly there are delays of the rolling stock. It is advisable that the tracks for the parking of locomotives awaiting the presentation of cars are situated in the throat of the station near the yards in which these locomotives will be given.



**Figure 1.** Principle schemes of the border railway stations:  
 П - the passenger yard, Тр - the up and down transit yards, О - the yard for crippled of the delayed cars, М - the park for "local work", ПДЗГ - production-storage zone, ПКТП - the boarder-checking post, 1 - the station with the post of the electrical centralization, 2 - the passenger platform, 3 - the examination footbridge, 4 - the administrative building for the frontier guard, 5 - the administrative customs building, 6 - the official-production building, 7 - the post of the frontier guard, 8 - the examination pit, 9 - a post of the military guard, 10 - the building for the yard's foreman, 11 - the building of the boarder-checking post, 12 - a fence.



**Figure 2.** Schemes of the throats of the border railway stations:

a - up, b – down

ПО – the arrival and departure yard for the transit trains of up and down direction, O - the yard for crippled of the delayed cars, M - the park for “local work”, ПДЗГ - production-storage zone, ПТОР – the post for the repair of the uncoupling cars, M1 and M2 – the stub tracks for the shunting operations, T1 and T2 – the stub tracks for the changing of the train locomotives

#### 4. Conclusions

The parallel location of arrival and departure yards causes the essential complication in the design of throats at stations on double lines connected with a need for ensuring the simultaneous execution of several trains moving in the throat. In the input throat it is necessary to provide the following simultaneously; arrival and departure of trains, execution of shunting operations on tracks for local work and the uncoupling of cars for detailed examinations.

In the opposite throat it is necessary to provide the possibility of the simultaneous execution of the same operations, moreover the shunting operations must take place on the tracks of the customs-storage zone.

An example of the construction of the throats of border railway stations which have 8 arrival and departure tracks in each direction is shown in Figure 2.

The proposed scheme for the throats of border railway stations give the possibility of shortening the time which a train spends at a border station by up to 10 – 15%.

#### References

- Russian Federation (2000). The Rules to technical usage on railways of the Russian Federation. Moscow, "Transport", 2000. – 160 p.
- Lengiprotrans (1994). The type schemes of the boarder railway station. Lengiprotrans, S-Petersburg, 1994.
- VNIIZT (1992). he type technological process of the work to boarder railway station and border checking point. Science - research institute of Railway transport (VNIIZT). Moscow, 39p.
- Regulations (2001). The Rules and technical rates of the stations and junctions designing on railways, which have gauge of 1520 mm. Moscow. - 255p.

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# The Potential of Russian Railways in China-Europe Transit Cargo Transportation

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## Abstract

This paper studies the development of trade relations between China and European countries. It analyses export/import cargo flows between those countries in order to determine the prospects for railway cargo transportation. The paper also studies the attractiveness of Russia as transit territory and scrutinizes the performance of Russian railway system. The main goal of the research is to determine the potential of Russian railways in China-Europe transit cargo transportation.

The research results reveal that constant growth in trade turnover between China and its main partners in Europe creates good chances for railways to attract additional cargo flows. This is especially true for Russian railways. However, it became evident that Russian railway system is not ready to respond to the growing demand for its services. Despite recent positive changes, the remaining problems are sufficient enough to deter the potential clients.

The study suggests that with the completion of Railway Reform and increased consolidation between private transportation companies the monopolistic power of RZD could be diminished and the favourable conditions for transit cargo transportation could be created.

**Keywords:** railways, transit, container transportation, Russia, China, EU

## 1. Introduction

The People's Republic of China (hereafter referred to as China) is emerging as a new political, economic and commercial superpower of the 21st century. With yearly economic growth rates of more than 7 %, the country can double successfully its economic weight every 10 years. China is tackling two major challenges: the first one consists of the combination of a strong and centralised political system with a rapidly developing market economy. The second challenge that China seems to tackle successfully is to finance its economic development through foreign enterprises without losing its industrial independence. In offering investment opportunities and production costs that defy all others in the region, China is fast becoming a major investment pole in Asia and a formidable competitor to other Asian countries. The accession of China to the World Trade Organisation has become a new essential engine of China's economic development. China's WTO membership will have lasting consequences for the country itself, but also for its trading partners. By becoming a WTO member, China is integrating its economy and trade into the

world's economy and engages itself to respect the multilateral trade rules. In doing so, China has eliminated a source of conflict and uncertainty that risked hampering its economic development. Undoubtedly China will make its weight felt within WTO and the other members will have to adjust to such an essential partner, but it will result in a win-win situation.

## **2. Trade Relations and Main Cargo Flows between China and European Countries**

China now emerges as a major world-trading nation due to more than 20 years of economic reform. It has gradually and successfully transformed from a centrally planned economy to a market-oriented one and become one of the leaders in the global commerce. Average foreign trade growth rate per year in the world for the period of 1990-2005 amounted to 7 % while this figure for China was about 17 %. The country's share for the world merchandise export in 2005 was about 6 % compared to the results showed twenty years ago when it was just 1 %. If earlier China was seen mainly as producer of toys and low-priced consumer goods, nowadays it is known by amazing increase in production of automobiles, computers and other high-tech products that are highly competitive on the world market.

### **2.1. China as fast growing market and influential trading partner**

During the last five years, foreign trade of China maintained a rapid development. The gradual improvement of the structure of foreign trade, quality and efficiency made an outstanding contribution to the economic and social development.

Imports and exports developed with a high speed. From 2001 to 2005, the annual average increase rate of foreign trade was 24.6 %, the highest record of foreign trade development since the reform and opening up of Chinese economy and much higher than that of global trade in the same period. Imports and exports in 2004 broke through \$ 1 trillion and amounted to \$ 1.1546 trillion that made China the third country, which trade value of goods exceeded \$ 1 trillion. Besides, imports and exports in 2005 maintained a growth rate of over 20 % and total value hit \$ 1.4221 trillion (<http://wto2.mofcom.gov.cn>).

## 2.2. EU-China Trade and Economic Relations

China's rapid economic development in the past twenty years has had a significant impact upon EU-China trade and economic relations. Total two-way trade has increased more than forty-fold since reforms began in China in 1978, and was worth € 175 billion € in 2004. The EU has gone from a trade surplus at the beginning of the 1980s to a deficit of € 78 billion in 2004, its largest trade deficit with any partner.

**Table 1.** China-European countries trade turnover

Partner	Total turnover, USD bln.	Growth 2005/2004 (%)	Exports, USD bln.	Growth 2005/2004 (%)	Imports, USD bln.	Growth 2005/2004 (%)	Share in China-EU turnover (%)
Germany	63 252	16,9	30 724	1,2	32 528	36,9	29,1
Netherlands	28 803	34,0	2 926	-1,5	25 877	39,7	13,3
Great Britain	24 503	24,2	5 526	16,1	18 977	26,8	11,3
France	20 649	17,5	9 009	17,8	11 640	17,3	9,5
Belgium	11 745	25,2	4 005	13,8	7 740	32,1	5,4
Finland	6 254	13,4	2 628	-13	3 626	45,4	2,9
Sweden	5 699	9,6	3 122	-6,5	2 577	38,6	2,6
Denmark	3 985	26,4	1 196	-0,8	2 789	43,3	1,8
Poland	3 153	35,3	557	14,4	2 596	40,8	1,5
Hungary	2 859	-8,6	366	-23,1	2 493	-5,9	1,3
Austria	2 492	8,8	1 609	6,6	883	13,1	1,1
Norway	2 466	1,6	1 144	-18,2	1 322	28,5	-
Czech Republic	2 039	13,7	372	-15,9	1 667	23,4	0,9

Overall, China is now the second largest trading partner to EU after the USA, and the EU became China's largest trading partner in 2004

([http://ec.europa.eu/comm/external\\_relations/china/intro/index.htm](http://ec.europa.eu/comm/external_relations/china/intro/index.htm)).

Among the 25 member countries of the EU, Germany, Netherlands, United Kingdom, France and Italy are the main trade and economic partners of China. They are followed by Belgium and Spain. China's trade turnover with these countries accounts for about 83 % of the total trade turnover between China and the EU.

China's exports to the EU mainly comprise electrical and electronic equipment, machinery and other high-tech products, as well as textiles, clothing and leather, metal products, chemicals products and plastic products. Wood and wood products rank tenth in the export of China to its main trading partners in the EU.

**Table 2.** The structure of European import from China

<b>Product groups</b>	<b>Rank</b>	<b>Average share in import, %</b>
Electrical and electronic equipment	1	38,7
Textiles, clothing and leather	2	21,7
Other manufacturing	3	11,2
Machinery and equipment	4	6,0
Metal and metal products	5	5,0
Chemicals and chemical products	6	3,5
Motor vehicles and other transport equipment	7	2,6
Precision instruments	8	1,7
Wood and wood products	9	2,5
Rubber and plastic products	10	1,9

China imports from EU capital-intensive goods, machinery and equipment, motor vehicles and other transport equipment, also metal and metal products (mainly steel).

**Table 3.** The structure of European export to China

<b>Product groups</b>	<b>Rank</b>	<b>Average share in export, %</b>
Machinery and equipment	1	25,5
Electrical and electronic equipment	2	20,0
Chemicals and chemical products	3	12,1
Metal and metal products	4	9,7
Motor vehicles and other transport equipment	5	10,9
Precision instruments	6	5,2
Wood and wood products	7	3,8
Food, beverages and tobacco	8	4,3
Textiles, clothing and leather	9	1,7
Rubber and plastic products	10	1,2

Wood and wood products rank seventh in the import of China from its main trading partners in the EU and third in China's import from Finland.

### **2.3. Finland**

The Chinese and Finnish economies are complementary to each other. Since the 1980s, the economic and trade relations between the two countries have developed rapidly and bilateral trade volume has increased by a big margin. According to

statistics of the Chinese Customs, the total trade volume between China and Finland in 2005 was \$ 6,25 billion, an increase of 13,4 % from the previous year. Finland's export value was \$ 2,63 billion and its import value was \$ 3,63, down by 13 % and up by 45,4 % respectively compared with the previous year.

At present, China's main exports to Finland are textiles and garments, cereals, oils and foodstuffs, light industrial products and mechanical equipment, and China's main imports from Finland are paper-making machines, generating sets, paper and paper board, composite fertilizer, wires and cables and telecommunication equipment.

#### **2.4. Russia -EU (CEC)**

Russia is an important partner, with which there is considerable interest to engage and build a strategic partnership. Russia is the EU's largest neighbour, brought even closer to the EU by the enlargement. The European Security Strategy correctly situates Russia as a key player on geo-political and security issues at global and regional level ([http://europa.eu.int/comm/external\\_relations/russia/intro/index.htm](http://europa.eu.int/comm/external_relations/russia/intro/index.htm)).

Since 1997 EU-Russia economic relations have been governed by the Partnership and Cooperation Agreement (PCA). PCA implementation is the keystone for developing the relationship between the EU and Russia. Under the terms of the PCA, Russia receives far better treatment from the EU than from its other major trading partners, as it has Most-Favoured-Nation (MFN) status, whereby no quantitative limitations are applied except on exports of certain steel products (which represent only 4 % of bilateral trade). In addition, an important number of Russian goods entering the Community market benefit from the EU's General System of Preferences (GSP), which lowers import duties below the MFN rate.

In November 2002, recognising the great efforts that Russia has made in its transition to a fully-fledged market economy, the EU granted "market economy status" to Russian exporters, which substantially increases their ability to defend their interests in the context of anti-dumping proceedings. It should be noted that anti-dumping is not a major aspect in EU-Russia trade at present, as only 12 anti-dumping measures are currently in force (<http://www.delrus.cec.eu.int>).

In addition, at the St. Petersburg Summit in May 2003, the EU and Russia agreed to reinforce their co-operation by creating in the long term four "common spaces" in the framework of the Partnership and Cooperation Agreement. It was decided to

create: a common economic space (including specific reference to energy and the environment); a common space of freedom, security and justice; a space of co-operation in the field of external security; as well as a space of research and education, including cultural aspects.

The aim of the Common Economic Space is to put in place the conditions for increased and diversified trade between the EU and Russia and to create new investment opportunities by pursuing economic integration and regulatory convergence, market opening, trade facilitation and infrastructure development. The Common Economic Space will cover a wide range of issues, such as trade, investments, industrial cooperation, enterprise policy, but also more specific areas such as intellectual property rights, competition and agriculture. In this space, the EU and Russia also intend to maintain the momentum of the existing energy dialogue and take forward work in the field of transport, on issues such as infrastructure projects, maritime safety, satellite navigation and aviation, including on the phasing out of Siberian over flight charges. Cooperation on environmental issues will form a central part of the work to create this space.

Since the emergence of an economy reflecting market forces in Russia, trade flows have been growing consistently. Bilateral trade dropped following the 1998 Rouble crisis, but it has picked up again substantially over the years 2000-2004 with the recovery of the Russian economy. The EU is by far Russia's main trading partner, accounting for 51.2 % of Russia's total trade turnover in 2005. Russia's share in EU external trade is also considerable – in 2004 Russia was the EU's fourth largest individual trading partner after the USA, Switzerland, China and before Japan. More specifically in 2004 the EU imported over € 80 billion worth of goods and exported goods for over € 45 billion, with a trade balance in clear favour of the Russian Federation.

The main trading partners of Russia in EU are Germany – \$ 32,9 billion of trade turnover in 2005 (+38,2 % as compared to 2004), Netherlands – \$ 26,5 billion (+59,4 %), Italy – \$ 23,5 billion (+53,5 %), Poland – \$ 11,4 billion (+41,9 %), United Kingdom – \$ 11,0 billion (+43,3) and Finland – \$ 10,7 billion (+31,4 %).

The pattern of bilateral trade reflects the comparative advantages of the two economies, with fuel and primary products representing the bulk of Russian exports – as opposed to capital and finished industrial and consumer goods imported from the EU. Russia now provides over 20 % of the EU's needs in imported fuel. Trade in

services retains great potential for growth and the dynamic services sector will undoubtedly be increasingly important to the trade relationship in the future.

## **2.5. Russia-China**

China is taking key place among the Russian leading trade partners. In accordance with the intergovernmental agreement the volume of mutual trade between Russia and China is going to be increased by 50% in the near future, and get bigger at three times for medium-term perspective.

Naturally railway transport plays very important role for foreign trade of Russia and China. It was the railways that made 80% of all the freight transported via the Russian-Chinese border.

The transportation volumes for Russia-China communication from 2000 to 2004 got bigger by two times (from 19.6 to 38.3 mln. tonnes) including transportation via Zabaikalsk station (from 5.8 to 12.8 mln. tonnes) and Naushki (from 1.7 to 4.9 mln. tonnes).

In 2004 export-import cargo transportation volumes between two countries amounted to 37.8 mln. tonnes: export from Russia to China took 36.0 mln. tonnes and import - 1.8 mln. tonnes

Timber takes the greatest volume of Russia's export to China (34.3% in 2004). Also oil and metal cargoes are quite sizeable towards China (21.5% and 19% in 2004 respectively). In general China takes the second place in the world on oil consumption and for the passed years has been making strategic reserve to provide energy safety. Thus railway export of oil to this market can be thought as the most dynamically developing direction.

Issue of Chinese transit via the Russian railways is of particular interest but export-import transportation. In 2004 it got up by 53.6% basically at the expense of coal, coke and other cargoes volumes increase.

It is obvious that cargo transportation volumes increase demands railway infrastructure carrying capacity enhancement.

In 2004 by the Transsib some 70.4 mln. tonnes of foreign trade cargo were transported (20% increase year-on-year) Russia and China mutual trade cargoes took 47% from this volume included transit transported by RZD from China to other



countries. By 2010 transportation volumes between two countries are planned to reach 60mln.tonnes. Practically all this volume will be transported along Transsib.

### **3. Russian Railway System and its Compliance with Growing Opportunities**

The role of Russia as transit territory for Asia-Europe cargo transportation is being widely discussed lately. Indeed, Russia enjoys advantage of geographical position and its territory represents unique overland freight link between the European countries and countries of Asia-Pacific Region, and in more distant perspective – between countries of America and Eurasia. Besides the escalation of the conflict in the Middle East, making traditional sea route through Suez Canal more expensive and less safe, and also the economic development of the North-West of China, bringing Chinese industrial facilities closer to the Russian border, provides Russia with the good chances to increase its share in transit cargo transportation between Europe and China.

The railway network of Russia is the world's second in length (85 500 km) and first in the degree of electrification (over 80 %). It includes the world's longest (about 10 000 km) Trans-Siberian railway (usually called *TransSib* in Russia) capable of transporting some 100 million tons of freight a year, including 200 000 containers of international transit freight calculated in "twenty-foot equivalent unit" (TEU). In addition, three of the nine Pan-European Transport Corridors (1, 2, and 9) have a combined length of about 2,000 km of well-equipped double-track electrified railway lines passing through Russia. However, Russian Railways have failed to attract a significant volume of transit cargo. Nowadays their share in container transportation between Europe and Asia does not exceed 1 per cent, while the rest of cargo flows (about 7 million of TEU) is transported via sea route.

What are the reasons for that? Are there any objective causes or is it just inability of Russian decision-makers to create effective railway transport policy, especially in the field of transit cargo transportation? How mature is Russian market of railway transportation services? How the situation could be improved?

However, certain bottlenecks in Russian railway system remain. Ministry of transport and its Federal Agency of Railway transport failed to create an effective tariff policy, especially in the field of transit transportation (high duty for container security, absence of discounts for empty containers). Today Russian railways tariffs

are uncompetitive not only in terms of size but also in terms of quality (frequent changes, delays in tariff announcement, unclear rules):

*In sea transportation tariff policy is announced in advance once a year. All participants are aware how much it will cost to deliver container from Pusan to Rotterdam. In our case [Russian railway transportation] RZD creates the new rules for every single dispatch. For example, at the end of the last year [2005] pay scale provision was changed three times: on border crossing, on arrival at receiving station and on compliance with cargo release procedures... (Nikolai Streltsov, the Commercial Director of "Russotra" (Gudok 2006));*

*Only in January we got information about the tariffs for different types of transportation for the current year [2006]. Before January the conditions of VAT implementation were not announced either. But transportation agreements are already concluded! And we can only hope that our guesses were right... (Olga Melnikova, the General Director of "Russotra" (Gudok 2006)).*

According to Mikhail Kozlovsky, the Expert of the Russian Federal Tariff Service, there are obvious shortcomings in legal basis for the railway operators' activity. The law allows an operator only to participate in the process of transportation accomplished by the carrier on the basis of a contract with the latter. The forms of this participation, the essence of the contract between an operator and a carrier, and its main conditions have not been determined so far and there is no legal basis for such contracts between the carrier and operators. Therefore, an operator has now to work as a consigner and accomplish certain carrying operations of the transportation process without a specified contract. Thus, operator submits itself to the fact that some of the operations accomplished by it have been paid for to the carrier as part of the transportation price (tariff) (Eng.rzd-partner.ru, 2005).

In this respect, it is necessary to understand that the difference between the payment according to the Tariff Regulation № 10-01 for cargo transportation in a carriage in common use and the own carriage including the empty mileage of the latter (return trip) is in fact almost the only source to return the company's investments in rolling stock, clear the credit and leasing, maintain the rolling stock, and ensure the company's existence in general. At the same time, in order to be

competitive an operator's tariff should be 1-2 per cent below that of RZD (equal to it in the maximum). Therefore, private operators are restricted in their ability to expand and develop their businesses (Eng.rzd-partner.ru, 2005).

The Law of the RF "On forwarding activity", which came into effect in 2003, also requires corrections. Nowadays, it mainly regulates the relations between different participants of road and sea transportation and does not reflect the results of Railway Reform.

It should be also pointed out that RZD (including its subsidiaries, e.g. TransContainer) retains its monopoly on infrastructure, locomotives and most freight businesses and continues to be the main owner and provider of locomotives and rail cars in Russia. At the same time, there is no appropriate regulatory framework for licensing or setting charges for the use of infrastructure or leasing locomotives from RZD.

RZD is often accused for its inability or unwillingness to create favourable operational environment for other participants of transportation process:

There is no proper regulation of high-capacity containers turnover and every railway and cross-border station establishes its own requirements to their transportation (Nikolai Streltsov, the Commercial Director of "Russotra" (Gudok 2006));

Any time platform with containers can be stopped under various excuses, let's say, for radiology test. And forwarders have to pay for the demurrage of that platform... (Representative of "Transsiberian Intermodal Service", 2006).

#### **4. Conclusions**

RZD perceives private operators rather as competitors than as partners, for example TransContainer, which owns the most of container terminals, restricts access of private companies to those terminals using different tricks. Besides, managers of independent transport companies note that rolling stock belonging to RZD has priority in loading and discharging, it leaves the station faster and is repaired in RZD's shed cheaper.

Another problem is low level of cooperation between railways and maritime terminals in combination with predominance of railways' carrying capacity over

ports' handling capacity. As a result, delays in discharging or lack of rail cars for loading are happening very often.

The issue of custom procedures deserves special attention. Despite significant improvement in custom legislation, its implementation is far from perfection and still represents significant barrier for transit transportation:

*Our custom considers transit cargo flows as sources of its income. 20 years ago custom could inspect cargo only in case of reasonable suspicion and only on its own account. And only after the suspicion was confirmed expenditures of custom were compensated. Nowadays custom inspects every box in container without any reason and without any responsibility, roundly blackmailing carriers... (Nikolai Streltsov, the Commercial Director of "Russotra" (Gudok 2006)).*

Among the others bottlenecks of Russian railway system the following could be named:

- Low level of computerization of transportation process and absence of unified information centre (still the competition of connections overweighs the competition of services);
- Underdevelopment of infrastructure, especially in part of cross-border stations and ports, lack of container terminals;
- Lack of powerful forwarding companies which would operate their own wagons and containers, would have branches in Europe and China and would provide full range of services (storing, handling, transportation, custom clearing, etc.).

## References

Andreeva, Tamara (2006). Кому выгоден «серый» транзит? (Who is benefited by gray transit?).

*Transport of Russia №16 (408), April 20, 2006* [www-document]

<http://www.transportrussia.ru/2006-04-20/train/tranzit.html>

Delegation of the European Commission to Russia [www-document] <http://www.delrus.cec.eu.int>

Gateway to the European Union [www-document] Available at URLs:

[http://ec.europa.eu/comm/external\\_relations/china/intro/index.htm](http://ec.europa.eu/comm/external_relations/china/intro/index.htm),

[http://europa.eu.int/comm/external\\_relations/russia/intro/index.htm](http://europa.eu.int/comm/external_relations/russia/intro/index.htm)

- Grigoriev, Leonid (2006). Сервисом не можем, тарифом не умеем (With service we can not, with tariff we are not able). *Gudok*, March 28, 2006 [www-document] Available at URL: <http://www.gudok.ru/index.php/print/34289>
- Kozlovsky, Mikhail (2005). Development of private carriers on the Russian railways: trends, problems, perspectives. *RZD-Partner International №1*, Much-May 2005 [www-document] Available at URL: [http://eng.rzd-partner.ru/journal/?action=sget&num=01\\_2005&id=19](http://eng.rzd-partner.ru/journal/?action=sget&num=01_2005&id=19)
- OECD Regulatory reform review of the Russian Federation: ECMT/OECD review of railways. Updated conclusions following the Seminar held at the Centre for Strategic Research Moscow on October 24, 2005. *European Conference of Ministers of Transport, February 1, 2005*
- Permanent Mission of the People's Republic of China to the WTO [www-document] Available at URL: <http://wto2.mofcom.gov.cn>
- Китайские грузы для России: конкуренция нарастает (Chinese cargo for Russia: competition is growing). *Container Business №1*, September 2005, 54-58
- Частные операторы – еще не конкурентная среда (Private operators – not competitive environment yet). *Transportweekly, internet version 2006* [www-document] [http://www.transportweekly.com/spc\\_articles/?x=3&id=16656867124249374caf2ea](http://www.transportweekly.com/spc_articles/?x=3&id=16656867124249374caf2ea)

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## Creating International Supply Chains in Europe and Russia – the Main Principles

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### Abstract

In this article Supply Chain definition will be analyzed, and three main reasons why to organize Supply Chains were showed. The article informs about the general trend in European logistics and large gap between industry's requirements for a high quality transport service and the standards provided by non-road modes. Russia has very active position on transport communication development to provide international cargo transportation. However, transportation costs in Russia are still very high. To cut down transportation costs there is necessity to open new logistics centers.

**Keywords:** supply chain, railways, transport infrastructure, globalization, logistics centers.

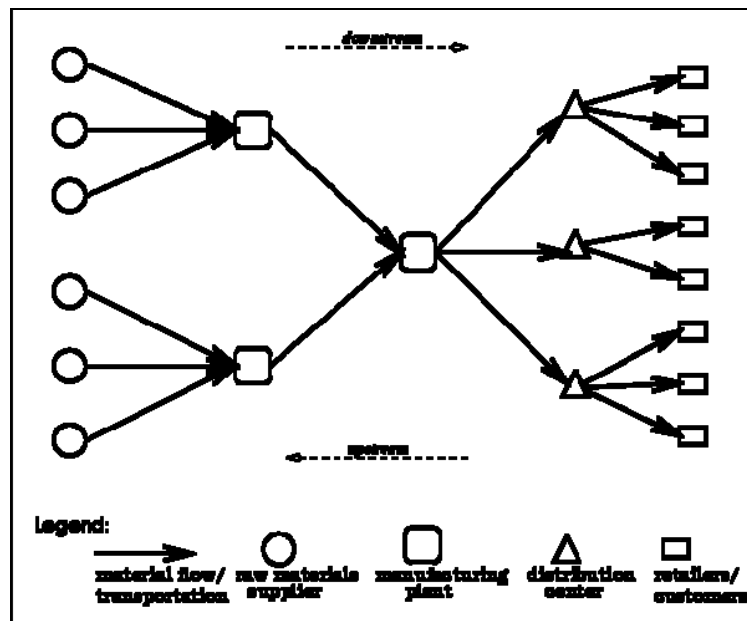
### 1. Introduction

Market globalization has forced enterprises to rethink traditional supply chain approaches. With the development of the Internet, customers are no longer restricted to local buying. Companies must increasingly focus on gaining competitive advantage through effective management of their supply chains. Globalization also brings foreign competition into markets that traditionally were local. Local companies are thereby forced to respond by improving their manufacturing practices and supply chain management. The e-business revolution is affecting supply chain management dramatically and is changing how companies integrate business processes, both inside and outside the enterprise. These developments introduce new business and technical challenges and spotlight existing business processes and supporting enterprise systems that revolve around the supply chain. Newer approaches to supply chain management attempt to organize the *supply chain as a network of cooperating intelligent agents, each performing one or more supply chain functions and each coordinating action with one another* (Horvath, 2001). Products are no longer produced and consumed within the same geographical area. Even the different parts of a product may, and often do, come from all over the world. This creates longer and more complex supply chains, and therefore it also changes the requirements within supply chain

management. Having different parts of a Supply Chain in different countries we can discuss it as an International Supply Chain.

There seems to be a universal agreement on what a supply chain is. Jayashankar et al. (1996) defines a supply chain to be *a network of autonomous or semi-autonomous business entities collectively responsible for procurement, manufacturing, and distribution activities associated with one or more families of related products*. Lee and Billington (Lee & Billington, 1995) has a similar definition: *A supply chain is a network of facilities that procure raw materials, transform them into intermediate goods and then final products, and deliver the products to customers through a distribution system*. And Ganeshan and Harrison (2006) has yet another analogous definition: *A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers*. Supply Chain refers to the distribution channel of a product, from its sourcing, to its delivery to the end consumer (also known as the value chain). The supply chain is typically comprised of multiple companies who are increasingly coordinating activities via an extranet.

As we can see on Figure 1 materials flow downstream, from raw material sources through a manufacturing level transforming the raw materials to intermediate products (also referred to as components or parts). These are assembled on the next level to form products. The products are shipped to distribution centers and from there on to retailers and customers. The common characteristic among supply chain leaders in all the industry segments is the extent to which the various supply chain constituents engage in supply chain collaboration. Organizations need to break the traditional paradigm of looking at the supply chain as a set of inter-connected constituents (Sahay, 2003). There is an urgent need to employ systems thinking to supply chain management.



**Figure 1.** An Example of a Supply Chain

Efficient supply chain management is the key to the profitability of all chains' participants, including retailers (customers). To be competitive, a supply chain must be cost-efficient, responsive, flexible, agile, accurate (in terms of product, quantity, place, time and quality) and easy for businesses to be part of. This model of thinking features a super-efficient production process in which each operation - buying products from manufacturers, distributing them to the retail stores, and selling them to customers - is linked to the next in a continuous 'just-in-time' chain. There are three main reasons why to organize Supply Chains:

- Providing proper customer service to satisfy clients. There are lots of ways we can define it, ex. *the company's ability to fulfill the business, emotional, and psychological needs of its customers*, or *quality of your service delivery expected by the customers*, or *providing good service in a pleasant manner and meeting the customer's expectations*. Customer service is often discussed in terms of the metrics which are used to measure it. Typical measures of customer service are a company's ability to fill orders within due date (fill rate), or its ability to deliver products to customers within the time quoted (on-time deliveries). Other metrics should be used to for example evaluate the delivery performance of orders that are *not* delivered

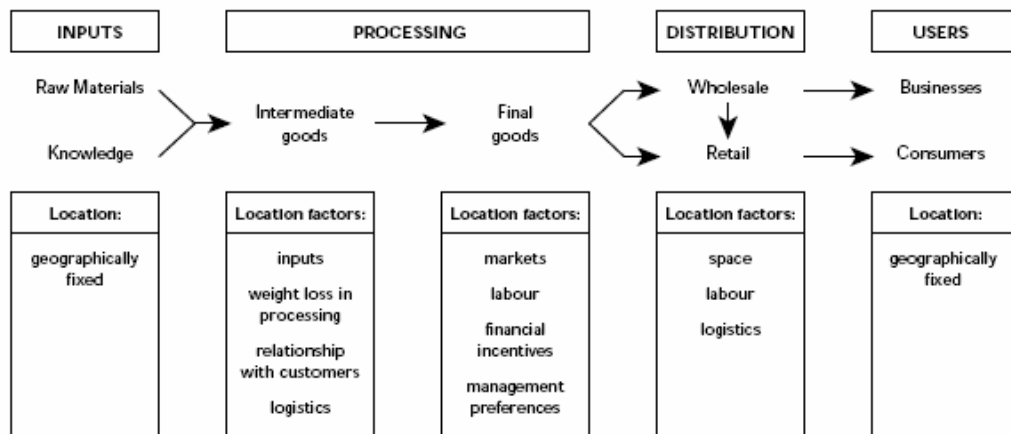


on-time. A way to indicate this is to measure the average time from order to delivery.

- Inventories – keeping them on proper level. The best description of inventories is the following: *a company's merchandise, raw materials, and finished and unfinished products which have not yet been sold*. Today's fast moving, competitive business environment requires companies to be very effective at balancing the use of capital with meeting forecasted product demand. The problem is that modern companies often don't always get it right. And when they finally discover a problem, it's too late - the damage to customer satisfaction, profitability, and revenues has been done.
- Flexibility – can be defined as *the ability to respond to changes in the environment*. or can be *characterized by a ready capability to adapt to new, different, or changing requirements*. In the case of a manufacturer, flexibility is the ability to change the output in response to changes in the demand. In a supply chain the flexibility of one entity is highly dependent on the flexibility of upstream entities. The overall flexibility of a supply chain will therefore depend on the flexibility of all the entities in a supply chain, and their interrelations.

All above mentioned reasons are independent, but they influence each other. A manufacturer's flexibility is its ability to respond to changes in demand. If the demand is rapidly increasing the manufacturer needs more raw materials to fulfill the demand. It can be taken from the inventory stock, in case if it is in. Usually keeping overstock costs too much. A supply chain may consist of many levels of production, transportation, and warehousing, each level adding to the lead time. In this case Supply Chain plays a role of a flexibility buffer for the manufacturer. On the other hand it is well known dependence between customer service level and level of inventories kept within logistics system. While oversized inventories are a costly inventory management strategy, low fill rates are also costly. Business may be lost through cancelled orders, and the company's reputation may be severely damaged. It is therefore in a company's interest to balance inventory holding cost and the cost of imperfect customer satisfaction. The trade-off inventory vs. customer satisfaction is one of the classic issues of logistics and supply chain management.

The general trend in European logistics has been from manufacturer-led to retailer-led supply chains (changing their strategies from “push” to “pull” supply chain economics). This is occurring in all three factors – customer service level, inventory level and flexibility, but at a different speed. Retailing is undergoing a period of consolidation, with the emphasis on continuous small improvements to existing location and distribution patterns. These will affect the location of wholesaling depots but will have relatively little effect on the location of primary manufacturing and retail sales outlets. Transport and logistics have relatively little effect on the global location of primary activities – the manufacture and sale of final products. This is determined by markets, labour conditions, financial incentives, and the social or cultural preferences of senior management. However they influence regional and local location decisions where site accessibility is a significant factor. Transport and logistics play a more important role in the location of secondary activities such as components manufacture, wholesaling and distribution, and service sector industries. Their importance varies according to the bulkiness of the product and its weight loss during manufacturing, the premium attached to quality/technological leadership, the level of competition within the industry, and the location of the activity within the supply chain.



**Figure 2.** Factors Influencing Location Decisions at Different Points in the Supply Chain

## **2. The Specific of Modern International Supply Chains in area of Transportation**

The main international transportation corridors have high level of congestion which makes material flows very difficult to manage. Traffic congestion costs are underestimated because official statistics do not take into account the “unseen” costs of the remedial measures used to maintain supply chain reliability – denser depot networks, longer scheduled journey times, investment in reserve vehicles. Concern about road congestion has resulted in a widespread aspiration to move more freight by rail. However there is a large gap between industry’s requirements for a high quality transport service and the standards provided by non-road modes. Industry’s requirements include:

- uninterrupted international services;
- the ability to handle small consignments (generally less than trainload and sometimes less than wagon load);
- frequent point-to-point services at scheduled times;
- guaranteed delivery times;
- conveniently located and easily accessible inter-modal terminals, and/or door-door delivery by intermodal transport;
- special wagons designed to meet the needs of individual cargo flows;
- automatic cargo tracking and monitoring;
- a faster response to queries and problems;
- support for the development of private sidings.

European railways are perceived to fall far short of meeting these needs, and industry representatives attending the three sector workshops offered several explanations of why this is happening:

- national railways pay too much attention to costs and not enough to quality of service;
- railway networks in Northern Europe are congested, with key bottlenecks restricting flows over much wider areas;
- priority is usually given to passenger services;
- large public sector organizations lack an entrepreneurial and customer-oriented culture;

- railways have not sought to expand the range of services they provide to customers, by offering door-to-door collection and delivery, consolidation and grouping, warehousing, IT-based order processing and Just-In-Time delivery;
- high charges for the use of rail infrastructure make it difficult for rail to compete with road;
- most long-distance traffic (for which rail has a natural competitive advantage) crosses frontiers, which are obstacles to guaranteed high quality services.

However where railways have restructured their services to meet industry's needs, the market response has been positive. There is a conflict between the steps needed to make road transport more efficient – authorization of larger vehicles, relaxation of restrictions on driving hours, construction of more motorways, limits on the growth of car traffic in towns – and sustainability arguments for limiting the growth of road freight. Road pricing has a role to play in resolving this conflict. However, the demand for road transport of freight is fairly inelastic, so higher road user charges will have little effect on the modal split of freight unless they are combined with structural reforms to make other modes of transport (particularly railways) more acceptable.

### **3. Character of Russian Supply Chains with Using of Railway Transportation**

Active position of Russia on transport communication development to provide international cargo transportation has found reflection in the Federal Program “Transport Strategy of Russian Federation”. “International transport corridors” is considered as one of its sub-program. The program has been approved at the Government session by the Russian Federation on August 2nd, 2001.

The purpose of the program is formation and development of the international transport corridor infrastructure in Russian territory as an interconnected measure of a complex component on transport system development in the Russian Federation. These interrelated measures are directed to full and effective satisfaction of demands of customers in transport services to maintain the foreign trade communications, to increase competitiveness of the Russian commodity producers and transport companies in the world commodity and charter markets, to create an atmosphere for

attracting international transit transportation to Russian transport communication, to increase efficiency and safety of all transport modes that are entering the international transport corridor system, to find solutions to the social problems.

Increasing effectiveness and safety of transport system can be provided by applying modern information technology. In the situation, when the tasks of railway transportation is becoming more complex and competition in international market of transit cargoes is increasing rapidly, main aspects in development of ICT-complex are:

- improve of effectiveness in transportation process.
- exclusion of human factor at different stages of technological circuit, first of all in making decisions on security of train transportation.

Russian Railways owns a developed IT infrastructure compare to other industries. Length of operable fiber-optic line makes 53 thousand km. To automate the control process and operate the transport system safely, a significant quantity of computerized system is applied.

Automated control system (ACS) "DISPARK" is introduced to operate the wagon-park. This system also helps to trace the wagons. Another system, called ACS "DISCON" is being developed, which offers the customers a query system for their containers. ACS "DISTPS" is being introduced for controlling the locomotive park. As one of the aspects of this system, a controlling technology is being developed for the locomotives in extended distances between changing the locomotives. Park of locomotives and a daily on-range brigade are being considered as well.

System of automatic identification for rolling stock, SAI "Palm", is being developed. This system helps to recognize the numbers and type of all kinds of wagons as well as locomotive sections. They can be traced as a component of a train or separately. Application of this system remarkably increases efficiency and reliability of information on displacement of the rolling stock and reduces operators' expenditures for manual work and also raises security of transportation on the next level. With using of new technologies Russian Railways meets industry's requirements for automatic cargo tracking and monitoring, guaranteed delivery times, high-quality special cargoes transportation.

#### 4. Conclusions

Transportation costs in Russia are in the end still very high. It depends on many factors: tariff, quality of infrastructure, level of service and technology. Transportation cost in Russia estimates at least 14-18% (can be more than 25%), in Europe it not more than 9-11%. To cut down transportation costs there is necessity to open new logistics centers for commerce and information coordination, centralization of forwarding operations and decisions of future transport development process. With using of these centers Russia's transport system can increase quality of transport service and be more competitive in international supply chains.

#### References

- Hau L. Lee and Corey Billington (1995). The Evolution of Supply-Chain-Management Models and Practice at Hewlett-Packard. *Interfaces* 25 (pp.42-63): 5 September-October.
- Horvath, L (2001). Collaboration: the key to value creation in supply chain management. *Supply Chain Management*, Vol. 6, No. 5, pp 205-207.
- Janyashankar M. Swaminathan, Stephen F. Smith, and Norman M. Sadeh (1996). A Multi Agent Framework for Modeling Supply Chain Dynamics. Technical Report, The Robotics Institute, Carnegie Mellon University.
- Ram Ganeshan and Terry P. Harrison (2006). An Introduction to Supply Chain Management. Penn State University. URL: [http://silmaril.smeal.psu.edu/misc/supply\\_chain\\_intro.html](http://silmaril.smeal.psu.edu/misc/supply_chain_intro.html)
- Sahay, B. (2003) "Supply chain collaboration: the key to value creation. *Work Study*, Volume 52, No. 2, pp 76-83.

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## Evaluation of the Suitability of AHP in Studying Transit Route Selection Criteria

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### Abstract

The value of transit traffic through Finland to Russia has almost doubled in the last three years and was 22 billion euros in 2005. The total import to Russia through Finland in 2005 was 27.7 billion euros (about 33% of Russia's total import). The remaining 5.7 billion euros was Finland's export.

The purpose of this ongoing project is to identify the transit route decision-makers and research the criteria contributing to the selection of transit route. In this paper special emphasis is laid to decision making process of transit routes. In this context, analytic hierarchy process (AHP) is applied in order to evaluate its suitability in analyzing the criteria affecting the route selection.

The AHP will be implemented through international expert interviews. Interviewees include manufacturers, distribution centers, logistic operators and consignees.

The preliminary results indicate that transit traffic route selection process is rather complex and that the AHP can be useful in analyzing the route selection criteria.

**Keywords:** transit traffic, via Finland to Russia, route selection, Analytic Hierarchy Process,, advantages, disadvantages

### 1. Introduction

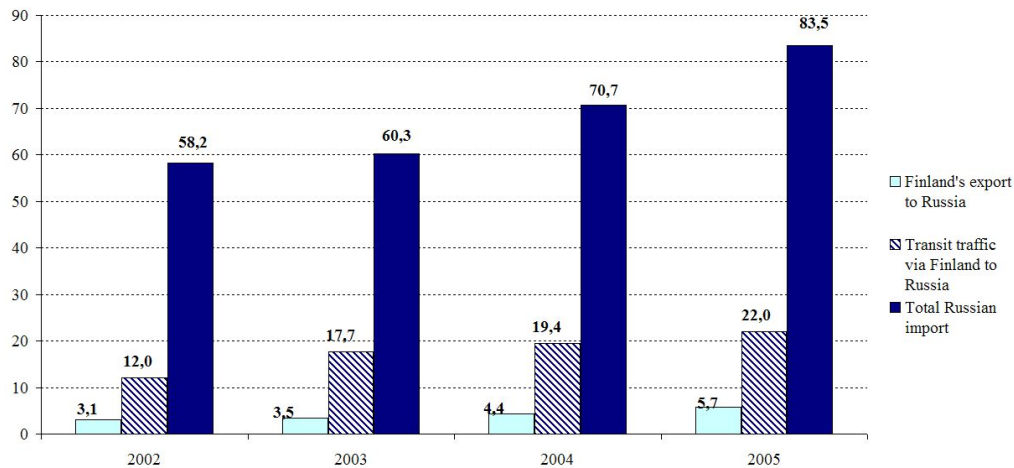
Transit traffic means transportation of goods through another country to the destination country. Transit goods are not purchased into the transit country, they are not cleared in the transit country's customs and they do not appear in the foreign trade statistics of the transit country. (Widgren et al. 2000)

The collapse of Soviet Union and the explosive growth of import to Russia in the beginning of the 1990's have a significant importance for the Finnish logistics industry. The sudden increase in the traffic from Finland to Russia created new business opportunities for the Finnish transport companies. However at the time of the Ruble collapse in 1998 import of consumer goods in Russia decreased significantly. The logistics service companies depending on the transit traffic of consumer goods experienced crisis. The outcome of the situation in Finland was that many trucking and forwarding companies stopped their activities or went bankrupt. At the same time the Russian domestic production took a boost. The Ruble collapse started a new era of value added logistics in the transit traffic via Finland to Russia. (Kilpeläinen 2004)



The value added services are operations which are extended from the basic logistical operations (transportation, warehousing and forwarding), for example, repacking of products (Pekkarinen 2005). The growth of the value added services shows that not everybody suffered financial losses during the 1998 crisis in Russia. Those, who had their assets in non-Ruble form, made profits enhancing their purchase power. The recovery of purchasing power after the 1998 crisis in Russia has been very strong. (Kilpeläinen 2004)

Route via Finland to Russia is the main transit route for valuable goods transported from EU to Russia (Lautso et al. 2005). The largest share of the eastbound transit traffic via Finland is transported to Russia but some of it is transported further to the other former CIS-countries (Statistics Finland 2006). Because of the large share of the valuable goods of the goods transported via Finland to Russia the transit traffic to Russia is mostly transported on road (Lautso et al. 2005; Tullihallitus 2006). The share of rail transportation in the eastbound transit traffic was in 2005 less than 7% and the share of the value even lower, because the rail transportations does not consist of as valuable goods as the road transportations (Tilastokeskus 2006). In the eastbound rail transportations about 70% are electronic appliances such as domestic appliances and the remaining is mostly sawn timber, special chemicals and special metals (Mäkinen 2006). Unfortunately there are no statistics published on the value of rail transit traffic. However because the effect of the rail transportations is very low, it is possible to assume the value development of the road transit traffic as the value development of the whole eastbound transit traffic. Figure 1 describes the importance of transit traffic to Finland.



**Figure 1.** Export and transit traffic via Finland to Russia compared to Russian import (billion euros) (Tullihallitus 2003, 2004, 2005a & b, 2006; Kevesh et al. 2006; Federal Customs Service 2006).

In 2005 the eastbound road transit traffic via Finland was 2.6 million tonnes and the value of it 22.0 billion euros. The largest groups in the eastbound transit traffic by volume were motor vehicles (19%), other machines, appliances and vehicles (10%) and groceries (10%). The largest groups by value were radio, television and computer appliances (23%), motor vehicles (22%) and other machines, appliances and vehicles (12%). (Tullihallitus 2006) If the development of the value of the eastbound road transit traffic (Figure 1) is compared with the development of the volume of the eastbound road transit traffic one may notice that the highest value goods were transported via Finland to Russia in 2003 (Statistics Finland 2006). This could be explained by the significant growth of transportation of motor vehicles in 2004 and 2005 via Finland and the simultaneous slight decrease in the transit traffic of the radio, television and computer appliances which have higher price per ton than the motor vehicles have. (Tullihallitus 2003, 2004, 2005a, 2006)

## 2. Literature Review

Transit traffic via Finland has been a topic of some previous researches. For instance, Kajander & Tervo (1999), Widgren et al. (2000), Kilpeläinen (2004), Kilpeläinen & Lintukangas (2005) and Nieminen et al. (2005) have approached the topic from different angles which are summarized in the following.

Kajander & Tervo (1999) studied the transport chains used in transit traffic via Finland. In addition, the price levels for containers and semi trailers transported from the Western Europe to Russia were compared in routes via the ports of Finland, St. Petersburg, Tallinn, Riga and Klaipeda. Also the land route from Western Europe to Russia was taken into account. Some of the most interesting conclusions regarding this study were that there were not huge differences in the price levels of different routes. Secondly, despite the Finnish route is longer than the others, the frequent liner traffic to Finnish ports makes the route competitive in regard to average transit times.

The study of Widgren et al. (2000) analyzed Finland's role as a hub of transport and trade between the world market and Russia. The aim was to assess Finland's role and competitiveness in transit trade between Russia and the rest of the world and to evaluate the economic impact of transit trade to the Finnish economy. In addition to transit trade there was studied the arbitrage trade, which means the import that is not consumed in Finland but exported to Russia. Some of the most interesting conclusions were that the route via Finland is competitive in the transportation of valuable eastbound goods. And that this kind of transportations includes also some value adding in storage, merging of deliveries and adapting the products to the clients needs.

Kilpeläinen (2004) analyzed the development of transit traffic via Finland in 1997-2003. The aim of the study was to clarify the change in the volume and content of the transit traffic via Finland and to analyze the reasons for the changes. It was stated that the curve of the eastbound traffic via Finland is a mirror image of the average earnings trend in Russia.

Kilpeläinen & Lintukangas (2005) analyzed cross-border zone as a possible competitive edge in transit traffic. The aim was to clarify the development of the competitive environment of transit traffic to and from Russia and to try to find solutions to the tightening competition by approaching the idea of a cross-border zone in South East Finland. One of the most interesting finding was that solution to the tightening competition could be found from partnership in which the coordination and managing of the supply chain could be in South East Finland and the manufacturing procedures would be conducted on the Russian side for cheaper labor costs.

Nieminen et al. (2005) did not actually concentrate on transit traffic but on import of customer goods to Finland. The aim of their study was to provide information about the changing environment of the customer goods import to Finland in the terms of unit load traffic, containers, trucks and trailers. Besides, the study concentrated on

the external, environmental, technical and economic factors affecting logistical decisions like route selection processes. On the basis of the findings the criteria affecting the route selection are reliability, experience, service and cost efficiency. It was also stated that customs and stevedoring companies should start operating 24 hours a day for increasing the competitiveness of Finnish route.

As it may be noticed, the transit traffic via Finland to Russia has been studied from very different angles. The studies of Kajander & Tervo (1999) and Nieminen et al. (2005) are closest to this study because they partly deal with the route selection criteria. However the route selection in transit traffic has not been studied earlier from the view point of the decision-maker. The former research on the route selection criteria has been more or less listing the criteria that could affect the route selection without measuring the relative importance of the different criteria on the viewpoint of the decision-making situation.

### **3. Analytic Hierarchy Process**

Analytic hierarchy process (AHP) is a multi-attribute decision-making methodology widely used by both practitioners and researchers (Leung & Cao 2001). AHP reflects the way people think and behave. It accelerates thought processes and broadens consciousness to include more factors in the decision-making process than would ordinarily be considered. (Saaty 1999)

AHP process involves the following phases: hierarchy structuring, weights defining and synthesis (Lirn et al. 2003; Saaty 1999). Structuring hierarchy means formulating the hierarchy in terms of objectives, criteria in different levels of hierarchy, rating scale used for the evaluation of decision-alternatives and formulating the alternatives to be evaluated. Defining weights means collecting data in order to obtain the weights for the criteria. And the synthesis means the final evaluation of the decision-alternatives performance on the basis of the lowest level criteria in the hierarchy. (Lirn et al. 2003) The method uses pair-wise comparisons and it has its own scale for the evaluations. The scale ranges from 1/9 for “least valued than”, to 1 for “equal” and to 9 for “absolutely more important than” covering the entire spectrum of the comparison. (Vaidya & Kumar 2006)

AHP has been used in almost all the applications related with decision-making. In addition to decision-making AHP has been utilized in different fields such as selection, evaluation, cost-benefit analysis, resource allocations, planning and development, priority and ranking, optimization and resolving conflict. (Vaidya & Kumar 2006) In the field of transport problems there are at least 20 known applications of AHP (Lirn et al. 2003). One of the most interesting ones regarding this study is the study by Lirn et al. (2003).

Lirn et al. (2003) used AHP to determine the importance of various criteria in the transshipment port selection decision-making process from a container carrier's perspective. The aim was to identify the criteria affecting to the selection of transshipment ports and to evaluate the performance of three major ports in Taiwan. The results indicate that in the port selection the order of importance of the criteria affecting to the selection is the following: port geographical location, carrier's cost perspective, port management and port basic physical characteristics.

#### **4. Advantages and Disadvantages of AHP**

Advantages of AHP are mainly based to its versatility, ability to handle complex problems and ability to deal also with qualitative criteria. Most criticized disadvantages of AHP are rank reversal, pair-wise judgments and comparison scale. At first the advantages of AHP are examined.

AHP is not limited to tangible attributes but it can be used to measure qualitative criteria as well (Leung & Cao 2001). Thus, an advantage is the ability to deal with qualitative and quantitative criteria (Leung & Cao 2001; Swiercz & Ezzedeen 2001; De Vreese et al. 2003).

Secondly, AHP has an ability to handle complex problems (Leung & Cao 2001; Banuelas & Antony 2004; De Vreese et al. 2003). Accordingly to Leung & Cao (2001) AHP is a method to handle complex problems with multiple levels, because it provides a consistency index that is used to measure the coherence that decision-makers have in their judgments (Banuelas & Antony 2004), and because the process illustrates easily the trade-offs between objectives and interests (De Vreese et al. 2003). The realization, understanding and awareness necessary to consider the different objectives that may affect the situation makes the decision-makers and

subject-matter experts contemplate the outcomes of the decision-making much more carefully (Banuelas & Antony 2004). Thus, the method is suitable for complex decision-making.

Third advantage is claimed to be the easiness of implementation (Braglia et al. 2001; De Vreese et al. 2003). AHP is versatile in application and easy to implement (Braglia et al. 2001). It is for example easy to interpret the estimated priorities in the hierarchy (De Vreese et al. 2003).

A major criticism has arisen from the fact that rank reversal exists in AHP (Leung & Cao 2001; Lehtonen 1999; Gass 2005). The order of superiority of the decision-alternatives may turn if new alternative will be added to the hierarchy. In some cases adding a new alternative will produce new information and the turn of order may be justified. However in some other cases the rank reversal will occur only because of mathematical characteristics of AHP. Therefore the comparisons of different alternatives and criteria in AHP are firmly bound up in the group of alternatives and criteria and if the group will be changed the comparisons have to be renewed. (Lehtonen 1999)

On the other hand AHP's ability to incorporate the phenomenon of rank reversal has also been evaluated as an asset (Leung & Cao 2001; Lehtonen 1999). Saaty and Vargas have presented the rank reversal to be one of the assets of AHP because the phenomenon of rank reversal can be observed also in the human behavior (Lehtonen 1999).

Secondly, it is argued that the pair-wise judgments in AHP are ambiguous (Leung & Cao 2001; Lehtonen 1999). The questions in AHP have been described irrational because question how much A is better than B does not describe the point of comparison. On the other hand in many practical applications the decision-makers have not considered the questions unpleasant to answer (Lehtonen 1999).

Thirdly, there has appeared critique towards the scale 1-9 in AHP because the scale limits the relations of the weightings. For example if the factor A was five times as important as factor B, and B was five times as important as factor C, then factor A should be 25 times as important as criterion C. However this outcome does not fit to the AHP scale. (Lehtonen 1999) There are also problems in transforming verbal expressions into numbers (De Vreese et al. 2003; Lehtonen 1999) because people may have very different interpretations of verbal expressions. (Lehtonen 1999)

Besides the aforementioned issues, it has been pointed out that adding to the number of criteria or alternatives increases the number of pair-wise comparisons exponentially (Swiercz & Ezzedeen 2001). Only a limited numbers of decision alternatives may be compared at a time. Saaty recommended 10 as the maximum number of alternatives to be compared with each other. (De Vreese et al. 2003) A small difference in the utility of alternatives cannot be taken as definite evidence that one alternative is preferable to another (Banuelas & Antony 2004). There is a lack of sound statistical theory behind the AHP (De Vreese et al. 2003). AHP does not assume transitivity of preferences which means that if alternative A is preferred to alternative B and alternative B is preferred to alternative C, then alternative A is not automatically preferred to alternative C (Gass 2005).

## **5. AHP in Route Selection**

In this section the AHP's suitability to the route selection problem of transit traffic to Russia is examined.

Arslan & Khisty (2006) utilized AHP and 'if-then' rules in explaining individual driver's route choice behavioral from behavior point of view. In their study one result was that a driver considers three factors for selecting his best route among the routes in his choice set. These factors were travel time, congestion and safety and these factors were used in the hierarchy of AHP. The result was that the most important criterion explaining driver's route choice behavior was travel time, the second one congestion and the least important criterion was safety.

Based on literature by Hernesniemi et al. (2005), Lautso et al. (2005), Nieminen et al. (2005), Hilska et al. (2003), Hokkanen et al. (2002), Cullinane & Toy (2000), Widgren et al. (2000), Kajander & Tervo (1999) and interviews of logistic operators and logistics experts in Finland, the Baltic States and Russia the hierarchy of the decision-making criteria affecting to the transit route selection to Russia has been structured in the following Figure 2. On the first level of the hierarchy there is the goal: the selection of the best route. On the second level there are the major criteria affecting the route selection: time, price, service and safety. And on the third level there are seven sub-criteria. For the evaluation of the performance of the studied

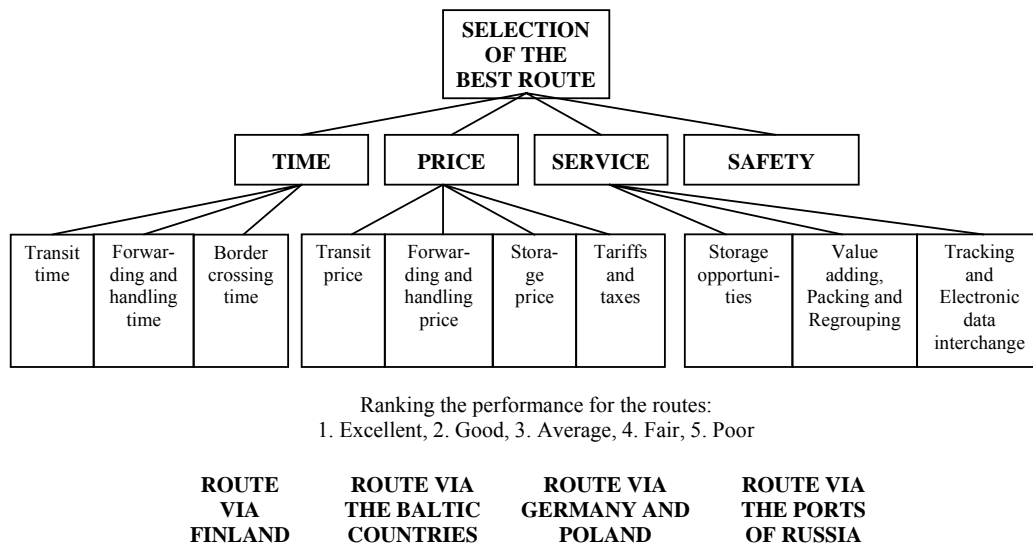
routes the same scale as used in Lirn et al. (2003) has thought to be the most appropriate for this kind of decision-problem.

In order to understand the structured hierarchy in a better way the sub-criteria will be explored more specifically. The transit time in the hierarchy means the time consumed in the transportation from Western Europe to Moscow by the used transportation modes. Forwarding and handling time means the time used in these operations in the transit country via which the goods are transported to Russia or in the case of St. Petersburg the time used for these operations in St. Petersburg. And the border crossing time means time spent at the border of the transit country and Russia. On the route from Western Europe via Poland also the border crossing time in the border of Poland and Belarus is taken into account because it is considered to be slow (Lautso et al. 2005).

Transit price means the price paid for the transportation of goods from Western Europe to Moscow. Forwarding and handling price means the price paid for these operations in the transit country as well as the storage price means the price paid for storing the goods in the transit country. Tariffs and taxes indicate the share of the price used for paying the costs produced by import to Russia. These costs are examined separately from the other cost factors because of the double checking (the change of the invoice) at the Russian border (Kivilaakso 2006).

Storage opportunities in the hierarchy mean the existence of adequate storage space in the transit country. Value adding, packing and regrouping include the existence of adequate services in the transit country and the tracking and electronic data interchange mean the possibilities of using these kind of electronic information channels on the whole route from Western Europe to Moscow in order to make the information flow easier in the transit chain.





**Figure 2.** Hierarchy of AHP in route selection problem

In the hierarchy structuring there have been utilized several sources of information in chasing up the criteria affecting the route selection decision in transit traffic to Russia. In real life, it is rather complicated to find out, which routes the transit goods are transported to Russia. Besides, finding out who are the persons to know, which criteria affect the selection between different routes, has turned out to be challenging. In this context, over 50 people have already been contacted mainly in Finland, the Baltic States and Russia.

Pair-wise judgments have been criticized to be ambiguous (Leung & Cao 2001; Lehtonen 1999), because the question how much time is more important than price does not necessarily describe the point of comparison (Lehtonen 1999). But as a matter of fact that is an essential feature in AHP. That feature and the measurement of consistency of the judgments of the decision-maker, which is a part of the process (Vaidya & Kumar 2006), makes the basis for AHP's ability to extend the rational thinking of human mind, and to include more criteria in the decision-making than otherwise could be considered. However, it has been questioned by some interviewees if in this research the pair-wise comparisons could be utilized in comparing the sub-criteria of time among themselves, and comparing the sub-criteria of price among themselves. One interviewee considered that these sub-criteria depend on the routes and therefore should be asked in some other way.

One of the AHP's advantages, ability to deal with qualitative and quantitative criteria is expected to become apparent in this research in comparing safety issues with time and price (Leung & Cao 2001; Swiercz & Ezzedeen 2001; De Vreese et al. 2003). This feature is of the utmost importance in this kind of selection situation because there are also qualitative criteria to be considered when selecting the route for transit traffic. There is also a concern if all criteria affecting the decision are taken into account. Therefore there have been several interviews, in which interviewees have, for example, recommended to pay attention to the differences of tariffs and taxes on the routes caused by the double checking. In addition, it has been considered if the routes under comparison are informative enough, or if the Baltic States should be asked separately. It has also been considered if Finnish ports could be investigated separately from each other in this research.

AHP's ability to handle complex problems with multiple levels is also important in the route selection case because there is a need to consider criteria in different levels (Leung & Cao 2001). For example, it should be taken into account that not only time is more important than the price, but also it should be investigated which part of the transit chain is critical concerning the time. One has to be careful and bear in mind that in the hierarchy there should not be criterion, which is dependent on another criterion.

The third advantage, the easiness to interpret the estimated priorities in the hierarchy (De Vreese et al. 2003), is much a consequence of the hierarchical structure of the process. The hierarchy structuring clarifies the decision-making objectives that may affect the situation, and thus the outcomes of the decision-making are supposed to be considered much more carefully. In the case of route selection the hierarchy structuring helps to widen the view of the criteria affecting the situation and therefore helps to get closer to the roots of the problem considered. The easiness of using the AHP in this case is ensured by keeping the amount of the pair-wise comparisons low enough. The amount of the pair-wise comparisons with this kind of hierarchy will be 18 and there will also be 10 questions on the performance of the different routes concerning the sub-criteria. If pair-wise comparisons would be used also in comparing the performances of the routes not only comparing the criteria, then the amount of comparisons would rise to 78, which would reduce the willingness of respondents to take part in the process. However, there has to be enough comparisons in order to get extensive information.

## 6. Conclusions

The transit traffic to Russia has a significant importance to Finland as the value of eastbound transit traffic is four times bigger than the value of Finland's export to Russia. Aim of this ongoing project is to identify the transit route decision-makers and research the criteria contributing to the selection of transit routes in car, cosmetics and valuable electronics industries. The aim of this paper has been to evaluate the suitability of analytic hierarchy process in analyzing the criteria affecting the route selection in the view point of the decision-maker.

In this paper it was discussed if the analytic hierarchy process could be used in analyzing the route selection criteria concerned the transit traffic to Russia via Finland, the Baltic States, Poland and the Russian own ports. As a consequence the hierarchy of AHP was structured and on the basis of preliminary experiences there seems to be no insuperable constraints on utilizing AHP in analyzing the route selection decision-making process.

In addition the advantages and disadvantages of AHP have been briefly analyzed. The advantages of AHP are mainly based to its versatility, ability to handle complex problems and ability to deal with both quantitative and qualitative criteria. The most criticized disadvantages of AHP have been rank reversal, pair-wise judgments and the comparison scale. Criticism concerning AHP is worth noticing while utilizing the method but the most of the criticism is supposed to be refutable in the closer review.

The next step of the project is to start to contact the manufacturers of cars, cosmetics and valuable electronics like TV-sets and computers to get more information of the routes in use and the criteria contributing the selection of route. With the information from the manufacturers it is possible to make further assessments if the hierarchy needs to be revised, or if it already includes all required criteria. After getting feedback of the hierarchy from the manufacturers the next step is to implement the AHP questionnaire.

## References

- Arslan, T. & Khisty, C. J. (2006). A rational approach to handling fuzzy perceptions in route choice. *European Journal of Operational Research* 168:2, 571-583.
- Banuelas, R. & Antony, J. (2004). Modified analytic hierarchy process to incorporate uncertainty and managerial aspects. *International Journal of Production Research* 42:18, 3851-3872.

- Braglia, M., Gabbriellini, R. & Miconi, D. (2001). Material Handling Device Selection in Cellular Manufacturing. *Journal of Multicriteria Decision Analysis* 10:6, 303-315.
- Cullinane, K. & Toy, N. (2000). Identifying influential attributes in freight route/mode choice decisions: a content analysis. *Transportation Research Part E: Logistics and Transportation Review* 36:1, 41-53.
- De Vreese, R., Konijnendijk, C., Ottitisch, A. & Salbitano, F. (2003). Strategic aspects. In: *Good practice in urban woodland planning and design*, Ed. Konijnendijk, C. & Schipperijn, J. NeighbourWoods. Advancing the Quality of Life and the Environment of European Cities through Socially-Inclusive Planning, Design and Management of Urban Woodlands. EU Fifth Framework Programme Quality of Life and Management of Living Resources. Available at URL: <http://www.sl.kvl.dk/euforic/docs/NeighbourWoods/NBW-good-practice-strategic.pdf> Retrieved: 23.Feb.2006.
- Federal Customs Service. (2006). Import Rossii vazhneih tovarov za janvar-dekabr 2005 goda. Available at URL: <http://www.customs.ru/ru/stats/arhiv-stats-new/trfgoods/popup.php?id286=121> Retrieved: 5.Apr.2006.
- Gass, S. I. (2005). Model World: The Great Debate – MAUT Versus AHP. *Interfaces, An International Journal of the Institute for Operations Research and the Management Sciences* 35:4, 308-312.
- Hernesniemi, H., Auvinen, S. & Dudarev, G. (2005). *Suomen ja Venäjän logistinen kumppanuus*, Elinkeinoelämän Tutkimuslaitos ETLA: Helsinki.
- Herrala, S. (2006). Managing Director, Port of Hamina Ltd. Interview 6.Mar.2006.
- Hilksa, L., Gröhn, J., Granqvist, J., Nokelainen, A., Sirkiä, A., Jaakkola, E., Särkkä, T., Silfverberg, B. & Lehto, H. (2003). *Itämeren ja Barentsin alueen tavaraliikenteen tietojärjestelmä FRISBEE* Liikenne- ja viestintäministeriö: Helsinki. Available at URL: <http://www.mintc.fi/www/sivut/dokumentit/julkaisu/mietinnot/2003/b122003.pdf>. Retrieved: 18.Apr.2006.
- Hokkanen, S., Karhunen, J. & Luukkainen, M. (2002). *Johdatus logistiseen ajatteluun*, Jyväskylän ammattikorkeakoulu: Jyväskylä.
- Kajander, S. & Tervo, R. (1999). *Yhdistetyt kuljetukset kauttakulkuliikenteessä* Turun yliopisto, Turun yliopiston merenkulkualan koulutus- ja tutkimuskeskus: Turku.
- Kevesh, A. L., Bashina, O. E., Beljaevskij, I. K., Bulah, T. I., Gorjatsheva, I. P., Masakova, I. D., Muhanova, O. A., Sabelnikova, M. A., Samko, P. B., Sedova, E. I. & Tkatchenko, A. V. (2006). *Torgovlja v Rossii 2005: Statisticheskij Sbornik* Rosstat: Moscow.
- Kilpeläinen, J. (2004). *Development of Transit Traffic via Finland in 1997-2003* Lappeenranta University of Technology, Northern Dimension Research Centre: Lappeenranta.
- Kilpeläinen, J. & Lintukangas, K. (2005). *Finland's Position in Russian Transit Traffic – Is Cross-Border Zone a Viable Alternative?* Lappeenranta University of Technology, Northern Dimension Research Centre: Lappeenranta.
- Kivilaakso, T. (2006). Director of the Eastern Customs District, Finnish Customs. Interview 10.Feb.2006.
- Lautso, K., Venäläinen, P., Lehto, H., Hietala, K., Jaakkola, E., Miettinen, M. & Segercrantz, W. (2005). *EU:n ja Venäjän välisten liikenneyhteyksien nykytila ja kehitysnäkymät*. Liikenne- ja viestintäministeriö: Helsinki.
- Lehtonen, M. (1999). *Preferenssien epävarmuusanalyysi AHP -päätoimilleissa*. Diplomityö. Teknillinen korkeakoulu, Teknillisen fysiikan ja matematiikan laitos: Espoo.
- Leung L. C. & Cao D. (2001). On the efficacy of modeling multi-attribute decision problems using AHP and Sinarchy. *European Journal of Operational Research* 132:1, 39-49.
- Lirn, T., Thanopoulou, H. A. & Beresford, A. K. C. (2003). Transshipment Port Selection and Decision-making Behaviour: Analysing the Taiwanese Case. *International Journal of Logistics: Research and Applications* 6:4, 229-244.
- Mäkinen, T. (2006). Key Account Manager, Russian, CIS & Far Eastern Freight Services, VR Cargo. Interview 2.Feb.2006.
- Nieminen, L., Lyijynen, E., Auramaa, M. & Lukka, A. (2005). *LOADER/CLIENT Part 2, The Changing Environment of Customer Goods Import* Lappeenranta University of Technology, Department of Industrial Engineering and Management: Lappeenranta.
- Pekkarinen, O. (2005). *Competitive Analysis of the Northwest Russian Transport Logistics Cluster – Finnish Perspective* Master's Thesis, Lappeenranta University of Technology, Department of Industrial Engineering and Management: Lappeenranta.
- Saaty, T. L. (1999). *Decision Making for Leaders: The Analytic Hierarchy Process for Decision in a Complex World* (3<sup>rd</sup> ed.) University of Pittsburgh: Pittsburgh.

- Tilastokeskus. (2006). Transitoliikenne Suomen kautta. Available at URL: <http://statfin.stat.fi/statweb/start.asp?LA=fi&DM=SLFI&lp=catalog&clg=transitotilasto>. Retrieved: 15.Feb.2006.
- Swiercz, P. M. & Ezzedeen, S. R. (2001). From Sorcery to Science: AHP, a Powerful New Tool for Executive Selection. *Human Resource Planning* 24:3, 15-26.
- Tullihallitus. (2003). Itään suuntautuva maantietransito v. 2002. Available at URL: [http://www.tulli.fi/fi/05\\_Ulkomaankauppatilastot/01\\_Tilastokatsaukset/pdf/2003/2003\\_M04.pdf](http://www.tulli.fi/fi/05_Ulkomaankauppatilastot/01_Tilastokatsaukset/pdf/2003/2003_M04.pdf). Retrieved: 6.Feb.2006]
- Tullihallitus. (2004). Itään suuntautuva maantietransito vuonna 2003. Available at URL: [http://www.tulli.fi/fi/05\\_Ulkomaankauppatilastot/01\\_Tilastokatsaukset/pdf/2004/2004\\_M02.pdf](http://www.tulli.fi/fi/05_Ulkomaankauppatilastot/01_Tilastokatsaukset/pdf/2004/2004_M02.pdf). Retrieved: 6.Feb.2006.
- Tullihallitus. (2005a). Itään suuntautuva maantietransito vuonna 2004. Available at URL: [http://www.tulli.fi/fi/05\\_Ulkomaankauppatilastot/01\\_Tilastokatsaukset/pdf/2005/2005\\_M03.pdf](http://www.tulli.fi/fi/05_Ulkomaankauppatilastot/01_Tilastokatsaukset/pdf/2005/2005_M03.pdf). Retrieved: 8.Jan.2006.
- Tullihallitus. (2005b). Suomen ja Venäjän välinen kauppa. Available at URL: [http://www.tulli.fi/fi/05\\_Ulkomaankauppatilastot/01\\_Tilastokatsaukset/pdf/2005/2005\\_M14.pdf](http://www.tulli.fi/fi/05_Ulkomaankauppatilastot/01_Tilastokatsaukset/pdf/2005/2005_M14.pdf). Retrieved: 6.Feb.2006.
- Tullihallitus. (2006). Itään suuntautuva maantietransito vuonna 2005. Available at URL: [http://www.tulli.fi/fi/05\\_Ulkomaankauppatilastot/01\\_Tilastokatsaukset/pdf/2006/2006\\_M03.pdf](http://www.tulli.fi/fi/05_Ulkomaankauppatilastot/01_Tilastokatsaukset/pdf/2006/2006_M03.pdf). Retrieved: 18.Apr.2006.
- Vaidya, O. S. & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. *European Journal of Operational Research* 169:1, 1-29.
- Widgren, M., Kaitila, V. & Arkonsuo, H. (2000). *Transitoliikenne ja välityskauppa Venäjälle Transit and Arbitrage Trade with Russia – Finland and the Baltic Region (with English summary)* Elinkeinoelämän Tutkimuslaitos ETLA: Helsinki.

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## The Future of Third-Party Logistics – Key Issues for a Logistics Integrator

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### Abstract

Logistics has increasingly been recognized as a vital part of an organization's competitive resources. With an increased outsourcing of the logistics function, due to increasing competition and high customer expectations on service-level, there is a need for more professional and well-equipped logistics services. This need is emphasized by the tendency that competition increasingly takes place between supply-chains more than between companies.

There is a development of actors, known as third-party logistics providers or logistics integrators, who can take the role as integrator for several companies in a supply chain. This article focuses on the driving forces of these actors and how they can stay competitive by providing customers specific logistics solutions. A case study is presented of a Logistics Integrator and three of its customers with a varying degree of integrated collaboration in the logistic chain, and some key issues are presented from the provider's and the customer's perspective.

**Keywords:** 3PL, third-party logistics, logistics integrator

### 1. Introduction

*"It is not the strongest of the species that survive nor the most intelligent, but the one most responsive to change."*

Charles Darwin

Many large and traditional transportation companies mostly take care of the physical flow of material. Since one vital part of the logistics process is information this also needs to flow along the chain as undisturbed as possible. To achieve this in an efficient and effective way is a great challenge but there is a potential for great improvements.

New types of logistics actors aim specifically to overcome these problems by providing new type of services. They have been known for some time, some called third-party or even fourth-party logistics integrators (Moore 1987, Berglund et. al. 1999). What is the market opportunity for these actors in the logistics field and why are the services of major actors as DHL and Schenker less competitive? Many transportation customers do not require more than having their goods moved from A to B which gives the large actors an advantage by economies-of-scale. For more

customer focused services it is more difficult for large actors to adapt their services to specific customer needs. By providing services that traditionally have been an integral part of a company e. g. order-fulfillment, warehousing, or maintaining a necessary service level there is a possibility for small actors to succeed.

The companies that will be the leaders of the future have to compete with both cost leadership and service leadership (Christopher, 1989). To meet and live up to these requirements the ability to participate in networks of business relationships is of vital importance (Jespersen and Skjoett-Larsen, 2000). The possibility appears in an increased cooperation through the supply chain and its actors to a higher extent than today. For many companies this is a result of the hard competitive environment which requires increased speed, quality and flexibility. The tendency of the global economic development makes the competition of the supply chains be the main and essential one between individual enterprises and only when the whole supply chain keeps high competitiveness could the enterprise survive for longer periods (Ying and Dayong, 2000). These factors also motivate the outsourcing of activities and processes that are not the core competence of a company (Bengtsson et. al. 2005). Earlier the outsourcing were based on reducing costs and release capital, when the driving forces today have a more strategic trust, which means to increase market coverage, improve the level of service or increase flexibility towards the changing requirements of customers (Skjoett-Larsen, 2000). To be able to deliver the correct quality and quantity, in exactly the right time to the customer the actors have to cooperate. Integration of the supply chain has therefore become more important to gain competitive advantage (Bowersox et. al. 1989, Council of Logistics Management 1995). Before a company is able to participate in a network it has to coordinate its internal processes first as well as making them efficient (Jespersen and Skjoett-Larsen, 2005). Looking at the internal processes are also for knowing what the company needs to outsource, i.e the company (customer) has to be a qualified customer. What kind of relationship, exchange of information, and services do the customers require? The purpose of this research is to explore and describe the situation of a logistics integrator and identify requirements and key issues for this type of actor. The key issues are divided in four main groups: Services, Relationship, IT-tools and customers.

## **2. Research Methodology**

Since the purpose of this study is to explore and describe the environment of a logistics integrator and what requirements they meet and which the key issues are and for this a case-study strategy is chosen. The qualitative approach and case study are appropriate for giving a deeper understanding of the environment for actors in the logistics business (Yin, 1994). The case study focuses on how a logistics integrator has to act to meet its customers' requirements for the purpose of growing and staying successful in the market. In the study attention is also given to the customer's view of this actor to achieve a better understanding of the cooperation. Primary data has been gathered by the researchers and person-to-person interviews have been performed. This approach is envisaged to include as many factors as possible about how and why the cooperation between the actors becomes successful or not. Before meeting the respondents they have received a questionnaire to allow for preparation and the interviews are semi-structured. The questions have been discussed with fellow researchers and the interviews have been recorded digitally. The customers were chosen on the basis of one mature customer, one new customer, one customer who use the whole set of services provided by the logistics integrator, and a customer who only use a part of the case-company's services.

## **3. The Literature Framework**

For the understanding of the relationship development among external actors has the theoretical framework its base in the network approach, i.e. about logistics partners and their participants and how they act together. Even the logistics literature and supply chain management is used for the understanding of the logistics actors, what they provide and their role in the business. The actors are involved in both chains and networks. Supply chain, seen from an external perspective, means suppliers, the company, and customers and can involve first tier of suppliers, second tier of suppliers, first tier of customers (wholesaler), second tier of customers (retailer), and end customer and the company is a part of this chain. The network perspective of the logistic system involves same actors but describe a more complex structure, where



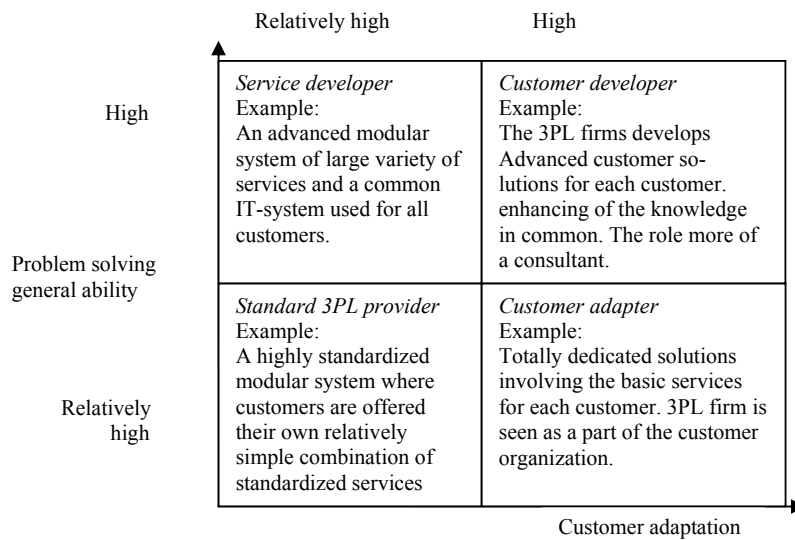
companies can be cross-linked and there are two-way exchanges (Harrison and van Hoek, 2005).

A broad definition of a 3PL is an external provider who manages, controls, and delivers logistics activities on behalf of a shipper (Hertz and Alfredsson, 2003). Another definition is all activities carried out by a logistics service provider on behalf of a shipper and consisting of **at least** management and execution of transportation and warehousing (if warehousing is part of the process) (Berglund et. al. 1999). In 2001 there was an agreement regarding a European definition of 3PL, and it is “*Third-party logistics (3PL) are activities carried out by an external company on behalf of a shipper and consisting of at least provision of management of multiple logistics services. These activities are offered in an integrated way, not on a stand-alone basis. The co-operation between the shipper and the external company is an intended continuous relationship*”. The goal for the relationship should be to develop into strategic alliances with win-win for both parties and long-term means not less than 2-3 years. (Andersson et. al. 2003) When talking and reading about 3PL, 4PL, logistic providers or integrators you find a great confusion of the concepts. A discussion of the meaning in this paper can therefore be needed. And maybe it is not the most important what the name of the actor is, but what kind of service the actor offer? You can see logistics integrators from two perspectives; one is, who are the actors have developed the services and the other in which scope the services are. First look at actors and you can see two types, those who own the infrastructure and equipment and those who do not own. The first type usually is finding in old companies that provide new services on top of the old ones. The other type is usually new-started companies. What kind of infrastructure and equipment can be meant is for example inventories, warehousing and trucks. The providers that not own this equipment have to engage other actors in every specific case, for each customer transaction (Eriksson et. al. 2004).

Next, what kind of services, and in what scope, do different actors provide? Even here you can divide it in two groups, where one is services that extent control and planning the physical distribution, usually called transport integration and the other group that extent control and planning of the whole supply chain inclusive their actors, usually called logistics integration. The first group focuses on services to do the physical distribution more efficient and logistics integrator focus of efficiency in the whole supply chain and here the physical distribution is just a part of the service (Eriksson et. al. 2004). The information is the base and what focus on. The

information is needed for the physical distribution from both suppliers and to customers. A more specific description about the services is divided in four categories; *service developer*, *customer developer*, *standard 3PL provider* and *customer adapter* (Hertz and Alfredsson, 2003). Service developers offer value-added services. This could be, in addition to transportation, cross-docking, forming specific packaging track and so on. These actors provide rather advanced services, but involve several sets of more standardized activities into different modules that could be combined dependence of the customers demand. Focus is also to create economies of scope and scale. IT system facilitates this development. Customer developers are the actors who offer the most advanced and difficult services. It involves a high integration with their customers and often the actors taking over the whole logistic process. The service their customers ask for is often know-how, methods, and knowledge development they miss in their own company or competence that they not classify as core competence. The number of customers often is limited and they work very intensive in the relationship with their customer. This customer developers can, for example be called “logistics integrator”. (Hertz and Alfredsson 2003, Moore 1987) In this category you find the case company of this paper and the term logistics integrator will be used from now and later.

In standard 3PL provider you find the actors that provide standardized 3PL services such as warehousing, distribution, pick and pack, etc. These actors are of more traditional character and offer new services besides the old one. Finally we have the customer adapter and they take over a company’s process. They perform and improve the process in an efficiency way but they do not make any developing of the services. Even these actors have a few customers they work for and they work very close to their customers. (Hertz and Alfredsson, 2003)



**Figure 1:** 3PL firms classified to abilities of general problem solving and customer adaptation (Hertz and Alfredsson, 2003).

Those actors described can be engaged in both supply chains and supply networks, the latter are more of a new way, and maybe more correct, to describe the cooperation between the partners, named collaboration. All those networks are based in different kinds of collaborations. From the beginning a rather loose cooperation to a more formalized cooperation to finally be a more virtual integration based collaboration. The collaborations have to be on all levels, including the strategic (Ericsson et. al. 2004). This new way to managing the networks is based on the customer as the starting point. Every activity has its starting point in something the customer is asking for and the supplier wants to satisfy the customer. To make it possible the information of the customer demand has to be shared through the whole network. The companies can achieve a long-term competitive advantage through develop strengths and competences with network partners (Ericsson et. al. 2004). But why do companies choose an external partner, a logistics integrator and why do they not develop the requirements inside the company? The reasons are several, but one can be it is hard to have all the competences needed. The need of competence also changes over time and then the customer can get the competence, and the flexibility, by the external partner in the network. If the required competence is logistics competence the company maybe say that it is not the core competence of the company, therefore it tries to get it through the network instead. Another reason can be that the company does not have the resources required. Even here you can find it from external partner. A third, very

important, reason can be that an external partner much easier can implement some changes that the company not is able to do. (Ericsson et. al. 2004) Companies even argue that the firm can release capital investments tied up in trucks and warehouses and invest this capital in their core business instead (Andersson et. al. 2003). To implement and use all these advantages you have to have a very tight and close relationship with your partners/customers.

The relationship in a supply chain or network has to be based on trust, mutual dependence, mutual commitment to customer satisfaction, and open lines of communication (McQuiston, 2001). The relationship also has to be of a long-term character, which often means not less 2-3 years. The partners have to exchange much of information which in turn requires trust for each other. Trust can be defined as reliance on, and confidence in, another party (Shaw, 1997) and becomes a key issue in relational exchanges. The actors also have to respect and agree with the goals of each other. They also have to cooperate in setting the goals and objectives because there must be a win-win situation. The relationships are not only to customers but also to suppliers, partners, customers' customer and so on. The exchange can involve technology, knowledge, information, physical, and social exchange (Hertz and Alfredsson, 2003). Therefore the trust between all involved partners is very important. Accordingly the partnership will develop both the provider's and the customer's competencies and expences. The sharing of knowledge both parties can develop, win-win situation. The integrator can use this experience on new customers and the customer can learn how to manage their logistic activities in a better way. Therefore both parties have to trust each other and share all knowledge and information. The openness in the relationship is conclusive. It is also very important, to be able to develop the dynamic competencies in the collaboration that even customer-company performs as a qualified and competent partner and opponent (Halldorsson and Skjoett-Larsen, 2004). To share information and have openness in the relationship the companies need tools, often in form of IT.

Information Technology and business applications, such as IT systems, often create great expectations to solve most of a company's problems. Unfortunately, these expectations seldom are fulfilled. IT can be a facility, among many others, in a relationship to share information and data. IT can help for shorter response time and better service (Baraldi and Waluszewski, 2005). IT has to be seen as an enabler, because the possibilities, but this does not mean that just because using the system all

problems are gone. IT gives the help needed but persons have to meet, discuss and decide in a personal way. But the great thing is that people do not have to be in the same place to have the same information to discuss about. Decisions can therefore be based on facts, even when people are far away from each other. They still have same information. For partners in networks and collaboration IT has to be a tool. The question is just how and what to use. Many companies today have ERP-systems, and lots of information is available through these. The investments in these systems are often rather expensive and different companies have different systems. The possibility to change information between different systems can be difficult and therefore it is necessary for the logistics integrator to be flexible in the use of IT-systems. Other IT tools can be EDI, own-developed web-based tools (Andersson et. al. 2003). The information in the ERP-systems can be used for feedback, follow-up as business ratio, learning about the processes, and for future planning. Although an information system can provide a framework and means to achieve integration another key issue, never to forget, is the coordination between the employees of the alliance partners (Bagachi and Virum, 1998). Meeting between persons from both partners, in all levels, are therefore very important. Both individual and group meetings are necessary and many contracts are made upon personal knowledge and relations.

#### **4. Sonat – a Logistics Integrator**

Sonat is located in Stockholm, Sweden and creates strategic alliances with their clients focusing on their supply network. Sonat has experts in operating and developing the logistics function in order to optimize the supply network capability and increase competitiveness. You can find Sonats' customer in lines of business like grocery and retail trade, manufacturing, pharmaceutical, and telecom services.

The mission of Sonat is:

*..... to increase the competitiveness of our clients by developing and operating their supply network to provide world-class performance in terms of cost efficiency, agility and change momentum.(www.sonat.se 2006-05-13)*

**1995** Sonat started as a consultancy company. Since then they have provided services in Supply Chain Management, developing suppliers and e-business strategies.

**1999** the owners of Sonat decided to be a total integrator and wanted to have a closer relationship with their customer and also to adjust their services for every unique customer.

**2000** dChain™ launched as Sweden's first service for outsourced Supply Chain Management

**2001** was a new dChain™ Operations Centre opened in Örebro in Sweden. From Örebro most of the tactical and daily operations were and are performed. (<http://www.sonat.se> 2006-05-13)

The way of *cost efficiency* means that Sonat act as support to their clients in different processes because of Sonat's resources, competences and knowledge. *Agility* means that Sonat has competences and resources that they can divide when by their customers needs. The organisation of Sonat is built upon development of competence. Sonat has a great strength in all their experiences and their great networks created during the years. They have network partners in all branches and through their customers and their needs. The third factor in the business concept is *change momentum*, which means the power, speed, and ability to be flexible. Sonat reacts very quickly to changes and find new opportunities and solutions in the area of logistics and purchasing.

The operational part of Sonat is located in Örebro and the company management in Stockholm. Sonat only own the offices where they work and the computers, so they do not own any warehouses, trucks, plants or other buildings and inventories. By delimiting from all infra-structure related flows they can focus on only working with information flows. It is the most important factor of success in the supply chain, according to Sonat. When the customer needs other competence Sonat provides that. Sonat consider that the ability to design and introduce customer adjusted supply chains are based on an extensive knowledge of these markets. The possibility in every unique situation to choose the actor who are most appropriate for a specific customer. Sonat considers it strategically important not to enter into partnerships with only one or a few actors, it is one of the strongest arguments to their customers, that they are independent of most actors. A logistics integrators' role is to be a critical partner to develop and control a customer driven supply chain. The concept will be built upon information and the tools will be IS/IT. The cooperation requires trust, transparency, and openness.

#### 4.1. Sonats' Service dChain™

The service dChain™ is a well proven, quality assured and efficient service that has been developed by Sonat for several years and provides a solid path to achieving increased delivery precision, increased cost efficiency and increased competitiveness. dChain™ is a strategic alliance where Sonat in close co-operation with their clients improve the efficiency of the supply network. Sonat perform an external and specialised function acting as a virtual logistics department or in other words an outsourced logistics department.

The customers have the opportunity to define how much of the supply network they would like to use dChain™ for. There are basically two versions of dChain™. The first one is dChain Supply™ where Sonat take responsibility for the whole supply network from suppliers to end customers. The second version is dChain Distribution™ which has a scope limited to distribution and transportation issues.

When *dChain Supply*™ is implemented it means that the following activities are performed by people from Sonat:

- The every day planning and administration of customer orders, orders of procurement ordering the transportation and customs documents
- Monitoring the operation flow and solve the problems in the operation flow
- Dimensioning the actors' ability. Involvements in purchasing of services and products
- Follow-up of component suppliers, contract manufacturer, and warehousing, own production plants, custom, transport actors, shipping partners etc..
- Analyzing the flows and the actors performance searching for new ways to work in a more effective and efficiency way, all to be more competitive

The service *dChain Distribution*™ means that Sonat is responsible for the whole transport- and distribution chain,. This network makes, together with Sonat, a customer-driven distribution where the level of service is decided of the customers' different needs. Sonat has the responsibility to secure this process, and also secure the development of the ability to meet new and different needs and opportunities. This solution is named Control Tower-solution. Both of the services have the starting point

from eight well defined processes in operational, tactical and strategically level. Sonat usually share these activities in three areas, Time to Customer (TTC), Tactical Planning and Improvement (TPI) and Strategic planning and development (SPD).

*TTC – Time to customer*

- *The acquisition process* - planning and controlling the acquisition of all products to the decided customer point.
- *The Order process* –to get and co-ordinate the information of an order from end customer and after that to choose and decide suppliers and distributors, all this to be sure that a complete order reach the end customer.
- *The Supplier process* –to supply the products the customers have ordered, in the order process, and with the decided service level.
- *Service- och return process* - the way the service are available for the customer and how complaints are handled so the customer feels satisfied. It has to be easy for the customer getting the service and even complaining. All has to be done in a flexible way for the customer. The process is unique for every customer.

*TPI - Tactical planning and improvement*

- *Continuous improvements* – measuring and analyzing the performance of the supply chain with a view of initiating the development of internal and external processes and also carry out rapid adaptations of exchanges in the market and make space for the company to growth.
- *Dimensioning*. This process is about how to decide in what way the flexibility in the supply chain should be managed. Even what kind of and how much capacity the chain need. What is acceptable time for a delivery? To decide this Sonat, and of course the client, has to know what do they do today and how did it look like yesterday (historical data), what does the market looks like and how flexible are the suppliers.

*SPD - Strategic planning and development*

- *Developing the base of the suppliers* –controlling and monitoring the market of the development of suppliers and also the structure. It also means the



responsibility of that the right suppliers are chosen both for now and for the future, in case of requirement of quality, effectiveness and efficiency.

- *Delivery strategy* – means the development of the delivery strategy in the way that the strategy supports the overall business strategy. Here long-term handling plans are created to secure the competitiveness in the future.

This is shortly the services Sonat works with to their customers, and to give a holistic view of the business of Sonat, the customers' opinions also will be given.

**Table 1: Short description of customers included in case study.**

Customer	Branch	Length of relationship	Using services of Sonat
Svenska Retursystem AB	Recycling	Since 2000	dChain Supply™
Apoteket	Pharmaceutics	Since February 2004	dChain Distribution™
Arla Plast AB	Supplier of plastic components	Since May 2005	dChain Distribution™

#### **4.2. Customer 1: Svenska Retursystem AB**

Svenska Retursystem AB (from now and latter called SRS) is the first customer of Sonat and has longest relationship of the interviewed customers. SRS runs the pool of Returnable Transit Packaging consisting of crates and plastic pallets for the Swedish food industry and retail trade. The system today contains in excess of 6 million crates and more than half a million plastic pallets and is rapidly growing. For 2005 more than 60 million crates and 2 million pallets, were delivered through their washing plants. Out of theses volumes approx. 10 % are shipped to customers outside of Sweden (<http://www.retursystem.se/eng/default.asp> 2006-05-13). SRS started 1999 but without any business. 2000 started the business and 5 people were in business, consisting in order registration, building the flows in the ERP-system, contracting and booking of transportations, and contacts with suppliers and customers. Soon this was too much for 5 people and the question “how to handle this” emerges. From the early beginning the ambition was to find a partner and be in a partnership. It was very important that it must be a partner and not a supplier. This was in the end of 2000 and in that time it was very few actors that could provide the services SRS asked for. SRS

only found two and one of them was Sonat. Even customers were not so good for telling what they needed and what their requirements were at this time. SRS got Sonat through a recommendation from another company which not alone could help SRS, but together with Sonat they could.

The first kind of services SRS needed were booking and controlling the transportation, solutions of problems, and differences, on operational level. The other service SRS needed were measuring and analyzing, which should help SRS and Sonat, together, to understand the mechanisms and forces that drive this kind of business. These two parts were discussed by Sonat and SRS and in the beginning of 2001 the partnership started in sharp version. All since that time Sonat and SRS has worked together as partners, learned and developed together.

The next stage was when Sonat took the responsibility of the supply of the crates and plastic pallets. SRS has the contract with the manufacturer but Sonat calls for the purchase, and make this from a prognoses and budgets from SRS. After that Sonat also took care of order registration, order taking and order handling. Now SRS use the whole dChain Supply™.

First of January 2004 a daughter company of SRS, AB Paletten, was started together with Sonat, who is responsible for the handling of order- and planning. 2005 refine SRS their business and the customer service were placed on Sonat and an export function was created. Also for this function the responsibility was placed on Sonat. In Örebro 14-18 persons work with just processes of SRS and they do it in the name of SRS. Two of these persons just work with SRS, no others of Sonats' customers. The team leader and the person of SRS who is responsible for the logistic in SRS have daily contact. They work and feel like colleagues. The cooperation is not regulated with a contract but just a framework which in an overall manner describe the processes the both work with. This kind of cooperation requires openness and this openness have been there the whole time, because both companies have seen this as learning and developing process. An example of this is that Sonat has full access in all SRS information systems and place order directly in SRS systems. From the early beginning Sonat had an IT-solution they used to work in but here they learned it is better Sonat adapt the customers system than contrary. Nowadays Sonat always let the customer choose in what system they should integrate in. SRS do not look at Sonat as an external partner but Sonat is SRS logistics function and a part of SRS. SRS and Sonat have meetings at least once a month. When business plans are going to be

created, meetings are more often. Together they create business plans and what kinds of projects are most important, when and how the project will be executed. A daily contact on the operational level and the cooperation is in a collegial way, not as an outside partner. SRS find the partnership with Sonat very important, they learn and develop together, but of course there is a risk. If something should happen with the company Sonat, it would be difficult for SRS to get the competence Sonat today help them with. Therefore it is very important that SRS require from Sonat a very carefully documentation of what Sonat do and the processes they are responsible for. Documentation, openness and feedback are very important.

#### **4.3. Customer 2: Apoteket**

Apoteket has been contracted with Sonat since 2003, but the operational work started 2004. Apoteket use dChain Distribution™ and Sonat handles the daily work of transportation in the name of Apoteket. Apoteket consists of 900-950 drugstores, where Sonat is not involved, 12 DOS-units (Drugstores that deal with doses for every single patient for his/her needs), APL-units, which is manufacturer of drugs, and 4 distance drugstores. In the three latter no customers come to get their drugs, but all drugs are distributed to the customer. It is in the distribution for these Sonat is involved. The DOS-units have been 29, now they are 12 and soon there are 11. This means that the distribution process has been changed, more complex, and centralized, which leads to more transportation and other services are needed. Because of that Apoteket needed more and other competencies than was in the house. There were two forces for the change of future: increased control of transportation and costs, and other requirements of transportation because of the re-construction of Apoteket. The decision was to centralize the distribution to one department, *The Department of Transportation*, and this would report to logistics management.

In this time Apoteket did not have the required competencies and the choice was to hire more staff or outsource. Apoteket chosen the latter and the partner they choose was Sonat. Another reason for outsource the Department of Transportation was because Apoteket did not know *what kind* and *how much* of competencies they needed, nor in that time or in the future. Sonat is flexible and can help Apoteket with this and together with Posten AB they now have the total responsibility for Apotekets' distribution process. A reason of why Sonat became the partner is depending of earlier

and personal contacts and in that connection Apoteket knew that Sonat had great competencies, were an independence partner and have world wide network. Concerning to price, performance and quality was Sonat together with Posten the best offer Apoteket got. Even the reason Sonat did not own trucks, warehousing or was contracted by special shipping companys, i.e. Sonat is independence, was conclusive. The goal for Apoteket to choose the solution with a “transport integrator”, as they name it, can be specified in some paragraphs:

- A long-term cooperation with openness, transparency, and nearness.
- Control, monitoring, and co-ordination of customer- and distribution services.
- Contribute to development of new solutions of distribution that promote the new business of Apoteket – flexibility in solutions and volumes.
- High effectiveness of costs and processes.

Services Apoteket wants from Sonat are: give suggestions of new transportation solutions, recommend, negotiate, and contract new partners of transportation, develop the shipping agents, and give Apoteket reports of costs and quality and also follow-up effect of the environment. Sonat is also responsible of measuring business ratios and give feedback if there are differences, and even proposals of solution for the differences. These follow-ups are presented in operating and business meetings, monthly. The relationship from the beginning was a little bit difficult, and Apoteket did not think that Sonat had the right engagement. One reason of this could be that it was not clarified who should response for what, Apoteket or Sonat. Another reason was that in-house staff did not like to leave their business or duties to Sonat. It was a hard time and work, for both parts, but today it works very well. Both Apoteket and Sonat have learned a lot of this partnership and the relationship is better and better for every day and today Sonat is treating as a part of Apoteket. There are no unclear points today and the trust and openness is total.

#### **4.4. Customer 3: Arla Plast AB**

Arla Plast AB is one of Sonat’s newest customer and the cooperation started just a year ago, Arla Plast AB as a company started 1960. The company has focused their

efforts on further development and refinement of the technique for producing mono-extruded and co-extruded sheet. Arla Plast AB is now one of Europe's leading suppliers of extruded sheet. The goal of Arla Plast AB is, *to be your best partner – ready to communicate on your wavelength, to listen and to get involved.* (<http://www.arlaplast.se/> 2006-05-13)

The products of Arla Plast are easy to transport, they are flat sheets and can be stapled on pallets. The pallets can be put upon each other, which lead to easier transportation. 80% of the products are exported so there are many and long transports. The company has most of their competitors in Europe and the hard competition and the long transports are factors that require that Arla Plast has to give the customers flexible solutions and a very good delivery precision. The cooperation with Sonat, started May 2005, consists of booking and handling the transportation. This means that Arla Plast use dChain Distribution™ and Sonat handle the daily work of transportation in the name of Arla Plast. But even on strategic level Sonat is involved, in form of giving long-term solutions of problems in the distribution area. The agreement between Sonat and Arla Plast is to August 2006 and after that a new agreement will be discussed. The reason to outsource the distribution process was the great volume of transports Arla Plast needed every year. They also felt they did not have enough of competence to perform it in an optimal way. Another reason was that Arla Plast did not know what is happening in the edge of the distribution area. They wanted to buy competence they did not have in-house.

Today Arla Plast is not satisfied with what Sonat has performed in creative solutions. The daily work, consisting of booking, monitoring and measuring, is very good. Lots of key issues are measured today and Arla Plast knows therefore where to put the resources. The control Arla Plast wanted is today much better. But to continue the cooperation Sonat has to work faster, give faster and more solutions for the future, for being an interesting partner. Arla Plast requires a much higher speed than Sonats' other customer. The independencies Sonat is able to provide, because they have no own trucks or warehousing or contracts with one or few partners, was very important for Arla Plast. It gave the opportunity to choose the best partner in every unique situation. Sonat has access to the ERP-system of Arla Plast, from this summer Jeeves, and do all booking in the system. There was no discussion about what system should be used. Even data for control and measuring Sonat will have from the system. Examples of measurements are: delivery delay, cost development, complaints, and

weights. Delivery delay divides in two part, one when the delay has been told and not been told. If the delay not have been told to Arla Plast, then Arla Plast do not pay for the transport. Today it is very few delays that not are told and the customers of Arla Plast are more satisfied. Sonat is responsible for measuring and presenting but also to explain why there are differences and how to solve the problems. The choices of business ratio have been decided together by Arla Plast and Sonat. Sonat and Arla Plast have monthly meeting with the company management but even with manufacturing management. Arla Plast has daily contact with persons in Örebro where the operational work is done.

## 5. Discussion and Conclusions

This paper describes the services and the customers' view of the partnership of a logistics integrator. First it can be concluded that Sonat, as a logistics integrator, is not engaged in the physical material flow, but only the *information flow*. Sonat can be responsible of and secures all activities about information the company wants to outsource. Information to the customers' customer, when, how, and how much delivery, to suppliers also information and to the customer business ratios, deviations of the ratios, why, how much and what to do with the deviations and so on. For the physical distribution, material flow, they recommend partners in their network to the customer who decides who to cooperate with. Sonat always start with a process mapping, and create a picture that all can agree on. Then both parts have a mutual starting point and can go on with the framework of responsibility areas. After that both parts know who and which is "my" responsibility.

Next the integrator has to offer broad and deep *competencies*. A logistics integrator has the experience of what is happening in the edge of the area. Another very important factor was the *flexibility*. The logistics integrator can take the responsibility for the whole supply chain on an operational, tactical and strategic level, according to the company needs. One more factor was the ability to on a short notice provide *various persons and competences*.

The third important key-issue is that Sonat *act as a part, a function, in the customers company*. Goals, business plans, and projects for the future are developed and decided together and both partners have to learn and make a profit in a win-win

relation. The relation is also considered in a long-term, not just to solve the problem at hand. Sonat also *act in the name of the customer*, so the customers' customer does not know that it is staff from a logistics integrator. The logistics integrator is also, compared to big traditional transport companies, much more flexible, and listens to what the customer wants. Yet another important factor is that Sonat does *not own trucks, warehousing and acts independent of contracted partners*. In every specific situation Sonat therefore can recommend the best solution for that situation by using the company's broad network. The fact that it is the information flow Sonat engage in makes it good not to engage in physical properties. The network of the integrator is enough and for the physical distribution flow the logistics integrator contract traditional shippers, i.e. DHL.

Summarized all three customers agreed it was Sonat's competence, flexibility, network, and the ability to participate as needed over time that made them engage Sonat as a logistics integrator. The customers also appreciated the fact that Sonat does not own trucks or are contracted with any shippers because they have the possibility to choose the right partner for every situation. The customer wants to become more aware of their processes and costs and the logistics integrator learns more from every new business and customer, which can be used in the next business. The cooperation with Sonat, SRS and Apoteket are clear and distinct proofs of that. Arla Plast has not reached this today, but if the partnership will continue there is a possibility. Arla Plast is not an experienced customer in this type of business, they have to learn and Sonat has to understand the way Arla Plast is operating, since they want activities performed more quickly than Sonat can provide.

One critical point is how to get the relationship to work smoothly. This study made it clear that two of the customers found it hard in the beginning, but over time one of them found it very good. SRS had no, or very little, business before Sonat entered as a partner and had therefore no problems even in the beginning. Apoteket is of the opinion that the relationship has developed and is today very good, but Arla Plast is in a start up phase and work for better relation on the strategic level. On the operational level the relation is very good. Another reason for why the relation can be a bit troublesome in the beginning may depend on that the customer has little experience to work in this way. It can even be hard to ask for and explain what the company really want and in what way, i.e the customer is not a qualified to specify their needs. SRS mentioned this reason and hope to improve

The factor there have to be requirements on the customers also came up. When a consultant are engaged the customer has a problem, solve it. When you work in a long-term partnership even the customer has to contribute with their competence, information and experience. Both parts have to engage for a successful relation. If the customer is inexperienced in this way to work the relation is halted and a hard work has to be done to learn the customer. SRS mentioned this factor and was a little bit worried because of the low process or maturity of customers. The customer also has to think, what I could have done in another way, not just say we are not satisfied with Sonat. Both SRS and Apoteket are experienced partners and have more of their functions outsourced, which probably has contributed to the success in these partnership. The customer also has to understand that long-term relationships have to take time and it is necessary to give the relation time to growth. Mentioned above it is the information flow which is interesting in these partnerships but how to get the information? From the very beginning Sonat had an IT-solution to offer its customer, but already in their first customer relationship the customer had an own IT-solution and did not want to change. Therefore Sonat has understood that Sonat has to be flexible and use the customers systems instead. So nowadays Sonat works in the customers systems, if they want, and if they not have own systems Sonat can solves it through its own. The most important is that both parts have the same information. Another thing about importance, about information, is the openness between the partners, and the interviewed customers say there are full openness. Sonat is working in their systems all the time. Even in these who have their IT- function outsourced.

Finally the most important reason to engage a logistics integrator is to have a partner you can trust and communicate with about the whole process, from the early beginning of your business to the end, when your customers are satisfied. The partnership also has to consist of the company's all levels, and developing the company with new solutions in each level. The holistic view is very important. No customer should come to a logistics integrator just to save money, they want so much more and mostly the requirements are about developing to stay competitive in their market.



## References

- Andersson D, Dreyer H.C, Halldórsson Á, Jahre M, Ojala L, Skjoett-Larsen T and Virum H. (2003), Third Party Logistics – A Nordic Research Approach, Kirjapaino Grafia Oy, Turku.
- Bagachi P.K and Virum H, (1998), Logistical Alliances: Trends and Prospects in Integrated Europe, *Journal of Business Logistics*, Vol 19, No 1, pp 191-213.
- Baraldi E, and Waluszewski (2005), A, Information technology at IKEA: an “open sesame” solution or just another type of facility?, *Journal of Business Research*, 58 pp 1251-1260.
- Bengtsson L, Berggren C and Lind J. (2005), *Alternativ till outsourcing*, Liber.
- Berglund M, van Laarhoven P and Sharman G, and Wandel S. (1999), Third-Party Logistics: Is there a Future. *The International Journal of Logistics Management*, Volume 10, Number 1: 59-70.
- Bowersox DJ, Daugherty PJ, Dröge CL, Rogers DL, Wardlaw DL (1989). Leading edge logistics – competitive positioning for the 1990s. Oak Brook (IL): CLM.
- Christopher M. (1989), *Logistics and Supply Chain Management – Creating Value-Adding Networks* (third edition). FT Prentice Hall Great Britain.
- Council of Logistics Management, (1995). The challenge of managing continuous change. Prepared by Global Logistics Research Team at Michigan State.
- Ericsson, D, Mårtensson A, and Rundqvist K, (2004) *Inköp & Logistik*, nr 1, pp 50-54.
- Halldorsson, A & Skjoett-Larsen, T., (2004), Developing logistics competencies through third party logistics relationships, *International Journal of Operations & Production Management*, Vol 24, No 2, pp 192-206.
- Harrison A and van Hoek R, (2005), *Logistics Management and Strategy – 2<sup>nd</sup> edition*, Prentice Hall – Financial Times.
- Hertz, S, Alfredsson, M. (2003), Strategic development of third party logistics providers. *Industrial Marketing Management* 32:139-149.
- Jespersen B D, Skjoett-Larsen T. (2005), *Supply Chain Management – in Theory and Practice*, Copenhagen Business School Press, Denmark.
- McQuiston D H. (2001), A conceptual model for building and maintaining relationship between manufacturers’ representatives and their principals. *Industrial Marketing*, 30, pp 165-181.
- Moore JW, (1987), Fourth party logistics strategic alliances in supply chain. CLM Annual Conference Proceedings, New Orleans, Sept. 24-27. Illinois: CLM 1987. p 234-56.
- Shaw R.B., (1997), *Trust in the Balance*, Jossey-Bass Publisher, San Francisco, CA.
- Skjoett-Larsen T. (2000), Third party logistics – from an interorganizational point of view. *The International Journal of Physical Distribution & Logistics Management*, Vol 30, No 2, pp 112-127. MCB University Press, 0960-0035.
- Yin, R.K. (1994) *Case Study Research – Design and Methods*, Sage Publications, London.
- Ying W, Dayong S. (2000) Multi-agent framework for third party logistics in E-commerce. *Expert systems with Applications* 29: 431-436.

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## Developing Distribution Channels in the Russian FMCG Sector – a Case Study of a Foreign Manufacturer

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### Abstract

The paper elaborates on the developing Russian consumer good distributions system, by providing (1) a thorough literature review on Russian distribution and logistics issues, (2) a description of the current state of the distribution system, and (3) the results of a pilot case study on foreign FMCG manufacturers operations in Russia. The system is seen to be in a state of change and development, especially with the emergence of organized retail with centralized distribution centers. Consequently improved opportunities for supply chain management exist in the sector. The developing business environment requires constant monitoring and proactive stance in the supply chain strategy development.

**Keywords:** distribution, FMCG, Russia

### 1. Introduction

The change in economic systems in many of the world's developing countries has brought about a new source of global economic growth. The consequent globalization of business and the emergence of new markets drive companies to internationalize their operations. In the case of the consumer goods sector, the opportunities in the emerging market economies (EME) for internationalization and foreign direct investment (FDI) can be analyzed by the means of annual Global Retail Development Index (GRDI) published by A.T. Kearney (e.g. 2005). Although focusing specifically on the retail sector, the index measures for example such variables as country and business risk, retail sales per capita, population, and business efficiency, which are highly relevant for all the consumer good supply chain incumbent firms. Currently the countries of Central and Eastern Europe (CEE) dominate the list with 60% of the top10 positions. During the last ten years the shift of growth and opportunity has been from Asia to CEE as Table 1 presents.

**Table 1.** Global Retail Development Index 1995 vs. 2005 (A.T. Kearney 2005)

GRDI 1995			GRDI 2005		
<i>Rank</i>	<i>Country</i>	<i>Region</i>	<i>Rank</i>	<i>Country</i>	<i>Region</i>
1	<b>South Korea</b>	<b>Asia</b>	1	India	Asia
2	Poland	Eastern Europe	2	<b>Russia</b>	<b>Eastern Europe</b>
3	Brazil	Americas	3	<b>Ukraine</b>	<b>Eastern Europe</b>
4	Chile	Americas	4	China	Asia
5	<b>Taiwan</b>	<b>Asia</b>	5	<b>Slovenia</b>	<b>Eastern Europe</b>
6	<b>Indonesia</b>	<b>Asia</b>	6	<b>Latvia</b>	<b>Eastern Europe</b>
7	<b>Malaysia</b>	<b>Asia</b>	7	<b>Croatia</b>	<b>Eastern Europe</b>
8	Argentina	Americas	8	Vietnam	Asia
9	<b>Thailand</b>	<b>Asia</b>	9	Turkey	Mediterranean
10	Czech Republic	Eastern Europe	10	<b>Slovakia</b>	<b>Eastern Europe</b>

In 1995, 50% of the top10 positions were occupied by Asian countries while the current situation is CEE centered. Russia (pop. 147 million) topped the list of attractive retail business markets for two consecutive years in 2003 and 2004, and came second after India in 2005. It is interesting to note the developments in Ukraine (pop. 50 million) that have significantly improved its ranking on the list (from 11th to 3rd). The phenomenon of CEE rise in significance is facilitated by the EU expansion, economic growth (which in the Russian case is partly due to the favorable world prices of raw materials, especially oil) and the emerging middle class.

Descending on to the micro level, we must acknowledge the challenges and operational issues in establishing business processes in a foreign country, especially in the above elaborated on emerging markets. Quite relevant to the manufacturers of consumer goods is the development stage of the distribution function, including wholesale and retail, an issue that has direct implications to the overall functioning of the supply chain. It is thus important to have an understanding on the market specific distribution issues and structures in order to operate successfully in a consumer good business as a manufacturer (Stern & El-Ansary 1992; Keegan 1999).

The case of Russian distribution is quite interesting for at least two reasons: (1) the vast geographic expanse of the country, and (2) historical burden of the command economy. In terms of land area, Russia is by far the largest country in the world with the characteristics of condensed urban centers dotting the vast expanse of sparsely populated rural areas. The great distances, coupled with poor transport infrastructure, cause problems for the nationwide distribution of consumer products. In the soviet era, the experiment with command economy caused a peculiarly inefficient distribution system to come into existence. Priority was given to producer goods as well as armament industries, with consumers' needs and preferences left largely

ignored (Rodnikov 1994). A more extensive review of the soviet era distribution will be given in the review of literature on Russian distribution. It is sufficient to say at this point that the era of communism left an inefficient system as a heritage for the emerging market economy in Russia during the 1990s.

During the last decade the problem of distribution in Russia has been well recognized. For example the McKinsey Quarterly (1995) attempted to raise awareness to the issue by stating the three most important issues in Russian consumer good business to be *distribution, distribution, distribution*. In our view, at least in most areas of Russia, not much has changed in ten years. The diversity and complexity remains, although evolution takes place. Intuitively it can be said that the same problems exist in many an emerging market, where the consumer society is starting to evolve in line with the growing purchasing power. In this paper we try to improve and enhance the current knowledge-base on the state of Russian distribution system. We thus attempt to answer the following research questions:

1. What has been done in terms of research in order to understand the Russian distribution sector?
2. What kind of channels can be identified in the Russian FMCG distribution system and what are the prominent solutions utilized?
3. What are some of the major implications to the foreign FMCG producers?

The paper is structured as follows. First, we present a concise literature review on marketing and distribution channels related seminal works from the earlier years. Second, we set out to review the literature on distribution in the context of Soviet Union and Russia in order to give a snapshot on the current state of discussion in the academia. Further, based on the authors' 15 years of combined academic and practical experience on the field, we provide a description of the current state of the Russian distribution system, with elaboration on some issues and trends. We supplement and validate this view with an empirical single case study (Yin 1984) on an FCMG company's distribution channel structures currently in operation. In-depth interviews were conducted in the case company's Russian subsidiary in December 2005. Interview reporting was subjected to comments and review by the sources in order to provide the true state of affairs. Finally, managerial implications are discussed in order to provide tools for improved control and efficiency in the market.

## 2. Literature Review

### *Distribution systems and channel structures*

Distribution systems and channel structures have been part of the marketing research for decades. Wilkinson (2001) provides a comprehensive review of the network and channel thinking as part of the marketing research in the 20<sup>th</sup> century. While many disciplines and groups of researchers around the world have contributed to the study of interfirm relationships and networks in marketing channels, we focus on providing a concise review of the few classic writings that emerged in the 1950s through 1970s, and provided the foundation for the current studies in distribution and supply chain management. Alderson developed the marketing thinking in general and with special emphasis on the structures and operations of the marketing channels and functions. His work include considerations on productivity measures in distribution (Alderson 1948), considerations on economic entities and their functions in the marketing channel (Alderson & Cox 1948), treatment of channel transactions and transvections (Alderson & Martin 1965), as well as the introduction of the principle of postponement (Alderson 1950). The presented ideas provided a foundation for research on the distribution issues, and they were indeed further developed and refined during the next decades.

Bucklin (1965) contributed to the field by developing the Aldersonian concept of postponement-speculation that aids in the determination of the appearance of inventories in general and speculative inventories in particular in the distribution channel as a function of distribution cost and delivery time. The principle thus aids in the analysis of channel structures and the role of intermediaries as title-holders. With references to Alderson, McCammon and Little (1965) introduced a systems approach to the study of marketing channels, with such formal characteristics as interrelated components (original sellers, agent middlemen, merchant middlemen, facilitating agencies, influentials, ultimate buyers), mutually acceptable objectives, marketing flows (inventories), open system and the single enterprise as administrator. Mallen (1973) discusses the functional spin-offs of marketing functions as way to understand change in the dimensions of channel structures. Further, Mallen (1970) presents a five-stage model on channel selection and structuring. A number of decisions must be made concerning the channel: for example the issues of directness, selectiveness, types of middlemen included, the number of channels employed, and the degree of

cooperation must be addressed. These decisions that ultimately define the structure of the channel should be made within the framework of four guidelines or objectives: (1) maximize sales, (2) minimize cost, (3) maximize channel goodwill, and (4) maximize channel control. The first two directly and obviously affect the goal of profit maximization, the guidelines 3 and 4 make up the goal of motivation maximization, and together these two goals contribute to the channel's long-run profit maximization (Mallen 1977). Importantly, the channel decisions have direct effect to the achievement of the channel objectives.

In order to complete the picture of the early distribution channel research, we must mention development of certain relevant models, enhancing the understanding of industrial dynamics and physical distribution logistics. The so called Forrester-effect (Forrester 1961), later coined as the bullwhip effect (Lee, Padmanabhan & Whang 1997), contributes to understanding of the importance of information sharing and collaboration in the supply chain in order to reduce demand distortions and amplification. Bowersox (1972) presented a model for the strategic planning of physical distribution systems, and called for the further development in the field towards the integrated physical distribution system design.

The previously mentioned scholars have contributed to the current understanding of distribution channels and supply chains with important theoretical concepts and empirical results. With the implementation of information technologies in the supply chains, many of the decades old concepts have experienced increased relevance to the researchers and practitioners. According to Lambert, Cooper and Bagh (1998), the early marketing channel researchers conceptualized key factors that underline the purposes and designs of marketing channels. The current research agenda is directed towards the study of supply chains and their management (SCM), a more holistic approach with obvious advantages, but the early analysis contributes in three significant ways: (1) the configuration of channel members are considered, (2) the need for channel coordination is considered, and (3) empirical channels are depicted.

Both practically and theoretically oriented tools and models have been presented in the more recent academic literature for the purpose of distribution channel and network design (e.g. Mourits & Evers 1995; Jayaraman 1998; Lalwani, Disney & Naim 2006). For example Neves, Zuurbier and Campomar (2001) introduced a model that provides practical guidelines for channel planning process with a classification of



detailed distribution functions in four flows, namely the product and services flow, communication flow, information flow, and payments and financial flow.

As was considered earlier, it is paramount for international marketers to understand the structure and function of market specific distribution system in order to succeed in their marketing operations. Much of the implementation of for example supply chain innovations depends on the market specific institutions and technologies. For example the Japanese and other Asian distribution systems with intricate structures and functions unknown to many foreign business managers have been elaborated on in terms of research to facilitate foreign entry and operations (Kuribayashi 1991; Min 1996; Luk 1998; Lohtia & Subramaniam 2000; Chung 2001). It has been concluded that the channels of distribution in existence in a specific national market are a result of culture and tradition (Jain 1996), and additionally, we may consider the national distribution system to depend on the existing institutional framework (North 1990). The presented seminal works on the subject provide a good base for the analysis of national distribution systems and their evolution.

#### *Distribution literature on Russia*

It is interesting to consider the case of Russia and the institutional heritage of communism, as we look into the national distribution system. It is most probably the lack of infrastructure and institutions (e.g. Rodnikov 1994) that brought the system to a standstill at the start of the transition period. As Russian economy recovers and reinvents itself, it is worthwhile to examine the distribution sector and channel evolution as it goes hand in hand with the general economic development (e.g. Mallen 1975).

The academic research on our focus subject can roughly be divided into three groups: (1) research targeting Soviet Union era distribution issues, (2) research targeting distribution issues after the launch of the economic transition period in the early 1990s, and (3) research targeting current and up to date post 1998 financial crisis distribution issues. The following Table 2 summarizes the relevant articles in chronological order.

Table 2 Distribution literature on soviet and market economy Russia

Reference	Title	Target era
Ware (1950)	Costs of Distribution in Soviet Domestic Trade	1
Gochberg (1988)	Report on the Food Logistics Delegation to the USSR (June 1987)	1
Huddleston (1993)	Russian Retail Distribution: Structure and Product Procurement	2
Jones (1993)	The Future for Fruit and Vegetable Distribution in Russia	2
Morton (1993)	Food Distribution in Eastern Europe	2
Welsh, Sommer & Birch (1993)	Changing Performance among Russian Retail Workers: Effectively Transferring American Management Techniques	2
Rodnikov (1994)	Logistics in Command and Mixed Economies: The Russian Experience	1 and 2
Taylor (1994)	Problems of Food Supply Logistics in Russia and the CIS	1 and 2
Hisrich (1996)	The Russian Distribution System: Problems for Entrepreneurs and New Venture Entrance	2
Robinson (1997)	Retailing in Eastern Siberia and the Russian Far East: a tale of two cities	2
Robinson (1998)	The role of retailing in the Russian consumer society	2
Huddleston & Good (1999)	Job motivators in Russian and Polish retail firms	2
Menkhaus, Yakunina & Herz (2004)	Food Retailing and Supply Chain Linkages in the Russian Federation	3
Roberts (2005)	Auchan's entry into Russia: prospects and research implications	3
Lorentz, Häkkinen & Hilmola (2006)	Analysis of the Russian retail sector: prospects for cross-border M&A activity	3

It is easily perceivable that the majority share of research has been concentrated on the period between the launch of the transition to market economy and the 1998 financial crisis, which affected the consumer goods sector significantly through inflation and the domestic incumbents' regaining of competitiveness. A notable fact is that only two articles describe the distribution related issues in the post-crisis environment. It is thus considered worthwhile to provide facts on the current state of the Russian distribution system: an important investment target for consumer goods sector foreign companies. In the following we provide brief descriptions on the articles, elaborating on each era in the Russian economic history in turn.

The Soviet Union era in the Russian distribution is covered to some extent by four authors. Ware (1950) provides the earliest description of the soviet distribution system with an analysis of costs. Some problems are discussed with emphasis on the discrepancy in the official claim of low distribution costs versus some of the criticism and empirical realities. Gochberg (1988) presents a report on the US food logistics delegation's tour in the Soviet Union, with special focus on packaged foods distribution and transportation. The major entities and the planning process are described with some of the major conclusions as follows: the soviet distribution and

logistics system is lacking in appropriate technology in comparison to the US system, much of the production system is localized or regionalized, long-haul transportation and finished good warehousing is generally avoided, productivity is low with significant levels of labor intensity, there exists little comprehension of the integrated logistics concepts. Rodnikov (1994) in turn elaborates on the centrally planned or command economy from the logistical perspective. The evolution of the Soviet distribution system is presented, which gives valuable insight into problems of distribution in the 1990s and the present day. Centralized control over economic decisions created the discordance of macro-economic planning and micro-economic management that led to major distortions in the economy. Some of the distortions are listed, namely the hypertrophy of the producer goods and armament industries, excess raw material and work-in-process inventories, and the preference of policy goals over accounting profits and efficiency. The problems of underdeliveries and stock-outs were common in the Soviet industry, and the phenomena are characteristic of the post-Soviet industry as well during the early 1990s. A core lesson from the Soviet command economy experience is the rise of severe distortions from the attempt to centrally plan the logistical functions. Taylor (1994) analyses the structure of Russian food supply systems and identifies major inherited problems in these systems from the soviet times. The specialization of Soviet states in the production of various agricultural products caused disruption in the production and supply of food as the Soviet Union disintegrated into independent states, which attempted to trade but lacked the hard currency to do so. Drastic price increases in some basic food products caused plummeting demand and consequently discontinued production. The Soviet food supply chains were characterized by three major traits: (1) massive scale, (2) centralized control, and (3) lack of competition.

The early 1990s period of economic transition is the most extensively covered era in the distribution literature, with ten relevant articles. Huddleston (1993) gathered early exploratory data on organizational structures and product procurement processes of Russian retail stores. Jones (1993) elaborates on the fruit and vegetable sector and the need for complete remodeling of the distribution system. Significant problems exist in the storage, processing and retailing stages of the channels. New middlemen are needed in order to organize some vital marketing and distribution functions. Morton (1993) compares the distribution systems in Eastern European countries, and concludes that while Russian system is in poor shape, favorably developing incomes

create the demand for consistent supply of high-quality food products. Taylor (1994) describes the various stages of the food supply chain, from production to retailing and their respective problems after the initiation of the market economy in Russia. Logistics management problems starting with lack of understanding of the supply chain concept are elaborated on. Hisrich (1996) proposes a model of the Russian distribution system in transition. The coexistence of market economy and centrally-planned economy principles has the following implications: (1) key to success is establishing good relationships both with suppliers and with customers, (2) lack of availability of capital for company development. In order to overcome distribution system related problems, entrepreneurs need to be flexible at their perimeters, as entering businesses for supplies or services may be required. Robinson (1997, 1998) describes the state of retail distribution in the Russian Far-East with elaboration on various types of entities and their ownership, and further the role of retailing in Russian consumer society. Lastly, Welsh, Sommer and Birch (1993) as well as Huddleston and Good (1999) address the management side of the emerging Russian retail business.

Articles written after the 1998-crisis and touching upon post-crisis issues are few and far apart. Menkhaus, Yakunina and Herz (2004) describe the evolution of the Russian food retailing and supply chain linkages. The recent evolution in the Russian retail sector has enabled the transfer of consumer preferences and buying habit information further upstream in the supply chain. Intermediaries have taken an important role in reducing transaction costs in the Russian food supply system characterized by fragmentation and the need to overcome vast distances. The article describes the current state of food retailing and alternative retail outlet types in one of the Russian million cities, namely Saratov. Suppliers of products to retail outlets are also elaborated on. Individual households have a surprisingly large share as product suppliers in the total Russian level. This quite possibly reflects the still large share of individual vendors, kiosks, and outdoor-markets in the Russian retailing. Vertical integration and ownership based control from large financial industrial groups characterizes the larger producers of food products. The importance of providing fertile ground for retail sector development is highlighted as the preferable policy, as Russia pursues the true consumer society.

Roberts (2005) provides insight to the current and important phenomenon of internationalization in the Russian retail sector, by elaborating on the French retail

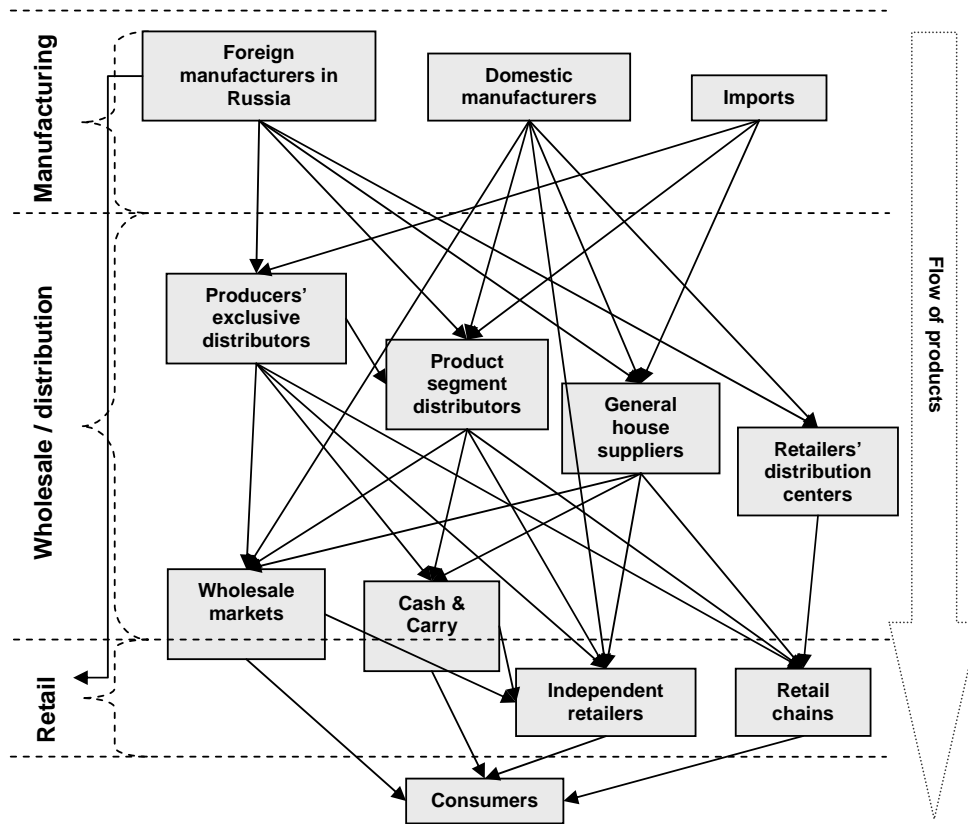
giant's entry to the Russian Market, whose success will depend on the ability to leverage competitive advantages developed in the domestic market. Analysis of the Russian retail landscape is provided with emerging consumption trends, with a special emphasis on the Moscow area. Lorentz, Häkkinen and Hilmola (2006) continue on the internationalization theme by providing a general review of the sector with prospects for M&A activity elaborated on.

### **3. Description of the Russian Consumer Goods Distribution System**

#### *General description*

The underlying reason behind the underdevelopment of distribution structure in the consumer good sector in Russia has been the dominant grey or black economy in the wholesales during the first decade of the new capitalist Russia. It has been estimated that a minimum of 50% of all wholesale operations are cash based and outside official accounting. However, during the last few years, the share of white operations has increased significantly across the whole value chain. Distribution tier is mostly white, and for example the foreign manufacturers in the sector adhere to sales documentation and financial reporting regulations.

The main impact of the grey economy domination during the 1990s on distribution can be geographically divided in to two parts. First, on national level, the evolution and development of national distribution structure has been weak. As a result there have been practically no national distributors having wide geographical coverage through own regional subsidiaries or through a network of local dealers under the distributors' real control. Second, on the city level (e.g. Moscow and St. Petersburg), autonomic and independently functioning distribution structure was not able to evolve in the framework of the grey economy. The retail distributors delivering to retail have been a result of various combinations of producer involvement in the channel. The current development of organized retail chains in Moscow and St. Petersburg should finally shape the structure towards an operating environment, where more controlled distribution can be achieved. The following Figure 1 describes the diversity of actors and the complexity in the Russian consumer good distribution system from the manufacturer's viewpoint.

**Figure 1.** Actors in the Russian consumer good distribution system

The manufacturing tier includes such incumbent aggregates as (1) foreign manufacturers, who have boldly made capital investments in Russia and thus have ongoing manufacturing operations in the country; (2) domestic manufacturers, who are usually small players and in desperate need of restructuring; (3) imports. Naturally there are cases of domestic manufacturers who have streamlined process and adequate finance, such as the leading juice and dairy product manufacturer Wimm-Bill-Dann, and thus are similar to foreign manufacturers in practical terms. We may perceive an increase in domestic and foreign direct investments (FDI) in the FMCG sector and food sector in general, gradually leading to improved operation capabilities and import substitution. The total volume of domestic investments in the food processing were approximately 3.6 billion USD in 2004, while FDI inflows in the same have been around 0.8 to 1 billion USD during 2003-2005 (Rosstat 2006).

The wholesale and distribution tier is probably the most complicated part of the system to comprehend. We have attempted a simple classification of distribution actors as follows: (1) producers' exclusive distributors, who have gained exclusive

distribution deals from manufacturers and can achieve wide coverage in their geographic area of exclusivity (e.g. a suburb, a regional capital); (2) product segment distributors, who concentrate on particular product groups, such as tobacco and beer; (3) general house suppliers, who extended their business to a number of product groups and segments; (4) retailers' distribution centers, which for the sake of emphasis have been included in this tier as they will significantly change the Moscow and St. Petersburg distribution situation in the medium-term. In terms of relationships with manufacturers the most interesting ones are the cases of (1) foreign manufacturer – general house suppliers and (2) the manufacturing tier – retailers' distribution centers. The former is based on traditional long-term relationships especially in the Finnish-Russian trade. The general house suppliers tend to be uncooperative, not customer oriented, and selective in their distribution strategies in spite of producer direction. The distribution centers are the future of distribution in the capital cities of Russia. They will simplify the distribution structure and consequently allow the implementation of modern supply chain practices in the medium-term. Most FMCG companies generate 50% share of total sales from the organized retail trade orders. Important from the foreign actors' point of view is that imports cannot be directed to these centers as they require lengthy customs procedures coupled with warehousing.

Purely wholesale intermediaries are the (1) wholesale markets, who have dominated the wholesale business for over a decade, (2) and the recently appeared cash and carry operations of some foreign companies (e.g. Metro) and a few domestic ones (e.g. Lenta). Wholesale markets are mainly outdoor complexes with entrepreneurial selling from containers both to consumers and independent store entrepreneurs alike. The cash and carry operations should by definition act as the suppliers of organizations but in reality fail to adhere to this regulation. The current unclear role and involvement in the retail tier of the wholesale function influences negatively the development of the modern retailing.

The retail tier consists of numerous entities from street vendors to multinational retail chains. Under the heading independent retailers we have included kiosks, outdoor markets, soviet style general stores (universam) and specialty stores. In contrast to these independent retailers, the retail chains operate numerous outlets and strive towards city-wide or even national coverage. These two distinctive segments of the retail sector have been popularized as uncivilized and civilized retailing respectively by the local business media. In addition to the already discussed issue of

retail chains' distribution centers, we must elaborate on the remaining two direct distribution channels bypassing the distribution/wholesale tier. Firstly, we see domestic manufacturers dealing directly with some independent retailers. This is a typical unconventional mode of operating, where a vendor appears to the factory in his van and requests goods against cash payment. On the other hand we have the example of Coca-Cola employing a sizeable sales-force with capability of making direct deliveries to the diversity of the entire retail tier. This operation method is immensely costly but facilitates impressive coverage and control.

### *Issues and trends*

Perhaps the single most discussed question among brand builders in Russia has been how to organize sales, delivery, and shelving, i.e. distribution in a constant, cost-efficient and qualitative way, in order to cover the entire retail sector in for example a city level. The core of this problem has been the distributor's role, now and in the further development of the distribution function. Especially problematic this key-question is with the independent retail outlets, which still compose the majority of the retail base. Regarding logistics, the most critical issue is the overcrowded Moscow and St. Petersburg, where mere logistic costs may exceed 20% for low value products when a distribution level of 50% is being targeted (approximately 5000 outlets). The costs of the retail sales force may reach more or less the same level. Consequently logistics is becoming the main source of competitive advantage in the Russian distribution. As the distributors' role is being second-guessed by the manufacturers and retailers, focusing on logistics in their services the distributors are effectively becoming third party logistics service providers. Some retailers still prefer to employ distributors in their sourcing as they are not prepared to handle the plethora of manufacturers.

In the end of 1990s, emerging Moscow based independently operating retail distributors charged 30-40% mark-up for the delivery and sales on credit of western branded products. Today this non subvented mark-up is closer to 25%. The operations of independent distributors' however cover only the most attractive outlets, i.e. chains and the top 500 shops in Moscow, and the fastest moving premium products; a combination that allows a substantial price difference to city markets. Most of the smaller outlets are price sensitive and mainly work with the smaller middle-men that function between wholesale markets and shops. In some cases the shop keepers



purchase directly from the wholesale markets. This kind of arrangement for the supply of products naturally cannot satisfy brand-producers' key requirements of constant, stable and high quality availability.

Under these circumstances, the local distributors have had limited possibilities to expand their operations to cover retail in a sufficient manner that would satisfy the producers. Producers have thus been forced to invest heavily into the distribution of their products in order to achieve their strategic targets for distribution coverage. Closing the considerable price difference to wholesale markets has been the starting point of organized retail distribution. After 12-13 years of development and evolution, a variety of channel designs for retail distribution are evident in Moscow and St. Petersburg, and additionally, in many regional cities. The emergence of retail chains in the capitals and the development of their distribution centers offer improved ability to solve the logistics related problems in the sector. One of the main issues for consumer good manufacturers in Russia becomes the implementation of key account channel structures that enable the increased control of product flows and brands in the market. Increased control implies greater visibility in the chain and consequent improvement in operations in general.

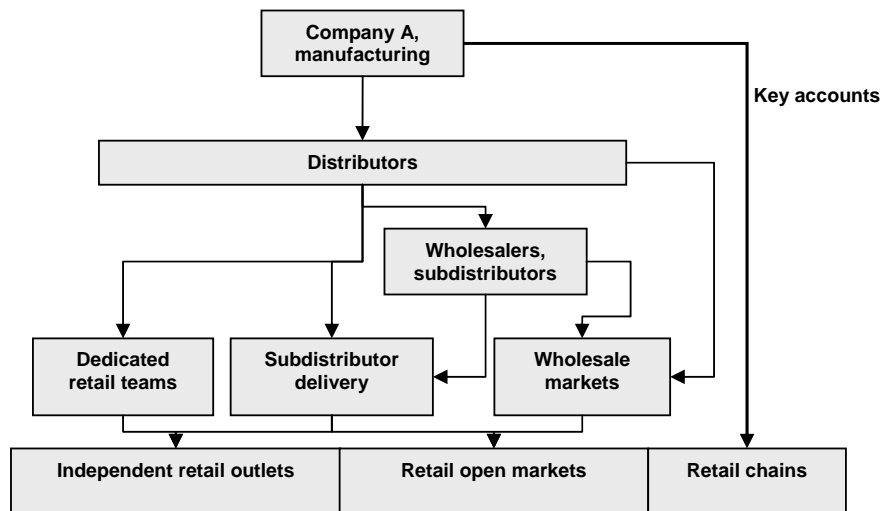
#### **4. FMCG Distribution Channels in Russia: Company Case**

The following empirical part will presents a company case from the Russian FMCG sector. The case company is foreign owned and managed, a fact that gives us interesting opportunity to view the attempts of striving towards western style operations in a business environment where the marketing institutions and employed technologies diverge significantly from salient industry best-practices elsewhere.

The case company, hereafter company A, is the subsidiary of an international confectionary manufacturer with a factory located in St. Petersburg and distribution operations in Moscow, St. Petersburg and other major population centers all over Russia. In 2004 the Russian subsidiary generated sales revenue around 20 million USD. The parent company has experienced rapid internationalization since 1995, with the establishment of factories in 8 countries by the end of the millennium. Three people were interviewed in the company A: the CEO; regional sales manager; and the demand, supply and production planner.

The company distribution and sales operations are organized into ten business units, namely National key accounts, Moscow, North-West, Central, Volga, South, Urals, Siberia & Far-East, Ukraine and other CIS Exports. Company's warehouse facilities in Russia are located in Moscow and St. Petersburg as well as consignment warehouses in Saratov, Tula, and in Kiev and Dnepropetrovsk in Ukraine. In terms of distribution the challenges and problems are different in Moscow and St. Petersburg in comparison to the other regions and major cities. In our analysis, we will mainly concentrate on the previously mentioned two major cities due to their relative importance in the Russian economy and simply due to the limitations in space. The general distribution scheme of company A, utilized in Russia, is depicted in Figure 2.

**Figure 2.** General distribution scheme in Company A



The distribution situation in the company A is a complicated one, but aimed towards as wide as possible coverage of the diverse Russian retail landscape. We can discern the complexity required in order to reach high coverage levels. Distributors deal with the variety in the traditional retail tier, by utilizing wholesalers, subdistributors or internal dedicated sales teams, which will be trained and supported by manufacturer and will be dedicated on selling the manufacturer's products. The company A cooperates with four major distributors in St. Petersburg, with separate nine exclusive distributors covering regional cities in the North-West Russia. In Moscow the seven company employed distributors are organized either as wholesale direct –distributors, with regional subdistributors, or retail direct –distributors in order

to better respond to the structural differences in these markets, as will be demonstrated below.

The dedicated sales force -channel is relatively extensive in St. Petersburg (50% of sales), but less in Moscow (8% of sales), due to the large share of even more efficient key accounts in the capital. The wholesale channel with various middlemen and diverse sales locations offers the least amount of control for the producers in terms of brands and shelving. The St. Petersburg wholesale channel accounts for only 13% of sales, while the corresponding figure in Moscow is 21%.

The most interesting channel in the future may be the key-accounts with direct deliveries, which in the St. Petersburg take up a 22% share of sales, and in Moscow a major share of 38%. The key-accounts (1) offer an opportunity for direct cooperation with the retail customers, (2) allow improved business profitability, but (3) are not without problems entirely. In general, the current Russian business culture does not support cooperative and trusting business relationships in the supply chain. Thus, for example POS data is generally not shared with the supply chain members. In some cases, the direct deliveries with the company-owned truck fleet run into problems at the key-accounts' terminals, as the tightly scheduled deliveries are not supported with adequate capacity, leading to hours-long delays. In cases of delivery deficiencies on the part of the supplier, demands are made for delivery fines. Thus key-accounts may imply hidden distribution costs that affect channel profitability estimations. On the other hand, some emerging retail chains have established very effective logistics operations and employ sophisticated methods in their business. Table 3 summarizes the utilized distribution channels in five separate geographical areas in terms of volume.

**Table 3.** Utilized distribution channels with shares of sales volume (%)

	<i>Direct KA:s<sup>1</sup></i>	<i>Dedicated sales forces</i>	<i>Wholesale</i>	<i>Other retail: distributor SF<sup>2</sup></i>	<i>Other retail: own SF</i>	
Moscow	38%	7%	21%	26%	8%	100%
St. Petersburg	22%	6%	13%	9%	50%	100%
Rest of Russia	-	35%	21%	21%	23%	100%
Ukraine	18%	33%	13%	28%	8%	100%
Other CIS	-	10%	10%	80%	-	100%

It is evident that direct deliveries to key accounts (distribution centers or outlets) dominate in Moscow and St. Petersburg, while the distributors have a more

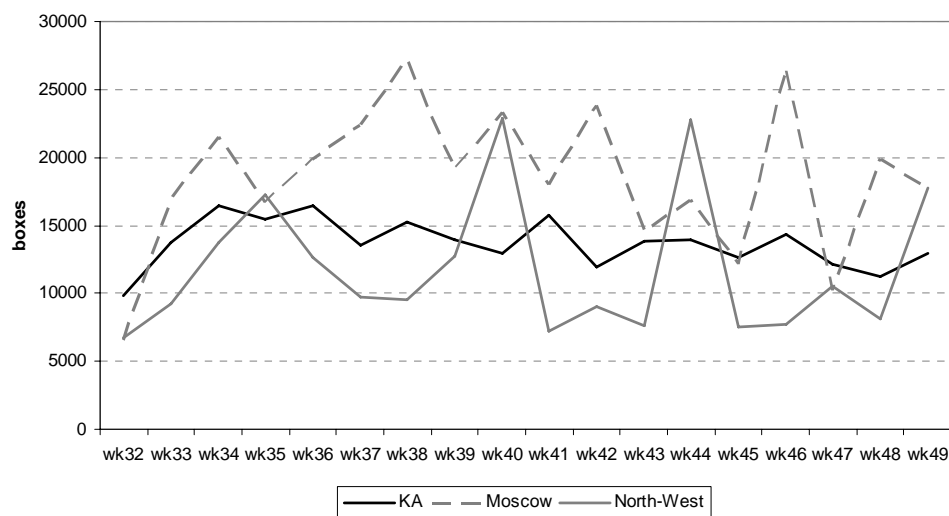
<sup>1</sup> KA: Key Account

<sup>2</sup> SF: Sales Force

pronounced role in the regions of Russia. This fact reflects the so far divergent state of distribution development in Russia and Ukraine. Other CIS country markets are served through importers.

While there is no clear position in the company on whether direct distribution to key-accounts is the most profitable channel, we may receive additional insight by examining the case company's sales dynamics per utilized channel. The reporting period is 18 weeks long with aggregated sales of boxes reported per week (Figure 3).

**Figure 3** Sales dynamics in the case company



The standard deviation for the key account sales is 1768 boxes, while the same indicator for other channels' sales in Moscow and in North-West Russia is 206% (5410 boxes) and 192% (5156 boxes) greater. It seems that the key-accounts with more direct distribution channel offer less varying sales patterns, indicating an improved interface with the actual consumer demand. It is evident from the previous considerations that still the majority of sales flows through the distributors. In this difficult operating environment the case company achieves low forecast accuracy: share of cases when weekly sales forecast stays inside the company goal of  $\pm 20\%$  deviation is 51% for national key-accounts, 11% for Moscow and 13% for North-West. These figures imply further problems to operations planning.

## 5. Summary and Conclusions

The emerging markets of Europe are seen as increasingly attractive markets for foreign expansion in the retail sector. The consequent development of the distribution sector improves the prospects for introduction of supply chain management practices and furthermore: increasingly efficient logistics operations in the FMCG sector.

The early research conducted on the marketing channels during the 1950s through 1970s provided a good foundation for distribution channel and system research, with main emphasis being on the channel design issues. The current research agenda is directed towards the management of whole supply chains, with emphasis on integration of processes, systems and the overall management. There exists a scarce literature on the logistics and distribution specifically elaborating on the Russian issues. Dividing the existing work by eras (soviet, early transition, after 1998 crisis), we may perceive that the majority of the articles concentrate on the early transition period. However, the distribution and supply chain management still continues to be an issue of vital importance in the emerging consumer market of Russia, where foreign companies in increasing degree struggle to cope with market specific challenges.

A description was provided on the Russian FMCG distribution system in general. The underlying reason behind the underdevelopment of distribution structure in the consumer good sector in Russia has been the dominant grey or black economy in the wholesales during the whole period of the new capitalist Russia. As a consequent the distribution system has lacked the incentive to develop and restructure properly, and in a way that would support the development of direct distribution channels. As a result a plethora of middle men of various types exist, making the navigation of distribution design for companies difficult. With the emergence of the modern retail sector with distribution centers in the urban Russia, opportunities for proper supply chain integration are starting to appear. Often the companies are forced to implement dual strategies in order to cover entire cities and to reach large enough sales volumes: the modern retailers (key accounts) and the distributor-wholesale channels are utilized at the same time. The emergence of retail chains in the capitals and the development of their distribution centers solve the logistics problem effectively. Simultaneously however, a new business problem is arising: who will now control the attractive key accounts, the producer or the distributor. The main issue for consumer good

manufacturers in Russia thus becomes the implementation of key account channel structures that enable the increased control of product flows and brands in the market. Increased control implies greater visibility in the chain and consequent improvement in operations in general.

Finally, a case study on foreign FMCG manufacturer's distribution operations was presented. The dual strategy in distribution was highlighted by the results, a requirement for large enough coverage of target markets. The higher level of development in terms of modern retail business in Moscow and St. Petersburg areas was evident. In terms of operations management, it was clear that the key accounts offer improved framework for forecasting demand as the sales dynamics are more stable and predictable. Distribution through middlemen distorts the demand information visible at the manufacturer, making forecasting and operations planning difficult. While it seems obvious that the dealings with retail chains and their distribution centers would offer a more cost effective way of distribution in every sense (including brand management), manufacturers in general are worried about the increasing bargaining power of the retail sector, which is evident in discount demands and other terms of trade (shelf rents, delivery scheduling, incomplete delivery fines). The future will show whether cooperation in the FMCG supply chains is initiated in large degree.

Further research is required in the distribution, supply chain management, logistics issues in the specific context of Russia. The developing business environment requires constant monitoring and proactive stance in the supply chain strategy development. In addition with the demand side, the FMCG manufacturers are concerned on the availability of quality raw materials and wide enough supply-base (supply side). These issues are paramount especially in the perishable food products sector. In general, the contextual issues in implementing SCM processes and systems are the general technological and institutional developments pertaining to SCM as well as their level of diffusion in the agribusiness/FMCG sector. The opportunities and strategies for cooperation and operations integration should be targeted thorough academic inquiry.

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## References

- Alderson, Wroe (1948) A Formula for Measuring Productivity in Distribution. *Journal of Marketing*, April, 12, 442-448.
- Alderson, Wroe – Cox, Reavis (1948) Towards a Theory of Marketing. *Journal of Marketing*, October, 13, 137-152.
- Alderson, Wroe. (1950) Marketing Efficiency and the Principle of Postponement. *Cost and Profit Outlook*, 3, 424.
- Alderson, Wroe – Martin, Miles W. (1965) Toward a Formal Theory of Transactions and Transvections. *Journal of Marketing Research*, May, 2, 117-127.
- A.T. Kearney (2005) *Emerging Market Priorities for Global Retailers – The 2005 Global Retail Development Index*.
- Bowersox, Donald J. (1972) Planning Physical Distribution Operations With Dynamic Simulation. *Journal of Marketing*, January, 36, 17-25.
- Bucklin, L.P. (1965) Postponement, speculation and the structure of distribution channels. *Journal of Marketing Research*, February, 26-31.
- Chung, Henry F.L. (2001) An analysis of Taiwan's distribution system. *International Journal of Retail & Distribution Management*, Vol. 29, No. 2, 87-98.
- Forrester, Jay W. (1961) *Industrial Dynamics*, MIT Press, Cambridge (MA).
- Gochberg, Howard S. (1988) Report On The Food Logistics Delegation To The USSR (June 1987). *Journal of Business Logistics*, Vol. 9, No. 1, 118-125.
- Hisrich, Robert D. (1996) The Russian Distribution system: Problems for Entrepreneurs and Venture Entrance. *Management Research News*, Vol. 19, No. 8, 1-18.
- Huddleston, Patricia (1993) Russian Retail Distribution: Structure and Product Procurement. *International Journal of Retail & Distribution Management*, Vol. 21, No. 4.
- Huddleston, Patricia – Good, Linda K. (1999) Job motivators in Russian and Polish retail firms. *International Journal of Retail & Distribution Management*, Vol. 27, No. 9, 383-297.
- Jain, S.C. (1996) *International Marketing Management (5<sup>th</sup> ed.)*, South-Western College Publishing, Cincinnati, OH.
- Jayaraman, Vaidyanathan (1998) Transportation, facility location and inventory issues in distribution network design. *International Journal of Operations & Production Management*, Vol. 18, No. 5, 471-494.
- Jones, Stephen (1993) The Future for Fruit and Vegetable Distribution in Russia. *British Food Journal*, Vol. 95, No. 7.
- Keegan, Warren J. (1999) *Global Marketing Management, 6<sup>th</sup> ed.*, Prentice-Hall, Upper Saddle, NJ, USA.
- Kuribayashi, Sei (1991) Present situation and future prospect of Japan's distribution system. *Japan and the World Economy*, Vol. 3, No. 1, 39-60.
- Lalwani, C.S. – Disney, S.M. – Naim, M.M. (2006) On assessing the sensitivity to uncertainty in distribution network design. *Journal of Physical Distribution & Logistics Management*, Vol. 36, No. 1, 5-21.
- Lambert, Douglas M. – Cooper, Martha C. – Bagh, James D. (1998) Supply Chain Management: Implementation Issues and Research Opportunities. *The International Journal of Logistics Management*, Vol. 9, No. 2, 1-19.
- Lee, Hau L. – Padmanabhan V. – Whang, Seungjin (1997) Information Distortion in a Supply Chain: The Bullwhip Effect. *Management Science*, Vol. 43, No. 4, 546-558.
- Lohtia, Ritu – Subramaniam, Ramesh (2000) Structural transformation of the Japanese retail distribution system. *Journal of Business & Industrial Marketing*, Vol. 15, No. 5, 323-339.
- Lorentz, H – Häkkinen, L – Hilmola, O (2006) Analysis of the Russian retail sector: prospects for cross-border M&A activity. *Baltic Journal of Management*, Vol. 1, No. 2, 148-168.
- Luk, Sherriff T.K. (1998) Structural changes in China's distribution system. *International Journal of Physical Distribution & Logistics Management*, Vol. 28, No. 1, 44-67.

- Mallen, Bruce (1970) Selecting channels of distribution: a multi-stage process. *International Journal of Physical Distribution*, Vol. 1, No. 1, 50-56.
- Mallen, Bruce (1973) Functional Spin-Off: A Key to Anticipating Change in Distribution Structure. *Journal of Marketing*, July, 37, 18-25.
- Mallen, Bruce (1975) Marketing channels and economic development: a literature review. *International Journal of Physical Distribution*, Vol. 5, No. 5, 230-237.
- Mallen, Bruce (1977) *Principles of Marketing Channel Management – Interorganizational Distribution Design and Relations*. Lexington Books, USA.
- McCammon Jr., Bert C. – Little R.W. (1965) Marketing Channels: Analytical Systems and Approaches. In George Schwartz, ed. *Science in Marketing*. New York: Wiley, 75-81.
- McKinsey Quarterly (1995) *The Russian Consumer Revolution*, No. 2.
- Menkhaus, D.J. – Yakunina, A.V. – Herz, P.J. (2004) Food Retailing and Supply Chain Linkages in the Russian Federation. *Journal of East-West Business*, Vol. 10, No. 3, 53-73.
- Min, Hokey (1996) Distribution channels in Japan – Challenges and opportunities for the Japanese market entry. *International Journal of Physical Distribution & Logistics Management*, Vol. 26, No. 10, 22-35.
- Morton, Catherine (1993) Food Distribution in Eastern Europe. *British Food Journal*, Vol. 95, No. 7.
- Mourits, Marcel – Evers, Joseph J.M. (1995) Distribution network design – An integrated planning support framework. *International Journal of Physical Distribution & Logistics Management*, Vol. 25, No. 5, 43-57.
- Neves, Marcos Fava – Zuurbier, Peter – Campomar, Marcos Cortez (2001) A model for the distribution channels planning process. *Journal of Business & Industrial marketing*, Vol. 16, No. 7, 518-539.
- North, Douglass C. (1990) *Institutions, Institutional Change and Economic Performance*, Cambridge University Press, USA.
- Roberts, Graham H. (2005) Auchan's entry into Russia: prospects and research implications. *International Journal of Retail & Distribution Management*, Vol. 33, No. 1, 49-68.
- Robinson, Terry (1997) Retailing in Eastern Siberia and the Russian Far East: a tale of two cities. *International Journal of Retail & Distribution Management*, Vol. 25, No. 9, 301-308.
- Robinson, Terry (1998) The role of retailing in the Russian consumer society. *European Business Review*, Vol. 98, No. 5, 276-281.
- Rodnikov, Andrei N. (1994) Logistics in Command and Mixed Economies: The Russian Experience. *International Journal of Physical Distribution & Logistics Management*, Vol. 24, No. 2, 4-14
- Rosstat (2006) <http://www.gks.ru/wps/portal>
- Stern, L.W. – El-Ansary, A.I. (1992) *Marketing Channels*, 4<sup>th</sup> ed., Prentice-Hall, Englewood Cliffs, NJ, USA.
- Taylor, David H. (1994) Problems of Food Supply in Russia and the CIS. *International Journal of Physical Distribution & Logistics Management*, Vol. 24, No. 2, 15-22.
- Ware, Henry H. (1950) Costs of Distribution in Soviet Domestic Trade. *Journal of Marketing*, Vol. 15, No. 1, 21-32.
- Welsh, Dianne H.B. – Sommer, Steven M. – Birch, Nancy (1993) Changing Performance among Russian Retail Workers: Effectively Transferring American Management Techniques. *Journal of Organizational Change Management*, Vol. 6, No. 2.
- Wilkinson, Ian (2001) A History of Network and Channel Thinking in Marketing in the 20th Century. *Australasian Marketing Journal*, Vol. 9, No. 2, 23-52.
- Yin, Robert K. (1984) *Case Study Research – Design and Methods*. Sage Publications, USA.





## Expansion of Container Traffic from Asia to the EU

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### Abstract

There has been a tremendous increase in the volumes of container traffic between Asia and the EU. The vast majority of this traffic is carried via all water routes. Another possibility would be to use intermodal landbridge services using either Russia or North America as landbridges between Asia and the EU. This could potentially lead to much faster transit times for this container traffic. During the peak of the Soviet era the Trans Siberian Container Service [TSCS] carried as much as 11-13% of the containers between Asia and the EU [consisting of 15 countries]. Current estimates are that only 1-2% of this container traffic moves via the TSCS.

Furthermore the EU has proposed the expansion of rail networks and has proposed many corridors to encourage the increased use of rail services via the Trans European and Pan European Networks and has projected the costs of these expanded networks in the Transportation Infrastructure Needs Assessment [TINA] studies. Advantages of increased rail usage include faster transit times vis-à-vis all water routes, less environmental damage and congestion vis-à-vis motor carriage and conservation of fuel.

Key questions and issues related to the use of Russia as a landbridge for container traffic between Asia and the EU will be discussed in this paper.

**Keywords:** Trans-Siberian Railroad, Trans-Siberian Container Service (TSCS), Landbridge, Asia, Europe container traffic, EU Railroads, Russian Railways

### 1. Introduction and background

There has been a tremendous increase in the volumes of container traffic between Asia and the European Union (EU) as consumers in the EU continue to purchase increasing quantities and types of goods manufactured in Asia at relatively low costs. The vast majority of these goods are transported by vessels on all-water routes. These all-water routes lengthen the supply chain and can take up to forty days. In addition in-transit inventory costs are quite high.

An alternative method of transport between Asia and Europe would be to use intermodal transportation via landbridges between Asia and Europe. One such landbridge routing utilizes the North American Continent as a “bridge” between Asia and Europe. For example a shipment would go from Hong Kong to Seattle (or Vancouver) by sea. The containers would then move by intermodal double stack trains to an east coast port such as Boston (or Halifax). The containers would then be

reloaded aboard another vessel for the final leg between Boston (or Halifax) and Rotterdam. This landbridge service could be considerably faster than the all-water alternative. (JSC Railways, 1999)

Historically the Trans-Siberian Container Service (TSCS) was an alternative to the North American landbridge for traffic between Asia and Europe. At one time it carried over eleven percent of container traffic in this market (Bergstrand et. al., 1987). This was at the height of the Soviet Union when railroads were the prime mode of transport. Today the TSCS carries only about one or two percent of the volumes due to inconsistent levels of service on this routing. The TSCS carried about 67,000 containers on this route in 2003 (Fadayevev, 2004). Estimates for an increase to 150,000 containers in 2005 were made due to an agreement between Russian Railways and Vladivostok based FESCO (Far East Shipping Company; Pronina, 2004). Another forecast predicted the movement of 300,000 TEUs within five years, i.e. by 2009 (Fadayevev, 2004). The most optimistic prediction for the long run was to develop this trade to one million containers per year. (Wagstyl, 2006)

## **2. Capacity of the TSCS network**

A closely related issue is whether there is an adequate supply of containers for these anticipated volumes of traffic as well as the necessary number of rail container wagons ( 24 meter platforms; Ma, 2005 and Maternovsky, 2004). Some shippers and forwarders in Japan and other Asian countries have had to provide their own containers for the intermodal services in direct contrast to shiplines which provide adequate numbers of containers to shippers and forwarders using their all-water routes. Finnish Railways (VR) has agreed to provide some containers in a joint venture with Transcontainer. (VR News, 2006). Efforts are also being made to enter a similar contract with the German Railways (DB) (The Economic Research Institute for N.E. Asia, 2004). Additionally a proposal for a joint venture between Russian Railways and FESCO to provide 40,000 TEUs and 10,000 rail platforms has been made (Maternovsky,2004). This will require borrowing up to 45 million dollars (Pronina, 2004).

If the TSCS were restored to a consistently high quality service it would be a much preferred landbridge service to the North American alternative. The TSCS

routing involves much shorter sea legs and would be much faster than the North American route. In an effort to promote the Russian landbridge representatives from the Russian Railways Ministry (now Russian Railways), The Community of European Railways (CER), and North American railroads met in 1998 to discuss the merits of using the TSCS landbridge.

### **3. TSCS Demonstration Project**

As a result of the aforementioned meeting a demonstration journey was made on the Nachodka-Moscow-Brest container express routing from 16-25 April, 1998. The trip covered over 10,500 km and took slightly less than nine days. An average speed of over 50 km/hr was achieved which is very good for rail freight services in the EU (Lewis et al., 2001-2002, Deutsche Bahn, 1999). If such a high quality of service could be provided on a routine basis it would divert considerable volumes of containers from the traditional all-water routes. If this occurred it would generate significant revenues for the Russian Railways as it would be derived from traffic volumes that normally would not move via Russian Railways or Russian shiplines. Additionally it would hasten the integration of the Russian Railways network with the Pan-European (rail) corridors of the EU. (Lewis et al., 2001-2002; Deutsche Bahn, 1999).

### **4. Impediments to the use of the TSCS**

Until recently there has been resistance by some shippers and forwarders to the use of the Russian landbridge. A recent master's thesis at Maastricht University in the Netherlands provides an excellent summary of the major reasons why there is still some reluctance to using the TSCS (Yarema, 2002). The thesis was based on questionnaires sent to business managers, politicians and railway officials from five countries (Belgium, Germany, Netherlands, Russia and Ukraine). In some cases follow-up interviews were also held with respondents to the survey.

The first major category of impediments was termed political impediments. These included excessive bureaucracy, paperwork and governmental controls; conflicts of interest between various government and railway institutions, political instability, lack

of governmental controls and a rigorous legal system; corruption , bribery and the existence of organized crime; and the occurrence of strikes on the rail system.

All of these factors could lead to delays in shipments and lack of security /safety for cargoes being transported (Yarema, 2002, pp.9-14). A second category of impediments was considered financial impediments. These included insufficient funding by the government, subsidization of unprofitable passenger services by the profitable freight services, and lack of foreign direct investments (FDI) due to the perception of high financial risks. One major result of the financial issues would be the inability to provide adequate quantities of rolling stock and proper maintenance of the right of ways. (Yarema, 2002, pp.14-19)

A third category of impediments was technical impediments. These included international railway standards such as track gauges, speed limits, train lengths; the availability of wagons and container platforms; information systems that would provide capabilities for the tracking and tracing of shipments; problems caused by the harsh weather conditions and extremes; and bottlenecks at terminals. (Yarema, 2002. pp. 19-24; see also Otsuka, 2000 & Orlov, 2001)

A final issue dealt with the inadequate training of personnel, especially in the areas of customer service and marketing. Many employees are not familiar with the high levels of customer service that are demanded by Asian and EU customers. (Yarema, 2002, p 24.)

Therefore it becomes crucial that these negative perceptions and attitudes of service quality in the Russian Railways system must be changed in order to gain more acceptance by the demands of shippers and forwarders. (Duthy, 1998)

## **5. The Trans Siberian Express Service (TSES)**

One step that was taken to address the concerns of potential users of the Trans-Siberian rail services was a 50%-50% partnership between the former Railways Ministry and the CSX Sealand Corporation from the United States. As a result the Trans Siberian Express Service (TSES) was established. The intent of this program was to combine the expertise of CSX Sealand and Russian Railways managers to provide a very high quality and consistent land bridge service that would appeal to Asian and EU shippers.

In one sense the TSES was a direct competitor of the TSCS. An argument can be made that the existence of a competitor could increase the quality of service and perhaps lead to a reduced price.

When the TSES was first begun its director was from CSX Sealand and the deputy director was from the Russian Railways Ministry. These positions were to be reversed after three years. CSX Sealand provided managers, technical expertise and access to information systems, port facilities and equipment and other in-kind assets. They were reluctant to invest a lot of cash into the program. The Russian Railways Ministry provided managers, wagons, locomotives and of course, the rail right-of-way.

Unfortunately problems developed in this partnership. A major issue was dissension in the management team. The Russian deputy director thought that he should be director and the American the deputy director. This led to frictions in the organization and a lack of teamwork and trust among managers. As a result it became more difficult to attract traffic. Additionally global market conditions changes led to excess capacity of container slots and the resultant lowering of container rates in the Asian markets.

Therefore landbridge traffic growth was slow and much of the traffic was bilateral traffic to/from the former Central Asia Republics. (The above information is based on confidential interviews with CSX Sealand managers in Jacksonville, FL. in November, 2002.) Finally another major “shock” took place when Maersk Lines bought Sealand from CSX. (Maersk Lines brochure, 2000).

## **6. Potential of the Korean Peninsula Rail Links**

One final consideration is the possibility of linking the rail system of South Korea to that of North Korea to join up with the Trans Siberian network. This would have the advantage of a very fast all-surface route for goods manufactured in South and North Korea and an extremely short sea leg for Japanese goods. South Korea has promoted this effort as part of its reunification plan and would be the primary source of funding to upgrade the North Korean rail system to international standards. This would be an extremely costly project and there would be high degrees of financial and political risks. Despite such risks Hyundai Corporation has been willing to fund the construction of the rail line through the demilitarized zone (DMZ) into a North

Korean industrial just across the border (Asia Times, 2001, Nesirky, 2002). Plans were made to begin test runs in May, 2006 (Financial Times, May 15, 2006). However these plans were abruptly cancelled by North Korea on May 24, 2006 (Financial Times, May 25, 2006). Only time will tell if this network will become a reality.

Based on the above there are four key research questions to ask. Hopefully some insights and answers can be gleaned at the conference.

*Research Question 1* — What is the potential of the TSCS to regain a large share of the container traffic between Asia and the EU? This includes a discussion of the reliability and safety of using the TSCS. Does the Russian Railways system have sufficient capacity and equipment (eg. container rail wagons) to carry the very large volumes that mega container ships would discharge at the ports?

*Research Question 2* – What has happened to service standards on TSCS after the demonstration project that was conducted in 1998? Has there been any follow through after the successful demonstration project?

*Research Question 3* — What is the current status of the TSES? Has this service been fully implemented by Maersk Lines after it purchased SeaLand? What is the current management process and organization? Does it compete directly with TSCS?

*Research Question 4* — What are the prospects for the development of the rail link through the Korean Peninsula to join up with the Trans Siberian rail line? Is it realistic to think that this is a feasible alternative?

## References

- Bergstrand, S. & Rigas Doganis (1987). *The Impact of Soviet Shipping*. London: Allen & Unwin, pp. 81-87.
- Duthy, J. (1998). Russian Reforms Herald New Era in Railfreight. *Lloyd's Freight Transport Buyer*, July/August, p.8.
- Fadayev, G. (2004). Container Landbridge will assure RZD's future prosperity. *Railway Gazette International*, 160:3, pp. 148-149.
- Koreas to open border to trains (2006). Financial Times, April 15, p.3.

- Lewis, I. & Janjaap Semeijn & David B. Vellenga (2001-2002). Issues and Initiatives Surrounding Rail Freight Transportation in Europe. *Transportation Journal*, 41: 2&3, pp.23-31.
- Ma, S. (2005). Interview with Dr. Ma, Vice President of Academic Affairs, *World Maritime University*, Malmo, Sweden, May 4, 2005
- Maternovsky, D. (2004). Shipping Giant Hires Frankov's Son. *The Moscow Times*.
- Nesirky, M. (2002). Trans-Siberian Link Attracts North Korea. *The St. Petersburg Times*, 36:770, May 21, p.7.
- Orlov, L. (2001). *Trans-Siberian Railway Gains Ground on Shipping*. Moscow Consultant.
- Otsuka, S. (2000). Central Asia's Rail Network and the Eurasian Land Bridge. *Transport News*.
- Pronina, L. (2004). Cargo Volumes to Increase on Trans-Siberian Route. *The St. Petersburg Times*.
- Pyongyang Cancels North-South trains (2006). *Financial Times*, May 25, p.4.
- Russia Seeks to Link Korean Railway with Trans-Siberian (2001). *Asia Times*.
- The Issues and Prospects for Transit Freight Using Ports of the Russian Far East (2004). *The Economic Research Institute for N.E. Asia*.
- The Pan-European Traffic Networks-An Opportunity for Europe's Railways* ( 1999). 2<sup>nd</sup> edition, July, Deutsche Bahn A.G. International Relations Office.
- The shortest distance through Russia and Central Asia* (2000). Maersk Sealand promotional brochure, Copenhagen, Denmark, July.
- Trans Siberian Trunk Railway (1999). JSC Railways.
- VR and Transcontainer Establish Joint Venture for Eastern Container Services (2006). VR ( Finnish Railways) News, March, 28.
- Wagstyl, S. (2006). Russian Railways Chief plans to sell off stakes in subsidiaries. *Financial Times*, April,25 , p.2
- Yarema, T. (2002). *The Integration of the Trans-Siberian Railway to EU Railways Network: Issues and Problems*. Graduate Thesis, University of Maastricht, The Netherlands.

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## European Railway Passenger Transports – Efficiency and Partial Productivity Analysis from Period of 1980-1999

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### Abstract

Railway transportation in European perspective is in the state of change, due to the reason that competition is free for market forces from the beginning of 2007. Demand growth has been modest for this mode in passenger transports, and market share has been lost within longer period to air and road. Therefore, we need to know more about comparative efficiency and productivity development of this sector, in order to understand the current status and magnitude of about to happen restructuring changes. Data Envelopment Analysis (DEA) is used to analyze efficiency in different European countries throughout longitudinal observation period of 1980 to 1999. We also use partial productivity analysis to support DEA evaluation.

Based on DEA evaluation, we find that basically three different countries establish frontier sustaining for two decades (Netherlands, Portugal and Denmark), and the rest of the observed countries are seriously lacking behind them. Interestingly, productivity in this sector has not developed favorably in 20 year perspective, and we could expect it to improve in the near future considerably. As a further question it reminds that whether passenger transports could exist in all European countries, and will they be integrated into freight transports at all. Or will European railways in future include countries, where there exist only railway freight or passenger operators?

**Keywords:** Railways, passenger transports, Europe, efficiency, DEA

### 1. Introduction

Public sector, and especially its transportation operations, is in the state of change – sea ports are in the curriculum to be privatized, and even local busses are operated through competitive bids via private sector companies. Also railways have experienced or are going to be facing similar development; from the beginning of year 2007 railways should be under free competition in the whole EU region. Despite this significant change in this industry going to appear, there exist only small number of research related to the competitiveness, productivity and efficiency of European railways (Christopoulos, Loizides & Tsionas 2001; Jorge & Suarez 2003). Deregulation and privatization process in railway freight market will most probably be less problematic as compared to passenger transports, since latter railway business sector has been heavily subsidized by local governments or transnational organizations (like EU, UN and World Bank). Efficiency of passenger transport sector

plays a vital role in the near future changes, despite that profitability of any for-profit company depends greatly in the changes of prices of inputs and outputs as well as on its innovativeness. However, it should be reminded that private sector could make profits with pure price increases, but its sustainability would be questionable in the longer term. On good example is Estonian railways in Russian transit transports (mostly oil); their efficiency of freight transports due to relatively small railway operations is top of the class in Europe (Hilmola 2006), and small price increases have secured high profitability in the recent years (Ojala, Naula Queiroz 2005). Similarly privatized airport in Wellington (New Zealand) improved its efficiency in the seven year period (1995 to 2002) in the class of its own (as compared to Australian and New Zealand airports), and eventually decided to increase service prices by 77 % (Domney, Wilson & Chen 2005) – we could expect similar results in here like in Estonian railways. In profitability decomposition research completed by Rao (2006), concerning privatized water treatment plant in US, it was concluded that connection between efficiency and price recovery (outputs regarding to inputs purchased) is vital issue to be understood, and acted in the organization with input efficiency improvements or sales price changes.

Efficiency comparison with Data Envelopment Analysis (DEA) has been popular research topic in the previous decade; Cooper & Rhodes (1978) developed it originally as a non-parametric efficiency evaluation technique, especially applicable for governmental and non-profit organizations (see e.g. Faucett & Kleiner 1994). However, the application domains have been diverse: (1) Banker et al. (1986) studied Canadian hospital production, (2) Jamasb & Pollitt (2003) deregulation effects on European electricity distribution, where Goto & Tsutsui (1998) compared the efficiency of Japanese and US electric utilities, (3) Birgun & Akten (2005) as well as Min & Park (2005) have completed comprehensive sea port terminal analysis, (4) technical efficiency of Western European railways was interest in De Jorge & Suarez (2003) research work, (5) Domney et al. (2005) were interested about efficiency and profitability of airports located in Australia and New Zealand, (6) Taiwanese industrial sectors were compared by Chen & Yeh (2005), (7) several different research works have studied the efficiency frontiers in banks, especially between branch offices of some corporate (Soteriou & Zenios 1999; Seiford & Zhu 1999; Ho & Zhu 2004; Gutierrez-Nieto, Serrano-Cinca & Mar Molinero 2005), and (7) even global semiconductor production (Kozmetsky & Yue 1998), retail trade (Keh & Chu

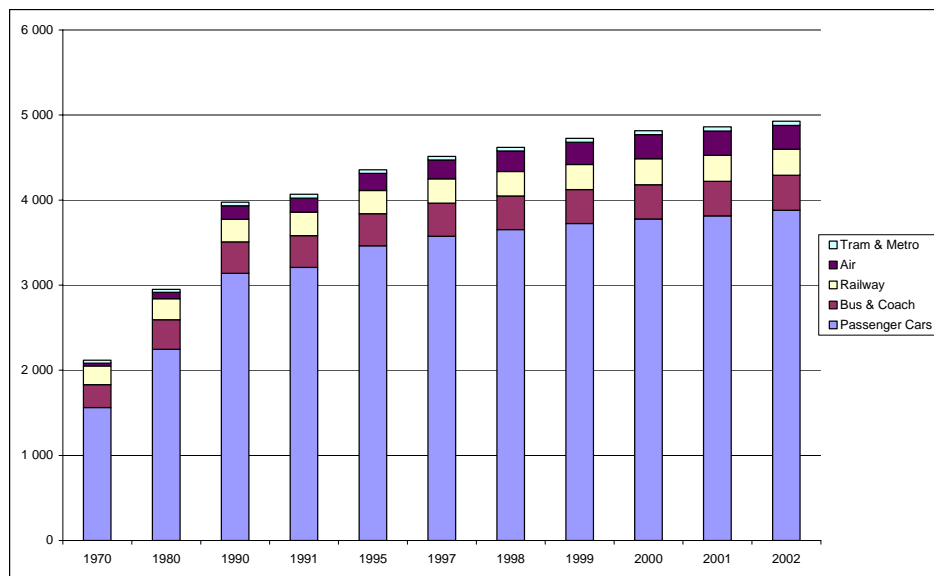
2003) and marketing efficiency has been under interest (Donthu, Hershberger & Osmonbekov 2005). It could be concluded that generally DEA evaluation is more popular among service type of industries (like hospitals, macro-logistics issues, banks, retail and electricity distribution) as well as low inventory or near of zero-inventory manufacturing (like electricity production and semiconductors typically are). Context could be regional, national or international. Therefore, we could rightly argue that efficiency evaluation of passenger transports in different European countries is appropriate, due to the service nature and government involvement.

This paper is structured as follows: In the following section 2 we will review railway passenger transportation from the European perspective. Interestingly we conclude that passenger transports have grown faster than freight transports, and growth has been primarily absorbed by road and air transportation modes. Thereafter we will introduce theoretical basis for productivity and efficiency measurement in section 3, especially from the point of view of partial productivity and DEA. Fourth section represents our research method and data; we used World Bank's (2006) railway database and two different DEA models as well as longitudinal data from 1980 to 1999. In the following section 5 two models based on DEA are being analyzed, where both different models indicate that efficiency frontier countries have been the same for two decades, and basically railway passenger transport sector lacks productivity improvement among different partial productivity measures. In section 6 implications of analysis results are further discussed, and current status of highest as well as lowest performing railways is briefly analyzed. We observe that output growth need is too significant in quite number of countries, and therefore heavy restructuring, price increases and probably also diminishing railway passenger transports will be reality in several European countries. In the final section we conclude our research work and provide avenues for further research.

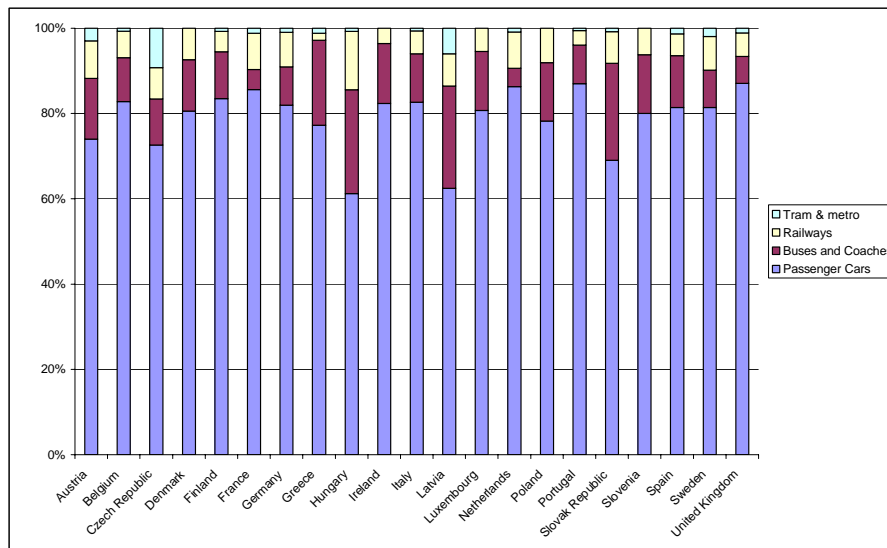
## **2. Literature Review: Railway Passenger Transportation, European Perspective**

In the freight transportation side, it has been argued that world economic growth has increased the world trade with higher multiples, and this has been verified with statistical data numerous times (e.g. United Nations 2005). For example, internal EU

freight transportation doubled in three decades, starting from 1970; this is mostly caused by road transportation, and significantly shortened transportation distances (e.g. Woxenius 1998). However, most often it is forgotten that passenger transports have gained even higher growth rates: As Figure 1 illustrates, passenger kilometers among EU 15 countries have increased nearly with 150 % within three decades, which is more than in the case of freight. So, basically we travel 2.5 times more today than 30 years ago; if we would compare to situation in one century ago, situation would be even more dramatic! Increase in 30 year respect has been mostly caused by road transports, since taking together passenger cars and bus & coaches, the share from total passenger transports have stayed steadily in the level of 87-88 % (the growth has been quite the same with total passenger transport growth). Thus, highest growth in relative terms could be found from air transports, which have increased by hefty 750 % within three decades. Transportation infrastructure research supports this increase, since built-up of air transport enabling facilities have been in constant increase (Marchetti 1988). More conservative, and simultaneously market share loosing transportation modes, are railways and tram & metro, recording approx. 40 % demand increase in three decades.



**Figure 1.** Passenger transports in EU15 countries (1000 million passenger kms) with modal split among years 1970-2002. Source: European Union (2004)



**Figure 2.** Passenger transports and modal split among different EU countries during year 2002. Source: European Union (2004)

If we observe passenger modal shares from different EU countries, including also lately joined countries (EU 25), the situation is rather uniform as it is analyzed through road transportation in total (Figure 2 in above, not including air transports, since these figures include only country internal passenger transport). This is quite interesting result, since former eastern block countries favored significantly railways instead of other modes. However, analyzing data a bit further, we could observe that these railway friendly eastern block countries have experienced demand collapse in very short time period: (1) Within two decades starting from year 1980 Baltic States (Estonia, Latvia and Lithuania) have experienced above 80 % decline in passenger transports of railways, (2) Slovenia, Bulgaria and Romania (last two are both EU member candidates) recorded in the same twenty year period decline of 50 % in demand, and (3) during 90's established Czech and Slovakia have lost considerable amount from demand in roughly ten year period of time. It should be noted that in the same period of time, passenger transports of railways in other EU countries have been increasing, and privatization has fostered this development trend in Sweden as well as UK (Hilmola, Ujvari & Szekely 2006).

Although, the number of private cars in former East-European countries is still observable from Figure 2 (although the number has been sharply increasing since early 90's, see Blackshaw & Thompson 1993), but taking into account also buses and coaches, we could have rather harmonized market share whatever the country actually

is. From country specific data we could identify the following countries representing the most railway lucrative market in the order of importance: Hungary (13.5 % share), Austria (8.8 %), France (8.5 %), Netherlands (8.5 %), Poland (8.1 %), and Sweden (7.9 %).

### **3. Literature Review: Partial Productivity and Efficiency**

Measurement of efficiency and productivity has manufacturing origins in industrial revolution; Adam Smith observed that dividing of artisan work to smaller pieces yielded significant improvements in output, labour productivity and eventually produced large fortunes for the owner(s) of greenfield factories. Later on in the early 20th century, the discussion concerning labour / capital investment ratios was under interest of Cobb and Douglas (1928), and they were able to estimate production output with these two most important input items. However, Solow (1958) showed later that the capital investment was key enabler of productivity improvement, but most often these investments were just small friction from technological improvements, which contribute the most for productivity improvements (estimated to be in range of 80-90 %). Technological change is just funneled through capital investments. As we are thinking about railway transportation, especially from passenger transports perspective, technical change has been conservative in time period of 1980 to 1999 (high speed trains however got more in common during late 90's, which disturbs the pure productivity and efficiency measurement a bit, UIC 2004), similarly as e.g. national electricity production with well established techniques. Also the service nature of a product leads to situation where inventories can't be used as a hedge for business changes. So, productivity and efficiency measurement in railway transportation has clearly demand with respect of theory development of productivity and efficiency.

**Equation 1.** Partial productivity measurement

$$PP_{ijt} = \frac{O_{it}}{I_{jt}}$$

where

$PP_{ijt}$  = Partial productivity of output  $i$  with regard of input  $j$  in period  $t$

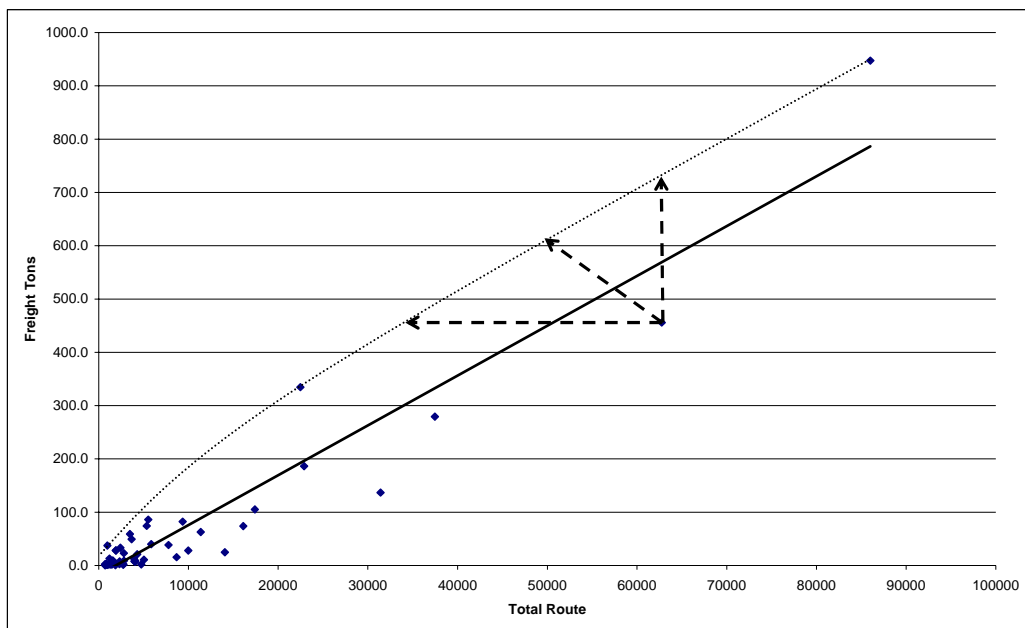
$O_{it}$  = Produced output of  $i$  in period  $t$

$I_{jt}$  = Invested input  $j$  in period  $t$

Despite the changes in productivity measurement, e.g. total productivity models in a firm level (Craig & Harris 1973; Sumanth 1998) as well as total factor productivity models (e.g. Baumol et al. 1989), the definition of production has remained as the same, and it is stated to be the relationship between outputs and invested inputs. However, it should be remembered that e.g. in the firm level there exist vast amount of productivity measurement systems, and only generic productivity measurement frameworks could be constructed (Tangen 2005). During 1980's several authors have defined productivity and price recovery as the factors affecting in profitability, when we are using monetary units as a measure of output and input values (e.g. Miller 1984; Pineda 1990). The most recent article from productivity and price recovery –area uses still the same method (Rao & Miller 2004), but after two decades we are looking forward to incorporate this 'old' innovation in a form of proper expert system. If we are strictly using non-financial measures to measure productivity, we do not have price recovery problem; so measuring railways productivity and efficiency, we could nearly isolate both prices and technological change. Also the service type of end-product eases our measurement, since inventory holding does not provide hedge against short-term demand changes; although this environment has been reported to be challenging in the productivity measurement side (Sahay 2005). Equation 1 illustrates measurement of typical partial productivity measures i.e. in transportation research; mostly volumes (like tons, number of passengers, number of platforms, containers etc.) or two dimensional like tonne-kilometers are used to represent output, and input factor includes invested infrastructure and most important cost items. Although these measures are rather simplified as being compared to manufacturing productivity research, it is good to remind that manufacturing productivity research has identified “*the network of productivity relationships*” in productivity improvements (e.g. Eilon 1985). For example, electrification of railroads might



increase capital investments of trains and lines, but in a meantime due to lower maintenance need improve employee productivity. Second short-term productivity enhancement technique in railway freights is usually related to wagon productivity; railway company just uses strict policy to prohibit the number of wagons, e.g. near of manufacturing unit or harbour, and enhances own capital productivity. However, downsize from this is the increased workload for administration personnel, as customer requests can't be handled in an appropriate and flexible manner. Also sub-optimization of own capital investments affect on the demand of railway freight transport, and output might be lost due to lowering customer service. Previous research has been shown that development of output as well as significance of different input items in the end decides whether implemented improvement eventually enhanced performance as a whole.



**Figure 3.** DEA efficiency frontier and regression line.

Data envelopment analysis is one of the efficiency evaluation techniques, and it was firstly introduced in Charnes, Cooper & Rhodes (1978) article; it shares plenty of similarities with classical Cobb-Douglas function as well as Total Factor Productivity, and has been proved to produce significantly better efficiency evaluations, especially in non-profit as well as governmental organizations, due to its non-parametric

requirement, while being able to incorporate multiple output and inputs. Figure 3 illustrates its main idea with one input and one output model; as regression model tries to ensure the goodness of fit by placing the line as middle as possible (minimizing the squared error), DEA efficiency evaluation takes all of the extreme points and places curvilinear line to represent efficiency frontier. As could be noticed from Figure 3, only three Decision Making Units (DMUs) out of 47 make the frontier (in other words have 100 % efficiency); remaining DMUs just need to either increase their output (freight tons) with current amount of inputs (total route), restructure heavily inputs while trying to keep output as the same, or combination of both of these actions where output increases and resources are slightly restructured.

**Table 1.** Two outputs and inputs DEA efficiency frontier evaluation in MS Excel.

Country	Freight Ton-km	Passenger-Km	Freight Wagons	Passenger Coaches	Weighted output	Weighted input	Efficiency	Difference
Finland	9753	3415	12647	994	0.72	1.00	72.4%	-0.28
Sweden	14400	7434	11168	1512	1.33	1.33	100.0%	0.00
Poland	55460	26187	96026	10069	4.85	9.37	51.8%	-4.51
Latvia	12210	984	7878	716	0.55	0.69	79.2%	-0.14
Lithuania	7849	745	10465	572	0.36	0.65	55.9%	-0.29
Estonia	7020	238	4567	242	0.28	0.28	100.0%	0.00
Weight	0.00003600958	0.00010911601	0.00002372110	0.00070422565				
Output/Input Weight	0.351	0.373	0.300	0.700				
Weighted Output/Input	0.724	0.724	1.000	1.000				
Share	0.485	0.515	0.300	0.700				

DEA efficiency measurement relies upon linear programming, and therefore graphical presentations like presented in Figure 3 are only possible to be constructed from one output/input scheme, or from the models containing one output and two input or either two outputs and one input. Multivariable models containing numerous outputs and inputs insist LP calculations, to show the efficiency frontier as well as how far away rest of the DMUs are from it. Table 1 illustrates this issue further; in our exemplary DEA model following DMUs make the frontier: Sweden and Estonia. As could be noticed, Poland is lacking behind 48.2 %, and correspondingly Lithuania 44.1 %. General linear programming model for DEA measurement is as follows, represented through our Table 1 example in Equation 2.

**Equation 2.** General linear programming model for hypothetical DEA example.

$$\text{Max } F_{\text{tonkms}}_{FI} \times F_{\text{tonkmweig}}_{ht} + Pass_{\text{skm}}_{FI} \times Pass_{\text{weight}}$$

Constraint s

$$\begin{aligned} Fr_{\text{wagons}}_{FI} \times Fr_{\text{wagonswei}}_{ght} + Pass_{\text{coache}}_{s_{FI}} \times Pass_{\text{coache}}_{s_{weight}} &= 1 \\ F_{\text{tonkms}}_N \times F_{\text{tonkmweig}}_{ht} + Pass_{\text{skm}}_N \times Pass_{\text{weight}} - \\ Fr_{\text{wagons}}_N \times Fr_{\text{wagonswei}}_{ght} + Pass_{\text{coache}}_{s_N} \times Pass_{\text{coache}}_{s_{weight}} &\leq 0 \end{aligned}$$

Where

$F_{\text{tonkms}}_N$  = Freight to n - km of country N  
 $Pass_{\text{skm}}_N$  = Passenger kilometers of country N  
 $Fr_{\text{wagons}}_N$  = Freight wagons in country N  
 $Pass_{\text{coache}}_{s_N}$  = Passenger coaches in country N  
 $F_{\text{tonkmweig}}_{ht}$  = Freight to n - km weight  
 $Pass_{\text{weight}}$  = Passenger kilometers weight  
 $Fr_{\text{wagonwei}}_{ght}$  = Freight wagon weight  
 $Pass_{\text{coache}}_{s_{weight}}$  = Passenger coaches weight  
N = Finland, Sweden, Poland, Latvia, Lithuania, Estonia  
FI = Finland

However, in the most of the situations this generic model hardly produces desired results; often after first LP calculation run only one output and input item has weights, and frontier is found, and rest of the variables are left out from the analysis. Therefore, it is important to include additional constraints in to model, to ensure that all of the output and input items are going to be taken into account. In this particular case solution was found with two constraints, ensuring that both of the input items have at least 30 % share from total weighted input. So, our equation needs to incorporate following additional constraints:

Constraints

$$\begin{aligned} \frac{Fr_{\text{wagons}}_{FI} \times Fr_{\text{wagonswei}}_{ght}}{Fr_{\text{wagons}}_{FI} \times Fr_{\text{wagonswei}}_{ght} + Pass_{\text{coaches}}_{FI} \times Pass_{\text{coacheswei}}_{ght}} &\geq 0.3 \\ \frac{Pass_{\text{coaches}}_{FI} \times Pass_{\text{coacheswei}}_{ght}}{Fr_{\text{wagons}}_{FI} \times Fr_{\text{wagonswei}}_{ght} + Pass_{\text{coaches}}_{FI} \times Pass_{\text{coacheswei}}_{ght}} &\geq 0.3 \end{aligned} \quad (2)$$

It depends from the situation, how many weight constraints are needed to be incorporated in to DEA measurement; as a general rule of thumb it is important to keep model as simple as possible, and therefore keep the number of constraints low. However, increasing number of decision making units as well as output/input items

makes LP models rather complicated, and therefore different softwares have been developed to give help for completing the DEA efficiency frontier analysis.

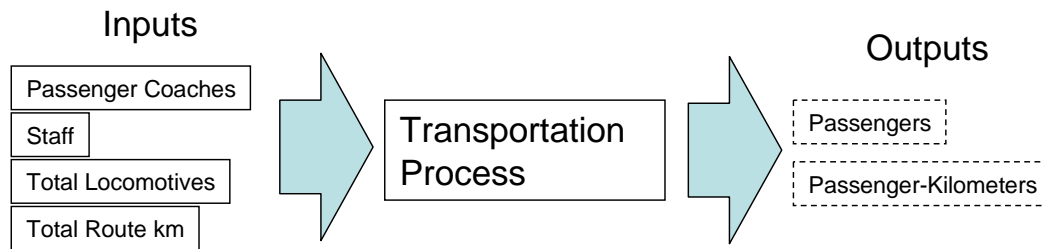
Number of research papers have dealt with the complexity of increasing number of different output/input factors by arbitrarily selecting lower amount of items for the one particular model, while evaluating e.g. ten different models at the time with same large data. Weighting has also been proven to be problematic, since even software vendors give careful instructions about it.

Recently some of the research works have proposed more complicated input and output causality models, to built up proper connections between operations inputs, operations outputs, and aggregate system outputs. However, at least Keh & Chu (2003) study in retail sector did not produce sufficient results; operative input had direct correlation with aggregate system outputs, but causality assumption did not hold true. Soteriou & Zenios (1999) did similar research from US banking, where they found that their service-profit chain did produce superior analysis insights to the efficiency evaluation of DMUs, and eventually hinders potential in the management process of bank, where there exists number of branch offices to be controlled.

#### **4. Research Method and Data**

We use in the DEA analysis of this paper World Bank's (2006) railway database, which consist longitudinal data starting from year 1980 and ending up to 1999 and 2000; this will give us an opportunity for productivity evaluation throughout the world. World Bank has extensively used this database in their research reports. However, in this research we are interested only from European passenger transportation, and what kind of efficiency differences we could find between different countries as well as what is the partial productivity development of this sector. Our analysis provides useful long-term perspective from the transition process of different countries from centrally planned and controlled communistic system in to free market competition. We also get an opportunity to benchmark, how Western European countries performed against Eastern Block, as it is well-known that communistic system favored as well as heavily paid subsidiaries for railways – this was especially the case with passenger transports, which had high shares from total passenger transportation. The second interesting theme is the efficiency evolution in

1990's, as European railways should start to have deregulated and harmonized development. How ready this industry is in passenger transportation side for free competition? Are countries showing uniform performance as compared with each other?



**Figure 4.** Two different DEA models based on number of passengers and passenger-km, and respective four inputs.

As Figure 4 shows, our two DEA models analyzed further in the forthcoming sections consisted same inputs; namely number of passenger coaches, head count in country's railways, total amount of locomotives and total route available for transportation. Used DEA efficiency evaluation models differed in a way that either number of passengers traveled or passenger travel kilometers during particular year were used as an output. Our efficiency analysis regarding to joint-inputs with freight transportation decreases the validity of completed analysis; tracks, locomotives and staff are just aggregate numbers, and used to produce and support railway freight movements as well as passenger transportation (for further discussion, see Brehmer & Ojala 1997). We selected five observation points (5 year observation frequency) from 20 years of complete data, starting from year 1980, and ending to year 1999. Due to the incompleteness of regarding to inputs and outputs used, were number of countries in efficiency evaluation a bit lower in the beginning of the observation period, as compared to the end of it. In some of the occasions particular country was included in our analysis only once (like Croatia, Lithuania and Slovenia). The reason for not including the country in to analysis was lack of one or two inputs or output parameters (in other words, data existed, but it was incomplete). All of the efficiency comparisons were completed with MS Excel, and its Solver linear programming add-in module. As the used models did not contain so many possible input and output parameters, Solver was capable to sufficiently complete DEA efficiency frontier

estimation. In the sensitivity analysis section we used MS Excel's Goal Seek add-in function, and identified its appropriateness in this task.

Linear programming model was forced to include more constraints, since the weights of different input and output items were zero with the plain DEA constraints. In all of the efficiency analysis models we added five additional constraints into models; in the selected country to lead our efficiency evaluation, we added four constraints, which told that each input factor should have at least 15 % from the total input value (as weight is multiplied with input value and divided thereafter with total weighted input). Also fifth constraint, telling that output weight should be positive, was added.

As used two DEA models contained only one output item, were partial productivity analysis convenient to complete. In a comparison, four different output items would have created in this case 16 different partial productivities, and many of them would not have justified connection between inputs and outputs. This would be the case, e.g. with in railway transportation (taking into account both freight and passenger sides) context with number of passengers in a year traveled and available freight wagons. As is shown in the following data analysis, partial productivity examination enables us to examine, where industry is currently developing, and what are the new standards for performance. This is the major drawback in DEA efficiency frontier evaluation; in here we know who is possibly the most efficient one, and what is the distance of other to the leader(s), but decision maker does not have any idea what is the performance standard and its likely development direction.

## **5. Empirical Data Analysis – Data Envelopment and Partial Productivity Analysis of European Railway Passenger Transports**

Tables 2 and 3 represent the results of DEA efficiency analysis, where decision making units are represented by different European countries. Generally it could be concluded that despite the output measure used, efficiency differences between different countries could be considered to be rather large. For example, in both of the cases, countries having above 50 % efficiency (as compared to frontier) are very few. So, efficiency in passenger transports in European railways is leaden and dominated only by small number of countries. If we use number of passengers as a measure,

Denmark, Netherlands and Portugal represent the standard for others to catch on – this observation concerns the whole 20 year period! We could have assumed a priori that at least some East European countries would be in this group during 80's. Similar situation persists in the latter case, where we are using passenger-kms as an output measure; Denmark and Netherlands set performance standards for the rest of the group. It is interesting to note that Netherlands has so strong performance during the whole observation period.

From the rest of the observation group we could argue that some former eastern block countries have faced severe efficiency decline after adapting themselves for market economy. In both of the models Yugoslavia (country in the war during 90's), Latvia and Romania could be identified to represent such countries; rest of the former eastern block, decline has been similar, but with smaller magnitude. However, opposite trends exist in West European countries: Denmark has improved its efficiency considerably among the observation period, and Ireland has showed similar development. However, it should be emphasized that the efficiency of total population is not developing to either direction, positive or negative, and it seems that poor performance is outweighed by similarly sized high efficiency.

**Table 2.** Efficiency comparison in observation period of 1980-1999 of European railways from freight transportation perspective as output is number of passengers traveled during a year.

Country	1980	1984	1989	1994	1999	n
Austria		20.4%	19.5%	23.2%	27.9%	4
Belgium	22.2%	21.4%	22.1%	24.5%	27.4%	5
Bulgaria			16.5%	10.6%	11.6%	3
Croatia				8.2%		1
Czechoslovakia	12.1%	12.2%	11.8%			3
Czech Republic				14.3%	14.0%	2
Slovakia				12.6%	11.5%	2
Denmark	56.7%		56.6%	69.1%	100.0%	4
Estonia				11.5%	9.8%	2
Finland	12.7%	13.0%	12.6%	12.2%	17.6%	5
France	21.0%	25.0%	23.5%	26.7%	30.7%	5
West Germany	27.7%	28.6%	27.2%			3
Germany				31.9%	46.6%	2
Greece	6.9%	7.3%	7.2%	6.7%	10.0%	5
Hungary	20.9%	20.1%	18.9%	17.0%	17.9%	5
Ireland	11.6%	13.3%	22.7%	25.3%		4
Italy		14.3%	16.1%	19.6%	24.1%	4
Latvia				24.3%	13.9%	2
Lithuania					6.9%	1
Macedonia			8.4%		3.5%	2
Netherlands	75.8%	77.7%	79.0%	97.4%	93.8%	5
Poland			24.1%	17.7%	17.0%	3
Portugal	100.0%	100.0%	100.0%	100.0%	82.6%	5
Romania	19.4%	17.7%	19.1%	8.7%	7.7%	5
Slovenia					13.0%	1
Spain	21.4%	23.3%	21.9%	49.6%	62.5%	5
Sweden	11.2%	11.4%	11.1%	20.5%	29.6%	5
Turkey	18.6%	24.2%	25.7%	22.8%	21.9%	5
Ukraine				25.0%	18.2%	2
United Kingdom	39.5%	56.0%	49.4%	57.8%		4
Yugoslavia	10.5%	11.6%	9.7%		3.1%	4
n	17	18	22	25	26	

As comparing the efficiency measurement results with two different output measures, we could conclude that generally in Table 2 (number of passenger traveled), the number of improving countries is much greater than what is the situation in Table 3. This might be indication from the forthcoming future changes; harmonized passenger transports strategies in Europe should be developed through number of passengers rather than long-distance connections (maybe long-distance is left for high speed trains as corridors). As compared to other DEA efficiency research works (e.g. Domney et al. 2005; Donthu et al. 2005), European railway passenger operations are far from the uniform performance, and most likely these countries will



use (even in the deregulated environment) their market power to improve profitability by increasing prices (not efficiency). This has been reported to have happened in airports (Domney et al. 2005), where infrastructure monopoly is even more concentrated on certain location and there exist only handful of actors.

**Table 3.** Efficiency comparison in observation period of 1980-1999 of European railways from freight transportation perspective as output is passenger kilometers.

	1980	1984	1989	1994	1999	n
Austria		26.2%	29.5%	24.9%	25.6%	4
Belgium	29.9%	27.9%	31.5%	25.3%	28.7%	5
Bulgaria			26.3%	18.1%	18.0%	3
Croatia				9.1%		1
Czechoslovakia	19.1%	19.9%	19.2%			3
Czech Republic				11.8%	11.5%	2
Slovakia				12.8%	10.2%	2
Denmark	47.2%		52.6%	52.1%	76.8%	4
Estonia				11.9%	7.5%	2
Finland	33.2%	31.0%	30.2%	18.7%	24.9%	5
France	53.3%	60.1%	63.5%	43.7%	51.4%	5
West Germany	31.7%	32.4%	36.0%			3
Germany				29.1%	42.0%	2
Greece	29.2%	31.2%	32.9%	21.1%	29.6%	5
Hungary	28.5%	24.7%	24.7%	20.0%	21.5%	5
Ireland	17.9%	17.8%	26.6%	27.4%		4
Italy		40.4%	47.6%	46.7%	48.5%	4
Latvia				17.1%	12.1%	2
Lithuania					9.6%	1
Macedonia			13.6%		6.8%	2
Netherlands	100.0%	100.0%	100.0%	100.0%	100.0%	5
Poland			41.4%	22.0%	24.1%	3
Portugal	73.1%	68.7%	67.7%	57.4%	48.3%	5
Romania	37.5%	38.7%	43.5%	17.2%	15.1%	5
Slovenia					12.6%	1
Spain	52.9%	56.2%	59.9%	46.5%	62.4%	5
Sweden	40.5%	37.6%	34.2%	28.5%	45.0%	5
Turkey	29.9%	35.1%	33.5%	26.8%	30.9%	5
Ukraine				53.3%	34.2%	2
United Kingdom	43.6%	58.2%	62.2%	52.3%		4
Yugoslavia	24.3%	26.0%	21.3%		6.0%	4
n	17	18	22	25	26	

Based on the findings concerning the static efficiency frontier appeared in Tables 2 and 3, it is not surprising to find out that partial productivity improvement in eight different measures has been less than impressive. As Table 4 shows, especially partial

productivity related to coaches has been on constant decline in 20 year time period, approx. on the average 4 % per year! Similarly routes have not shown any positive development. We could argue that as passenger operations of railways were in the administration of these respective countries during observation period, and their purpose was to serve public, the efficiency improvement in longer term investments were hard to be justified among management (e.g. to reduce or even remove connections inside of a country). It is not surprising to observe that actually productivity of staff has been the only indicator, which has shown constant improvement. Partial productivity of locomotives has remained in the same level for two decades.

**Table 4.** Partial productivity index development in the observation period.

Year	Ps/Coaches	Ps/Staff	Ps/ Locomotives	Ps/Route	Ps-kms/ Coaches	Ps-kms/ Staff	Ps-kms/ Locomotives	Ps-kms/ Route
1980	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1984	87.6	96.2	92.1	94.6	90.4	102.5	99.8	105.0
1989	94.2	108.8	95.9	102.8	96.9	115.7	104.7	115.9
1994	90.6	126.2	101.0	99.6	88.6	124.6	106.9	107.8
1999	42.7	134.2	96.6	81.9	47.2	135.6	101.4	90.8
Average growth:	-4.17%	1.48%	-0.17%	-1.00%	-3.68%	1.53%	0.07%	-0.48%

Efficiency frontier countries remind the same pattern with average improvement, as Tables 5, 6 and 7 show. For example, Portugal has only been able to improve productivity of staff among the years, while e.g. productivity of coaches has nearly collapsed. Netherlands repeat the same pattern, but the magnitude in productivity improvement of staff is higher, and drop in coaches is more severe. However, interestingly partial productivities of locomotives and route are in the increase as well. This might be the reason, why Netherlands has been able to keep its efficiency frontier position among the years in a model, where output is measured with passenger-kms.

**Table 5.** Efficiency frontier Portugal (number of passengers, 1980-1994) and its partial productivity development.

<i>Portugal</i>	Ps/Coaches	Ps/Staff	Ps/ Locomotives	Ps/Route
1980	100.0	100.0	100.0	100.0
1984	95.6	104.6	94.5	95.6
1989	98.7	113.4	101.4	120.5
1994	89.1	150.9	87.8	117.8
1999	28.7	143.1	80.1	93.9
Average growth:	-6.05%	1.81%	-1.10%	-0.32%

**Table 6.** Efficiency frontier Netherlands (passenger-kilometers, 1980-1999) and its partial productivity development.

<i>Netherlands</i>	Ps-kms/ Coaches	Ps-kms/ Staff	Ps-kms/ Locomotives	Ps-kms/ Route
1980	100.0	100.0	100.0	100.0
1984	70.7	106.5	98.1	102.0
1989	81.8	122.3	97.5	116.1
1994	67.9	171.4	135.9	169.3
1999	18.8	174.0	232.7	165.0
Average growth:	-8.02%	2.81%	4.31%	2.53%

**Table 7.** Efficiency frontier of 1999 in the number of passengers model, Denmark, and its respective partial productivities during twenty year period.

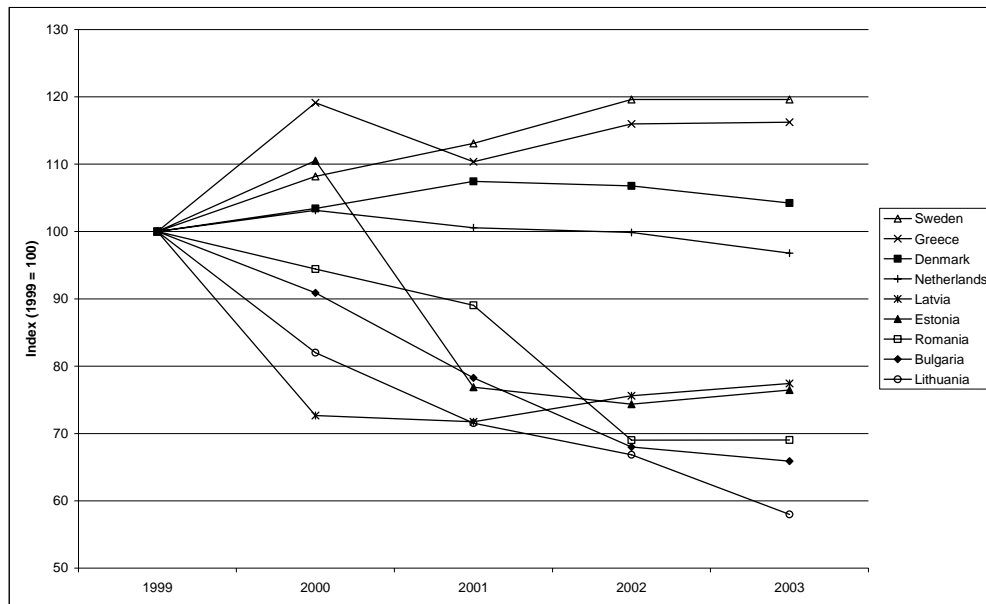
<i>Denmark</i>	Ps/Coaches	Ps/Staff	Ps/ Locomotives	Ps/Route
1980	100.0	100.0	100.0	100.0
1989	126.5	107.4	93.7	92.3
1994	180.8	114.9	115.7	93.6
1999	112.7	230.2	171.7	99.3
Average growth:	0.60%	4.26%	2.74%	-0.04%

In the model where efficiency was measured with number of passengers, Denmark was able take the leading position during the last observation year. The reason for this could be concluded from Table 7: (1) rarely improved productivity of coaches was in the constant increase during the observation period, instead of decline (performance in 1994 is exceptional), (2) productivity of labour was considerably higher than on the

average, and (3) partial productivity of locomotives was also improved within impressive manner during the observation period (especially during the last observation year).

## 6. Discussion

Due to EU enlargement, quite large proportion of the analyzed countries have started to take steps towards privatization and deregulation of railways. Based on the research of Hilmola et al. (2006), it could be argued that in UK as well as Sweden, where this process has been effective more than a decade, they have reported to gain more demand on rails as a result of this process. However, it is important to note that in US privatization and deregulation resulted on severe increase of freight transports, but the loss in passenger side was considerable. Due to the analysis period of this research, it is important to enlarge the output observation period for additional four years, to identify, whether EU's emphasis on deregulation and privatization has changed the operating environment. As Figure 5 shows, only Sweden and Greece have been able to create new demand on the rails, but still with rather small incremental steps. Interestingly, both Denmark and Netherlands have showed some saturation in the demand, and situation is more or less the same than what was in 1999.



**Figure 5.** Passenger-kms development in selected European countries in period of 1999 to 2003 (1999 = 100). Source: European Union (2004)

Former eastern block countries show rather warning example in the sales development during five year period. For example, Lithuania has lost above 40 % from the demand, while Romania and Bulgaria above 30 %, and Latvia and Estonia above 20 %. In the case of Baltic States, their railway systems has started to remind quite much US, where demand grows rapidly in freight side, but passenger operations show rather marginal changes in revenue, and usage is in the constant decline (declining demand could be compensated with ticket price increases). Based on Ojala, Naula & Queiroz (2005), in all of the Baltic States, revenues from passenger operations are rather marginal, as compared to freight side (max. 10 % from freight revenues). Situation with Romania and Bulgaria is even worse; freight transports faced demand collapse in early 90's, and this has not been compensated at all during previous years. So, we could rightly argue that these both countries have really a significant structural problem in railways.

**Table 8.** How much output should increase in order other to catch up Danish efficiency in passengers and Netherland's efficiency in passenger-kms (year 1999)?

	Passengers (000)	Change	Passenger-kms (000,000)	Change
Bulgaria	456756.4	760%	21262.6	457%
Czech Republic	1250387.6	615%	60470.7	773%
Slovakia	602069.9	767%	29200.8	884%
Hungary	671934.8	457%	31106.6	364%
Poland	2318489.2	487%	108842.1	316%
Romania	1687491.6	1205%	81306.5	561%
Turkey	450717.4	356%	19897.4	224%
Macedonia	48026.4	2790%	2189.8	1363%
Yugoslavia	312783.8	3158%	14242.9	1576%
Slovenia	106215.6	670%	4943.1	693%
Ukraine	2948843.7	450%	139049.4	192%
Estonia	69270.0	919%	3172.8	1233%
Latvia	179069.4	620%	8148.8	728%
Lithuania	167339.0	1355%	7765.6	942%
Austria	651948.8	259%	30858.8	291%
Belgium	538146.6	265%	25653.9	249%
Denmark	149300.0	0%	6657.5	30%
Finland	302628.5	469%	13738.3	302%
France	2773026.1	226%	129306.3	94%
Greece	122388.3	895%	5351.9	238%
Italy	1794464.5	315%	84419.2	106%
Netherlands	315610.5	7%	14330.0	0%
Portugal	198517.0	21%	8958.3	107%
Spain	670361.2	60%	29086.6	60%
Sweden	387802.8	238%	16536.8	122%
Germany	3643299.8	115%	172696.7	138%

As DEA analysis phase showed, efficiency differences between small number of high performing countries, and the rest of the group are enormous. This leads us to the situation, where e.g. output increasing based efficiency improvement strategy is rather demanding for poor performing countries. Also input restructuring becomes inappropriate – we run couple of mixed scenario analysis, and found that the most important input item, locomotives, should be decreased with more than 70 % in these countries to have output growth expectations a 30 % lower. Table 8 shows required changes in output in two different DEA models, as data from last observation year is being used, and efficiency is being improved to frontier level without input restructuring. As could be noticed, passenger transports demand rather significant changes in demand as well as in price side to improve current situation. This means in larger perspective that heavy restructuring is expected to be seen in European railway passenger operations, and some countries could end up into situation of US, where freight is developing favorably, but passenger transports has diminished nearly entirely from the picture. Without heavy investment packages directed especially for former East European countries in new railway infrastructure (especially high speed), this scenario will most probably materialize.

## **7. Conclusions**

Passenger transports have experienced considerable growth within previous decades – currently people are traveling more than ever, and surprisingly passenger transport growth exceeds freight transport. So, as world economy is growing, not only freight grows, but passenger side as well. However, as we look this subject from the perspective of Europe, and especially from the transportation mode side, interesting outcomes appear. It seems that railways and metros have been unable to catch the growth curve, and market share has been lost for air and road transportation. In the same time EU and local governments has emphasized to privatize and deregulate railways, in order to improve efficiency, and eventually demand. Efficiency comparison completed in this paper indicates that this is not an easy task at all, and most probably some European countries will face hard time to have both passenger and freight transports represented in railways. Or if they do, ticket prices in passenger

side will increase significantly. This does not mean that restructuring would not continue among input items, since growth objectives for output in different countries are so demanding that output alone is not able to justify efficiency frontier catch up. However, it should be noted that efficiency performance highly differs between different European countries, and we could assume Denmark, Netherlands and Portugal to prosper after privatization and deregulation have really took off (as railways still have space to enlarge market share in these countries).

One rather frightening finding in European railway sector is the non-existence of productivity improvement among different partial productivities. This is the case even with the high performing frontier countries. We could assume that in the near future railway networks will be significantly modified and old routes are removed, and as these have been completed, the number of passenger coaches could be considerably decreased. This finding concerns the most of European countries. However, it should be reminded that among EU countries the ownership of railway infrastructure and actual passenger/freight operations is divided during deregulation process, and this will most probably mean some sort of delay in the productivity improvement process. This would be one interesting avenue for further research, since this sector does clearly need productivity improvement, but this should be completed among different actors rather than inside of a large organization.

In European railways, we could identify in the near future that not only infrastructure ownership and actual operations are divided, but also operations will most probably be divided for different smaller actors with respect of freight and passenger operations. In European context, it would be interesting to complete research work, where passenger and freight operations of each country would be included in two different DEA models, representing these two different business segments. We could most probably find some number of countries, where passenger and freight side could both have a justification in terms of efficiency in order to co-exist, but also pinpoint those countries which are heading in the direction of US railways (low amount of passenger operations, but high share of freight) or having suitable structure for passenger transports only. As the efficiency differences between different countries in this research were rather substantial, this further research would also give some guidance whether argumentation about weak performance in both these business segments could exist, as was argued in discussion section about Romania and Bulgaria.

## References

- Analoui, Farhad (1995). Management skills and senior management effectiveness. *International Journal of Public Sector Management*, 8:1, pp. 52-68.
- Banker, Rajiv D., Robert Conrad & Robert P. Strauss (1986). A comparative application of data envelopment analysis and translog methods: An illustrative study of hospital production. *Management Science*, 32:1, pp. 30-44.
- Baumol, William J., Sue Anne Batey Blackman & Edward N. Wolff (1989). *Productivity and American Leadership: The Long View*. Cambridge, MA: MIT Press, pp. 225-250.
- Blackshaw, Philip W. & Louis S. Thompson (1993). Railway reform in the Central and Eastern European Countries. *Policy Research Working Papers, World Bank, WPS 1137*.
- Bozec, Richard & Gaétan Breton (2003). The impact of the corporatization process on the financial performance of Canadian state-owned enterprises. *International Journal of Public Sector Management*, 16:1, pp. 27-47.
- Birgun, Semra & Necmettin Akten (2005). Relative efficiencies of seaport container terminals: a DEA perspective. *International Journal of Integrated Supply Management*, 1:4, pp. 442-456.
- Brehmer, Per-Olof & Lauri M. Ojala (1997). The mobility market and the organisational transformation of the British, Swedish and Finnish Railways. *Conference Proceedings of the annual conference of the British Academy of Management*.
- Charnes, A., W.W. Cooper & E. Rhodes (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2:6, pp. 429-444.
- Chen, Chung-Jen, Quey-Jen Yeh (2005). A comparative performance evaluation of Taiwan's high-tech industries. *International Journal of Business Performance Management*, 7:1, pp. 16-33.
- Christopoulos, Dimitris, John Loizides & Efthymios G. Tsionas (2001). Efficiency in European railways: Not as inefficient as one might think. *Journal of Applied Economics*, 4:1, pp. 63-88.
- Cobb, Charles W. & Paul H. Douglas (1928). A theory of production. *The American Economic Review*, 18:1, pp. 139-165.
- Craig, Charles E., & R. Clark Harris (1973). Total productivity measurement at the firm level. *Sloan Management Review*, Vol. 14, No. 3, pp. 13-29.
- De Jorge, Justo & Cristina Suarez (2003). Has the efficiency of European railway companies been improved? *European Business Review*, 15:4, pp.213-220.
- Domney, Mark D., Heather I.M. Wilson & Er Chen (2005). Natural monopoly privatization under different regulatory regimes. *International Journal of Public Sector Management*, 18:3, pp. 274-292.
- Donthu, Naveen, Edmund K. Hershberger & Talai Osmonbekov (2005). Benchmarking marketing productivity using data envelopment analysis. *Journal of Business Research*, 58:11, pp. 1474-1482.
- Eilon, Samuel (1985). A framework for profitability and productivity measures. *Interfaces*, 15:3, 389-393.
- European Union (2004). *Energy and Transport in Figures 2004*. European Commission.
- Faucett, Allen & Brian H. Kleiner (1994). New developments in performance measures of public programmes. *International Journal of Public Sector Management*, 7:3, pp. 63-70.
- Goto, Mika & Miki Tsutsui (1998). Comparison of productive and cost efficiencies among Japanese and US electric utilities. *Omega, International Journal of Management Science*, 26:2, pp. 177-194.
- Gutierrez-Nieto, Begona, Carlos Serrano-Cinca & Cecilio Mar Molinero (2005). Microfinance institutions and efficiency. *Omega, International Journal of Management Science*, forthcoming.
- Ho, Chien-Ta & Dauw-Song Zhu (2004). Performance measurement of Taiwan's commercial banks. *International Journal of Productivity and Performance Management*, 53:5, pp. 425-434.
- Ho, Chien-Ta & Dauw-Song Zhu (2004). Performance measurement of Taiwan's commercial banks. *International Journal of Productivity and Performance Management*, 53:5, pp. 425-434.
- Hilmola, Olli-Pekka (2006). European railway freight transportation and market economy adaptation – Efficiency and partial productivity analysis from period of 1980-1999. *International Journal of Productivity and Performance Management* (article proposal in referee process).



- Hilmola, Olli-Pekka, Sandor Ujvari & Bulcsu Szekely (2006). Deregulation of railroads and future development scenarios in Europe – Literature analysis of privatization process taken place in US, UK and Sweden. *Nofoma Conference Proceedings*.
- Keh, Hean Tat & Singfat Chu (2003). Retail productivity and scale economies at the firm level: a DEA approach. *Omega*, 31:2, pp. 75-82.
- Kozmetsky, G. and P. Yue (1998). Comparative performance of global semiconductor companies. *Omega, International Journal of Management Science*, 26:2, pp. 153-175.
- Jamasb, Tooraj & Michael Pollitt (2003). International benchmarking and regulation: An application to European electricity distribution utilities. *Energy Policy*, 31:15, pp. 1609-1622.
- Marchetti, C. (1988). Kondratiev revisited – after one Kondratiev cycle. *International Conference on Regularities of Scientific – Technical Progress and Long-Term Tendencies in Economic Development*, 14 March 1988, Novosibirsk, USSR.
- Miller, David M. (1984). Profitability = productivity + price recovery. *Harvard Business Review*, Vol. 62, No. 3, pp. 145-153.
- Min, Hokey & Byung-In Park (2005). Evaluating the inter-temporal efficiency trends of international container terminals using data envelopment analysis. *International Journal of Integrated Supply Management*, 1:3, pp. 258-277.
- Ojala, Lauri, Tapio Naula & Cesar Queiroz (2005). *Transport Sector Restructuring in the Baltic States as Members of the European Union – Proceedings of the 3<sup>rd</sup> Seminar Held in Vilnius*. Turku School of Economics Publications, Finland.
- Pineda, Antonio J. (1990). *A Multiple Case Study Research to Determine and Respond to Management Information Needs Using Total-Factor Productivity Measurement*. Michigan: University Microfilms International.
- Premachandra, Im, John G. Powell & Jing Shi (1998). Measuring the relative efficiency of fund management strategies in New Zealand using a spreadsheet-based stochastic data envelopment analysis model. *Omega, International Journal of Management Science*, 26:2, pp. 319-331.
- Rao, Mohan P. (2006). A performance measurement system using a profit-linked multi-factor measurement model. *Industrial Management & Data Systems*, 106:3, pp. 362-379.
- Rao, Mohan P. & David M. Miller (2004). Expert system applications for productivity analysis. *Industrial Management and Data Systems*, 104:9, pp. 776-785.
- Sahay, B.S. (2005). Multi-factor productivity measurement model for service organization. *International Journal of Productivity and Performance Management*, 54:1, pp. 7-22.
- Solow, Robert M. (1958). Technical change and the aggregate production function. *The Review of Economics and Statistics*, 39:3, pp. 312-320.
- Soteriou, Andreas & Stavros A. Zenios (1999). Operations, quality, and profitability in the provision of banking services. *Management Science*, 45:9, pp. 1221-1238.
- Sowlati, Taraneh & Joseph C. Paradi (2004). Establishing the “practical frontier” in data envelopment analysis. *Omega, International Journal of Management Science*, 32:4, pp. 261-272.
- Seiford, Lawrence M. & Joe Zhu (1999). Profitability and marketability of the top 55 U.S. commercial banks. *Management Science*, 45:9, pp. 1270-1288.
- Tangen, Stefan (2005). Demystifying productivity and performance. *International Journal of Productivity and Performance Management*, 54:1, pp. 34-46.
- UIC (2004). *Railway Time-Series Data*. International Union of Railways, Paris.
- United Nations (2005). *Regional Shipping and Port Development Strategies (Container Traffic Forecast)*. Economic and social commission for Asia and the Pacific.
- World Bank (2006). Railways database. Available at URL: <http://www.worldbank.org/transport/rail/rdb.htm> Retrieved 9.Feb.2006.
- Woxenius, Johan (1998). *Development of Small-Scale Intermodal Freight Transportation in a System Context*. Chalmers University of Technology, Report 34 (Doctoral Diss.).

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