LAPPEENRANTA UNIVERSITY OF TECHNOLOGY
Department of Industrial Engineering and Management
Kouvola Research Unit
Research Report 175

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Logistics Development in Finnish and Swedish Companies with Respect of Russia and Four Asian Countries: Traffic Flow and Warehousing Analysis from Current Situation and Likely Development Trends

ISBN 952-214- 283-2 (paperback)
ISBN 952-214- 284-0 (pdf)
ISSN 1459-3173

ABSTRACT

It is evident that nowadays the centre of world trade is slowly shifting its place to Asia in general and to China in particular. Especially in manufacturing terms the change is obvious and this fact puts a significant pressure on cost efficient and lead time wise supply chain solutions. At the same time there is a massive imbalance in the traffic flows between continents. This is in most cases due to the supply chain strategies large multinational companies opt for. Many of them optimize their network by embracing "local sourcing" to achieve control and responsiveness in their supply chains. As a consequence, plenty of manufacturing units in Europe must use expensive raw materials and semi-finished items. The critical factors in most cases are related to transportation, warehousing costs on the one hand and waste of time as a result of delays on the other. The optimal decision has to be reached considering the choice between centralized and decentralized inventory policies together with the choice of choosing the right combination of transportation modes. From Asia to Europe to ship goods via sea is cheap, but takes very long time – in some cases even eight weeks. In contrast air transport is expensive and poses limits to the size and weights of the products. Still there is a third option that would seem to be the solution: railways transport is more advantageous in terms of cost wise in comparison to air transport and provides shorter lead times when looking at the choice of sea containers.

In this scrutiny we are to analyze the situation by taking under consideration large enterprises of Finland and Sweden. On the bases of this investigation we track the way of how the market shares between transportation modes will evolve in the future and cast a detailed view on traffic flows between Europe, Russia, South-Korea, India, China, and Japan. Alongside we show estimations on the development of transportation and warehousing of these companies in the forthcoming years. Based on our survey results, we identify that pure transportation costs will not change that greatly in the next five years, and sea and road transports are the most favoured modes. However, air transports will face small decrease in popularity, where railways will gain small increase in transportation share. Issues regarding to emerging markets, we identify that especially China and Russia will face increasing volumes in amount of containers transported, while India has a bit less significant increase. Our research also reveals that transportation unbalance will persist with Russia; Swedish as well as Finnish companies mostly exploit export based strategy in the future too. In the warehousing issues we identify that amount of smaller warehouses is likely to continue small decline in the future, and the interest will shift to larger warehousing facilities. Interestingly, Finnish companies have more warehouses in Central and Eastern Europe, as compared to Swedish companies, which are concentrating more on Western Europe. Both of the countries have largest presence in home country. As selecting warehouse location, companies emphasize issues such as low distribution costs, proximity of assembly/manufacturing units, inbound logistics integration, and available third party logistics connections. In the end of our research report we speculate that warehousing locations will not that greatly change due to the structure of ports and connections. We also suggest some avenues for further research.

Keywords: International transportation, transportation modes, emerging markets, warehousing

TIIVISTELMÄ

On selvää, että tänä päivänä maailmankaupan painopiste on hiljalleen siirtymässä Aasiaan ja varsinkin Kiina on ollut huomion keskipisteessä. Erityisesti valmistavien yritysten perspektiivistä muutos on ollut merkittävä ja tämä tosiasia kasvattaa yrityksissä paineita luoda kustannustehokkaita toimitusketjuratkaisuja, joiden vasteaika on mahdollisimman lyhyt. Samaan aikaan kun tarkastellaan kuljetusvirtoja, huomattaan että maanosien välillä on suuri epätasapaino. Tämä on enimmäkseen seurausta suurten globaalisti toimivien yritysten toimitusketjustrategioista. Useimmat näistä toimijoista optimoivat verkostonsa turvautumalla ”paikalliseen hankintaan”, jotta he voisivat paremmin hallita toimitusketjujaan ja saada näitä reagointiherkimmiksi. Valmistusyksiköillä onkin monesti Euroopassa pakko käyttää kalliita raaka-aineita ja puolivalmisteita. Kriittisiksi tekijöiksi osoittautuvat kuljetus- ja varastointikustannukset sekä näiden seurauksena hukka-aika, joka aiheutuu viivästyksistä. Voidakseen saavuttaa optimiratkaisun, on tehtävä päätös miten tuotteet varastoidaan: keskitetysti tai hajautetusti ja integroida tämä valinta sopivien kuljetusmuotojen kanssa. Aasiasta Pohjois-Eurooppaan on halpaa käyttää merikuljetusta, mutta operaatio kestää hyvin pitkään – joissain tapauksessa jopa kahdeksan viikkoa. Toisaalta lentokuljetus on sekä kallis että rajoittaa siirrettävien tuotteiden eräkokoa. On olemassa kolmaskin vaihtoehto, josta voisi olla ratkaisuksi: rautatiekuljetus on halvempi kuin lentokuljetus ja vasteajat ovat lyhyemmät kuin merikuljetuksissa.

Tässä tutkimuksessa tilannetta selvitetään kyselyllä, joka suunnattiin Suomessa ja Ruotsissa toimiville yrityksille. Tuloksien perusteella teemme johtopäätökset siitä, mitkä kuljetusmuotojen markkinaosuudet tulevat olemaan tulevaisuudessa sekä luomme kuvan kuljetusvirroista Euroopan, Venäjän, Etelä-Korea, Intian, Kiinan ja Japanin välillä. Samalla on tarkoitus ennakoida sitä, miten tarkastelun kohteena olevat yritykset aikovat kehittää kuljetuksiaan ja varastointiaan tulevien vuosien aikana. Tulosten perusteella näyttää siltä, että seuraavan viiden vuoden kuluessa kuljetuskustannukset eivät merkittävissä määrin tule muuttuman ja meri- sekä kumipyöräkuljetukset pysyvät suosituimpina vaihtoehtoina. Kuitenkin lentokuljetusten osuus laskee hiukan, kun taas rautatiekuljetusten painotus kasvaa. Tulokset paljastavat, että Kiinassa ja Venäjällä kuljetettava konttimäärä kasvaa; Intiassa tulos on saman suuntainen, joskaan ei niin voimakas. Analyysimme mukaan kuljetusvirtoihin liittyvä epätasapaino säilyy Venäjän kuljetusten suhteen: yritykset jatkavat tulevaisuudessakin vientiperusteista strategiaansa. Varastoinnin puolella tunnistamme pienemmän muutoksen, jonka mukaan pienikokoisten varastojen määrät todennäköisesti vähenevät tulevaisuudessa ja kiinnostus isoja varastoja kohtaan lisääntyy. Tässä kohtaa on mainittava, että suomalaisilla yrityksillä on enemmän varastoja Keski- ja Itä-Euroopassa verrattuna ruotsalaisiin toimijoihin, jotka keskittyvät selkeämmin Länsi-Euroopan maihin. Varastoja yrityksillä on molemmissa tapaukissa paljolti kotimaassaan. Valitessaan varastojensa sijoituskohteita yritykset painottavat seuraavia kriteereitä: alhaiset jakelukustannukset, kokoamispaikan/valmistustehtaan läheisyys, saapuvan logistiikan integroitavuus ja saatavilla olevat logistiikkapalvelut. Tutkimuksemme lopussa päädymme siihen, että varastojen sijoituspaikat eivät muutu satamien rakenteen ja liikenneyhteyksien takia kovinkaan nopeasti.

Avainsanat: Kansainväliset kuljetukset, kuljetusmuodot, tulevaisuuden markkinat, varastointi

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1. Introduction

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

Research problem in this paper concerns the North-European countries, Finland and Sweden, and their logistical operations with Russia and Asian countries. We are interested about countries, which have significance in the trade and economic growth, and could be reached, if alternatives would be further developed, with all different transportation modes. So, from Asia we have picked China, Japan, South-Korea and India. The last country in the list, India, does not necessarily represent the most feasible alternative to plain rail or road transports from e.g. Europe, but major parts of the needed journey could be completed through Russia, by near of Kazakhstan (with either train or

road), ending up to Iranian harbour and continuing from there towards Mumbai harbour in India (Molnar & Ojala 2003).

This paper is structured as follows: In the second section we will review the world trade development, traffic flows and unbalanced nature of world transports. Our literature review concludes that developed countries (US, Japan and EU-15) still hold the significance in the world economy, but in transportation, the growing number of transactions indicates that "the fast phase" developing countries have already taken the lead. In the third section of our research we review literature of location decision of warehouses, business logistics and supply chain management issues. As theory suggest, shorter supply chains as well as more centralized warehouses are increasing trend in global operations. As large world-wide corporations are the major cause of traffic flows in a world context, we have gathered empirical material with a survey from largest companies from Finland and Sweden. We will review the research methodology of this questionnaire in the fourth section of this research report. Empirical part is analyzed in the fifth section, and we find that with several items our questionnaire supports previous research, but our analyzed answers reveal that companies are planning to implement relatively small amount of actions with regard to traffic unbalance, and integration of developing countries into their manufacturing/customer network. Transportation volumes are significantly increasing towards Russia and China, but also India. In warehousing side, we identify that location between Swedish and Finnish companies differ. Overall, there is small tendency that amount of smaller warehouses will decline, while larger ones are being favoured. We also present findings from warehousing location selection criteria from respondent companies. In the fifth discussion section we will speculate whether warehousing location will change at all in the future; this is justified with preliminary sea port network analysis from Finland, Sweden, Central Europe and Russia. In the final section we will conclude our research, and propose further avenues for it.

2. Literature Review – World Trade, Traffic Flows and Major Continents

As Figure 1 shows, world GDP has increased steadily during the last 50 years. However, this means that as the world trade is increasing by a higher magnitude compared to GDP, the amounts of transportation, especially international, also increases. The relationship between world trade and GDP growth was for a long time near of 1.5, meaning that every time the world GDP grew with one percent, trade increased with 1.5 times. However, as globalization turned real during 1990's, this relationship has only fostered, so nowadays the multiplier is 2.5 (United Nations 2005b). So, it is not surprising to find out that all the other three transportation modes, namely road, sea and air freight have increased their total transportation amount for decades. From these three most popular alternatives, air freight has been predicted to grow annually by 6.2 percent (Boeing 2005), nearly without any limits. Also infrastructure research related to transportation models supports this mode; infrastructure in air freight transportation is constantly increasing, while e.g. road transportation has started to fall (Marchetti 1988), and rail infrastructure has been on the constant decline for several decades. Sea transportation was revolutionized after the 1950's with container transports, and volumes have followed similar rates with air freight; United Nations (2005b) estimates that the growth was 8.5 % per year during 80's and 90's, while in the forthcoming years we could expect slightly lower growth rates, 6.6 %. However, it is important to note that in railroad freights, although there exist a demand for increased international transportation, the proportional share and absolute amount of railroad freights have been in constant decline, e.g. in Europe. A number of different authors argue that this decline has been due to the collapse of communism/socialism, and overall changed production structures as European economies have developed via agriculture to industrial and further on to information/service economies. We can not argue against these factors; however, the reason for this declining development in the business side has mostly been the lack of international cross-border scheduled routes as well as the flexibility to connect railway freights to other transportation modes.

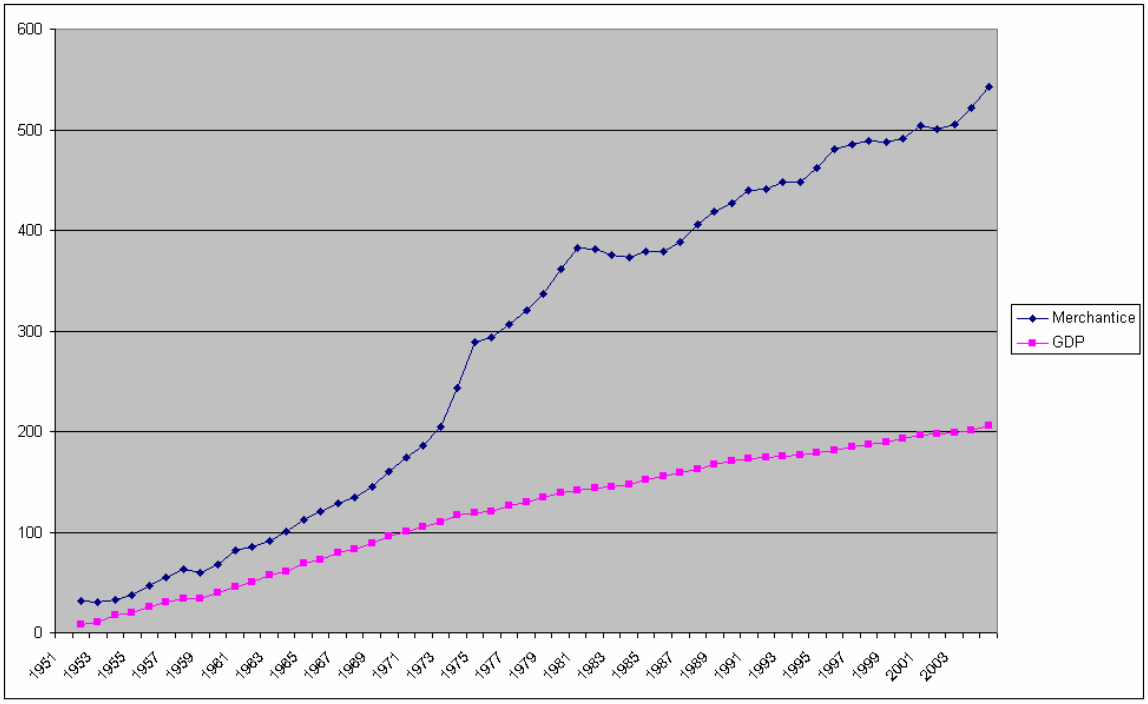

Figure 1. World trade and GDP development. Source: World Trade Organization

Although, the developing nations, like China as well as India are showing remarkable growth rates, our world is still organized in a rather triad manner. Like Ohmae (1985) argued that fifteen original members of EU, USA and Japan rule the world, as we think it through of world's GDP. This is still the story, as Table 1 illustrates: Total GDP from these countries is still near of 70 %, while during 80's this figure was five percentage points higher. So, the developing world is getting richer, but with rather slow speed (in absolute terms), and formerly mentioned three regions still make the most important economic decisions in the world, and hold their significance in transportation flows. However, within the next five years, we could expect that these rapidly developing economies are taking even larger share from world economy, and also traffic flows. This has already occurred in the sea transportation side; from TOP20 container ports (United Nations 2005a: p. 76), 12 are located in Asia, and six in China alone. Correspondingly only seven ports from the economic triad make the list, three from both US as well as Europe, and one from Japan. Change has been enormous; three decades ago (during year 1976) North America and Europe had above 60 % share from container traffic (Rodrigue 1997). During 90's situation changed so, that Asia took the similar amount proportional

share from container transports. It is good to remember that volume of container transports have multiplied more than four times during these 20 years.

Table 1. European Union 15 countries, USA and Japan, and their respective Gross Domestic Products, comparison to world total. Source: Statistics Finland (2006).

	1999	2000	2001	2002	2003	2004	2005 (est.)
EU-15	8,648,231	7,996,255	8,044,712	8,784,353	10,684,165	12,274,554	12,672,476
USA	9,268,425	9,816,975	10,127,950	10,469,600	10,971,250	11,734,300	12,452,417
Japan	4,471,201	4,750,191	4,167,494	3,980,206	4,299,732	4,671,198	4,672,291
Total	22,387,857	22,563,421	22,340,156	23,234,159	25,955,147	28,680,052	29,797,184
Percent from total	72.77%	71.55%	71.59%	71.71%	71.68%	70.08%	67.84%
Whole World	30,767,197	31,535,529	31,203,983	32,400,683	36,211,676	40,925,893	43,920,000

Transportation traffic imbalance has been under interest in the continental perspective, since the starting of Japanese exports to US with significant manner in 60's and 70's. This in the end resulted in the legislation that e.g. Japanese car manufacturers were forced to establish own factories (could be characterized as screw-driving assembly places) to US soil to prevent increasing import taxes. However, traffic imbalance has continued in US case with both Asia, but as well with Europe. As Figure 2 illustrates, sea container traffic alone is three times higher from Asia to US than vice versa. However, in year 2004 from Europe sea container traffic was above 50 % more than from US to Europe. It should be remembered that the valuation of US currency was in relatively low levels, as compared to Euro and Japanese Yen, and "traffic unbalance" should be at relatively low level then (since it favours US manufacturing units). Thus, until last year Chinese Yuan was having fixed rate with respect of US dollar, and simplistically speaking China and US were the same "common" trade area. Interestingly, European and Asian container traffic is nearest of balance, although, Europe does export more to Asia than other way around. Imbalances in world traffic flows lead into increased transportation costs, since empty transports increase significantly. For example, United Nations (2005) have estimated that during previous years empty container movement has been on the range of 20 to 22 % in the world scale. In the end it is good to remember that large world-wide corporations hold the key in transport decisions; their internal material

movements account majority from foreign trade of US, Japan and Europe (Barros & Hilmola 2003).

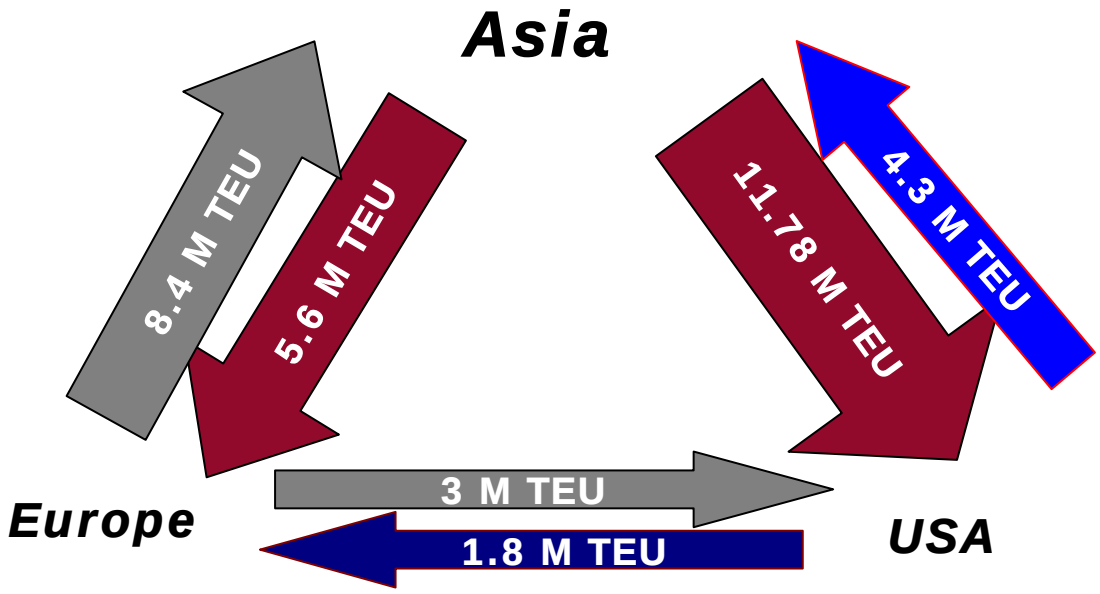

Figure 2. Trade imbalance between three major continents is great, container transports (Twenty-feet Equivalent Units) in year 2004. Source: United Nations (2005b)

Among continents, traffic unbalance exists also between countries; for example, Finnish-Russian traffic could be considered as one good example. Kilpeläinen (2004) estimated that road transit traffic from Finland to Russia was 17.5 times larger than vice versa. So, basically trucks traveled empty from Russia to Finland, in order to take the load from some harbour (e.g. Hamina, Kotka, Helsinki or Hanko), and continue with full load to Russia. Traffic unbalance problem is created by the structure of Russian national economy and well-developed Northern-Europe; prestigious raw material base favors sea (54 % from the value of Russian import to Finland) and rail (22 %) as transportation modes, and ignores road transportation (9 %). In contrary Finnish export relies on the road transportation side (86 % from the value of Russian import to Finland), and rail as well as sea has much smaller share (approx. 6-7 % share each). As a solution, some of the local development programmes have chosen rail transportation as a key to unbalanced

traffic problem. For example, Innorail in Kouvola, Finland, has attracted shareholders from Russia, China and Japan to develop Trans-Siberian Railway to serve container traffic between Finland, Russia and China (as well as near-by Asian countries). It is a well-evident fact that further development of the Russian distribution system is in larger extend dependent on railways, and interestingly rail container traffic between Finland and Russia has increased in seven years by five times to 100,000 TEU. However, during year 2006 this traffic has slowed down, due to the reason of increased tariffs. In the end of 90's United Nations (1999a) estimated that below 5 % of container transports between Europe and Asia uses railway route through Russia, and at the moment this figure is nearer to 1 %.

3. Literature Review – Business Logistics

Issues relating to centralization and decentralization have been considered as one of the most important issues in business logistics, particularly concerning physical distribution and multinational manufacturing companies. In practice the issue of inventory centralization/decentralization is closely related to the problem of inventory push/pull deployment and to make to order/make to stock options to achieve as short time-to market lead time as possible (Wanke & Zinn 2004: 466, Lemoine & Skjoett-Larsen 2004: 794). However, cost efficiency and economies of scale in manufacturing are not costless due to *"global delivery responsibility"*. Most companies prefer to have decentralized inventory systems to centralized one in their supply chains (Rajesh & Fu 2005: 598). Multinationals with several different product families and a *"decentralized"* distribution inventory structure could observe increase of inventory and transportation costs, and fill rates can be quite low as well (see the illustration in Figure 3 in below for four product families and two alternative distribution policies). The constrains may well turn into negative risks and cause in reality lost capacity, transport and subcontracting premiums and suboptimal use of labor (Disney et al. 2006: 152). This is the case especially in Russia (see for example Toikka & Ivanova 2006: 40-41).

The effect of distribution centralization has long been an area of logistics research. In the 1970's, a classical work in this area was published (Maister 1976), arguing that inventory will decline according to the *"square root law"*. Mathematically, the new inventory level can be calculated as given below.

$$INV = 1-\sqrt{[(m/n)]} \qquad \textbf{(1)}$$

where

INV = inventory reduction due to centralization
m = number of locations after consolidation
n = number of locations before consolidation

Source: Maister, 1976

THE SQUARE ROOT LAW

This simple formula relies on numerous assumptions, as one might expect. For instance, demand for different product families is assumed to be independent from each other, total demand also remains constant, and so on (see Evers & Beier 1993 for a full list). These assumptions can also be quite unrealistic, for instance the independence among demand patterns (products may have positively or negatively correlated demands) and so on. However, the purpose of including the equation in here is that it shows a simple relationship between spatial decisions concerning warehouse location and the only costs that are additive from the micro to the macro-level, i.e. inventory costs. In short, space will seriously affect inventory costs and these costs will propagate through the economy through the supply chains (see also Buxey 2006). In the hypothetical example given in Figure 3, total inventory should decline about 50 percent due to centralization. In addition, there should be an increase in blue-collar worker productivity at the warehouse, increased invested capital returns, all due to the economies of scale.

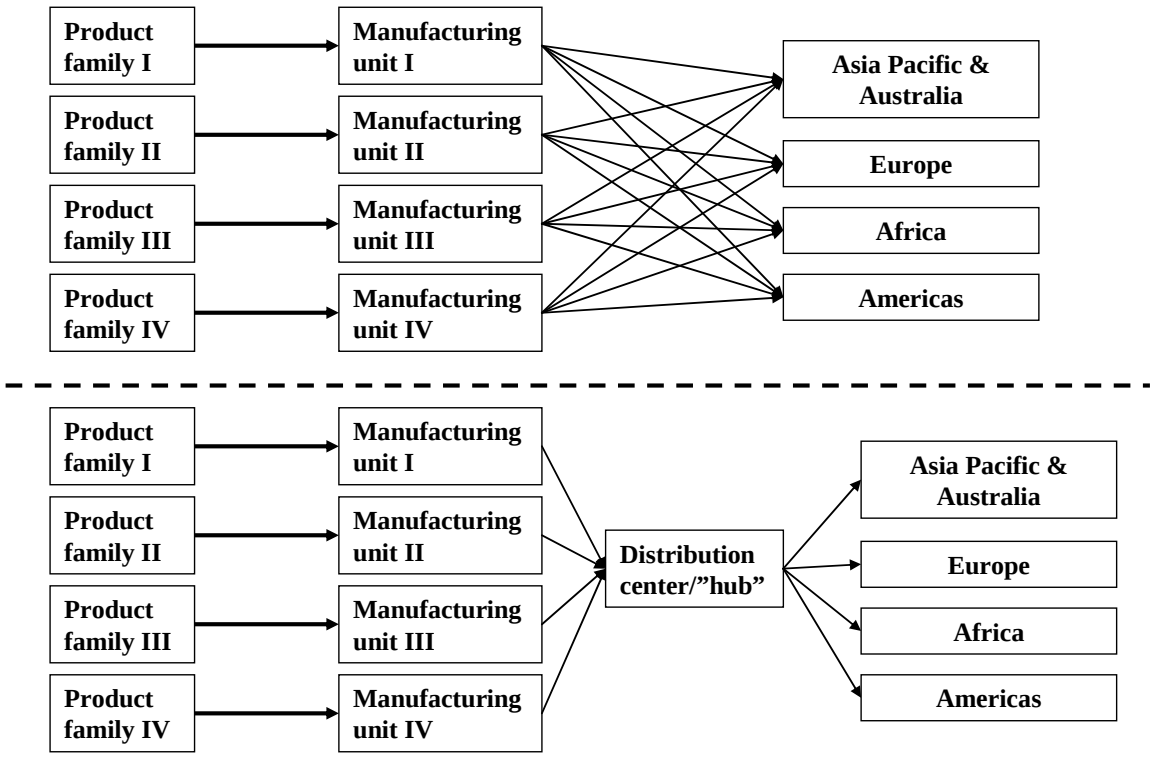

Figure 3. Multinational with four different product families, with specialized manufacturing locations. Distribution can be either decentralized (above) or centralized (below).

Sources: Albino & Garavelli (1993); Garavelli (2001)

In practice, shifts to centralized distribution are more often driven by external pressure (e.g. customer service improvements) than simply an emphasis to decrease costs and inventory investment. Discussion around square root law has continued since 1970's (see for instance, Das & Tyagi 1999; Hammel, Phelps & Kuettner 2002). Zinn, Levy & Bowersox (1989) argued that the square root law is only a special case of the *"portfolio effect"* shown in Equation 2 below. The most impressive decline in inventory investment would be achieved when two different product families have negatively correlated demand but the same standard deviation.

$$PE = 1 - \frac{\sqrt{M^2 + 1 + 2M\rho_{12}}}{M + 1} \qquad \textbf{(2)}$$

where

PE	=	portfolio effect
S_i	=	Standard deviation for product family i, i=1,2
M	=	S_1/S_2 , and $S_1 \geq S_2$ $S_2 \neq 0$
ρ_{12}	=	correlation coefficient between product families 1 and 2

Source: Zinn, Levy & Bowersox, 1989.

Portfolio Effect Equation

Another recent model developed for the supply chain at business level has to do with the demand amplification effect (see for example Korovyakovsky & Szoltysek 2006: 43, Jäger & Ujvari 2006: 67, Lorentz & Riihinen 2006: 93, Towill 2005: 555). Demand amplification is important in the sense that nowadays supply chains are increasingly controlled via demand (Hesse & Rodrigue 2004: 175). This argumentation is generally based on Forrester (1958), but numerous other researchers have further developed and applied this theory (Towill, Naim & Wikner 1992; van Ackere, Reimer Larsen & Morecroft 1993; Lee, Padmanabhan & Whang 1997; Lee & Whang 2000; Helo 2000; Holweg & Pil 2001; Shapiro 2002; Swensson 2003; Dejonckheere et al. 2004; Zhang 2004). Generally, information sharing within the supply chain (or production system) is the key factor for enhanced performance, and shorter, more responsive as well as simplified supply chain/network structure. Benefits include lower levels of inventory,

higher delivery accuracy, lower total cost and higher revenue, all a result from smaller demand variation, or alternatively, due to better information among parties (see for example Mason et al. 2005: 142, Lasserre 2004: 82)

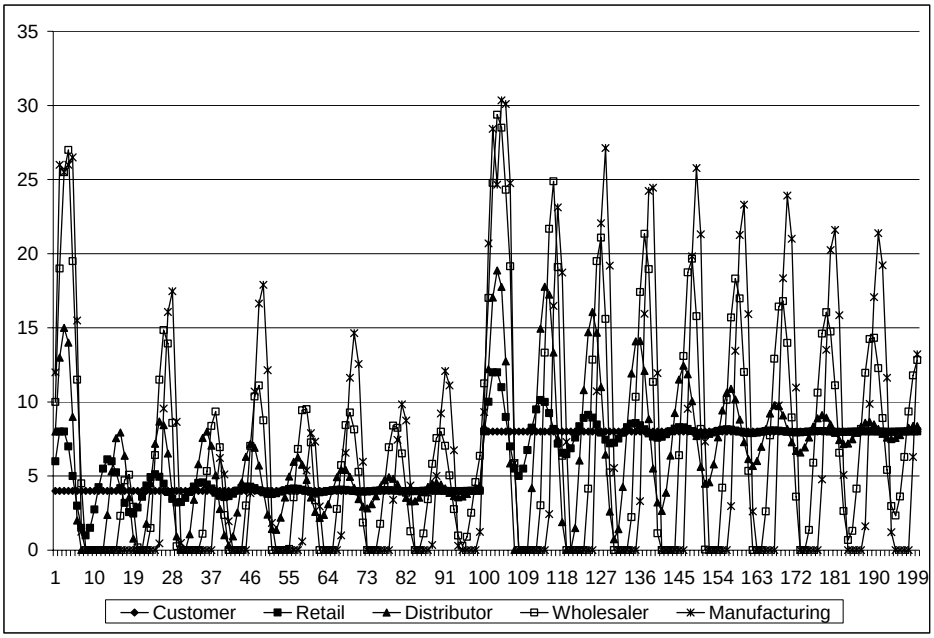

Figure 4. Forrester Effect (demand amplification, as customer demand increases from four to eight in period of 101) with a Single Four-Staged Supply Chain (Retailer-Distributor-Wholesaler-Manufacturer).

Fig. 4 illustrates the "demand amplification effect" within a supply chain. In this four-staged supply chain, as "information distortion" continues to develop further, the two final stages (wholesaler & factory) face dramatic changes. Demand from the factory itself (fourth stage in this supply chain) is between zero and thirty units per time unit, meaning that lead-times for placed orders change dynamically (if inventory levels are limited). In this small chain, the effect goes through the retail, distribution and manufacturing sectors but it could of course touch many sectors in the economy. Some preliminary evidence from bullwhip effect on economics could be found from Ramey (1989); five different recessions were analyzed in this research work, and retail, wholesale as well as manufacturing inventories decreased nearly in all of the occasions. However, interestingly Ramey (1989) found that labor is in several industrial sectors more flexible

resource as compared to different inventory types (raw materials/components, work in process, finished), while work in process represents the most flexible inventory type.

4. Research Methodology

As North-European countries are so important for Asian traffic flows, we decided to complete survey for the largest Finnish and Swedish companies. We chose TOP500 lists from both of these countries (in Finland we used local business newspaper Talouselämä and in Sweden Affärsdata database), and searched contact information for logistics decision makers in these largest companies (similar questionnaire strategy in logistics has been used before by Häkkinen et al. 2004). However, all 1000 companies were not targeted with a survey, since financial companies (funds, investors, banks), service companies, insurance companies, and electricity production and distribution companies were basically out of our interest (simply, no significant traffic flows). Also during the questionnaire we learned that a number of large retail companies, due to centralized and outsourced purchasing, do not have any connection to traffic flow decisions, and were unable to answer into our questionnaire. Also some other unhappy occasions happened, i.e. order driven machine manufacturers (engineering to order or make to order production control) argued that they are unable to estimate cargo flows in the five year respect, and twenty feet containers are not a valid measurement unit for them. In number of situations also large manufacturers argued that their logistical flows are controlled from France, Germany or US, and therefore Swedish and Finnish representatives do not have any knowledge, what the actual traffic flows are (as these business units are part of larger global conglomerate). So, after these we were having all in all around 750 companies, which presented our target group in the questionnaire.

In the questionnaire we used a web-based survey format, meaning that all the answers were collected through three identical web-pages (in Finnish, Swedish and English; please see English version in Appendix C). We contacted companies mostly by email, either directly to the logistics director or to the corporate communication or general contact address. This email contact list required relatively large amount of work, since all the addresses were collected via web search engine. As we started our questionnaire, and sent first request for answers, we were amazed that even info addresses reached logistics managers and directors. So, email forwarding works pretty well in Finland as well as in Sweden! Two additional reminders for answering were sent after the first contact letter, and in total we received 72 answers from population of 750. So, this corresponds to just

below 10 % response rate, which is rather conventional for web-based surveys (Häkkinen et al. 2004). Five answers from 72 were entirely empty, so in reality total number of responses was 67 (8.9 %). However, it should be reminded that our questionnaire was rather long, and contained numerous detailed question areas (questionnaire, see Appendix C). So, some of the companies answered only in general questions, and did not provide any data on specific areas. Therefore, in some of the cases our response rate was around 40 (approx. 5.5 %), and in some 67.

In the beginning of the survey form, we had some background questions regarding to the respondent itself, and the company. These revealed to us that responses were given with minor proportion from directors, but mostly from managerial and blue-collar workers. However, all the respondents had long experience working in the company, and also in the logistics function (most of the respondents had over six years of working experience with logistics issues). So, this observation confirms to us that the given answers represent higher validity as experience is so long, and that companies have interest towards our researched topic. For example, more than half of the respondents indicated that they would like to receive questionnaire analysis results in the form of a written report, and ten of the respondents agreed to act as a potential case study companies in a future research works.

5. Empirical Data Analysis

Transportation and Warehousing

As some sort of background variable, share of transportation costs (not including warehousing) in respondent companies, shows interesting results (Figure 5 in below). In three observation points (or in a ten year time period), companies do not indicate that large changes would happen in the transportation cost side. However, smaller interesting trends could be identified: (1) companies which had previously very low amount of transport costs, are facing increase, (2) companies which had very high transportation costs are in contrary a bit decreasing, but (3) taking two lowest and two highest cost groups together, the total "big picture" situation will not change that much. (See Figure 5 below).

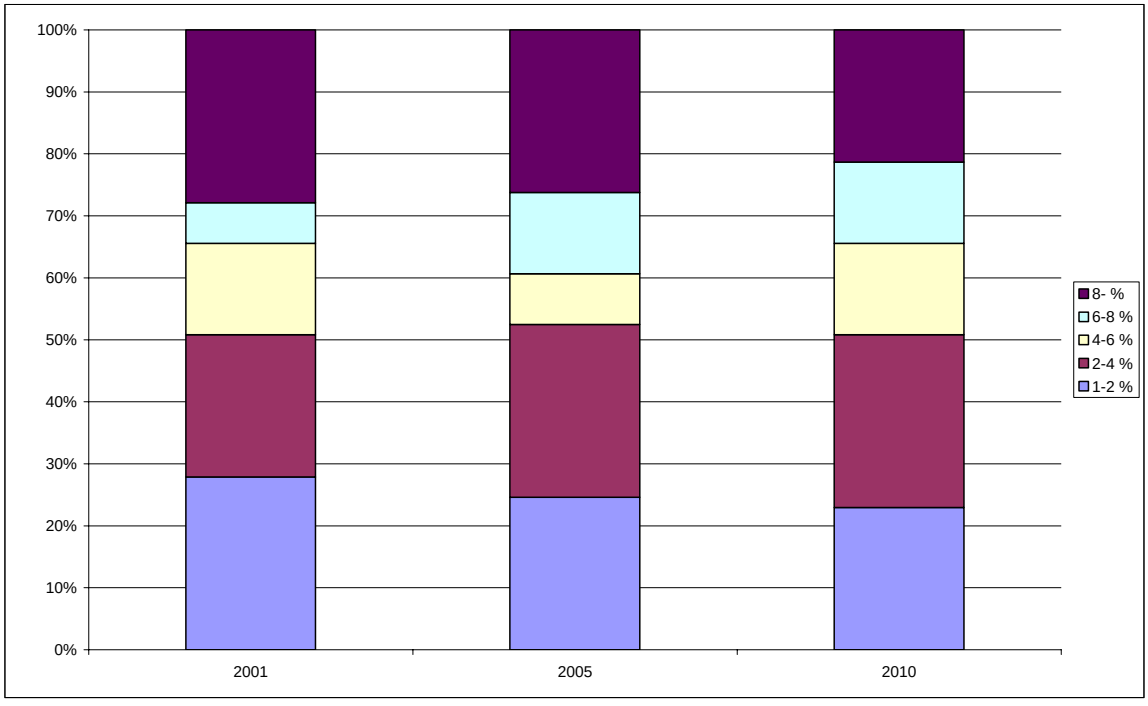

Figure 5. Share of transportation costs from revenues (year 2010 estimate, n= 61).

When examining warehousing costs the results extracted point to the same direction as in the case of transportation costs: the data gathered from the three observation years

of target the responds of the firms enquired do not show remarkable shift in either direction in warehousing. More detailed information can be drawn upon figures appeared in below.

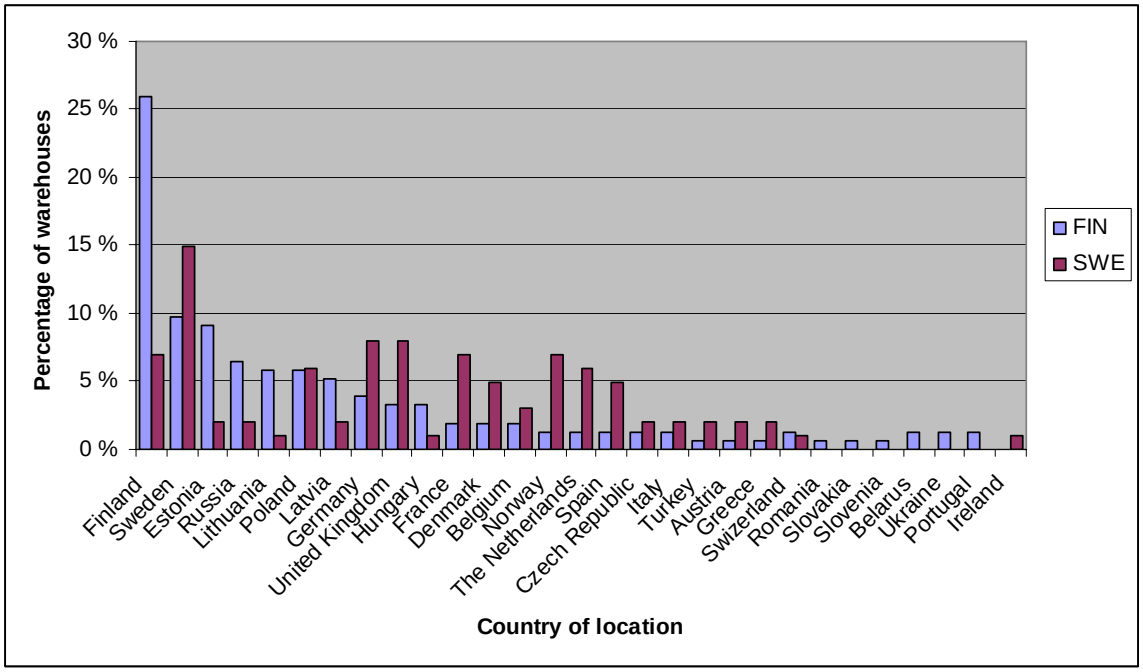

Figure 6. The location of warehouses of Finnish and Swedish companies in Europe (n = 55).

In Figure 6 above there is presented about how Finnish and Swedish businesses locate their warehouses throughout Europe. The blue column represents the percentage of the warehouses of Finnish firms whereas the red column depicts the same for Swedish enterprises. At the first glance it can be concluded that currently Swedish and Finnish companies prefer to have warehouses in their own countries while more or less ignoring the chance of establishing distribution centres elsewhere. Finnish companies locate 26 % out of their warehouses in their own home country. Swedish companies set 15 % out of their distribution centres in Sweden. The number two country of location for Finnish firms is Estonia, but only 9 % out of their warehouses can be found there. Swedish enterprises prefer Germany as number two place to locate their distribution centres: there are 8 % out of the total amount of warehouses of the Swedish companies. The United Kingdom actually reaches exactly the same level of popularity among the Swedish

businesses. Almost as high score Norway, France and Finland. Lithuania, Russia and Poland are on the other hand the fairly noticeable place to locate warehouses for Finnish companies. On the basis of these result one can assume that Finnish firms prefer Central and Eastern Europe (CEE) to Western Europe whereas Swedish companies opt for Western Europe instead of CEE. At the same time there are quite many countries that do seem to have minor role in the operations of Finnish and Swedish firms: one could refer to for example Ukraine, Ireland, Portugal or Romania.

Additional valuable information can be extracted from our sample when applying chi square test to the results we obtained from warehousing location. Table 2 describes four fields in below: both Finland and Sweden have warehouses located in Western Europe as well as Central and Eastern Europe. The numbers in the sector of 2×2 matrix depict the amount of warehouses of companies have in that region of Europe. According to the numbers Finnish companies have larger weight on warehouses in the region of CEE in comparison to the amount of Swedish firms have (64 versus 18). The real difference nevertheless is smaller as the sample of the test includes 153 Finnish warehouses and only 97 Swedish ones. One other interesting observation is that in Western Europe there is still substantially more distribution centres (168) than in the eastern part (82) of the continent. At the same time the nature of the difference can be stated statistical significance as according to the results the probability of having interrelations between the behaviour of Finnish and Swedish businesses is smaller than 0.001%.

Table 2. Chi square test for the warehousing sample examined.

Country/ Region	Western Europe	Central and Eastern Europe	Subtotals
SWE	Actual observations: 79 Expected value: 65.2	Actual observations: 18 Expected value: 31.8	**97**
FIN	Actual observations: 89 Expected value: 102.8	Actual observations: 64 Expected value: 50.2	**153**
Total	**168**	**82**	**250**

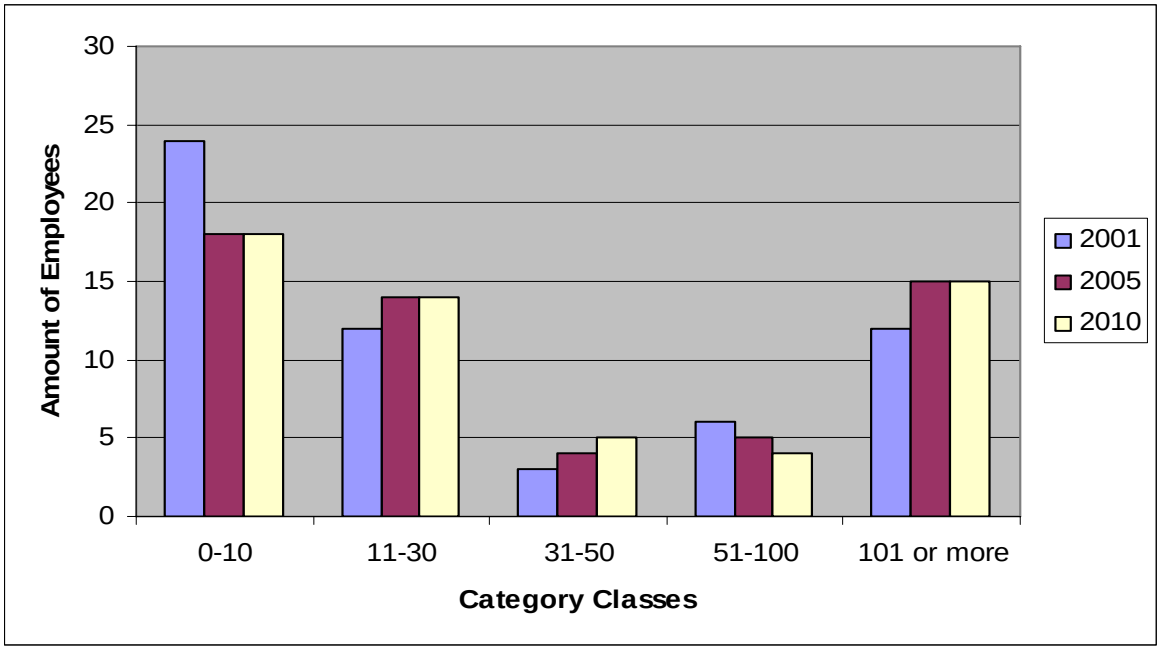

Figure 7. Average employment in the major warehouses of Finnish and Swedish firms in Europe (n = 55).

In Figure 7 above the trend of employment in warehouses in Finland and Sweden is examined. The examination points during the 10 year period are 2001, 2005 and 2010. In each of these years the columns with different colours corresponds the category of the size of warehouses. In a case of one cast a glance on the employability of warehouses of

the selected companies the results still point to the same direction: costs of warehousing will not diminish in the future. This is despite the fact that there is an aim to keep the workforce employed in these distribution points low: our analysis suggests that in 2010 firms are going to have only slightly larger workforce employed for their warehouses in comparison to that of in 2001. This change can be spotted when looking at the long-term trend of employment between 2001 and 2010: the amount of employees working in small distribution centres will have small decrease while the amount of people in larger-scale warehouses will grow correspondingly. Between this period especially the amount of warehouses with 0 to 10 employee are about to decrease while the ones with over 101 employees and the ones employing 31-50 people are most likely to increase. In this regard there are differences between the operation of Finnish and Swedish firms too: In Finland the amount of warehouses with 11 – 30 employees will diminish whereas in Sweden this number will increase by 2010. The most common class in all check points (20001, 2005, 2010) is the one with 0-10 employees and the median class is in each case the one with employees of 11 – 30.

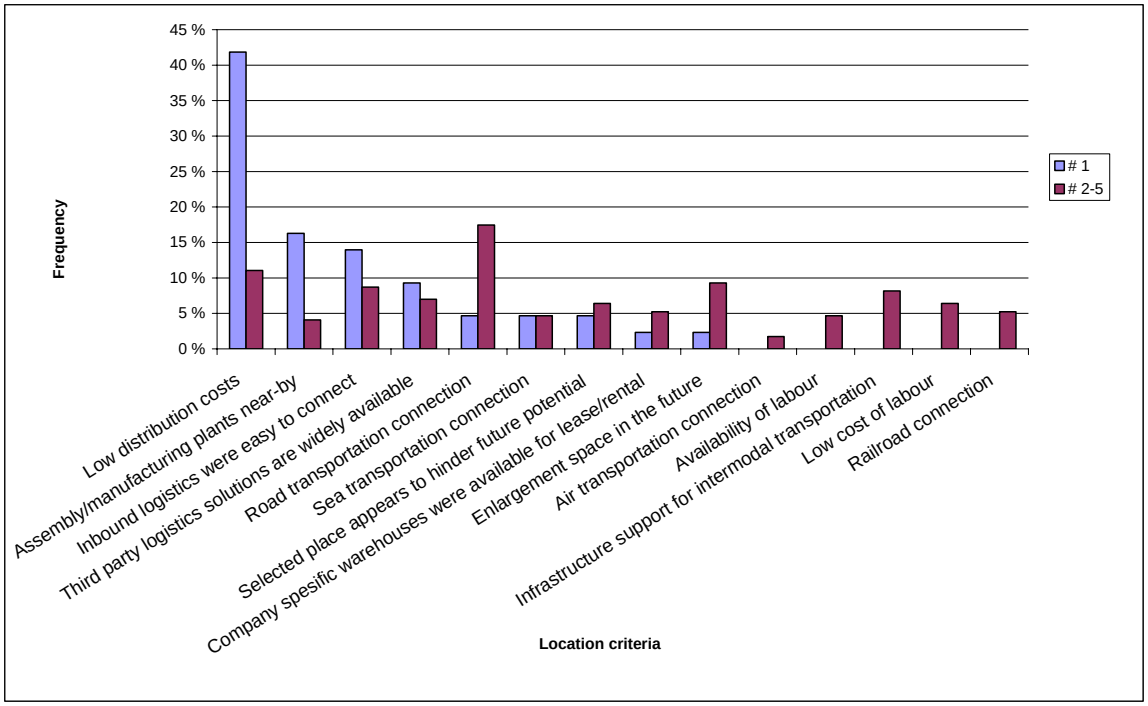

Figure 8. Criteria determining the location of distribution centres of the selected group of Finnish and Swedish companies in 2006 (n = 43).

In Figure 8 above there are two dimensions are measured: the blue column reflect each individual criteria as number one decisive factor in the decision making process of these selected companies whereas the red columns mirror the aggregated importance (from no.2 to no.5) of a criteria in the location decision of the targeted firms. There seems to be four major decisive factors considered as number 1 issue: low distribution cost, assembly/manufacturing plants near by warehouse, the possibility of inbound logistics to be connected, and third party logistics solutions availability. For these the criteria of "low distribution costs" is clearly the single most important factor in the decision making process of locating warehouses. At the same time it is interesting that road connection is far behind in terms of being the number one criteria, but when looking the aggregated indicator – the red column – it is the most marked one. This means that companies don't consider each transport mode as an independent entity but they want to optimize the whole system to reach lower distribution costs. Third party service providers are a popular option nowadays to achieve this goal. It is also seen as necessary in many cases that the warehouses are near by to the assembly plants and this is the reason why most of the warehouses of Finnish and Swedish companies are found in Finland and Sweden.

On the other hand according to our results there are plenty of issues that are not considered at any extent when making the decision about locating a warehouse. Companies know that there will be no lack of skilled workforce and they are ready to pay as much as it needed to hire the right person for the right tasks. The infrastructure for intermodal transportation is not an issue on the desks of managers either. The most surprising matter here is the result according to which railroad connection is not held to have any relevance in the decision making process for locating new warehouses. This outcome can be interpreted in a way that railroad is a completely neglected option and its role can be extended very much as soon as companies realise the benefits offered by it: it is far cheaper than air connection and substantially quicker then transport done by means of ships. It can be stated however that especially Finnish companies will have to opt for railroad much more in the future as the Russian transport infrastructure relies in major extent on railways as above stated. Also integration issues of factories located in Russia becomes less troublesome with railways. So, although companies currently think that railways are less significant in warehouse location decision making, but this could

suddenly change as manufacturing network will enlarge and spread more geographically around regions.

Regarding the difference between behaviours of Finnish and Swedish companies in selecting the location for their warehouses one has to be cautious when drawing conclusions on the state of matters since the sample of analysis here is too small – only 43 answers. Nevertheless according to the results Swedish companies seem to be more self-reliable and consider future attributes of the potential place to be selected more than Finnish firm. In Finland again businesses are more third party service provider oriented than the enterprises in Sweden.

Transportation Mode Selection and Traffic Flows

The first major item of our questionnaire, among the transport cost share from total revenue, concerned transportation mode choice. Figure 9 reports the results with respect of four different modes and their shares from total transportation services used by respondent companies. It should be remembered that agreed terms of delivery will effect, which party takes responsibility from transports (e.g. Ex. Works gives customer all the responsibility, as Cost, Insurance and Freight paid demands logistical arrangements from manufacturer's side). However, all in all survey results with respect to modal choice are quite shocking news: There exist a number of companies, which rely entirely on road transports, and this will not change in the near future. It seems to be the case that air and rail transportation modes are having only a very minor role, mostly supporting one, as a mode choice. Sea transport is the only mode, which is having "in the middle share" from the modal alternatives. Our further data analysis shows, however, that rail transports are going to increase their popularity a bit in the future, but this is just a minor trend. This is also indicated in the 0 % class of railways, which shows a decline from above 40 observations in year 2001 to around 30 during 2010. Oppositely companies are arguing to remove air transports, 0 % level is targeted in above 40 responses.

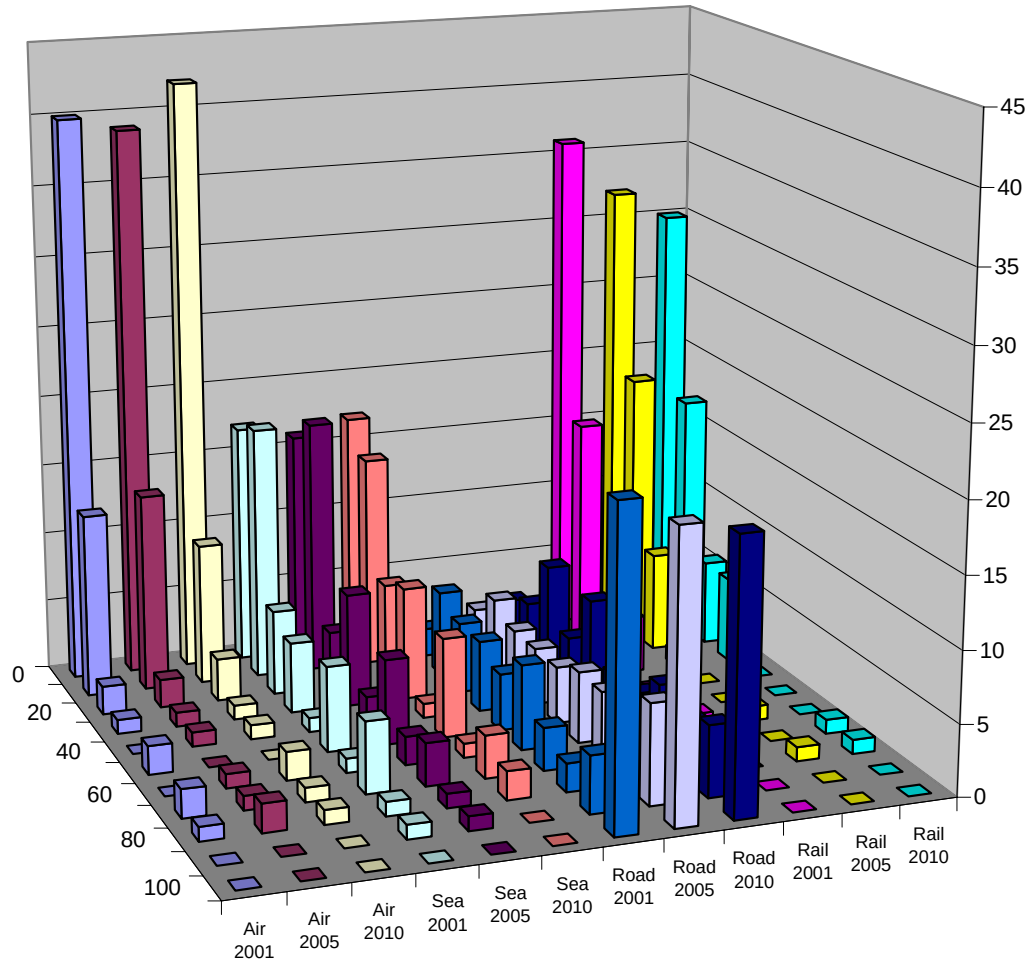

Figure 9. Transportation mode choice during years 2001, 2005 and 2010 (n = 62).

Traffic flows within the companies, and selected five different countries and European Union are shown in Figure 10. Generally it could be argued that traffic flows between Europe and *China*, Europe and *India*, and Europe and *Russia* are going to face significant increase in the near future. However, countries of Japan and South-Korea are under minor growth in the future, and their relevance for logistics effectiveness of these companies is about to be smaller. We could argue that several interesting issues arise from the three growth routes. Firstly, larger companies are going to increase quite significantly their transportation amounts, shifting to above 50 thousand containers per year in a five year time. This is the case in both Russia and China. In the third growth traffic route, Europe and India, transportation volumes are arising, but within a smaller scale (shift from the first observation group to the second lowest).

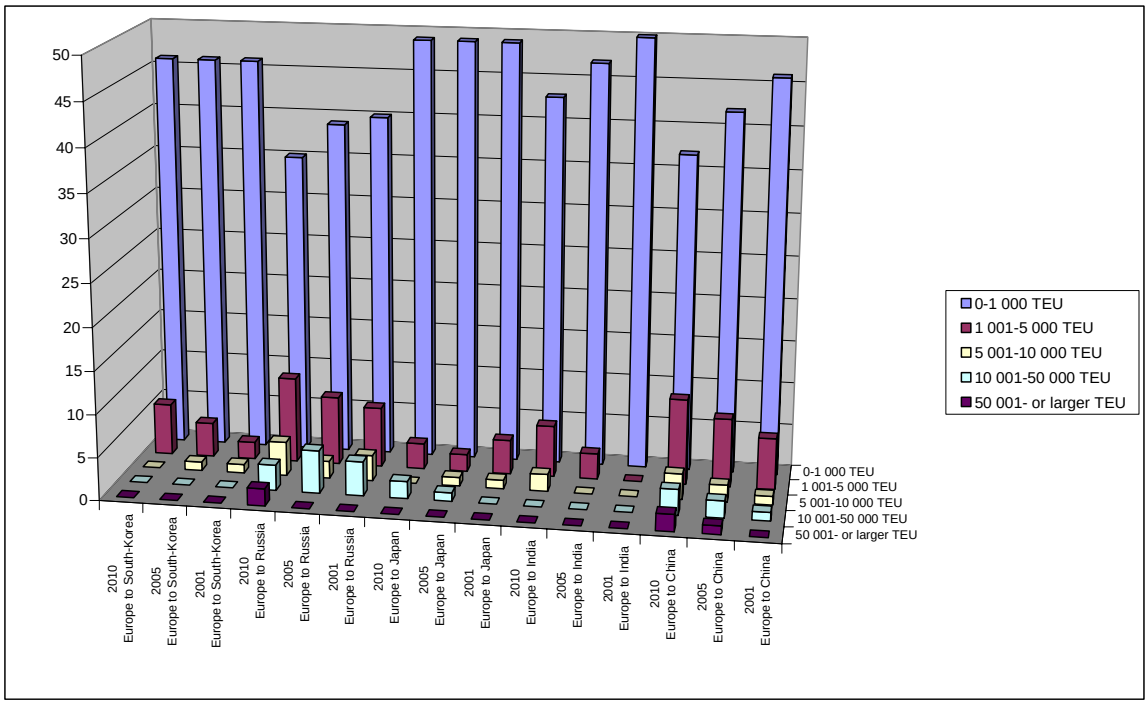

Figure 10. Traffic flows (Twenty feet Equivalent Units) between Europe and five selected countries (China, India, Japan, Russia and South-Korea; n = 57).

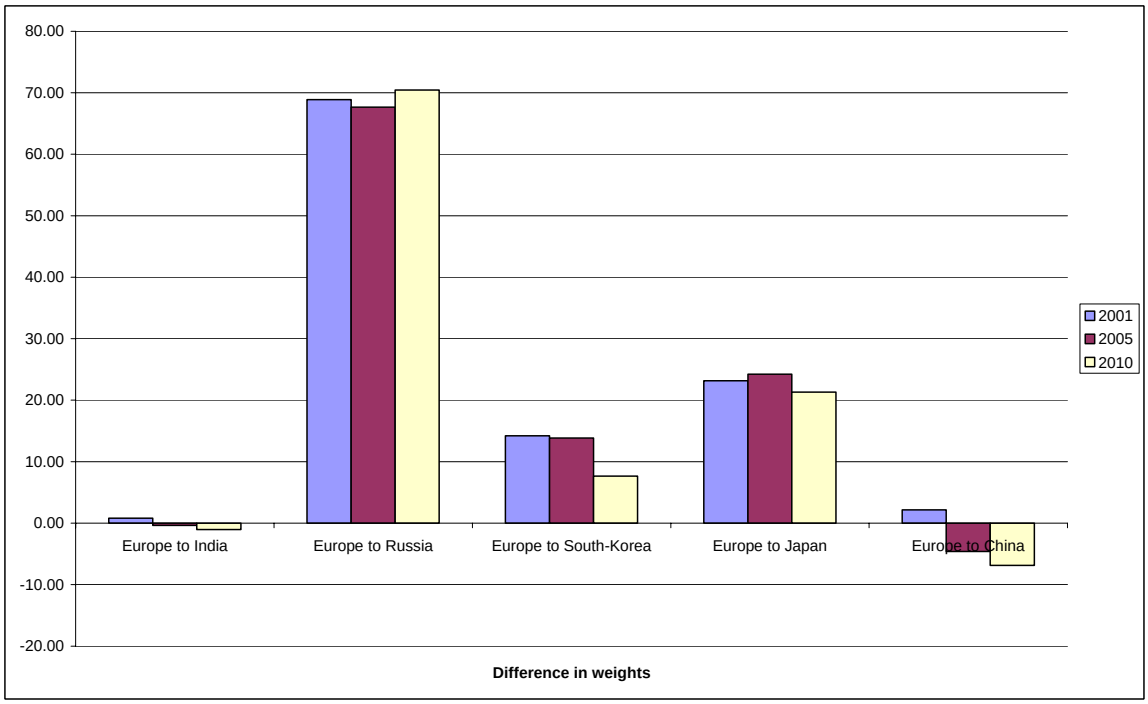

Figure 11. Traffic balance (percentage from Europe minus percentage to Europe from respective region) between Europe and five selected countries (average; n = 38).

As in traffic flows we are able to observe number of different trends, in traffic balance the situation is more simplified. In all of the other countries, except Russia, the average (, also median, not available in Figure 11) traffic balance is quite near of zero (only Japan shows that from Europe to Japan there exists more traffic than vice versa). However, as we analyze the responses from individual companies a bit deeper, we recognize that in these four countries, companies either transport a lot from Europe to respective country or the other way around. This is particularly the situation in Swedish companies; in Finland traffic in both ways exist to a higher degree. Observation means that companies in both Sweden and Finland, have integrated e.g. their factories poorly in a global scale, so factory (or factories) in Europe serve the entire demand of Asian countries or vice versa. However, in the future this will change a bit in some of the cases, especially with China and among Finnish leaden companies. This only reveals that third party logistics operators (e.g. Van Laarhoven, Berglund & Peters 2000) have business opportunities in wise customer picking, to ensure more balanced traffic flows between these countries.

Russian transports are an entirely different story; currently Swedish and Finnish companies are basically transporting items from Europe to Russia, and traffic to other direction is very scarce. As average numbers in Figure 11 also reveal, this situation will not greatly change in the near future. So, the transportation weight is on the European exports to Russia. However, interestingly some Finnish companies show different development, they might have plans to establish factories to Russia, which are serving more than the home market of that respective country. Thus, in the big picture, Swedish and Finnish companies both try to keep with their current export strategy, and only minor shifts exist in the direction that traffic flows (either from own manufacturing units or supplier network) will become more balanced. So, Russian market traffic is going to be very unbalanced within the future, if you ask the situation from Swedish and Finnish companies, which have been argued to cover situation by establishing own factories in this region. Our observations do not confirm this. Situation is similar with Russian retail industry; major players are having Russian origin, and only foreign entrance is completed by small number of multinational retailers (e.g. Lorentz, Häkkinen & Hilmola 2006). So, we could argue that customer picking does not necessarily provide support for the existence of third party logistics services in the case of Russia; the business model is

more based on the knowledge with border procedures, and inventory management services (please see Häkkinen 2005: 221-231 for third party logistics operator trying to achieve this niche).

6. Discussion

Will the findings of this research work persist? As our research results revealed, in the future sea and road transportation will dominate as well. If we take a step further deductive thinking – in our case, both Sweden and Finland are islands located in Northern Europe, and most often items need to flow through sea harbors (exception is Sweden with its bridge connection to Denmark, and from there on to Central Europe), except for high value items, which use air transports. As both Finnish and Swedish companies were showing quite significant activity in inventory holding in their own country, we were motivated to continue analyze, what kind of container transport flows (and connections) exist from and to these two countries. We used European Statistical Office data from year 2003, and used Pajek network analysis software in the drawing process of these connections. Data regarding to Russian harbors in Asian side, we used webpages of these harbors, to sketch available connections to other Asian countries.

Regarding to Finnish situation, which is shown in Figure 12, container transport connections are basically feeder traffic for larger European container hubs, namely Hamburg (Germany), Antwerp (Belgium), Rotterdam (Netherlands) and Felixstowe (UK). Also some smaller volume connections exists to other European countries, but as well to Russia and US. However, situation in Sweden is different (Figure 13); through port of Goteborg, connections to Americas, Africa, Asia and Australia exist. This is clearly strength for Swedish companies in the future as well; it provides lead time advantage for their Asian market transports, since additional transshipments in other European harbors are unnecessary. However, with the rest of the ports of Sweden, situation is the same as in Finland. These ports are basically feeders of large European hubs. Large hubs, and their connections are relatively shocking news for first time reader, as is shown in Figure 14. Basically these large hubs offer connections to all over the world. However, it should be reminded that shipment times through these harbors are relatively long, and therefore other alternatives for transports or additional inventory holding strategies are needed.

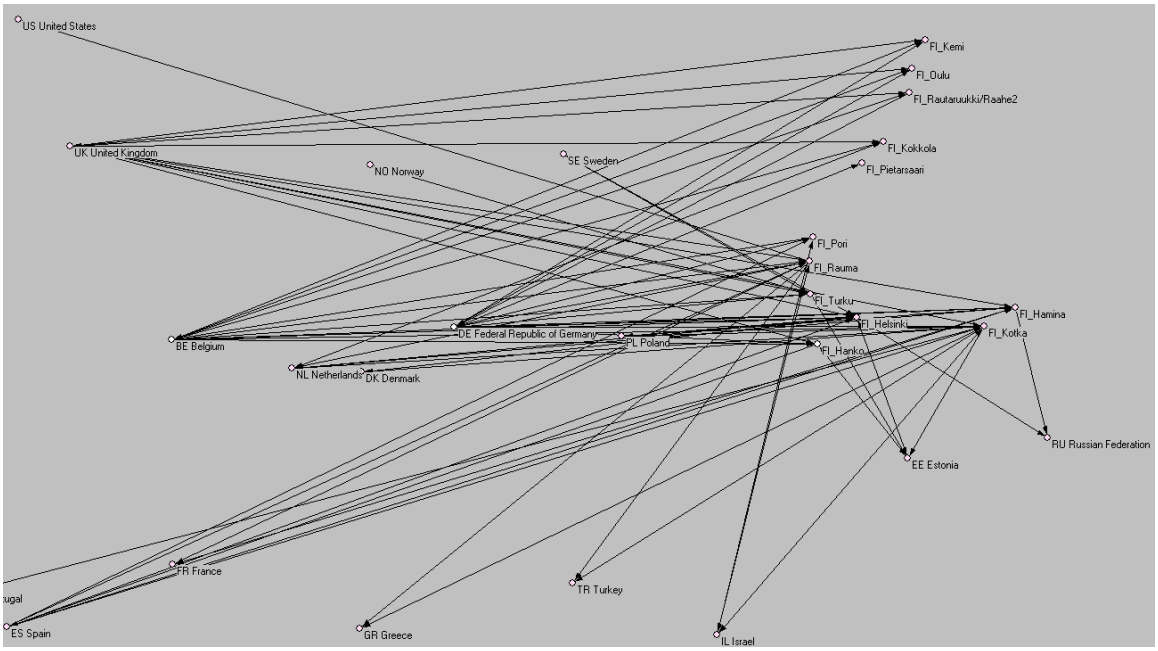

Figure 12. Container flows from different Finnish harbors to different countries, year 2003.

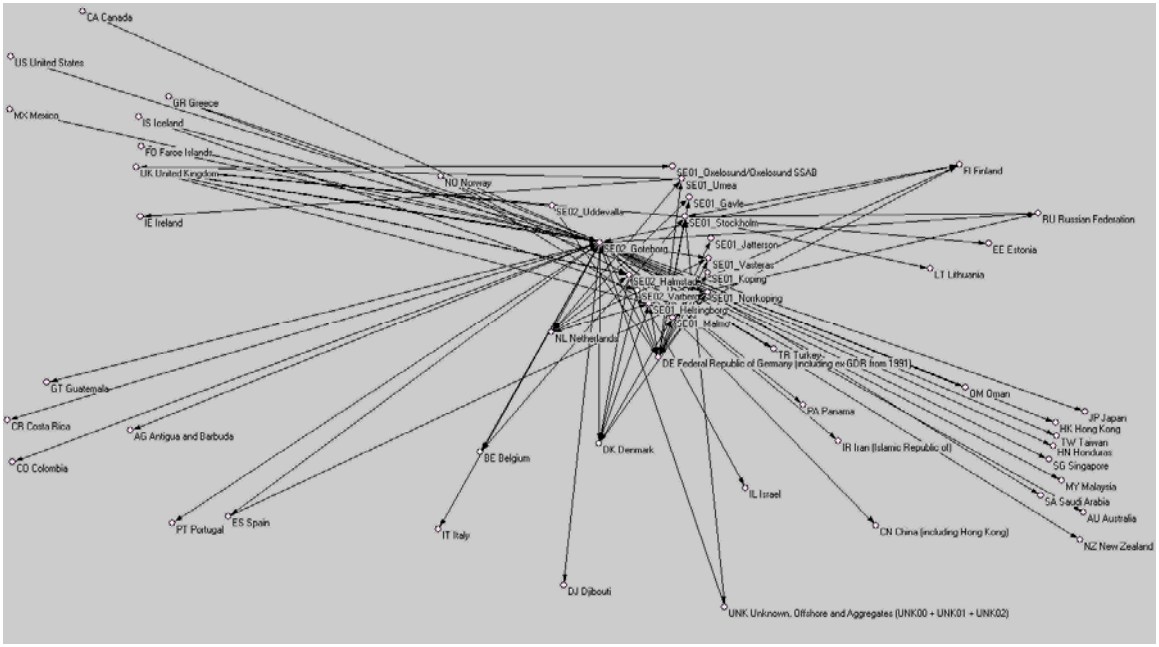

Figure 13. Container flows from different Swedish harbors to different countries, year 2003.

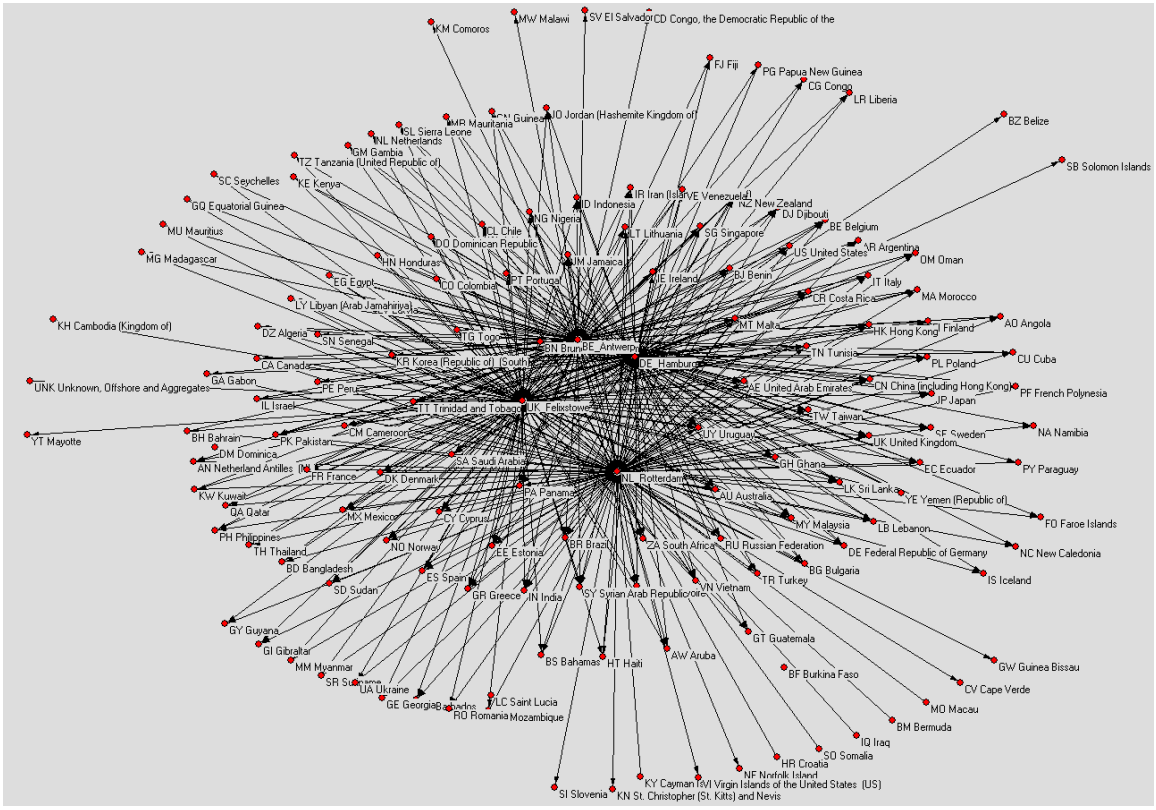

Figure 14. Container flows from the most important European container ports, year 2003.

One already existing alternative for shorter lead time transports to Asia is Russian Trans-Siberian railway. This connection starts from Finland and ends up to very Eastern part of Russia, and offers an alternative. Baltic States, and especially Latvia, offers this same opportunity. This route concerns also Swedish companies, since there exist naturally good connection from Sweden to Finland, as well as direct sea connection to St. Petersburg, Estonia and Lithuania. However, at the moment this route is not that popular, since tariffs of transports have been increased, and container transport cost is approx. double as compared to sea transportation via large hubs to Asia. Based on the information, which we received through Internet sources, best connections to interest countries of this research work are offered through port of Vostochniy (traffic from Europe to these countries) – see Figure 15. Via this port Japan, South-Korea, and most important ports of China could be reached. It seems to be the case that Vladivostok serves as incoming traffic harbor, and it has links appearing from US, Japan, Vietnam, South-Korea, and China. Based on harbour statistics, however, Vostochniy is handling above

two times more containers (TEU) than Vladivostock (Sea News 2006: 51). Overall Russia's eastern terminals handled approx. half a million TEUs during year 2005 (growth from previous year is 26.5 %).

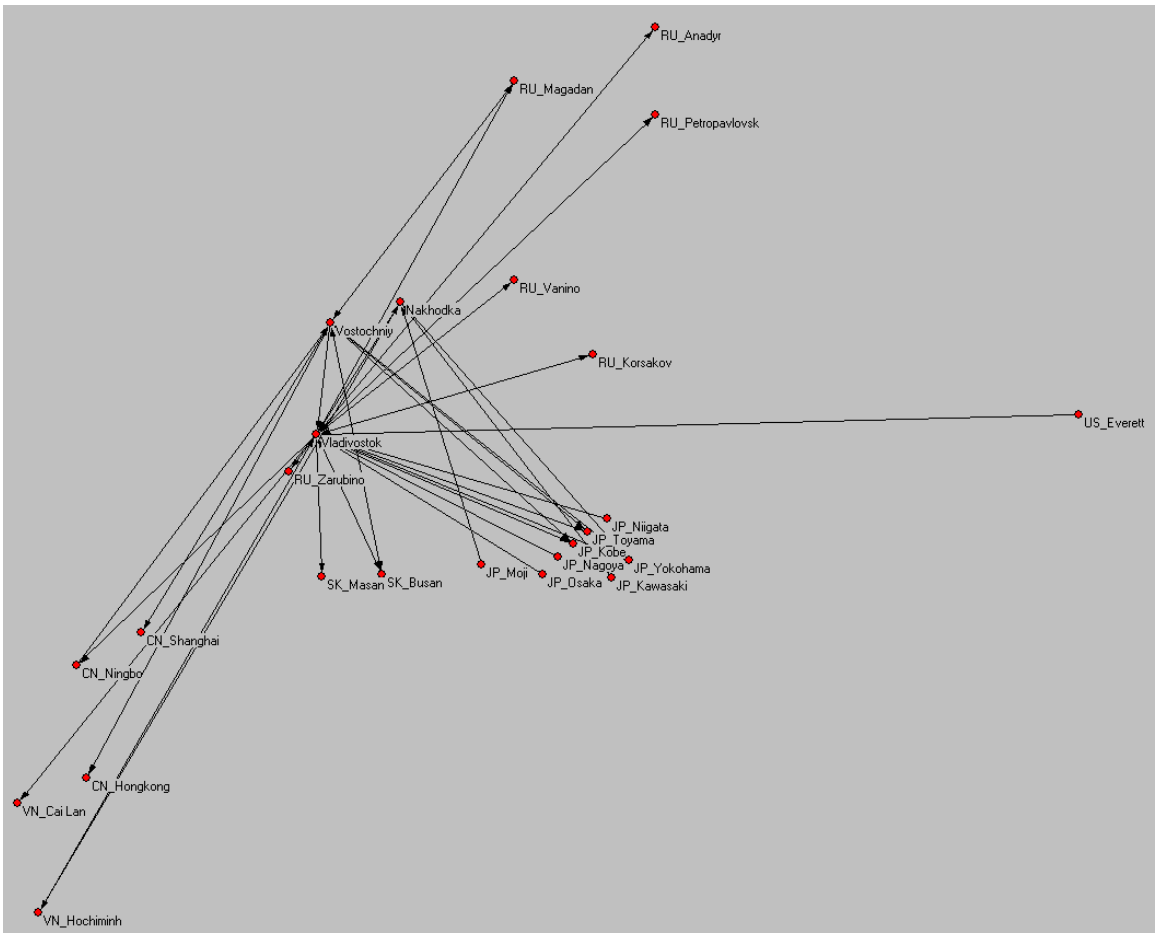

Figure 15. Container ship connections from Asian side of Russia (end of Trans-Siberian railway), year 2006.

Based on these further findings from container traffic, we argue that the structure of warehousing is not going to change in future that much. Germany and UK already showed high rankings in warehousing location, among Finland, Sweden, Estonia, Poland and Russia. As we analyze the results of container flow from different harbors – these all warehousing locations offer, in some cases except Russia and Estonia, proper distance to the most important sea port hubs, give easiness to connect inbound logistics properly, and offer enlargement space. Therefore, warehousing regarding to Finnish and Swedish

companies will not change that much, if we consider it through the increasing importance of Japan, China, India and South-Korea. In European context harbors in Finland and Sweden offer needed direct routes to most important European countries. So, this will also make results of this research more sustainable in terms of time.

7. Conclusions

World trade and transportation have developed together in the recent decades, and this effect has only fostered during the real plummet of global economy; a more than a decade we have witnessed that every time world GDP grows with 1 %, the merchandise will increase with 2.5 %. We also presented that large corporations hold the key in the movements in a world-scale, and in the continental as well as country level several imbalances exist. Therefore, in the medium-term developing markets, especially Russia, China and India, should be carefully integrated with logistics into global economy (as countries specialize more, global productivity improvement lead into economic prosperity). However, our survey results indicate that Finnish and Swedish companies are not showing any remarkable development with this respect. Companies do not report to have plans for two-way balanced material movements, but in the five year observation period are planning either transport from Japan, China, South-Korea and India to Europe or vice versa. In the case of Russia, Finnish and Swedish companies they are planning to continue with an export based strategy; only few companies are reporting to establish operations in Russia, and planning to fulfill also European demand, but these are too few to make a difference. However, our survey results confirm that traffic flows will increase with developing economies, and that transportation costs at the whole company level are not going to decline. Survey responses also confirmed that road as well as sea transportation are the most popular transportation mode choices. In a five year time period we could identify the rising popularity of rail, but this shift is only minor according to the questionnaire.

As a further research, we could suggest two different directions; either continue with questionnaire, and complete it with other North-European countries, including Germany and UK, or alternatively complete case study research in the selected companies of this already completed and analyzed survey. It would be especially interesting to investigate those companies, which are planning to make large operating infrastructure investments in Russia, and having emphasis of integrating operations in their manufacturing/customer network (not having these manufacturing units only isolated, and serving only local demand). Similarly to Russia, interesting further avenue would be the integration of Chinese factories into North-European manufacturing units. Factories in e.g. developed

nations would greatly benefit, if the semi-finished items from Chinese manufacturing units could be used in the manufacturing/assembly process, e.g. taken place in Finland or Sweden. The current shift in manufacturing units to Asia, is other words removing standardized item manufacturing to low cost labour countries, could have a real alternative, as developed world factories would concentrate in the early life-cycle manufacturing in a global scale as well as in their local "own region" manufacturing/assembly phases. Cost efficient and responsive transportation, and logistics solutions play major role in this process, and most convenient practices should be reported by the forthcoming research.

Acknowledgements

We would like to give sincere thanks for PhD Sandor Ujvari and PhD Thomas Andersson from University of Skövde (Sweden) as well as Prof. (act.) Marko Torkkeli from Lappeenranta University of Technology (LUT) for giving important aid and comments in process of completing logistics questionnaire for the group of companies in Finland and Sweden. Technical and operative issues were managed by Aptual ltd. and M.Sc. Maria Levänen (working for LUT in that time) with great success. In the network analysis concerning Finnish, Swedish, European, and Russian harbours, we would like to express our gratitude for LUT's M.Sc. students Ville Savolainen and Tero Toikka. Container volume verification concerning Russia's eastern ports was kindly assisted by researcher Oksana Ivanova from LUT.

References

Albino, V. and A.C. Garavelli (1998). Some effects of flexibility and dependability on cellular manufacturing system performance. *Computers and Industrial Engineering*, 35:3-4, pp.491–494.

Barros, Lilian & Olli-Pekka Hilmola (2003). Quantifying and modeling logistics at business and macro levels. Keynote paper for Nofoma conference (12-13 of June 2003 in Oulu, Finland).

Boeing (2005). *Current Market Outlook.* Boeing Commercial Airplanes.

Buxey, Geoff (2006) Reconstructing Inventory Management Theory. *International Journal of Operations & Production Management.* 26:9, pp. 996-1012.

Das, Chandrasekhar & Rajesh Tyagi (1999). Effect of correlated demands on safety stock centralization: Patterns of correlation versus degree of centralization. *Journal of Business Logistics*, 20:1, pp. 205-213.

Dejonckheere, J., S.M. Disney, M.R. Lambrecht and D.R. Towill (2004). The impact of information enrichment on the Bullwhip Effect in the supply chains: a control engineering perspective. *European Journal of Operational Research*, 153:3, pp.727-750.

Disney, S. M. & Farasyn, I. & Lambrecht, M. & Towil, D.R. & Van de Felde, W. (2006) Taming the bullwhip effect whilst watching customer service in a single supply chain echelon. *European Journal of Operational Research*, 173:1, pp. 151 -172

Eugene, Korovyakovsky & Jacek Szoltysek (2006). Creating International Supply Chains in Europe and Russia - the Main Principles. In Hilmola (ed.): *Contemporary Research Issues in International Railway Logistics*, Research Report 171, Lappeenranta University of Technology, Finland, pp. 43-53.

Evers, Philip T. & Frederick J. Beier (1993). The portfolio effect and multiple consolidation points: A critical assessment of the square root law. *Journal of Business Logistics*, 14:2, pp. 109-125.

Forrester, Jay W. (1958). Industrial dynamics – a major breakthrough for decision makers. *Harvard Business Review*, 36:4, 37-66.

Garavelli, A.C. (2001). Flexibility configurations for the supply chain management. *16th International Conference on Production Research*, Prague, Czech Republic.

Hammel, Todd, Tom Phelps & Dorothea Kuettner (2002). The re-engineering of Hewlett-Packard's CD-RW supply chain. *Supply Chain Management: An International Journal*, 7:3, pp. 113-118.

Helo, Petri (2000). Dynamic modelling of surge effect and capacity limitation in supply chains. *International Journal of Production Research*, 38:16, pp. 4521-4533.

Hesse, Markus & Jean-Paul Rodrigue (2004). The transport geography of logistics and freight distribution. *Journal of Transport Geography*, 12:3, pp. 171-184.

Holweg, Matthias & Frits K. Pil (2001). Successful built-to-order strategies start with the customer. *Sloan Management Review*, 43:1, pp. 74-83.

Häkkinen, Lotta (2005). Operations Integration and Value Creation in Horizontal Cross-Border Acquisitions. Turku School of Economics and Business Administration, A-6 (Doctoral Diss.). Available at URL: http://www.tukkk.fi/julkaisut/vk/Ae6_2005.pdf

Häkkinen, Lotta, Andreas Norrman, Olli-Pekka Hilmola & Lauri Ojala (2004). Logistics integration in horizontal mergers and acquisitions. *International Journal of Logistics Management*, Vol. 15, No. 1, pp. 27-42.

Jäger, Kerstin & Sandor Ujvari (2006). The Future of Third Party Logistics - Key Issues for a Logistics Integrator. In Hilmola (ed.): *Contemporary Research Issues in International Railway Logistics*, Research Report 171, Lappeenranta University of Technology, Finland, pp. 67-88

Kilpeläinen, Jaakko (2004). Development of Transit Traffic via Finland in 1997-2003. Lappeenranta University of Technology, Northern Dimension Research Centre, Publication 8.

Krugman, P. (2005). 'Currency crisis', Available at: http://web.mit.edu/krugman/www/crises.html, Retrieved on May 11th of 2005, Originally published on October 1997.

Lasserre, Frédéric (2004). Logistics and the Internet: transportation and location issues are crucial in the logistics chain. *Journal of Transport Geography,* 12:2, pp. 73-84.

Lee, Hau L. & Seungjin Whang (2000). Information sharing in a supply chain. *International Journal of Technology Management*, 20:3/4, pp. 373-387.

Lee, Hau L., V. Padmanabhan & Seungjin Whang (1997). The Bullwhip effect in supply chains. *Sloan Management Review*, 38:1, pp. 93-102.

Lemoine, W., Olga & Tage Skjoett-Larsen (2004). Reconfigurations of supply chains and implications for transport: a Danish study. *International Journal of Physical Distribution & Logistics Management*, 34:10, pp. 793 -810

Lorentz, Harri, Lotta Häkkinen & Olli-Pekka Hilmola (2006). Analysis of the Russian Retail Sector – Prospects for Cross-Border M&A Activity. *Baltic Journal of Management*, 1:2, pp. 148-168.

Lorentz, Harri & Riihinen, Tapio (2006). Developing distribution channels in the Russian FMCG Sector – a case study of a foreign manufacturer. In Hilmola (ed.): *Contemporary Research Issues in International Railway Logistics*, Research Report 171, Lappeenranta University of Technology, Finland, pp. 89-110.

Maister, D.H. (1976). Centralization of inventories and the square root law. *International Journal of Physical Distribution and Materials Management*, 6:3, pp. 124-134.

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.

Mason, J. Scott, P. Mauricio Ribera, Jennifer A. Farris & Randall G. Kirk (2003). Integrating the warehousing and the transportation functions of the supply chains. *Transportation Research Part E*, 39:2, pp. 141-159.

Molnar, Eva & Lauri Ojala (2003). *Transport and Trade Facilitation Issues in the CIS 7, Kazakhstan, and Turkmenistan.* World Bank Report.

Märkälä, Maija & Jumpponen, Jari (2006) Evaluation of the suitability of AHP in studying transit route selection criteria. In Hilmola (ed.): *Contemporary Research Issues in International Railway Logistics*, Research Report 171, Lappeenranta University of Technology, Finland, pp. 53-66.

Ohmae, Kenichi (1985). *Triad Power*. Free Press, USA.

Piplani, Rajesh & Fu Yonghui (2005) A coordination framework for supply chain inventory alignment. *Journal of Manufacturing Technology Management*, 16:6, pp. 598-614.

Ramey, Valerie A. (1989). Inventories as factors of production and economic fluctuations. *American Economic Review*, 79:3, pp. 338-354.

Rodrigue, Jean-Paul, Claude Comtois & Brain Slack (1997). Transportation and spatial cycles: evidence from maritime systems. *Journal of Transport Geography*, 5:2, pp. 87-98.

Shapiro, F. Jeremy (2002). Approaches for integrating inventory with other supply chain decisions, SLIM Technologies, LLC, Available at: http://systems.almyta.com/inventory_and_supply_chain/Inventory.pdf, Retrieved 9.7.2006.

Sea News (2006). Container transportation in Russia and in the Neighboring States. Results of 2005. Sea News Information & Consulting, St. Petersburg, Russia.

Swensson, Göran (2003). The principle of balance between companies' inventories and disturbances in logistics flows: Empirical illustration and conceptualisation. *International Journal of Physical Distribution & Logistics Management*, 33:9, pp. 765 -784

Tero, Toikka & Oksana, Ivanova (2006) the Potential of Russian Railways in China-Europe Transit Cargo Transportation. In Hilmola (ed.): *Contemporary Research Issues in International Railway Logistics*, Research Report 171, Lappeenranta University of Technology, Finland, pp. 31-42.

Towill, D.R., M.M. Naim & J. Wikner (1992). Industrial Dynamics Simulation in the Design of Supply Chains. *International Journal of Physical Distribution & Logistics Management*, 22:5, pp. 3-13.

Towill, Dennis R. (2005). The impact of business policy on bullwhip induced risk in supply chain management. *International Journal of Physical Distribution and Logistics Management*, 35:8, pp. 555-575.

United Nations (1999a). Development of Asia – Europe container transport through block-trains. Northern corridor of the Trans-Asian railway. *Economic and Social Commission for Asia and the Pacific*.

United Nations (1999b). Development of the Trans-Asian Railway – Trans-Asian Railway in the Southern Corridor of Asia-Europe Routes. *Economic and Social Commission for Asia and the Pacific*.

United Nations (2005a). *Review of Maritime Transport 2005.* United Nations Conference on Trade and Development, New York & Geneva.

United Nations (2005b). *Regional Shipping and Port Development Strategies (Container Traffic Forecast).* Economic and social commission for Asia and the Pacific.

Van Ackere, Ann, Erik Reimer Larsen & John D.W. Morecroft (1993). Systems thinking and business process redesign: an application to the beer game. *European Management Journal*, 11:4, pp. 412-423.

Van Laarhoven, Peter & Magnus Berglund & Melvyn Peters (2000). Third Party Logistics in Europe – five years later. *International Journal of Physical Distribution and Logistics Management*, 30:5, pp. 425-442.

Wanke, F. Peter & Walter Zinn (2004). Strategic logistics decision making, *International Journal of Physical Distribution & Logistics Management*, 34:6, pp. 466-478.

Zhang, X. (2004). The impact of forecasting methods on the Bullwhip Effect. *International Journal of Production Economics*, 88:1, pp.15–27.

Zinn, Walter, Michael Levy & Donald J. Bowersox (1989). Measuring the effect of inventory centralization/decentralization on aggregate safety stock: The "square root law" revised. *Journal of Business Logistics*, 10:1, pp. 1-14.

Appendices

Appendix A – Median classes of warehouse employment (bolded).

Year 2001	Actual observations		Cumulative frequency	
0-10		24	24	42,1 %
11-30		**12**	**36**	**63,2 %**
31-50		3	39	68,4 %
51-100		6	45	78,9 %
101 or more		12	57	100,0 %

Year 2005	Actual observations		Cumulative frequency	
0-10		18	18	32,1%
11-30		**14**	**32**	**57,1%**
31-50		4	36	64,3%
51-100		5	41	73,2%
101 or more		15	56	100,0%

Year 2010	Actual observations		Cumulative frequency	
0-10		18	18	32,1 %
11-30		**14**	**32**	**57,1 %**
31-50		5	37	66,1 %
51-100		4	41	73,2 %
101 or more		15	56	100,0 %

Appendix B – Chi square test for warehouse location in Europe and Swedish and Finnish responses.

Chi Square	2006
Sweden	97
Finland	153
Total	250

Should be '06	WE	CEE
Sweden	65,184	31,816
Finland	102,816	50,184

Act. '06	WE	CEE
Sweden	79	18
Finland	89	64

Chi Square Test (prob.):
0.000

Appendix C – Logistics questionnaire sent to Finnish and Swedish companies

Innorail Kouvola

Logistics/Supply Chain Questionnaire Concerning Traffic Flows and Warehousing

This questionnaire is used strictly for research purposes (developing further Kouvola region's infrastructure to support modern supply chains), and the anonymity of answers is assured in every publication and research report being made. This questionnaire is being funded with academic research grants, and there does not exist any for-profit organization, which is involved in this activity.

For further information, please contact Prof. (act.), PhD Olli-Pekka Hilmola, firstname.lastname@lut.fi.

Answering code: ☐

Your position in the company:

☐ Director ☐ Manager ☐ White-collar worker ☐ Administration

Years worked in the company:

☐ 1-2 years ☐ 2-4 years ☐ 4-8 years ☐ more than 8 years

Years worked in a logistics function:

☐ 1-2 years ☐ 2-4 years ☐ 4-8 years ☐ more than 8 years

Please estimate how much your company spent (years 2001 and 2005) and is planning to spend in year 2010 for simply transportation of goods (excluding warehousing):

2001	2005	2010
☐ 1-2 % from sales	☐ 1-2 % from sales	☐ 1-2 % from sales
☐ 2-4 %	☐ 2-4 %	☐ 2-4 %
☐ 4-6 %	☐ 4-6 %	☐ 4-6 %
☐ 6-8 %	☐ 6-8 %	☐ 6-8 %
☐ 8- %	☐ 8- %	☐ 8- %

Please estimate realized, and planned modal split in transportation:

	2001	2005	2010
Air	%	%	%
Rail	%	%	%
Road	%	%	%
Sea/Water	%	%	%
Altogether	100 %	100 %	100 %

Estimate annual cargo volume between Europe and China (TEU = Twenty Feet Equivalent Units):

2001	2005	2010
0-1 000 TEU	0-1 000 TEU	0-1 000 TEU
1 001-5 000 TEU	1 001-5 000 TEU	1 001-5 000 TEU
5 001-10 000 TEU	5 001-10 000 TEU	5 001-10 000 TEU
10 001-50 000 TEU	10 001-50 000 TEU	10 001-50 000 TEU
> 50 000 TEU	> 50 000 TEU	> 50 000 TEU

Weight of cargo volume between Europe and China:

From	2001	2005	2010
Europe to China	%	%	%
China to Europe	%	%	%
Altogether	100 %	100 %	100 %

Estimate annual cargo volume between Europe and Japan:

2001	2005	2010
0-1 000 TEU	0-1 000 TEU	0-1 000 TEU
1 001-5 000 TEU	1 001-5 000 TEU	1 001-5 000 TEU
5 001-10 000 TEU	5 001-10 000 TEU	5 001-10 000 TEU
10 001-50 000 TEU	10 001-50 000 TEU	10 001-50 000 TEU
> 50 000 TEU	> 50 000 TEU	> 50 000 TEU

Weight of cargo volume between Europe and Japan:

From	2001	2005	2010
Europe to Japan	%	%	%
Japan to Europe	%	%	%
Altogether	100 %	100 %	100 %

Estimate annual cargo volume between Europe and South-Korea:

2001	2005	2010
0-1 000 TEU	0-1 000 TEU	0-1 000 TEU
1 001-5 000 TEU	1 001-5 000 TEU	1 001-5 000 TEU
5 001-10 000 TEU	5 001-10 000 TEU	5 001-10 000 TEU
10 001-50 000 TEU	10 001-50 000 TEU	10 001-50 000 TEU
> 50 000 TEU	> 50 000 TEU	> 50 000 TEU

Weight of cargo volume between Europe and South-Korea:

From	2001	2005	2010
Europe to South-Korea	%	%	%
South-Korea to Europe	%	%	%
Altogether	100 %	100 %	100 %

Estimate annual cargo volume between Europe and India:

2001	2005	2010
0-1 000 TEU	0-1 000 TEU	0-1 000 TEU
1 001-5 000 TEU	1 001-5 000 TEU	1 001-5 000 TEU
5 001-10 000 TEU	5 001-10 000 TEU	5 001-10 000 TEU
10 001-50 000 TEU	10 001-50 000 TEU	10 001-50 000 TEU
> 50 000 TEU	> 50 000 TEU	> 50 000 TEU

Weight of cargo volume between Europe and India:

From	2001	2005	2010
Europe to India	%	%	%
India to Europe	%	%	%
Altogether	100 %	100 %	100 %

Estimate annual cargo volume between Europe and Russia:

2001	2005	2010
0-1 000 TEU	0-1 000 TEU	0-1 000 TEU
1 001-5 000 TEU	1 001-5 000 TEU	1 001-5 000 TEU
5 001-10 000 TEU	5 001-10 000 TEU	5 001-10 000 TEU
10 001-50 000 TEU	10 001-50 000 TEU	10 001-50 000 TEU
> 50 000 TEU	> 50 000 TEU	> 50 000 TEU

Weight of cargo volume between Europe and Russia:

From	2001	2005	2010
Europe to Russia	%	%	%
Russia to Europe	%	%	%
Altogether	100 %	100 %	100 %

Your company is currently having major warehouses/distribution centres in the following European countries:

EU member States

- Austria
- Belgium
- Cyprus
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany

EU Applicant Countries

- Bulgaria
- Croatia
- Romania
- Turkey

Other European Countries

- Albania
- Andorra
- Belarus

- ☐ Greece
- ☐ Hungary
- ☐ Ireland
- ☐ Italy
- ☐ Latvia
- ☐ Lithuania
- ☐ Luxembourg
- ☐ Malta
- ☐ Poland
- ☐ Portugal
- ☐ Slovakia
- ☐ Slovenia
- ☐ Spain
- ☐ Sweden
- ☐ The Netherlands
- ☐ United Kingdom
- ☐ Bosnia-Herzegovina
- ☐ Republic of Macedonia
- ☐ Iceland
- ☐ Liechtenstein
- ☐ Moldova
- ☐ Monaco
- ☐ Norway
- ☐ Russia
- ☐ Serbia and Montenegro
- ☐ Swizerland
- ☐ Ukraine

Average employment in major warehousing/distribution centres:

2001	**2005**	**2010**
☐ 0-10	☐ 0-10	☐ 0-10
☐ 11-30	☐ 11-30	☐ 11-30
☐ 31-50	☐ 31-50	☐ 31-50
☐ 51-100	☐ 51-100	☐ 51-100
☐ 101 or more	☐ 101 or more	☐ 101 or more

Please rank with numbers starting from 1 (the most important) to 5 (the least important) the five most important factors while making selection of a place for a major warehousing/distribution centre:

☐ Low distribution costs

☐ Inbound logistics easy to connect

- [ ] Company spesific warehouses available for lease/rental
- [ ] Low cost of labour
- [ ] Availability of labour
- [ ] Enlargement space in the future
- [ ] Railroad connection
- [ ] Air transportation connection
- [ ] Road transportation connection
- [ ] Sea transportation connection
- [ ] Assembly/manufacturing plants near-by
- [ ] Selected place appears to hinder future potential
- [ ] Third party logistics solutions widely available
- [ ] Infrastructure support for intermodal transportation

Please indicate, if your company would like to receive a research report from the survey:

( ) Yes ( ) No

Email address where PDF-file will be sent

Is your company interested to be involved in the future research works concerning this topic (e.g. interview or providing data)?

( ) Yes ( ) No

Contact information (e.g. email)

Send answers